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‘Mind the Gap’ between ecosystem services classification and strategic decision making

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ABSTRACT

Ecosystem services (ES) are increasingly embedded in policy agendas, but if and how policy actors are considering them is not often reported. This study assesses the extent to which ES were considered by key policy actors involved in the strategic decision-making process leading to an innovative large-scale Dutch coastal management project. We analysed retrospective interviews to ascertain which ES were considered and how they were described by policy actors. Over half of the quotes (118/228) and 16 out of the 17 interviewees referred to three broad ES categories, with high degrees of adoption: coastal safety, recreation and cognitive development (learning by doing). The broad terms ‘nature’ and ‘spatial quality’ were also referenced often (36 times). Our findings suggest that broad, unspecified ecosystem services were adopted highly by the policy actors, while specific ecosystem service categories were rarely considered. Relatable and comprehensible cultural ecosystem services also constituted critical arguments for policy actors in their strategic decision making. We reflect that ambiguous, broad terms can help to garner support and unite efforts across disciplinary and institutional boundaries. For ES to align with relevant aspects of decision making, a ‘translation step’ between ES research and decision making might be required and ambiguity should be acknowledged.

1. Introduction

In the past decades, scientific research has embraced the ecosystem services concept, which connects nature to human wellbeing (TEEB, 2010). Ecosystem service assessments can inform policy makers on the socio-economic and cultural consequences of biodiversity loss and environmental degradation in an intuitive way, which aids communication (Ruckelshaus et al., 2015). Ecosystem services are increasingly embedded in national and supranational policy agendas, such as that of the United States (Arkema et al., 2015), the European Union (Maes et al., 2012) and the recently established Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (www.ipbes.net). However, the uptake of the concept in general and of specific ecosystem services in policy decision making (‘decision making’ throughout this paper) seems to have occurred slowly and perhaps not as comprehensively as initially expected (Bouwma et al., 2018; Schleyer et al., 2015). If and how policy actors consider ecosystem services in decision making has only recently been considered in the literature, as have the factors influencing this adoption (Laurans and Mermet, 2014; Wright et al., 2017).

The ecosystem services concept assumes a decision-making model in which explicating and quantifying ecosystem services enables comparison of the benefits of different courses of action, and choosing and planning accordingly (Daily et al., 2009). However, the limitations of this model include policy actors’ shifting goals, the haphazard and opportunistic search for information and policy alternatives, and the often incomplete and non-systematic analysis of those alternatives (Eisenhardt and Zbaracki, 1992). So, providing well-founded, science-

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based assessments of the changes in ecosystem services, i.e. instrumental use, is not necessarily sufficient to give the ecosystem services concept weight and significance in decision making (Laurans and Mermet, 2014; Wright et al., 2017). Recent studies suggest that decision makers are more likely to utilize ecosystem services research outcomes if the concept and specific reporting categories have been explained to them and the classification is based on stakeholder consultation (Hauck et al., 2013; King et al., 2015). In addition, Posner et al. (2016) showed that attributes enhancing salience and especially legitimacy best explain the impact of ecosystem services information on decision making. This suggests that the topics covered in ecosystem services assessments need to be relevant to decision making (laws, policies, problems or election themes), but also that policy actors need to be heard in such assessments (van Oudenhoven et al., 2018). Such insights can help identifying which factors to consider when conducting ecosystem service assessments for decision making, and when communicating to policy actors on topics related to ecosystem services (Ruckelshaus et al., 2015).

With this paper, we contribute to the literature on the uptake and adoption of ecosystem services in decision making. The majority of this relatively recent body of work has focused on the question if and how ecosystem services information reaches and influences decision making, and relates to how individual ecosystem services have been embedded in existing policies, implemented laws and formal policy processes (Bouwma et al., 2018; Mann et al., 2015; Schleyer et al., 2015; Wright et al., 2017). In our paper we take a step back, by observing arguments of Dutch policy actors in support of a decision that could shape Dutch coastal management in the future. By relating ecosystem services to the arguments and motivations of policy actors who have not been exposed to ecosystem services information, a sense of the coherence, relevance and compatibility of specific ecosystem services can be obtained, as well as of the concept as a whole (Bouwma et al., 2018). In addition, instead of assessing a formal decision making process leading to the formulation of concrete policies or laws, we observe a *strategic* decision-making process in the context of a large-scale *pilot project*, where we follow Mintzberg et al. (1976) in defining a *strategic* decision as one that is important in terms of the actions taken, resources committed, and the precedents set. Furthermore, studying decision making in *pilot projects* offers unique insights, because policy actors may employ pilot projects strategically to test the potential success or failure of innovations and decisions in a non-linear, iterative decision-making process (Vreugdenhil et al., 2010). Finally, coastal management in The Netherlands has traditionally been 'forced' to be innovative and multifunctional (van Wesenbeeck et al., 2014). Studying a large-scale pilot project in Dutch coastal management can therefore be regarded as a litmus test – it offers us the opportunity to observe if innovation and multifunctionality in coastal management have been explained by policy actors in terms of ecosystem services or in terms of other concepts and ideas. This forms an important contribution to the literature on the uptake of ecosystem services in coastal and marine decision making, on which few studies have been published to date (c.f. Beaumont et al., 2017; Drakou et al., 2017).

The case study considered in this paper is an innovative large-scale coastal management pilot project, the pilot 'Sand Motor' in the Netherlands. The Sand Motor is a large, locally concentrated sand nourishment of 21.5 million m^3, which was realized in 2011 on the North Sea coast in the Netherlands (Aukes et al., 2017; Bontje and Slinger, 2017). This sand nourishment required finances of 70 million euro to be committed and an unprecedented stock of sand to be deposited in one location, while it triggered a worldwide interest in large-scale sand nourishment technology. Strategic decision making in the pilot involved first establishing and then widely communicating the Sand Motor's added value, next to the original goal of coastal protection, in terms of the multiple goals of recreation, knowledge development and innovation, and nature development (Aukes et al., 2017). Although the aims of the pilot Sand Motor are intimately linked to some ecosystem services, the extent to which ecosystem services were considered by policy actors has not been studied yet. Therefore, the pilot Sand Motor provides a case study of theoretical relevance (c.f. 'theoretical sampling' in Corbin and Strauss, 1998), to evaluate the consideration of ecosystem services in the pilot's initiation and design process.

Hence, the objective of our study is to assess the degree of adoption of ecosystem services by policy makers involved in the strategic decision-making process leading to the pilot Sand Motor. We explore this process through the eyes of key policy actors, i.e. policy actors involved in the initiation of the pilot Sand Motor. To achieve our objective, we analysed a series of retrospective in-depth interviews with policy actors to ascertain which ecosystem services were considered in support of this coastal protection alternative. We also characterised how the ecosystem services were described by policy actors and the degree of adoption of the ecosystem services by Dutch coastal policy actors representing different organisational levels. Finally, we reflect on the implications for the utility of the ecosystem services concept, the definitions of ecosystem services and their classification at the science-policy interface, focusing particularly on coastal and marine decision making.

