Ecological Complexity 7 (2010) 349–358

Contents lists available at ScienceDirect

Ecological Complexity

journal homepage: www.elsevier.com/locate/ecocom

Cultural ecosystem services in the context of offshore wind farming: A case study from the west coast of Schleswig-Holstein

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ARTICLE INFO

Article history:
Received 20 October 2009
Received in revised form 5 February 2010
Accepted 10 February 2010
Available online 24 March 2010

Keywords:
Values
Cultural ecosystem services
Intangible benefits
Coastal and marine ecosystem
Offshore wind farm

ABSTRACT

Although frequently referred to in the literature, the concept of cultural ecosystem services (CES) has so far been limited in its application. Difficulties arise when specifying the nature of intangible values, but more significantly when it comes to relating intangible values to ecosystem functions. After setting out some conceptual issues, this paper uses a case study on the German North Sea coast to illustrate ways of operationalising the concept in a marine context. Based on a survey of local residents, we first identify current CES in the sea and the intangible values associated with them. Seascape and place emerge as useful conceptual bridges linking ecosystem functioning outcomes to key CES values. We then relate this to offshore wind farming, which some residents perceive as a significant threat to certain CES. Although the approach presented increases the visibility of intangible ecosystem values, the problem remains that such assessments are temporal, in need of added calibration and do not automatically put intangibles on a par with market ecosystem value.

1. Introduction

The concept of ecosystem services (ES) has been developed to provide a holistic assessment of the benefits humans derive from ecosystems. It is based on the idea that goods and services are ultimately generated by ecological functions (or processes), which give rise to benefits or things that have value to people (de Groot, 1992, 2006; de Groot et al., 2010; Costanza et al., 1997). Mostly, such value has been interpreted as economic value, or market or tangible value (Carpenter and Turner, 2000), and direct links have been established between different services and related economic benefits (Millennium Ecosystem Assessment, 2005). Whilst economics is useful, not least in developing and enforcing incentives for the conservation of important ecosystems, it is well known that the language of the market only captures part of the total value of ecosystems (Vejre et al., 2010; Ludwig, 2000; Rees, 1998). Some aspects of ecosystems, for instance, can only be expressed in biological terms, but still have value in that they contribute to ecosystem functioning (Heal, 2000). Although some quantification has taken place of ecosystem value outside the traditional commodities approach (Vandewalle et al., 2009; Daily et al., 2000), cultural ecosystem services (CES) have proven resistant to monetary valuation since many aspects of ecosystems – such as their aesthetic or spiritual qualities – are valued precisely on account of the non-market benefits they provide. A prerequisite for holistic ecosystem assessment, and for intangibles to be put on a par with 'classic' market goods and services, is thus to increase their visibility (Daily et al., 2009; Plummer, 2009). This paper contributes to this by presenting the results of an investigation into the nature and value of cultural ecosystem services in a case study on the west coast of Schleswig-Holstein, Germany, with particular focus on the marine environment.

Just like cultural ecosystem services, the marine environment tends to be underrepresented among ecosystem services studies (Turner et al., 2003). Economic evaluation of marine ecosystem services has largely focused on fisheries and related industries, and there is increasing understanding of the ocean's role in global materials cycling (e.g. CO_2 absorption and release) (Sabine et al., 2004). The Millennium Ecosystem Assessment (UNEP, 2006) classifies marine and coastal CES as tourism and recreation, aesthetic and spiritual services, traditional knowledge and educational and research services. Only few studies have been done on the relationship between ecosystem services and tourism, the world's most profitable business (UNEP, 2006) (Williams and Shaw, 2009; Gössling, 2002; Peterson and Lubchenco, 1997), and to our knowledge none have yet become available that deal with the aesthetic or spiritual services of the marine environment. In their "review paper on concepts of dynamic ecosystems and their

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doi:10.1016/j.ecocom.2010.02.008

services", Vandewalle et al. (2009, RUBICODE project) did not review any case study on marine ecosystem services, and only 15 out of 64 case studies dealt with CES. Only one of these was about tourism, another dealt with recreational services, and a third was related to CES provided by farmland birds. All were carried out at local scales.

As elaborated by the MA (2005; UNEP, 2006), most ecosystem services in coastal and marine areas are used unsustainably and therefore degraded. Drivers of change have been identified, and habitat loss has been described as a consequence, but this has rarely been applied to the specific case of the sea. Our case study refers to the German North Sea where the installation of a huge number of offshore wind farms represents a significant driver of change (Gee et al., 2006). The potential impacts of offshore wind farms have been considered at various scales. At the global scale this includes the impact of renewables on climate and environmental stability (Makarieva et al., 2008). Regional and local descriptions of impacts have often focused on marine habitats and species (Gilles et al., 2009; Drewitt and Langston, 2006; Köller et al., 2006). Little is known about the potential impacts of offshore wind farms on CES.

In this paper we seek to contribute to a better understanding of the nature of CES and the tools that can be applied to elicit them. We also seek to draw greater attention to the sea as a carrier of CES, defined by and large by intangible values such as aesthetic and spiritual significance. One aspect is that our study is not local, but regional in scale. But more significant is the fact that we use the demand perspective of CES consumers as a starting point, although we also attempt to build a conceptual bridge to the supply side of specific ecosystem services. In order to identify and describe CES in the German part of the North Sea we address the following specific questions:

- Other than purely economic value, what are the sea's key values in the case study area?
- Can these values be translated into CES?
- Are offshore wind farms likely to have an impact on the CES identified?

