Understanding the interplay between knowledge and coastal governance

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01. GOVERNING KNOWLEDGE: INTRODUCTION
1.1 THE DUTCH WADDEN SEA: CONSERVATION, CONFLICT, AND COLLABORATION

The Wadden Sea area, with its tidal flats, salt marshes, and islands stretching from the northern coast of the Netherlands to the western coast of Denmark, is widely recognized as a valuable area in both ecological and social-economic terms. One of the main indicators of its ecological value is that each year it provides an important foraging and resting place for 10-12 million migratory birds; moreover, the area provides “rich nurseries for fish and shrimp” and hosts about 10,000 species of plants, animals, and fungi (Reise et al., 2010: 9). Social-economic activities in the area include fisheries, recreation, gas and salt mining, and shellfish harvesting and cultivation.

The widespread appreciation of the value of the Wadden Sea as a nature area is a relatively recent phenomenon. The rise of nature conservation in the Netherlands started in the late 19th century, but the Wadden Sea did not become a center of interest to conservationists until much later (Van der Windt, 1995). During the 1960s, governmental plans for large-scale embankments and land reclamations incited both scientific and societal conservation initiatives. For instance, in 1965 a scientific working group was started, which aimed at creating knowledge and stimulating awareness of the allegedly unique and conservation-worthy character of the Wadden Sea (Van der Windt, 1995). In the same year, the Wadden Sea Society was established as a reaction against plans to build embankments between the mainland and the island of Ameland.1 This organization grew out to be a prominent nature conservation NGO.

During the same period, the Dutch government started reconsidering its plans regarding the Wadden Sea. For instance, the Second Memorandum on Spatial Planning in the Netherlands (1966) stated that “an all-round study […] is to show whether land reclamation plans for parts of the Wadden Sea area or for the entire Wadden Sea are indeed desirable.”2 This call for a study resulted in the institution of a Wadden Sea Committee, which concluded in 1974 that reclaiming large parts of the Wadden Sea would be unfeasible for various reasons, including its negative impact on fisheries and the lack of an urgent need for more land; moreover, land reclamations were deemed undesirable because “the Wadden Sea in its current state is a valuable nature area”.3 For this latter reason the committee urged the Dutch government to improve the public administration, management, and conservation of the Wadden Sea.

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1 http://www.waddenvereniging.nl/vereniging/oprichting [last accessed on 7-1-2016].
2 Tweede nota over de ruimtelijke ordening in Nederland (1966): 64.
Since the 1970s, the conservation of the Wadden Sea by means of regulations and management initiatives has gradually gained prominence. Since 1978, Denmark, Germany, and the Netherlands have collaborated in the conservation and management of the Wadden Sea in the context of the Trilateral Wadden Sea Cooperation (Wolff et al., 2010). The Dutch Wadden Sea was designated as a “wetland of international importance” under the Ramsar convention in 1984. Furthermore, in 2009 the Dutch Wadden Sea was officially designated as a Natura 2000-site, which implies that it officially became a protected area under the European Birds and Habitats Directives. Finally, large parts of the Dutch and German Wadden Sea were inscribed on the UNESCO world heritage list in 2009; five years later, the inscribed area was extended across the Dutch, German, and Danish Wadden Sea. Thus, the Wadden Sea is nowadays managed under a multitude of international conservation regimes.

On a national level, two main instruments regarding the management and conservation of the Dutch Wadden Sea are the Wadden Sea Memoranda and the Nature Conservation Act. The Wadden Sea Memoranda (1980, 1994, 2007) are policy plans of the Dutch government that outline the general national policy on the Wadden Sea. The most recent Memorandum of 2007 states that its main policy goal is “the sustainable protection and development of the Wadden Sea as a nature area and the conservation of the unique open landscape” (VROM, 2007a: 9). The Nature Conservation Act (NCA) is an important legal framework for nature conservation in the Netherlands; a large part of the Wadden Sea has been designated as a protected area under this act. The NCA provides competent authorities with several nature conservation instruments, including the right to temporarily or permanently close off parts of the Wadden Sea to humans. Moreover, it demands scientific impact assessments of plans and projects that do not directly contribute to the management of the area. Such plans or projects are only permitted if an assessment proves that they have no significant adverse effect on achieving the legal nature conservation objectives.

This rise of the conservation of the Wadden Sea has been accompanied by a rise of controversy and conflict between governmental agencies, nature conservation NGOs, economic sectors, and societal organizations. In the last decades, several conflicts emerged about the possibly negative impact of human activities on nature in the Wadden Sea area. Two of these conflicts that have notably been in the societal, political, and scientific spotlights concern gas mining and the cockle fishery. The controversy on gas mining started in the 1970s; central issues in this case included the
possible ecological effects of soil subsidence caused by gas mining, and how such effects could be prevented. After a moratorium and many societal protests, political debates, and scientific assessments, gas mining was allowed in 2004 under the condition that an adaptive management approach called “hand on the tap” would be applied. This approach entails that the gas extraction volume can be reduced if the land or seabed subside too quickly. This controversy has been described and analyzed in detail in several publications (e.g., Verbeeten, 1999; Turnhout et al., 2008; Runhaar & Van Nieuwaal, 2010). The controversy on the cockle fishery started around 1990 and revolved around the detrimental impact of the large-scale mechanical cockle fishery on the Wadden Sea ecosystem. A combination of societal protests, political deliberations, research and advisory reports, and legal rulings resulted in a ban on the mechanical cockle fishery on the Wadden Sea in 2004. Like gas mining, the cockle fishery controversy has been extensively analyzed in several publications (e.g., Steins, 1999; Swart & Van der Windt, 2005; Imeson & Van den Bergh, 2006; Swart & Van Andel, 2008; Turnhout et al., 2008; Hanssen et al., 2009).

The literature cited above indicates that knowledge has played crucial and sometimes problematic and contested roles in these controversies (see also Floor et al., 2013). For instance, the decision-making on the permissibility of both the cockle fishery and gas mining in part relied on ecological monitoring, impact studies, and expert judgement. However, uncertainty on the effects of these activities and a lack of scientific consensus complicated decision-making processes (Hanssen et al., 2009). Moreover, several authors have identified disconnections between knowledge creation and decision-making, for instance because of limited interactions between researchers and policy-makers and because of a mismatch between scientific knowledge and dominant policy discourses (Hanssen et al., 2009; Runhaar, 2009; Floor et al., 2013). Furthermore, both in the cockle fishery and gas mining controversies competing actor coalitions have used uncertainties and knowledge gaps “to undermine knowledge claims put forward by the competing coalitions”; reports, experts, and institutes were “actively discredited” (Turnhout et al., 2008: 235). Finally, scientific experts have sometimes played controversial roles. Some scientists have for instance been criticized for taking a too political and activist stance in conflicts on the management and conservation of the Wadden Sea (Steins, 1999; Swart & Van Andel, 2008).

Various research and advisory reports have addressed the knowledge conflicts between actor coalitions and the crucial role of knowledge in the management of the Wadden Sea (e.g. Adviesgroep Waddenzeebeleid, 2004; Toonen & Staatsen, 2004; Kabat et al., 2009a; Klostermann et al.,
These reports have identified several shortcomings in the knowledge and research infrastructure of the Wadden Sea, such as a lack of integrated knowledge management, inadequate collaboration between research institutes, a lack of interdisciplinary integration, and disconnections between scientific information and public decision-making. In recent years, various initiatives have been taken with the aim of improving this situation, such as the institution of the Wadden Academy in 2008. This organization focuses on research programing, knowledge exchange across science-policy boundaries, and scientific collaboration and integration (Kabat et al., 2009a). Furthermore, initiatives are being implemented to integrate various monitoring efforts and to make monitoring data more easily accessible to actors involved in management practices. These various initiatives indicate that improving the knowledge infrastructure and the interactions between knowledge and management of the Wadden Sea are currently high on the agenda.

From the above may be inferred that the relations between knowledge and policy on the Wadden Sea have already been addressed quite extensively, including in the scientific literature, in advisory reports on the public administration, and in initiatives to improve the knowledge and research infrastructure. However, a relatively recent development in the Wadden Sea area that has not yet received much attention is that in various policy domains new collaborative arrangements have emerged, which aim at settling conflicts between actor coalitions that have sometimes been engaged in lengthy disputes. A common characteristic of these arrangements is that they intend to balance the conservation and utilization of nature by means of a form of governance that involves ongoing deliberation between governmental agencies, nature conservation NGOs, and other societal actors. Given the crucial role of knowledge in the management of the Wadden Sea, this emergence of collaborative governance arrangements raises several questions. For instance, what has been the role of knowledge in their establishment? Does this new form of governance pose new requirements to knowledge creation and exchange? How do the participants deal with the contestation of knowledge that often occurs in conflicts on the conservation and utilization of nature?

These questions about the interactions between knowledge and governance are not just relevant for the management of the Wadden Sea area. In many places around the world, nature areas are under pressure of human activities. Moreover, in several of these areas governance practices have emerged that aim at finding a balance between the utilization and conservation of natural resources, and that in the pursuance of this aim are confronted with knowledge-related issues such as uncertainty, complexity,
and contestation (Ellis, 2005; Evans, 2010; Clarke et al., 2013; Trimble & Berkes, 2013; Bixler, 2014). Consequently, the interrelations between environmental knowledge and governance have been identified as an important topic in the environmental management literature (Van Buuren, 2009; Bremer & Glavovic, 2013a; Plummer et al., 2013).

1.2 RELATIONS BETWEEN ENVIRONMENTAL KNOWLEDGE AND GOVERNANCE

This section outlines some key lines of research on the interrelations between knowledge and governance that can be found in the environmental management literature. As a way of ordering the literature it distinguishes between two main ways of conceptualizing knowledge-governance relations: in terms of divisions and in terms of intertwinements. This distinction draws inspiration from the literature that has used similar concepts in order to characterize various kinds of science-policy interactions. This literature includes the work of Hoppe (2002), who has argued that science-policy arrangements may be characterized in terms of either divergence or convergence between science and politics. In the former case, science and politics are perceived to be separated and functionally differentiated; in the latter case, they are much more seen as two sides of the same coin. Moreover, a source of inspiration for using this distinction is the work of the Stuurgroep Toekomstonderzoek en Strategisch Omgevingsbeleid (2001), which has used the distinction between “interwoven” and “disentwined” relations between research and policy. Unlike these sources, my aim is not to use the categories of divisions and intertwinements for classifying particular science-policy arrangements. Rather, I use these categories to distinguish between different strands of literature that focus on different types of interactions between environmental knowledge and governance. The literature that I assign to the category of divisions predominantly focuses on the differences and boundaries that may occur in knowledge-governance relations. The literature in the category of intertwinements predominantly focuses on ways in which environmental knowledge and governance may be interwoven or amalgamated.

1.2.1 Divisions

A first line of research that can be situated in the category of divisions focuses on the differences between the various knowledges that may be relevant for environmental governance. In this approach, environmental governance is seen as a process in which various knowledgeable actors
such as conservationists, citizens, and resource users (should) participate. Such actors with different backgrounds may bring different insights and experiences to the table (e.g., Birkenholtz, 2008; Edelenbos et al., 2011; Mauelshagen et al., 2014). Several scholars of environmental governance have referred to such differences in terms of the various forms of knowledge that may be of value to environmental governance, such as scientific, local, and indigenous knowledge (Ellis, 2005; Birkenholtz, 2008; Berkes, 2009; Crona & Parker, 2012; Taylor & De Loë, 2012). Furthermore, various notions have been used to signify the different social and normative configurations in which the knowledge of various actors may be embedded, such as the notion of the “knowledge system” (Evans, 2010; O’Toole & Coffey, 2013). From this perspective, performing environmental governance requires connecting or integrating the disparate knowledge systems of different actor groups (King, 2004; Robinson & Wallington, 2012). Other authors have used the notion of “ways of knowing” to denote such epistemic and normative differences (Janssen et al., 2015). Different ways of knowing “give rise to different understandings of precisely which factual knowledge is valid and relevant; they feed different world views, problem perceptions, and values”, and they “encompass different sets of organizing capacity” (Van Buuren, 2009: 209).

A second approach within the category of divisions focuses on the divisions that may exist between knowledge and policy-making. Within this approach, such divisions are often conceptualized in terms of boundaries and interfaces. The notion of the science-policy interface is a concept that has been widely applied (Pihlajamäki & Tynkkynen, 2011; Bremer & Glavovic, 2013a; Janssen et al., 2015). Alternatively, scholars of environmental governance have applied the notion of a “science-society-policy” interface (Buizer et al., 2011). Within the governance literature the open, dynamic, and negotiated character of such interfaces is generally acknowledged, for instance by conceptualizing the science-policy interface as a “governance setting” that encompasses the dialogue between and the inclusion and integration of disparate knowledges (Bremer & Glavovic, 2013a). Besides the concept of interfaces, knowledge-governance relations are also conceptualized in terms of the “utilization” of knowledge. In this case, an analytical distinction is made between the production of knowledge and its use or application in decision-making (Giebels et al., 2013; Lemos, 2015).

The literature focusing on interfaces between environmental knowledge and policy seeks strategies for improved governance in bridging or managing these interfaces. The concept of “boundary work” and related concepts are often applied to issues regarding the management of
science-policy interfaces. The term boundary work was coined in the field of Science and Technology Studies as an analytical concept that denotes the social construction work that is performed to grant epistemic authority to scientific knowledge, to demarcate it from non-scientific knowledges and activities (Gieryn, 1983). However, in the environmental governance literature it is often applied as a management concept that refers to joint knowledge production, coordination work among experts and policymakers, and translating knowledge into action (Robinson & Wallington, 2012; Turnhout et al., 2014; Wyborn, 2015b). Closely connected to this managerial interpretation of boundary work is the concept of boundary organizations; such organizations “play an intermediary role between knowledge production and decision-making (in different domains and levels), with a view to achieving co-operation in relation to a shared objective (Clarke et al., 2013: 94). Finally, the concept of “boundary objects” is used in the environmental governance literature to denote objects or concepts that may facilitate collaborations across science-policy interfaces (Star & Griesemer, 1989; Wyborn, 2015b). They are able to do so because they are flexible enough to be of value to actors with various backgrounds and concerns, yet robust enough to maintain a stable identity in different social contexts (Star & Griesemer, 1989). The collaborative creation of boundary objects is seen as a means of translation across boundaries of knowledge and governance (Robinson & Wallington, 2012).

It should be noted that the literature that employs these various concepts concerning boundaries and interfaces usually does not conceive of knowledge and governance as being strictly divided. I have categorized this literature under “divisions” because its main focus lies on how divides between knowledge and governance are created, bridged, or managed. The processes, objects, and institutions by which such work may be performed usually combine social, epistemic, and political elements (Miller, 2001). In this sense, the distinction between the categories of divisions and intertwinnements that I use here is not completely clear-cut.

1.2.2 Intertwinenments

A first body of literature that conceptualizes knowledge-governance relations in terms of intertwinement is the one that focuses on adaptive governance. Adaptive governance has been argued to be a fruitful way of dealing with the uncertainty and change that are associated with the governance of complex and dynamic natural systems (Folke et al., 2005). It involves the capacity to “understand environmental change”, “use this understanding to inform decision making”, and “act on decisions” in
a manner that promotes desirable system states (Evans et al., 2011: 21). Moreover, it involves the capacity to “review and adapt decisions as new information becomes available” (Cvitanovic et al., 2015: 26). Thus, gaining insight into and learning from both ecosystem change and the effects of human interventions in nature are seen as integral and vital aspects of governing (Termeer et al., 2010; Weiss et al., 2012).

A second body of literature that conceptualizes knowledge-governance relations in terms of intertwinements and hybridity is associated with, or draws inspiration from, interpretive and critical studies of policy and politics. This body of literature includes research in the tradition of interpretive policy analysis (e.g., Wesselink et al., 2013) and governance studies inspired by the work of Michel Foucault (e.g., Van Assche et al., 2011). In this line of thought, power and knowledge are thought to imply each other; for instance, wielding power inevitably involves knowing, while knowledge creation takes place in a context of power relations (Van Assche et al., 2011; Winkel, 2012). Environmental governance studies have for instance explored this power-knowledge nexus through studying environmental discourse. A discourse is defined as “a specific ensemble of ideas, concepts, and categorizations that are produced, reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities” (Hajer, 1995: 44). Discourses shape the objects of knowledge and the interpretive frameworks through which those objects can be known; at the same time, they construct social reality by shaping social order, including social subjects and relationships (Arts & Buizer, 2009; Rajão, 2013).

Finally, a third approach that can be situated in the category of intertwinements focuses on the coproduction of knowledge and social order. In the environmental governance literature the term coproduction has various denotations. Firstly, it is used to signify collaborative processes in which various groups of actors produce knowledge together. Secondly, it is used to give expression to the idea that knowledge and social order do not come about separately but are produced together in social practices (Jasanoff, 2004). This latter notion of coproduction has, for instance, been employed to conceptualize adaptive governance initiatives as settings in which knowledge, social processes, and normative visions are produced together (Wyborn, 2015a). Furthermore, it has been applied in studying the interplay between knowledge and power that may occur in governance practices (Muñoz-Erickson, 2014). These examples illustrate that both adaptive governance practices and knowledge-power interactions in governance arrangements can be understood to be processes in which knowledge and social order are coproduced. In this sense, there may be
some overlap between the three conceptual approaches that I assign to the category of intertwinements.

The different approaches and strands of literature on knowledge-governance interactions that I outlined above can be interpreted in various ways. Firstly, they can be seen as different conceptual frameworks that may provide different ways of theorizing or reasoning about the relations between knowledge and governance. In this sense, they provide different interpretive lenses to investigate knowledge-governance interactions. Secondly, these different strands of literature suggest that environmental knowledge and governance may interact and be interrelated in highly diverse ways. In this thesis I intend to both reflect on ways of conceptualizing knowledge-governance relations and to gain insight into the diversity of such relations that may occur in practice.

1.3 CONTRIBUTION AND FOCUS OF THIS THESIS

In the Dutch Wadden Sea area and many other areas around the world, environmental governance arrangements have emerged in which governmental and non-governmental actors collaborate in managing the natural environment. Knowledge has been argued to be crucial for managing nature in a sustainable way. Yet, it may be difficult to fruitfully connect environmental knowledge and governance, for instance because of uncertainty, conflicting perspectives of involved actors, and the complexity of natural and political-administrative systems.

A first aim of this thesis is to gain understanding of the interactions between knowledge and governance that may occur in the emergence and operation of collaborative governance arrangements. From the literature on the relations between environmental knowledge and governance (see section 1.2) may be inferred that such interactions can be diverse. Little research has investigated the full scope and diversity of such interactions in collaborative governance arrangements. This thesis intends to contribute to the literature by producing insight into the plurality of interactions between knowledge and governance that may play a role in building collaborations between actors towards the sustainable management of natural resources. I assume that this plurality of interactions may include both divisions and intertwinements between knowledge and governance. Accordingly, in this thesis I do not choose one explicitly divisions- or intertwinements-oriented conceptual framework. Rather, I use a combination of concepts that enables me to identify and signify both the divisions and the intertwinements that may occur in the cases that I study.
A second aim of this thesis is to translate the findings on these interrelations into practical recommendations on how to enable well-informed governance arrangements. The latter term signifies arrangements that are able to produce, mobilize, and draw upon the knowledge that is needed for governing human-environment interactions in a sustainable way. With these recommendations, I aim to provide ideas that are relevant to current developments in the Wadden Sea area regarding the improvement of the knowledge infrastructure and the interactions between knowledge and management. Moreover, these recommendations may be relevant to other areas and settings in which improving the interactions between knowledge and governance is a matter of interest. The research questions that have guided my research in working towards these two aims are:

1. How do environmental knowledge and governance interact in the context of collaborative governance arrangements?
2. What recommendations for enabling well-informed governance arrangements can be derived from insight into such interactions?

The first research question will be further specified and addressed in chapters 2-5. Chapter 6 will provide main conclusions on knowledge-governance interactions, as well as recommendations on enabling well-informed governance arrangements.

1.4 KEY CONCEPTS

Four of the chapters in this thesis have come about as separate papers. They have been written with the main research questions provided above in mind, but they also each have their own internal logic. With this I mean that each paper addresses a particular question and uses a particular conceptual and analytical framework in doing so. My reasons for using such a case-specific approach, i.e. for refraining from using a single analytical framework for all papers, are the following. Firstly, a certain level of conceptual openness helps to avoid that the analysis of empirical materials becomes overly structured by preconceived categories; thus, it facilitates an in-depth understanding of the particularities of the various cases. Secondly, the avoidance of overly structuring preconceived categories and the adjustment of conceptual frameworks on a case-to-case basis provide favorable conditions for a learning process that is informed by both empirical research and the literature. As a consequence of this approach, the analytical frameworks that are used to analyze the cases shift from chapter to chapter. These shifts in part are motivated by the particularities of the
cases, and in part reflect progressing theoretical insight. That being said, this thesis does sustain a degree of conceptual stability in order to achieve comparability of the cases and the substantive coherence of the research as a whole. This section gives an overview of the key concepts that form the conceptual “backbone” of the thesis.

1.4.1 Knowledge

With respect to knowledge, the focus of this thesis lies on the environmental knowledge that may be relevant for utilizing, managing, or conserving the environment. Such knowledge encompasses the experiences, insights, and factual beliefs regarding the state of the natural environment, whether or not in relation to human activities (Haas, 1992; Corburn, 2003; Edelenbos et al., 2011). I assume that the knowledge that is potentially relevant for particular governance efforts may be held by any actor who has a role or stake in those efforts. Such actors may include scientists, consultants, policy-makers, conservationists, citizens, and representatives of societal groups and economic sectors. Furthermore, this may include both formal and informal manifestations of knowledge. The former for instance includes scientific reports, assessments, and monitoring efforts, the latter includes knowledge that is based on local and practical experience (Fabricius et al., 2006; Raymond et al., 2010; Giebels et al., 2015).

A key matter of interest in this thesis concerns the ways in which knowledge is embedded in social practices and settings, particularly in relation to governance. A central concept that is used to capture this embedment is that of the knowledge system, which is defined as a social system that combines a set of experiences, insights, and factual beliefs with particular ways of creating and mobilizing knowledge (Reid et al., 2006; O’Toole & Coffey, 2013; see also section 1.2.1). The concept of the knowledge system as I use it in this thesis does not impose strict dichotomies between forms of knowledge. Rather, it takes as its point of departure the idea that different knowledges, scientific or other, may co-exist in various configurations (Wynne, 1996). Moreover, this concept privileges neither primarily science-based nor other knowledge systems “in terms of producing true or good knowledge”; it is impartial towards different epistemologies (Watson-Verran & Turnbull, 1995: 136).

1.4.2 Governance

In this thesis the term environmental governance signifies the measures, institutions and processes of collective decision-making and action
that are deployed to protect the environment and resolve conflicts over natural resources (Paavola, 2007;Tacconi, 2011; Driessen et al., 2012). Furthermore, a key characteristic is that it involves a plurality of governmental and non-governmental actors, often in a participative or deliberative manner (Wallington et al., 2008; Klinke, 2012; Bixler, 2014).

A key matter of interest in this thesis is how governance efforts in particular domains stabilize and get organized. A central concept in this respect is the governance arrangement, which is defined as a temporary stabilization of the content and organization of a specific governance domain (Arts et al., 2006; Driessen et al., 2012). Governance arrangements may be characterized by different ways of governing; this variation is highlighted in terms of different “modes of governance” (Driessen et al., 2012). Such modes are particular ways in which governance arrangements are structured in terms of the division of roles and competences among actors. They include centralized governance in which national governments “take the lead”, decentralized governance in which regional or local governments are in the lead, interactive governance in which governments and societal actors “collaborate on equal terms”, and self-governance in which societal actors “enjoy far-reaching autonomy” (Driessen et al., 2012: 145, 148).

1.4.3 Coproduction

As a general interpretive framework for studying the interactions between knowledge and governance this thesis uses the notion of coproduction, in the sense of the combined construction of knowledge and social order (see section 1.2.2). Coproduction in this sense is “shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it” (Jasanoff, 2004: 2). From this perspective, “knowledge and its material embodiments are at once products of social work and constitutive of social life; society cannot function without knowledge any more than knowledge can exist without appropriate social supports” (Jasanoff, 2004: 2-3). Thus, knowledge and social order are understood to be mutually constitutive.

Research in the field of Science and Technology Studies indicates that this notion of coproduction provides a useful way of interpreting and analyzing the interactions between knowledge and social order that emerge in the context of practices of democratic engagement (Chilvers & Kearnes, 2015). However, how environmental governance can be understood in terms of the coproduction of knowledge and social order has received relatively little attention in the literature. One of the aims of this thesis
is to further explore the ways in which environmental governance can be understood in terms of the coproduction of knowledge and social order.

### 1.5 **Methodological Considerations**

The empirical part of this thesis encompasses three case studies of domains of coastal governance that are strongly, albeit not exclusively, related to the Dutch Wadden Sea. As a first step towards the selection of cases a broad investigation was made of issues and developments regarding the management of the Dutch Wadden Sea, which resulted in a long list of 14 candidate cases. These candidate cases were explored on the basis of sources such as newspaper articles, reports, and websites. Subsequently, I assessed which of the candidate cases appeared to best match the scope and aims of this research. The main criteria in making this assessment were the following. Firstly, I gave preference to cases in which conflicts between various groups of actors on the utilization and conservation of the Wadden Sea were manifest. Secondly, I decided to focus on cases in which knowledge-related issues such as confrontations between divergent knowledge systems appeared to play a role. Thirdly, I gave preference to cases in which a form of governance had emerged that aimed at dealing with these conflicts. Fourthly, I aimed at covering some of the breadth and variety of Wadden Sea governance through the selection of the cases. Therefore, I selected cases in different domains of human-environment interactions that on the basis of a first exploration appeared to be characterized by different modes of governance. These considerations resulted in the selection of the mussel fishery, recreational boating, and dynamic coastal engineering as cases.

In all three case studies, semi-structured interviews were a main method of data collection. I tried to interview as many actors as possible who were actively involved in the deliberations connected to the selected cases. These actors mainly include civil servants, researchers, and representatives of economic sectors, societal interest groups, and environmental protection NGOs. Candidate respondents were identified on the basis of both written sources and snowball sampling. The interview questions were fine-tuned for each case; however, all the interviews focused on a common set of main topics. These topics are: actors’ perspectives on key issues regarding the case, interactions between the actors involved, the emergence and workings of governance arrangements, and the roles of knowledge in governance. The 69 interviews were recorded, transcribed verbatim, and analyzed on a case-to-case basis with software for qualitative data analysis (NVIVO 10). In all three cases I combined two coding strategies. Firstly,
I used setting-specific codes that were constructed on the basis of the issues that were brought up by the respondents; secondly, I used analytical codes that were based on the analytical frameworks that I operationalized for the various cases (Lofland et al., 2006). In the case studies on the mussel fishery and recreational boating I used focus groups as an additional data collection method. The set-up of the focus groups was based on the methods of the Reflexive Monitoring in Action approach (Van Mierlo et al., 2010). A more detailed description of these focus groups and their roles in the data collection is provided in the chapters concerned. Furthermore, as a validation mechanism I performed methodological triangulation in all three cases (Stake, 1995). For this triangulation I combined the interview and focus group data with written sources such as legal texts, agreements and covenants, policy reports, workshop and meeting reports, and research and evaluation reports.

1.6 OUTLINE OF THIS THESIS

Chapter 2 spotlights the mussel fishery in the Dutch Wadden Sea. It aims to answer the question how it is possible that a long-standing and often heated conflict between the mussel sector, nature conservation NGOs, and the Dutch government could be transformed into a collaborative transition process towards sustainable mussel fishery. In answering this question, it focuses on the interplay between knowledge creation, power, and rules; the latter include legal rules and collaborative agreements. Chapter 3 explores the case of recreational boating to investigate how changes towards interactive and participatory forms of governance may come about over the course of several decades. It analyzes such changes in terms of the interconnected shifts of governance modes and knowledge systems. The third case study, which is described in chapter 4, focuses on the domain of coastal engineering to investigate the tensions and synergies that may occur in joint knowledge creation for coastal governance. Such tensions and synergies may occur in efforts to simultaneously achieve scientific quality, relevance for decision-making, and legitimacy with respect to the concerns of stakeholders. Subsequently, chapter 5 aims to contribute to insight into the intertwinemements of knowledge and governance by investigating the ways in which knowledge can be understood to be a constitutive element of environmental governance. In order to do so, it conceptualizes the various capacities that are needed to perform environmental governance in terms of the coproduction of knowledge, values, and social order. This framework of governance capacities is used to synthesize the findings of the three case studies. Finally, chapter 6 draws conclusions on the interac-
tions between environmental knowledge and governance, reflects on the theoretical frameworks used, and provides recommendations on how well-informed governance arrangements may be enabled.
02. THE COPRODUCTION OF KNOWLEDGE AND POLICY IN COASTAL GOVERNANCE: INTEGRATING MUSSEL FISHERIES AND NATURE RESTORATION

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Abstract
One of the challenges of coastal governance is to connect a variety of knowledge systems. The purpose of this paper is to show how a coastal governance practice can emerge and stabilize, such that actors with disparate knowledge systems collaborate towards the shared goal of sustainable resource use. We analyze this stabilization in terms of the coproduction of knowledge and policy. This paper is empirically informed by a case study on the transition towards a sustainable mussel fishery in the Dutch Wadden Sea. Our study illuminates the difficulties of underpinning a coastal governance practice with scientific research, since the relevance, quality, and results of research are interpreted differently from the perspectives of resource users and conservationists. Furthermore, our analysis shows that such a governance practice can stabilize through a combination of rule negotiation, legal, societal, and political pressure, along with collaborative knowledge creation. Based on our analysis, we identify several aspects of collaborative knowledge creation that enable the formation of a shared knowledge base for governance in a context of controversy. These include the shared ownership of research, knowledge creation as an integral part of governance, a focus on data and basic facts, and the close involvement of trusted experts. The findings of this study suggest that a controversial setting strongly structures knowledge creation, while at the same time knowledge creation enables coastal governance as a way of dealing with conflicts.

2.1 INTRODUCTION

In coastal areas worldwide, tensions exist between ecological conservation and economic development. Such tensions often lead to conflicts between different actor groups and institutions with contrasting interests in coastal zones. Coastal governance has emerged as a key mode of dealing with such conflicts. In the context of coastal management, governance is often seen as an interactive form of policy-making or management, in which governmental and non-governmental actors collaborate in order to deal with social and ecological problems in coastal areas (Cicin-Sain & Belfiore, 2005; Jentoft, 2007; Frangoudes et al., 2008). Coastal governance practices are characterized by interdependence and the distribution of power and competences among the actors involved in coastal management issues (Folke et al., 2005; De la Torre-Castro, 2012). This paper investigates a case of a coastal governance practice in the Dutch Wadden Sea that integrates a transition towards a sustainable mussel fishery with a process of nature restoration.

In the coastal management and marine policy literature a number of governance-related principles can be discerned, which include adaptivity,
integration, and inclusion. Adaptivity in management approaches is deemed necessary in order to deal with uncertainty, along with the social and ecological complexity of coastal zones, and to promote the resilience of coastal systems (Berkes & Turner, 2006; Lane, 2008; Rijke et al., 2012). Integration is a key principle of coastal governance, as exemplified by the rise in integrated coastal zone management (ICZM). This form of management aims at dealing with the multiplicity of uses, actors, stakes, and environments in coastal zones by integrating sectors, governmental levels and policies, spatial and temporal scales, and science and policy (Cicin-Sain & Belfiore, 2005; Shipman & Stojanovic, 2007; Lane, 2008; Portman et al., 2012). Furthermore, inclusion of stakeholders is a key principle, as exemplified by the application of comanagement in fisheries governance (Trimble & Berkes, 2013).

This adaptive, integrative, and inclusive character has consequences for the roles of knowledge in coastal governance. In this paper we will expand on two knowledge-related themes that figure prominently in the coastal governance literature. First, knowledge in the context of coastal governance is often described as a diverse, fragmented, and situated phenomenon (O’Toole & Coffey, 2013). An integrated approach, for instance, necessitates a diverse, interdisciplinary, scientific knowledge base (Bremer & Glavovic, 2013a). Furthermore, due to the inclusion of multiple actors with multiple backgrounds and worldviews, “other-than-scientific” knowledge plays an important role in coastal governance. Such other types of knowledge are conceptualized in terms of, for example, experience-based knowledge (Berghöfer et al., 2008); traditional ecological knowledge (Berkes & Turner, 2006), fishermen’s ecological knowledge (Holm, 2003), and local (ecological) knowledge (Gerhardinger et al., 2009; Bundy and Davis, 2013; Clarke et al., 2013). Moreover, the diversity and the situated character of this knowledge are expressed in terms of the different knowledge systems that are involved in coastal governance (Gerhardinger et al., 2009; Evans, 2010; Hastings et al., 2012; Clarke et al., 2013; O’Toole & Coffey, 2013). Second, the coastal governance literature proposes a variety of approaches for connecting or integrating these disparate kinds of knowledge. Institutional approaches include proposals to improve interfaces between knowledge creation and decision-making, for instance by creating flexible institutions for adaptive management, in which stakeholders can interact and evaluate the effects of management measures on an ongoing basis (Bremer & Glavovic, 2013a), and by instituting boundary organizations (Tribbia & Moser, 2008). The latter “play an intermediary role between knowledge creation and decision-making (in different domains and levels) with a view to achieving co-operation in relation to
a shared objective” (Clarke et al., 2013: 94). Process-oriented approaches include deliberation and dialogue (Le Heron et al., 2008; Clarke et al., 2013) and learning in the context of coastal governance practices (Jentoft, 2007; Evans et al., 2011).