2. Strategic decision making in pilot projects

Literature on the adoption of the ecosystem services concept in decision making has mainly centred around existing policies or landscape planning (Bouwma et al., 2018; Mann et al., 2015; Verutes et al., 2017). The concept's role in strategic decision making in pilot projects, which essentially are policy instruments feeding into wider policy processes, has received little attention. Studying decision making in pilot projects is more common in social sciences studies. Such studies offer unique insights, because pilot projects allow technological or administrative innovations to be tested and learning to occur about the working of the innovation in practice as a policy instrument (Vreugdenhil et al., 2010). This evidential basis can then be used to roll out the technological or administrative innovation at a broader institutional scale (Sanderson, 2002). A successful pilot project may therefore act as a stepping stone to wider application of policies and innovations, making it a favoured policy instrument (Vreugdenhil et al., 2012). The relatively small scale of a pilot project is usually selected to reduce risks, while allowing for experimentation. Cross-sectoral and cross-disciplinary issues can be tackled, and by facilitating temporary cooperation between actors in unconventional coalitions, pilot projects can bring usually disconnected policy actors together and can build shared learning experiences.

The execution of the pilot Sand Motor allowed an unprecedented large-scale sand nourishment that combines the multiple goals of coastal safety, nature and recreation, among others, to be tested in the field. The goals of nature and recreation were added to the project after having formulated the initial goal of coastal safety (Aukes et al., 2017). In addition, to make sure that learning occurred about the working of this innovation in practice, knowledge development and innovation were subsequently also listed as part of the pilot's goals. The pilot brought together, and facilitated cooperation between, multiple actors and multiple disciplines. The coalition of actors that signed the ambition agreement leading to the Sand Motor's realization consisted of the Province of South Holland, the Ministry of Transport, Public Works and Water Management, local municipalities, the local water board and, finally, an environmental NGO not involved in the formal decision-making process (Province South Holland, 2008). As such, this actor coalition provided a forum in which coastal management change could be practised and a shared learning experience could be built (cf. Vreugdenhil, 2010). The pilot Sand Motor was identified as an advocative and precedent-setting pilot project by Vreugdenhil et al. (2010) and experienced by several initiating policy actors as an 'iconic' departure, in the sense that different ongoing development processes in

Dutch coastal management were interwoven resulting in a new step in the development of sand nourishment techniques (Bontje and Slinger, 2017).

Eisenberg (1984) established that strategic ambiguity is essential in communicating effectively in decision-making situations with multiple and potentially conflicting goals. This is particularly relevant for pilot projects, in which actors work in unconventional coalitions and tackle cross-sectoral and cross-disciplinary issues to enable innovation. In such transdisciplinary pilot project settings, boundary objects, such as ecosystem services or sustainability, often play an important role as they are concepts that are intentionally vague and, thus, remain adaptable and flexible enough for participants to maintain their identities across themes, contexts, and networks (Abson et al., 2014; Schröter et al., 2014).

3. Methods

3.1. Data collection

The data for this study were drawn from two sets of qualitative in-depth interviews conducted between January 2014 and November 2015, described in more detail elsewhere (Bontje and Slinger (2017) and Aukes et al. (2017)). Both interview sets dealt with the decision-making process that led to the pilot Sand Motor (i.e. before the year 2011), not with an evaluation of the on-going pilot. Neither of the sets of interviews dealt with ecosystem services, nor did the interviewers explicitly ask about them. In one set of seven interviews the interviewees narrated their experiences in the decision-making process that preceded the pilot Sand Motor (Table 2, 'Narrative interviewing' (Bontje and Slinger, 2017)). The other set of eleven semi-structured interviews dealt with critical moments during discussions around the policy process leading to the pilot Sand Motor (Table 2, 'Semi-structured interviewing' (Aukes et al., 2017). For the purposes of this current study, we ensured that all interviews were transcribed and that if requested by the interviewee, the transcripts had been sent back for verification. Because our study involved a re-examination and analysis of the interviews in the light of the ecosystem services concept, the permission of interviewees for the re-use of the interview material was requested. The interviewees are anonymized in the presentation of the research.

The involved actors can be divided into four organisation categories: provincial government (Province of South Holland; eight interviewees), the Public Works Agency (PWA, a division of the Dutch Ministry of Infrastructure and the Environment; six), municipalities (two) and the water board (one) (Table 1).

3.2. Classification of coastal and marine ecosystem services

We made use of a consistent classification system of coastal and marine ecosystem services when coding the interview transcripts. Ecosystem service classifications specific to coastal and marine ecosystems have only recently been discussed and proposed (Böhnke-Henrichs et al., 2013; Hattam et al., 2015; Liquete et al., 2013). Based on these classifications, we adopted the classification shown in Table 2 as it applies to both the marine and the coastal context, whereas most others tend to focus more strongly on the marine context. Furthermore, this classification excludes purely ecological phenomena, such as ecological functions or processes (c.f. Van Oudenhoven et al., 2015).

Posner et al. (2016) and van Oudenhoven et al. (2018) underlined the importance to consider scientific credibility as well as salience and legitimacy when assessing ecosystem services in relation to decision making. The classification systems incorporated by us were based on those by TEEB (De Groot et al., 2010) and CICES (Haines-Young and Potschin, 2013), both of which are widely considered, approved by decision makers and, in case of the latter, even co-developed with a wide range of stakeholders (Czúcz et al., 2018), thus providing the salience and legitimacy required. In addition to using a deductive approach based on this classification, we were also open to considering additional terms that would not fit within an ecosystem services classification system. This is further explained in Section 3.3.

3.3. Data analysis

We developed a deductive coding scheme, in which we linked the ecosystem services classification (Table 2) to individual codes (final column in Table 2), using Atlas.ti (http://atlasti.com/) and Nvivo (QSR International). Four ecosystem services did not feature in the interview transcripts: genetic resources, medicinal resources, air quality regulation and biological control. We applied the coding scheme to the interview transcripts to record the number of references to ecosystem services. Recreation was coded as a general term, as well as split into specific activities: hiking, kite surfing and beach activities. This aligns with other studies on the recreation ecosystem service that also divided the service into specific activities (e.g. Lamb et al., 2014). The absence of ecosystem services from the interview topic list allowed us to assess how the interviewees themselves talked about the natural aspects of the case without prior explanation of the concept. In doing so, we avoided the pitfall of influencing their answers. We tested for inter-coder agreement by randomly selecting samples from interview transcripts, anonymising them and then requiring the other authors to code them (Miles and Huberman, 1994). When coding conflicts or ambiguities arose, these occasions were discussed and, if necessary, the coding

Table 1
Organisation and occupation of interviewees, as well as interview technique applied. Material from a total of 17 interviewees was analysed in this study.

Organisation	Occupation	Narrative interviewing	Semi-structured interviewing
Province of South Holland	Programme manager	x	x
	President of steering group		x
	Two project group members		x
	Project manager		x
	Coastal management expert		x
	Provincial governor*	x	x
	Member of provincial council	x	
Public Works Agency (PWA), division within Ministry of Transport, Public Works and Water Management	Vice president		x
	Two permit officers		x
	Project manager implementation		x
	Policy advisor		x
	Manager innovation program, policy advisor	x	
Local municipalities	Policy advisor*	x	x
	Policy advisor	x	
Water Board	Policy advisor	x	

* Interviewees were interviewed using a combination of both interviewing techniques. Interviewee's responses were considered as derived from one person.

Table 2
Classification of coastal and marine ecosystem services, adapted from those by Böhnke-Henrichs et al. (2013), Hattam et al. (2015) and Liquete et al. (2013). The codes used to identify these ecosystem services in the interviews are provided (see methods). An asterisk in the final column means that the ecosystem services were not encountered in our study. Two additional broad terms, i.e. 'spatial quality' and 'nature', are listed as explained in the methods section.