Naturally, processes in marine and coastal systems and their provision of ecosystem services are highly variable in space and time (Koch et al., 2009) and CES themselves are contingent in nature (Haines-Young and Potschin, 2007). Our analysis should therefore be considered a snapshot of a system at a particular point in time.

Before working with the CES concept, a clearer idea is required of some of the difficulties that have to be overcome in operationalising it. The paper therefore begins with a conceptual part and theoretical overview of some of the concepts we employ, with particular focus on the notion of 'values' and 'landscape' as a bridge between ecosystem function and benefits, in other words the supply and demand of services.

2. Working with cultural ecosystem services

2.1. Conceptual background: how to value cultural ecosystem services?

CES are defined by the Millennium Ecosystem Assessment (MA) as the "non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (MA, 2005, p. 40). The MA still provides the most comprehensive overview and categorization to date, with the following categories suggested:

- *Cultural diversity* (in the sense that the diversity of ecosystems is one factor contributing to the diversity of cultures)
- *Spiritual services* (recognising that many religions attach spiritual and religious values to ecosystems or their components)
- *Knowledge systems* (*traditional and formal*) (appreciating that ecosystems influence the types of knowledge systems developed by different cultures)
- *Educational values* (understanding that ecosystems and their components and processes provide the basis for both formal and informal education in many societies)
- *Inspiration* (in the sense that ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising)
- *Aesthetic values* (many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations)
- *Social relations* (in the sense that ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies)
- *Sense of place and identity* (ecosystems as a central pillar of the "sense of place" that is associated with recognised features of their environment)
- *Cultural heritage values* (understanding that many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species)
- *Recreation and ecotourism* (recognising that people often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area)

Despite the intuitive logic of the above categories, working with the concept of CES brings forth a number of problems. The MA (2005) and the RUBICODE project (Vandewalle et al., 2009) concede that so far, spiritual, religious, recreational, and educational services have only been assessed in small local studies, mostly because the data required for these assessments are not widely available. There is also the issue of a clear conceptual delineation of the above categories to avoid double-counting as well as locating them in space, as needed in spatial planning for example. Recreation and ecotourism, for instance, are linked to aesthetic and cultural heritage values, with influences on health, education and cognitive development. But where exactly does the category of "aesthetic value" begin and end? Precise definitions will be essential and need to be established for each respective social and geographical context.

Other problems in working with CES are more fundamental in nature. One is the inherent difficulty of establishing a clear relationship between the intangible values that might be assigned to certain elements of the ecosystem and ecosystem functions and benefits (Vejre et al., 2010). As with other ecosystem services, working with CES requires identifying distinct 'operational units' for CES to which functions, benefits and values can be assigned (Haines-Young and Potschin, 2007). But what exactly is being valued in the ecosystem, and what value categories are being applied (e.g. Farber et al., 2002)? To illustrate this point: When appreciating a view, or a concept such as wilderness, for example, is it the thing itself (e.g. the actual physical landscape), knowledge of the thing or the satisfaction that people derive from the thing, either by visiting it or simply knowing it exists? (More et al., 1996) Peterson and Lubchenco (1997, p. 187) state that people coming to the sea want to "enjoy immersion in an undegraded coastal setting" and relate certain recreational activities such as swimming, sailing or surfing to selected abiotic components and services (Peterson and Lubchenco, 1997). Some components of the ecosystem, such as stinging jellyfish or storms and erosion, can even be related to ecosystem disservices (Lyytimäki et al., 2008;

Weslawski et al., 2006). Whilst this demonstrates the possibility of locating and also quantifying the services provided by distinct biotic or abiotic elements of the ecosystem, it is much more difficult to do so in case of the 'enjoyment of an undegraded coastal setting', never mind relating the aesthetic value of gazing out to sea to the functioning of the marine ecosystem.

Another problem is that even if distinct carriers of CES can be identified, value is not a calculable outcome. Awareness of the formal qualities of a place, for example, is only one element of the many dimensions that combine into an aesthetic experience (Robinson, 2008). Factors related to the observer, such as social and cultural experience, habits and belief systems, traditions of behaviour and judgement and styles of living also come into play, factors in other words that are related to the observer and indirectly at best to the ecosystem (Kumar and Kumar, 2008; Hansen-Möller, 2009). Working with CES must therefore consider the values in the ecosystem as much as the relationship between the observer and the environment including personal and social driving forces that influence the demand side.

2.2. Concepts of value and landscape as an ecosystem unit

Table 1 is a classification of values that can be applied, with non-use and intrinsic values of particular importance in the context of the CES listed above. In the category "existence values" (see also Ranganathan et al., 2008) we specifically include the intrinsic value of nature and biodiversity, which we find under-represented in the ecosystem services concept (Chee, 2004). The European Commission (2008) suggested in their TEEB (The Economics of Ecosystems and Biodiversity) report, that biodiversity itself is not an ecosystem service, but underpins the supply of other services. There the intrinsic value of biodiversity is placed under "ethical values".

None of the value categories in Table 1 are mutually exclusive; on the contrary there is considerable overlap. On top of their instrumental value, objects (physical and abstract) can be valued for a range of intangible benefits we derive from them, such as inspiration drawn from a near-natural landscape, or our or identification with a particular place. 'Benefit' in this instance is similar to the 'satisfaction that can be derived from the thing' (More et al., 1996), measured for instance in the degree of joy experienced from indirect use values (such as aesthetic appreciation), or the moral satisfaction experienced from knowing something has been preserved for future generations. Conceptually, it is important to draw a distinction between objects of value – the 'what' we value in the environment (Brown, 1984; McFarlane & Boxall, 2000) – and values used as standards for judgements. Tangible and intangible ecosystem entities may thus be judged based on standards for truth (rational values—e.g. the economic value of fish), standards for conduct (moral values—e.g. the belief that we have a duty to preserve biodiversity), standards for appreciation (aesthetic values—e.g. the beauty of a landscape) and standards for meaning (spiritual values) (More et al., 1996).

