Original Article

Science, Technology, & Human Values
1-27

DOI: 10.1177/01622439241239768
journals.sagepub.com/home/sth


The Politics of Amphibiousness: Shifting Coastal Management in the Netherlands

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Abstract

This paper explores the consequences of a shift in Dutch coastal management. The management approach transitioned from aiming to keep the sea at bay toward the stimulation of dynamic sea-land relations. This shift toward "dynamic management" can be seen as part of wider trends in both ecological and science, technology, and society thinking on coasts as amphibious more-than-human entanglements. We draw on a case study of the Wadden Sea barrier island Ameland to develop the notion of amphibious response-ability. We show that while dynamic management enabled amphibiousness in the land–sea interface, it limited

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other types of amphibiousness, with consequences for the possibilities to respond to coastal changes. These consequences for amphibious response-abilities became critical when rapid coastal erosion threatened and partially destroyed a gas platform. Our case shows that even when coastal management regimes are amphibious because they unleash and build on natural processes, they can still have harmful consequences, and they can in fact limit the possibilities for integrated responses to coastal change. We conclude by suggesting that heterogeneous knowledge alliances are needed to expose and work with the politics of (amphibious) coastal management regimes.

Keywords
dynamic management, response-ability, amphibiousness, Wadden Sea, mining remediation

Introduction

This paper explores a major shift in coastal management in the Wadden Sea region of the Netherlands, and its consequences for diverse humans and nonhumans. The Wadden Sea region is an intertidal system of sand and mud flats, meaning it is an amphibious place where land and sea meet and mingle. The area changes constantly in form through the dynamic interplay between wind, water, waves, vegetation, and sand. These dynamics are praised as extraordinary by many and motivated United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2009 to recognize the Wadden Sea as a World Heritage site (UNESCO World Heritage Convention n.d.). At the same time, these dynamics destabilize coastlines and present challenges for human and nonhuman communities that populate the islands and the northern coast of the Dutch mainland. Through a case study of Dutch barrier island Ameland, we analyze the shift in management from "keeping stability" toward "managing dynamics" to understand the kind of responsibilities this shift enables and constrains.

Since the early twentieth century, the Dutch government has aimed at enhancing coastal stability and keeping the unpredictable, potentially destructive, sea at bay (Bijker 2007a; Disco and Toussaint 2014). Evidenced by two major coastal engineering projects, this approach was based on reducing the interplay between land and sea by using solid infrastructures such as seawalls, dikes, or dunes (Helmreich 2019; Schmitt 2018;

Disco 2002). This management approach is well-known worldwide and has influenced coastal management regimes across the globe (Zwarteveen 2015; Morita 2016). The labor-intensive practices of helm-grass planting by Dutch island communities to reduce coastal erosion are less well-known (Clarke and Rendell 2015; Woodall and Lund 2009).

From the 1970s, Dutch coastal management gradually shifted from keeping the sea at bay to guiding the amphibious interplay of land and sea. This "dynamic management" approach increasingly gains international popularity (Deltacommissie 2008; Interreg North Sea Region (EU) n.d.; Loffler et al. 2016; van Slobbe et al. 2013) and is exemplary of the growing attention to amphibious infrastructural solutions that embrace land–sea entanglements that are presumedly better able to anticipate rising sea levels and storms associated with the climate crisis (Morita 2017; Wesselink 2016). Dynamic management has been promoted as a more natural approach to coastal management because it allows hydromorphological processes to run their course. However, despite these promises of naturalness, the shift to dynamic management does not abandon human interventions. On the contrary, it involves large-scale engineering interventions such as controlled flooding or relocating large amounts of sand to balance and mitigate erosion processes around islands (Ebbens 2022; Borsje et al. 2018).

Through the conceptual lens of amphibiousness (Jensen 2017; Krause 2017; Jensen and Morita 2015), we examine how shifts in management can change the flows and entanglements of water, land, and humans. As we will show, the shift in management approach from helm-grass planting to large-scale engineering enabled certain amphibious entanglements but prevented others from coming into being. At the west coast of Ameland, the contrasts between stability and turbulence are particularly stark as currents, wind, and waves erode the coast quickly, and frequent management intervention is undertaken to keep the coastline in place (Schmitt 2018; Vermaas et al. 2019; Ebbens 2022). For this reason, this case is uniquely suited to interrogate the assumptions and performativity of the dynamic management approach for enabling certain amphibious relations while neglecting others. Specifically, we discuss how the introduction of dynamic management transformed relations of responsibility. We illustrate this argument by analyzing a disruptive event in 2019, when a nascent gas exploration site in the dunes of Ameland was partly eroded, resulting in the release of chemicals into the sea. This event shows that the dynamic management approach enacted distanced relations of responsibility, which stalled an adequate response to coastal erosion. We conclude by reflecting on the

need for the concept of response-ability within amphibious studies and management practices to attend to the politics within amphibious entanglements and flows.