Ecosystem Service	Description	Code
Provisioning		
1. Food	Coastal and marine flora and fauna available to human consumption	FOOD
2. Fresh water	Potable fresh water for human consumption	FWATER
3. Energy	Alternative energy, due to waves, wind, currents etc.	AENERG
4. Biotic materials	Biotic materials used for construction – wood, seaweed, sand, shells etc.	BMAT
5. Genetic resources	Genetic material for use in non-marine/-coastal contexts (excluding research value, covered in 20)	*
6. Medicinal resources	Extraction of material for its ability to provide medicinal benefits (excluding research value, covered in 17)	*
7. Ornamental resources	Material extracted for use in decoration, fashion, souvenirs etc.	ORNRES
Regulating		
8. Air quality regulation	Influence on concentration of pollutants from the atmosphere by soil, vegetation and water	*
9. Climate regulation	Contribution to favourable climate through impacts on hydrological cycle, temperature regulation and atmospheric substances	CLIMREG
10. Coastal protection	Contribution to the integrity of the beaches and dunes as a flood defence barrier	COASTSAF
A. Disturbance prevention	Contribution to buffering energy of waves, storm surges and hurricanes, preventing inundation	DISTPREV
B. Coastal erosion prevention	Contribution to coastal erosion prevention by transporting sediment to coasts vulnerable to erosion or likely to be threatened	EROSPREV
11. Water regulation	Maintaining the constant supply of fresh water, balancing dynamics of local water flows, water bodies and currents	WATERSTORE
12. Waste treatment	Removal of pollutants added to water and/or sediments	WASTETREAT
13. Biological control	Contribution to the maintenance of disease and pest control	*
Cultural		
14. Nature-based leisure and recreation and tourism	Providing opportunities for tourism, recreation and leisure that depend on a particular state or feature of the ecosystem	RECREA
a. Surfing	Providing opportunities for kite-/windsurfing	RECREAKITE
b. Bathing	Providing opportunities for bathing	RECREABATH
c. Beach activities	Providing opportunities for beach activities – cycling and walking	RECREAACT
15. Aesthetic experience	Contribution to the existence of landscape features that generate a noticeable emotional response by the observer	AESEXP
16. Inspiration for culture, art and design	Contribution to environmental features that inspire elements of culture, art and design	INSPCULT
17. Information for cognitive development	Contribution to education, research, knowledge development	COGNDEV
18. Spiritual experiences	Spiritual experience – contribution to formal and informal religious experiences	SPIREXP
19. Cultural heritage	Contribution to cultural heritage and identity, either local or global. Includes coastal/marine environments in local traditions/folklore	CULTHER
Habitat		
20. Gene pool protection	Contribution to the maintenance of viable gene pools, which enhance the resilience of the ecosystem and species adaptability to environmental change	GENEPOOL
21. Life-cycle maintenance	Contribution to migratory species of commercial or protection interest through providing essential habitat for reproduction or maturing	LIFECYCL
Additional broad terms		
Spatial Quality	A broad description, but no ecosystem service. Umbrella term that captures 'landscape', quality of surrounding and environment, etc. Excludes reference to beautiful landscapes, which is covered in 15	SPAQUA
Nature	A broad description, including 'green', 'nature', 'biodiversity' in general, 'animals', 'plants', 'flora & fauna' etc. Excludes aspects covered in 15, 20, 21	NATURE

scheme was adapted. For example, few interviewees referred specifically to the ecosystem services 'erosion prevention' or 'disturbance prevention' (Table 2). Instead, the interviewees frequently mentioned broader terms, such as 'coastal protection' or 'coastal safety'. We subsequently aggregated the two codes 'erosion prevention' and 'disturbance prevention' into a 'coastal protection' code. This process of inter-coder reliability testing allowed for a better agreement on what we meant by the coding categories and reduced coding inconsistencies. Furthermore, 'nature' or 'spatial quality' were not part of the initial coding scheme. Because many interviewees mentioned them as desired functions of the Sand Motor, we added these two general terms to the coding scheme (Table 2). No other broad terms emerged during the coding.

The coded quotes were linked anonymously to the respective organisation. This completed the compilation of the raw data (e.g. Table 3) prior to the final analysis. For each transcript, we counted how frequently the 17 interviewees referred to the ecosystem services or the broad terms. Apart from focusing on overall trends, we were also interested in how representatives of different organisations (the Province, Public Works Agency (PWA), water board and municipalities) referred to those terms. We corrected for the number of interviewees per organisation, as this ranged between one and eight. Differences per organisation were considered as a criterion for the degree of adoption (see below). We also compared the corrected number of quotes by actors representing the two largest organisations that played a crucial role in the pilot Sand Motor, namely PWA and the Province (Aukes et al., 2017).

Next, a qualitative characterization of how the interviewees referred to the individual ecosystem services was developed based on all the quotes per category. Finally, we inferred the degree of adoption of each ecosystem service and the broader themes amongst the involved policy actors in the pilot Sand Motor, in line with Bouwma et al. (2018) and Raum (2018). The degree of adoption of an individual ecosystem service category or broad term was based on qualitative and quantitative criteria, namely 'widely referred to', 'consistency across organisations' and 'overall consistency'. The first criterion was met if quotes referring to a term were provided by more than half of the interviewees and the second criterion was met if interviewees from at least three of the four governmental organisations referred to the term. The third, qualitative, criterion was met if the reported category was referred to in a consistent and coherent manner (Bouwma et al., 2018). The overall degree of adoption was only deemed 'high' if all three criteria were met.

Table 3
Example of the raw data used for our analysis, for the ecosystem service 'coastal protection' and 'recreation', and the broad term 'nature', respectively. Respondents were assigned a letter, for reasons of anonymity. Note that the quotes were originally in Dutch.

Code	ES category	Respondent	Quote	Governmental organisation
FWATER	Provisioning	H	"And behind this beach, a drinking water company provides water to around three million inhabitants. It would affect the ground water level. And there were possibilities that drinking water extraction would be under threat. So that company wanted guarantees."	Public works agency
COASTSAF	Regulating	K	"I mean, we are not just concerned with the safety of today, but also for the coming twenty years."	Province
COGNDEV	Cultural	L	"We also wanted to learn, and we have really learnt a lot. Within a pilot like this, almost everyone is seeking for something."	Province
Nature	None	O	"At a certain moment we discovered that many things were still unclear regarding the effects of sand nourishments on shellfish and other animals."	Public works agency

4. Results

4.1. Quantitative overview of references to ecosystem services

A total of 228 quotes referring to specific ecosystem services and the broad terms 'spatial quality' and 'nature' were compiled from the interview data. The term 'ecosystem services' or a synonym thereof was not mentioned in any of the interviews, but ecosystem services were certainly considered during strategic decision making in the pilot Sand Motor. As shown in Fig. 1, particularly regulating services (78) and cultural services (103) were referred to often, whereas provisioning (8) and habitat services (3) were only referred to by a few interviewees. All 17 interviewees referred to cultural services, but only two interviewees referred to habitat services. More than half of the quotes (118) and 16 out of the 17 interviewees refer to three ecosystem services: coastal safety, recreation and cognitive development.