The above suggests that the overall value assigned to ecosystem functions or benefits cannot be derived from simply adding together the value of biophysical ecosystem components. In the context of CES, the biophysical environment may play a subordinate role in that 'the thing of value' may be an abstract layer of meaning rather than the 'factual' environment itself. Abstract layers of meaning arise from a specific relationship between the observer and the environment and are linked to deeply held personal beliefs and convictions and specific social contexts. On the west coast of Schleswig-Holstein for example, the sea features prominently in the construction of sense of place, and communities have been shown to have a special relationship to the sea (Fischer et al., 2007; Fischer and Hasse, 2001). The physical environment is a mere bedrock of perception; intangible value is assigned by adding cognitive and imaginative overlays to this environment (Brady, 2003). The nature of these overlays depends on prior experience, knowledge, imaginations, expectations and tradition.

"Landscape" is a particularly useful concept here because it is located at the intersection between objective space and subjective place (Eisenhauer et al., 2000). The relationship between values and landscape is explored in a wide body of literature, expressed for instance in the long-standing issue of landscape quality assessment (e.g. Zube et al., 1974; UKCC, 1987; Hull and Stewart, 1995; Lothian, 1999). A recent study suggests that landscape significance can be clustered around the fundamental components of form (the physical and tangible aspects of a landscape), practices (the activities associated with a landscape) and relationships (the meanings generated between people and their surroundings) (Stephenson, 2008). We therefore suggest that many of the CES listed in the MA can in fact be tapped by eliciting landscape values.

2.3. The case study offshore wind power in the German North Sea

The ecological and social impacts of offshore wind farms have been monitored as case studies in various North Sea countries. Examples with similarities to the German case include the US (e.g. Firestone et al., 2009), the UK (e.g. Scott et al., 2005; Braunholtz, 2003), and the Danish offshore wind farms at Horns Rev and Nysted (Kuehn, 2005; Ladenburg, 2008). Our case study area is the coastal and marine ecosystem of the North Sea off the west coast of Schleswig-Holstein in northernmost Germany (Fig. 1), delineated spatially to comprise all German waters including the Exclusive Economic Zone (EEZ). If current government plans are realised, a

Table 1
A classification of values.

		Market values	Non-market values
Instrumental value (the value of something not as an end in itself but as a means of achieving something else)			
Use values	The benefits a resource produces for those who actually use it	*Direct use values* extractive or non-extractive uses such as recreation or tourism	*Indirect use values* e.g. aesthetic appreciation and spiritual value
Non-use values	Uses not associated with any use or material benefit. Also the benefits a resource produces for those who do not use it	*Option value* (keeping open the option to make use of a resource in the future although no use is taking place at present. Direct use value is generated when the good is actually consumed)	*Altruism* (the value derived from having other contemporaries use a resource) *Bequest value* (preserving a resource or biodiversity for future generations)
Intrinsic values (the value of something as an end in itself)	Value of an entity independent of any valuer		*Existence value* (the value people receive from simply knowing a resource or biodiversity exists)