Our analysis is based on two months of fieldwork at Ameland, during which the first author conducted about forty semi-structured and informal interviews and undertook guided walking, bike, horse, and car tours across the island. All respondents were briefed about the goals and outputs of the research and about their option to withdraw according to the Nethics Code of Ethics. Interviews were held with two current employees of Rijkswaterstaat (the executive agency for coastal protection of the Dutch Ministry of Transport, Public Works, and Water Management) and three former employees of the local Rijkswaterstaat office; a former helm-grass planter; the former senior ecological manager of the company that owned the gas platform (NAM, Nederlandse Aardolie Maatschappij, a partnership between ExxonMobil and Shell); residents of the island; local governmental authorities; politicians; site managers; and researchers studying sand movements (ecologists, hydrologists, and geomorphologists). Fieldwork insights were complemented with desk research and targeted interviews. After a first fieldwork period in spring 2021, the first author returned to the island in winter 2022 to see firsthand how winter storms can quickly and dramatically change the dunes, rehear and elaborate on the stories of the islanders, receive their feedback on preliminary analyses, and discuss anonymity and use of names. Several Rijkswaterstaat employees and NAM employees offered feedback by commenting on earlier drafts of this article.

Amphibious Response-ability

Dutch coastal engineering projects in the twentieth century have managed amphibious environments through strictly separating land and sea (van Koningsveld and Mulder 2004; de Vriend et al. 2015; Bijker 2007a). These projects were enabled by technological advances and reflected a land–sea dichotomy (Zwarteveen 2015; Helmreich 2011). The last decade saw a growing number of publications in anthropology, science studies, and affiliated disciplines exposing the limitations of this dichotomy and the policies it underpins (Anderson 2012; Pauwelussen 2017; Steinberg and Peters 2015), and reconceptualizing the fluid, more-than-human and emergent relationality of coastal and marine environments (Gumbs 2020; Pauwelussen 2021).

In this search for fluid thinking, the concept of amphibiousness has gained traction as an analytical tool to foreground the dynamic entanglement between land and sea and the practices that these entanglements

involve and enable (Gagné and Rasmussen 2016; Jensen 2017; Krause 2017). As such, amphibiousness has been used to challenge dualist conceptions of land and sea and destabilize separations in the governance regimes through which land and sea are managed. As a result, perspectives on coasts shifted from seeing them as borders between land and sea to seeing them as hybrid land–water interfaces involving both human and more-than human agencies (Krause 2017). This shift runs parallel with wider trends in ecological thinking, coastal safety, and societal understandings of water, which increasingly move away from the idea that natural forces can or should be fully controlled (Wesselink 2016; Nelson et al. 2020; Tubridy et al. 2022). Conceptualizing areas and infrastructures as amphibious has also influenced coastal engineering, including dynamic management approaches, helping engineers to understand and intervene in coastal or delta regions in a way that fosters the intermingling of water, land, and human dwelling in these areas (Bijker 2007b; Carse 2012; Lahiri-Dutt 2014). For example, amphibiously oriented infrastructures such as particular forms of dams and dikes can sustain human dwelling in flood-prone landscapes (Morita 2016; Barba Lata 2017).

Beyond fostering the hybridity of coastal environments and infrastructures, the concept of amphibiousness has also infused conceptualizations of the relational more-than human practices through which reality takes shape. Amphibiousness as a theoretical concept has been used for its connotation of "ambiguity" and "moving in-between worlds" to put center stage the junctures between multiple placemaking and worldmaking practices (Gagné and Rasmussen 2016; Pauwelussen 2021; ten Bos 2009). Amphibiousness as a theory and method thus destabilizes modernity's categorizations of the world into dichotomies (land/sea, mind/body, and nature/culture), focusing instead on their material and conceptual leakiness (Ballestero 2019). Along that line of thinking, Neimanis's (2017) posthumanist feminist phenomenological work on "bodies of water" suggests that humans in relation to deltas, coasts, and watersheds together form bodies that are always in a process of transformation, where bodies do not have determined contours. Instead, they are "leaky": they are entanglements that interpermeate and partially flow into each other (Neimanis 2017; Pauwelussen 2022). It is through their interpermeability that bodies and entities become entangled and take particular forms and shapes (Barad 2007; Haraway 2008). Amphibiousness, then, is about the flows between different kinds of human and more-than-human bodies, and how these encounters shape what they become and what they can do (Barad 2013; Neimanis 2017).