Recreation (58 quotes, 14 interviewees) and cognitive development (31 quotes, 15 interviewees) were the most frequently mentioned cultural ecosystem services (Table 4). However, the majority of quotes to cultural ecosystem services referred to recreation in the broad sense (38 quotes, 14 interviewees), without further specifying the type of recreation (20 quotes for hiking, kite surfing and beach activities combined, 8 interviewees). This trend is similar to the quotes on coastal protection; 49 quotes referred to coastal protection in the broad sense (15 interviewees), whereas considerably fewer quotes referred to the specific coastal protection services of disturbance prevention (13 quotes, 6 interviewees) and coastal erosion prevention (8 quotes, 5 interviewees). Finally, six of the eight quotes on provisioning services referred to fresh water, whereas all three quotes on habitat services referred to life-cycle maintenance.

In total, 111 references to ecosystem services could be attributed to interviewees from the Province (13,9 quotes per interviewee), followed by 49 references by the PWA (8,2 quotes per interviewee), 21 references by the municipality (10,5 quotes per interviewee) and 11 by the one interviewee of the water board. Despite these considerable differences in number of interviewees and references, general trends can be discerned from the results in Table 4. For instance, interviewees from all organisations referred to cultural services, specifically recreation (2,2 quotes per interviewee) and cognitive development (1,8 quotes per interviewee), and regulating ecosystem services, specifically to coastal protection (2,9 quotes per interviewee). To put these numbers in perspective, note that none of the other ecosystem service categories was referred to more than once per interviewee (range: 0,1–0,8 quotes per interviewee). Furthermore, interviewees from all organisations, except the water board, referred to all categories of cultural services

Comparing the results from the Province and the PWA (Fig. 2, Table 4) reveals that more interviewees from the Province referred to a higher number of ecosystem services and did so more often than the interviewees from the PWA. Despite these differences, the relative contribution of the quotes to ecosystem services show a largely similar distribution. The only exceptions are for recreation (general) and cognitive development. A larger percentage of the quotes by interviewees from the Province refer to recreation as compared to the PWA (16,7% vs. 10,4%, 2,8 vs. 1,2 quotes per interviewee, respectively), while the inverse was true for cognitive development (12,1% vs. 20,9%, 2,0 vs. 2,3 quotes per interviewee, respectively).

4.2. Characterisation and degree of adoption of ecosystem services

This section describes how the interviewees referred to ecosystem services, and the extent to which these descriptions per ecosystem service category are consistent with each other. These aspects, combined with the quantitative assessment in Section 4.1 inform on the degree of adoption of individual ecosystem services (Table 4). Coastal protection, recreation and cognitive development were most frequently mentioned and were characterised by a high degree of adoption

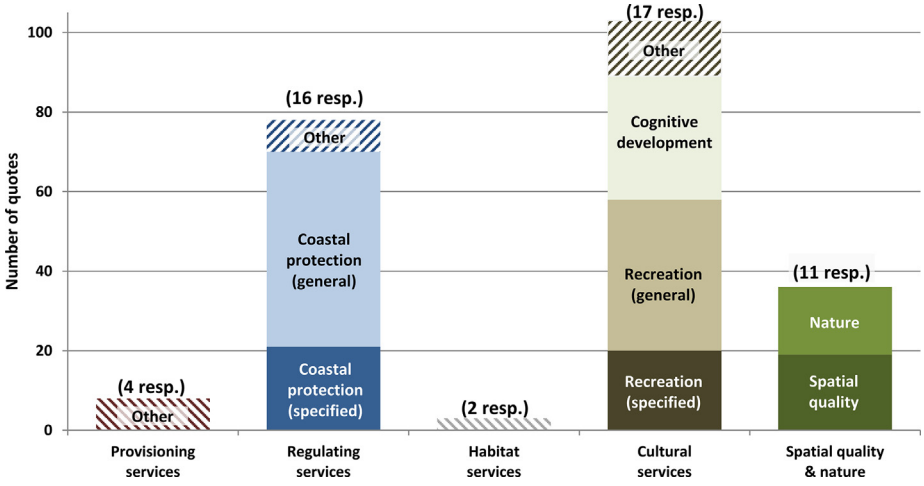
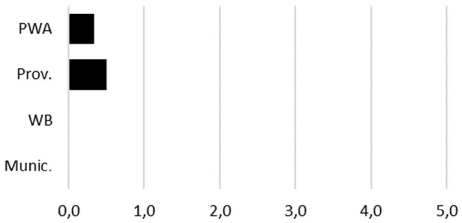
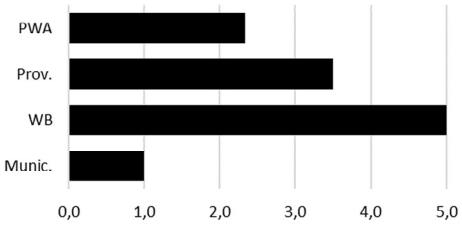
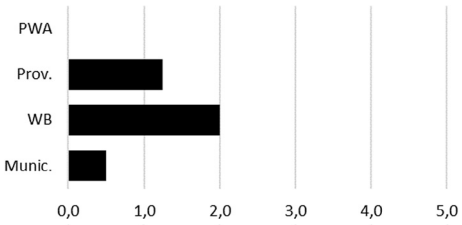
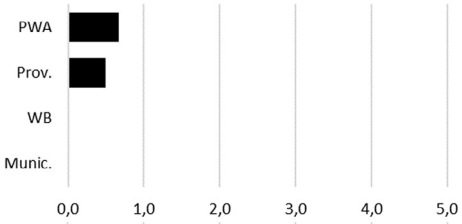
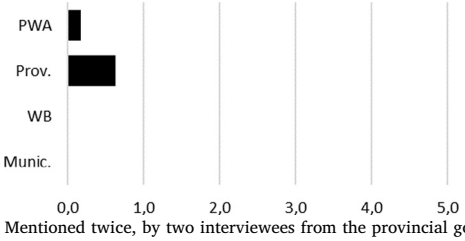
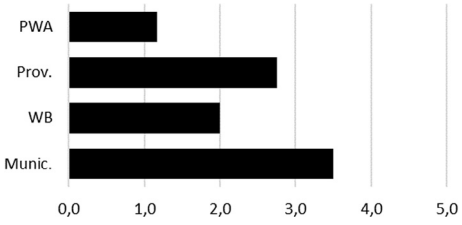