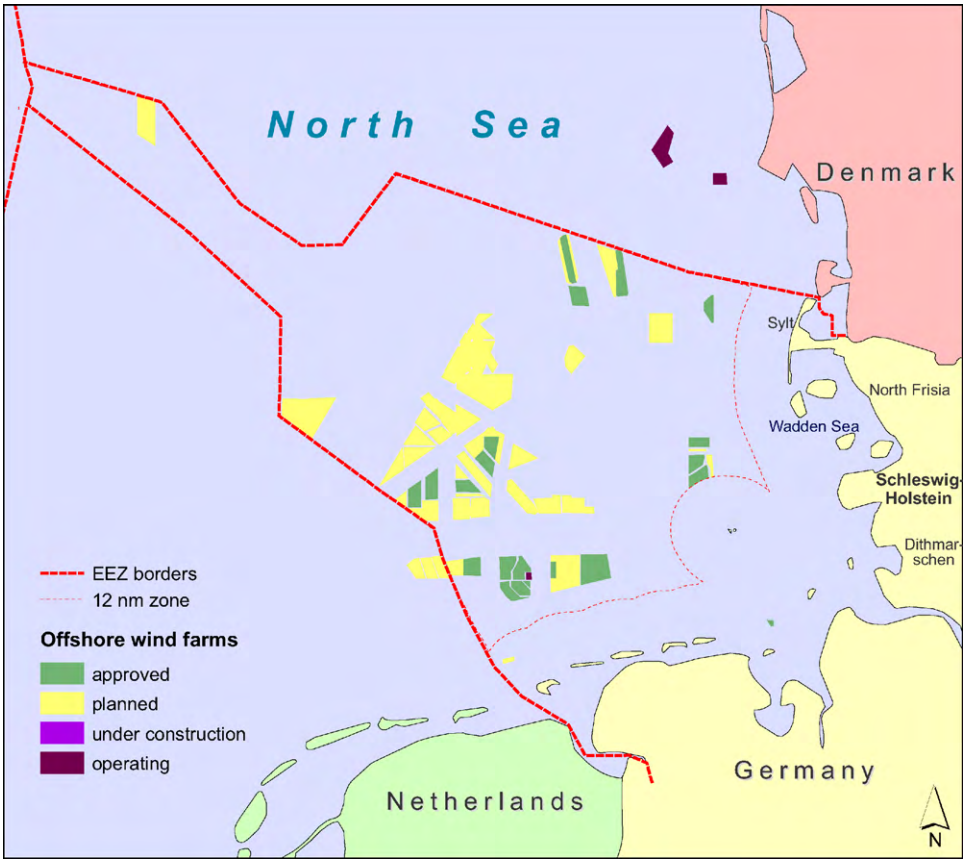

Fig. 1. Map of the south-eastern part of the North Sea showing the German Exclusive Economic Zone (EEZ) and possible future offshore wind farm developments (data sources: Zukunft Küste—Coastal Futures project data and German Federal Maritime and Hydrographic Agency BSH).

total of about 5000 wind turbines will be built in the German share of the North Sea by 2030 with a capacity to deliver a total of 25,000 MW in electricity and covering a large part of the German EEZ. The potential impacts of offshore wind farm construction extend to spatial competition, but also to the region's economy, highlighting the close interrelationship of uses and benefits within a complex socio-ecological system (Kannen and Burkhard, 2009).

Offshore wind farm development in the German North Sea is controversial, with impacts expected on the marine ecosystem (Köller et al., 2006; Burkhard et al., 2009) and spatial exclusiveness representing strong concerns (Michler-Cieluch et al., 2009). One spin-off is the drafting of a spatial planning framework for the German EEZ in response to the increasing density of uses (BSH, 2009). Other studies have focused on the expected ecosystem impacts of offshore wind farm construction in the sea (Zucco et al., 2006). These have covered direct impacts of wind turbines on ecosystem processes in the sea and indirect impacts such as those of cable connections to the mainland or impacts on marine mammals (Gilles et al., 2009) and resting and migratory birds (Garthe and Hüppop, 2004). Impact assessments have covered different spatial scales, ranging from local impacts (at the level of individual wind turbine piles) to regional impacts (affecting larger parts of the North Sea), and different temporal scales, such as short-term and reversible impacts during the construction phase and long-term irreversible impacts during the operation phase. Most studies conclude that the insertion of hard structures in the North Sea bottom can provide a substrate suitable for the settlement of benthic organisms. In a long term, this might lead to the emergence of artificial reef-like ecosystems which might provide a broad range of ecosystem services (Burkhard et al., 2009). Nevertheless, negative impacts on migrating and resting sea birds as well as marine mammals are to be expected (Gilles et al., 2009; Hüppop et al., 2006; Köller et al., 2006)

The most explicit critics of offshore wind farm proposals are those that make use of specific landscape services on the west coast of Schleswig-Holstein. These include tourism operators, who rely on a specific image of the coast or sea, visitors to coastal holiday areas and also residents of coastal communities who enjoy the coast and sea for their amenity and recreational value. On the German island of Sylt, a local campaign was founded to oppose offshore wind farms on the grounds that it would despoil the horizon and severely impact on tourism because it would remove the essential landscape qualities tourists come to enjoy ("Gegenwind Sylt", www.gegenwind-sylt.de). These concerns are reflected in statements given in offshore wind farm planning consent procedures and are particularly prominent in those coastal municipalities that are located directly on the coast and therefore physically closest to the proposed offshore wind farms. Some studies have looked at the visual impacts of offshore wind farms on coastal communities and acceptance of offshore wind farming (Kempton et al., 2005; Ladenburg, 2008; Bishop and Miller, 2007), but they do not place visual amenity threats into the context of marine CES.

2.4. The questionnaire survey

In October 2005, a postal questionnaire survey was carried out in the two administrative districts of Dithmarschen and North Frisia to establish local residents' views of the local landscape and offshore wind farming (Gee, 2010). Based on the premise that potential 'affectedness' might considerably influence how residents view offshore wind farming, area sampling was employed as a special form of variation sampling to reflect as many baseline conditions as possible (Patton, 1990). Whilst this clearly limits the study's representativeness, it was chosen to ensure that a broad

range of places of residence were included in the sample. The 15 municipalities selected thus included rural and urban settings, municipalities located directly on the coast and in the hinterland, some that might directly benefit from offshore wind farm construction (e.g. on account of port facilities), as well as some strongly or less strongly dependent economically on tourism.

Within these municipalities a random sample of residents was drawn, picking names from the local telephone book until a pre-set quota of 1% of the respective total number of residents was achieved. The rate of return varied between 66% and 15%, but averaged a relatively low 22%, which is lower than comparable surveys in Denmark (Ladenburg, 2008) and the US (Firestone and Kempton, 2007). The response rate could have been increased by conducting a personal follow-up to non-respondents; this however could have compromised their sense of anonymity which they had been assured of. The low response rate may be coincidental, but might also reflect the fact that offshore wind farming was still a relatively new issue in the case study area at the time and could have been deemed irrelevant by those who do not perceive themselves to be directly affected. This, of course, might have changed over time, and further studies would be of interest to confirm this. A total of 387 returned questionnaires form the basis for the analysis presented here. The sample contained slightly above-average representation of the well-educated and slightly more men than women, but other than age, the sample demographics (e.g. income, employment, household size) were close to the population average (SAHSH, 2006). No distinction was made between long-standing residents and recent arrivals. Bias was introduced by the fact that returns were predominantly men and women aged 45–65, with some representation of 26–44-year-olds but very little representation of 18–25-year-olds. We did test the significance of other variables in the responses (e.g. coastal and island residents versus hinterland residents, rural versus urban), but did not detect any significant differences between the sub-samples.