Applied to amphibious settings, how bodies are shaped by their coastal entanglements affects the set of actions that become possible in responding to coastal change as well as the distribution of coastal risks and responsibilities (Carse 2012). Such distributions are "thick with politics" (Bijker 2007b, 109), sometimes placing large burdens of responsibility with actors who have few possibilities to act (See and Wilmsen 2020; Kaufmann, Priest, and Leroy 2018). The connection between responsibilities and possibilities to act is expressed in the feminist posthumanist reconceptualization of responsibility as response-ability (Barad 2007; Haraway 2012). The term response-ability posits "actions" as "responses," because activities are always reactions to the already ongoing formation of relations (Brown and Dilley 2012; Fukukawa 2019). Therefore, response-ability turns our attention to the conditions for action rather than to the actions themselves (Barad 2010, 2007; Giraud 2019). In other words, response-ability is not about assessing individual actions but about the entanglements that disable and enable actions (Thaler 2022). In contrast to a rule-governed idea of responsibility, response-ability draws on ambiguity and situatedness "where to be responsible is to remain receptive and responsive within the encounter" (Beausoleil 2017, 294). Thereby, the concept helps to focus on the processes through which agency emerges and is distributed and to the politics that are implied in these processes.

While amphibiousness is a powerful concept to think and design more fluidly, complementing it with a notion of response-ability allows us to examine the politics involved in what kind of flows are assumed, desired, neglected, or rendered invisible. The entanglements and flows enacted by coastal management regimes are thus politically conditioned, as they prompt possible responses to some futures and not others (Urueña 2022). We introduce the notion of amphibious response-ability to attend to the relational possibilities for responses in coastal settings, how they shape which things are allowed to flow and entangle more than others, and how they affect the ways in which amphibiousness plays out in practice (ten Bos 2009; Helmreich 2011; Jensen and Morita 2015).

In this article, we compare the amphibious qualities and corresponding response-abilities in the dynamic management approach with those present during the preceding approach of helm-grass management. We explore the human–land–sea entanglements enacted in both approaches and analyze which possibilities to respond emerged because of these entanglements. Acknowledging the politics in generating response-abilities, we begin by comparing helm grass with dynamic management to show both management regimes are similar in the sense that both deliver capacities

to respond to coastal change by virtue of more-than-human arrangements. However, they differ in their understandings and enactments of amphibiousness, because of their temporal orientation, scope, and definition of safety, all of which account for differences in the more-than-human response-abilities the two regimes bring forth, which we subsequently discuss.

Maintaining Ameland's West Coast

Planting Helm Grass

Sand circulates between large sandbanks north of Ameland and the coast of the island (Van Rooijen 2014). For generations, coastal management in Ameland relied on capturing and stabilizing incoming sand. In the dunes, this was done by planting helm grass to create a wind shadow—a place behind which wind is blocked and sand could settle. Repeated helm-grass planting enables dunes to grow over multiple years (Arens and Van der Wal 1998; Clarke and Rendell 2015), resulting in permanently green, steep dunes (Provoost and Bonte 2016). However, dune growth is regularly interrupted when the sea eats chunks of the coast due to winter winds and springtides, after which helm-grass planting would build them up again. This shows the porosity of the island's coastline, and how efforts to stabilize the coast are situated in an ongoing interplay between stabilization and erosion processes. Navigating this dynamic interplay has shaped the situated knowledge of local coastal managers.

Until 1990, ten helm-grass planters employed by the local Rijkswaterstaat office through local contractors were used to meticulously replant bare patches in the dunes on a daily basis. Ten other Amelanders were employed full-time by Rijkswaterstaat to monitor the dunes. Both groups relied on their situated, practical knowledge, and formed a collective of "eyes on the ground" that was able to determine the design of, and strategy for, realizing and repairing dunes. This practical knowledge had been developed through intergenerational and ongoing tinkering with the situated amphibious interactions between water, wind, sand, and grass and through frequent adaptation to disruptions when the coastline was in danger of becoming too leaky. Many of the coastal management activities concentrated on preparing for and responding to high tides and storms, for instance, by replanting damaged patches, putting up emergency barriers, or repairing monitoring technology during

nightly storms (former helm-grass planter, face-to-face interview, April 21, 2021). In this arrangement of localized coastal management, Amelanders enjoyed considerable autonomy in determining appropriate responses to disruptions.