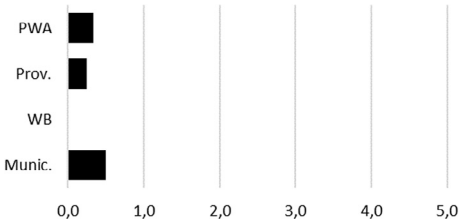
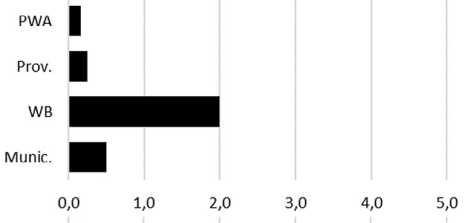
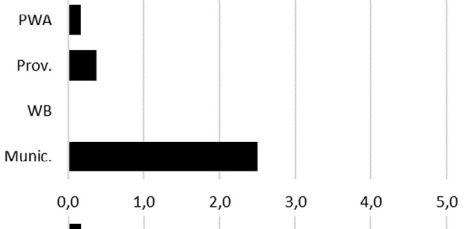
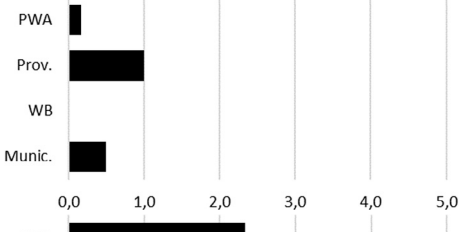
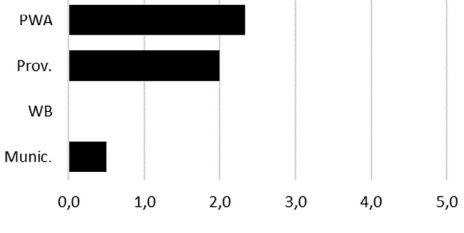
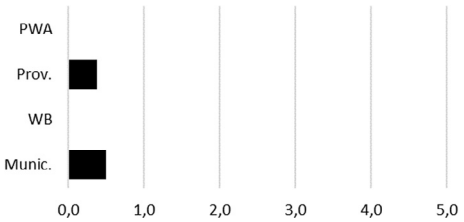
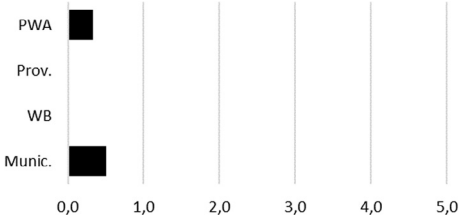
Fig. 1. Total number of quotes referring to the four broad categories of ecosystem services, as well as 'spatial quality' and 'nature' combined. Sub-categories are indicated per bar. Diagonally shaded sections refer to all other sub-categories combined. Numbers above the bars indicate the number of respondents (resp.) that contributed quotes (n = 17).

Table 4
Overview of number of quotes per governmental organisation referring to ecosystem services. The characterization of how the terms were referenced is also provided, as well as the degree of adoption by the policy actors.

Ecosystem service	Number of quotes per governmental organisation[a]	How respondents referred to ecosystem service[b]	Degree of adoption
Food	Mentioned once, by the provincial government.	Sustainable fishery and aquaculture. No specific reference to the case.	Low
Fresh water		Increased water lens of Sand Motor will contribute to extra drinking water. Often referred to in combination with water regulation. All quotes refer specifically to the case.	Low
Energy	Mentioned once, by the provincial government.	Solar, wind, osmosis-based, geothermal, biomass and tidal energy. No specific reference to the case.	Low
Coastal protection		A strengthened coastline to provide coastal protection. Consistently referred to as coastal protection or simply safety, without reference to how and what. Mostly referred to in the light of negotiations, budgets and long-term visions (20 to 50 years). Most quotes refer to larger scale policy aims and visions, some of which are then applied to the case.	High
Coastal protection: disturbance prevention		A sufficiently wide, tall and well-maintained dune area will reduce the potential impacts of sea level rise and the occurrence of a 'super storm', which occurs every 10.000 years. These impacts are by some interviewees specifically related to green houses and residential areas. Only one quote makes specific reference to the case, the others explain a vision for future coastal management.	Low
Coastal protection: erosion prevention		Maintenance of the beach and coastline, by keeping the natural flow of sand intact. 'Feeding' the beach areas that are 'hungry' for sand. Unsafe areas are those where erosion is highest. Making sure that the flow of sand is maintained and understood. Most quotes refer to wider context of sand nourishment, rather than the case.	Low
Water regulation		Maintaining the groundwater level in case of intensive rainfall and protecting the fresh water lens against salinization. Often used in combination or interchangeably with fresh water provision.	Low
Waste treatment	Mentioned twice, by two interviewees from the provincial government.	Threats to surface water quality and salinization of groundwater. Both quotes refer to the case.	Low
Nature-based leisure, recreation and tourism		Recreation opportunities as a result of the local expansion of the coastline. Very little description of the kind of envisioned recreation, and some respondents are uncertain of whether recreation would really catch on at the Sand Motor. Some respondents address concerns people had about safety for recreants. Most quotes refer to the case.	High
Recreation: kite surfing		Lagoon and shoreline provide good opportunities for kite surfing. Unexpected form of recreation, and not specifically accounted for in the planning phase. Services often referred to in combination with other recreation	Low

(*continued on next page*)

Table 4 (*continued*)

Ecosystem service	Number of quotes per governmental organisation[a]	How respondents referred to ecosystem service[b]	Degree of adoption
		opportunities. All quotes refer to case.	
Recreation: bathing		Concerns of reduced swimmer safety as a result of the Sand Motor. No quote mentions the actual service without also referring to the safety concerns. All quotes refer to the case.	Low
Recreation: beach activities		Opportunities for hiking and walking on the Sand Motor, which results in all year around visitation. Half of the quotes refer to concerns regarding reduced walking experience, for instance due to inaccessibility, risk of getting lost and instable terrain. All quotes refer to the case.	Low
Aesthetic experience		A wide and unique landscape, an attractive landmark. In addition, quotes refer to its quiet environment, accessibility and lack of fences, which contribute to the experience. Several individuals recognise that this service's benefits cannot be captured in monetary terms, although two individuals highlight that the coast can be made more 'luxurious'. All quotes refer to the case, but some place it in a wider context of coastal landscapes.	Low
Cognitive development		The Sand Motor is a unique large-scale experiment, that, combined with the unprecedented decision-making context and the multifunctional approach in its design, provides a learning experience for the numerous scientists studying it. In addition, when understood, the Sand Motor can serve to promote and export the gained knowledge. Some respondents believe the knowledge is of national importance, and innovation is much needed in The Netherlands. All quotes refer to the case, but some place it in the wider context of coastal engineering and management.	High
Cultural heritage		The Sand Motor is a quintessentially Dutch landmark, a testimony to the country's tradition in coastal management and land reclamation. Quotes refer mostly to the case, but also to the general Dutch approach to coastal management.	Low
Life-cycle maintenance		The existence of, in the Dutch context, unique habitats (dune lake, lagoon) that could support seals, birds and bottom dwelling animals. Consistently referred to in relation to the potentially negative impacts of the Sand Motor and other coastal infrastructure on such habitats. Quotes refer mostly to the case, but also to the general Dutch approach to coastal management.	Low

[a] PWA = Public works agency; Prov. = Provincial government of South Holland; WB = Water Board; Munic. = Municipality. If no graph shown, the number of quotes is given.

[b] Also mentioned if quotes generally apply to the case or not.

