



REVIEW OF MARINE CULTURAL, SOCIAL AND HERITAGE INDICATORS

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Executive Summary

Project Background

- Within the UK, the Marine Strategy provides the framework for delivering UK national marine policy and outlines how the vision of clean, healthy, safe, productive and biologically diverse oceans and seas will be achieved.
- As part of the UK Marine Assessment in 2019, the UK Marine Science Coordination Committee (MSCC) Social Science Task Group (SSTG) identified that there is currently limited cultural, social and heritage evidence for public values, attitudes, perceptions, concerns, levels of ocean literacy, and indeed, barriers and motivations to behaviour change relating to our seas.
- This report provides an initial scoping of the literature and identifies the current state of play with respect to the development and application of cultural, social and heritage indicators in the UK marine environment.

Identification of Indicators

- A range of cultural, social and heritage indicators have been identified within the literature which could be applied to the marine environment – these are summarised below:

Cultural	Social	Heritage
Recreation, Leisure and Tourism	Marine sector employment	Employees Working in Sector
Aesthetic Benefits	Marine sector employment as a proportion of total coastal community employment	Participation in Marine Cultural Heritage
Inspiration for Culture, Art and Design	Coastal community employment deprivation	Academic Engagement
Spiritual Experience	Coastal community employment rate	Number of Volunteers Engaged
Cognitive Development, Education and Research	Coastal community income deprivation	Visit Numbers to Cultural Heritage Attractions
Cultural Heritage and Identity	Number of recreation visits to the coast	Digital Engagement Numbers
Health Benefits	Health deprivation	Viewing Figures for Broadcast Media
		Social Media Engagement

Areas for Future Study

- A number of evidence gaps and further research requirements have been highlighted within the literature - these are summarised below:

Cultural	Social	Heritage
Improved definitions of cultural ecosystem services.	Develop robust ecosystem service indicators to feed into marine national natural capital accounts.	Develop datasets or an accepted means of attributing a proportion of national figures to the marine component of heritage.
Further development of valuation methods for cultural ecosystem services.	UK Standard Industrial Classification of Economic Activities (SIC) codes to better fit marine industries.	Clearer understanding of how marine cultural heritage is perceived by and contributes to coastal communities.

Cultural	Social	Heritage
More studies on cultural ecosystem services in the context of ecosystem service bundles.	Establish the most appropriate spatial delineation of marine plans for which it will be appropriate to monitor social outcomes.	Establish where marine cultural heritage fits within ecosystem service frameworks.
More clearly articulating policy implications.	Data on how society values changes in amenity supply over time.	Need for marine cultural heritage questions in existing data gathering exercises.
Testing and developing integrated marine cultural ecosystem service assessments, which require closer interactions with stakeholders.	Amendments to water-sports participation surveys are required to be used in marine planning.	Sharing of knowledge and practice between marine cultural heritage practitioners and others.
More focus on subjective and intangible classes of cultural ecosystem services such as existence, bequest, and symbolic services.	Development of quantitative indicators for seascape character area assessments.	Develop materials and workshops that identify data, research and practical outcomes across the full range of marine heritage and its audiences.
Further development of indicators to measure trade-offs between cultural ecosystem services and human wellbeing.	Social survey data to analyse coastal communities and marine and coastal activities.	Interdisciplinary workshop to propel the social and economic value of the marine historic environment onto the research agendas of others.
Better understanding of the role of non-natural capital in the co-production of marine and coastal cultural ecosystem services.	Designation of MPAs and spatial management needs to take account of social, cultural and economic issues.	There is a need for acquiring data, engaging in debate, joining-up, stimulating research and enabling outcomes that make more of the social and economic benefits of marine cultural heritage.
Identifying the role of open ocean and deep-sea areas in providing cultural ecosystem services.	Research needs to take account of the diversity of communities across the UK - values and perceptions will differ spatially and temporally – need for long-term data.	Develop toolkits on best practice in planning, in using existing social and economic indicators, and in gathering new data.

Concluding Comments

- A relatively small number of studies have developed cultural, social and heritage indicators which may be appropriate for use in the marine environment, with data availability being identified as one of the major challenges for their application.
- Given the potential overlap between these three categories and their indicators, there needs to be more cross-cutting studies which bridge this divide.
- There is a requirement for standardised terminology within the UK as cultural, social and heritage indicators cover multiple disciplines within academia and often cross multiple Government departments with respect to policy.
- Only limited studies have been identified where indicators have been developed and applied successfully within the UK marine environment.
- It is recommended that further work is required within this field to continue the development and application of cultural, social and heritage indicators and to ensure that data are collected and reported in an appropriate way to populate the indicators.