The first part of the questionnaire consisted of a range of open and closed questions designed to elicit perceptions of the North Sea and the coastal landscape. This was followed by questions on opinions on offshore wind farming and the believed impacts of offshore wind farming. Open questions were subjected to content analysis, which meant coding and categorization of responses. Emerging coding was used in the sense that categories were not established a priori. Coding units were either individual words or propositional units which break down the text in such a way to allow for underlying assumptions to emerge (Stemler, 2001).

Here we use selected material from the questionnaire to determine what local residents value in the North Sea environment. We then describe the intangible benefits that are linked to specific CES in the case study area and consider how these benefits might be affected by the introduction of offshore wind farming in the North Sea.

3. Results

3.1. Linking land- and seascape perception to specific sea values

In line with the contention that CES are closely related to landscape values (including the notion of seascape as a marine equivalent), our case study survey first sought to identify the many ways of perceiving the sea and the values accorded to it by local residents. The question was "What do you spontaneously associate with 'sea'" (n = 387). Typical responses received were:

> "pure sea, recuperation, nature, fresh breeze, pure air, influences the soul and physical health, sense of well-being, away from hectic life and a sense of being confined."

> "The sea is life. It is shipping, boats and infinity. It is creation, and unpredictable, but also a calming sense of comfort."

Fig. 2 shows the distribution of different notions mentioned by the respondents across eight overall categories. This analysis is based on the number of mentions within each category, with a mention (coding unit) consisting of either individual words or concepts. It shows that objects or 'things' perceived in the environment represent the strongest overall category, followed by reference to aesthetic experiences and symbolic meanings accorded to the sea. Of interest is also the fact that many residents directly refer to the tangible or intangible benefits they experience when using or experiencing the sea (dashed bars).

'Physical environment' is a category that refers to tangible objects and processes perceived in the sea – the constituting physical elements of the sea both natural and man-made – as well as more intangible features such as climate. Common mentions in this category are waves, the ebb and flow of the tide, beaches, islands, lighthouses, storms and the sea breeze. The terms used here primarily denote North Sea attributes (e.g. storminess) and functioning outcomes (e.g. the Wadden Sea, sandy beaches), although man-made features add a layer of meaning that is only indirectly related to ecosystem functioning. The features mentioned can be considered constitutive elements of the environment, elements in other words that are in some way typical and lend the sea its specific character. They can also be argued to be responsible for the sea's emergent properties from an ecological point of view, for instance by shaping the Wadden Sea ecosystem.

The category of 'environmental character' refers to the specific North Sea setting as experienced and described by the respondents. We use 'setting' to mean a specific (and mostly visual) combination of environmental features which determine the subsequent use of this environment. The main character of the North Sea setting appears to be determined by expanse and depth, as well as unpredictability and changeability. Land reclamation is another element of the specific North Sea setting, suggesting that the nearshore waters can be viewed as a constituting element of the cultural landscape in the case study area.

The category of aesthetic experiences brings together a range of experiences related to beauty. In the context of the sea, it predominately refers to the visual character of the sea, which is strongly defined by the wide expanse of water and the open horizon. Specific mention is also made of the flat expanse of the Wadden Sea, the beauty of the islands and the ever-changing face of the sea, suggesting that aesthetic experiences are closely related

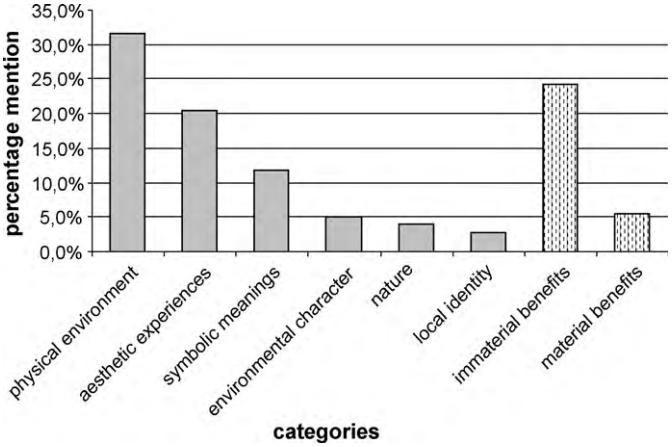

Fig. 2. Categorization of responses and category strength in terms of percentage mentions (total coding units = 1363). Dark grey bars refer to services, dashed lines specifically refer to benefits.

to the specific environmental character of the case study area. The experiences denoted under this heading can be summarized as seascape experiences, where seascape denotes a visual entity, but also a distinct space with various cultural and heritage values linked to it. In the UK the term 'seascape' has become commonly employed in the context of coastal landscape character assessment, not least for the purpose of offshore wind farm planning (Hill et al., 2001). Regarded purely from a morphology perspective, the expansiveness of the sea and the other constituting elements of aesthetic experience can be understood as an indirect outcome of ecosystem function.