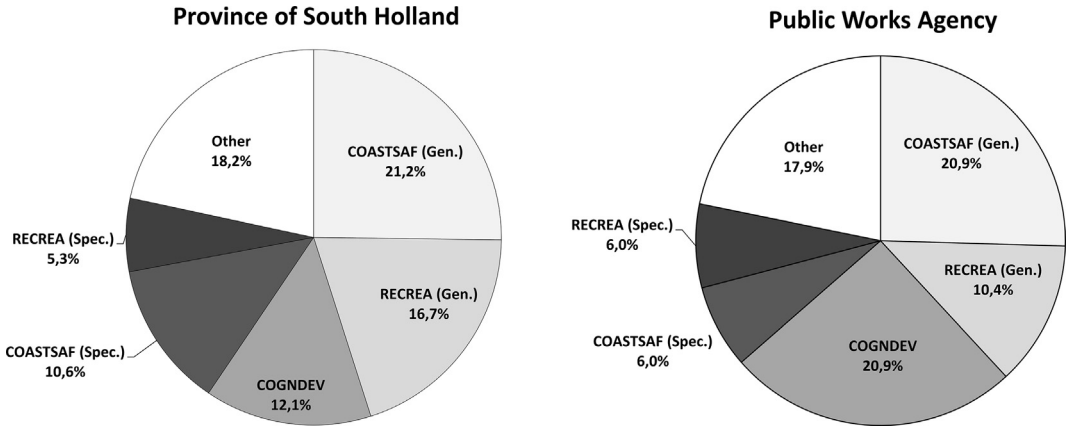


Fig. 2. Comparison of the number of references (as percentage of total) by interviewees from the Province of South Holland (left, total references: 111) and the Public Works Agency (right, total references: 49) inferred to selected ecosystem services, starting top right: coastal protection (general), recreation (general), cognitive development, coastal protection (specified), recreation (specified) and all other ecosystem services.

(Table 4). Although interviewees referred to these services in a consistent manner, their descriptions remained broad. The descriptions generally focus on the fact that the ecosystem services are provided, instead of being able to explain how. For instances, references to coastal protection and recreation generally did not extend beyond mentioning these terms. Cognitive development is an exception. Opportunities for learning were provided, according to the interviewees, due to the uniqueness of the pilot Sand Motor, in terms of spatial extent, biophysical aspects and stakeholders involved, and the fact that it had never been done before. All involved stakeholders, be them policy actors, engineers or scientists, had an interest in learning by doing.

Aesthetic experience and disturbance prevention represent two ecosystem services exhibiting a low degree of adoption. Relatively few interviewees referred to these services, and those who did were mainly from the Province. Aesthetic experience was attributed to the attractive landscape. Disturbance prevention was either referred to in terms of reduced storm surge risk or the contribution of increasing dune size to prevent coastal flooding. Most of the other ecosystem services with a low degree of adoption were referred to in an inconsistent manner. Bathing opportunities, for instance, were either described as the activity of swimming, or as a concern for the negative consequences for swimmer safety following the construction of the Sand Motor. Erosion prevention either referred to the process of distributing sand elsewhere or preventing the beach width from further reduction. Finally, life cycle maintenance was sporadically and inconsistently referenced, addressing either specific animals or the area in general.

4.3. Reference to the broad terms ‘nature’ and ‘spatial quality’

The broad terms ‘spatial quality’ and ‘nature’ were referred to 36 times in total, third only after cultural and regulating ecosystem services (Fig. 1). In fact, ‘spatial quality’ (19 quotes, seven interviewees) and ‘nature’ (17 quotes, nine interviewees) were the fourth and fifth most frequently referenced terms, respectively (Table 5). Interviewees from all four organisations referred to ‘nature’ (1,0 quote per interviewee overall), whereas interviewees from three organisations referred to ‘spatial quality’ (1,1 quote per interviewee overall). Moreover, 73% of all the quotes referring to the latter are provided by interviewees from the Province (1,8 quotes per interviewee), with only 0,3 quotes per interviewee attributed to the PWA and 3 quotes to the one interviewee from the water board (Table 5). ‘Spatial quality’ was often not clearly described, or was mentioned as an attractive environment to live in or in which to develop residential areas and nearby businesses. ‘Nature’ was uniformly regarded as providing green space, rather than as the existence of a dynamic ecosystem or of particular species. Considering the above, de degree of adoption by policy actors for ‘nature’ was high, whereas that of ‘spatial quality’ was low (Table 5).

5. Discussion and conclusion

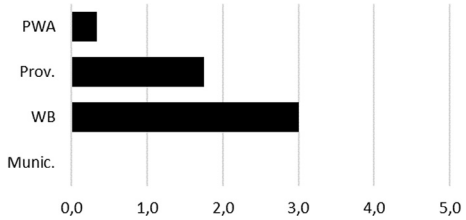
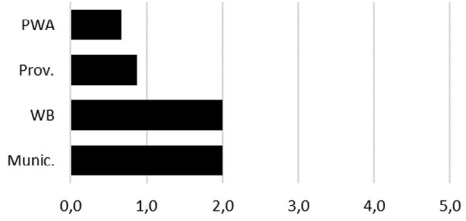
This study assessed the adoption of ecosystem services by policy actors involved in the strategic decision-making process leading to the initiation of the pilot Sand Motor. Because the retrospective interviews dealt with the first-hand experiences and insights of key policy actors, the analysis of the interview data unveils the extent to which ecosystem services were considered in the strategic decision-making process that led to the innovative, large-scale pilot Sand Motor. Due to a lack of current data, however, no comparative analysis was possible with experiences of policy actors that are currently involved in the ongoing decision-making process of the pilot.

In the retrospective interviews considered in our research, the term ‘ecosystem services’, or an equivalent thereof, was never mentioned explicitly. However, our findings confirm that the ecosystem services concept was certainly part of strategic decision making in the pilot Sand Motor. Half of the quotes that we identified as relating to ecosystem services referred in broad terms to coastal protection, recreation or cognitive development, with high degrees of adoption. This indicates that some ecosystem services were considered by most involved policy actors. In addition, the broad terms ‘nature’ and ‘spatial quality’ were also referenced often, albeit only ‘nature’ with a high degree of adoption. This underlines that the pilot Sand Motor’s multiple goals of coastal defence, recreation, knowledge development and innovation, and nature development were considered consistently by the policy actors and can mostly be explained in terms of ecosystem services. Conversely, nine ecosystem services were not referenced and ten were only sporadically referenced. The latter included ecosystem services that are intimately related to the pilot’s goals, but that could not be explicated by the policy actors. Our findings suggest that some broad, unspecified ecosystem services were adopted highly by the policy actors, while many specific ecosystem service categories were not considered and inconsistently referenced. In the following sections, we reflect on the retrospective interview approach that we adopted, the role of broad, ambiguous terms and cultural ecosystem services in strategic decision making and, finally, the scientific application of our findings.

5.1. Retrospective interview approach

Research on attitudes towards and adoption of normative concepts, such as ecosystem services and sustainability, generally involves direct and interactive approaches, such as interviews, surveys or focus-group discussions (Hansen et al., 2015; Reed et al., 2009). Especially when

Table 5
Overview of number of quotes per governmental organisation referring to 'Spatial quality' and 'Nature'. The characterization of how the terms were referenced is also provided, as well as the degree of adoption by the policy actors.