The detailed work of planting led to every spot in the dunes being checked regularly to the extent that every "rabbit hole was planted with helm grass, so to speak" (former Rijkswaterstaat team leader Ameland, face-to-face interview, April 28, 2021). Such monitoring was motivated not only by safety concerns but also by the valuation of historical coastal management work and the resulting high dune row as a shared heritage. To one respondent, the dunes were material expressions of a shared history of land reclamation and coastal maintenance. In this way, the landscape functioned as an archive for stories of coastal dwellers and dialogues between humans, the island, and the sea. Because of this broader range of affective relations, respondents who were not formally assigned to coastal monitoring or maintenance also expressed a sense of collective responsibility to take care of the dunes. For example, one respondent said that even though he was not involved in the practice by himself, he felt connected to the dunes because fellow Amelanders used to "help the dunes" by planting helm grass (resident 2, face-to-face interview, April 24, 2021). This shows that affective relations involved in maintaining and sustaining the stability of the coast in a constantly changing environment also distribute engagement with and responsibility for coastal management as a community-based practice.

Historical Dutch coastal governance that promoted coastal management systems organized around helm-grass planting and dune maintenance is exemplary in assigning relative autonomy to local and regional governments. Particularly in northern Dutch provinces, there is a long history of regional autonomy in water management, in which villages independently organized the maintenance of coasts and dikes, dating back to the start of land reclamation practices in the Middle Ages (Kaijser 2002). However, the independence of the northern provinces also left these coastal regions with limited resources for ensuring the safety of the Wadden Sea islands (Kaijser 2002). This became critical in the 1980s when multiple hectares of dune area were eroded by floods, resulting in increased attention to the need for profound interventions to address the projected effects of climate change, including sea-level rise and increased frequency and intensity of storms. This stimulated a growing realization that localized practices would not suffice to safeguard the islands from erosion (Arens, Loffler, and Nuijen 2007).

The Shift to Dynamic Management

Because of intensified coastal erosion in the 1970s and 1980s, the head office of Rijkswaterstaat no longer considered helm-grass coastal management sufficient to ensure coastal safety and adopted the dynamic management approach (Loffler et al. 2016; van Koningsveld and Mulder 2004; Ministerie van Verkeer en Waterstaat 1989; Rijkswaterstaat employee 1, face-to-face interview, April 22, 2021). This also entailed a shift in the organization of coastal management, from the local Rijkswaterstaat office with employees living on the island to Rijkswaterstaat headquarters. And it involved a fundamental change in understanding coastal safety from a preference for static dunes that could keep the water out to one that ensures a minimum amount of sand to provide a safe "coastal base." This shift was motivated by Rijkswaterstaat's observation that there was a lack of incoming sand that could be captured with helm grass. In comparison to helm grass planting, sand suppletions were more amenable to centralized control and scaling and were therefore considered better able to keep up with sea-level rise in the coming 200 years (Vessem, Cleveringa, and Dijkhuis 2006, 52). Rijkswaterstaat also preferred dynamic management over dike-like helm-grass dunes, as the latter was considered less "natural" because they did not allow for irregular and rough morphological features in the coastline (Arens, Loffler, and Nuijen 2007; DHV 2005; Rijkswaterstaat employee 1, online interview, July 1, 2022).

Sand suppletions are large-scale operations where sand is replenished on beaches or foreshores (the area that falls dry in low tide) to sustain a coastline or reclaim land. To replenish the beaches of Ameland, sand suppletions are carried out by vessels that dredge sand from the seabed about ten kilometers north of the island. The vessels relocate this sand to the foreshore or the beach, and the wind then transports the sand to the dunes. Determining the locations for collecting, dumping, and monitoring of sand is a complex task that involves modeling and engineering (Bruun 1989; Elias et al. 2022; Rijkswaterstaat employee 1, face-to-face interview, April 22, 2021; Rijkswaterstaat employee 2, online interview, June 17, 2022). These activities require different skills, equipment, and expertise than were available among the Amelanders. Local knowledge and monitoring practices were no longer needed, and the number of Rijkswaterstaat employees based on the island gradually reduced to one part-time relations manager (de Amelander 1998).

The shift in coastal management sparked reservations among Amelanders. Amelanders were suspicious about the loss of jobs and the economic

rationale behind the shift. In the context of general austerity policies of the early 1990s in the Netherlands (Montesquieu Instituut n.d.), they wondered whether the change to sand suppletions was part of national cost-reduction strategies. Some Amelanders also considered the lack of maintenance for the green dunes as a lack of respect for the historical achievements of the islanders' ancestors in coastal management (resident 1, face-to-face interview, April 25, 2021). While these two reservations persisted, a third reservation that related to coastal safety gradually diminished over time. Although Amelanders had initially been skeptical about the possibility of safeguarding the island without stable dunes, at the time of research, Amelanders felt safe in the sense that they believed that "Rijkswaterstaat would not let them drown" (resident 1, April 25, 2021). National policy evaluations confirmed that the amount of sand in the coastal system had even increased, which was seen to demonstrate the effectiveness of dynamic management for preventing flooding (Ebbens 2022).