3.2. Added meanings and values

Results so far have described relationships between North Sea attributes and functioning outcomes, with environmental character and the visual character of the seascape regarded as functions of landscape morphology. In order to properly describe the CES in the case study area, further layers of meaning need to be added. To fill the gap between ecosystem functioning and valuation, we use landscape and place to achieve a conceptual shift (Fig. 3). Landscape (and seascape, respectively) is understood here as the visual manifestation of (coastal and marine) ecosystem structure and operation, whilst place is employed to add dimensions such as place dependence, place attachment and identity (McIntyre et al., 2008). Place therefore goes beyond the concept of landscape in that it is even better able to capture symbolic perceptions and interpretations of space (Eisenhauer et al., 2000). Fig. 3 illustrates the transition from structure to space and ultimately place, mirroring the progression from ecosystem structure to operation to benefits. The more we move towards place, the more we move away from the 'real' biophysical environment of the ecosystem and towards meanings of space which are only very indirectly related to ecosystem functioning. For the beauty of a sunset to emerge, for example, the seascape plays the role of a spatial canvas, on which ecosystem function still has some bearing. The sun itself is also instrumental in generating the experience of the sunset, but is not a constituting part of the marine ecosystem. Neither the seascape as a canvas nor the setting sun, however, would combine to form aesthetic value were it not for a receptive observer using the respective aesthetic standards.

In terms of CES, the aesthetic value assigned to the North Sea is thus a composite that brings together to specific visual seascape qualities of the ecosystem (the wide expansive horizon), added visual qualities located outside the ecosystem ('incredible sunsets', 'the ever-changing play of clouds'), other environmental qualities ('the sea breeze') and intangible benefits ('a sense of calm, rest and recuperation'). The aesthetic seascape experience is therefore both 'the thing itself' as well as the satisfaction derived from experiencing the thing (More et al., 1996).

Aesthetic value in turn can be considered a constituting element of specific experiences of the marine and coastal environment where emotional and cultural connections are added to the sensual appreciation of the sea. This is where past and present human activities come into play, as well as the many symbolic values accorded to the sea, for instance the sea as a symbol of trade, of tradition and identity (Vollmer et al., 2001). The CES sense of place and identity, as well as cultural heritage values, can thus be located near the end of the space-place continuum, manifested for instance in the high importance respondents accord to local shrimp fishing boats, the continuation of traditions such as fishing and the fact that the land itself, the 'dwelling place' (Ingold, 2000), has been reclaimed from the sea over many centuries.

Table 2 links the categories of how the sea is perceived to the CES specified in the MA (2005), to perceived benefits and ultimately value categories.

Respondents do refer to direct use values in the context of the sea, mostly on account of the tangible benefits that can be obtained from commercial fisheries, shipping and tourism. Fig. 3 however indicates that indirect use values are more important, with recuperation, relaxation and peace and quiet representing important benefits. Recreational activities are important, but just as much indirect use value is derived from passive forms of experiencing or simply contemplating the sea. The benefits associated with such contemplative experiences are strongly linked to the visual aesthetic qualities of the North Sea, in particular the wide and open horizon. Mention should also be made of the inspirational value of the sea, which was found here to

North Sea ecosystems	→ **North Sea attributes**	→ **North Sea functions**	→ **North Sea functioning outcomes**	→	**CES**		← **Values**
As determined by locational and functional factors and structures	geographic (spatial) geologic hydrologic biologic climatic	e.g. cycling of nutrients, energy and water maintenance of the self-organising capacity preservation of habitats and biodiversity	productivity water quality improvements flood protection provision of space and habitats		aesthetic values inspiration	spiritual services sense of place and identity cultural heritage values	direct use value and benefit indirect use value (e.g. resilience) non-use value (e.g. altruism)
Structure	→ **Operation**		→ **Benefits (welfare changes)**				
		recreational setting		spatial and environmental character	visual character, sensual perception, landscape beauty	sense of belonging, local identity symbolic value	intrinsic value (existence value) moral value ('ought' character)
Structure	→ **Space**			→	**Place**		
				character of setting	**landscape/ seascape**	**cultural and emotional connection**	← **Values**

Fig. 3. Locating cultural ecosystem services within the established framework of ecosystem services. Adapted from Turner and Daily (2008).

Table 2
Survey results in the context of CES and value categories.

Categories of how the sea is perceived	Ecosystem service	Cultural ecosystem service (MA)	Benefit	Value categories
Physical environment	Provisioning service (e.g. commercial fish)	Sense of place and identity	Tangible	Direct and indirect use values
Local identity		Sense of place and identity	Intangible	Indirect use values and some direct use values
Symbolic meanings		Spiritual services and aesthetic values	Intangible	Indirect use values and existence value
Environmental character		Cultural heritage values, recreation and ecotourism, and aesthetic values	Intangible	Indirect use value
Nature			Intangible	Ethical and existence values and bequest value
Aesthetic experiences		Aesthetic values	Intangible	Direct and indirect use values, altruism, bequest value, ethical and existence values

relate to human well-being in the sense of happiness rather than artistic inspiration as described in the MA (2005).

An interesting category is that of nature, which refers to respondents' notions of the sea as a habitat, to biodiversity and particular species. Often, this is linked to the view that the sea is a vulnerable and threatened environment and that this environment should be protected from harm. Statements such as these imply non-use values such as bequest value, which is the belief that particular qualities of the North Sea should be passed on to the next generation. The North Sea is also identified as a carrier of existence value, in the sense that it is valued simply because it exists independent of any human use. In addition, calls for protection indicate a strong 'ought' character, suggesting moral rightness as a central driving force behind this view. To a degree, a similar perception applies to the visual character of the seascape, in particular the visual aspects of the wide and open horizon. On the one hand, this is linked to intangible benefits to be derived by gazing out to sea ("restoration"), on the other it is linked to symbolic meanings accorded to the sea ("sense of freedom, no limits") and the view that these should be preserved as a last vestige of untouched nature and source of spirituality ("creation"). It is interesting that respondents repeatedly refer to the sea as 'untouched', reminiscent of the US Wilderness Act of 1964 where wilderness is described as "an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain". Respondents do understand that the sea is not a pristine environment, but rather than any structures such as oil platforms they mention pollution and overuse. We therefore suspect that this view of the sea has a strong visual component. In the minds of respondents, the idealised version of the sea untouched is characterized by ephemeral use and a pristine look unmarred by fixed structures; there is also something akin to hope that the sea will always retain a vestige of mystery that man cannot conquer.