Broad term	Number of quotes per interviewee per governmental organisation[a]	How respondents referred to this term[b]	Degree of adoption
Spatial quality		Characteristic of attractive living and building environment, which exists next to or combined with green space. Important for people's wellbeing as well as the regional economy and housing/business market. Most quotes refer to the case, but some place it in the wider context of spatial planning and/or urban development.	Low
Nature		A not further described green space, usually referred to as a designated function of an area. Often mentioned in combination with recreation and as a compensation measure for urbanisation (loss of green) elsewhere. Few references to nature as a system, others refer to 'animals and plants'. All quotes refer to the case, but some place it in the wider context of coastal engineering and management.	High

[a] PWA = Public works agency; Prov. = Provincial government of South Holland; WB = Water Board; Munic. = Municipality.
[b] Also mentioned if quotes generally apply to the case or not.

studying references made to predefined terms, such as ecosystem services, or attitudes towards nature, it is key to first establish respondents' previous knowledge and to introduce such terms in a clear unbiased manner (Martín-López et al., 2012; Reed et al., 2009). In addition, consistently explaining the concept at hand, perhaps without actually mentioning it will help to avoid educational biases and to make the topic more understandable (De Vreese et al., 2016). The retrospective interviews considered in our study did not deal explicitly with ecosystem services, nor did the concept feature in the questions. Hence, we did not have to explain or frame the concept and, therefore, avoided the pitfalls mentioned above. To ensure our own consistency, we conducted an iterative process of inter-coder agreement between all involved authors, which preceded the final coding, sensu Miles and Huberman (1994). This contributed to clarifying and improving the coding list and the distinctions between ecosystem services. We recommend to incorporate such a process into stakeholder analysis to ensure conceptual clarity and coherence between researchers involved in such interdisciplinary research.

Our retrospective interview approach enabled us to observe arguments of Dutch policy actors, unbiased towards the ecosystem services concept. Given the general sense of expectation around the concept's uptake in decision making (e.g. Schleyer et al., 2015), it is crucial to assess whether decision-making argumentation is coherent and compatible with specific ecosystem services, as well as the concept as a whole. The degree of adoption, as studied here, was based on qualitative and quantitative criteria, namely 'widely referred to', 'consistency across organisations' and 'overall consistency' (Section 3.3). These criteria, especially the latter, were inspired by the scarce literature on the adoption of the ecosystem services concept by policy actors, e.g. in the European Union (Bouwma et al., 2018) and in the forestry sector of the United Kingdom (Raum, 2018). The mostly qualitative and single criteria used in the literature to evaluate the degree of adoption, relate to the wording around terms or whether terms are mentioned in existing policy or documents. Because our research focused on social representations of policy actors, we made use of multiple criteria, both qualitative and quantitative, that together capture whether terms have been adopted widely and to what extent they are understood consistently. Due to the nature of the original interviews (Section 3.1) we could not assess the level of awareness or understanding of ecosystem services.

Our approach yielded social representations of the functional role of ecosystems in the wider context of coastal management. Social representations reflect views on the topic that are likely to have been developed through interaction, i.e. the exchange of ideas and knowledge, between policy actors and other stakeholders, including scientists. The representations consist of definitions and concepts that appear to resonate with other actors, and reflect their beliefs and values (De Vreese et al., 2016). We are aware, however, of the fact that the policy actors in our study might have been exposed to the term 'Building with Nature' (i.e. an ecological engineering concept emphasizing multifunctional coastal management) during the initiation of the pilot Sand Motor (van Slobbe et al., 2013). This could have contributed to increased awareness and knowledge of multifunctional or nature-friendly approaches to coastal management and, hence, of 'nature' and 'spatial quality', which could have influenced the interviewees arguments and the degree of adoption of the term 'nature' especially. However, neither the ecosystem services concept nor specific referenced ecosystem services feature in the early documentation and parlance around 'Building with Nature' (Aukes et al., 2017). In addition, although the literature on ecological engineering has recently started to make more reference to ecosystem services, concrete case studies that use the concept are scarce (Barot et al., 2017). This underlines that the ecosystem services concept is yet to be embedded in ecological engineering approaches, which poses an important scientific and practical challenge. In addition, the interview data used in this paper deals with the pre-realisation phase of the pilot project, i.e. before 2011, when 'Building with Nature' and ecological engineering were mostly referred to as alternative engineering approaches that have less impact on ecosystems as compared to regular engineering approaches (Barot et al., 2017; Borsje et al., 2011). All in all, we consider our retrospective interview approach to have generated a realistic view of how ecosystem services featured in a practical example of strategic decision making. The findings discussed in the following sections can help to improve communication and uptake of the ecosystem services concept in the science-policy interface.

5.2. *The importance of relatable cultural services*

Cultural ecosystem services are not often considered in decision

making, potentially due to their subjective nature and scientific challenges to quantify them (Bouwma et al., 2018; Fish et al., 2016). However, other studies suggest that cultural services are becoming increasingly important to decision makers (Drakou et al., 2017; Ruckelshaus et al., 2015). We found that in addition to the primary aim of coastal protection, the cultural services recreation and cognitive development constituted critical arguments for policy actors to initiate the pilot Sand Motor and that these two ecosystem services resonate well with them. These ecosystem services were later on in the policy process added to the list of goals of the pilot Sand Motor, in addition to coastal protection (Aukes et al., 2017; Bontje and Slinger, 2017). The high degree of adoption of recreation is more common, as it relates to an experience people can relate to, recognise, and possibly engage in themselves (Ghermandi, 2015). In addition, cognitive development, i.e. learning by doing, is inherent to pilot projects (Ettelt et al., 2015; Vreugdenhil, 2010). In the ecosystem service literature, however, cognitive development is rarely studied. When mentioned at all, it is usually referred to conceptually as opportunities for education (Mocior and Kruse, 2016), knowledge systems (Gould and Lincoln, 2017) or, most important for ecological engineering, to biomimicry (Fisch, 2017). In our study, we typify cognitive development as learning by doing, or engaging in an innovative large-scale experiment both from a scientific, engineering and policy-making point of view. On the one hand, the pilot Sand Motor could contribute to informed learning about ecological and biophysical phenomena (Fish et al., 2016; Gould and Lincoln, 2017), usually studied culturally or individually but here seen in a policy-making setting. Also, when the workings are understood scientifically (Mocior and Kruse, 2016), the pilot Sand Motor can serve to promote and export the gained knowledge. This innovation and exportability argument was the key argument to participate in the pilot for many respondents (Aukes et al., 2017). This study underlines how cognitive development, as a cultural ecosystem service, can help to bridge the gap between science and decision making by providing a learning opportunity. Note that innovation and the related search for cognitive development can be seen as both a risk and an opportunity, and this uncertainty about the outcome is inherent to pilots and experiments. Our findings confirm those of Vreugdenhil et al. (2010) that not knowing the outcome of projects or policy decisions can result in reluctance among policy actors, but framing a policy decision as an innovative pilot, rather than a 'policy experiment' can help to mitigate the perceived risk (Ettelt et al., 2015).

Our findings underline that both broad and specific cultural ecosystem services were considered by policy actors involved in strategic decision making. Other cultural ecosystem services, which were referenced less often and more inconsistently by the policy actors, can only be fully understood and appreciated with pre-existing and specific knowledge, which makes them abstract and more difficult to take into account in decision making. This includes specific recreation ecosystem services, which were rarely mentioned by policy actors, and cultural heritage. Future multifunctional coastal management projects should thus look beyond optimising just the regulating and provisioning coastal and marine ecosystem services (Drakou et al., 2017). This will entail the better integration of a wide range of cultural ecosystem services and socio-cultural aspects in the existing evaluation methods for coastal decision-making. In addition, the broad terms 'nature' and 'spatial quality' were often referenced as if they were cultural ecosystem services. This suggests that, depending on the context, an environment or the presence of nature itself, can also be regarded as a contribution to human wellbeing (Díaz et al., 2018).