This paper aims to contribute to the body of literature on knowledge in coastal governance by showing how an adaptive coastal governance practice can emerge and stabilize, in which actors with disparate knowledge systems collaborate towards the shared goal of sustainable resource use. Here, “stabilization” means the formation of a collaborative practice and the existence of this practice over a substantial timespan. Our research question is: what are the factors and conditions that are influential in this emergence and stabilization? We argue that this emergence and stabilization needs to be understood in terms of the reciprocal relationship between the formation of epistemic order and regulatory order. Epistemic order refers to the establishment of knowledge systems, how knowledge disputes are dealt with, and how actors collaborate in knowledge creation. Regulatory order refers to policy-making, regulation practices, and jurisdiction. This reciprocal relationship, also referred to as coproduction (Jasanoff, 2004), is an aspect of knowledge-policy relationships that has hitherto been scarcely addressed explicitly in the coastal governance literature.

The next section describes the analytical framework in further detail, after which section 2.3 outlines the methodology and section 2.4 introduces the case of the mussel fishery in the Dutch Wadden Sea. Subsequently, section 2.5 describes the empirical results of the case study and section 2.6 provides our conclusions on the role of knowledge systems and the coproduction of knowledge and policy in coastal governance.

2.2 THE COPRODUCTION OF KNOWLEDGE SYSTEMS AND POLICY ARRANGEMENTS

In this study, we use the concept of coproduction as a general interpretive framework for the interrelationship between knowledge and policy (Jasanoff, 2004). In Jasanoff’s words, “co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it” (Jasanoff, 2004: 2). In this sense, the coproduction of epistemic and regulatory order means that the two are mutually constitutive. Rather than a “fully fledged theory, claiming lawlike consistency and predictive power”, coproduction is “far more an idiom – a way of interpreting and accounting for complex phenomena […]” (Jasanoff, 2004: 3). The value of
Governing Knowledge

this idiom is that “we gain explanatory power by thinking of natural and social orders as being produced together” (Jasanoff, 2004: 2). Coproduction provides an interpretive device that enables us to explain the interwoven character of knowledge and policy in the context of governance practices. It is better suited to do so than theoretical models that depict science and policy as separate worlds that interact through a predominantly one-way linear process, such as the “speaking truth to power” model of science and politics (Hoppe, 1999).

As an analytical framework to study epistemic order we will use the concept of the knowledge system, which we consider to be a “body of propositions actually adhered to (whether formal or otherwise) that are routinely used to claim truth” (Reid et al., 2006: 11). Furthermore, inspired by the concept of epistemic cultures, we will conceptualize knowledge systems as social systems of creating and warranting knowledge, which “make up how we know what we know”9, and which are characterized by specific “machineries of knowledge construction” (Knorr Cetina, 1999: 1, 3). Thus, knowledge systems are social systems that are characterized by specific ways of creating, exchanging, and legitimating knowledge. This concept of the knowledge system entails a symmetrical analytical approach, in which different kinds of knowledge and conflicting viewpoints are investigated by means of a single framework, and in which no knowledge system is privileged “in terms of producing true or good knowledge” (Watson-Verran & Turnbull, 1995: 136). The concept enables us to identify differences between knowledge systems without reifying preconceived classifications and asymmetries of knowledge, for instance, between scientific and other knowledge (Knorr Cetina, 1999; Verran, 2001).

As a framework for analyzing regulatory order we will use the policy arrangements theory. Other authors have demonstrated the suitability of this theory for analyzing collaborative policy processes in the context of coastal management and marine policy (Bogaert et al., 2009; Seijger et al., 2013). A policy arrangement is defined as “the temporary stabilisation of the content and organisation of a policy domain” and is analyzed in terms of four dimensions (Arts et al., 2006: 96). The first dimension refers to actors (i.e., individual persons and organizations such as NGOs, fishing organizations, and governmental agencies) and coalitions. The second dimension refers to the division of power and resources among actors. Power is on the one hand regarded as “the ability of actors to mobilise resources in order to achieve certain outcomes in social relations”, and on the other hand as a “dispositional and a structural phenomenon of social and political systems” (Arts & Van Tatenhove, 2004: 343). The third dimension concerns the rules of the game that are in operation. In this

9 The original italics are deleted.
case study we focus on rules in terms of national and international legislation and rules in terms of collaborative agreements such as covenants. The fourth dimension is discourse: “a specific ensemble of ideas, concepts, and categorizations that are produced, reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities” (Hajer, 1995: 44; Arts & Van Tatenhove, 2004). Discourses are thus dominant interpretative schemes, which include formal policy concepts, popular story lines, and views concerning norms, values, problem definitions, and possible solutions (Arts & Van Tatenhove, 2004; Arts et al., 2006). We use these four dimensions somewhat loosely as a heuristic and interpretive framework. The advantage of applying such a flexible framework is that it enables the identification of the most noteworthy aspects of the case as it enables a focus that is not too rigidly structured by theory. Moreover, the advantage of combining this multi-dimensional theory of policy arrangements with the concept of knowledge systems is that it enables us to identify various possible ways in which knowledge is interconnected with specific aspects of policy-making and regulation such as power and rules.

2.3 METHODS

This case study is empirically informed by interviews, focus groups, and document analysis. A total of 28 semi-structured interviews were conducted with actors who were involved in the collaborative practice concerning the mussel fishery in the Dutch Wadden Sea or in the processes that preceded this collaboration. The majority of the interviewees were intensively involved for many years, both before and during the collaboration. Therefore, the set of interviews has provided rich information on how the collaborative practice emerged, stabilized, and functioned during the last decade. The interviews were held in two rounds: an exploratory round in 2012 of 8 interviews, and a second round of 20 interviews in 2013. Most of these interviews lasted between 45 minutes and 2 hours. Interview questions were formulated according to the analytical framework described above. The interviewees were representatives of the mussel sector, government officials, representatives of the NGOs involved, and scientific experts. The interviews were recorded, transcribed verbatim, and coded with software for qualitative data analysis (QSR Nvivo 10). Two types of codes were used: setting-specific codes, which emerged inductively from the data (such as current issues concerning the case), and analytical codes, which were derived from the analytical framework (Lofland et al., 2006). The coded data was stored in an Nvivo project database.
Moreover, three focus groups with between 3 and 8 participants were conducted with representatives of the NGOs involved, civil servants from the Department of Economic Affairs, and representatives of recreational sailing organizations and the shrimp fishing sector. The focus groups were held to validate findings from the interviews, collect additional data, and identify problem formulations and perspectives of groups of actors involved on a more intersubjective level as compared to the individual interviews. The set-up of the focus groups was based on the methods developed in the Reflexive Monitoring in Action (RMA) approach (Van Mierlo et al., 2010). The focus group sessions were recorded and the data was processed and analyzed in a similar way to that of the interview data.

Furthermore, we used case-related documents such as policy documents, research and advisory reports, and progress reports. In our analysis we applied triangulation of interview transcripts, focus group transcripts, and case-related documents to validate the results (Hastings, 2010). We started out by analyzing the interview transcripts and focused on statements that were made by multiple interviewees as a first validation strategy. Subsequently, we used the focus group transcripts and case-related documents to validate the analysis of interview data; we used these sources to enrich our analysis with additional data. The quotes in this paper are anonymized to meet the confidentiality agreement that was agreed upon with the interviewees and the focus group participants.

2.4 THE MUSSEL FISHERY AND MUSSEL CULTIVATION IN THE DUTCH WADDEN SEA

The Wadden Sea, which stretches from the northwestern coast of the Netherlands to the southwestern coast of Denmark, is a coastal wetland area of both ecological and socioeconomic importance. It contains intertidal sand and mud flats, salt marshes, and barrier islands. Its value as a nature area is, for instance, reflected by its inscription on the UNESCO World Heritage List. Mussel beds (Mytilus edulis) are considered an important element of the Wadden Sea ecosystem (Dankers and Zuidema, 1995).

Mussel cultivation in the Netherlands originated in the southwestern delta of Zeeland. Traditionally, Dutch mussel culture is a semi-culture, in which mussel spat resulting from natural reproduction is fished from the “wild” seabed, cultivated on plots that are rented from the government for some two years, and then brought to market (Van Ginkel, 1990; Smaal, 1991). From around 1950 onwards, mussel fishermen started to cultivate mussels on plots in the Wadden Sea since the mussel population

Formerly the Ministry of Agriculture, Nature, and Food Quality.
in Zeeland was severely affected by a parasite (Dankers & Zuidema, 1995; Ens et al., 2004). Since then, they have been using both the Wadden Sea and the Eastern Scheldt (Oosterschelde) in the southwestern delta for collecting and cultivating mussels (see figure 2.1). Until the early 1990s, the mussel fishery was a relatively “free” fishery under limited regulation (Van Ginkel, 1990).

In the early 1990s, low spat falls of both cockles and mussels occurred (Floor et al., 2013). The remaining intertidal mussel beds and “almost all dense cockle beds” were removed by the mussel and cockle fisheries, which resulted in food shortages among birds and eventually in a high bird mortality (Dankers & Zuidema, 1995: 78). These events spurred conflicts and
legal procedures between the fishing sector and nature conservationists involving the impact of shellfish fisheries on the Wadden Sea ecosystem (Imeson & Van den Bergh, 2006). However, a broad scientific consensus on this matter was not reached; scientific knowledge was “continuously debated” by experts and other actors involved (Turnhout et al., 2008: 233). Despite this lack of scientific and societal consensus, a stricter fisheries policy based on the principle of comanagement was introduced in 1993 (Steins, 1999). Key principles of this policy were a “division of responsibilities” between the fishing sector and the government and “the integration of fisheries and nature”, for instance by means of food reservation for birds (Steins, 1999: 130).

In 2004, a revised shellfish fisheries policy was introduced, which emanated from the yet unsettled conflicts between the fishing sector and environmental NGOs, deliberations between various actor groups involved, and a series of research and advisory reports on shellfish fisheries and sustainable development of the Wadden Sea (Adviesgroep Waddenzeebeleid, 2004; Ens et al., 2004; Swart & Van Andel, 2008; Runhaar & Van Nieuwaal, 2010). This revised policy encompassed a ban of the mechanical cockle fishery from the Wadden Sea as of 2005 and investments in economically and ecologically sustainable mussel fisheries.

Between 2004 and 2008, both Dutch and European courts of law handled new court-cases that were instituted by the NGOs. The latter argued that the shellfish fishing permit regime was insufficiently attuned to nature conservation. These procedures culminated in 2008 in the nullification by the Dutch Council of State of the mussel spat fishing permit that was issued in the spring of 2006. This situation created the leverage to find a structural solution for a sustainable mussel fishery. Later in 2008, the Dutch government, the Producers’ Organization (PO) Mussel Culture, and a group of environmental NGOs signed the “Transition Mussel Sector and Nature Restoration Wadden Sea Covenant”.

The first key element of the covenant is the step-by-step replacement of the seabed spat fishery by alternative methods of spat collection in the water column, in order to minimize the ecological impact of the mussel spat fishery on the seabed (see also Puente-Rodríguez et al., 2015). With each transition step, parts of the wild mussel spat beds are closed for nature restoration purposes. The main alternative method so far deployed involves the use of mussel spat collection installations (Dutch acronym: MZIs13). MZIs are floating constructions of lines, pipes, or rafts, which are anchored to the seabed and have ropes or nets (“substrate”) hanging in the water. Mussel spat, which floats in the water column in its first stages of

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11 The signatories of the covenant are the minister of Agriculture, Nature, and Food Quality; the Society for the Protection of Birds; the Wadden Sea Society; the WAD Foundation; the Society for the Preservation of Nature Monuments in the Netherlands; and the Producers’ Organization Mussel Culture.

12 In Dutch: Convenant Transitie Mosselsector en Natuurherstel Waddenzee.

13 MZI stands for mosselzaadinvanginstallatie (literally: mussel seed collection installation).
development, adheres to the substrate and can subsequently be harvested and cultivated. Other alternatives to spat collection on the seabed, such as MZIs on the North Sea and mussel reproduction and cultivation in more industrial settings on land, are also being explored in order to eventually further diminish mussel spat collection in the Wadden Sea. The second key element of the covenant is a nature restoration program for the Wadden Sea,\textsuperscript{14} which encompasses a wide array of nature restoration initiatives.

Despite the collaborative effort around the covenant, the mussel transition is contested. For instance, the mussel sector doubts the necessity of fully completing the transition for several reasons, which include the conviction that the spat fishery on the seabed has a limited ecological impact. Thus, they question the very foundations of the covenant and the transition. Other groups of actors are also critical about the mussel transition. For instance, the increase of MZIs and closed areas decreases fishing grounds for shrimpers. Furthermore, recreational sailing organizations oppose the transition as MZIs may lead to unsafe situations for sailors and are found to be aesthetically unattractive.

\section*{2.5 RESULTS}

In this section we will first describe the roots of the conflict concerning the mussel fishery in the Dutch Wadden Sea in terms of a clash between two perspectives on using and protecting natural resources: a mussel fishery perspective and a nature conservation perspective (section 2.5.1). Subsequently, we will describe two examples of knowledge creation efforts, which exemplify the knowledge dynamics that have occurred in the context of these conflicting perspectives (section 2.5.2). Finally, we will explain how the two perspectives were connected in a governance practice through the coproduction of power, rules, and collaborative knowledge creation (section 2.5.3).

\subsection*{2.5.1 The Wadden Sea mussel conflict as a clash of two perspectives}

At the basis of the Wadden Sea mussel conflict lies a clash of two dominant perspectives: a mussel fishery perspective and a nature conservation perspective. We use the term “perspective” to describe a more or less coherent unity that encompasses interconnected discourses and knowledge systems. We are aware that, within both the nature conservationist sector and the fishing sector, different approaches and viewpoints exist that sometimes

\textsuperscript{14} The Program “Towards a Rich Wadden Sea” (PRW).
overlap (e.g., Van der Windt et al., 2007). However, during this conflict the two contrasting perspectives described here were dominant.

2.5.1.1 THE MUSSEL FISHERY PERSPECTIVE

The idea that mussel fishermen are “farmers on the water” who produce and “work in nature” is a key story line in the mussel fishery discourse. Several interviewees stated that they “live on nature”, implying that they depend on nature for their livelihood and therefore are responsible for keeping their workplace territory in good condition. Moreover, they argued that mussel cultivation is a type of “nature management”; because mussel spat is “safely stored” and cultivated, mussel cultivation enriches nature.

This discourse is founded on truth claims concerning nature, the mussel fishery, and how nature and the mussel fishery are interrelated. Interviewees described nature as capricious, autonomous, and dynamic. For instance, one of them argued that “nature does what it wants”; another interviewee argued:

“Processes in the area are so autonomous, our activities so to say brush against them. […] Destroying the Wadden Sea: a mussel fisherman is not able to do that.”

Moreover, the spat fishery on the seabed is perceived to have a limited impact on nature. Furthermore, the fishermen see mussel cultivation as beneficial to nature as it increases mussel biomass and thus food for birds in the Wadden Sea. Many of them work in family businesses, which have sometimes been using the same plots for several generations. This serves as an argument for the sustainability of mussel cultivation:

“Here in the Eastern Scheldt […] we have been fishing for 100 years on a plot of our own […]. If we caused significant damage we would be done fishing sooner or later.”

In addition to these truth claims about the interrelationship between fisheries and nature, the mussel fishery discourse is strongly founded on truth claims concerning economic and operational management aspects of the fishery practice and its current transition. Several interviewees stressed the high investments necessary for the transition and the relatively high price of MZI-caught spat; also, they expressed their concerns about the efficiency and the returns of these new production methods. These economic considerations have served as arguments for the claim that the goal

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15 All of the quotes in this section are from interviews with actors from the mussel sector; most of them have practical experience as fishermen. The short quotes at the beginning of the section are statements that were made in multiple interviews.
of a fully completed transition is unattainable. Moreover, the fishermen argued in the interviews that the MZI-based practice sometimes conflicts with the traditional spat collection and cultivation cycle and that the new methods are much more laborious than the traditional ones.

On the one hand, the mussel fishery knowledge system is traditional in the sense that many fishermen work in family businesses and acquired their knowledge from their fathers or other family members. Moreover, the knowledge system has a strongly experiential character, as mussel cultivation is not a trade that mussel fishermen learn in school; they learn the tricks of the trade by seeing their colleagues and family members work, and trying it themselves. Furthermore, the knowledge system has a local character; to be able to do his work, a mussel fisherman needs knowledge about local conditions, such as the suitability of specific cultivation plots for parts of the cultivation cycle. For instance, one of the interviewees explained about one of his cultivation plots:

“It is very good for sowing seed and taking it off a year later as juvenile mussel […] from juvenile to consumption-sized mussel, it doesn’t work.”

On the other hand, the mussel fishery knowledge system has become increasingly formalized through research, monitoring, and collaborations between the sector and research organizations. This formalization occurred under pressure from regulation, legal cases, and agreements that were made in the context of the mussel covenant. Examples of regulation-induced, formalized knowledge creation include periodic inventories of mussel stock, black-boxing of ships, and making scientific “appropriate assessments” of the effects of fishing practices that need to accompany permit requests under the Nature Conservation Act. Moreover, new fisheries policies have led to research efforts. According to mussel fishermen, the results of these research projects validate and objectify their experiential knowledge. The mussel sector has close ties with a number of experts and research organizations such as IMARES. It collaborates with the latter by, for instance, financing research on the yield of cultivation plots and by organizing “study days”.

The mussel fishery knowledge system is thus partly traditional, but it is also part of an economic sector engaged in processes of innovation and transition. The success of the MZI technology can at least in part be attributed to the experiments, innovations, and adaptive capacity of both individual fishermen and companies. For instance, one of the interviewees argued that “you need to be open to modernization in your cultivation.”
2.5.1.2 THE NATURE CONSERVATION PERSPECTIVE

In the nature conservation discourse, the Wadden Sea is first and foremost a nature area. Furthermore, “restoration”\(^\text{17}\) of nature is a key concept within this discourse. Nature is defined in terms of an ecosystem, the state of which is described in terms of its biodiversity and the functioning of its “food web”. Restoration of the ecosystem is seen as a long-term and large-scale process. Within this discourse, mussels are framed in terms of their structural role in the ecosystem. For instance, “wild multiple-year mussel beds” are a nature restoration objective because mussels serve as a “bio-builders”.\(^\text{18}\) The development of such mussel beds must take place in a way that is as “undisturbed” as possible; therefore, “seabed disturbing” fishing activities must be banned. Hence, “coming loose from the seabed” is the central objective of the transition for the nature protection NGOs involved. The mussel fishery is described as a form of “human co-use”, which is only allowable within the “usage space” defined by “nature objectives”. For instance, one of the representatives of the NGOs argued:

“[Our organization] is of the opinion that the types of co-use, where they do not match the nature objectives, should be discontinued or brought into conformity with the nature objectives for the area.”

This nature conservation discourse is underpinned by truth claims as to the beneficial impact of wild mussel beds on the ecosystem. For instance, interviewees argue that mussel beds are the foundation of the ecosystem and are important for many species because they form habitats on the seabed. Furthermore, this discourse is underpinned by claims that the mussel fishery has a negative impact on the ecosystem. For instance, one of the representatives of the NGOs stated:

“Mussel beds have an enormous impact on their surroundings, so if you take away a mussel bed, you don’t just take away a couple of mussels but you take away a bio-builder […]”

The knowledge system of the nature protection NGOs involved in the transition is strongly rooted in scientific ecosystem ecology. A science-based image of the ecosystem serves as a frame of reference within this

\(^{17}\) All of the quotes in this section are from the interviews or the focus group with representatives of the NGOs. The short quotes at the beginning of the section are statements that were made in multiple instances.

\(^{18}\) The term bio-builder refers to species that through their physical characteristics may create habitats for other species.
knowledge system. Interviewees have expressed their preference for a scientific knowledge base; for instance, one of them argued:

“We as nature conservationists are looking for internationally published science, which was assessed in peer review, as a foundation.”

In addition, an ideal image of nature serves as a frame of reference; according to the NGOs, nature should be under no or very limited pressure from human activities, and the latter should pose no risk to the ecosystem. This ideal is a structuring element of the knowledge system as it plays a role in determining which type of research is deemed relevant and important, and which is not.

Many of the representatives of the NGOs involved in the mussel transition have science-based ecological expertise and the NGOs have many members who are amateur field biologists. Moreover, some of these organizations have employees who keep up to date with research reports and the scientific literature. The coalition of the NGOs serves as a network for intensive knowledge exchange. Furthermore, the NGOs have both formal (e.g., as clients of scientific reports) and informal ties with scientists and experts. For instance, one of the interviewees argued:

“There are very strong connections between science and nature conservation. There are the people at NIOZ\(^{19}\) and the ornithologists at SOVON\(^{20}\), those relationships have been very strong traditionally.”

Some scientists with an active stance in nature conservation and fisheries controversies, for instance, from the University of Groningen, are criticized by representatives of the mussel sector for being too closely connected to the nature conservation movement and for having lost their scientific objectivity. Steins (1999: 136) describes such scientists as “political biologists”.

Whereas the contrast between the perspectives is apparent, there is also common ground between them. Both perspectives do not exclude human intervention in nature, although they differ on the degree and goal of the intervention. Moreover, both perspectives draw on biological science as a source of legitimation and are informed by local and informal knowledge at the same time. Finally, respect for nature forms a part of both perspectives.

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\(^{19}\) Royal Netherlands Institute for Sea Research.

\(^{20}\) Dutch Centre for Field Ornithology.
2.5.2 Knowledge creation in the context of conflicting perspectives: two examples

The case of the Wadden Sea mussel transition is characterized by a variety of knowledge creation efforts. Some of these efforts were the subject of ongoing contestation, whereas others were productive in terms of collaboration and outcome. In this section we will describe two examples of such efforts. We will deal with these examples at some length as they simultaneously convey several key issues and patterns that are of importance for insight into this case. Notably, the two examples:

1. show the different types of difficulties and obstacles for knowledge creation in a governance context that stem from the conflicting perspectives;
2. illustrate the different ways in which knowledge creation efforts can play a crucial role in the emergence and stabilization of a coastal governance practice;
3. convey contrasting aspects of knowledge creation, which inform our identification of aspects of productive knowledge creation in a governance context.

Moreover, by providing a chronological account of these two knowledge creation efforts, we will show how the role of such efforts in governance may shift over time and how productive knowledge creation for coastal governance can be a lengthy step-by-step process.

2.5.2.1 THE PRODUS RESEARCH

The Dutch government initiated the research project PRODUS, which was started in 2006, in order to support the sustainable development of the mussel fishery by filling a number of knowledge lacunae. These lacunae concerned, among other issues, alternative forms of spat collection and mussel cultivation and the ecological effects of the mussel fishery in permanently flooded areas in the Wadden Sea. The research was executed by scientists from several research organizations, including IMARES and NIOZ, and had a natural-scientific character; it was cofinanced by the Dutch government and the mussel sector.

In 2007, PRODUS became one of the topics in new deliberations between the government, the mussel sector, and NGOs on the future of the mussel fishery in the Wadden Sea. The NGOs expressed their doubts about the research set-up and thought that PRODUS was biased, in the sense that it was mainly aimed at facilitating the fishing permit regime.

21 Dutch acronym for Research Sustainable Shellfish Fishery Project.
A year later, PRODUS played a decisive role in the legal procedure against the mussel spat fishing permit of spring 2006 (see section 2.4). According to the law such a permit may be granted if the permit request is accompanied by an ecological assessment, which excludes adverse effects on nature conservation objectives. The Council of State qualified the results of PRODUS as “essential to be able to assess the effects of the permitted activity for the natural characteristics of the Wadden Sea”\(^{22}\). However, PRODUS could not meet this knowledge requirement as it had not yet produced conclusive results. Consequently, the Council of State nullified the permit. Thus, the mere fact that PRODUS existed, and not the knowledge it had produced, played a decisive role in the verdict (Herman et al., 2008).

After the verdict, the Dutch parliament and the parties involved in the deliberations discussed whether PRODUS’s research questions and methodological set-up were adequate and whether the project could be adjusted and accelerated in order to settle the mussel conflict. A scientific audit of PRODUS, commissioned to answer these questions, concluded that the research questions were formulated adequately albeit narrowly and that some methodological and statistical adjustments were necessary (Herman et al., 2008). The audit also concluded that speeding up the research would be impossible as the recovery of mussel beds is a long-term process; producing valid results would take at least ten years. It thus became clear that PRODUS would not be able to settle the mussel conflict in the near future, as the short-term dynamic of the social-political controversy on the mussel fishery was not compatible with the long time scale of ecological recovery. Dealing with such incompatible time scales can be a key challenge for coastal governance (Clarke et al., 2013: 93).

The audit committee also formulated an unsolicited critique concerning the role of knowledge in the mussel conflict. It pointed out the fundamentally different “visions”\(^{23}\) concerning the Wadden Sea among the parties involved: a user vision that focuses on how to improve mussel culture, and a conservationist vision that focuses on how to bring the ecosystem into an “ecologically richer state” (Herman et al., 2008: 6). The committee therefore concluded that the PRODUS research on the ecological effects of the conventional mussel fishery is “viewed by none of the directly involved parties as desired, well-spent, or necessary research” (Herman et al., 2008: 6).

In spite of these objections, PRODUS was continued and reframed as one of the activities contributing to the collective research and monitoring program of the mussel transition. However, the project remained contested among the covenant partners. Representatives from the mussel


\(^{23}\) What the committee calls “vision” is similar to what we call “perspective”.
sector are pleased with the results of the project. They argue that PRODUS scientifically proves that the mussel spat fishery has some influence but does not damage the Wadden Sea ecosystem; thus, they argue that a full transition is not necessary. Representatives of the NGOs, in contrast, remain critical of the project as it remains incompatible with their nature restoration perspective. They argue that PRODUS does not provide insight into processes of nature restoration due to the small scale of the plots, the short term of the research, and the fact that the research does not focus on the nature restoration efforts that are made in the context of the transition. However, they also see parts of the research results as useful, for instance, in as much as PRODUS provides knowledge about the effects of mussel beds on biodiversity.

The example of PRODUS shows the difficulties of underpinning a coastal governance practice with scientific research. In this case, the controversy concerning the research topic reinforced the contestation of the research project. Furthermore, as the actors involved have different perspectives that provide different interpretive frameworks, they assess the relevance, the quality, and the results of the research differently. Therefore, the research failed to become an uncontested source of knowledge for the governance practice.

2.5.2.2 THE SOUTH-NORTH TRANSPORTS

The transport of mussel spat from the Eastern Scheldt to the Wadden Sea has been a principal topic of conflict between the mussel sector and the NGOs in recent years. From the mussel fishery perspective, such “south-north transports” (SNTs) are essential to optimize the profitability of their cultivation practice. The Eastern Scheldt, which is less dynamic than the Wadden Sea, provides good conditions for collecting mussel spat on MZIs and for “safely storing” mussel spat in winter. The Wadden Sea, with its higher nutrient load, provides more productive cultivation areas. As spat from MZIs is relatively expensive due to capital and labor costs, mussel fishermen want to use their best plots to store it and to cultivate it profitably. For instance, one of the fishermen interviewed argued:

“The south-north transports give every company the room to handle its stock better, […] to probably cultivate a bit more mussels than we have been doing until now, because you, for instance, safeguard them in the Eastern Scheldt and cultivate them faster in the Wadden Sea.”
From the nature conservation perspective, SNTs are problematic. The key problem is that these transports pose a sheer insurmountable risk of introducing invasive exotic species into the Wadden Sea. The Eastern Scheldt harbors several exotic species of plants and animals which are not known in the Wadden Sea. Representatives of the NGOs stress that the effects of introducing such species into the Wadden Sea ecosystem could be devastating and irreversible.

Since signing the covenant in 2008, the covenant partners have been engaged in ongoing efforts to find a solution for the issue of the SNTs. In the execution plan of the transition they agreed that transports were only possible within “ecological conditions”. However, it was not immediately clear what these conditions were. Therefore, a working group was appointed, which organized expert meetings, performed a literature review, made a risk analysis, and issued research on the prevalence of exotic species in the Wadden Sea. This research resulted in an inventory report on exotic species in the Wadden Sea and a “quick scan” of exotic species in the Eastern Scheldt (Gittenberger et al., 2009). From these new insights the covenant partners concluded that a number of exotic species found in the Eastern Scheldt were probably not present in the Wadden Sea, and that some of these species could be transported via mussel spat transports. Subsequently, they concluded that SNTs would not be possible until a monitoring program for “effective prevention and management of exotic species” and a “coherent exotic species policy” were in place.

The monitoring protocol for SNTs was based on a protocol previously applied to the import of shellfish from Ireland and Great Britain into the Eastern Scheldt. It includes periodic species inventories (SASIs) on isolated cultivation plots in the Eastern Scheldt and sampling the load of the fishing ships before they enter the Wadden Sea. This approach was formalized in 2012 in “policy rules” concerning shellfish relocation into the Eastern Scheldt and from the Eastern Scheldt to the Wadden Sea. These include rules concerning integral risk assessment, risk management, and monitoring.

In spite of this progress, the covenant partners had not yet reached agreement on structural provisions for the SNTs by 2012. In that year pressure arose to allow transports, since the fishermen had become more dependent on spat from MZIs, including those in the Eastern Scheldt, due to low spat fall on the seabed in the two preceding years. Consequently, the covenant partners agreed on a one-off “emergency provision”. Transports were allowed under the risk management and monitoring protocol,

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24 Plan van Uitvoering Convenant Transitie Mosselsector en Natuurherstel Waddenzee, 3 februari 2010.
26 Shellfish Associated Species Inventory.
complemented with additional measures to accommodate the demands of the NGOs, such as planning the transport in early April, when the water is cold and activity of possibly harmful species is still low.

In 2013, the Producers’ Organization (PO) decided to request a permit for SNTs without consulting the other covenant partners, in order to “force a breakthrough”. Later that year, the ministry issued a new temporary permit for SNTs under the conditions of the risk management and monitoring protocol. In early 2014, this permit was extended to a year-round permit. Thus, the provisions for the transports have gradually become more structural as a result of the ongoing coproduction of knowledge and rules of the game.

The example of the south-north transports illustrates the difficulties of finding a common ground between user and conservationist perspectives on issues of risk and uncertainty. The representatives of the mussel sector argue that the monitoring and risk management protocol is more than sufficient. Moreover, they feel that the NGOs force them to take more precautionary measures than necessary. Representatives of the NGOs state that they are satisfied with all the knowledge concerning invasive exotic species that has been produced over the past few years, and with the systematic and well-organized risk management regime that has been developed. However, they continue to see the transports as problematic, since the protocol is based on statistical sampling, and thus a risk always remains.

This example also shows how a solution to such a clash of perspectives can be brought closer step by step. The actors involved engaged in an ongoing process of creating knowledge and negotiating the rules of the game within the context of the covenant collaboration. This process turned an opaque issue into a manageable risk over the course of five years. In the next section, we will expand on this process of knowledge creation and rule formulation as key elements of collaborative governance.

The examples of PRODUS and the south-north transports show the different knowledge dynamics that may occur in the context of conflicting perspectives. In the former example, distrust and conflicting assessments of quality and relevance of research were key issues that remained unresolved. In the latter example, the two perspectives manifested themselves in conflicting risk perceptions; a step-by-step knowledge creation process integral to the collaborative practice proved to be a productive approach for dealing with this conflict.
2.5.3 The mussel transition: connecting the two perspectives

Since 2008, the mussel fishing sector, nature conservation NGOs, and the Dutch government have been engaging in a collaboration aimed at the combined goals of nature restoration and an economically feasible mussel fishery in the Dutch Wadden Sea. How did the stabilization of this collaborative practice come about, given the conflicting perspectives between these parties? We will explain this stabilization in terms of three interrelated aspects: power, rules, and collaborative knowledge creation.

2.5.3.1 JURISDICTION, POWER, AND THE PRESSURE TO COLLABORATE

In 2004, the European Court of Justice ruled that the mechanical cockle fishery was a “plan” or “project” under the European Habitats Directive; therefore, appropriate assessments proving the absence of adverse effects on the nature conservation objectives needed to accompany permit requests. Cockle fishing permits were only to be granted if “no reasonable scientific doubt remains as to the absence of such effects”.

In 2005, the Dutch Council of State ruled that this requirement of making an appropriate assessment also applied to the mussel fishery. Later that year, the Dutch Nature Conservation Act was altered so as to include the legal requirements of the European Birds and Habitats Directives.