1. Introduction

1.1 Project Background

It was proposed by Gibbs and Cole (2008) that the marine and coastal environment could be considered a Complex Adaptive System which is formed through the interconnection between:

- natural systems (e.g. terrestrial, freshwater, estuarine, coastal and oceanic);
- designed systems (e.g. extractive industries, tourism, and power generation); and
- social systems (e.g. environmental activist groups, fishing communities, local communities etc.) (Atkins et al., 2011).

As such, sustainable development and marine management practices are required which consider and value the environmental, economic and social impacts of all human activities. In order to fully achieve such a holistic (ecosystem) approach in marine management, an interdisciplinary approach is required which bridges the divide between natural and social sciences research (Burdon, 2016). There is also the need for understanding the international (e.g. OSPAR, Convention on Biological Diversity), European (e.g. Marine Strategy Framework Directive, Water Framework Directive) and national (e.g. Marine and Coastal Access Act 2009) laws and policy which drive coastal and marine management within the UK (Boyes & Elliott, 2014).

Within the UK, the Marine Strategy provides the framework for delivering UK national marine policy and outlines how the vision of clean, healthy, safe, productive and biologically diverse oceans and seas will be achieved (UK Marine Online Assessment Tool, 2019). As part of the UK Marine Assessment in 2019, the UK Marine Science Coordination Committee (MSCC) Social Science Task Group (SSTG), presented evidence on the social value of the marine environment and public perceptions which can enhance UK decision-making to protect and manage the marine environment. Their summary recognised that while there has been some work on economic values of marine ecosystem services and benefits, there is limited social and cultural evidence for public values, attitudes, perceptions, concerns, levels of ocean literacy, and indeed, barriers and motivations to behaviour change relating to our seas (UK Marine Online Assessment Tool, 2019).

A number of studies have been identified within the literature which call for the inclusion of social sciences into marine planning and management (Flannery et al., 2016; Bennett et al., 2017; Grimmel et al., 2019). For example, Grimmel et al. (2019) recognise that the integration of social aspects and views has been found to lack well-rounded consideration in processes supporting decision-making, and they suggest that the absence of an existing framework that defines social variables and dimension components in ocean management approaches is a key priority for future research. This is of importance here given the role of social impact assessments and social indicators within Strategic Environmental Assessments.

While the marine environment includes spaces of major cultural and recreational significance (e.g. historical ship wreck sites, fishing grounds, areas of outstanding natural beauty), there has been little research to evidence a broader suite of cultural ecosystem service benefits it provides (Turner et al., 2014). A series of Defra-funded workshops which ran in 2019, also identified some relevant issues including the impact of climate change on marine cultural heritage, the cultural value of fishing and fisheries, the challenge of the intangible nature of cultural heritage, the link between place attachment, heritage and values; and the need to map cultural heritage and to consider how it can be included within marine planning (McKinley, in prep.). These issues emphasise the importance of

developing a meaningful set of indicators for cultural, social and heritage values for use both within policy and the decision-making process and by the academic and research community to support the collection of useful data that contributes to our wider understanding of these issues.

1.2 Indicators

Given the complexity of the marine environment and the need for integrated management (Burdon et al., 2018), indicators are required to provide insight into the behaviour and state of coastal and marine ecosystems, together with an indication of the trajectory of change due to natural and human events (Elliott, 2011; Atkins et al., 2015). Indicators can also be used to assess process and outcomes, for example to monitor the efficacy of policy responses or programmes. It has been suggested that indicators have three basic functions: to simplify, to quantify and to communicate (Aubry & Elliott, 2006). Indicators can be used to reflect the state of the science of an area (Atkins et al., 2015) and provide a useful tool for supporting management decisions (Hattam et al., 2015). Indicators can also provide a link between scientific knowledge and policy practice and link objectives to management (Potts, 2006). A key commitment of the UK Government's 25 Year Environment Plan (25YEP) was to develop a comprehensive set of indicators, which collectively describes environmental change as it relates to the 10 goals in the 25 Year Environment Plan.