5.3. Ambiguity and broad terms vs. scientific rigour

Ambiguity is intrinsic to, and perhaps necessary for, strategic decision making (Mintzberg et al., 1976). Using ambiguous, broad terms can help in narrative construction to garner support and unite efforts across disciplinary and institutional boundaries (Bontje and Slinger, 2017; Ettelt et al., 2015). Our findings seem to support this notion, since 75% of the quotes of the policy actors referred in general terms to broad associated ecosystem services, rather than specific ecosystem services terms. These broad terms included (coastal) safety, recreation, innovation, and nature and spatial quality, and often lacked specific definition or consistent description by policy actors. By employing such ambiguous terms, the policy actors seem to have achieved sufficient flexibility in formulating their objectives, and yet allowed for some freedom of interpretation. Schleyer et al. (2015) state that the ambiguity and vagueness of the ecosystem services concept result from different perspectives related to the aims and intentions of involved users. In this sense, the ecosystem services concept is indeed acting as a boundary object in a trans-disciplinary and intra-institutional project context (Schröter et al., 2014). A boundary object is a concept robust enough to bind opposing views and values, flexible enough to allow for creativity, and facilitating cooperation and communication between actors with different paradigms or interests without necessarily striving for consensus (Abson et al., 2014; Chaudhary et al., 2015). Crucially, the boundary object should not impose strict or accurate knowledge requirements, which those from another disciplinary background are unable to fulfil.

The realisation that ecosystem services are a boundary object has practical consequences for the interaction between scientists and policy actors, particularly related to defining and specifying terms, findings and concepts. Although the concept's ambiguity and associated vagueness have often been criticized (Nahlik et al., 2012; but see Schröter et al., 2014), stakeholders have also lauded the potential of terminological ambiguity to facilitate dialogue and develop a common understanding (Carmen et al., 2017). This is particularly relevant for the dialogue around ecosystem services in the science-policy interface. This dialogue is typified by a clash of predominantly ecological economic parlance and thinking of involved scientists versus that of decision makers who often have other concerns as their main priority (Bouwma et al., 2018; Schleyer et al., 2015). The boundaries within which the concept and related terminology moves have to be clearly revealed and reflected on carefully for the concept to be used optimally (Schleyer et al., 2015). This can also mean that scientific terminology and classification, for instance around specific ecosystem services, might need to be translated or broadened to better reflect the frames of decision makers (Carmen et al., 2017). Furthermore, ecosystem services scientists are more likely to relate to involved policy actors, and vice versa, if the scientific terms used relate to existing terminologies and topics (Bouwma et al., 2018).

Scientific literature on coastal management and decision making seems to also have embraced the term 'functions' next to or interchangeably with ecosystem services (Borsje et al., 2011). Moreover, in recent years the term nature-based flood defenses (van Wesenbeeck et al., 2014) or nature-based solutions also seem to resonate with decision makers. Most of these terms are not that different, and the subtle conceptual differences are unlikely to resonate with decision makers (Carmen et al., 2017). For optimal dialogues in the science-policy interface and effective decision making, introducing novel terms is of secondary importance to the coherence and adoption of existing concepts.

5.4. Gap between ecosystem services classification and strategic decision making

The ecosystem services concept's potential as a boundary object has been lauded often, and the concept has been embedded in many policy agendas. However, most specific ecosystem services are currently not considered in decision making, apart from fish provision and tourism (Bouwma et al., 2018; Laurans and Mermet, 2014), let alone in coastal and marine decision making (Beaumont et al., 2017; Drakou et al., 2017). This suggests a need for insights on how to share ecosystem services information with decision makers in the complex and non-

linear policy process. Wright et al. (2017) underline the importance of ecosystem services classification, which forms crucial elements that need to be linked with decision maker's motivations and decisions. Such a link can be consolidated either through conceptual use of specific ecosystem services, or their instrumental use (Wright et al., 2017). In the case of the latter, actual decisions are based on gains and losses of ecosystem services, and in the former case, policy actors understand ecosystem services more broadly in their decision making.

Our findings indicate some conceptual use of broad ecosystem services, but mostly suggest a mismatch between the scientific, specific classification of ecosystem services and the broad ecosystem services and related terms that policy actors referenced. Although the multiple aims of the pilot Sand Motor were intimately related to ecosystem services and biodiversity, the involved policy actors predominantly referred to visions, problems and aims, such as securing coastal safety, expanding recreation opportunities, creating nature areas and generating knowledge, without explicit reference to biodiversity or the concept of ecosystem services. Furthermore, specific ecosystem services were only sporadically referenced and often inconsistently. This suggests a clear distinction between the steadily advancing specific scientific classification of ecosystem services on the one hand and the set of clear, relatable outcomes which our interviewed policy actors associated to their strategic decision making. Although ecosystem services hold promise for improving decision making, especially in coastal settings where they are not widely used, we note that to achieve such promise the concept and its classification and definition require embedding in the decision-making setting, and not the other way around (Arkema et al., 2015; Verutes et al., 2017).

Classifications of ecosystem services will continue to serve an important academic purpose, to link ecological processes with consequences for human well-being and to determine socio-economic indicators for specifying the link. To further refine classifications, differences between broad and specific services should be acknowledged and, for instance, embedded in a hierarchical classification, such as presented for recreation and coastal safety in this study, or in a context-specific classification, as suggested by Díaz et al. (2018). In addition, the studied or considered ecosystem services need to align more effectively with real-world issues, contexts and relevant aspects of decision making, rather than challenge them (Díaz et al., 2018; Dick et al., 2017; Ruckelshaus et al., 2015). A reason for the limited instrumental use of specific ecosystem services in coastal and marine decision making could be the potential conflict with existing better known terms, which are often related to existing sectors (Bouwma et al., 2018). This begs the question whether the current ecosystem services categories are suitable to directly inform decision making, or if a 'translation step' between ecosystem service research and decision making is required, for instance through bundles of indicators (Martín-López et al., 2012) or narratives combining multiple topics, not limited to ecosystem services (Bontje and Slinger, 2017; Delmotte et al., 2017). The interplay between scientific classifications and policy-relevant issues is likely to remain dynamic, and will depend on the socio-environmental and decision-making context (Díaz et al., 2018). For instance, the 'next Sand Motor' will probably not be a pilot project, which might make the quest for the 'learning by doing' component of cognitive development less important than coastal protection and other ecosystem services.

In conclusion, with our study we provide useful insights in the motivations of coastal policy actors involved in a unique pilot project. It offered the opportunity to observe if innovation and multifunctionality in coastal management have been explained by policy actors in terms of ecosystem services or other concepts and ideas. This is an important contribution to the literature on the uptake of ecosystem services in coastal and marine decision making, on which few studies have been published (Drakou et al., 2017). Although the policy actors involved in the initiation of the pilot Sand Motor seemed aware of the role of nature and ecosystem services in coastal management, a gap exists between highly specific scientific classifications of ecosystem services and the adoption of the full range of ecosystem services potentially available to support their strategic decision making. The ecosystem services concept is currently mostly conceptually used, but it could also become used instrumentally (Wright et al., 2017). In order for that to happen, the role of ambiguous and broad terms needs to be better reflected as well as the importance of cultural ecosystem services, especially recreation and cognitive development. Moreover, increasingly precise scientific classifications of ecosystem services seem to be undesirable for optimal science-policy dialogues on ecosystem services.

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The opinions expressed in this document are the sole responsibility of the authors.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.ecoser.2018.09.003.

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