"Cultural disservices" (Lyytimäki et al., 2008) include the notion that the sea can be threatening to human life; and that it constitutes an alien environment that commands respect and awe. There is also occasional reference to the sea as a dump for waste, leading to negative connotations and dislike.

3.3. Expected impact of offshore wind farms on the CES identified

In order to establish which CES are considered particularly valuable, the last stage of analysis considers the degree to which the CES identified could be threatened by offshore wind farming. This is based on a further part of the questionnaire survey where respondents were asked to state their attitude to offshore wind farming together with their reasons for this attitude. Since no offshore wind farms exist in the German case study area as yet, these views are based on local residents' imagination of what they might look like in this particular context. It is likely that these mental images are based on experiences of land-based wind farms, although some respondents might also have seen offshore wind farms, for example Horns Rev and Nysted in Denmark or photographs of these. Coding was based on the same principle set out in Chapter 2 in that categories were not established a priori and coding units (individual words or propositional units) were sorted into thematic groups. Most residents brought to bear a broad range of arguments including contradictory statements. Typical responses in opposition to offshore wind farming were the following:

> "An open landscape and the expansive horizon represent the most important capital of this landscape, this is being destroyed for absolutely no gain."

> "Offshore wind farms upset nature and animals, never mind the visual impacts, disappearance of the last remaining porpoises, pollution, even more dead birds."

Table 3 gives an overview of the main arguments raised in opposition to offshore wind farms. These were used as a basis for identifying the major threats to CES.

Out of all the arguments brought to bear, 21.8% reflected fears of negative visual impacts of offshore wind farms. These fears can be interpreted as an imagined threat to the aesthetic seascape values set out above. For some respondents this was the only argument raised, its importance underscored by multiple repeats, for others it was one out of a long overall list. The fact that the great majority of respondents mentioned visual impact at least once underlines the high importance accorded to the visual qualities of the sea, which emerge stronger now in the context of a potential threat than they did in the first part of the questionnaire. There are evident links to the amenity value and symbolic values accorded to the seascape.

Table 3
Selected arguments fielded in opposition to and support of offshore wind farming. 28.7% of all arguments were in favour of offshore wind farming, 15.2% represented a neutral attitude or concerns, and 56.1% were against offshore wind farming.

Argument	Percentage out of all arguments fielded
Arguments primarily raised against offshore wind farms	
Aesthetic qualities of the landscape	21.8
Nature conservation	15.1
Emotional arguments	7.6
Shipping safety	3.6
Other categories	8.0
Doubts raised (qualified support)	
Feasibility/technology/financing	4.4
Economic viability	4.6
Other	6.2
Arguments primarily raised in support of offshore wind farms	
Renewable/clean form of energy generation	23.3
Creates employment in the region	5.2
Counteracts climate change	0.2

15.1% of all the arguments raised cited potential threats to nature as a reason to oppose offshore wind farms. Reference is made to the expected impacts of offshore wind farms on specific ecosystem attributes (species) and functional outcomes (habitats). In the minds of respondents, offshore wind farming represents a threat to the direct and indirect use value of migratory birds for example, which are used in creating a tourist image of the case study area or simply a source of pleasure when watching them in flight. Offshore wind farms also seem to threaten the intrinsic value of species and habitats, expressed in fears that species could disappear and followed with strong 'should' statements indicating this would be morally wrong.

Of particular interest are purely emotional arguments which amount to nearly 8% of all arguments used in opposition. Often they are linked to aesthetic arguments. "Loss of the open horizon" and "sense of being limited" are typical examples, but there are much stronger and deeply personal arguments such as "loss of everything that is important to me", "cruelty" and "rape of the sea". Clearly, these arguments go beyond the expected visual impacts of offshore wind farms, representing perhaps a more deep-seated antipathy towards any structures that might detract from what is perceived as the essence of the sea. Although it is difficult to pinpoint what these special qualities might be, the expected loss is significant and touches the very core of why these respondents value the sea. Symbolic values may be a significant contributor here, as might be the felt existence value of the sea in terms of an entity that should remain untouched by human structures. Strong emotional feelings might also be elicited because of an underlying perception of the sea as vulnerable, which makes it all the more important to protect it from harm.

4. Discussion and conclusion

This paper began by setting out some of the conceptual difficulties that arise when applying the concept of CES in practice. Defining CES was shown to be a two-step process consisting of a contextual definition of non-market values and locating these within a specific ecosystem. The two concepts of landscape (or seascape in the context of the case study considered here) and place emerged as useful conceptual bridges linking ecosystem functioning outcomes and values in the ecosystem. The paper also drew a distinction between objects of value – the things that we assign value to – and personal held values as a universal motivational or driving force.