Currently, there are no obvious indicators or standard metrics for measuring cultural ecosystem services, particularly identity and experiential aspects such as spiritual and aesthetic aspects (Bryce et al., 2016). Cultural ecosystem services are broadly accepted as being intangible (Milcu et al., 2013), are rarely marketable (Carpenter et al. 2009; Martín-López et al. 2009) and as such are often under-represented in ecosystem service assessments (Martin et al., 2016). Indeed, Milcu et al. (2013) suggest that the challenges of incorporating cultural ecosystem services into a broader ecosystem services framework mean they may be undervalued in favour of economic and ecological priorities, for which more established valuation methods are developed. In their systematic review of 145 marine and coastal ecosystem services papers, Liqueste et al. (2013) concluded that social sciences are under-represented in the studies and the main research gaps relate to indicators of cultural ecosystem services. Such indicators need to be able to address both tangible and intangible cultural heritage which are deeply rooted in the ideas of seascape, cultural practices etc. (UNESCO, 2019). There is a need to not only develop appropriate indicators that can be used to encapsulate the richness and diversity of social and cultural evidence, but this needs to be supported by a clear pathway for the inclusion of this evidence within marine management and decision-making (UK Marine Online Assessment Tool, 2019). This report is a first step in addressing this issue.

1.3 Natural Capital, Ecosystem Services and Benefits

The concepts of natural capital and ecosystem services are considered as critical components of a broader ecosystem approach which has social-ecological links and engagement at its core. The development of natural capital and ecosystem service frameworks has been an essential step in the development of indicators for components within them. To date, there has been no agreed definitions of these terms in the literature, however, for the purposes of this report the following definitions are used (Natural Capital Committee, 2017):

- *Natural Capital*: "The elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions".
- *Ecosystem Services*: "Functions and products from nature that can be turned into benefits with varying degrees of human input".

- *Benefits*: “Changes in human welfare (or well-being) that result from the use or consumption of goods, or from the knowledge that something exists”.

The Millennium Ecosystem Assessment identifies four categories of ecosystem services (MA, 2005):

- *Provisioning services* are “the products obtained from the ecosystem”;
- *Regulating services* are “the benefits obtained from the regulation of ecosystem processes”;
- *Supporting services* are “those that are necessary for the production of all other ecosystem services, but do not yield direct benefits to humans”; and
- *Cultural services* are “the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences”.

A number of conceptual frameworks have been developed to identify what ecosystem services are delivered by the marine environment (Beaumont et al., 2007; de Groot et al., 2010; Turner et al., 2015) all of which have centred around the categorisation of provisioning, supporting, regulating and cultural ecosystem services as first proposed by the Millennium Ecosystem Assessment (MA, 2005). Within a UK context, a summary of the ecosystem services provided by the marine environment was developed by the UK National Ecosystem Assessment Follow-On Project (Turner et al., 2015) and has been adapted here to reflect natural capital as well as ecosystem services and societal benefits (Figure 1). The marine environment can therefore be considered in terms of stocks, flows and links to well-being. Such natural capital ‘stocks’ can deliver a range of ecosystem services which can be defined as the links (‘flows’) between the marine ecosystem (i.e. the natural assets) and the benefits which are obtained by society and improve societal well-being. For example, in a ‘healthy’ marine ecosystem (as defined by Tett et al., 2013), sandbanks provide suitable habitat for sandeel populations to thrive (‘stock’), seabirds (e.g. puffins) then feed on sandeels (‘flows’), resulting in healthy seabird colonies which provides a valuable resource for recreation in the form of nature watching (i.e. a cultural benefit for society). This framework recognises the importance of all four categories of ecosystem service, with a broad range of benefits derived from cultural services, including health benefits, aesthetic benefits and cognitive (education) benefits.

Chan et al. (2012a) asked the question “where are cultural and social in ecosystem services?”, and despite a growing literature since then, there still remains a number of challenges which need to be overcome to ensure that social and cultural considerations are included within sustainable marine management. At present cultural and social issues are encapsulated within the overarching category of cultural ecosystem services. Within the UK, as part of the UK National Ecosystem Assessment Follow-on Project, Fish et al. (2016) defined cultural ecosystem services as the interactions between environmental spaces (i.e. physical settings such as coasts, woodlands, allotments) and the cultural or recreational practices (e.g. fishing, walking, gardening) that take place within them. In so doing, they further developed the UK NEAFO cultural ecosystem services framework (Church et al., 2014) which takes a geographical or place-based approach to assessing cultural ecosystem services.