Dutch coastal management thus transitioned from a coastal safety regime based on stabilizing the dunes with helm grass toward a regime based on the principle of unleashing natural processes (i.e., using the wind to carry the sand from the beach). Both regimes include amphibious entanglements. Helm-grass planting functions within the dynamics of existing incoming sand flows, enacting coastal managers with their hands and feet in the sand and their eyes on the coastline. The helm-grass planting practices facilitated diverse, practical, community, and place-based entanglements between humans, sea, and dunes. These entanglements can be described as amphibious because humans and the coast shape each other within the dynamics of land–sea relations. However, in this approach, land and sea continued to be visibly separated. In contrast, the dynamic management regime denounced a rigid separation between land and sea and actively created an amphibious transition zone in which dunes are shaped by waves and sand suppletions. This approach enacted a relatively dynamic coastline with sand on the move but with coastal managers primarily operating at a distance from the Dutch mainland and based to a greater extent on scientific hydromorphological expertise.

This shift in national coastal management starting in the 1990s can therefore be seen as a shift in amphibiousness response-abilities. It established new coastal entanglements and disabled others and it also enacted a change in the abilities to respond to coastal changes. Below we illustrate how this change in abilities to respond came with risks.

The Sea Dismantles a Gas Exploration Platform

Although the dynamic coastal management regime was promoted as a more effective and natural approach to enhancing coastal safety, not all unleashed natural processes were fully under control. While some flows of water and sand were desired—like those enabled by sand suppletions—other flows were unforeseen or neglected. At the southwest coast of Ameland, the North Sea displayed an exceptional hunger for sand, leading Rijkswaterstaat to accept that these dunes would gradually diminish (Roelse 1994, 2002; Rijkswaterstaat employee 2, online interview, June 17, 2022). Precisely at this location lay an obsolete gas exploration platform, to which the sea gained unrestricted access by eroding the dunes that used to protect it. In 2018, this platform was partially destroyed during a storm.

The exploration platform consisted of a tarmac surface that covered a reservoir of soil containing chemicals that had been used during gas exploration. It was a relic of gas exploration activities in the 1960s by NAM, a major gas corporation that operates solely in the Netherlands. These exploration activities never led to the active production of gas because the reserve was not considered profitable at the time. Yet, NAM kept the platform in place in anticipation of possible economic and technological developments that would make drilling here cost-effective (Arcadis 2019). For more than fifty years, NAM left the location largely unattended, while the platform stored contaminants such as mineral oil, xylenes, and barium (ARGUS Milieukundig Ingenieursbureau bv 1991; Antea Group 2016). At the time of construction, the gas exploration site was protected against erosion by a broad line of dunes. This, however, changed profoundly from 2006 onward because a deep gully in the Amelander inlet gradually shifted closer to the beach, causing more coastal erosion (Van Rooijen 2014). In December 2018, the sea eroded a part of the dunes 200 meters northeast of the platform, and as a result, seawater flooded the dune valleys. This erosion was a harbinger of further erosion; on January 9, 2019, a western wind combined with springtide eroded part of the platform, and a portion of the chemicals stored underneath it flushed into the sea.

The decline of the dunes near the exploration site had been a matter of concern among Amelanders for many years. Several Amelanders were in the habit of monitoring the coast and the dunes. Some had been involved in coastal management before and still regularly inspected the dunes. Others kept an eye on the coast while walking their dogs, fishing, or going for a ride. They would regularly comb the beach and document coastal erosion by publishing photos on social media, in particular after heavy storms.

Landscape elements, such as a dwindling bridle path next to the platform, served as reference points to communally track the progress of erosion. Stories about this site also transferred over generations. For example, one respondent described how her parents had protested the arrival of gas companies in the 1960s, and how community members who worked on the site in the 1960s made her aware of the storage of chemicals in the dunes. Such intergenerational observation practices enacted an informal monitoring system that was made possible by the entanglements between (generations of) humans, the dunes, the sea, and economic activities. Because of these entanglements, several Amelanders had been aware of the risks of erosion, and they had warned local governmental authorities, including Rijkswaterstaat employees, about the speed of erosion and the risks associated with the platform.