This series of legal events, culminating in the nullification of the mussel fishing permit by the Council of State in 2008, constituted a legal-political shift in the furnishing of proof (see also Herman et al., 2008). It imposed the burden of proof on a party requesting a permit, in casu the mussel sector. This proof was to be given in an assessment based on the best available scientific knowledge. Moreover, the law was formulated according to the logic of the precautionary principle, which implies a “negative” burden of proof; the mussel sector had to prove the absence of effects from its activities on the nature conservation objectives. This shift is legal in that it is grounded in national and European legislation and jurisdiction; it is political in that it constituted a shift in the power balance between parties who had been engaged in an ongoing controversy concerning the use and protection of the Wadden Sea.

The nature conservation NGOs gained a strong power position through the verdict of February 2008; in the words of one of the interviewees, the verdict “sealed the shift of power” that had been going on for a longer time. The end of Dutch mussel culture, instigated by the NGOs, was a plausible short-term scenario in the eyes of all parties involved. For instance, one of

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28 Court of Justice Judgment of the Court (Grand Chamber) of 7 September 2004 in Case C-127/02. Court of Justice, Luxembourg, 7472.
the representatives of the NGOs explained that part of their constituency argued for a full ban on the mussel fishery after the verdict:

“[Part of the constituency said] lad, you have won the legal case, they don’t have a permit anymore, now carry it through. That is not my approach but a minority of the constituency put us under pressure in that direction.”

One of the interviewees from the mussel sector described the sentiments after the verdict as follows:

“It was like 9-11 for the mussel sector. Everybody still knows where he was on that day. […] Grown-up men were crying, simply the end of the story. […] Doing this for centuries and then [the NGOs] say that what you are doing is so wrong that you can’t do it any-

In reaction to the verdict, the mussel fishing community started campaigning against the NGOs under the slogan “Stop the Green Lie”. National newspapers reported about the predicament this community was facing, and members of parliament and top administrators became involved in the public debate about the conflict. One of the issues the debate focused on involved the funding sources of the NGOs. For instance, appeals were made to boycott the Postcodeloterij (Postal Code Lottery), an influential sponsor of societal initiatives and “good causes” such as nature conservation NGOs. With their campaign, the fishing sector succeeded in drawing political and societal attention, and in increasing the pressure on the NGOs and the government.

After the verdict, in order to find a solution the Minister of Agriculture, Nature, and Food Quality became personally involved in the conflict by entering, for example, into consultation with managers of the NGOs involved. Moreover, the Royal Commissioner of the province of Zeeland began a dialogue with the NGOs. This strong political support to find a way out of the situation resulted in the involvement of top civil servants.

Negotiations as to the future of the mussel fishery had already been going on for a long time. However, the verdict of the Council of State, the involvement of top politicians and administrators, and the fervent campaign of the fishing community created a necessity; this series of events created strong pressure on all parties involved to find a solution. The immediate pressure was abated through a set of agreements, which are formulated in the covenant and execution plan. These agreements reflect the skewed
power balance between the NGOs and the fishing sector. They enabled the relatively powerful NGOs to instigate both a drastic transition of the fishery and a nature restoration program for the Wadden Sea, which are activities that are in line with their “core business”. Mussel fishermen argue that they were “with their backs to the wall” and describe the agreements as a “forced marriage”. The agreements induced them to invest in MZIs and concomitant alterations of operational management, and to allocate financial resources for research and monitoring.

2.5.3.2 THE RULES OF THE GAME AND THE ACTORS ON THE PLAYING FIELD

The rising pressure created a precondition for forging a collaboration; many rules and agreements were needed in order to make the collaboration function. The mussel covenant of 2008 was a first set of agreements between the Minister of Agriculture, Nature, and Food Quality, the Mussel Culture PO, and the NGOs. The covenant includes agreements both on an economically viable mussel sector and on a nature restoration program for the Wadden Sea; therefore, the covenant itself is a materialization of the connection between the perspectives of the mussel fishery and nature conservation. The execution plan of 2010 contains further agreements concerning the mussel transition.

The following agreements are key rules of the game, which have constituted a workable collaboration. First, the parties have agreed to refrain from undertaking further legal actions or public campaigns against each other. Instead, they have started to work together constructively. Second, they have agreed to work towards a shared future goal: In 2020, mussel spat collection on the seabed is to be replaced by alternative means of spat collection. Third, they have agreed to apply a type of adaptive management (“learning by doing”) in order to reach their goal.²⁹ Since the transition path through to 2020 is surrounded by many uncertainties, for instance, in terms of “the success of MZIs, the effects on nature of such installations, nature development”, along with deliberations with other actors, the transition is designed as a recursive process of experimenting, scaling up, monitoring, evaluating, and adjusting.³⁰ Moreover, the speed of the transition steps depends on MZI yield; therefore, the transition path is contingent upon both the success of innovation and upon natural variability. Fourth, the parties have agreed on applying specific technologies, notably MZIs, which serve their mutual interests. MZIs make the mussel fishermen less dependent on natural variability; they provide them with a relatively constant supply of mussel spat (Programma Naar een Rijke Waddenzee, 2012). For the NGOs, MZI technology is an important key in

reaching their goal to “come loose from the seabed”, since other alternatives to seabed spat collection are still in an earlier experimental stage.

Besides the rules of the game, the execution plan also describes a “playing field”, in which ongoing deliberation, negotiation, and creation and exchange of knowledge take place. This playing field is governed by two committees: a managerial consultation group that supervises the execution of the mussel transition, and which serves as a strategic deliberation and communication platform for the covenant partners, and a project group that deals with technical and substantive aspects of the transition, and “prepares the decisions of the managerial consultation group”.31 According to the chairman of the execution plan process, this division of tasks worked very well during the realization of the execution plan, “but only because both groups strictly kept to their task description: creation and exchange of knowledge in the project group, strategic considerations in the managerial group”.32

Representatives of the NGOs and the Mussel Culture PO, and civil servants of the Department of Economic Affairs are members of the committees. The latter play a facilitating role in several respects; for instance, they try to keep the dialogue between the covenant partners going, and they facilitate by providing a regulatory framework for the transition through formulating policy rules and providing permits. Other actors, including the shrimp fishing sector and sailing recreational organizations, have only a limited say, although they are affected by the mussel transition. In the “pressure-cooker” that arose after the Council of State verdict, the parties involved in the controversy have focused on forging a collaboration among the main actors and have refrained from setting up a more inclusive governance practice. As a consequence, these other stakeholders were not involved in key decisions about the mussel transition and had only limited influence, for instance, on MZI locations. In this sense, the covenant brought about a new distribution of power. The covenant partners combined forces and became a powerful coalition, whereas other stakeholders, although they are users of the same area, were given only a consultative role.

2.5.3.3 Creating a Shared Knowledge Base

Since the transition process recursively connects research, monitoring, and action, a shared and uncontested knowledge base is essential. One of the fishermen involved, for instance, argued that prior to the transition,
“the mistake was made that research projects were carried out and then there was major disagreement about results. […] We said: We have to tackle that from the start. Folks, we are entering this trajectory: Do we agree?”

Several interviewees used the term “joint fact finding” to describe the collective knowledge creation and exchange process that has emerged between project group members from both the NGOs and the mussel sector since the covenant was signed. As the chairman of the execution plan process described it, “the experts in the project group got along unexpectedly well […] it quickly became clear that [they] were able to respect each other’s knowledge and considerations”. The knowledge creation involving invasive exotic species (see section 2.5.2.2) is an example of this joint fact-finding process.

The collective knowledge base of the transition encompasses two key elements. First, a monitoring program creates the factual data necessary for knowing the actual status of mussels in the Wadden Sea and the actual results of the transition efforts. This monitoring program includes periodic inventories of mussel stock in the western Wadden Sea (Van Stralen, 2012), monitoring of mussel spat yield in MZIs (Van Stralen, 2011), and monitoring of the development of mussel beds in closed nature restoration areas (Programma Naar een Rijke Waddenzee, 2013). Moreover, the periodic shellfish inventories in the Eastern Scheldt (SASIs, see section 2.5.2.2) can be seen as a part of this monitoring program. The monitoring is executed by a small group of experts, and produces data that is uncontested among the covenant partners. An important condition for this uncontested character is that the experts who execute the monitoring are trusted by all parties.

A second element of the knowledge base is the research program of the transition (not to be confused with PRODUS), which is executed by four research organizations under the collective authority of the covenant partners; the latter share the “ownership” of this research. This program produces knowledge concerning relationships between the transition and the Wadden Sea ecosystem, notably on the ecological effects of scaling up MZIs. For instance, research has been performed on the effects of MZIs on the ecological carrying capacity of the Wadden Sea, the disturbance of wildlife by the operation of MZIs, and waste and pollution caused by the operation of MZIs (Programma Naar een Rijke Waddenzee, 2012). The covenant partners formulate research questions for this program, and they communicate the progress and results of the research in their annual progress reports.

34 IMARES, Deltares, NIOZ-Yerseke, and MarinX (Programma Naar een Rijke Waddenzee, 2012).
2.5.3.4 RE-ARRANGING THE POLITICS OF KNOWLEDGE

At the onset of the mussel transition, the role of knowledge with respect to the mussel fishery in the Wadden Sea shifted. This shift entailed a re-arrangement of the specific ways in which power, rules, and knowledge were coproduced. The pre-covenant era was dominated by an adversarial politics of knowledge, in which conflicting knowledge was at the core of the controversy and in which the actors involved mutually deployed or challenged claims of truth in order to settle the controversy to their advantage. Since the covenant was signed, a constructive politics of knowledge has emerged, which is characterized by collaborative knowledge creation in order to find a workable solution to the controversy. The politics of knowledge was re-arranged in three ways. First, the covenant states that its signatories will refrain from taking any legal actions against each other. Therefore, as long as the signatories adhere to the covenant, and they have strong incentives to do so, the covenant rules out the possibility of “systematically doubting proofs of no effect” as a means of power (Herman et al., 2008: 5). Second, the mussel transition curtails knowledge conflicts by means of a shared knowledge base. The monitoring data provide information with an interpretive flexibility different from that of PRODUS. This information has a strongly “factual”, simple, and homogeneous character, and neither establishes cause-effect relationships nor provides explanations concerning controversial phenomena, such as the ecological impact of the fishery. Therefore, the monitoring data themselves are not complex, multifaceted, and interpretive enough to easily become the object of contestation or incongruous interpretations. The research program forms an integral part of the collaboration and thus has an inherently negotiated character and a shared ownership among the covenant partners. PRODUS lacked these characteristics of a shared knowledge base, which explains why it failed to become an uncontested source of knowledge for the mussel transition. Third, the layout of the “playing field” of the transition is designed to create a functional and productive division between the descriptive and the normative. The organizational structure of the transition curtails adversarial politics of knowledge by imposing a formal separation of explicitly substantive and explicitly strategic considerations.

2.6 DISCUSSION AND CONCLUSION

Conflicts on the use and protection of natural resources occur in coastal zones worldwide. This paper shows how such conflicts can be analyzed
in terms of clashes of user and conservationist perspectives. Knowledge is both a core element of the conflicts about natural resources in coastal zones and a key to their resolution.

Disparate knowledge systems may clash in the context of a governance practice, due to their normative and value-laden character. In the case presented in this paper, the mussel fishery knowledge system is, for instance, structured by tradition as a mode of creating and exchanging knowledge, and by economy as a key frame of reference. Since the mussel sector is interested in ways to sustain a profitable livelihood today and for generations to come, it is mainly interested in knowledge that may contribute to attaining this goal. In contrast, the conservationist knowledge system is structured by an ideal image of nature under limited human pressure, and by the goal to restore nature to an undisturbed and ecologically richer state; this point of view poses different knowledge requirements. Moreover, disparate knowledge systems may clash, since they constitute incongruous interpretive frameworks. As the example of the PRODUS research project shows, scientific knowledge, which is meant to provide knowledge for governance, may be interpreted quite differently in terms of user and conservationist perspectives. In this case, the relevance, quality, and results of the research were interpreted differently. This example illustrates the difficulties of underpinning a governance practice with a scientific knowledge base.

From the case presented in this paper, several lessons concerning integrated and inclusive governance can be learned that may be valuable in dealing with other conflicts on the use and protection of natural resources. Notably, this case demonstrates the productivity of an approach in which involved stakeholders settle disputes through mutual deliberation and the formulation of shared objectives instead of employing legal means. Moreover, a clear set of mutually accepted rules of the game concerning the collaborative practice is of the essence in conflicts such as this. Furthermore, our study confirms what several other authors have argued in the coastal governance literature, namely that adaptivity and learning are key elements of a productive governance approach; room for collective problem-solving can be created by negotiating a shared future goal and by adaptively working towards that goal. Finally, this case demonstrates the importance of putting knowledge and collaborative knowledge creation at center stage in a governance practice. From our analysis, we identify the following ways in which disparate knowledge systems can be accommodated in the context of collaborative governance:
1. Our findings suggest that a shared ownership of research efforts among actors involved in a governance practice enhances the integration of knowledge in governance. This shared ownership may involve the collective formulation of research questions, dialogue on the interpretation of results, and, subsequently, collective decision-making based on the results. This implies that research as an integral part of a governance practice better suits the requirements of that practice than research that is external to that practice, such as external scientific research projects.

2. A focus on data and knowledge with a “fact-like” character contributes to curtailing knowledge disputes in governance settings (cf. Van Buuren, 2009). In such a fact-oriented approach, monitoring of key parameters is of the essence for well-informed governance. Moreover, our results suggest that such an approach is enabled by formally or structurally separating substantive considerations and strategic or normative considerations. One way of doing so is by installing separate groups or platforms for strategy and knowledge creation.

3. Trusted expertise is an important issue for governance in controversial settings. In such settings, often a polarization of expertise arises, in which experts are distrusted and criticized for being too closely involved with either the conservationists or the users of natural resources (Steins, 1999; Turnhout et al., 2008). Therefore, it is advisable to involve experts in collaborative knowledge development who are closely connected to the governance practice and whose expertise is valued and trusted by all parties involved.

Our coproductionist perspective illuminates how knowledge creation and the regulatory setting in which this knowledge creation takes place are mutually constitutive. The case described in this paper is characterized by high pressure and controversy; the governance practice was forced into being. Such a situation strongly structures the setting for knowledge creation and gives rise to specific knowledge dynamics, such as knowledge disputes, joint fact-finding, and calls for independent audits of knowledge. At the same time, knowledge enables governance. This is exemplified by the shift from adversarial to constructive politics of knowledge: knowledge as a means of adversarial power was replaced by collaborative knowledge creation as a key element of governance.

Moreover, our analytical perspective that combines knowledge systems and policy arrangements illuminates the multitude of ways in which knowledge is interconnected with specific dimensions of policy. For in-
stance, various groups of actors involved in policy, such as stakeholders and policy-makers, are linked to different knowledge systems. The knowledge that exists and is created within these knowledge systems forms a part of specific discourses on how to use and protect natural resources. We may conclude that the combined analysis of discourses and knowledge systems provides insight into the conflicting perspectives of conservationists and resource users. Moreover, our results indicate that the collaboration between such groups of actors with conflicting perspectives can be facilitated by creating a shared knowledge system as a part of a governance practice. Furthermore, due to the legal rules of the game in this case, scientific knowledge is an important means of power that for instance can be deployed both for acquiring and challenging fishing permits. At the same time, our case shows that both the formulation of a shared set of rules and pressure that is created by political and societal power can play crucial roles in the formation of a collaborative governance practice and thus of a joint knowledge system that meets the requirements of the various actor groups involved.

Our account of the interrelation between knowledge creation and coastal governance clearly fits in with key debates on the relation between science and society in contemporary knowledge cultures. A main diagnosis within these debates is that knowledge creation increasingly takes place in heterogeneous social networks or “hybrid fora” and is characterized by a focus on social problem-solving and by a strong interconnection between societal interests and scientific considerations; a shift also referred to as the emergence of “Mode 2 science” or “post-academic science” (Ziman, 1996). This paper demonstrates that coastal governance practices are very suitable sites for studying such knowledge dynamics. Moreover, it demonstrates that the idiom of coproduction provides a suitable lens for investigating the dynamic and complex interrelations between knowledge and regulatory order in such settings. At the same time, this paper contributes to the further development of this theory by showing how an interdisciplinary analytical framework encompassing knowledge systems and policy arrangements provides a workable means for analyzing and interpreting such interrelations.

The mussel transition provides a modus operandi for dealing with the conflict involving the mussel sector, the government, and the NGOs. Yet, the governance practice, in which these parties have been engaging since 2008, has not fully settled the conflict. The mussel fishery in the Wadden Sea is still a contested issue, and it remains to be seen whether the collaboration will stand the test of time. A consequence of the governance approach described in this paper is that it occupies areas of the Wadden
Sea which are of value to parties other than the covenant partners. The paradox of this model of coastal governance is that it is inclusive of some actors, and exclusive of others. Therefore, the quest for more inclusive and integrated coastal governance is still ongoing. This quest may be furthered by means of an overarching integrated management structure that encompasses all forms of use and conservation of a coastal area and that connects the various governance practices in this area through coordination and knowledge and information exchange.

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Abstract
Through shifts towards interactive and participatory forms of environmental governance, knowledge dynamics may come into play that differ from those of traditional forms of policy-making. This paper investigates how shifts of environmental governance and knowledge are related. In order to do so, it reconstructs the development of the governance of recreational boating in the Dutch Wadden Sea on the empirical basis of interviews, document analysis, and a focus group. Moreover, it analyzes this development by means of an analytical framework that combines governance arrangements, knowledge systems and knowledge-governance interfaces. Our results show that in the last decades partly an accumulation and partly a sequence of various governance arrangements concerning recreational boating occurred; this entailed a shift from predominantly centralized governance to a combination of governance modes with a stronger emphasis on decentralized, interactive and self-governance. This shift occurred together with an increasing prominence of qualitative local knowledge, stakeholders’ knowledge, and the integration of various forms of knowledge. Furthermore, a shift occurred towards more participatory knowledge-governance interfaces. Our analysis suggests that environmental governance and knowledge are interconnected in various ways: the regulatory and epistemic aspects of environmental issues are bound up with each other, and governance and knowledge are coproduced and mutually constitutive. Key lessons from this analysis are that room for experimentation is an important factor in improving environmental governance, and that increasing stakeholder involvement in governance implies that new modes of jointly creating and exchanging knowledge may need to be taken into account.

3.1 INTRODUCTION

Many nature areas worldwide are the scenes of conflicts over the use, accessibility, and protection of nature. Both scholarly debates and environmental management and policy practices reflect a shifting paradigm regarding the resolution of such conflicts. This shifting paradigm can be summarized as the emergence of environmental governance. The literature on environmental governance is heterogeneous and comprises various definitions and scholarly perspectives (Tacconi, 2011). In this paper, the term environmental governance signifies the measures, institutions and processes of collective decision-making that are deployed to protect the environment and resolve conflicts over natural resources (Paavola, 2007; Tacconi, 2011; Driessen et al., 2012).

The emergence of environmental governance implies a “dispersion and displacement of politics” in multiple ways (Buizer, 2008: 11). Firstly, environmental governance arrangements usually include a plurality of societal
actors in a participative or deliberative manner (Wallington et al., 2008; Kline, 2012; Bixler, 2014). As a consequence, power, competences, and responsibilities are redistributed among the actors involved (Berkes, 2010; Lockwood et al., 2010). Secondly, environmental governance often takes place in a variety of political arenas and levels beyond the boundaries of the traditional governmental institutions of the nation-state (Buizer et al., 2011; Compas, 2012).

In the context of environmental governance, knowledge dynamics may come into play that differ from those of traditional forms of policy-making. For instance, such knowledge dynamics include the increased critical scrutiny of the role of science in decision-making and the broadening of the notion of expertise (Bäckstrand, 2004). The latter entails a more pluralistic view on the various forms of scientific and other knowledge, such as local and traditional knowledge, that may be relevant to decision-making (Ellis, 2005; Birkenholtz, 2008). This theme has for instance received scholarly attention in governance studies that focus on participatory forms of nature conservation and management (Berkes, 2004; King, 2004; Robinson and Wallington, 2012). Moreover, collaborative knowledge creation and the integration of various forms of knowledge are described as key knowledge processes that may enhance the legitimacy of environmental governance practices (Cash et al., 2003; Bohensky & Maru, 2011; Hegger et al., 2012; Robinson & Wallington, 2012). Finally, research in the fields of adaptive governance and adaptive co-management has shown that learning is instrumental in productively dealing with complex environmental issues (Armitage et al., 2008; Crona & Parker, 2012; Baird et al., 2014).

Thus, we can infer from the literature that modes of governance may be related to modes of creating and exchanging knowledge. Consequently, we may expect that particular governance shifts are related to particular knowledge shifts. Despite the growing body of literature on the role of knowledge in governance (e.g., Bäckstrand, 2004; Van Buuren, 2009; Evans, 2010; Bremer & Glavovic, 2013a), the relation between shifts of governance and shifts of knowledge has received little attention. This paper aims to contribute to insight into this relation through a longitudinal study of the governance of recreational boating in the Dutch Wadden Sea (1981-2014). The research question we will address in this paper is: how have modes of governance and modes of knowledge creation and exchange concerning recreational boating changed through the years, and what insights does this provide on the interrelation between shifts of governance and knowledge?

The next section describes the framework employed to analyze the case. Section 3.3 outlines the methodology, after which section 3.4 introduces
the main issues and actors that have played a role in the case. Subsequently, section 3.5 describes the empirical results. Finally, section 3.6 discusses the results and draws conclusions on the interplay between knowledge and governance in a context of change.

3.2 ANALYTICAL FRAMEWORK: GOVERNANCE MODES, KNOWLEDGE SYSTEMS AND INTERFACES

In order to analyze shifts of governance, we use the framework of governance modes that has been developed by Driessen et al. (2012). According to these authors, the “large number of conceptual labels” that have emerged in the broad and heterogeneous governance literature “have contributed to confusion, rather than to order and clarity” (Driessen et al., 2012: 145). In order to contribute to clarity in the study of shifts of governance, they have developed a typology of governance modes that “helps to meaningfully differentiate between various governance arrangements” (Driessen et al., 2012: 145). A governance arrangement is the ensemble of the content and organization (i.e., actor configurations and institutional features) of a specific governance domain (Arts et al., 2006; Driessen et al., 2012). The value of this typology is that it helps to analyze how modes of governance shift from one to the other by means of classifying successive governance arrangements. The typology in itself does not provide clear clues as to why modes of governance shift; however, this is not problematic in the context of this paper as we are mainly interested in the how-question.

In the first two modes of governance that the typology distinguishes, governmental actors “take the lead”; “the market and civil society are the recipients of the government’s incentives” (Driessen et al., 2012: 145). If national governmental actors are the main protagonists, this is called centralized governance; we speak of decentralized governance when regional or local governments are in the lead. The third mode is public-private governance; in this case, joint efforts and collaborations occur “mainly between government and market actors” (Driessen et al., 2012: 145). In the fourth mode called interactive governance “the actor base is broader and governments, market actors and civil society are collaborating on equal terms” (Driessen et al., 2012: 145). The fifth and final mode is self-governance in which “actors from the market and civil society enjoy far-reaching autonomy and are able to initiate new approaches themselves” (Driessen et al., 2012: 148). These five categories are not mutually exclusive; in practice, governance arrangements may combine features of various governance modes.
In order to analyze shifts of knowledge, we identify the ways in which specific governance arrangements were or have been informed. As these ways may vary greatly, we deploy the deliberately open and flexible concept of the “knowledge system” in our analysis. We define a knowledge system as a social system that comprises actors and specific ways of creating and exchanging knowledge (Watson-Verran & Turnbull, 1995; Turnbull, 2000). Knowledge creation may for instance include a wide array of ways ranging from formalized scientific methods to direct personal experience. Moreover, knowledge systems can be characterized by specific forms of knowledge such as local and generic knowledge. Local knowledge pertains to phenomena and circumstances that are highly time- and place-specific; it is “strongly rooted in a particular place” (Geertz, 1983: 75). Generic knowledge pertains to phenomena on larger spatial and/or temporal scales, such as large-scale patterns or statistics; thus, it has a more aggregated character than local knowledge. The term generic does not imply that this form of knowledge transcends all locality; it is constructed in specific places by specific communities of actors and may have different meanings in different local contexts. Our concept of the knowledge system does not impose strict dichotomies between forms of knowledge. Rather, it takes as its point of departure the idea that different knowledges such as local and generic knowledge and expert and lay knowledge co-exist in various configurations (Wynne, 1996). Moreover, this concept privileges neither scientific nor other knowledge systems “in terms of producing true or good knowledge”; it is impartial towards different epistemologies (Watson-Verran & Turnbull, 1995: 136).  

In our analysis, we use the term “interface” to describe how knowledge and governance are connected in the context of specific governance arrangements. Like the concept of the knowledge system, this is a deliberately flexible concept; it denotes the “multitude of ways in which knowledge, in all its forms, is used in support of public decisions” (Bremer & Glavovic, 2013b: 110). It embraces the processes, institutions, and social relationships between experts, stakeholders and decision-makers that are aimed at connecting or integrating knowledge and governance (Bremer & Glavovic, 2013b: 110). Knowledge-governance interfaces may be science-based, but they may also have a participatory character; in the latter case, actors with various backgrounds and knowledges are “empowered to contribute their perspectives” (Bremer & Glavovic, 2013b: 110). Like the categories mentioned above, these two types of interfaces are also not mutually exclusive; they may overlap in practice.

36 The original quotation marks are deleted.
3.3 METHODS

This paper reconstructs the development of the governance of recreational boating in the Dutch Wadden Sea on the empirical basis of interviews, document analysis, and a focus group. A total of 26 semi-structured interviews were conducted with actors who were actively involved in the governance of recreational boating in the Dutch Wadden Sea. The main issues concerning this case were explored in a first round of 5 interviews in 2012 with representatives of recreational boating organizations. These interviewees were selected after they had presented themselves in response to a call for research participants, which was made at a Wadden Sea symposium in December 2011. In a second round of 21 interviews in 2013 and 2014, a wide variety of actors were interviewed, including representatives of national, provincial and municipal governments, nature conservation NGOs, terrain management organizations, and research organizations. These interviewees were selected because they were actively involved in the governance of recreational boating in the Dutch Wadden Sea, either as representatives of their organizations or networks, or as specialists within their organizations. Because many of the interviewees have been or were involved in various current and former governance arrangements, the interviews allowed for a historical reconstruction of the various conflicts and collaborations between the actors involved. Semi-structured interviews were used because they enabled the in-depth investigation of the concerns and perspectives of the various actors involved, and they allowed for combining theoretically structured and exploratory empirical investigation. The main interview topics included: actors’ perspectives on the relation between recreational boating and nature, the collaborations between the actors involved, the role of knowledge in governance, and the main rules and agreements concerning recreational boating and nature conservation. Most of these interviews lasted between 45 and 90 minutes. Furthermore, a focus group with representatives of recreational boating CSOs (civil society organizations) was conducted in order to update and supplement the information that was obtained in the first interview round. The interviews and focus group were recorded, transcribed verbatim, and analyzed in two rounds. In the first round, we analyzed various aspects of the case, including:

- knowledge- and governance-related aspects of the governance arrangements mentioned in the interviews and the focus group;
- the main topics, issues, and developments according to the respondents concerning the governance of recreational boating.
In this first round, we used software for qualitative data analysis (Nvivo 10) and we applied an inductive coding strategy using setting-specific codes that we constructed on the basis of the issues that were brought up by the respondents (Lofland et al., 2006). In the second round, we analyzed the various governance arrangements using the analytical framework described in section 3.2. In order to validate our results, we triangulated interview and focus group data with relevant documents, such as legal texts, policy documents, agreements and covenants, and research and evaluation reports.

3.4 RECREATIONAL BOATING IN THE DUTCH WADDEN SEA: MAIN ISSUES AND ACTORS

The Wadden Sea area is widely recognized as an important nature area with a unique character due to the combination of its location, scale, biodiversity and dynamics. It is a partly intertidal wetland area, bounded by a series of islands and the mainland of The Netherlands, Germany and Denmark. It hosts populations of harbor seals (Phoca vitulina) and grey seals (Halichoerus grypus) and serves as an important staging area for many migratory birds (Steins, 1999; Piersma & Lindström, 2004).

Since the 1970s, various policies and regulations at both national and international levels of government have been implemented to conserve nature in the Wadden Sea area. These policies and regulations have restricted and altered human activities in the area, including recreational boating, in a variety of ways. In this paper, the term recreational boating denotes the staying on or moving around with a vessel such as a motor-boat, sailing boat or canoe for recreational purposes.

In recent decades, the growth of recreational boating on the Wadden Sea area has raised concerns among policy-makers and nature conservationists about its possibly adverse effects on wildlife; the main concern is that recreational boating may cause disturbances of birds and seals (LNV, 2009). In this case, the term disturbance denotes situations in which animals in the wild change their behavior due to the nearness of humans (Smit & Visser, 1993). Disturbance may for instance hamper the nursing of seals or the building up of the fat reserves that migratory birds need for their long journeys. The issue of disturbance has been the object of both scientific research and heated debate among policy-makers and stakeholder organization in the Netherlands. Research has provided insight in some aspects of the disturbance of seals and birds, such as the distances at which different species of birds fly up when they are approached by sources of

37 A coding summary report is available at the corresponding author.
38 Other definitions also include non-human sources of disturbance (Smit and Visser, 1993). We focus on the relations between human activity and nature conservation; thus, we focus on human sources of disturbance.
disturbance (Spaans et al., 1996; Krijgsveld et al., 2008). However, still much is unknown about disturbance, for instance regarding its effects on bird populations in the Wadden Sea area. This is exemplified by the following quote of one of the interviewed researchers:

“[…] what does it mean for the population in the long run, that is the question. We are continuously confronted with: a direct reaction can be easily measured but what does it mean for the birds?”

Furthermore, recreational boating CSOs (civil society organizations) have through the years challenged conservation measures aimed at preventing disturbances, under the argument that these measures were in some cases poorly motivated and that disturbance is a relatively limited problem that is caused by a small group of culprits. For instance, a representative of one of the CSOs stated:

“Disturbance by water sports enthusiasts exists […] But relatively speaking, how much influence it has on the conservation of bird species, seals, eelgrass, and other variables on the Wadden, I doubt whether it is that important.”

Thus, disturbance by recreational boating is a relatively “intangible” issue in several respects; it is surrounded by uncertainties, there are conflicting perspectives on how problematic it is, and moreover it is difficult to “micro-manage” as recreational boating is a highly dispersed and individual activity. The governance of recreational boating in the Dutch Wadden Sea is characterized by complex social and administrative conditions with a multitude of actors, collaborations, networks and deliberation platforms. The most actively involved actors can be divided in the following main groups:

- Governmental organizations at the national level have key regulatory tasks and competences regarding nature conservation. These tasks and competences include designating closed marine protected areas (MPAs) to protect birds and seals, and executing control and enforcement. Moreover, the Dutch government participates in the trilateral Wadden Sea Cooperation together with the governments of Germany and Denmark.
- Three provincial governments are the competent authorities regarding harbor expansions in the Wadden Sea area under the Dutch nature conservation regulation. They have an intermediary position between the parties and governmental levels involved and

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39 These organizations are notably the departments of Economic Affairs (EA) and Infrastructure and the Environment (I&M). These departments have succeeded the departments of Agriculture, Nature and Food Quality (LNV) and Transport, Public Works and Water Management (V&W).

40 The Provinces of North Holland, Fryslân and Groningen.
have played initiating and coordinating roles in the governance of recreational boating.

17 municipal governments, collaborating in two platforms, are primarily involved in the governance of recreational boating for two reasons.\textsuperscript{41} Firstly, they aim to safeguard the exploitation, safety and possible expansion of the marinas within their territories.\textsuperscript{42} Secondly, they aim to safeguard the local economic activities that are directly dependent on the accessibility of the Wadden Sea, such as guided seal-watching tours.

An alliance of civil society organizations (CSOs)\textsuperscript{43}, including water sports associations and sector associations, are the most active representatives of the interests of vacationers who sojourn and sail around in the Wadden Sea area, and of the water sports industry.\textsuperscript{44} They share a set of more or less common values and interests. For instance, these organizations all highly value the ability to move around freely and to enjoy the quiet and natural beauty of the Wadden Sea. For a part of their constituency, beaching and staying on sand flats during low tide is a key element of sailing on the Wadden Sea. Furthermore, these organizations advocate good accessibility and facilities of harbors and good nautic circumstances which enable safe and smooth passages through the area.

Various non-governmental nature conservation organizations (NGOs) are involved. Three provincial landscape organizations are responsible for the terrain management of a part of the area. In addition, a coalition of five nature conservation NGOs plays an active role in the governance of recreational boating.\textsuperscript{45} These NGOs are involved in nature conservation and restoration in a variety of ways, and two of them are formally terrain managers. They advocate the intensification and improvement of nature management in the Wadden Sea area and they develop initiatives with which they aim to obtain a more structural and executive role in the management of the Wadden Sea.