The North Sea case study then identified CES as perceived by local residents in the specific context of a coastal–marine ecosystem. Although some CES were found to directly relate to North Sea attributes (e.g. the value accorded to particular North Sea species) or functional outcomes (habitats, biodiversity), most required the use of a conceptual shift that turned North Sea attributes into a specific setting that could be defined by a distinct environmental character. Stimulated by perception, and underscored by various cultural filters that apply to the viewers, this setting is turned into landscape and place. It is these two concepts that offer links to aesthetic and symbolic values, described in the MA in the CES categories of inspiration, sense of place and identity and cultural heritage value. Indirect use values were found to be most prevalent out of the value classes described; these are closely associated with the many intangible benefits that were considered essential in the context of experiencing the North Sea environment. Although these CES also play an important role in generating feelings of "home",[2] rootedness and local identity, those same cultural services find expression in hard economic currency (jobs, local income) in sectors such as tourism.

[2] "Heimat" in German, indicating home, place of belonging and place of origin.

Offshore wind farms are clearly considered a potential threat to key CES by local residents. The strength of the objections raised against offshore wind farms on account of their feared aesthetic impact indicates that much will depend on the actual visibility of offshore wind farms in the German North Sea. For the 'open horizon' argument at least, and the potential threat to the seascape experience, there is some truth in the adage of 'out of sight out of mind'. Careful siting may go some way towards resolving aesthetic concerns and ensuring that the respective CES is not impacted. Of note is a potential trade-off between possible benefits to the landscape – and with this perceived quality of life – and negative impacts on the seascape. Some residents consciously argue that wind farms in the sea might go some way towards taking the pressure off the land and would be acceptable if they lead to a reduction of wind turbine density on the mainland.

Siting, however, does not resolve the concerns of residents who perceive offshore wind farms to be a threat to nature and the symbolic values of the sea. Long-term ecological studies will be needed to show the real effect of offshore wind farms on the ecosystem and to determine which species and habitats are showing detrimental effects and whether others might be showing positive trends (e.g. on account of the potential artificial reef effect of offshore wind farms). Although some links can be suspected to the actual visibility of offshore wind farms, values such as creation, freedom and "ability to breathe" do seem to touch upon a perception of the sea that goes beyond experiences of the seascape. This harks back to the view of the sea as a raw force of nature, representing an environment which can never be entirely tamed and which is treasured precisely for the fact that it offers a contrast to the highly controlled and man-made mainland. The essence of the sea is also its mystery and the fact it is still an unknown quantity, with any form of fixed construction perceived as detraction. Some of the symbolic values accorded to the sea would therefore seem to be lost with the idea of fixed 'industrial' structures irrespective of whether these structures are visible or not.

The case study considered here offers some general lessons for working with CES. At a conceptual level, CES have been shown to add another level of complexity to an approach that is a complex socio-ecological systems approach already. An essential aspect in working with CES is to identify the ecosystem units to which value is ascribed, where the difficulty remains of relating CES to distinct ecosystem functions. We have used landscape and place as conceptual bridges to capture the many layers of meaning assigned to the ecosystem and to link ecosystem functional outcomes to particular values. Other bridges may be necessary to establish links between ecosystem function and the spiritual value of the ecosystem, for example.

In terms of operationalisation, surveys offer a useful tool for gaining insights into intangible values ascribed to ecosystems by groups of stakeholders. Results can enhance the visibility of intangibles and enable their ranking in order of relative importance, although this case study clearly did not capture all of the CES mentioned in the MA. Nevertheless, some problems do remain. One is that survey results only offer a snapshot in time and space. The imagined impacts of offshore wind farms may be worse than the actual fact, and a similar habituation effect may occur that has been noted for wind farms on land. Perceptions may therefore shift within a relatively short spate of time. Age may also play a role: A recent survey established that 27% of over-50-year-olds consider wind farms on land an eyesore but only 8% of those under 30 years of age (GEO, 2008). Surveys are also limited in their reach and cannot always be considered representative of all stakeholders. This is relevant because different interest groups may construct rather different narratives of a particular ecosystem, depending not least on their respective interests. In our case study area, this has partly been resolved by comparing the views of local

residents to the views of group stakeholders (Licht-Eggert et al., 2008).

The present case study highlights another problem, which is a potential mismatch between the spatial scales of ecosystems and those of CES. One way to delineate ecosystems is by their structural and functional context (Müller and Burkhard, 2007; Post et al., 2007; Bailey, 1987), but the symbolic value of the sea or the specific aesthetic qualities of the seascape cannot always be matched to the exact boundaries of the ecosystem. Where, for example, does the horizon end? There is also the question of where to locate services and/or benefits. The sea seems a classic case of directional service flow (Fisher et al., 2009) where the service is provided in one place – in this instance, the seascape – but the benefit reaped in another. This may include a tourist taking home a rich tapestry of images and experiences, so benefits are not only reaped in 'real' and physical places but also at a mental and emotional level.

The greatest difficulty, however, is still to find meaningful ways of comparing the intangibles to the economic values generated from ecosystems. What is more important, the market value of electricity generated by offshore wind farming or the symbolic value of the sea to local residents? Ultimately, these are decisions that need to be taken by society through transparent and inclusive dialogue. The lesson from the case study is that it is possible to bring the intangibles to the discussion table and to operationalise them in the context of ecosystem services.

Acknowledgements

The project *Zukunft Küste—Coastal Futures* is funded by the German Ministry of Education and Research (BMBF FKZ 03F0476B). The authors would like to thank their project collaborators, all colleagues and the anonymous reviewer who contributed to the development of this paper.

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