Rijkswaterstaat had been aware of the dunes' decline for at least a decade before the event in 2019, because they frequently and regularly monitored the development of dunes, especially at the west coast of the island where the exploration site was located (Rijkswaterstaat employee 1, email conversation, August 17, 2022). Five years before the destructive event, the regional Rijkswaterstaat department had already expressed concerns about damage to the platform to the Rijkswaterstaat head office (Van Rooijen 2014). Despite this concern, Rijkswaterstaat did not respond with an intervention to counter the erosion. A regional Rijkswaterstaat employee explained that it is not part of Rijkswaterstaat's formal responsibilities to mitigate risks for pollution as a consequence of erosion. Only when erosion poses a direct threat to flooding, Rijkswaterstaat needs to intervene, usually by means of sand suppletions (Rijkswaterstaat employee 1, email conversation, July 1, 2022). Hence, additional sand suppletion was not considered as an option to prevent damage to the platform due to erosion; Rijkswaterstaat's policies prescribed that flooding was an accepted risk at this site because of its exceptional dynamics. The fact that the platform was located outside of the inner row of dunes (*buitendijks*) also mattered. The boundary between the *buitendijks* and the area within the inner row of dunes (*binnendijks*) demarcated different "safety regimes" that regulated the responsibilities, including which local or national agencies had jurisdiction over a given area. This meant that Rijkswaterstaat was not responsible for maintaining this site (Rijkswaterstaat employee 1, written comments in early draft, August 8, 2022).

As a result of these considerations, the risks involved in the erosion were legally and contractually the exclusive responsibility of NAM. The regional

Rijkswaterstaat employee warned the former NAM environmental manager about the declining coast and stipulated NAM's responsibility. The Rijkswaterstaat employee described this warning as a "request to intervene in order to prevent risks *for NAM*" (our emphasis). However, this warning was not interpreted by the former NAM environmental manager as a matter that required an immediate response (former NAM environmental manager, face-to-face interview, June 13, 2022). According to the former NAM manager, this interpretation was partly because Rijkswaterstaat had initially downplayed the safety risks to avoid concerns among Amelanders. For one current Rijkswaterstaat employee, the failure to explicitly call for action was explained by the platform being barely noticeable due to its inactivity and because it "had always been there" (Rijkswaterstaat employee 2, online interview, June 17, 2022). For the Rijkswaterstaat employee who had warned the NAM environmental manager, the reason for not signaling "code red" to NAM or the Amelanders was that there was no risk in terms of flooding—Rijkswaterstaat's sole responsibility. In other words, Rijkswaterstaat narrowly defined the dunes and the platform as leaky only in terms of flooding; their chemical leakiness was not part of this definition and beyond Rijkswaterstaat's duties.

After the warning, NAM expressed their intention to rapidly remediate the site, but then postponed multiple times because they felt that the dunes offered sufficient protection. It was only in 2018, when the sea fully eroded a dune directly northeast of the platform, that the responsible ecological manager of NAM realized that swift intervention was needed. After this realization, he started a process to initiate the remediation. However, this process was again delayed multiple times for different reasons, including other priorities within the larger NAM organization and stringent environmental regulation that prohibited large machines in the dunes. Another reason for the delay was that NAM initially intended to remediate several polluted areas at once, for which it sought cooperation with Rijkswaterstaat which was formally responsible for three other polluted sites. While these sites were not directly at risk for coastal erosion, an integrated remediation process was initially preferred by NAM because it would be more efficient and cost-effective than several separate remediations. However, this combined operation increased bureaucratic complexity, and therefore NAM eventually decided to focus solely on the platform. Ultimately, the remediation activities started before the sea reached the platform (and before an environmental permit was given) but not in time to prevent part of the remaining chemicals to flow into the sea (former NAM environmental manager, face-to-face interview, June 13, 2022).

Extractive industries have been linked to the creation of material and emotional distance between the sites where decisions are made and sites where the impacts are felt (Appel 2012; Orihuela et al. 2021). Such distancing has been described as particularly notorious for remediation activities because they tend to drag on for several decades and are associated with informational chaos (Shriver et al. 2020; Lawrence 2022; Kramarz 2022). In our case, centralized and technocratic management had detached NAM and Rijkswaterstaat employees from the lived material reality in the dunes due to their organizational fragmentation and physically distant locations. The legal division of responsibilities between NAM and Rijkswaterstaat also enacted separated understandings of who carried the burden of risks. To Rijkswaterstaat, potential pollution was a risk for and responsibility of NAM. In turn, NAM rendered "risk" a matter of liability, and neglected the material implications for the dunes, the Ameland communities, and for the marine environment more broadly.

Shifting Response-abilities

Our analysis demonstrates that different coastal management approaches enact different amphibious response-abilities. Although helm-grass management focuses on creating barriers to keep the sea out, it has amphibious qualities as it produces close-knit human-coast entanglements. However, in the Wadden Sea, the ability of helm-grass management to respond to increasing erosion, among others due to climate change, turned out to be limited. In contrast, dynamic coastal management provides an infrastructure to enact amphibious land–sea interactions that enable sand and seawater to flow and run their course. This approach aims to work with the dynamics of the intertidal Wadden Sea and is promoted for its ability to respond more effectively to rising sea levels. However, the partial erosion of the gas exploration platform also showed that the capacity of dynamic management to respond to events that were not anticipated, or that were outside the scope of what is considered a "natural" process, was limited. Thus, the shift in management approaches replaced a set of amphibious human–sea–land entanglements capable of responding well to visible, short-term, and situated changes with a set of differently amphibious entanglements. This latter set of entanglements was able to respond to long-term, unprecedented changes in the coastal dynamics but lacked the ability to respond to disruptions outside of Rijkswaterstaat's understanding of coastal safety.