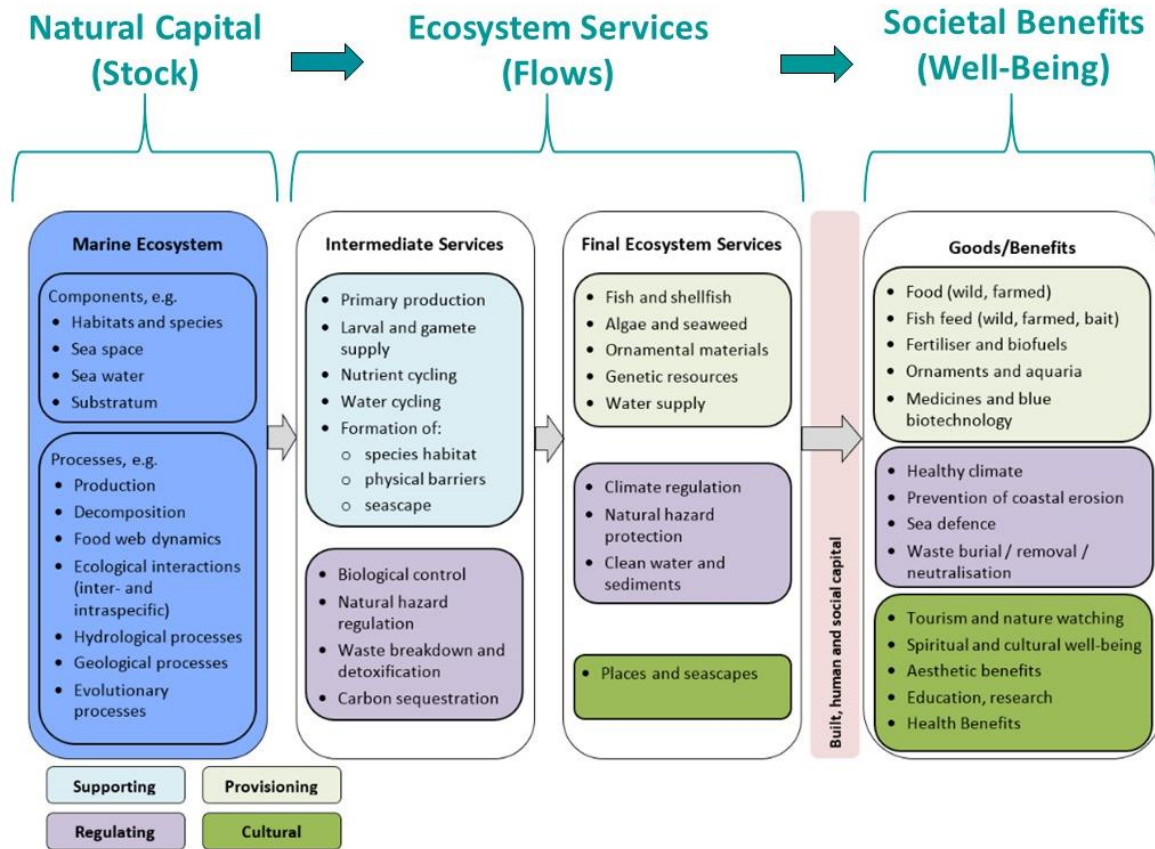


Figure 1: Ecosystem services supplied by the UK marine environment (adapted from Turner et al., 2015).

A complimentary framework has been developed by Hooper et al. (2019) who take natural capital as their focus, but which also recognises the distinction between natural capital, ecosystem services and benefits (Figure 2). Their study defines the natural capital approach as a somewhat broad term that encompasses assessment of the quantity, quality, function and value of environmental assets and the goods and services that flow from them, with the aim of ensuring the sustainable use of natural resources. The framework they present identifies the assessment and appraisal mechanisms that would enable the natural capital approach to be operationalised within the UK marine environment. Hooper et al. (2019) conclude that by linking natural capital objectives to other policy goals (such as employment, health and well-being, cultural heritage and income inequality) this may improve outcomes.