\textsuperscript{41} The Association of Wadden Sea Coastal Municipalities and The Wadden Islands Collaborative Association.

\textsuperscript{42} The interests of the marinas in the Wadden Sea area are also promoted by the Wadden Sea Marinas Foundation.

\textsuperscript{43} The distinction between CSOs and NGOs is not clear-cut as the former are also non-governmental. We use the term CSOs for the organizations that promote the recreation-related interests of citizens and watersports companies. Moreover, we use the two terms in order to clearly distinguish between these two groups of organizations.

\textsuperscript{44} These organizations include: the Wad Sailors Association, the Dutch Association of Tour Sailors, the Royal Dutch Touring Club, the Royal Dutch Water Sport Union, the Dutch Trade and Industry Association for Shipbuilding and Water Sports, and the Association for Professional Charter Navigation.

\textsuperscript{45} The participants in this coalition are: the Society for the Protection of Birds, the Wadden Sea Society, the WAD Foundation, the Society for the Preservation of Nature Monuments in the Netherlands, and Staatsbosbeheer [the Dutch Forestry Commission]. The latter is a former governmental agency that has gained a more autonomous status; it is not fully non-governmental but it participates in this otherwise NGO-based coalition.
3.5 RESULTS AND ANALYSIS: SHIFTING GOVERNANCE AND KNOWLEDGE

3.5.1 A genealogy of arrangements

From 1981 onwards, several governance arrangements concerning recreational boating in the Dutch Wadden Sea have emerged, evolved, co-existed, and sometimes vanished. Together, they have constituted the regime that governs recreational boating. In this paper, the term “regime” denotes the informal composition of various interrelated governance arrangements that constitutes a way of governing. This section describes this shifting governance regime in terms of its various arrangements. As several arrangements arose out of others, the history of the regime resembles a genealogy.

3.5.1.1 THE NATURE CONSERVATION ACT: CLOSING AREAS

The Nature Conservation Act provides an important legal framework for nature conservation in the Netherlands. Under this act, the Dutch government can designate specific areas as protected nature areas, or “nature monuments”. The major part of the Wadden Sea has been designated as a State nature monument in two steps that were taken in 1981 and 1993. A key governance instrument regarding recreational boating is provided by Article 20 of this act, which gives competent authorities the possibility of closing specific areas within a protected nature area. In the Wadden Sea, this instrument has been applied by the department of Economic Affairs to close the areas that are the most important for birds and seals. Some of these areas are closed temporarily, for instance during the breeding season or around high tide, others are closed permanently.

The governance arrangement of the Nature Conservation Act has a mainly centralized character as the national government is the initiating and leading actor and the mode of decision-making is predominantly top-down oriented. However, in recent years the arrangement has become somewhat more interactive. In 2009, the department of Agriculture, Nature and Food Quality implemented a guideline for the decision-making procedure concerning the closing of areas (LNV, 2009). The aim of this guideline is to make this procedure more transparent by describing the ecological assessment framework that informs the procedure and by clarifying and formalizing the successive process steps that constitute the consultation- and decision-making cycle. These steps include: formulating new measures based on monitoring by researchers and nature manage-
ment professionals, discussing them in stakeholder and expert groups, and finally enacting and publishing them.

The designation of “Article 20 areas” as a conservation instrument has been strongly contested by CSOs for several reasons, including those mentioned in section 3.4. Moreover, a main point of criticism was that the instrument was too rigid and poorly attuned to the dynamics of the Wadden Sea nature, because the decision-making process took place in a yearly cycle. Recently, the process of closing off areas has been made more flexible and adaptive. A representative of the CSOs stated about the old procedure:

“Where the birds alight changes all the time. [...] The closing-off cycle starts in August and applies during the next year. [...] It is well possible that shoals are closed off where they don’t come at all. [...] It should be argued that, if they’re not there this year, it can be easily thrown open.”

The knowledge system that informs this governance arrangement has a multifaceted character. Key sources of information include the scientific expertise from research organizations such as IMARES\(^\text{46}\) and SOVON\(^\text{47}\) and the input from nature management professionals of the department of Economic Affairs. These experts notably provide place-specific quantitative knowledge on the occurrence of birds and seals in the area. Furthermore, the knowledge system includes the experiential knowledge of stakeholders such as sailors, who are consulted on the proposed measures. As the process of monitoring, advice, consultation and decision-making takes place in a cycle of adaptive management, the knowledge-governance interface has an adaptive character. Moreover, given the inclusion of both scientific expertise and broad stakeholder consultation, the interface has both a science-based and participatory character.

3.5.1.2 THE 200M-RULE: RESTRICTING BEACHING

Besides the national level, the conservation of the Wadden Sea takes place at the trilateral level, i.e. in collaboration between the Netherlands, Germany and Denmark. Since the 1970s, this trilateral collaboration has gradually intensified and resulted in common declarations and policies concerning the conservation of the Wadden Sea area (Wolff et al., 2003). Between 1978 and 2014, 12 governmental Wadden Sea conferences were held.

\(^{46}\) Institute for Marine Resources and Ecosystem Studies, part of Wageningen University.

\(^{47}\) Dutch Centre for Field Ornithology.
At the sixth trilateral Wadden Sea conference (Esbjerg 1991), it was decided to “concentrate recreation pressure by allowing ships to stay only within 200m of the nearest channel at low water”. After the Dutch government implemented this rule in 1993, beaching was only allowed within 200 meters of the buoyed fairways. This regulation can be characterized as a centralized form of governance as it was top-down oriented and national governments were the initiating actors.

Since the 1990s, integrative scientific reports (Quality Status Reports - QSRs) on the state of the Wadden Sea area have been a key source of knowledge for trilateral governance and notably the trilateral conferences (De Jong et al., 1999). As the scientific report of the Esbjerg conference indicates, the 200m-rule was established on the basis of generic quantitative data on marina capacities in terms of the number of moorings, sluice passages to and from the Wadden Sea, and the “number of boats on the Wadden Sea on representative days” (NFNA & CWSS, 1991: 149). The latter information was generated through aerial surveys (NFNA & CWSS, 1991: 149). Thus, the knowledge system that informed this regulation was geared towards creating generic, quantitative scientific knowledge, and the knowledge-governance interface was science-based.

Through explicitly linking knowledge integration in QSRs to trilateral conferences, knowledge creation and governance at the trilateral level are strongly connected. However, in case of the 200m-rule the research, decision-making and implementation took place in separate phases without feed-back loops; the 200m-rule did not have an adaptive character like the Nature Conservation Act.

3.5.1.3 THE CODE OF HONOR: RAISING AWARENESS

The 200m rule was contested by recreational boating CSOs as it limited their room to move on the Wadden Sea. One of the members of the CSOs explained this as follows:

“No beaching allowed beyond 200 meters from the channel […] implies that the entire Wadden Sea area becomes off-limits. […] You are allowed to [enter the area] but you don’t take the risk, because if you run aground on the ebb tide, you commit an offence.”

Moreover, they argued that it was based on an ill-defined notion of disturbance. As an alternative to this rule they developed a voluntary code of conduct for sailors concerning “responsible beaching on the Wadden Sea”, which is called the Code of Honor (CoH). This code contains practical

48 Memorandum of Agreement on Responsible Beaching in the Wadden Sea, 2003.
49 The initiators of the CoH include the Wad Sailors Association and the Association for Professional Charter Navigation.
rules on responsible behavior in order to prevent disturbances of birds and seals, such as “when the first birds fly up you are getting too close”. The underlying rationale is that, if the code is well-observed, “nature suffers no ill effects from beaching on – spatially speaking – a larger scale on the Wadden Sea”. 50 The CoH was introduced in the form of a four-year experiment from 2003 to 2007. 51 This introduction marks a shift from the centralized governance mode of the 200m-rule towards self-governance; the arrangement came about as a bottom-up initiative from the CSOs and its main steering concept is that of voluntary self-regulation by sailors on the Wadden Sea.

The knowledge system of the experiment comprised a monitoring practice that was set up and executed in collaboration between professionals from governmental and terrain management organizations and amateurs from the CSOs. The aim of the monitoring was to show whether the introduction of the CoH would lead to changes in disturbances and violations. Observations of individual beaching activities and their effects were recorded using a standard monitoring protocol and served as input for yearly interim evaluations of the results of the experiment. Through consistently using this monitoring protocol, individual observations could be aggregated into more generic knowledge about the effectiveness of the governance by means of the CoH. 52 At the end of the experiment, it was concluded that “the number of disturbances and violations does not seem to have increased. In this sense, the experiment can be considered a success”. 53 Consequently, the CoH was continued. More than 10 years after its introduction, it is still widely regarded as a successful and effective means of governance. For instance, one of the civil servants from the national government stated:

“I think it is very important to keep on calling for attention to the Code of Honor. It was introduced at the beginning of this century and it has simply proven to be very effective.”

Governance and knowledge creation were adaptively connected through an experiment which was informed by a participatory monitoring practice. Moreover, the CoH applies the dissemination of knowledge on responsible behavior and the promotion of awareness about disturbances among sailors as a steering mechanism for nature conservation. Thus, the knowledge-governance interface of this arrangement has an integrated and participatory character.

50 Responsible Beaching on the Wadden Sea: Final Evaluation, 2007, p.3.
51 In the Memorandum of Agreement on Responsible Beaching in the Wadden Sea this experiment was formally agreed upon. Its signatories are the Department of Agriculture, Nature and Food Quality (LNV), most of the organizations listed in footnotes 40, 41, and 44, and six other water recreation organizations.
3.5.1.4 THE THIRD WADDEN SEA MEMORANDUM: QUANTITATIVE REGULATION

The Wadden Sea Memoranda are policy plans issued by the Dutch government which formulate the outlines of the national Wadden Sea policy. The three consecutive Memoranda of 1980, 1994, and 2007 aimed at the protection and sustainable use of the Wadden Sea area, and contained policy measures for all kinds of human activities including recreational boating. Moreover, they aimed at stabilizing and controlling recreational boating in order to limit the recreational pressure on the Wadden Sea. Several drafts of the third Memorandum (2001, 2006) proposed to maximize the number of moorings in recreational marinas in the Wadden Sea area at around 4500. Recreational boating CSOs and provincial and municipal governments criticized this proposal as they argued that the number of moorings in marinas and the actual disturbance on the Wadden Sea are not causally related. For instance, one of the municipal civil servants stated:

“We quickly indicated that a maximization of the number of moorings was unacceptable to us, because we were of firm opinion that the number of moorings along the edges of the area does not influence whether or not natural values in the area are affected; the behavior of people is the only thing that matters.”

In line with this criticism the Dutch parliament replaced the quantitative regulation of moorings with a qualitative and integrated governance approach existing of a “widely supported body of measures for the ecological feasibility and manageability of recreational boating”; this approach was to be further elaborated and implemented by means of a Covenant between national, provincial and municipal governments. The Memorandum determined that this Covenant was to become effective before 2008; otherwise, the quantitative regulation would be implemented nevertheless (VROM, 2007a: 17).

The adjustment of the Memorandum marks a shift from top-down governance in which the central government was the leading actor to decentralized governance with an initiating role for the provinces. One of the representatives of the nature conservation NGOs for instance stated about the realization of the Covenant:

“In 2007 the provinces got cracking with that. They gave the lead to the Province of North-Holland, which almost fully allocated the time of two of its civil servants so that went quite well, and they
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started a deliberation process. They convened everyone […] [and said:] we have to do something. “

Moreover, this adjustment marks a shift with regards to knowledge. The explanatory note (VROM, 2007b) of the Third Memorandum (VROM, 2007a) states that “it is not so much the number of vessels, which usually stay in the fairways, but rather the time, place and behavior of vessels and persons on board that can lead to disturbance” (VROM, 2007b: 33). It therefore argues that it is necessary to “steer towards these latter aspects” through “raising recreational sailors’ awareness of the vulnerability of the Wadden Sea” (VROM, 2007b: 33).

3.5.1.5 THE RECREATIONAL BOATING COVENANT: QUALITATIVE GOVERNANCE

In December 2007, representatives of 13 recreational boating, governmental, nature conservation and harbor organizations signed the Covenant that had been announced in the Third Memorandum. The rationale of the Recreational Boating Covenant (2008-2011) was that the “sustainable protection and the maximally natural development of the Wadden Sea area” can be combined with “economic development” and the ability of inhabitants and visitors “to experience nature in a broad sense”. It aimed to attain these objectives through qualitative governance that focused on education and information in order to raise awareness and appreciation of the natural characteristics of the area. The execution program of the Covenant contained a large collection of initiatives including a vision on the responsible development of marinas, a communication and dissemination plan for the Code of Honor and a system of observation and information posts on vulnerable locations in the area, which was called “Wadden Watchers”.

A key element of the knowledge system connected to the Covenant was a monitoring program, which aimed to investigate the effects of the Covenant in terms of the behavior of people on the Wadden Sea and the occurrence of disturbances. It was a collaborative effort in which both professionals from governmental and terrain management organizations and amateurs from recreational boating organizations participated. Interviewees who were involved in the Covenant assess the results of the monitoring program quite differently. Some of them argue that the monitoring data is inconclusive on the effects of the Covenant as the involvement of amateur sailors and the low number of records limited its validity and reliability. For instance, one of the representatives of the nature conservation NGOs argued:

55 The signatories of the Covenant include the organizations that are mentioned in footnotes 39-42, three of the CSOs mentioned in footnote 44, and Staatsbosbeheer.

“In fact, you let the fox guard the chickens. Moreover, you have a very poor observation position on board of a small ship; you simply can’t survey the area.”

Others argue that the collaborative monitoring was productive as it helped to raise awareness and facilitated dialogue among the participants. One of the coordinators of the monitoring for instance stated:

“We came together every autumn to discuss what we had seen that year. A really quantitative analysis of the data never came about, but we did have qualitative conversations about what we had seen. The recreational sailors started to realize: “gee, we never looked at our colleagues like this before”. Their awareness strongly increased.”

When the quantitative regulation of the Memorandum was replaced by the qualitative regulation of the Covenant, a shift of knowledge systems occurred from a focus on generic, quantitative inventories to a focus on local, qualitative knowledge of the area among the people on board. At the same time, sailors became more empowered to use their knowledge within a mode of governance that became more self-regulatory, and some of them participated in the monitoring connected to the Covenant. Thus, the knowledge-governance interface became more participatory.

3.5.1.6 THE WADDEN WATCHERS: HOSPITALITY AS GOVERNANCE

The concept of the Wadden Watchers (WWs) was introduced by nature conservation organizations including Staatsbosbeheer and the WAD Foundation that have a long-standing experience with bird-watching posts in the Wadden Sea. Over the years, such posts have proven to be useful vehicles for informing vacationers who walk or sail around in the area about the natural qualities and vulnerabilities of specific locations. Since the mid-2000s, the coalition of NGOs have argued that a system of WWs is instrumental in improving nature management and they have been seeking external funding for this initiative (De Jong & Van den Heiligenberg, 2005: 56). In 2007, they introduced the WWs as an essential element of the Covenant; however, disagreement arose among the parties involved about whether or not the WWs were to be structurally implemented. For instance, one of the representatives of the NGOs stated:
“When the Recreational Boating Covenant came about, the NGOs made the implementation of the WWs system a prerequisite for signing it. The Covenant contained 12 or 13 or more points […] that were executed, except for this one.”

Notably, governmental organizations have been critical of the initiative. One of the professionals from the national government for instance stated:

“A disadvantage […] is: people have already entered an area before they receive information on the spot. That needs to be obviated by spreading good information in advance. Another disadvantage is that it draws in more and more people.”

Therefore, the national government favors experimenting with WWs on selected locations over structural implementation. In 2014, WWs posts were started as pilots on three locations in the Wadden Sea. At this time, the concept of WWs had been reframed into the somewhat broader and friendlier concept of “hosting”. This broader concept of hosting emphasizes hospitality and includes both Wadden Watchers on posts and other information activities aimed at sailors, e.g. in harbors.

The nature conservation NGOs are the initiating and leading actors in the WWs initiative. Moreover, the initiative aims at increasing the awareness and knowledgeability of visitors as a means of self-regulation. Therefore, this governance arrangement can be characterized as self-governance. In this case, knowledge and governance are strongly integrated as monitoring, knowledge dissemination and regulation are inextricably bound up with each other within one practice. The posts are manned by volunteers who are knowledgeable about the specific qualities of their location, and who transfer this knowledge to visitors. Therefore, the knowledge system that informs this initiative is based on “amateur expertise” and qualitative local knowledge.

3.5.1.7 THE PACT OF REDE: GOVERNANCE WITHOUT GOVERNMENT?

In 2009, a group of 12 recreational boating and nature conservation organizations started a collaboration called the Pact of Rede. The closing of new areas by virtue of the Nature Conservation Act spurred strong criticism towards the national government, notably among recreational boating CSOs. A representative of the latter for instance explained about this collaboration:

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58 The initial participants in this pact were five CSOs mentioned in footnote 44, three of the NGOs mentioned in footnote 45, and four other recreation and fisheries organizations. The word “Rede” refers to both “reasonableness” and a tidal flat near the island of Schiermonnikoog.
“It started as a reaction to the approach of the department regarding the Article 20 areas. We felt that we were investing in the Covenant, and nevertheless the department kept on closing off extra areas.”

Moreover, many of the recreation and nature conservation organizations had found rapprochement through participating in the Recreational Boating Covenant. One of the nature management professionals for instance stated:

“The organizations became better acquainted through participating in the Covenant. They thought: let’s start the Pact of Rede to try to get closer to one another.”

These developments incited the initiators of the Pact to search for new “steering mechanisms”⁵⁹. The rationale of the Pact was that nature conservationists and recreational sailors were able to formulate a shared perspective without the involvement of the government on how to both conserve and experience the nature of the Wadden Sea. One of the sailors’ representatives for instance explained:

“The Pact of Rede [...] is our own initiative that brings together nature conservation organizations and recreational sailors. [...] What business do the jurists have to subject that to rules?”

A key activity concerning the Pact was a map-drawing session in 2013 during which the participants discussed which specific areas in the Wadden Sea are valuable or problematic from conservation and recreation perspectives.⁶⁰ This resulted in a consensus on which areas are the most critical and pressurized in the sense that they highly valuable for both conservation and recreation; these areas have also been referred to as “hotspots”.⁶¹ Moreover, the deliberations between the participants resulted in a consensus on the need for a more flexible way of closing off areas, which was coined “dynamic zoning”. The concept of dynamic zoning emerged out of the criticism of the limited flexibility of the process of designating closed areas under Article 20 of the Nature Conservation Act (see section 3.5.1.1). It entails adaptively closing off or throwing open specific areas based on observations of changing circumstances in the field. In 2013, a dynamic zoning pilot was executed in collaboration between a group of canoers and nature management professionals from the depart-

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⁶⁰ Meeting report on the elaboration of the Pact of Rede, March 2, 2013.
⁶¹ Not to be confused with the concept of “biodiversity hotspot”.
ment of Economic Affairs. One of the latter explained about this flexible type of nature conservation:

“We want people [...] to be able to optimally enjoy an area. [...] Therefore, we need to sharply close off areas and investigate opportunities for doing so. That requires a tailored approach, it is very intensive. But it creates an optimal opportunity for experiencing the Wadden Sea.”

As the Pact of Rede at its onset explicitly excluded the government, its governance mode was predominantly self-governance. In later stages some civil servants from the national government became involved in the collaboration and discussions concerning the Pact. Therefore, although it primarily remained a self-governance arrangement, the Pact also got some characteristics of interactive governance. The experiential and local knowledge of the participants concerning the qualities of areas in the Wadden Sea played a key role in this governance arrangement. In this case, knowledge exchange and decision-making were integrated and were contingent upon the participation of both the recreational boating and nature conservation actors. Therefore, the knowledge-governance interface had an integrated and participatory character.

3.5.1.8 THE ACTION PLAN RECREATIONAL BOATING: COMBINING INITIATIVES

The evaluation of the Covenant (2012) showed that some of the Covenant initiatives needed renewed attention or had not been satisfactorily executed. Consequently, a broad coalition of governmental, nature conservation and recreational boating organizations started the Action Plan Recreational Boating in 2014 as a follow-up to the Covenant. A key element of the Action Plan is “learning from hotspots” through pilot projects that combine control and enforcement, hosting, dynamic zoning and monitoring. These pilots aim at learning about effective integrated governance that fits in with the local circumstances; they exemplify how the Action Plan combines elements from many of the preceding arrangements, such as the Covenant and the Pact of Rede. As in the case of the Covenant, the provincial governments played an initiating and coordinating role in the Action Plan. Moreover, NGOs and CSOs have been actively involved in both the preparation and the execution of the Action Plan; therefore, it combines decentralized and interactive governance. One of the provincial civil servants for instance said:

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64 This coalition includes nearly all of the organizations mentioned in footnotes 39–42, 44, and 45, along with three individual municipalities.
65 As in the case of the covenant this was notably the province of North Holland.
“In this case it was chosen […] to write the new Action Plan together with all of the stakeholders in order to create an as large as possible support.”

In the context of the Action Plan a new monitoring concept is under development. The monitoring related to the Covenant had proven to be unsuitable for identifying generic causal relations between recreational activities and disturbances of wildlife. The adjusted monitoring concept of the Action Plan still involves both amateurs and professionals, yet now focuses on “monitoring the behavior of vacationers and the local effects on the development of nature” in order to inform adaptive management on an ongoing basis. Moreover, a new aspect of the monitoring concept is the connection of this local monitoring to larger-scale and more science-based monitoring networks, such as the bird monitoring network of SOVON. The aim of this connection is to eventually increase insight into the more generic effects of recreation on bird and seal populations in the Wadden Sea. As the Action Plan aims to combine these various monitoring practices, it aims to bring about a knowledge-governance interface that is both participatory and science-based.

The arrows signify the main shifts and relations between the governance arrangements as described in section 3.5.1. The dark bars signify governance arrangements with a formal status. The light bars signify initiatives that did not (yet) have a formal status but that were of influence in the governance regime. The bar under “WS Memo” does not refer to the entire Wadden Sea Memorandum, but to the part of the Memorandum that dealt with quantitatively regulating recreational boating (see section 3.5.1.4).

3.5.2 How governance and knowledge have changed

The development of the recreational boating governance regime (see Figure 3.1) can be characterized as partly an accumulation and partly a sequence of governance arrangements, rather than a complete replacement of arrangements or governance modes (cf. Driessen et al., 2012: 153). The accumulation occurred as new arrangements were started through the years, while others were continued; the sequence occurred as new arrangements were started as alternatives or follow-ups to preceding arrangements. For instance, the Code of Honor and the Covenant were started as alternatives to the 200m-rule and the regulations of the Memorandum respectively. Both of these alternative arrangements emerged out of cri-
tiques of the rigid, quantitative, top-down regulations of their “predeces-
sors”. Thus, the critical scrutiny of governance arrangements and the will
to improve governance by making it more flexible and participatory have
served as key driving forces in the development of this governance regime.

Through this ongoing process of initiative, critique, and improvement
of governance, the mode of governance within this regime has shifted
from predominantly centralized governance to a combination of govern-
ance modes with a stronger emphasis on decentralized, interactive and
self-governance. Again, this has not been a process of the complete re-
placement of governance modes, but rather of the partial replacement and
partial accumulation of governance modes. This shift has entailed the
partial devolution of governance from the (supra)national to the provin-
cial and regional level. This means that the organizations at these lower
levels of government have gained responsibilities and coordinating tasks,
and thus a stronger position, in governing recreational boating. Moreover,
this shift has entailed that nature conservation and recreational boating
organizations have become more prominent players within this domain of
governance. Both of these groups have put much effort in attaining this
increased prominence through initiating governance arrangements such
as the Pact of Rede and the Wadden Watchers. However, this governance
shift does not only imply that organizations have become more prominent
players. It also implies an empowerment of individuals, such as individual
sailors. Through the emergence of self-regulation arrangements such as
the Code of Honor, individual sailors have gained both more freedom and
more responsibility for their own actions.

Simultaneously with this governance shift, a shift of knowledge systems
has taken place that may be characterized as the diversification and inte-
gration of knowledge. Initially, the centralized governance of recreational
boating was predominantly informed by knowledge with a clearly quanti-
tative component provided by specialized experts and research organiza-
tions. As the above described accumulation and sequence of governance
arrangements took place, knowledge systems shifted accordingly. Firstly,
as qualitative governance emerged as an alternative to quantitative gov-
ernance, which is exemplified by the emergence of the Covenant as an
alternative to the Memorandum regulations, qualitative knowledge also
 gained a more important role. This means that the local knowledge of
specific qualities and vulnerabilities of specific areas has gradually gained
importance as an alternative and a complement to generic quantitatively-
oriented knowledge. Secondly, the empowerment of stakeholders from
both the worlds of recreation and nature conservation implies that their
knowledge, which is based on their experiences and observations in the
area and which is exchanged within their networks, has gained importance within this governance regime. Thirdly, several of the emerging governance arrangements had or still have a strongly integrated character. This tendency towards integration can also be observed in the knowledge systems that are connected to these arrangements. For instance, recent governance arrangements such as the Action Plan have served as forums for the integration of knowledge by facilitating the collaboration between professionals and amateurs in the creation and exchange of knowledge.

### Figure 3.1: The development of the recreational boating governance regime 1981-2014

The arrows signify the main shifts and relations between the governance arrangements as described in section 3.5.1. The dark bars signify governance arrangements with a formal status. The light bars signify initiatives that did not (yet) have a formal status but that were of influence in the governance regime. The bar under “WS Memo” does not refer to the entire Wadden Sea Memorandum, but to the part of the Memorandum that dealt with quantitatively regulating recreational boating (see section 3.5.1.4).

<table>
<thead>
<tr>
<th>Year</th>
<th>Centralized</th>
<th>Decentralized</th>
<th>Self Governance</th>
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<tr>
<td>1980</td>
<td>NCA</td>
<td>200M RULE</td>
<td>PACT REDE</td>
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<tr>
<td>1990</td>
<td></td>
<td>WS MEMO</td>
<td>CoH WWs</td>
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<td>2000</td>
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<td>2010</td>
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These shifts of governance and knowledge imply that a shift of knowledge-governance interfaces has occurred. The governance regime examined in this case study comprises various arrangements connected to specific knowledge systems. Therefore, it comprises multiple knowledge-governance interfaces; we cannot speak of a single knowledge-governance interface in this case. A first aspect of this shift is the emergence of multiple coexisting participatory interfaces, such as the interfaces of the Covenant and the Pact of Rede, next to more science-based interfaces such as that of the Nature Conservation Act. This means that the knowledge of various groups of stakeholders has gradually taken on a more prominent role in governing and decision-making. Furthermore, the interfaces within this regime have shifted towards a more adaptive, reciprocal relation between knowledge and governance. This is exemplified by the introduction of dynamic zoning and the various experiments and pilots that have been performed over the years.

3.6 DISCUSSION AND CONCLUSIONS

Our analysis shows that shifts of governance modes and knowledge systems go hand in hand. In the case presented in this paper, the mode of governance has shifted from predominantly centralized governance to a combination of governance modes with a stronger emphasis on decentralized, interactive and self-governance. Simultaneously, a shift of knowledge systems has occurred, entailing the rising prominence of qualitative local knowledge, stakeholders’ knowledge, and knowledge integration. Moreover, more participatory knowledge-governance interfaces have emerged within this governance regime.

These findings suggest that environmental governance and knowledge are not so much two worlds separated by a gap; rather, they are often closely interconnected. This interconnectedness manifests itself in various ways. Firstly, many environmental issues, including recreational boating in protected nature areas, are regulatory and epistemic issues at the same time; the ways of regulating and knowing them are bound up with each other. Salient examples of this are the various governance arrangements in this case that have employed the raising of awareness and knowledgeability as a steering mechanism. Consequently, we gain explanatory power by looking at the ways of governing such issues in terms of both their regulatory and epistemic aspects (cf. Jasanoff, 2004). Secondly, the development of the governance regime in this case has been a process of scrutinizing centralized governance and initiating alternative governance modes. Each time a new initiative was started, both a new governance
arrangement and a new knowledge system came about. This process, which recurred several times over the last decades, exemplifies how governance arrangements and knowledge systems are constructed together. In other words, they are coproduced (Jasanoff, 2004). Thirdly, governance arrangements and knowledge systems have a mutually constitutive relation, which means that they both restrict and enable each other. For instance, the centralized governance of the 200m-rule restricted the possibilities of including stakeholder knowledge in governance. To give another example, the participatory monitoring of the “responsible beaching” experiment was decisive in enabling the structural implementation of self-governance by means of the Code of Honor.

Moreover, our analysis suggests that the development of an environmental governance regime can be seen as an innovation process in which governance and knowledge are coproduced through experimenting, learning, and re-framing. In this case, this learning process pertains to which governance approaches are effective and to what are the best ways to create and exchange knowledge in order to inform governance. This latter aspect is exemplified by the ongoing efforts to improve monitoring based on previous monitoring experiences. Conceptual innovation has notably occurred in the form of new or renewed governance concepts such as “dynamic zoning” and “hosting”. One lesson from this analysis is that room for experimentation is an important factor in improving environmental governance.

A second lesson is that a shift towards more interactive and self-regulation-based environmental governance implies that the role of knowledge in governance shifts as well. Consequently, those who want to set a shift in motion towards higher stakeholder involvement in environmental governance need to deal with the question of how to give shape to the creation and exchange of knowledge in such a changing context. A key issue in this respect is that the knowledge of various groups of stakeholders is a valuable source for governance. Moreover, productive interactive governance may require connections between various forms of knowledge; practices of joint knowledge creation such as collaborative monitoring are instrumental in making such connections.

ACKNOWLEDGEMENTS

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04. TRADE-OFFS AND SYNERGIES IN JOINT KNOWLEDGE CREATION FOR COASTAL MANAGEMENT: INSIGHTS FROM ECOLOGY-ORIENTED SAND NOURISHMENT IN THE NETHERLANDS

Franke van der Molen, Jac. A. A. Swart, Henny J. van der Windt [submitted]
Abstract

Establishing fruitful connections between knowledge creation and action is a critical issue in many domains of environmental management. Establishing such connections requires environmental research to produce legitimate, credible, and salient knowledge. Although trade-offs and synergies between these three attributes of knowledge have been argued to exist, little research has focused in detail on identifying them. This paper addresses the following questions: first, what trade-offs and synergies may occur in collaborative research for environmental management? Second, what lessons may be learned from this for organizing environmental research that balances these three attributes? This paper is empirically informed by a case study on a collaborative and management-oriented research program on the ecological effects of coastal protection by means of sand nourishment. Our findings suggest that the legitimacy and salience of knowledge creation for environmental management, particularly in an interactive governance context, may be mutually complementary. Furthermore, we identify two key trade-offs: one between practical relevance and fundamental knowledge creation, and one between issue diversity and the depth and quality of scientific inquiry. Based on our findings we formulate several recommendations for balancing legitimacy, credibility, and salience in environmental knowledge creation.

4.1 Introduction

A key issue in various domains of environmental management is how to create and mobilize knowledge that can fruitfully inform collective action with respect to the environment. In an influential paper Cash et al. (2003) have argued that in order to fruitfully link environmental knowledge and action, knowledge creation efforts must be respectful of disparate concerns and values of involved actors, meet standards of scientific and technical quality, and be relevant for decision-making and management. These three attributes are respectively called legitimacy, credibility, and salience. The triad of legitimacy, credibility, and salience has been widely applied in studies of environmental knowledge-policy interactions (Tuinstra et al., 2006; e.g., Runhaar et al., 2016). Moreover, in line with Cash et al. (2003) various authors have argued that trade-offs between these three attributes may occur, as efforts to strengthen one of them may come at the cost of the others (White et al., 2010; Sarkki et al., 2014). Furthermore, some authors have argued that besides trade-offs also synergies between these attributes may emerge (Hegger et al., 2012). However, little research has examined in detail what kinds of trade-offs and synergies may occur and what the factors and conditions are that are of influence on their occurrence. The aim of this paper is to further insight into the occurrence of trade-offs and
synergies between legitimacy, credibility, and salience. We deem insight into this matter important as it may help to identify the difficulties and opportunities of balancing these three attributes. This in turn may inform how to give shape to successful knowledge creation efforts in the context of environmental management.

The empirical part of this paper is a case study of a collaborative research program on the ecological effects of sand nourishment (Ecology-oriented Sand Nourishment, ESN, 2009-2015). In the Netherlands, sand nourishment is applied as a key means of coastal engineering that aims at countering coastal erosion and facilitating coastal adaptation by making use of the natural dynamics of sand and water along coasts. However, there are still many uncertainties and knowledge lacunae regarding its ecological effects. The program on which our case study focuses has aimed to inform the sand nourishment practice while addressing the concerns of environmental conservation NGOs and meeting standards of scientific quality. The two main research questions that this paper will address in this case study are the following. First, what trade-offs and synergies may occur between legitimacy, credibility, and salience in collaborative research for environmental management? Second, what lessons may be learned from this for organizing environmental research that balances these three attributes?