Our focus on amphibious response-ability demonstrates how various sets of relations enact different entities that are equipped with different abilities

to act and be acted upon. In our case, this was most explicit for the gas exploration platform. In the entanglements of the coast and the Amelanders, the place-based practices of the community of Amelanders prevented the platform from becoming invisible. This shows that these locally situated practices do more than just greening dunes, entertain dogs, or clean up beaches; they enact entanglements in which industrial ruins can be seen and placed within a context of coastal management (cf. Morrill 2017; Edensor 2005; Awâsis 2020). In contrast, for the actors in the dynamic approach, the obsolete platform had become an industrial ruin that fell outside their classifications of amphibious dynamics, with consequences for management and responsibilities. That is, although the coastal managers monitored and communicated about the erosion, this ultimately did not activate the necessary responses to prevent pollution. Only after the sea made the platform leak toxic chemicals into the sea did NAM start to understand the site as one that required intervention.

The calamity with the platform demonstrates that even when coastal management regimes are amphibious because they deliberately shape dynamic water–land relations, they can have harmful consequences (Floor 2018). Some amphibious encounters may be unexpected and destructive for entities that rely on stable ground (cf. Jensen and Markussen 2001; Asplen 2008; Carse 2012). While some trade-offs may be inevitable (Giraud 2019; Ginn, Beisel, and Barua 2014), they become problematic when they are depoliticized. When trade-offs are naturalized, certain processes are rendered inevitable, invisible, impossible, or undesirable. In other words, when a management regime only fosters relations that can respond to a restricted set of coastal changes, this means that risks that fall outside of its scope are not addressed. In the set of relations enacted in the dynamic management approach, a mixed land–water interface was realized, but other more-than-human bodies were not equally allowed to interpermeate, and the undesired flow of chemicals could not be responded to. Our analysis shows that the risk that the platform would be eroded was a matter that was inactionable by design, partly due to institutional separations between land and sea in the management regime. This shows that when governance arrangements are latently based on a strict land–sea separation, they can affect the distribution of responsibilities in harmful ways. In effect, all involved institutions and groups carry the risk of becoming unresponse-able. Softening compartmentalization and finding the right balance between distributing responsibilities between and among institutions are therefore critical to foster response-abilities. Moreover, it is important to note that mining contexts such as gas exploration sites are notorious for disrupting integrated response-abilities

and for enacting situations of slow violence (Nixon 2011; Kramarz 2022; Whitney 2019). This indicates that contexts of resource extraction require that governmental authorities scrutinize which entanglements are enacted, how they facilitate and obstruct flows, and how this distributes risks and response-abilities.

Scholarship on amphibiousness has demonstrated that the boundaries separating coastal bodies (including land and sea, but also humans, sand, grass, waves, and regulations) and the flows in-between are enacted through more-than-human practices (Jensen and Morita 2015; Empson 2017; Hill 2020; Pauwelussen 2017, 2022). Our analysis makes explicit how amphibiousness is political, because not all flows are equally allowed and enabled. When coastal management focuses on amphibiousness only as unleashing and building on natural processes, while maintaining or erupting separations between other bodies, it limits the possibilities for mixed approaches to respond to harmful leaks such as chemical spills. The limitations of each of the coastal entanglements in responding to environmental disasters marks the importance of making political what kind of dynamics are foregrounded or rendered invisible in (shifting) coastal management regimes since all these aspects together shape who or what can act, is at risk, and is allowed to be porous and leaky (Kramarz 2022; Choi 2015; Bridel 2021).

To be clear, our analysis is not an assessment of the superiority of one coastal management regime over another. Although it is possible that under the helm-grass management regime—due to its situated, place-based and material understanding of risks—the need for intervention might have been signaled earlier and more forcefully to NAM, we are not suggesting that helm-grass management would have been able to prevent the pollution. Instead, our concern is that with the exclusion of place-based relations for amphibious coastal management, particular response-abilities were also excluded. Considering increases in frequencies and intensities of extreme weather events and rising sea levels, and the uncertainties and risks associated with this, the question is how to enable multiple, flexible, and diverse amphibious response-abilities. Appropriately dealing with calamities requires resisting the tendency to depoliticize amphibiousness and equate it with specific natural processes, in our case, the changing location of the coastline. Although response-abilities are forward-looking, in practice, these actions are equally conditioned by predictions of the future as by the formation of relations in the past through coastal management schemes (Choi 2015). What is needed are amphibious coastal management practices that recognize the unpredictability of land–sea entanglements, the

inevitable leakiness of more-than-human bodies, and the politics involved in the enactment of water bodies, coastal relations, and response-abilities. Such a management approach can foster more politically informed, pluralist, and situated abilities to prevent environmental calamities (Moore 2016). We end this article by articulating suggestions for how Dutch coastal management can foster pluralist and political amphibious response-abilities.