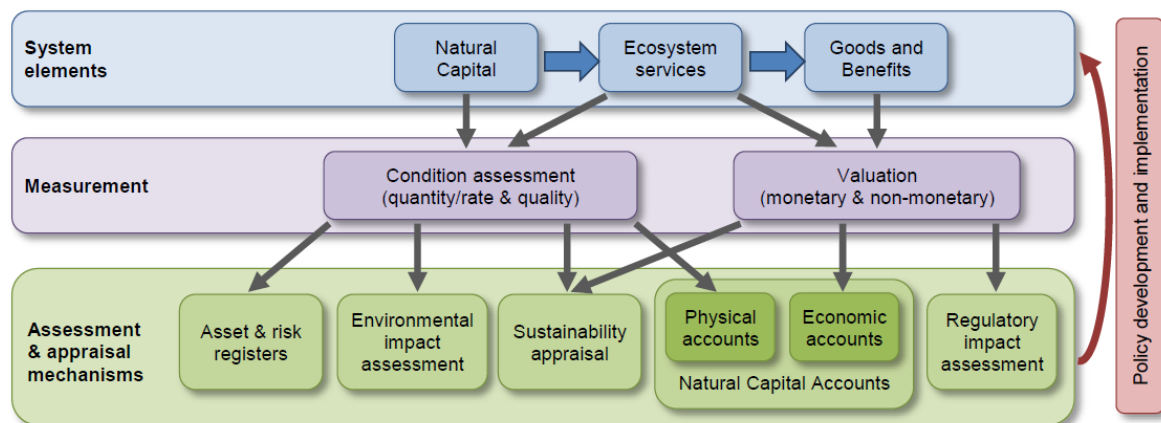


Figure 2: Mechanisms for implementation of the natural capital approach within the UK policy framework (Hooper et al., 2019).

1.4 Valuation

The concept of value is central to the natural capital approach (see Figure 2 above), as it seeks to better integrate environmental and economic information and thus to redress the historic trend in which natural capital and ecosystem services were undervalued and overexploited (Hooper et al., 2019). Since marine ecosystem services, which flow from natural capital, have the potential to lead to benefits for society it is appropriate to consider and determine their value (Atkins et al., 2011; Ruiz-Frau et al., 2012; Cooper et al., 2013). When it comes to valuation, the above frameworks are extremely useful as they identify the underlying processes, the flows of ecosystem services and the benefits they provide for society. Both frameworks recognise that for society to gain such benefits, this often requires an input of complimentary capital (built, human or social capital) for example a fisherman needs to invest time and knowledge (social capital) and resources (fishing gear, fuel, etc.) before they can capture fish (food provision) and therefore the focus of valuation is on the societal benefits.

Value can be defined in terms of ecological value (the health of the system measured using ecological indicators), economic value (including both use and non-use values identified using market or non-market techniques) and/or socio-cultural value (for example relating to cultural identity) (MA, 2003; Burdon et al., 2018). The term ‘socio-cultural’ has been defined by McKinley et al. (2019) as a broad term to incorporate the many different facets of human society, including attitudes, values, behaviours as well as the structures that frame social organisations and actions. It is worth noting that cultural ecosystem services do function in a very different way to the other services (as identified above); they are often connected to land/seascapes and can bring up individual subjective and broader societal values. The concept of ‘total social value’ can be used to incorporate the views of society and their values associated with ecosystem service provision into the decision-making process in order to determine policy options and management measures and comprises these three domains (Burdon, 2016). Whilst the valuation of ecosystem services has progressed significantly over recent decades, issues and challenges remain that question the appropriateness and effectiveness of valuation in marine planning and management (Börger et al., 2014; Cavanagh et al., 2016).

The majority of social valuation studies focus on the values of individuals, however Kenter et al. (2015) recognise that social value is often shared. Shared values are defined as those that bind people together, for example as citizens and as members of communities - these collective values often relate to the landscapes people live in and visit. In relation to social valuation of ecosystem services. Kenter

et al. (2015) identify eight types of shared/social values which interact with cultural ecosystem services (Table 1).

Table 1: Main types of shared and social values with definitions and dimensions along which they can be discriminated (Kenter et al., 2015).