The next section provides a review of the environmental management literature that focuses on legitimacy, credibility, and salience. Section 4.3 outlines the methods and materials, after which section 4.4 describes the broader coastal policy and management background within which our case is situated. Sections 4.5 and 4.6 provide the results and analysis of the case study. Finally, section 4.7 draws conclusions and discusses how trade-offs may be dealt with in organizing collaborative and management-oriented environmental research.

4.2 LEGITIMACY, CREDIBILITY, AND SALIENCE: LITERATURE REVIEW

Legitimacy “reflects the perception that the production of information and technology has been respectful of stakeholders’ divergent values and beliefs, unbiased in its conduct, and fair in its treatment of opposing views and interests” (Cash et al., 2003: 8086). This notion of legitimacy concerns a form of procedural fairness and trustworthiness in dealing with disparate standards and perspectives (Bauler, 2012; Holden, 2013). Credibility “involves the scientific adequacy of the technical evidence and arguments”; thus, it is a measure of scientific and technical quality (Cash et
In the literature various attributes have been connected to the notion of credibility, which include the accuracy, reliability, validity, and authoritativeness of knowledge (White et al., 2010; Koetz et al., 2012; Cook et al., 2013). Salience “deals with the relevance of the assessment to the needs of decision makers” (Cash et al., 2003: 8086). It may involve responsiveness to policy or management needs and the capacity to influence policies or management practices (Heink et al., 2015).

The triad of legitimacy, credibility, and salience has been applied in studies of science-policy interfaces within various domains of environmental policy and management, such as air pollution (Tuinstra et al., 2006), climate change (Shaw et al., 2013), nature conservation (Hauck et al., 2013), coastal and marine management (Röckmann et al., 2015; Runhaar et al., 2016), biofuel policy (Schut et al., 2013), and landscape planning (An and Powe, 2015). These studies generally acknowledge that legitimacy, credibility, and salience need to be combined in order to successfully mobilize knowledge for decision-making, policy-making, or other forms of collective action concerning the natural environment. Moreover, it has been oftentimes argued that trade-offs between these three attributes may occur, as “efforts to enhance any one normally incur a cost to the others” (Cash et al., 2003: 8086; see also Pietri et al., 2011; Sarkki et al., 2014; Runhaar et al., 2016). Therefore, combining the three attributes can be seen as a “balancing act” (Kunseler et al., 2015: 2). This balancing act is challenging for several reasons; for instance, the three attributes may be “perceived differently by different actors” (Sarkki et al., 2014: 195). Moreover, how to reach an appropriate balance between them may vary according to various contextual factors such as the stage of the policy cycle and the type of science-policy interface (Sarkki et al., 2014).

Balancing legitimacy, credibility, and salience is often seen as a matter of boundary management between knowledge creation and decision-making. For instance, Cash et al. argue that “those systems that made a serious commitment to managing boundaries between expertise and decision making more effectively linked knowledge to action than those that did not. Such systems [...] more effectively balanced salience, credibility, and legitimacy in the information they produced” (Cash et al., 2003: 8089). Such boundary management has been suggested to involve the establishment of boundary organizations that serve as intermediaries between science and policy, and the deployment of boundary objects that accommodate the concerns and demands of various groups of actors (Cook et al., 2013; van Enst et al., 2016).

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67 Some authors prefer to use the term “relevance” instead of salience (Tuinstra et al., 2006; Sarkki et al., 2014; e.g., Heink et al., 2015). In this paper we use the terminology as introduced by Cash et al. (2003), which includes salience.
Although it is widely acknowledged that trade-offs may occur between legitimacy, credibility, and salience, little scholarship has explicitly focused on identifying such trade-offs. A notable exception to this is the work of Sarkki et al. (2014), which identifies four trade-offs based on empirical research on biodiversity-related science-policy interfaces. Firstly, scientists and policy-makers have to deal with a “personal time trade-off”, because they have to choose whether they invest their time in participating in science-policy interfaces or in their core activities (Sarkki et al., 2014: 198). Secondly, a clarity-complexity trade-off may occur; presenting “simple, strong and clear messages” in order to enhance salience may come at the expense of the “thorough treatment of uncertainties and ignorance and diverging values” in order to enhance credibility and legitimacy (Sarkki et al., 2014: 199). Thirdly, a “speed-quality trade-off” may occur; providing “rapid responses to policy needs” to enhance salience reduces time for quality assessments and consensus building processes, thus reducing credibility and legitimacy (Sarkki et al., 2014: 200). Fourthly, Sarkki et al. identify a “push-pull trade-off” that occurs between supply-driven strategies that foster credibility and demand-driven strategies that focus on salience (Sarkki et al., 2014: 201). Trade-offs between credibility and legitimacy are not addressed by these authors. Several scholars have argued that besides trade-offs, also synergies between legitimacy, credibility, and salience may occur (Hegger et al., 2012; Sarkki et al., 2014). For instance, exploring a broad range of views in order to achieve legitimacy may also be conducive to quality assessment in the form of “extended peer review”; thus, in this sense a synergy between legitimacy and credibility may emerge (Sarkki et al., 2014; see also Funtowicz & Ravetz, 1993). However, little empirical research has explicitly focused on identifying synergies between the three attributes.

The identification of trade-offs and synergies between legitimacy, credibility, and salience may contribute to insight in how to give shape to knowledge creation processes that meet the concerns and demands of various groups of actors involved. However, creating generalized knowledge on such trade-offs and synergies is challenging because, as argued above, the ways in which they come about and may be dealt with are often context-specific. Hence, in order to contribute to insight in trade-offs and synergies, more insight in process- and context-specific factors that are of influence on trade-offs and synergies is needed. In this paper we take such factors into account by examining both how a collaborative research practice is constructed in order to achieve legitimacy, credibility, and salience, and the broader setting in which this construction work is situated.
4.3 METHODS

This paper is empirically informed by a case study on the Ecology-oriented Sand Nourishment (ESN) collaborative arrangement and the research program that is part of this arrangement. It reconstructs the establishment of this arrangement and the efforts that have been made to achieve legitimacy, credibility, and salience on the empirical basis of interviews and document study. In a first round, a broad investigation was made of policy-related and societal developments concerning “ecological” or “natural” approaches to coastal defense in The Netherlands. This investigation was made on the basis of a study of scholarly literature, research reports and “grey” literature such as policy documents. In a second round, which zoomed in on the ESN arrangement, 15 semi-structured interviews were conducted with actors who have been actively involved in this arrangement. The interviewees include researchers who coordinated and executed the research and monitoring, the key representatives of the NGOs involved, and civil servants who were involved in the coordination and management of the program. The main interview topics included the establishment of the collaborative arrangement on sand nourishments, the programming of the research, the interactions between the actors involved, the main issues concerning coastal protection by means of sand nourishment, and the salience, legitimacy, and credibility of the research program. Most of the interviews lasted between 45 min. and 2 h. The interviews were recorded, transcribed verbatim, and analyzed with software for qualitative data analysis (Nvivo 10). In the analysis we combined two coding strategies. Firstly, we used an inductive coding strategy involving setting-specific codes that were constructed on the basis of the issues that were brought up by the respondents (Lofland et al., 2006). Secondly, we used credibility, legitimacy, salience, and the trade-offs and synergies between these attributes as analytic codes in the analysis of the interviews (Lofland et al., 2006). This analysis was bolstered through triangulation with written sources that were produced in the context of the collaborative arrangement, such as research plans, legal documents, workshop reports, and research reports.

4.4 BACKGROUND: THE DYNAMIC PRESERVATION OF THE DUTCH COAST

The Netherlands, with almost one-third of its territory below sea-level, has a long history of protecting its inhabitants and land from flooding (Van Koningsveld et al., 2008). The Dutch coastline is over 400 km long
and 75% of the coast is protected by sandy structures and dune areas; the remainder is protected by hard structures such as dams, dikes, and storm surge barriers (De Ruig, 1998; Mulder et al., 2011). Thus, sand plays a crucial role in the coastal defense of the Netherlands. Due to an imbalance between sediment supply and sea level rise, the sandy coast has been subject to erosion during at least the last centuries, and presumably for up to 1500 years (Bakker et al., 2012). This has resulted in land loss and threats to e.g. drinking water supply and ecological, residential, and industrial functions in the coastal zone (Van Koningsveld & Mulder, 2004).

Before 1990, the Dutch coastal defense policy aimed at countering only the most urgent erosion problems and at stabilizing the defensive structure of the sandy coastline through fixating and restoring dunes and creating sand dikes (De Ruig, 1998; De Jong et al., 2014). However, by 1990 a political consensus had come about that this policy would not suffice for safeguarding the Dutch coast in the long run (Hillen & Roelse, 1995). Therefore, a new policy was implemented that aims at fully countering coastal erosion, thus maintaining the Dutch coastline at the position in which it was in 1990 (Rijkswaterstaat, 1990). This is accomplished by means of an ongoing program that encompasses monitoring the position and sediment volume of the coast and applying sand nourishments in locations where the actual situation deviates from the 1990 reference (Bakker et al., 2012). This program is executed by Rijkswaterstaat (RWS), the national governmental organization responsible for maintaining the Dutch coast and executing coastal defense policy. Sand nourishment entails collecting sand from the deeper parts of the North Sea (outside the 20 m isobath) and depositing it on the shoreface or the beach where water and wind have free play in its further transport and accumulation in the coastal zone (Hillen & Roelse, 1995; De Jong et al., 2014). The new policy is called “dynamic preservation” because it aims to preserve the coast by making use of and stimulating the natural dynamics of sand and water; for this reason, it is also characterized as “building with nature” (Van Koningsveld & Mulder, 2004; Kabat et al., 2009b; De Jong et al., 2014). Various evaluations have pointed out that the policy has succeeded in maintaining the coastline at its reference position (Mulder et al., 2011). Moreover, the policy is thought to be sustainable in the long run as it allows the coast to grow along with sea-level rise (Kabat et al., 2009b).
4.5 EFFORTS TO ACHIEVE LEGITIMACY, CREDIBILITY, AND SALIENCE IN THE ESN PROGRAM

4.5.1 The establishment of the ESN program

The Ecology-oriented Sand Nourishment (ESN) program originated in discussions about the regulation and unknown ecological effects of sand nourishment. Since 1990, Rijkswaterstaat (RWS) has been executing its program of sand nourishments along the Dutch coast. Initially, it perceived these nourishments as “regular” maintenance activities that were comparable to other forms of regular infrastructural maintenance. Therefore, it deemed requesting permits for sand nourishments unnecessary. An RWS employee for instance argued:

“RWS was of the opinion that it fell under the regular maintenance of the system. […] We do not need to request a permit for replacing a layer of asphalt on the freeway either.”

However, by the mid-2000s a group of nature conservation NGOs had become critical of this practice. The main points of criticism were that the execution of sand nourishment was unregulated and that there was little known about its ecological effects. One of the representatives of the NGOs who was involved at that time stated:

“We had no problem with dynamic preservation as such, but we did have a problem with the way it was executed, its unregulated character, the lack of research underpinning its execution, and also the lack of knowledge on its optimization with regard to nature.”

Consequently, four NGOs (the Wadden Sea Society, the Society for the Protection of Birds, the Dune Conservation Foundation and the North Sea Foundation) formed a coalition aiming to address these issues. They argued that RWS should request permits for sand nourishments under the Nature Conservation Act (NCA). Doing so would impose a formal decision-making and consultation procedure on sand nourishments. Moreover, it would impose the requirement to create and apply knowledge concerning the ecological effects of sand nourishments, as the NCA prescribes that a scientific assessment of such effects is to be part of the decision-making.\footnote{This assessment is called an “appropriate assessment.”} However, RWS initially did not intend to meet the demands of the NGOs. One of the NGOs’ representatives for instance recalled:
“We put quite some pressure on RWS to request an NCA-permit for the nourishments […] That was extremely laborious […]. There were people at RWS who absolutely did not feel like doing so and who thought that they as a governmental organization were not obliged to.”

This incited the NGOs to take various formal actions, including issuing comments in the consultation procedure concerning the yearly sand nourishment program and filing “enforcement requests” at the province of Fryslân and the Department of Agriculture, Nature, and Food Quality (LNV). The latter two are competent authorities under the NCA. In reaction to these formal actions, RWS started requesting NCA permits for sand nourishments in 2008. The permits requests that were filed since then were granted by the competent authorities. However, the NGOs were critical of these initial requests; in consultation procedures concerning the first permits they argued that the permit conditions and impact assessments of the intended sand nourishments were inadequate and that integrated research on large-scale and long-term ecological effects was needed.

In order to find a way out of this complex situation of knowledge lacunae and formal procedures RWS proposed to enter into an agreement with the NGOs; this “Collaborative Agreement Sand Nourishments” was signed on March 24, 2009. The crux of this agreement is that RWS and the NGOs collaborate in a research and monitoring program that aims at “gaining more knowledge on the influence of the execution of sand nourishments on natural values, and on possibilities of optimizing the sand nourishment program and its execution regarding the conservation and development of natural values”. Moreover, the agreement states that the NGOs “exercise restraint in taking recourse to legal remedies” with respect to sand nourishments.

The research program called Ecology-oriented Sand Nourishment that emerged from this agreement (ESN, 2009 - 2015) is executed in collaboration between RWS, the four NGOs, and the research organization Deltas. The fieldwork is executed by several specialized research agencies who work in annual contracts under the authority of Deltas. The ESN

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69 An enforcement request is a message to a competent authority that points out a possible breach of a regulation and requests the enforcement of this regulation.
73 Deltas is a merger of various water and civil engineering research organizations including several former research departments of RWS; it serves as one of the principal “knowledge suppliers” of RWS.
74 These are mostly privately owned research agencies that are specialized in ecological monitoring and fieldwork. They include the Belgian agency eCoast and the Dutch agencies EGG Consult and The Fieldwork Company.
program is embedded in the larger research program “KPP Management and Maintenance Coast” (KPP Coast), which aims at providing RWS with the knowledge required for optimizing the dynamic preservation of the Dutch coast. Through introducing ESN in KPP Coast, an ecological subprogram has been added to a research program that previously solely focused on coastal morphology. KPP and its subprograms are coordinated by RWS and Deltares.

Since 2009, various research activities have been executed within the scope of the ESN program, including:

- A study on the ecological effects of sand nourishment on the dunes along the Dutch coast, in collaboration with the research network for nature management O+BN (Arens et al., 2012).
- A literature study on where and when effects of sand nourishments on birds may be expected (Jonkvorst et al., 2013).
- A case study on the effects of sand nourishments on the ecology of the foreshore and beach of the island of Ameland. This case study forms the principal part of the ESN program. One of its key research questions concerns the speed of ecosystem recovery after sand nourishments. It has an experimental character inasmuch as these sand nourishments were designed, based on the input of the program participants, to have a limited ecological impact (Holzhauer et al., 2014).

4.5.2 Efforts to achieve legitimacy

Through their initiatives, the nature conservation NGOs have had a strong influence in placing ecology on the knowledge agenda for coastal protection. In a sense, the ESN research program that emerged from these initiatives is inherently legitimate as it is a materialization of the ecological concerns of the NGOs. However, the parties to the agreement have done more than just starting an ecological research program in order to produce legitimate knowledge; in fact, much efforts have been made by RWS and Deltares to ensure that the content of the research program reflects the various concerns of the NGOs.

Although many of the NGOs’ concerns fall under the general category of “ecology”, they also differ to some extent. For instance, the Wadden Sea Society is interested in the effects of sand nourishments on the ecological

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75 KPP stands for “Knowledge for Primary Processes”. The wiki site of this program can be found at https://publicwiki.deltares.nl/pages/viewpage.action?pageId=72844168 (last accessed 1-25-2016).
76 O+BN is a Dutch acronym for Development and Management Nature Quality. It is a research network that aims to create and disseminate application-oriented knowledge for environmental management.
77 Ameland was chosen as a case study for pragmatic reasons; at the time the research program was started up, there were already plans for sand nourishments near Ameland that could serve as a case study.
and morphological systems of the Dutch Wadden Sea, The Society for the Protection of Birds is interested in the effects on the coastal food web, and the Dune Conservation Foundation is interested in the possible contribution of sand nourishments to the restoration of dune ecosystems.\textsuperscript{78}

The creation of a legitimate research program has been a process in which the concerns of the NGOs and the focus of the research practice have been aligned in several ways. First, tentative research questions were formulated on the basis of the concerns put forward by the NGOs. These questions were based on the comments that the NGOs had provided in the consultation procedure concerning the sand nourishment program. An RWS program manager for instance said about this:

“As a basic source we had the comments that had been submitted. They included an appendix with […] a big pile of questions and concerns and doubts about sand nourishment […] Together with IMARES and Deltares […] we analyzed how we could turn those doubts and concerns into research questions.”\textsuperscript{79}

Subsequently, the further specification of the focus, the questions and the set-up of the research were discussed in three workshops in the summer of 2009, in which representatives of RWS, the NGOs and research organizations participated. The results of these workshops served as input for the 5-year research plan that was finalized in late 2009 and that served as the basis for subsequent yearly research plans.\textsuperscript{80} The 5-year research plan contains 31 research questions on the ecological effects of sand nourishment that are distributed among five themes that roughly cover the concerns of the NGOs (Holzhauer et al., 2009):

1. Large-scale ecological and morphological systems, specifically those of the Wadden Sea.
2. Three types of habitats:
   a. Offshore (i.e. the deeper parts of the North Sea where sand is collected)
   b. The foreshore and the breaker shore.
   c. The beach and the dunes.
3. Food web relations.

Furthermore, the program leaders have aimed to ensure the legitimacy of the program by means of regular deliberation between RWS, the NGOs, and the researchers. Notably, interim results and possible adjustments to

\textsuperscript{78} The Wadden Sea is a protected intertidal area that stretches from the northern coast of the Netherlands to the western coast of Denmark.

\textsuperscript{79} IMARES, the Institute for Marine Resources & Ecosystem Studies, was involved in the initial stages of the research program.

\textsuperscript{80} Workshop Report Effects of Sand Nourishments on Dunes (Knowledge Lacunae and Research Questions), June 29, 2009, Harlingen.
the yearly research plans have been discussed by the parties to the agreement in yearly workshops. However, in recent years this process of “legitimation through deliberation” has come under pressure due to the decreasing involvement of the NGOs in the research program. The NGOs have to divide their limited time and manpower among the various issues and processes in which they are involved. Once the issue of the ecological impact of sand nourishments had been placed on the agenda and solidified in the collaborative agreement, other issues started demanding more attention of the NGOs. Thus, limited time and resources and shifting priorities confronted the NGOs with the personal time trade-off that has also been identified by Sarkki et al. (2014). One of the representatives of the NGOs for instance argued about the shifting priorities:

“Such is […] the fate of these kinds of covenants […]. In the build-up they take priority and everyone is strongly involved. Once they have been settled […] they become less primary on the agenda. There is a risk to that. […] It then becomes quite difficult to keep a finger on the pulse.”

4.5.3 Efforts to achieve credibility

Throughout the programming and the execution of the research, researchers from Deltares and the other research organizations have made various efforts to create a credible research program. Deltares has had the prime responsibility for the technical and scientific quality of the program (Holzhauer et al., 2009). As a first step towards creating credible knowledge, the tentative questions were transformed into a set of researchable questions that fitted within the five main themes of the program. A program manager for instance stated about this:

“We tried to fit the directly answerable questions into the components that we had, and to adjust the questions that required very long or expensive research or that we simply could not answer [by asking]: what is the question that we should ask instead?”

As a result of this process of filtering and adjusting, a further focus in the research program came about. For instance, researching the large-scale cumulative effects of beach nourishments has a high priority for the NGOs; however, it was decided to focus on the local effects of beach nourishments in a case study as research on cumulative effects was deemed too complicated (Holzhauer, 2010).
Furthermore, quality control was employed to achieve a credible research program. For instance, a peer-review process was organized to assess the scientific quality of the 5-year research plan. In this process several experts, notably from Ghent University, reviewed the research plan. The key conclusion of this review was that the program insufficiently linked fundamental research and practical applications of the research; this resulted in the further adjustment of some of the research questions (Holzhauer, 2010).

Moreover, the credibility of the program has in part relied on the specialized expertise of the research agencies involved. Notably, several specialized ecological research and monitoring agencies have been involved in the execution of the monitoring; these agencies have produced detailed methodological designs and fieldwork reports on both the case study on Ameland and the research on the ecological effects on dunes (e.g., Everts & De Vries, 2010; Vanagt et al., 2011). A Deltares program manager for instance stated:

“We handle a part of the questions ourselves but we work together with many other parties who do parts of the research, with an eye to doing research that has a broader foundation than something that was simply and solely contrived between these four walls. […] Oftentimes there are portions of the research for which we don’t have the best and highest credentials; in that case other parties are better fit for the job.”

Some of the involved researchers have called into question the validity and the representativeness of the Ameland case study. Because the foreshore is a dynamic system that quickly recovers from interferences, the ecological effects of sand nourishments may be small and difficult to measure. Whether the statistical power, the set-up and the execution of the monitoring have been adequate to measure such effects has been called into question. For instance, the latter aspect was hampered because the contractor of the sand nourishments had a flexible planning for executing the work. Therefore, the researchers were not able to work according to a predetermined sampling plan (Holzhauer et al., 2014: viii). Furthermore, the representativeness of the case study has been questioned in various respects. Various interviewees pointed out that because of its spatial and temporal limitations the case study has a limited representativeness with respect to the effects of sand nourishment on a larger scale, on a longer term and in other parts of the Dutch coast. Consequently, the involved researchers have called for a nuanced interpretation of the results of the program.
4.5.4 Efforts to achieve salience

As stated in section 4.4, the ESN research program that stems from the collaborative agreement is to provide knowledge for the optimization of sand nourishments with respect to “natural values”\(^1\). Therefore, the research program is strongly aimed at producing salient knowledge for the practice of dynamic preservation. As a first step in achieving salience, the notion of what constitutes salient knowledge for dynamic preservation was redefined. Before the NGOs’ initiatives and the collaborative agreement, sand nourishment was not regulated under the Nature Conservation Act (NCA), and research and monitoring in the KPP Coast program focused on geomorphological aspects of the coast. Thus, ecological knowledge was not officially considered to be salient for dynamic preservation. Through the initiatives of the NGOs, sand nourishment became regulated under the NCA. Consequently, ecological effects were officially to be taken into account in the decision-making on the permissibility of sand nourishments. This created a situation in which it was in principle possible for ecological research to be salient for dynamic preservation. As a second step, the parties to the agreement gave shape to the salience of the ESN program by programming the research in such a way that specific sub-projects served as sources of knowledge for the decision-making on sand nourishments under the NCA permit regime. Within the program, several short-term research projects were executed, e.g. on the behavior of seals and sanderlings \((Calidris Alba)\) in relation to sand nourishments, with the explicit aim of providing knowledge for permit requests.\(^2\)

Furthermore, the salience of the ESN program has been given shape through the institutional design of the program. By embedding the ESN program in the KPP Coast program, it became a part of the already existing management-oriented research infrastructure in which RWS and Deltares collaborate. As the ESN program follows the institutional logic of the KPP Coast program it is, like other subprograms of the latter, coordinated in close collaboration between the program managers of RWS and Deltares. Consequently, RWS is involved on an ongoing basis in assessing and safeguarding the salience of the research that is done. For instance, an RWS program manager stated about this:

“One of the research questions concerns the effects of sand quality. […] We concluded that addressing that question might produce results, but we would not be able to apply them in the execution of sand nourishments, so we let that rest for the time being. […] It is aimed at improving sand nourishments, not just at knowing more.”

Finally, the program aims to provide salient knowledge through contributing to design principles or a guideline for ecologically sound sand nourishment, also referred to as “green sand nourishment”. Such principles may for instance concern the intensity, phasing, and sediment composition of sand nourishments. However, such principles have not yet been formulated. For instance, one of the NGOs’ representatives stated:

“The research’s aim is to produce a guideline for ecological nourishment. The results are now known. […] As yet we haven’t thought out: how are we going to do things differently than in the past?”

This may be explained by the current results, which as yet do not give cause to radical adjustments to the current sand nourishment practice. One of the program managers said about this:

“[The research] does not indicate that we have to do things radically differently. Either we don’t know enough yet about the relations between sand nourishments and dynamics, or the recovery time [of the ecosystem] is not much longer than the repetition time of the beach nourishments.”

4.6 LEGITIMACY, CREDIBILITY, AND SALIENCE: TRADE-OFFS AND SYNERGIES

4.6.1 Legitimacy – salience: synergy between addressing concerns and informing decision-making

A synergetic relation between legitimacy and salience has emerged within the ESN research program in the following ways. Firstly, the ecological concerns put forward by the NGOs have gained a structural position within knowledge creation and decision-making on the dynamic preservation of the coast. This has for instance occurred by making sand nourishments fall under the NCA permit regime, which implies that addressing ecological issues has become inevitable in decision-making about the conditions under which sand nourishments are permissible. Moreover, ecological research appears to have gained a structural position in the KPP Coast program that provides knowledge for the practice of dynamic preservation. A program manager from Deltares for instance argued about this:

“For 25 years we have been working on how we manage our coast, what we see there and what we can learn from it. The ecological part that has entered now is still in its infancy. It is starting to stand on solid ground, […] we will continue to work on it in a structured way”

Thus, both in the context of the NCA permit regime and the KPP Coast program, addressing the ecological concerns of the NGOs has resulted in a positive impulse for the substantive underpinning of the decision-making on the execution of sand nourishments.

Secondly, a governance arrangement has emerged in which the boundary between the “stakeholders” and the “decision-makers” has become more permeable. For instance, the NGOs have exerted a strong influence on the way decisions are made on sand nourishments by inciting RWS to apply permits under the NCA. Furthermore, RWS and the NGOs are working towards the shared goal of optimizing sand nourishments with respect to ecology and the latter are consulted in early stages of decision-making on the sand nourishment program. In this sense, addressing ecological concerns and making decisions on the execution of sand nourishments have become more tightly coupled in the context of the collaborative agreement and the ESN program. For instance, one of the representatives of the NGOs stated:

“We are involved even before the formal consultation procedure […] a big advantage of the collaborative agreement is that we sit round the table much more often, so we are involved in an earlier stage.”

4.6.2 Salience – credibility: practical relevance versus scientific considerations

The ESN research program provides a setting in which there is room for safeguarding both the scientific adequacy and the relevance of the knowledge it creates. This is exemplified by the expert review of the 5-year research plan, which among other things resulted in a stronger focus on the practical relevance of the program’s results for coastal management practice (Holzhauer, 2010). Therefore, the program has to some extent enabled fruitful combinations of credibility and salience. However, trade-offs between the two have also occurred, notably due to the institutional design and embedment of the program.
The ESN program is geared towards providing salient knowledge for the executive practice of dynamic preservation. This salience has been given shape by making the program a part of the already existing management-oriented knowledge infrastructure of the KPP Coast program. However, the drawback of this institutional design from the perspective of credibility is that the program is subject to the institutional rules and mechanisms of the KPP program. One of these mechanisms is a contracting model under which research projects are put out to tender on a yearly basis. Thus, multi-year research projects are sometimes executed by contractors that vary from year to year; this has also occurred in the case of the ESN program. This yearly contracting model is in tension with the formation of a stable community of researchers and the continuity of long-term research. In this sense, a trade-off exists in the KPP Coast program between achieving a scientifically ideal research practice and embedding the program in a management-oriented knowledge infrastructure. One of the interviewed researchers argued about this issue:

“The way [the research] was contracted out in many different ways, resulting in a lack of a logical continuity of its [...] execution, is definitely a point for improvement”

Another researcher said about the contracting model:

“It takes away the continuity of your project and moreover it completely removes the zest, the cooperation and the mutual goodwill of the researchers.”

Moreover, the management-oriented institutional design of the program has been argued to be in tension with the current state of ecological knowledge, i.e. the many scientific knowledge lacunae concerning the ecology of the foreshore and the beach in relation to sand nourishments. Some of the interviewed researchers argued that fundamental and long-term scientific research is first needed before more applied research can be done. Such research has for instance been argued to include basic research on the ecology of the foreshore and research on the long-term and large-scale effects of sand nourishments. One of them for instance stated:

“[The research] is actually so fundamental because it purely concerns knowledge creation about an almost unknown area; therefore, I wonder whether it should be done in a program like this, or be led in a much broader setting, or placed with NWO.”

NWO is the Netherlands Organisation for Scientific Research; it funds scientific research at public research institutions in the Netherlands.
4.6.3 Legitimacy – credibility: issue diversity versus depth of inquiry

The translation work that molded the concerns of the NGOs into researchable questions has resulted in a focus of the program that to some extent meets the requirements of both legitimacy and credibility. However, there is no full complementarity between these two aspects; rather, the translation work resulted in a compromise that reflects the trade-offs between them. On the one hand, spreading the resources of the program among the various research themes that reflect the concerns of the NGOs has imposed limits to the depth of inquiry. In other words, the democratization of the research programing in order to achieve legitimacy has drawn on the credibility of the research. One of the interviewed researchers for instance argued about this:

“One expects that in such a dynamic area […] the differences are subtle. This means that measurements should have high [statistical] power, which they hadn’t. That is because […] the scientific arguments are not the most important. There are people at the table with different backgrounds and interests.”

On the other hand, the translation work towards researchable questions has also resulted in a research focus that only partly reflects the concerns of the NGOs. Thus, the parties involved were also confronted with a trade-off between researchability and the accommodation of various concerns. Notably concerns about the impacts of sand nourishments on a large-scale systems level were left unaddressed due to perceived limits to their researchability. For instance, an NGO representative argued:

“The most difficult to address […] has been the impact of sand nourishments on the Wadden Sea itself. This had a technical motivation; for a very long time it was maintained that this impact was unmeasurable […] either because of background noise, or because it concerns such a small amount of sand. I have never chosen to fully believe that.”

Finally, the ESN program rests on the implicit assumption that it can achieve a synergy between creating credible and legitimate knowledge by facilitating regular in-depth discussions between researchers and representatives of the NGOs about both the programming and the results of the research. However, this has proven difficult in practice due to different
levels of scientific expertise and the limited time and resources of the NGOs (see also section 4.5.2). One of the interviewed researchers for instance stated:

“What I always miss a bit is a clear input from the NGOs with respect to content. [...] The flaw is that they lack substantive research knowledge. But meanwhile they were the ones to whom account was given. Now and then I thought that was a bit complicated.”

4.7 DISCUSSION AND CONCLUSIONS

It has often been argued that successful environmental management demands fruitful linkages between knowledge creation and action. Research within various domains of environmental management suggests that in order to bring about such linkages, knowledge creation efforts need to balance legitimacy, credibility, and salience. Although trade-offs and synergies between these three attributes have been argued to exist, little research has focused on identifying specific trade-offs or synergies that may emerge. This paper has aimed to contribute to insight into this matter by mapping the efforts to achieve legitimacy, credibility, and salience in the context of a collaborative research program on ecology-oriented coastal defense, and by identifying the trade-offs and synergies that have emerged in the context of this program.

Our findings suggest that the legitimacy and salience of knowledge creation for environmental management, particularly in a governance context with strong interactions between societal and governmental actors, may overlap and be mutually complementary. In the case examined here a synergy has come about between legitimacy and salience as addressing the ecological concerns of NGOs in the ESN research program has provided knowledge for decision-making under the permit regime of the Nature Conservation Act; moreover, addressing these concerns is to contribute to the optimization of the beach nourishment practice with respect to nature conservation. Interestingly, this synergy between legitimacy and salience was in part enabled by reframing the notion of salience. Through the initiatives of the NGOs ecological knowledge has become indispensable for decision-making on the conditions under which beach nourishments may be allowed. A lesson that can be drawn from this is that enabling salience need not merely entail attuning research efforts to the needs of decision-makers; it may also entail redefining what the decision-making is about, how such decisions may be reached, and what knowledge forms or disciplines may be relevant for decision-making. The same point may be
made *mutatis mutandis* for legitimacy and credibility. For instance, efforts to achieve legitimacy may involve a reorientation on who the stakeholders are, and efforts to achieve credibility may involve rethinking the standards that are used to assess the quality of knowledge. Thus, our results suggest that legitimacy, credibility, and salience are not standards that are set in concrete, but rather fluid and negotiable attributes.

Besides this synergy our analysis has identified two main trade-offs that both involve credibility. Firstly, the ESN research program has been confronted with a trade-off between salience and credibility. The research has been executed in a practice-oriented setting that is geared towards short-running applied research projects. This institutional design has been at tension with the demand for creating fundamental knowledge on the ecology of the foreshore in long-term academic research. This trade-off between practical relevance and fundamental knowledge creation involves both the clarity-complexity and push-pull trade-offs that have been identified by Sarkki et al. (2014). In the case examined here, RWS and the NGOs have expressed a demand for clear results that can be translated to management practice, while researchers have argued from a knowledge supply perspective that a more thorough understanding of the ecosystem and the long-term effects of sand nourishments is needed before clear practical conclusions can be drawn. Furthermore, a trade-off in this case has occurred between legitimacy and credibility. Addressing a diversity of concerns has imposed limits to the depth of inquiry; simultaneously, efforts to achieve scientific researchability have come at the cost of addressing some of these concerns. This is a trade-off between issue diversity on the one hand and the depth and quality of scientific inquiry on the other.