Conclusion

As we have seen, the shift in Dutch coastal management was motivated by the judgment that dynamic management generates better abilities to respond to sea-level rise and ensure dry feet for human coastal residents. Indeed, the entanglements enacted by dynamic management enabled amphibiousness in the sense of dynamic land–sea relations that proved to be effective in reducing the risk of flooding for Ameland. At the same time, dynamic management decreased amphibiousness in how humans are entangled in these relations, and it failed to recognize what kinds of amphibious entanglements were enabled and disabled, and with what consequences for abilities to respond. While dynamic management has enhanced abilities to respond to some risks—sea-level rise and extreme weather events being the most prominent ones—it has not been able to address other risks that equally demanded a response. We therefore conclude that amphibious coastal regimes need to attend to the diverse amphibious bodies and flows, and the associated possibilities to act, that can be brought into being.

Dynamic management and its attention to amphibious resilience align well with suggestions and recommendations derived from science and technology studies (STS) research (Morita 2016). Our analysis raises the ante. To become more response-able to environmental risks, an integrated understanding of the politics of amphibiousness is required. Our emphasis on politics is motivated by the same reasons that propelled dynamic management into existence in the first place: the need to cope with increasingly unpredictable extreme weather events associated with climate catastrophes and crumbling coasts. It is also motivated by the observation that a transition from one coastal management regime to another is always situated in a particular history and context, including place-based more-than-human relations as well as industrial artifacts. Such situatedness tends to get overlooked in crisis situations, and this risks authoritarian and depoliticizing interventions that often render centralized technical relations as the only legitimate ones to respond to urgent threats (Aykut, Demortain, and Benbouzid 2019; Choi 2015; Gagné 2019). Centralization and technicalization

redistribute risks and vulnerabilities in particular ways, in our case, from the risk of flooding to the risk of pollution. To respond to possible future risks, management approaches require a multitude of entanglements that can see and democratically take care of the dynamic unpredictability of future coasts across times, scales, and types of risks (Nelson et al. 2020).

Therefore, we end with a suggestion for coastal management to be more ambitious (and more pluralist and political) in its amphibiousness. For this, we draw inspiration from historical Dutch water governance and from contemporary experiments with the coproduction of expertise. The co-dependence between the Dutch and water has historically resulted in innovative engineering *and* innovative governance, leading to a participatory and decentralized organization of human–water relations (Kaijser 2002; Bijker 2007b; Brouwer 2006). To connect such long-standing ideas of decentralized water responsibilities to more contemporary democratic innovations, we suggest that amphibious response-ability can be better achieved through collaborations between scientific, executive, and local experts in the form of local knowledge and management alliances (Whatmore 2013; Lane et al. 2011). This suggestion does not include a formulation for what amphibiousness in this locality should entail precisely, as it is for the knowledge alliance to collectively and situatedly determine what events require what response-abilities. Instead, we suggest to shape this alliance as an amphibious and more-than-human partnership. For this partnership to be amphibious, it requires embracing and even encouraging pluralism and politics in the process to allow for human, water, and other bodies and matters to be permeable (Latour 1993; Waterton 2017). It would be a key task of this alliance to collectively determine what knowledge is salient and missing for the diverse response-abilities that might support that locality (Liboiron 2021). To achieve this, participants should be willing to bring their personal histories, relations, and knowledge to the table, open up every phase of knowledge production for contestation, including scientific work that usually does not allow local and nonlocal experts to be involved (Tsouvalis and Waterton 2012). Ultimately, what is at stake is the ability of the alliance to generate caring and capable entanglements between and across people and nonhumans—entanglements that include different forms of scientific and local forms of knowledge, that connect centralized policies and place-based practices, and that involve not just management but also living, walking, and playing at and with the coast (Landström et al. 2011; Waterton 2017). In this way, such an alliance can spur inclusive political decisions about which issues require a response.

Acknowledgments

Thanks to Jelle Behagel and Judith van Leeuwen for their useful feedback on earlier versions of this article. Thanks to Sammy Hemerik and Veerle Boekestijn for their help with fieldwork and analysis. We further wish to thank the respondents for their insights and time and acknowledge that without them, this work would not have been possible. Lastly, we are grateful for the elaborate and constructive feedback of three anonymous reviewers.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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