The work of Cash et al. (2003) and other authors suggests that the occurrence of trade-offs between legitimacy, credibility, and salience is inevitable. However, how and which trade-offs manifest themselves has been argued to be contingent upon process- and context-related factors. Consequently, a highly relevant question concerns what the factors and conditions are that may be of influence on the manifestation of particular trade-offs and synergies. We will now turn to a brief discussion of such factors and conditions based on a comparison of our results with the findings of Sarkki et al (2014). Based on this discussion, we will formulate recommendations on how various trade-offs may be dealt with.

Firstly, both our findings and those of Sarkki et al. suggest that in a context in which there is a demand for practically relevant knowledge and in which at the same time there are uncertainties or fundamental knowledge lacunae, trade-offs between salience and credibility are bound to exist. Such trade-offs may be dealt with by making an explicit distinction
between the knowledge questions that can be addressed in a practice-oriented research setting, and those that are better addressed in an academic research setting that is relatively independent of the context of application. Secondly, both our findings and those of Sarkki et al. indicate that the personal time trade-off is contingent upon the availability of resources. In our case this trade-off notably played a role for the NGOs due to limited resources in combination with shifting priorities. This trade-off may be dealt with by focusing attention on how to ensure sustained commitment among the various parties involved, for instance through incentives, resources, and the formalization of commitment in collaborative agreements. Moreover, it may be dealt with by focusing attention on how to efficiently and effectively organize the representation of actor groups in the collaborative process, for instance through delegation. Our findings highlight the importance of such commitment-building efforts as they may enable synergies between legitimacy and salience. Thirdly, the speed-quality trade-off as identified by Sarkki et al. did not play a major role in our case. This may be explained by the fact that the ESN program was expressly organized as a research program for the medium range (2009-2015), while in its first years it also addressed urgent knowledge questions related to permit requests that could be answered quickly. Thus, the program was able to both provide timely responses to urgent demands and accommodate longer-running research efforts. This indicates the importance of taking into account the diverging time frames and degrees of urgency of various research efforts in the organization of joint research programs. Finally, as indicated above we have identified a trade-off between issue diversity and the depth of inquiry, which has not been addressed by Sarkki et al. This trade-off is contingent upon the number of actors involved and the diversity of their perspectives and concerns. Dealing with this trade-off may involve clearly delineating who the key actors are, investigating what their concerns of these key actors are, and finding ways of prioritizing those concerns that are shared among various actors.

If we look at this case from a broader perspective, additional conditions may be identified that are likely to have facilitated the emergence of the ESN research program. For instance, the program has emerged in a governance setting that is characterized by a strong tradition of network-building, collaboration, and deliberation between governmental organizations and environmental protection NGOs (Turnhout et al., 2008). Furthermore, the program emerged in a context in which an established management-oriented research infrastructure that links research to coastal management was already in place. Finally, the program emerged in a legal context in which a legal framework was already in place (i.e.
the NCA) that requires scientific assessments of the ecological effects of human interventions in nature. Thus, our findings suggest that broader contextual factors such as governance traditions, research infrastructures, and legal frameworks may be of influence on the emergence of joint research for environmental management.

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05. How Knowledge Enables Governance: The CoProduction of Environmental Governance Capacity

Franke van der Molen [submitted]
Abstract
The creation and mobilization of knowledge are key issues in environmental governance. Consequently, understanding the roles that knowledge may play in governance is crucial for enabling well-informed governance arrangements. An aspect of knowledge-governance interactions that has received relatively little focused attention is that knowledge can be understood to be an intrinsic element of environmental governance. This paper aims to further the theoretical and empirical insight into this aspect. In order to do so, it elaborates a framework that conceptualizes various governance capacities in terms of the coproduction of knowledge, values, and social order. This framework is applied in the analysis of three cases of governance arrangements that notably concern the management of the Dutch Wadden Sea area. My findings suggest that settling disputes about natural resources and working towards a sustainable equilibrium between conserving and utilizing nature may be enabled by means of interactive and flexible governance arrangements that complement centralized governance. Moreover, knowledge may constitute the governance capacities that are needed for reaching such an equilibrium in various ways: as a steering mechanism, as a key to learning, and as a connective element of governance. The findings indicate that enabling well-informed environmental governance is not just a matter of managing the interfaces between knowledge and governance, but also a matter of capacity-building in order to bring about reflexive governance arrangements.

5.1 INTRODUCTION
A key question in many domains of environmental management is how the conservation of the natural environment and the utilization of natural resources can be balanced in a sustainable way. A growing body of literature suggests that governance-oriented forms of environmental management may contribute to realizing such a balance. Environmental governance encompasses forms of collective decision-making and action that are aimed at protecting the environment and resolving conflicts over natural resources; it usually entails the active involvement of both governmental and non-governmental actors (Paavola, 2007; Wallington et al., 2008; Tacconi, 2011; Driessen et al., 2012; Bixler, 2014). The literature has widely acknowledged that the creation and mobilization of knowledge are crucial issues with respect to environmental governance. For instance, environmental governance may involve informing decision-making on environmental change, bringing together a variety of scientific and other knowledges, and dealing with knowledge disputes that may exist between various groups of stakeholders (Burns & Stöhr, 2011; Evans et al., 2011; Armitage et al., 2015; Runhaar et al., 2016). One aspect of knowledge-
governance relations that has notably received attention in the literature is that realizing well-informed environmental governance requires managing the boundaries or interfaces that exist between knowledge and governance (Bremer & Glavovic, 2013a; Clarke et al., 2013; Wesselink et al., 2013). Such boundary management may involve processes of boundary work, such as coordination work and knowledge exchange between experts and policy-makers (Robinson & Wallington, 2012; Jordan, 2014; Wyborn, 2015b). Moreover, it may involve boundary organizations that “play an intermediary role between knowledge production and decision-making (in different domains and levels), with a view to achieving cooperation in relation to a shared objective” (Clarke et al., 2013: 94; see also van Enst et al., 2016). The recent literature usually conceptualizes such boundaries and interfaces as dynamic, interactive, and socially constructed phenomena (Bäckstrand, 2004; Bremer & Glavovic, 2013a; Wesselink et al., 2013; Janssen et al., 2015). In doing so, it implicitly or explicitly dismisses the “linear model” that depicts the relation between knowledge-creation and policy-making as a one-way flow across a static boundary or gap. (Atkinson and Klausen, 2011; Hegger et al., 2012; O’Toole & Coffey, 2013; Wesselink et al., 2013; Wyborn, 2015b).

What has received less attention is that knowledge, besides something that needs to be connected with or brought into governance, can also be seen as an intrinsic element of governance. This paper aims to further the theoretical and empirical insight into this aspect. Here, the term “intrinsic” signifies that performing environmental governance always involves knowledge in one way or another. In this paper I will operationalize this idea by means of a conceptual framework that combines the notion of governance as something that is constituted by a set of capacities (e.g., Termeer et al., 2013; Wyborn, 2015a) with the notion of the coproduction of knowledge and social order (Jasanoff, 2004).

The rationale behind this framework is twofold. Firstly, the framework distinguishes three key aspects of collaborative environmental governance. The first aspect is that environmental governance is a form of regulation that aims at reaching particular outcomes regarding the management or conservation of the environment (Lemos & Agrawal, 2006). The second aspect is that environmental governance often needs to deal with complex and dynamic processes in natural systems and with uncertainty on the effects of human interventions. Consequently, it has been argued that environmental governance arrangements need to be adaptive in order to be effective (Folke et al., 2005). The third aspect is that environmental governance usually includes a variety of governmental and non-governmental actors with diverging interests and perspectives. In order
to enable collaborative action such interests and perspectives need to be bridged or integrated (Raymond et al., 2010; Bohensky & Maru, 2011). From these three aspects may be inferred that performing environmental governance requires the capacities to regulate, adapt, and integrate. The next section provides a further operationalization of these three capacities on the basis of the environmental governance literature. Secondly, each of these capacities has an epistemic, a normative, and a social component. Thus, building and putting into action these capacities can be understood to be processes in which knowledge, values, and social order are coproduced (Jasanoff, 2004). I will use this framework to analyze how governance capacities were built and put into operation in three cases of coastal governance in the Netherlands. This analysis is notably focused toward identifying the roles of knowledge in relation to these capacities. This in turn may provide insight into the ways in which knowledge can be mobilized for building environmental governance capacity.

Section 5.2 provides an elaboration of the conceptual framework of co-production and governance capacities. Subsequently, section 5.3 describes the materials and methods and briefly introduces the three cases. Section 5.4 provides the empirical results; it focuses on how governance capacities were built and put into action in the cases and it identifies cross-case patterns. Finally, section 5.5 provides a discussion and conclusion.

5.2 CONCEPTUAL FRAMEWORK

5.2.1 Coproduction

The term coproduction, as applied in the environmental governance literature, has two distinct meanings. Firstly, it is oftentimes used to denote a type of interactive process in which experts, policy-makers, and stakeholders are involved in the production, exchange, and application of knowledge (Berkes, 2009; Armitage et al., 2011; Edelenbos et al., 2011; Taylor & De Loë, 2012; Clarke et al., 2013). A second denotation of the concept concerns the ways in which knowledge and social order are created together. In this second sense “co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it” (Jasanoff, 2004: 2). From this perspective “knowledge and its material embodiments are at once products of social work and constitutive of social life; society cannot function without knowledge any more than knowledge can exist without appropriate social supports” (Jasanoff, 2004: 2-3). Thus, in this sense knowledge and social order are constructed together in social
practices and have a mutually constitutive relation. In recent environmental governance scholarship this second form of coproduction has been applied as an analytical framework, for instance in examining the interplay between knowledge and power dynamics in governance arrangements (Muñoz-Erickson, 2014). Moreover, it has been applied to conceptualize adaptive governance in terms of the “coproductive capacities” that “enable groups of actors to connect knowledge with action” in a governance context (Wyborn, 2015a). The latter application entails conceptualizing governance as a process of coproduction that involves the simultaneous employment of material, cognitive, social, and normative capacities (Wyborn, 2015a). The merit of this way of theorizing is that it conceptualizes knowledge as inherent to governance, thus lending insight into the roles of knowledge as a constitutive element of governance. However, it draws strong analytical divisions between knowledge, values, and social aspects by defining them in terms of distinct capacities (e.g., cognitive capacity, normative capacity, social capacity). The analytical framework I elaborate and apply in this paper provides a stronger analytical sensitivity to the intertwinements of knowledge, values, and social order, as it conceptualizes particular governance capacities as being constituted by the interplay of epistemic, normative, and social elements. The next section will provide a further operationalization of this conceptual framework based on the environmental governance literature. Table 5.1 summarizes the next section by providing a structured overview of the epistemic, normative, and social elements of the three governance capacities. These elements are not so neatly separated as this table may suggest; they are interrelated, imply each other, and may overlap.

5.2.2 Governance capacities

5.2.2.1 Regulatory capacity

Environmental governance involves organizing and steering collective action in order to deal with environmental problems and conflicts (Paavola, 2007; Tacconi, 2011; Driessen et al., 2012). Thus, performing environmental governance requires regulatory capacity, which I define as the capacity to steer collective action with respect to the environment in desired directions. This involves the formulation and pursuance of normative goals or visions, such as objectives laid down in environmental regulations or policies, or normative visions that have been formulated in the context of collaborative practices (Wyborn, 2015a). Moreover, it may

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85 The term collective action in this paper refers to forms of human action with respect to the environment, such as the utilization and conservation of resources, in which multiple actors or collectives are involved.

86 This paper uses the term “regulatory” in a relatively broad social-scientific sense. It not only denotes legal forms of regulation but also other ways in which human action may be steered, organized, or directed.
Table 5.1: Conceptual framework

In this paper, I focus on governance arrangements as the locus in which governance capacities are built and put into action. Governance arrangements are temporary assemblages that combine the employment of coalition-building, power, discourses and rules in order to govern collective action (Arts et al., 2006). Of these four aspects, power and rules are the most closely and observably related to regulatory capacity. Power is both “the ability of actors to mobilise resources in order to achieve certain outcomes in social relations” and a “dispositional and a structural phenomenon of social and political systems” (Arts & Van Tatenhove, 2004: 343). Rules
may for instance include national and international legislations and rules that are laid down in collaborative agreements such as covenants.

Governance arrangements may encompass various ways in which knowledge and governance are interconnected. For instance, the ability to govern presupposes a “knowledge base” that informs decision-making; such a knowledge base for instance includes data, models, and practical experiences (Janssen et al., 2015: 313). However, governance arrangements may also encompass more intricate ways in which knowing and governing are interconnected. Power and knowledge for instance have been argued to constitute and imply each other; the exercise of power in a governance context necessarily involves knowing, just as much as producing knowledge for governance cannot be seen as independent of power relations (Van Assche et al., 2011; Winkel, 2012). Furthermore, rules laid down in environmental regulations and policies can structure the ways in which environmental issues are made knowable and measurable (Turnhout et al., 2014; Floor et al., 2016).

The social organization of governance arrangements may come in various forms; I highlight this variation in terms of different “modes of governance” (Driessen et al., 2012). Modes of governance are particular ways in which governance arrangements are structured; they include **centralized governance** in which national governments “take the lead”, **decentralized governance** in which regional or local governments are in the lead, **interactive governance** in which governments and societal actors “collaborate on equal terms”, and **self-governance** in which societal actors “enjoy far-reaching autonomy” (Driessen et al., 2012: 145, 148). Because these different modes of governance involve different divisions of competences and power among actors, they represent different ways in which collective action is organized and regulated. In this sense, they can be interpreted as different ways of organizing and tapping into regulatory capacity.

### 5.2.2.2 ADAPTIVE CAPACITY

The governance of complex social-ecological systems entails dealing with issues of environmental change, uncertainty, and unforeseen consequences of human interventions in nature (Folke et al., 2005). This requires environmental governance arrangements to be adaptive. Adaptive governance involves the capacity to “understand environmental change”, “use this understanding to inform decision making”, and “act on decisions in a manner that sustains resilience of desirable system states” (Evans et al., 2011: 21). Moreover, it involves the capacity to “review and adapt decisions as new information becomes available” (Cvitanovic et al., 2015:
Consequently, gathering knowledge through monitoring and learning from both ecosystem change and the effects of management interventions in natural systems are conceived to be key epistemic aspects of adaptive governing (Termeer et al., 2010; Weiss et al., 2012). On a normative level, adaptive governance requires the willingness to adapt or revise decisions in the light of changing circumstances.

In the adaptive governance literature, two key forms of learning are discerned. Firstly, due to its collaborative and participatory character, adaptive governance entails learning as a multi-actor process; this type of learning is also referred to as “social learning” (Pahl-Wostl et al., 2007; Rijke et al., 2012). The term social learning is used to denote changes in understanding that occur through social interactions and that become situated in social settings or practices (Reed et al., 2010). Secondly, in order to enable the adaptive capacity of governance arrangements, learning is to take place by means of feedback loops between natural systems and adaptive governance arrangements (Berkes, 2010; Evans et al., 2011; Giebels et al., 2013; Wilson et al., 2013). These forms of learning may be enhanced by means of flexible governance arrangements and iterative governance processes (Clarvis & Engle, 2015). Consequently, knowledge creation, learning, openness to change, and flexible and adaptive social processes together constitute adaptive governance capacity.

5.2.2.3 INTEGRATIVE CAPACITY

In this paper, the term integrative capacity signifies the capacity to gain insight in diverging knowledges and normative perspectives and to bridge or integrate these for the sake of collaborative action with respect to the environment. Such capacity is required as environmental governance is usually a process in which different knowledgeable actors with different backgrounds, interests, and ideas are (expected to be) involved. Such knowledgeable actors may include citizens, scientists, NGOs, companies, and policy-makers (Birkenholtz, 2008; Edelenbos et al., 2011; Mauelshagen et al., 2014). Consequently, in environmental governance different knowledges and values meet and are confronted with each other.

A variety of concepts to distinguish between such differing knowledges can be found in the literature. Firstly, various conceptual distinctions have been applied in order to highlight the different forms or types of knowledge that may be relevant for environmental governance. For example, distinctions between scientific or expert knowledge and other forms of knowledge have often been highlighted (Birkenholtz, 2008; Berkes, 2009; Crona & Parker, 2012; Taylor & De Loë, 2012). Such “other” forms of
knowledge include local and indigenous knowledge; these terms usually signify forms of knowledge that resource-users have accumulated through close and long-standing interactions with the local environment (Ellis, 2005; Crona & Bodin, 2010; Taylor & De Loë, 2012; Bowie, 2013; Linke & Bruckmeier, 2015). Secondly, various concepts have been used to give expression to the idea that different or conflicting knowledges are embedded in different social and normative configurations. One of these concepts is the “knowledge system”, which signifies a social system encompassing knowledge claims, groups of actors, and ways of creating and exchanging knowledge; these elements together constitute a particular worldview or perspective on reality (Evans, 2010; O’Toole & Coffey, 2013). From this conceptual point of view, one of the key challenges of governance is to find fruitful linkages between conflicting knowledge systems, such as those of resource users and conservationists (King, 2004; Robinson & Wallington, 2012). A related line of environmental governance research focuses on the different “ways of knowing” of different coalitions of actors who are involved in governance (Janssen et al., 2015). Different ways of knowing “give rise to different understandings of precisely which factual knowledge is valid and relevant; they feed different world views, problem perceptions, and values” (Van Buuren, 2009: 209).

The literature that highlights different knowledges in the context of environmental governance suggests a number of ways in which the integrative capacity of governance arrangements may be built and put into action. Firstly, this may involve the integration or inclusion of various knowledges in governance, for instance by organizing joint knowledge creation processes in which various actors such as researchers, policy-makers, and stakeholders “cooperate in the exchange, production and application of knowledge” (Hegger et al., 2012: 53). Secondly, this may involve explicating and reflecting on often implicit “normative frames of reference” that actors with various backgrounds have (Van Buuren, 2009: 215). Thirdly, it may involve the identification and awareness of “the different epistemological beliefs which underpin knowledge claims”, such as beliefs concerning “the validity and reliability of different knowledge claims” (Raymond et al., 2010: 1775).

5.3 METHODS AND MATERIALS

5.3.1 Methodology

This paper is empirically informed by three case studies of coastal governance in the Netherlands. All three cases are related to the governance
of the Dutch Wadden Sea area. This area is part of a UNESCO world heritage site that covers parts of the coasts of the Netherlands, Germany, and Denmark. It includes intertidal zones, salt marshes, and barrier islands. Moreover, it is deemed highly valuable from both ecological and social-economic points of view. The central focus of the case studies was to understand the roles of knowledge in the emergence and functioning of environmental governance arrangements. The data collection was performed by means of 69 semi-structured interviews and 4 focus groups with key actors. Furthermore, relevant documents such as policy documents, meeting reports, and research reports were analyzed to provide additional data and validate the results of the interviews and focus groups. The cases were analyzed separately with software for qualitative data analysis (NVivo 10), using an inductive coding strategy with setting-specific codes that were constructed on the basis of the issues brought up by the respondents (Lofland et al., 2006). The detailed methods, results, and analyses of the three case studies are provided separately (see chapters 2-4). Subsequently, the three cases were analyzed together using the conceptual framework that has been described in section 5.2.

5.3.2 Introduction to the cases

5.3.2.1 THE TRANSITION OF THE MUSSEL FISHERY

The mussel fishery in the Dutch Wadden Sea was the object of a long-standing and often heated conflict between the mussel sector, the Dutch government, and a coalition of environmental protection NGOs. This conflict, which went through some of its most intense phases between 1990 and 2008, revolved around the question whether the mussel fishery could be reconciled with nature conservation and if so under what conditions. A series of legal cases instituted by the NGOs between 2004 and 2008 forced the mussel sector to switch to fishing methods with a lower ecological impact. As a result, a governance arrangement was started in 2008 in which the mussel sector, the NGOs, and the government participate. This arrangement combines a nature restoration program for the Dutch Wadden Sea with a stepwise transition towards mussel fishing methods that do not harm the seabed.

5.3.2.2 RECREATIONAL BOATING ON THE WADDEn SEA

The rise of recreational boating on the Wadden Sea in recent decades has caused concerns among nature conservationists and policy-makers about
its impact on bird and seal populations. In order to control this impact, several governance arrangements have been implemented since the 1980s. These arrangements include centralized legal regulations, collaborative agreements between governmental and societal organizations, and self-regulatory initiatives. The implementation of regulations has spurred conflicts between recreational boating organizations, environmental NGOs, and the government concerning both the effectiveness and necessity of nature conservation measures. In recent years, ongoing deliberations and governance renewal have reduced the level of conflict between these parties.

5.3.2.3 SAND NOURISHMENT

In 1990, the Dutch government implemented the coastal protection strategy of “dynamic preservation”, which focuses on countering coastal erosion by means of sand nourishment. The latter entails collecting sand from deeper parts of the North Sea and depositing it close to the shoreline or on the beach. Sand nourishment is thought to be an effective way of countering erosion that utilizes the natural dynamics of sand and water and that also facilitates adapting to sea-level rise. Dynamic preservation is a form of adaptive management that involves the ongoing monitoring of coastal erosion and responding to this erosion in a periodically updated sand nourishment program. Environmental protection NGOs have criticized this sand nourishment program because they argued that it was unregulated and did not take the ecological effects of sand nourishments into account. After several legal actions the Dutch Government and the NGOs started a collaborative governance arrangement. A key element of this arrangement is a research program on the ecological effects of sand nourishments. This program is to provide knowledge on how to optimize sand nourishments with respect to nature conservation.

5.4 RESULTS

5.4.1 Building regulatory capacity

5.4.1.1 THE MUSSEL FISHERY

Until 2008 the conflict on the Wadden Sea mussel fishery was fought out in legal proceedings, in which a coalition of NGOs challenged the fishing permits that the Dutch state had granted to the mussel sector. The playing field of this conflict shifted between 2004 and 2008 when, due to
legislative changes and several court rulings, the mussel sector became obliged to provide impact assessments that proved that their fishery did not significantly interfere with legal nature conservation objectives; these impact assessments were subsequently disputed by the NGOs. In 2008 the mussel fishing permit was nullified by the Dutch Council of State because such proof of no effect could not be provided. This created the leverage to start a governance arrangement that encompasses a transition process towards fishing methods with a lower ecological impact. A key epistemic element of the transition process is a monitoring and research program that provides knowledge concerning the status of the mussel stock and the results of the transition efforts. Thus, in this case a shift occurred from systematically challenging environmental impact assessments as a means of wielding power that was deployed by the NGOs involved, to joint knowledge creation as an enabling force for collaborative governance.

Besides a shifting role of knowledge in governance, these events reflect a shift of the normative orientation concerning the use of natural resources in the Wadden Sea area. The shifting regulations and jurisprudence show that nature conservation objectives have gradually gained primacy over resource use. Mussel fisheries and other forms of resource use have become forms of “human co-use” of nature that are only possible within the limits that are set by nature conservation objectives, notably those that have been laid down under the regulatory framework of Natura 2000.

Furthermore, these events reflect a shifting social order as the mode of governance shifted. Before 2008, the conflict focused on the question whether the centralized permit regime and the fishing permits it produced were legitimate; this conflict was fought out by means of the legal rules of the game. The shifting legislation and jurisprudence empowered the NGOs to introduce their nature restoration agenda in the fishery management. Moreover, it created a situation in which the NGOs, the mussel sector, and the government were enabled to collaborate on relatively equal terms, according to mutually agreed upon and negotiated rules, towards the shared objective of sustainable fishery. Consequently, a strongly interactive form of governance was introduced as a complement to the centralized permit regime.

5.4.1.2 RECREATIONAL BOATING

In recent decades, the governance of recreational boating on the Wadden Sea has been aimed at finding a balance between two key normative objectives: conserving nature by means of preventing the disturbance of birds and seals, and promoting the freedom to enjoy and experience nature in
a responsible manner. The efforts to find this balance have resulted in a gradual shift of governance towards decentralized, interactive, and self-governance. This shift has entailed a decreasing prominence of centralized command-and-control regulation, a rising prominence of societal organizations in governing, and the empowerment of individual sailors by means of self-regulation. Moreover, it has entailed a shift from legal rules to the application of voluntary and less formal rules, such as covenants and codes of conduct. There are two key motivations for this shift of governance. Firstly, nature conservation and recreational boating organizations have initiated various self-governance initiatives as alternatives for, and out of dissatisfaction with, rigid state-led regulation. Secondly, this shift has been motivated by the idea that sharing knowledge and building awareness among sailors on how to prevent disturbances is an effective way of protecting wildlife. Consequently, knowledge has increasingly been used as a regulatory instrument for nature conservation.

5.4.1.3 SAND NOURISHMENT

Initially, coastal protection by means of sand nourishments was focused on the normative objectives of countering coastal erosion and safeguarding long-term coastal safety. This sand nourishment practice was challenged by a coalition of environmental protection NGOs. Firstly, they criticized the unregulated character of this practice, as the Dutch government did not request permits under the Nature Conservation Act (NCA) for the execution of sand nourishments. Secondly, they argued that more knowledge was needed on the ecological effects of sand nourishments in order to attune coastal protection to nature conservation. Consequently, they took various formal actions to incite Rijkswaterstaat87 (RWS) to request permits for sand nourishments under the NCA, as this would impose a formal decision-making and consultation procedure on sand nourishments. Moreover, this would impose the requirement to create and apply knowledge concerning the ecological effects of sand nourishments, as the NCA prescribes that a scientific assessment of such effects is to be part of the decision-making. After sustained pressure from the NGOs, the RWS started applying for permits under the NCA. Furthermore, RWS and the NGOs signed a covenant in which they agreed to exercise restraint in taking any further legal actions, and to participate in a collaborative research program on the ecological effects of sand nourishments. This program aims at providing knowledge for the optimization of sand nourishments with respect to nature conservation.

87 Rijkswaterstaat is the executive department of the Dutch Ministry of Infrastructure and the Environment.
The initiatives of the nature conservation NGOs resulted in the emergence of an interactive form of governance in which they collaborate with the government. Furthermore, a combination of legal rules (the permit regime) and negotiated rules (the covenant) was applied in order to steer the practice of sand nourishments towards the objectives of nature conservation.

5.4.1.4 CROSS-CASE PATTERNS

In all three cases governance arrangements have emerged that are aimed at attuning human interventions in nature, such as fisheries and coastal protection, to nature conservation. The normative “driving force” behind this attunement appears to be twofold. Firstly, the cases indicate that knowing, appreciating, conserving, and restoring nature have gradually gained prominence in thinking about how human activities and interventions in coastal nature should be governed. Secondly, the cases show an emerging focus on balancing the utilization and conservation of nature in such a way that the level of conflict between these two objectives, and between the actor coalitions who promote these objectives, is kept as low as possible. In other words, these governance arrangements are normatively oriented towards harmonizing the intervention in and protection of coastal nature.

The regulatory capacity aimed at realizing such harmonization was built by combining these normative objectives with interactive forms of governance and the deployment of knowledge as a steering mechanism. This shift towards interactive governance is a shift of social order that has encompassed empowering stakeholders, starting collaborations between societal and governmental actors on relatively equal terms, governing according to negotiated and mutually agreed-upon rules of the game, and refraining from taking legal action in dealing with conflicts. Furthermore, knowledge has been deployed as a steering mechanism in several ways. These include using the legal requirements regarding environmental impact assessments as a means of wielding power, applying joint research and monitoring as a means of steering human interventions towards the aims of nature conservation, and using the dissemination of knowledge and the building of awareness as means of promoting ecologically responsible behavior.
5.4.2 Building adaptive capacity

5.4.2.1 The Mussel Fishery

The normative objective of the mussel transition is to replace traditional “seabed disturbing” mussel fishing methods with methods that collect mussel spat in the water column, thus inflicting no damage to the ecology of the seabed. The guiding principle of the transition process is “learning by doing”, which means that the transition process has a step-by-step, iterative process design in which learning from experiment and experience is a key element. The new collection method is scaled up stepwise; once a new transition step has yielded enough mussels a part of the fishery according to the old method is abandoned. The latter involves both lowering the quota for the traditional fishery and closing off areas in which wild mussel beds are likely to settle. Thus, the transition is an adaptive process in the sense that its speed is contingent upon both natural variability (the natural process of mussel spat fall) and innovation success (the amount of spat that the new technology manages to collect). In order to enable this adaptive process, a monitoring program is executed that provides knowledge on the mussel stock in the Wadden Sea, the yield of mussels produced by the new collection technology, and the development of mussel beds in the areas that have been closed off for nature restoration. Moreover, experimentation with new spat collection and mussel cultivation methods has been promoted as a means of enabling the transition towards sustainable mussel fishery. In sum, learning, adaptive management, and iterative and flexible forms of social organization have been combined in order to achieve the normative objective of a more sustainable mussel fishery.

5.4.2.2 Recreational Boating

The governance of recreational boating has evolved in the last three decades due to an ongoing accumulation, renewal, and replacement of governance arrangements. A key driving force behind this change process has been the will, notably among stakeholders, to make governance more flexible, adaptive, and participatory. There is a strong normative orientation towards adapting to natural variability among various groups of actors involved because adaptive management is thought to improve both the effectiveness of nature conservation and the possibilities of recreating on the Wadden Sea. Adaptive management for instance allows for attuning conservation measures to the ongoing moving around of birds and seals.
in the area; simultaneously, it allows for throwing open specific areas at
times when there is no wildlife present, thus creating space for recreation.

This ongoing renewal of governance towards increased adaptivity has
been enabled by means of temporary and flexible governance arrange-
ments in at least two ways. Firstly, the application of various temporary
arrangements, such as covenants with a fixed duration of e.g. four years,
has spurred governance renewal and learning as it has incited participants
to evaluate, identify improvements, and reformulate the rules of the game.
Secondly, this renewal of governance has been enabled by pilots and ex-
periments, such as pilots in which forms of self-regulation and adaptive
management were tested in collaboration between sailors and government
officials.

5.4.2.3 SAND NOURISHMENT

Dynamic preservation is an adaptive form of coastal engineering that re-
quires ongoing feedback between monitoring erosion and programming and
executing sand nourishments. The research program on ecology-oriented
sand nourishment is embedded in the research and monitoring infra-
structure that is to provide knowledge for the adaptive execution of sand
nourishments. In this sense, it is one of the elements of a larger adaptive
management practice. The program is aimed at learning about how adap-
tive coastal management by means of sand nourishments can be improved
with respect to nature conservation. The participants in the program
have given shape to this learning process by setting up and performing
experimental “green sand nourishments” at the island of Ameland. This
experiment encompassed designing and executing ecology-oriented sand
nourishments, and monitoring their ecological effects for several years.
Therefore, like the mussel transition this program has applied a learning-
by-doing approach. Moreover, the research has been set up as a learning
process by adaptively programming and focusing research activities on the
basis of progressing insight and ongoing deliberations between the NGOs,
researchers, and civil servants involved.

5.4.2.4 CROSS-CASE PATTERNS

The three cases suggest that adaptive capacity is a crucial aspect of gov-
ernance for various reasons. The literature has often argued that adap-
tive capacity is needed in order to effectively respond to uncertain cir-
umstances that are caused by natural variability; our cases confirm this.
Furthermore, our cases suggest that adaptive capacity facilitates working
towards a shared normative objective, such as sustainable fisheries, under conditions that make it unclear how exactly that objective may be reached. Finally, adaptive capacity enables the improvement of governance in the long run by means of observing the effects of governance and if necessary altering the mode of governing.

In these cases, adaptive capacity was built by deploying knowledge creation for learning in several ways. Firstly, observing change by means of monitoring is has been a precondition for learning. Secondly, experimenting, for instance in the form of pilots or learning-by-doing approaches, has enabled both adaptation and the improvement of governance. Thirdly, organizing feed-back loops between governance and knowledge creation has facilitated learning and adapting in several ways. In these cases such feed-back loops were created by applying flexible and iterative process designs, and by working in temporary governance arrangements that were followed by evaluations.

5.4.3 Building integrative capacity

5.4.3.1 THE MUSSEL FISHERY

The mussel sector and the environmental protection NGOs have conflicting normative and epistemic perspectives on the mussel fishery and its relation to nature. Whereas the mussel sector sees the traditional seabed-based mussel fishery and cultivation as a sustainable form of resource use that bears resemblance to organic farming or agricultural nature management, the NGOs see traditional mussel fishery as an obstacle for the recovery of the Wadden Sea ecosystem towards a richer and more pristine state. Thus, although sustainable mussel fishery is a shared normative objective of the mussel transition, the participants have diverging perspectives on what sustainability actually entails. Moreover, these parties have conflicting perceptions of risks, for instance concerning the introduction of invasive exotic species in the Wadden Sea as a result of shellfish transport. These conflicting perspectives have resulted in many knowledge disputes, for instance on scientific reports and impact assessments concerning the ecological impact of the mussel fishery.

In this case, frequent interactions and deliberations between the participants were organized in order to find common ground between their clashing perspectives. These have included organizing joint fact-finding processes and executing a joint research and monitoring program in order to create shared knowledge. These processes have been focused on creating facts that are deemed relevant and reliable by representatives of both
the mussel sector and the NGOs. Moreover, the involvement of trusted experts and independent process facilitators has supported these processes. Finally, knowledge reviews by independent experts have been applied to deal with conflicting interpretations of knowledge, for instance concerning ecological impacts of the mussel fishery.

5.4.3.2 RECREATIONAL BOATING

Efforts at attaining the two objectives of conserving nature and enabling the freedom of recreationists on the Wadden Sea have led to conflicts between governmental agencies, environmental protection NGOs, and recreational boating CSOs. These conflicts have revolved around diverging interpretations as to the gravity of wildlife disturbances and the necessity of particular conservation measures. The latter notably include the temporary or permanent closing off of parts of the Wadden Sea to recreational boating. Since the mid-2000s, a gradual shift has occurred from relatively polarized positions on these matters to a shared normative perspective between the parties involved. The gist of this shared perspective is that experiencing and protecting the Wadden Sea can go together well.

The emergence of this shared perspective has been enabled by a combination of factors. Firstly, sustained participation and deliberation in several collaborative governance arrangements has resulted in network-building and rapprochement between the various groups of actors involved. This rapprochement notably came about between environmental protection and recreational boating organizations, who for instance became aware of their shared dissatisfaction with rigid centralized regulations by collaborating in a covenant. Secondly, various initiatives of joint knowledge creation and knowledge exchange have contributed to this shared perspective. These initiatives include collaborative monitoring practices in which government officials, conservationists and recreationists have participated. Thirdly, conflicts on the gravity of wildlife disturbances and the necessity of conservation measures have gradually lost priority because pragmatic and adaptive ways of preventing disturbances have been implemented that meet the demands of both recreationists and conservationists. These include a voluntary code of conduct for sailors and adaptively closing off and throwing open protected areas.

5.4.3.3 SAND NOURISHMENT

Like the other two cases, the conflict on sand nourishment between RWS and the coalition of environmental protection NGOs involved a clash of
two perspectives. The dominant policy perspective on coastal protection by means of sand nourishment focused on coastal safety and morphology. The NGOs propagated an alternative perspective on sand nourishments, which focused on the ecological aspects of coastal protection. These perspectives were brought together in two ways. Firstly, after sustained legal pressure by the NGOs RWS started requesting permits under the NCA in 2008. Consequently, ecological impact assessments became a formal part of the decision-making on sand nourishments. Secondly, the collaborative research program on ecology-oriented sand nourishment introduced ecological aspects in the knowledge development on sand nourishments. In this research program, the ecological concerns of the NGOs were translated into research questions. In order to ensure that the ongoing research matched these concerns, an interactive research process has been followed with iterated feedback and deliberation between the NGOs, civil servants and researchers.

5.4.3.4 CROSS-CASE PATTERNS

In all three cases, governing nature has involved dealing with the conflicting normative and epistemic perspectives of various groups of actors involved. Moreover, in all three cases integrative capacity has been built by re-arranging social order through setting up governance arrangements that provide for the sustained and iterated collaboration and deliberation between various groups of stakeholders. Within these arrangements knowledge has served as a connective element in several ways. Firstly, joint knowledge creation processes have been deployed in order to produce knowledge that is deemed relevant from the different perspectives involved. Secondly, knowledge exchange between stakeholders has facilitated finding common ground between diverging perspectives. Thirdly, the involvement of independent experts has contributed to dealing with conflicting perspectives, for instance by providing independent reviews of the available knowledge.

5.5 DISCUSSION AND CONCLUSION

Like environmental governance initiatives in many places around the world, the governance arrangements analyzed in this paper have sought to attune various human interventions in nature to the conservation and restoration of nature. These arrangements have aimed to reach this objective by means of settling conflicts between governments, resource users,
and conservationists, and by means of working towards objectives that meet the various concerns of these groups of actors.

This paper has argued that settling such conflicts and working towards sustainable human-environment relations is a multifaceted process that encompasses various forms of capacity building. Firstly, our analysis suggests that the regulatory capacity towards such aims may be built by engaging in interactive governance, which involves the active involvement and empowerment of societal stakeholders and negotiating and implementing mutually agreed-upon rules. Moreover, it suggests that such interactive governance processes do not replace but rather complement more hierarchical, centralized forms of governance such as governance arrangements that are connected to nature conservation legislations. Secondly, our analysis highlights various ways in which adaptive capacity may enable the sustainable governance of nature. For instance, adaptive capacity may enable responsive forms of governance that are able to adapt to dynamic natural systems, and may facilitate working towards shared objectives under conditions of uncertainty and lacking knowledge. Moreover, adaptive capacity may enable the long-term improvement of governance through the ongoing evaluation and renewal of temporary governance arrangements. Thirdly, the three cases show that integrative capacity may be built by means of governance arrangements that provide for the sustained and iterated collaboration and deliberation between various groups of stakeholders. My findings suggest that building integrative capacity requires both the reflection on diverging epistemic and normative perspectives among interested actors and a shared desire among these actors to somehow bridge or integrate their perspectives. Such bridging and integration may be facilitated by interactive knowledge processes such as knowledge exchange and joint knowledge creation. From this analysis may be concluded that settling disputes about natural resources and working towards a sustainable equilibrium between conserving and utilizing nature can be enabled by means of interactive and flexible governance arrangements that complement centralized governance and that provide spaces for joint knowledge creation and knowledge exchange. However, sustaining such arrangements may be challenging because it requires the long-term, intensive, and often voluntary involvement of various groups of actors with diverging interests.

The relations between environmental knowledge and various forms of environmental politics and action, such as management, policy-making, and governance, have received ample scholarly attention in recent decades. A prominent tradition within this scholarship conceptualizes these relations in terms of the boundaries and interfaces between environmen-
tional knowledge and governance. From this perspective, realizing well-informed governance requires the successful organization and management of interfaces between for instance experts and decision-makers or scientific and political institutions. However, there is more to knowledge-governance relations than the organization and management of interfaces. This paper has aimed to elaborate an additional perspective that provides an analytical sensitivity to aspects of knowledge-governance interrelations that have received less attention in the literature. The rationale of this perspective is that knowledge can be understood to be an intrinsic part of governance; moreover, knowledge can be understood to be a constitutive element of the various capacities that are needed in order to govern sustainable human-environment interactions.

The results indicate that this additional perspective on knowledge-governance interactions has several merits. Firstly, it incites us to rethink the very notion of environmental governance. The literature often emphasizes that governance is a collaborative process of policy-making and regulation in which both governmental and non-governmental actors are involved. However, this paper suggests that it is also an essentially epistemic process. This means that environmental governance encompasses various forms of knowledge, various ways of knowing, and various knowledge-related dynamics and processes. Secondly, it helps to identify particular ways in which knowledge constitutes environmental governance capacities. My findings suggest that knowledge may serve as a steering mechanism for governance, for instance by using environmental impact assessments as a tool for improving the ecological soundness of human interventions in nature, or by using the building of knowledgeability and awareness as nature conservation instruments. Furthermore, well-informed environmental governance is constituted by learning, which may involve experimenting, learning by doing, and using temporary governance arrangements to enable governance renewal. Finally, knowledge may serve as a connective element of environmental governance. In the cases analyzed here, notably joint knowledge creation, knowledge exchange, and the involvement of experts have enabled collaborations between actors with different normative perspectives on how to utilize and conserve nature.

The framework of governance capacities that this paper has employed is an operationalization and application of the notion of the coproduction of knowledge and social order (Jasanoff 2004). Jasanoff has argued that coproduction is not a “fully fledged theory, claiming lawlike consistency and predictive power”, but rather “a way of interpreting and accounting for complex phenomena” (Jasanoff 2004: 3). Likewise, the framework of the epistemic, normative, and social aspects of governance capacities is not
a model with lawlike consistency or predictive power but rather a way of reasoning about the makings and workings of environmental governance. My findings suggest that this framework is useful for identifying the heterogeneous elements of knowledge, values, and social order that together constitute governance capacities. This paper has distinguished between regulatory, adaptive, and integrative capacities. This triad of governance capacities is notably applicable to environmental governance arrangements that face the challenges of dealing with dynamic and complex natural systems and dealing with a diversity of interested actors with diverging perspectives. Such challenges may occur in a variety of environmental governance domains, but need not always be as expressly present as in the cases I have studied. Consequently, not all three capacities are necessarily needed in all environmental governance arrangements; moreover, the framework may be expanded with other governance capacities that did not play prominent roles in the cases studied here. Still, such additional capacities may be argued to be constituted by epistemic, normative, and social elements.

A practical consequence of the way of reasoning I have elaborated in this paper is that building well-informed environmental governance arrangements is not just a matter of managing the interfaces between knowledge and governance; it is also a matter of capacity-building in order to enable the reflexivity of governance arrangements. Here, reflexivity has a twofold meaning. Firstly, it signifies the capacity to identify diverging normative and epistemic perspectives and to connect these perspectives to collaborative action with respect to the environment. Secondly, it signifies the capacity to gain insight into complex and dynamic natural systems and to respond to changes in an adaptive manner. My findings suggest that governance arrangements that combine these two forms of reflexivity may be enabled by a combination of negotiated rules, joint knowledge creation and knowledge exchange, adaptive and experimental governance, and interactions and deliberations between interested stakeholders.
06. Conclusions and Reflection
6.1 The interplay between environmental knowledge and governance

This thesis has investigated the diverse interrelations between environmental knowledge and governance that occur in the context of collaborative governance arrangements. The objective of this investigation has been to identify ways to enable well-informed environmental governance arrangements. The latter signifies arrangements that are able to produce, mobilize, and draw upon the knowledge that is needed for governing human-environment interactions in a sustainable way. This section provides the main conclusions on knowledge-governance interactions that can be drawn from my research. Section 6.2 builds on these conclusions in formulating recommendations on how well-informed governance arrangements may be enabled. Subsequently, section 6.3 reflects on the concepts and theoretical frameworks that have been used in this thesis, after which section 6.4 provides a closing reflection on the generalizability of my findings and directions for future research.

6.1.1 Governance as dealing with conflicts

In all three domains of governance that have been studied in the preceding chapters, governance arrangements have emerged as a way of dealing with conflicts between governmental agencies, environmental protection NGOs, economic sectors, and civil society organizations. These conflicts have concerned different issues and have in part been characterized by different dynamics, but they also show clear resemblances. One common aspect is that they emerged between actors with different normative perspectives on whether particular human interventions in nature are acceptable, and if so, under what forms of regulation and under what conditions with respect to nature conservation.

A second key aspect of the conflicts I have studied is that knowledge has played a prominent role in them in various ways. For one thing, my findings suggest that it can be difficult to mobilize scientific knowledge for environmental governance in situations of conflict. The case of the mussel fishery illustrates that such difficulties may emerge when various actor coalitions with disparate knowledge systems are involved who have conflicting interpretations of the relevance and quality of the knowledge that is available or under development. Furthermore, the cases suggest that knowledge conflicts may come in the form of conflicting assessments of the nature and the gravity of the effects of human interventions in nature such as the effects of the disturbance of wildlife, the effects of shellfish collection
on the seabed, and the effects of sand nourishments on the coastal ecosystem. Moreover, in all three cases knowledge conflicts have played a role that concerned the substantive underpinning of existing policies, regulations and permit regimes. For instance, the mussel fishery permit regime, the designation of closed areas to protect birds and seals, and the execution of the sand nourishment program were all criticized and challenged by societal organizations for being poorly substantiated.

Accordingly, collaborative governance arrangements can be seen as initiatives that aim at dealing with multifaceted disputes that simultaneously relate to knowledge, interests, values, and objectives. My findings indicate that the arrangements I have studied have been quite successful in achieving this aim. An indicator of this success is that in all three cases conflicts between the involved actor groups and organizations have been channeled into collaborations that have existed and functioned for a substantial amount of time. This leads to the question: how have these arrangements managed to deal with these complex normative and epistemic conflicts?

My analysis indicates that the answer to this question lies in a combination of factors. Firstly, in all three cases interactive and participatory forms of governance have been started in which the various governmental and non-governmental actors are actively involved and collaborate on a relatively equal footing. This implies that in these cases settling disputes, solving problems, and making decisions have become joint efforts of negotiation and deliberation in which the interests and perspectives of various concerned actors are included. Secondly, in all three cases working according to a shared set of negotiated agreements has been an important factor in dealing with these conflicts. Notably two types of agreements have been crucial in dealing with conflicts and constituting collaborative processes. In all three cases the actors involved have worked together under the agreement to refrain from using legal means in settling conflicts and to use a deliberative approach instead. Furthermore, they have agreed to work together towards a shared common goal. Examples of such goals include the optimization of sand nourishment regarding nature conservation and promoting a form of recreational boating that combines experiencing and protecting the Wadden Sea. A third factor that has been important in dealing with conflicts is joint knowledge creation, which has occurred in several forms in the three cases. In the case of the mussel fishery, joint fact finding has contributed to creating shared and uncontested knowledge in a strongly polarized situation in which experts were distrusted, research was discredited, and conflicting interpretations of knowledge were abound. In the case of recreational boating, collaborative monitoring has
for instance played an important role in testing new modes of governance that were proposed as alternatives to contested centralized governance arrangements. In the sand nourishment case, the conflict concerned a perceived lack of knowledge on the ecological effects of sand nourishments. Joint research was formulated and executed to fill various knowledge lacunae and to address the concerns of the stakeholders who had contested this allegedly ill-informed coastal engineering practice. My findings correspond with those of other authors who have indicated the value of joint knowledge creation for enabling collaborations between actors with different institutional backgrounds (e.g., Hegger et al., 2012; Seijger et al., 2013).

In the next section I will elaborate further on joint knowledge creation for collaborative governance by highlighting the requirements that collaborative governance processes pose to knowledge creation. For this, I will use the notions of legitimacy, salience, and credibility that were introduced in chapter 4.

6.1.2 Knowledge requirements for collaborative governance

The case studies indicate that it is important that knowledge creation reflects the concerns of the stakeholders involved in a way that is perceived as fair and unbiased. Thus, legitimacy is a key requirement in joint knowledge creation for collaborative governance. Both the mussel fishery and sand nourishment cases indicate that such legitimacy may be achieved by translating stakeholder concerns into research questions, and by actively involving stakeholders in formulating research questions and discussing the results of the joint research or monitoring efforts. However, the involvement of stakeholders in joint knowledge creation may be difficult to sustain, for instance due to shifting priorities and limited time and resources. Consequently, ensuring the commitment and organizing the representation of interested actors seems to be a crucial aspect of building and sustaining the legitimacy of knowledge creation in a collaborative governance context.

The case studies suggest that legitimacy is a particularly important requirement if there are strong conflicts between the normative and epistemic perspectives of various stakeholders. The example of the PRODUS research program on the effects of seabed mussel spat collection illustrates this point. This research project was criticized by environmental protection NGOs for being too one-sidedly formulated from a fisheries perspective and for being biased, in the sense that it was allegedly aimed at legalizing the conventional mussel fishery. For these reasons, the program was
never fully accepted as a legitimate source of knowledge for the mussel transition by all of the parties involved. This clearly contrasts with the research program on ecology-oriented sand nourishment, in which the coordinators managed to achieve legitimacy, for instance by securing the sustained and iterated involvement of the interested NGOs in the formulation and execution of the research. One factor that explains this contrast is that in the sand nourishment case the concerns of the NGOs and the governmental department of Rijkswaterstaat could be reconciled relatively easily, whereas in the mussel fishery case the concerns of the mussel sector and the NGOs were more polarized. This polarization made it more difficult to achieve legitimacy with respect to all concerns.

The case of recreational boating provides a somewhat different perspective on the issue of legitimacy. Unlike the other two cases, in this case environmental protection NGOs and recreational boating CSOs have not primarily been involved as the principals of research efforts or the recipients of the results of these efforts; in this case, the interested parties have been more actively involved as the creators and disseminators of knowledge. This is illustrated by various interactive and self-governance arrangements in which societal organizations have played a key role in the dissemination of knowledge on responsible beaching and in collaborative monitoring of sailing activities on the Wadden Sea. This case suggests that the active involvement of stakeholders in knowledge creation efforts such as participatory monitoring is conducive to the legitimacy of those efforts as it provides a way of including their concerns and perspectives.

The notion of salience signifies the relevance of knowledge to the needs of decision-makers; this may include the responsiveness of knowledge creation to policy- or management-related needs and the capacities to inform or influence policies and management practices. The case studies indicate that in the context of collaborative environmental governance, salience is a broad and multifaceted notion because there are many ways in which knowledge can be relevant to decision-makers or decision-making. For instance, in the mussel fishery case the salience of the monitoring program has been crucial because the decision-making on the advancement of the transition process has depended on ongoing insight into the natural mussel stock and the yield of mussel spat in mussel spat collection installations (MZIs, see also chapter 2). Moreover, the monitoring of invasive exotic species has been crucial for the decision-making on shellfish transports. In the case of recreational boating, the salience of monitoring also played an important role, for instance because closing off areas under the Nature Conservation Act has depended on up-to-date information on the locations of birds and seals. These two cases suggest that salience is
a particularly important requirement in adaptive governance processes that are contingent upon ongoing feedback between knowledge creation and decision-making. In the sand nourishment case, salience was a key requirement because the research in this case was to provide knowledge on the optimization of the sand nourishment practice with respect to nature conservation.

The sand nourishment case also indicates that salience can be a fluid and negotiable attribute. In this case, the notion of salience in the domain of coastal engineering was reframed by redefining what the decision-making concerning sand nourishments is about; the NGOs introduced ecological considerations that are to be taken into account in addition to geomorphological considerations. Furthermore, this case indicates that in an interactive governance context a substantial overlap between legitimacy and salience can come about, for instance because addressing the concerns of stakeholders may simultaneously improve the substantive underpinning of decision-making and management.

The cases also suggest that the salience of knowledge for interactive governance does not only entail relevance for decision-making, but also practical relevance. In other words, salience does not only encompass the capacity to inform decision-making, but also the capacity to inform practice. This is illustrated by the governance of recreational boating, in which knowledge that enables sailors to sail around on the Wadden Sea in a way that does not disturb wildlife has played a crucial role. This knowledge includes practically applicable knowledge about the behavior of birds and seals, the vulnerability of particular areas at particular times, and ways to prevent disturbances.

The credibility of knowledge creation efforts, like legitimacy, appears to be particularly at stake in cases in which a strong conflict between the perspectives of stakeholders plays a role. Of the three cases covered by this thesis, the controversy on mussel fishery in particular has been a setting in which the credibility of various research projects, reports, and experts has been strongly debated and contested. Such a contestation of credibility also occurred in earlier Wadden Sea-related controversies such as the one regarding the cockle fishery. In the mussel fishery case, credibility became a key issue for several reasons. For instance, the continued existence of the mussel fishery strongly depended on knowledge about its ecological impact, the parties involved had conflicting assessments and interpretations of this impact, and a polarized and politicized situation existed in which scientific experts played prominent and sometimes contested roles. This case suggests that a combination of joint knowledge creation and the involvement of trusted experts can help to deal with such credibility-
related issues. In the sand nourishment case, a somewhat different dynamic emerged with respect to credibility. In this case, credibility was not contested like in the case of the mussel fishery, but it came under pressure due to a strong focus on achieving legitimacy and salience. This case suggests that credibility may be achieved by keeping sufficient focus in order to ensure depth of inquiry; moreover, it may be achieved by making a clear distinction between applied research questions that can be answered in a management-oriented setting, and fundamental research questions that should be addressed in academic research that is more independent of the context of application.

In the environmental management literature that uses the triad of legitimacy, salience, and credibility, the latter term often refers to the scientific quality of the evidence and arguments (Cash et al., 2003: 8086). My findings suggest that credibility may also pertain to whether insights and beliefs are commonly recognized as being factual and valid by the various parties who are involved in collaborative governance. Consequently, building and assessing the credibility of knowledge in collaborative governance arrangements may not only involve considering scientific quality; it may also involve considering whether the knowledge that is produced matches the experiences and factual beliefs of interested societal actors.

6.1.3 The coproduction of knowledge and governance

In this thesis, coproduction has served as a guiding concept in the analysis of the interplay between environmental governance and knowledge. The term coproduction has different denotations in the literature; in this thesis it signifies the ways in which knowledge and governance are created together and have a mutually constitutive relation. In this section I will elaborate on the insights that my research has provided on the coproduction of knowledge and governance in the context of collaborative governance arrangements.

6.1.3.1 SHIFTING GOVERNANCE, SHIFTING KNOWLEDGE SYSTEMS

The results of this research indicate that shifts towards new modes of governance may bring about shifts of knowledge systems in various ways. For one thing, shifts of governance may bring about shifts in the knowledge systems of particular groups or coalitions of actors. A clear example of this is the way in which the knowledge system of the mussel fishery community has shifted over the years. This knowledge system used to have a
strongly traditional and experiential character; it has gradually become more formalized and science-based due to the implementation of fisheries policies and regulations and concomitant research, monitoring, and impact assessments. Moreover, the introduction of the mussel transition has given a new impulse to the mussel fishery knowledge system as it has incited the mussel sector to experiment with new methods of mussel collection and cultivation.

A second way in which shifts of governance and shifts of knowledge systems may go together is that new governance arrangements can set the stage for new modes of creating and mobilizing knowledge that take place in the context of those arrangements. For instance, the mussel transition has provided a setting in which new forms of knowledge creation have emerged such as learning-by-doing and joint monitoring and research that is executed in collaboration between experts, the mussel sector, and the NGOs involved. Moreover, the mussel transition has introduced new research themes such as the impact of new mussel collection methods on the Wadden Sea ecosystem. In the case of recreational boating, a shift towards interactive and self-governance has enabled knowledge exchange between the various actors involved and has brought about an increased prominence of joint knowledge creation efforts such as collaborative monitoring of recreational boating activities on the Wadden Sea. In the sand nourishment case, the collaborative agreement has introduced ecology as a new research theme in the domain of dynamic coastal preservation and has introduced research collaboration between NGOs, experts, and government officials as a new mode of knowledge creation within this domain. In conclusion, the cases suggest that shifts towards interactive governance may both give rise to new themes and avenues of research and constitute shifts to more interactive and participatory forms of knowledge creation. At the same time, these new forms of knowledge creation have also enabled these interactive governance arrangements.

6.1.3.2 MANIFESTATIONS OF KNOWLEDGE AND EXPERTISE IN A GOVERNANCE CONTEXT

The case studies suggest that interactive governance arrangements are not only associated with particular ways of creating and mobilizing knowledge, but also with particular forms and manifestations of knowledge. In the first place, in all cases the creation and mobilization of knowledge have been primarily directed towards political and strategic aims such as improving regulation, executing nature management, settling conflicts between adversarial actor coalitions, and working towards shared objectives.
with respect to nature. Therefore, the knowledge creation that takes place in the context of interactive governance arrangements can be understood to be essentially a political and strategic process. Creating knowledge in such a context is primarily aimed at informing practice and getting things done. Consequently, the knowledge that is produced in and informs such governance arrangements has a strongly political-strategic and practice-oriented nature. This form of knowledge differs from much of the knowledge that is produced in academic research, which often has a less explicitly political and practice-oriented nature.

In the second place, much of the knowledge that has informed these arrangements has a local and temporal nature, in the sense that it often encompasses place- and time-specific data, insights, and experiences. For instance, in the context of the mussel transition knowledge has been produced on the development of mussel beds in closed nature restoration areas and on the suitability of specific locations in the Wadden Sea for cultivating mussels and for collecting mussel spat in MZIs. Creating such local knowledge about the development of the mussel stock and the characteristics of particular areas has played a crucial role in the transition process. In the case of recreational boating, creating and disseminating time- and place-specific knowledge about for instance the locations of seal and bird populations and the vulnerability of particular locations in the Wadden Sea area to disturbances has been indispensable for performing adaptive management and self-governance. In the sand nourishment case, the research program focused on local effects of sand nourishments near Ameland; also in this domain, local knowledge has played a crucial role because the adaptive execution of sand nourishments requires ongoing place-specific insight into the erosion of the Dutch coast.

An issue that relates to this prominence of local knowledge is that in the governance arrangements I have studied it has been difficult to produce or apply more generic or fundamental environmental knowledge. The case studies suggest various reasons for this difficulty. For instance, the research on the ecological impact of the conventional mussel fishery in the Wadden Sea has been subject to conflicting interpretations of its relevance, quality, and results. Therefore, it failed to become an undisputed source of knowledge for the mussel transition. In the case of recreational boating there has been an ambition to identify more generic insight into causal relations between recreation, the disturbance of wildlife, and the development of wildlife populations. However, creating such generic knowledge has been hampered by a deficiency of data and a lack of an integrated monitoring system that connects the monitoring of recreational boating to the monitoring of bird and seal populations. In the sand nourishment case, involved
experts have stressed that fundamental research on the ecology of the fore-shore is needed; however, the research program on ecology-oriented sand nourishment has focused on relatively practical and local issues for various reasons. These reasons include a pressure to address a broad variety of stakeholders’ concerns, a demand for practically applicable knowledge among involved organizations, and limited time and resources.

A third manifestation of knowledge that has emerged in the three case studies relates to how expertise takes shape in governance arrangements. In all three cases, establishing interactive forms of governance has entailed a manifestation of expertise as something that is not reserved to a select group of scientific experts, but something that is dispersed among the various actors involved. The latter include researchers, civil servants, and the representatives of societal organizations. In all three cases, shifts towards interactive governance have resulted in more active roles of stakeholders in the coordination and execution of monitoring and research efforts; the governance arrangements on which this thesis has focused in part depend on the substantive input of the stakeholders involved. It may therefore be argued that the establishment of interactive governance arrangements has brought about a democratization of expertise; at the same time, the expertise of a diverse group of stakeholders has enabled these arrangements as it has served as an important source of knowledge.

6.1.3.3 KNOWLEDGE AS A CONSTITUENT OF GOVERNANCE CAPACITIES

Chapter 5 has distinguished three types of capacity that are needed in order to perform collaborative environmental governance: regulatory capacity, adaptive capacity, and integrative capacity. Regulatory capacity is the capacity to structure or steer collective action with respect to the environment in desired directions. The case studies suggest various ways in which knowledge may play a role in building and putting into action such capacity. First of all, the knowledge requirements posed by nature conservation legislation may serve as a regulatory instrument in conflicts regarding the utilization and conservation of nature. Of the studied cases this notably has occurred in the mussel fishery and sand nourishment cases. In the former case, a coalition of nature conservation NGOs successfully challenged the mussel fishery permit regime by contesting the ecological impact assessments that supported the fishing permits. This provided them with a strong position of power to instigate a transition towards a mussel fishery with a lower ecological impact. In the latter case a coalition of NGOs incited the governmental department of Rijkswaterstaat to comply with the Nature Conservation Act, which imposed the requirement
to make ecological impact assessments and to use those assessments in the decision-making on the execution of sand nourishments. In this case, ecological research has been used as an instrument to steer the sand nourishment practice in an ecologically more feasible direction. In both these cases, ecological research and impact assessments have been used as regulatory tools for attuning human activities to the objectives of nature conservation. Furthermore, my findings suggest that joint knowledge creation may constitute regulatory capacity for environmental governance. In all three cases, joint knowledge creation has served as a mode of conflict-setting and collaboration that has enabled actors to work together towards shared objectives such as ecologically feasible forms of mussel fishery and sand nourishment. In this sense, joint knowledge creation has been instrumental in governing collective action towards desired directions. Besides joint knowledge creation, monitoring may also serve as a regulatory tool in a collaborative governance context. This is exemplified by the crucial role of the monitoring of invasive exotic species in regulating mussel transports between the Eastern Scheldt and the Wadden Sea. Finally, knowledge may constitute regulatory capacity in the sense that raising knowledge and awareness may serve as a steering mechanism. In the recreational boating case this form of regulation played an important role, as disseminating knowledge among recreational sailors has served as a way of preventing the disturbance of wildlife.

Adaptive capacity is the capacity to gain insight into environmental dynamics and use this insight to adapt or review governance in order to reach desirable human-environment interactions. Adaptive capacity is required in order to deal with the uncertainty and dynamics that are associated with complex and constantly changing natural systems such as the Wadden Sea. One way in which adaptive capacity has been built and put into action in the cases covered by this thesis is by means of processes of experimentation and learning by doing. Examples of such experimental governance include various self-governance pilots and experiments in the recreational boating case and the application of learning by doing as a central principle in the mussel transition. Experimental governance may both enable the renewal and improvement of governance arrangements, and enable achieving a shared goal under conditions of uncertainty and lacking knowledge about how that goal may be reached. The case studies suggest that building adaptive capacity requires flexibility, iterativity, and feedback loops between knowledge creation and decision-making. Furthermore, the recreational boating case suggests that adaptive capacity may come in the shape of a long-term learning process in which a
sequence of temporary governance arrangements and evaluations results in the renewal of governance.

A third form of governance capacity that was introduced in chapter 5 is integrative capacity, which is the capacity to gain insight in diverging knowledges and normative perspectives and to bridge, connect, or integrate such perspectives. My findings suggest that such capacity is a crucial element of environmental governance, particularly in situations in which there are strong conflicts between the normative and epistemic perspectives of various interested actors. In the cases I have studied, one key way of building and putting into action integrative capacity has been to engage in interactive processes of creating and exchanging knowledge. For instance, in the case of the mussel fishery joint fact finding has produced knowledge that meets the requirements of both the mussel sector and the NGOs involved. In the case of recreational boating, the knowledge exchange and interactive map-drawing in the context of the Pact of Rede have contributed to developing a shared perspective on combining recreation and nature conservation. In the sand nourishment case, joint research with the iterated involvement of NGOs has enabled the integration of an ecological perspective on coastal protection in the domain of dynamic preservation. In all three cases, building integrative capacity started with the acknowledgement that conflicting perspectives existed between interested actors and that it was desirable to reconcile these perspectives. Subsequently, interactive knowledge processes have produced shared knowledge or a shared perspective that bridges or incorporates the concerns of the actors involved. Furthermore, independent experts may play a role in building integrative capacity, for instance by providing reflections on issues and conflicts regarding nature conservation or by reviewing existing knowledge creation efforts. This is exemplified by the review of the PRO-DUS research on the ecological impact of mussel collection on the seabed (see chapter 2). In this review, an expert committee provided a reflection on the clashing perspectives of the mussel sector and the NGOs involved, and used this reflection to give advice on future avenues of knowledge creation that would meet the concerns of these parties. In sum, my findings suggest that integrative capacity for environmental governance may be constituted both by reflection and interactive knowledge processes among interested actors and by the involvement of independent experts who are able to bridge the perspectives of the involved actors. These findings match those of Termeer et al. (2013) who have argued that organized reflection on the diverging frames of involved actors is essential for building governance capacity.
6.2 TOWARDS WELL-INFORMED GOVERNANCE ARRANGEMENTS

From the findings described above it may be inferred that there are some key challenges that need to be dealt with in order to enable well-informed environmental governance arrangements. One of these challenges is to achieve collaboration and collective action towards sustainability in complex social settings that are often characterized by diverging or conflicting perspectives of interested actors. A second challenge is to achieve desirable ecological states in natural systems that are characterized by complexity and dynamics; the impact of human interventions in such systems is often uncertain. Consequently, the question is how to bring about linkages between knowledge and action under conditions of both social and ecological complexity. In other words, the question is how to organize governance arrangements in such a way that they can both accommodate a diversity of perspectives and deal with ecological dynamics and uncertainty. In sections 6.2.1 up to and including 6.2.3, I will formulate recommendations on how to deal with these issues. In section 6.2.4, I will reflect on the contribution of my findings to some current diagnoses and recommendations on knowledge-policy interactions.

6.2.1 Use knowledge creation as a key to dealing with conflict

Knowledge disputes often play a central role in conflicts about nature conservation and natural resource management. Consequently, knowledge may also serve as a key to dealing with such conflicts:

- Bringing together the diverging perspectives of various interested actors calls for building awareness of and insight into these perspectives. Consequently, reflecting on diverging knowledge and values with respect to nature should be an organized activity that the participants in a governance arrangement actively engage in. A task for coordinators or facilitators is to see to it that such reflection is built into the governance process as an iterative element.
- Interactive knowledge processes may help to settle conflicts between the actors involved in a governance arrangement. Such processes include the joint creation of new knowledge and the integration and exchange of existing knowledge.
- Legitimacy is a key requirement to knowledge creation for collaborative governance; it is enhanced by giving interested parties active
roles in various phases of the knowledge creation process. These phases may include: formulating research questions, executing research or monitoring, discussing results, and planning and performing evaluations.

- Successful joint knowledge creation requires a pluralistic notion of credibility. It is advisable to look beyond scientific considerations in assessing the factuality and validity of knowledge claims, and to involve the experiences and factual beliefs of the various interested actors in making such assessments.

- Trust and distrust in experts may play crucial roles in interactive knowledge creation. Dealing with knowledge-related disputes between various groups of actors may require the involvement of individual experts that are trusted by all parties involved; alternatively, it may require the involvement of expert committees in which the various backgrounds, worldviews, and knowledge systems of involved actors are sufficiently acknowledged or represented. In either case, it is advisable to involve experts that are empathic to a variety of values and perspectives.

### 6.2.2 Use learning as a key to dealing with ecological complexity and dynamics

My findings suggest the following ways in which knowledge may serve as a key to dealing with the complexity and dynamics of natural systems and with the associated uncertainty of knowledge:

- Dealing with complexity and uncertainty requires environmental governance to be a learning process. One way in which such a learning process may come about is through adaptive management, in which governance is updated and revised on the basis of ongoing monitoring. Adaptive management may come in a variety of shapes and forms, such as adaptive zoning of protected areas, incremental transition processes, and coastal management according to the principle of building with nature.

- A second way of enabling learning is by organizing environmental governance as an experimental process in which new or revised technologies, modes of regulation, or interventions in nature are tested and evaluated before they are fully implemented.

- Both adaptive and experimental forms of governance require the flexibility of governance arrangements and the willingness to reconsider existing ways of governing among interested conservationists,
resource users, and policy-makers. This flexibility may for instance pertain to the methods of transition processes, the way regulations are implemented, and the focus and approach of research and monitoring efforts.

· Adaptive and experimental governance are strongly contingent upon well-functioning feedback loops between knowledge creation and action. Such feedback loops may be constituted by executing pilot projects, performing monitoring that is closely connected to the governance arrangement, using iterative process designs such as stepwise transitions, and building and maintaining networks that facilitate flows of information between researchers, policy-makers, and stakeholders.

6.2.3 Build capacity for interactive and adaptive forms of governance

A central theme of this thesis has been how interactive and adaptive governance arrangements emerge and what the roles of knowledge are in this process. My findings indicate that a shift towards such forms of environmental governance is a change process that can be enabled and given shape in the following ways:

· Shifting towards interactive and adaptive governance arrangements requires a reflexive approach to governance. This reflexivity entails the reflection on and scrutiny of the workings and effects of governance and the according re-thinking, renewal, and improvement of governance. In practice, such reflexivity may be enabled by a combination of deliberation, organized reflection, monitoring, knowledge exchange, and evaluation.

· The renewal of governance may also be stimulated by learning from experiences with previous governance arrangements. It is advisable to organize evaluations in which all of the interested actors are involved in both formulating the evaluation questions and in discussing the results and consequences of the evaluation.

· Existing legislations may play crucial roles in enabling changes of governance. For one thing, legal procedures may provide the leverage for starting new governance arrangements and shifting to new modes of governance. Furthermore, the design and implementation of regulations should provide room for flexibility and experiment.

· Engaging in interactive governance may require dealing with power asymmetries between policy makers, conservationists, and the users
of natural resources. This may for instance involve finding a power balance that enables the participation of the various interested actors and the collaboration of these actors towards shared objectives. Collaborative arrangements in which the involved parties agree to refrain from legal actions and to use deliberation to settle conflicts can help to find such a balance.

6.2.4 Reflection on existing diagnoses and recommendations

I am neither the first to investigate the interactions between knowledge and management of the Dutch Wadden Sea, nor am I the first to formulate recommendations on improving them. As indicated in chapter 1, knowledge management in relation to the conservation and public administration of the Wadden Sea area has been the topic of various advisory and research reports (Adviesgroep Waddenzeebeleid, 2004; Toonen & Staatsen, 2004; Kabat et al., 2009a; Klostermann et al., 2009). Central recommendations in these reports are that the knowledge infrastructure and monitoring of the area should be strengthened, that scientific knowledge lacunae regarding the Wadden Sea should be identified, and that these lacunae should be addressed by programming and executing new scientific research. Moreover, it has been recommended that the coordination, exchange, and interdisciplinary integration of scientific knowledge and research should be improved (Kabat et al., 2009a). In 2008, the Wadden Academy was installed with the task of stimulating the improvement of the Wadden Sea knowledge infrastructure along these lines. Moreover, initiatives have been taken to improve and integrate monitoring in the Wadden Sea area.

The contribution of this thesis to the existing diagnoses and discussions is that it provides an in-depth investigation of how to improve knowledge management in an interactive and adaptive governance setting. My findings suggest that the emergence of such modes of governance necessitates a shift of emphasis in how knowledge management in the Wadden Sea area is reasoned about and organized. Firstly, a shift is needed from a dominant focus on natural scientific knowledge to a more pluralistic notion of the knowledge and expertise that are relevant for the governance of the Wadden Sea. This pluralistic notion includes scientific, local, experiential and practical knowledge, and recognizes the expertise of a variety of actors such as researchers, civil servants, conservationists, and actors who use the resources of the Wadden Sea. Secondly, my findings suggest that the primary focus in knowledge management should not be on what
Governing Knowledge

Science may have to offer, but on what governance arrangements need. The latter includes local and practically applicable knowledge and strong feedback loops between knowledge creation and governance. As for this, my findings endorse the necessity of a monitoring system that is tailored to the needs of management practices. Thirdly, attention is needed to the various types of knowledge creation and exchange processes and how such processes may be of value to governance. Such processes include participatory research and monitoring, joint fact finding, and experimental and adaptive management. Knowledge management in the Wadden Sea area may be improved by building the capacity of interested actors and organizations to perform such processes. Finally, the improvement of governance requires reflexivity. The Wadden Sea knowledge infrastructure can facilitate such reflexivity by inventorying and exchanging experiential, reflective, and evaluative knowledge about governance processes.

My recommendations partly correspond with the recommendations of other authors on how to enable joint knowledge creation. For instance, they partly match the recommendations of Regeer & Bunders (2007), who have argued that joint knowledge creation (“knowledge cocreation”) may be enabled by a combination of flexible processes, monitoring, reflection, exchange of experiences, and capacity building for interactive forms of research. Moreover, both Regeer & Bunders and Hegger et al. (2013) have emphasized that creating common ground on problem definitions and frames of reference is conducive to joint knowledge creation. Compared to the work of these authors, my research more prominently spotlights different forms of adaptive and experimental governance as ways of dealing with ecological complexity and dynamics. Moreover, my findings and recommendations more strongly emphasize that processes of joint knowledge creation often take place in regulatory and political settings; accordingly, rules, agreements, legislations, and power dynamics are often influential factors in joint knowledge creation.

Furthermore, my recommendations partly tie in with those of other authors on how to enable the utilization of scientific knowledge and expertise in policy-making. Meffe & Viederman (1995: 331) have for instance argued that scientists who want to translate their knowledge to environmental policy development must adopt a “postnormal approach”, which entails pragmatism, pluralism, the inclusion of social perspectives on nature, and the acceptance of dynamics and uncertainties. Slob & Staman (2012) have urged scientific experts to take account of the diverging values and interests that exist in the social-political settings in which they operate. The recommendations of both Meffe & Viederman and Slob & Staman relate to settings in which clear divisions of roles between experts and
decision-makers exist; the latter authors argue that such divisions should be reinforced. My findings provide a different perspective on the relations between knowledge and policy-making, as they indicate that in an interactive governance setting both expertise and decision-making have a diffuse character and are dispersed among experts, stakeholders, and policy-makers. Consequently, my findings suggest that knowledge creation, deliberation, decision-making, and reflection should be seen as collective actions that take place within governance arrangements and that are performed by heterogeneous groups of interested actors.

6.3 CONCEPTUAL AND THEORETICAL REFLECTION

In order to analyze the regulatory and policy-related aspects of the cases, I started out with the concept of policy arrangements as an analytical tool. The policy arrangements theory distinguishes between four dimensions of policy: actors, rules, discourse, and power and resources (Arts et al., 2006). Chapter 2 used these four dimensions somewhat loosely as a heuristic and interpretive framework in order to prevent them from overly pre-structuring the analysis. Given the aim and focus of my research, a drawback of the policy arrangements theory is that it provides little analytical sensitivity to the roles of knowledge in policy or governance. Like other authors before us, this incited us to add concepts pertaining to knowledge to the analytical framework (see also Seijger et al., 2013; Janssen et al., 2015). In this thesis the notion of the knowledge system has served as such a concept. The combination of policy arrangements and knowledge systems has proven useful in analyzing the case of the mussel fishery because it has enabled us to gain insight into both the diverging perspectives of actors involved and the factors that were influential in the establishment of the mussel transition. However, a drawback of this analytical approach is that it fosters a schematic way of thinking in which knowledge and policy are principally treated as separate rather than intertwined entities. In order to overcome this drawback I added the notion of coproduction to the analytical toolkit. Moreover, in the subsequent case studies I shifted to a conceptualization of the governance arrangement as the stabilization of the content and organization of a governance domain. I found this concept to be more useful for studying the roles of knowledge in governance than the concept of the policy arrangement. The latter also focuses on the content and organization of policy, but operationalizes these two elements into four dimensions that make little explicit references to knowledge and how knowledge and policy may be related. Because the concept of the
governance arrangement as the content and organization of governance does not include such an operationalization, it has better suited my objective to do exploratory research on the various ways in which knowledge may be related to governance. A contribution of this thesis to theory development on governance arrangements is that it has provided a detailed account of the various ways in which knowledge may constitute the capacities to perform environmental governance, and therefore may constitute environmental governance arrangements.

A second drawback of the policy arrangements theory from the perspective of my research is that this theory does not distinguish between types of governance. Therefore, an additional analytical lens is needed in order to investigate how ways of governing may shift from one to the other. For this reason I added the framework of modes of governance, which includes centralized, decentralized, interactive, and self-governance, to the analytical framework (Driessen et al., 2012).

This research has focused on collaborative governance arrangements that are related to the Dutch Wadden Sea. These arrangements, notably in the domains of the mussel fishery and recreational boating, have a strongly regional orientation. At the same time, national and international policies and regulations may play crucial roles in the emergence of collaborative environmental governance. The case studies suggest that a multi-level perspective on governance is needed for understanding the emergence and functioning of collaborative governance in protected nature areas. Such a multi-level perspective includes local, regional, national, and international actors, policies, and regulations.

The concept of the knowledge system has been applied in this research as a way of capturing the ways in which knowledge is embedded in social settings and practices. Over the course of the research the conceptualization of knowledge systems has shifted somewhat. In chapter 2 I used the concept to identify how particular communities and groups of actors create and exchange knowledge, and I focused on the content of such knowledge systems in terms of the propositions and truth claims that these groups of actors adhere to. Used in this way, the notion of the knowledge system is useful for gaining insight into knowledge-related controversies between adversarial actor groups by highlighting the different perspectives of these groups. Subsequently, I shifted the focus to the ways in which governance arrangements are informed by particular forms of knowledge and are connected to specific ways of creating and mobilizing knowledge. In chapter 3, I argued that such ways in which governance arrangements are informed can also be seen as knowledge systems.
The case studies suggest that in a domain of environmental governance a multiplicity of knowledge systems may exist that are rooted in communities, coalitions, and governance arrangements. My findings indicate that such knowledge systems may overlap and be interconnected. This is exemplified by the mussel fishery case, in which I identified both community-based knowledge systems and a knowledge system that is embedded in the governance arrangement of the mussel transition. The knowledge systems of the NGOs and the mussel sector feed into the joint knowledge system of the transition, while the latter also provides new insights that feed back into these communities. Consequently, new governance arrangements may both constitute new knowledge systems and create linkages between already existing knowledge systems. From this can be inferred that the knowledge systems in an interactive governance context are likely to be entangled in knowledge networks rather than strictly divided. Furthermore, the findings suggest that such knowledge systems are dynamic, as they for instance may change due to the implementation of new regulations or policies. Finally, the results confirm the idea that knowledge systems in an environmental governance context may comprise various forms of knowledge, such as scientific, experiential, and local knowledge. The implication of my findings for theory development on knowledge systems is that the latter should not be conceptualized as systems that are by definition confined to a homogeneous group of actors; my findings suggest that knowledge systems may be embedded in governance arrangements or other social practices or structures in which strongly heterogeneous groups of actors participate.

The multiplicity of knowledge systems and governance arrangements I have encountered implies that knowledge and governance can be interrelated in various ways. I have for instance identified various forms of knowledge-governance interfaces, such as science-based, adaptive, integrated, and participatory interfaces. My findings indicate that a governance domain may encompass a multitude of knowledge-governance interfaces that accumulate, interchange, and shift in the course of time.

This thesis has employed the concept of coproduction in order to gain insight into the intertwinements of environmental knowledge and governance. Jasanoff has argued that coproduction is not a “fully fledged theory, claiming lawlike consistency and predictive power”, but “far more an idiom – a way of interpreting and accounting for complex phenomena […]” (Jasanoff, 2004: 3). The open and flexible nature of this idiom has matched my ambition to avoid overly structuring preconceived categories and to attune the conceptual framework to the particularities of cases in order to gain new insights. At the same time, using this idiom of coproduction in
such a flexible way poses the risk of conceptual vagueness and confusion. In the environmental management literature the term coproduction has various distinct meanings. Like me, some authors have used the notion to signify the combined production of knowledge, values, and social order that takes place in the context of governance arrangements or practices (e.g., Muñoz-Erickson, 2014; Wyborn, 2015a); others have used it to signify processes in which actors with different backgrounds collaboratively produce knowledge (e.g., Berkes, 2009; Armitage et al., 2011). It has been argued that these two denotations are quite similar, as the collaborative production of knowledge can be seen as a process in which knowledge and social order are produced together (Hegger et al., 2012). However, I would like to argue that mixing up these two meanings of the term coproduction is uncalled-for because they pertain to distinct phenomena. Rather, it is advisable that research employing the notion of coproduction clearly states which denotation of the term it uses and is specific about what the entities are that are coproduced.

In the introductory chapter, I have distinguished between two theoretical approaches to the interrelations between knowledge and governance. Theories and concepts within the category of divisions predominantly reason about knowledge-governance relation in terms of differences and boundaries; those within the category of intertwinements reason about environmental knowledge and governance as intertwined, amalgamated, or hybrid entities. From my findings it may be inferred that in order to gain insight into the interrelations between environmental knowledge and governance, susceptibility to both divisions and intertwinements is needed. For instance, my findings indicate that dealing with the divisions between knowledge systems and normative perspectives is a central issue in interactive governance arrangements. At the same time, they indicate that knowledge may form an intrinsic and constitutive element of governance in various ways. I would therefore like to argue that further research and theory development should take this duality of knowledge-governance relations (i.e. the combination of divisions and intertwinements) into account.

6.4 IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This thesis has argued that there may be several advantages to interactive forms of environmental governance. For instance, my findings indicate that interactive governance arrangements can be instrumental in settling conflicts between various groups of actors with respect to the environment.
Moreover, such arrangements may enable actors to work towards shared objectives that harmonize the conservation of nature and the utilization of natural resources. Therefore, my findings may be interpreted as recommendations for the promotion and wider implementation of the forms of interactive governance that this thesis has studied. However, there are two issues that call this interpretation into question. Firstly, to what extent are my findings generalizable to other contexts and settings? Secondly, how to assess the desirability of this promotion and wider implementation of interactive governance in protected nature areas?

The issue of generalizability concerns two sets of outcomes in particular. The first set encompasses the insights that this research has produced on the factors and conditions that may be influential in dealing with conflicts and establishing collaborative governance arrangements (see section 6.1). My findings on this matter are likely to be of interest for environmental management practices in various settings. However, the specific context within which the arrangements in the case studies emerged limits the generalizability of my findings. For instance, these arrangements came about in a setting in which both a strong legal nature conservation framework and an extensive research infrastructure were already in place. Moreover, they emerged in a setting that is characterized by a strong tradition of deliberation and network-building between governmental and non-governmental organizations. In settings that lack these contextual factors it will probably be much more difficult to establish the kinds of knowledge-intensive and collaborative forms of regulation and management I have studied. Consequently, a direction for future research would be to investigate what such contextual factors are, how they influence the emergence of governance arrangements, and how they differ between national contexts.

A second set of outcomes that raises questions with respect to generalizability encompasses the recommendations on enabling well-informed governance arrangements (see section 6.2). These recommendations on joint knowledge creation and adaptive and experimental governance may be applicable to a variety of environmental governance domains and practices. However, this applicability is limited by some preconditions. The kind of governance recommended in the above requires a multi-actor setting in which collaboration and deliberation between groups of governmental and non-governmental actors are practically and politically feasible. Moreover, they require room for adapting governance practices and experimenting with new ones. There may be settings in which the existing power structures, policies, and regulatory frameworks do not allow for such adaptation and experimentation.
The issue of desirability concerns both the positive outcomes and the possible downsides of interactive governance arrangements. In this thesis, I have used the notion of well-informed governance as a positive normative concept that refers to governance arrangements that are able to connect knowledge and action in such a way that the sustainable management of nature and natural resources is promoted. However, my findings indicate that it is difficult to say unequivocally whether such governance arrangements are actually able to achieve sustainability. The arrangements I have studied can be argued to promote sustainability in the sense that they have enabled adversarial actor coalitions to work towards shared sustainability objectives concerning the utilization and conservation of nature. However, it remains to be seen whether these objectives will be met in the long run. For instance, the ecological effects of interactive governance arrangements on complex natural systems are highly uncertain. Producing insight into such effects will require sustained monitoring and research.

Some aspects and possible downsides of interactive governance arrangements are in need of further investigation and reflection. Firstly, the case studies illustrate that a tightened up nature conservation legislation in combination with an increasingly interactive governance have put environmental protection NGOs in powerful positions with respect to nature management and have incited governmental organizations to play more facilitating roles. It remains to be seen whether this development is desirable from the perspective of accountability and the democratic legitimacy of nature management. Secondly, the arrangements I have studied rely on the agreement between involved actors to refrain from using legal means in settling disputes. However, there may be several weaknesses to such arrangements, for instance because external actors who do not participate in the arrangement may still take legal steps against decisions made by the participating actors. Thirdly, each of the interactive governance arrangements I have studied focuses on a particular sector and involves a select group of interest organizations that are connected to that sector. Consequently, such sectoral arrangements may induce administrative fragmentation and hamper the integrated management of nature areas. Fourthly and finally, the arrangements on which this thesis has focused display a preference for participatory, negotiated, and management-oriented forms of knowledge production. This raises questions about quality control and the role of independent academic research in environmental governance. For instance, are the independence and quality of knowledge production for interactive governance sufficiently warranted, and what roles can or should academia play with respect to such forms of governance in order to advance its societal relevance?
Consequently, a second direction for future research would be to investigate the sustainability and desirability of interactive governance arrangements from a variety of perspectives that include ecology, legal and democratic legitimacy, the quality of public administration, and the quality and independence of scientific research. Such multidisciplinary research is needed for investigating whether interactive environmental governance will live up to the expectations it has aroused concerning its ability to harmonize society and ecology.


Wilson, J., Hayden, A., Kersula, M. (2013). The governance of diverse, multi-scale fisheries in which there is a lot to learn. *Fisheries Research* 141, 24-30.


Het natuurbeheer in het waddengebied is vanaf de jaren ’60 van de twintigste eeuw geleidelijk geïntensiveerd. Tegenwoordig zijn er diverse vormen van beheer, beleid en regelgeving die als doel hebben om de wadden-natuur te beschermen. Deze opkomst van natuurbescherming is vergezeld gegaan van conflicten tussen overheidsorganisaties, natuurorganisaties en gebruikers van het gebied. Centrale vragen in veel van deze conflicten waren, en zijn, hoe groot de invloed van menselijk handelen op de natuur is en welke mate van invloed al dan niet toelaatbaar is. Kennis speelt vaak een cruciale en soms ook problematische en omstreden rol in dergelijke controverses. Besluitvorming over natuurbescherming is bijvoorbeeld in sterke mate afhankelijk van wetenschappelijk onderzoek en monitoring. Tegelijkertijd doen zich diverse problemen voor bij het mobiliseren van kennis voor beleid en beheer, zoals onzekerheid, een gebrek aan wetenschappelijke consensus, botsende belangen en interpretaties van kennis en een gebrekke aansluiting tussen onderzoek en de beheerpraktijk.

De afgelopen jaren zijn er binnen diverse beleidsdomeinen die met de Waddenzee te maken hebben nieuwe arrangementen ontstaan, die gericht zijn op het oplossen of beheersen van dit soort conflicten tussen beleidsorganisaties en verschillende groepen belanghebbenden. Deze arrangementen hebben met elkaar gemeen dat ze gericht zijn op het vinden van een balans tussen het beschermen en benutten van de natuur door middel van een vorm van governance waarin samenwerking en overleg tussen belanghebbenden centraal staan. Mijn doel in dit proefschrift is om inzicht te krijgen in de relaties tussen kennis en beheer/beleid die zich in dergelijke arrangementen voordoen. Op basis hiervan formuleer ik aanbevelingen over hoe in dit soort samenwerkingsverbanden kennis kan bijdragen aan een duurzame omgang met natuurlijke hulpbronnen. Het onderzoek omvat casestudy’s in drie verschillende domeinen van kustbeheer. Ik analyseer de casussen met behulp van begrippen en inzichten uit wetenschaps- en technologiestudies, beleidswetenschappen en literatuur over natuur- en milieubehoe.

De mosselvisserij op de Waddenzee is gedurende lange tijd het onderwerp van controverse tussen de mosselsector en natuurorganisaties geweest. Natuurbeschermers maakten zich zorgen over de schade die de traditionele mosselvisserij toe zou brengen aan het ecosysteem van de Waddenzee en pleitten voor een betere afstemming tussen visserij en natuurbeheer. De mosselvissers zagen geen reden tot verandering, omdat ze ervan overtuigd waren dat hun werk in harmonie was met de natuur. In hoofdstuk 2 staat de vraag centraal hoe het mogelijk is dat er, ondanks deze botsende perspectieven, sinds 2008 een arrangement bestaat waarin de mosselsector, natuurorganisaties en de overheid samenwerken aan...
een transitie naar duurzamere vormen van mosselvisserij. Een samenspel van factoren heeft bijgedragen aan de totstandkoming van deze transitie. Om te beginnen was er sprake van een grote juridische, maatschappelijke en politieke druk om over te schakelen naar nieuwe visserijmethoden. Deze druk liep hoog op nadat de Raad van State bepaalde dat de visserijvergunning van 2006 ten onrechte was verstrekt, omdat er geen uitsluiting was over de mogelijke schade van de mosselvisserij aan de natuur. Daarnaast zorgde een set gedeelde spelregels, onder meer vastgelegd in een convenant, voor een werkbaar samenwerkingsproces. Voorbeelden hiervan zijn de afspraken om overleg te verkiezen boven juridische procedures en om op een adaptieve manier (“leren door te doen”) naar het gezamenlijke doel van duurzame visserij toe te werken. Ten slotte speelden gezamenlijke waarheidsvinding en kennisontwikkeling een belangrijke rol in het beslechten van dit conflict. De casus van de mosselvisserij laat zien dat botsende perspectieven op natuur en natuurbeheer overbrugd kunnen worden door gedeeld eigenaarschap van onderzoek en monitoring, door te zoeken naar gedeelde inzichten en door kennisontwikkeling en leren als een integraal onderdeel van governance te benaderen.

De tweede casestudy betreft de governance van vaarrecreatie. Natuurorganisaties, recreantenorganisaties en overheden waren het met elkaar oneens over de mogelijke invloed van vaarrecreatie op de natuur, de ruimte die vaarrecreatie op de Waddenzee zou moeten krijgen en de manier waarop belanghebbenden bij natuurbeheer betrokken zouden moeten worden. De centrale vraag in hoofdstuk 3 is hoe binnen dit domein veranderende vormen van governance samengingen met veranderende vormen van kennisontwikkeling en kennisuitwisseling. De analyse van deze casus laat zien dat vanaf de jaren ’80 de vaarrecreatie onderhevig is geweest aan een veranderend samenstel van beheer- en reguleringsvormen die elkaar deels opvolgden en deels aanvulden. Door dit vernieuwingsproces is de sturingsvorm gaandeweg verschoven van overwegend top-down en centralistisch naar een combinatie van sturingsvormen waarin decentrale overheden en belangenorganisaties actiever betrokken zijn en waarin zelfregulering door recreanten en natuurbeschermers een prominente rol speelt. Samen met deze veranderende regulerings zijn er ook nieuwe vormen van kennisontwikkeling en kennisuitwisseling opgekomen. Om te beginnen is lokale, kwalitatieve kennis over de bijzonderheden en kwetsbaarheden van specifieke plaatsen en gebieden gaandeweg belangrijker geworden. Daarnaast zijn de gebiedskennis en ervaringskennis van vaarrecreanten en natuurbeschermers een prominentere rol gaan spelen door hun toegenomen betrokkenheid in het natuurbeheer. Ten slotte zijn er diverse vormen van kennisuitwisseling en kennisintegratie opgekomen,
bijvoorbeeld in de vorm van samenwerking tussen experts, professionals en recreanten op het gebied van monitoring. Deze casus leert ons dat het reguleren en kennen van de natuur sterk met elkaar vervlochten kunnen zijn en dat het daarom zinvol is om natuurbeheer tegelijk als regulerings- en kennisvraagstuk te beschouwen. Daarnaast laat deze casus zien hoe governance en kennis in onderlinge samenhang tot stand kunnen komen, waarbij zij elkaar zowel mogelijk maken als inperken. Om deze redenen is het raadzaam om bij het vergroten van participatie in natuurbeheer stil te staan bij de vraag of er nieuwe vormen van kennisontwikkeling en kennisuitwisseling nodig zijn en hoe deze vormgegeven zouden moeten worden.

De derde casestudy gaat over een samenwerkingsverband waarin Rijkswaterstaat, natuurorganisaties en onderzoekers kennis ontwikkelen over de ecologische effecten van zandsuppleties. Sinds 1990 voert Rijkswaterstaat een programma van zandsuppleties uit om de erosie van de Nederlandse kust tegen te gaan. Natuurorganisaties hadden kritiek op het ongereguleerde karakter van de zandsuppleties en vonden dat er te weinig bekend was over het effect van deze vorm van kustverdediging op de natuur. De acties die deze organisaties ondernamen leidden onder meer tot een onderzoeksprogramma dat inzicht moet geven in hoe zandsuppleties op natuurbescherming kunnen worden afgestemd. Hoofdstuk 4 beschrijft hoe de betrokkenen hebben gepoogd om in dit programma wetenschappelijke geloofwaardigheid, relevantie voor kustbeheer en legitimiteit ten opzichte van uiteenlopende waarden en belangen met elkaar te combineren. Vervolgens wordt ingegaan op de manieren waarop deze drie ambities elkaar kunnen versterken, maar ook ten koste van elkaar kunnen gaan. De casestudy laat zien dat in dit soort participatieve processen de legitimiteit en relevantie van kennisontwikkeling complementair kunnen zijn. Het agenderen en onderzoeken van door belanghebbenden aangedragen thema’s kan bijvoorbeeld een positieve impuls geven aan de inhoudelijke onderbouwing van beheer of beleid. Er ontstond in dit geval een spanningsveld tussen het streven naar praktisch toepasbare kennis en de roep om fundamentele kennisontwikkeling. Daarnaast stond de wens om in het onderzoek een grote diversiteit aan thema’s en belangen te agenderen op gespannen voet met de ambitie om wetenschappelijke diepgang te bereiken. De bevindingen wijzen op het belang van een weloverwogen programmering van interactieve en beheergerichte kennisontwikkeling, waarin onder meer aandacht is voor de vertegenwoordiging van belanghebbenden, de timing en tijdskaders van onderzoeksactiviteiten en het bereiken van voldoende focus en afbakening.

Over kennis wordt vaak gesproken als iets dat buiten de domeinen van beleid en politiek tot stand komt en dat vervolgens deze domeinen binnen-
gebracht moet worden. In hoofdstuk 5 ontwikkel ik een aanvullend per-
spectief op de relatie tussen kennis en beleid door te onderzoeken op welke
manieren kennis een intrinsiek onderdeel van governance kan vormen.
Hiertoe formuleer ik een conceptueel kader dat drie verschillende go-
vernancevermogens omvat: regulatief, adaptief en integratief vermogen. De
centrale vraag in dit hoofdstuk is welke rol kennis kan spelen in het tot
stand brengen en uitoefenen van deze vermogens. Op basis van inzichten
uit de casestudy’s betoog ik dat kennis een rol kan spelen als sturingsme-
chanisme, bijvoorbeeld door kennisontwikkeling in te zetten om mense-
lijke activiteiten beter af te stemmen op natuurbescherming en door ken-
nisdistributie als beheerinstrument te gebruiken. Daarnaast maken de
casestudy’s het belang van leerprocessen voor governance duidelijk. Zulke
leerprocessen kunnen mogelijk gemaakt worden door bijvoorbeeld het
toepassen van experimenten, pilots en adaptief management. Ten slotte
can kennis een verbindend element van governance vormen, bijvoorbeeld
door gezamenlijke waarheidsvinding en kennisuitwisseling te gebruiken
om scheidslijnen tussen de botsende perspectieven van belanghebbenden
to overbruggen. Op basis van deze bevindingen kom ik tot de conclusie dat
het tot stand brengen van goed geïnformeerde governance van de natu-
rijlijke omgeving twee vormen van reflexiviteit vereist. De eerste vorm be-
helst het verbinden van uiteenlopende waarden en vormen van kennis met
collectief handelen ten aanzien van de natuur. De tweede vorm behelst het
verkrijgen van inzicht in complexe en dynamische natuurlijke systemen en
het op een adaptieve manier reageren op verandering.

Het afsluitende hoofdstuk begint met conclusies over de wisselwerking
tussen kennis en governance. In alle drie de casussen speelden ingewik-
kelde conflicten die gelijktijdig betrekking hadden op kennis, waarden,
belangen en doelen. Mijn bevindingen laten zien dat het combineren van
overleg, onderhandeling, gedeelde spelregels en gezamenlijke kennisont-
wikkeling een vruchtbare manier kan zijn om met zulke conflicten om te
gaan. Voorts ga ik in op de eisen die interactieve governance-arrangementen
stellen aan kennis en kennisontwikkeling. Ik doe dit aan de hand van
de begrippen legitimiteit, geloofwaardigheid en relevantie. De casestudy’s
maken duidelijk dat de legitimiteit en geloofwaardigheid van kennis onder
druk kunnen komen te staan door de polarisatie van belangen en perspec-
tieven van betrokken partijen. De casestudy’s laten onder meer zien dat
de actieve betrokkenheid van belanghebbenden in verschillende fasen van
kennisontwikkeling kan helpen om met dergelijke druk op legitimiteit en
geloofwaardigheid om te gaan. De relevantie van kennis is een meerduidig
en plooibaar begrip in dit soort settings, onder meer omdat kennis op veel
verschillende manieren relevant kan zijn, of gemaakt kan worden, voor beheer- en samenwerkingspraktijken.

Vervolgens ga ik in op de inzichten die mijn onderzoek oplevert over de coproductie van kennis en governance. Ten eerste laten mijn bevindingen zien dat veranderende vormen van governance en nieuwe thema's, vormen en praktijken van kennisontwikkeling in onderlinge samenhang tot stand komen. Ten tweede valt uit de casestudy's op te maken dat in interactieve governance bepaalde vormen van kennis en deskundigheid een prominente rol spelen. Zo heeft de kennis die tot stand komt in dit soort arrangementen, en die tegelijk deze arrangementen informeert en mogelijk maakt, een overwegend politiek-strategisch, praktijkgericht en lokaal karakter. Ten derde laat ik zien hoe we het tot stand brengen en uitoefenen van governancevermogens kunnen begrijpen als processen waarin kennis, waarden en sociale orde gecoproduceerd worden.

Op basis van mijn bevindingen formuleer ik aanbevelingen, die ik onderverdeel in drie thema's. Het eerste thema betreft manieren waarop kennis kan bijdragen aan het omgaan met conflicten over natuurbeheer en het gebruik van natuurlijke hulpbronnen. Hier benadruk ik onder meer het belang van interactieve kennisontwikkeling en reflectie op uiteenlopende perspectieven. De tweede set aanbevelingen betreft leren als een sleutel tot het omgaan met complexiteit en dynamiek. Hier pleit ik voor adaptieve en experimentele vormen van governance. De derde verzameling aanbevelingen gaat over hoe verschuivingen naar interactieve en adaptieve vormen van governance mogelijk gemaakt kunnen worden. Hierbij benadruk ik het belang van reflexiviteit, het formuleren en benutten van spelregels en het omgaan met soms scheve machtsverhoudingen. Ik sluit het hoofdstuk af met aanbevelingen voor toekomstig onderzoek. Uit mijn onderzoek komt naar voren dat interactieve governance kan helpen om met conflicten over natuurbeheer om te gaan en om gezamenlijke duurzaamheidsdoelen te formuleren en na te streven. Het is wel de vraag of dergelijke vormen van governance op de langere termijn bijdragen aan effectief en legitiem natuurbeheer. Om deze vraag te beantwoorden is interdisciplinair onderzoek nodig dat vanuit verschillende invalshoeken de duurzaamheid en wenselijkheid van interactieve governance in kaart brengt. Deze invalshoeken zouden mijns inziens ten minste ecologie, wetelijke en democratische legitimiteit, de kwaliteit van het openbaar bestuur, en de kwaliteit en onafhankelijkheid van wetenschappelijk onderzoek moeten omvatten.
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