Type of shared/social values	Definition	Associated dimension
Transcendental value	Conceptions about desirable end states or behaviours that transcend specific situations and guide selection or evaluation of behaviour and events (Schwartz and Bilsky, 1987).	Concept
Cultural and social values	Culturally shared principles and virtues as well as a shared sense of what is worthwhile and meaningful. Cultural values are grounded in the cultural heritage and practices of a society and pervasively reside within societal institutions (Frey, 1994). Societal values are the cultural values of a society; societies may be more or less homogenous, so there may be multiple sets of cultural values in one society that overlap to a greater or lesser degree with each other.	Provider
Communal values	Values held in common by members of community (e.g., geographic, faith/belief-based, community of practice or interest), including shared principles and virtues as well as a shared sense of what is worthwhile and meaningful.	Provider
Group values (with valuation)	Values expressed by a group as a whole (e.g., through consensus or majority vote, or more informally), in some kind of valuation setting.	Provider
Deliberated values	Value outcomes of a deliberative process; typically, but not necessarily, a deliberative group process that involves discussion and learning.	Process
Other-regarding values	As contextual values: the sense of importance attached to the well-being of others (human or non-human). As transcendental values: regard for the moral standing of others.	Intention
Value to society	Benefit, worth or importance to society as a whole.	Scale

1.5 Report Structure

Before appropriate indicators can be developed, we need a better understanding of what data are currently available which capture cultural, social and heritage evidence, are they relevant for application within a marine context, are there case studies available where such indicators have been applied, and where is there a lack of indicator development to encapsulate the richness and diversity of cultural, social and heritage evidence. The aim of this report is not to undertake a comprehensive review of evidence, but rather to identify a baseline from which a research agenda can be built upon going forwards. Therefore, by using a combination of desk-based literature searches and engagement with key stakeholders and researchers, this report:

- Reviews the published and grey literature which defines, develops and applies cultural, social and heritage indicators to the UK marine environment;
- Identifies UK case studies where cultural, social and heritage indicators have been successfully applied; and
- Highlights areas for future research based on current gaps in the evidence.

2. Review of Indicators

The focus of this report is on the development and application of cultural, social and heritage indicators in relation to the UK marine environment. There are no agreed definitions within the literature for each of these categories. Cultural ecosystem system service indicators will by their very nature include elements of social and heritage indicators and therefore it is recognised here that there is a degree of overlap between them. However for the purposes of this review this section is divided into three sub-sections. The first sub-section reviews our current understanding of cultural indicators as identified within the cultural ecosystem services literature. Cultural ecosystem services can be considered as the products of natural processes, the application of human labour and the outcome of human thought and perception. They have been defined by Fish et al. (2016) as the contributions that ecosystems make to human well-being in terms of the identities they help frame, the experiences they help enable and the capabilities they help equip. The second sub-section reviews the growing area of research on social indicators. Social indicators can be defined as numerical measures that describe the well-being of individuals or communities, and as such can be used to describe and evaluate community well-being in terms of social, economic, and psychological welfare (NOAA, 2019). The third sub-section focusses on our current understanding of marine heritage indicators. Marine heritage (or cultural heritage) has been defined by Henderson (2019) to encompass tangible remains such as shipwrecks, submerged settlements, coastal settlements, ports and harbours, maritime ecologies, and geology as well as equally vital intangible components such as cultural practices, artistic and linguistic expressions, local skills, traditional and historical knowledge.

A summary of the headline indicator categories for each section is presented in Table 2, with further details and examples provided below.

Table 2: Summary of the headline indicator categories for cultural, social and heritage indicators.

Headline Indicator Categories		
Cultural	Social	Heritage
Recreation, Leisure and Tourism	Marine sector employment	Employees Working in Sector
Aesthetic Benefits	Marine sector employment as a proportion of total coastal community employment	Participation in Marine Cultural Heritage
Inspiration for Culture, Art and Design	Coastal community employment deprivation	Academic Engagement
Spiritual Experience	Coastal community employment rate	Number of Volunteers Engaged
Cognitive Development, Education and Research	Coastal community income deprivation	Visit Numbers to Cultural Heritage Attractions
Cultural Heritage and Identity	Number of recreation visits to the coast	Digital Engagement Numbers
Health Benefits	Health deprivation	Viewing Figures for Broadcast Media
		Social Media Engagement

2.1 Cultural Indicators

Despite there being a plethora of ecosystem service frameworks developed since the MEA (e.g. Beaumont et al., 2007; de Groot et al., 2010; Atkins et al., 2011; Mace et al., 2011; Potts et al., 2014; Turner et al., 2015; Hattam et al., 2015), the four core groupings of ecosystem services (provisioning, supporting, regulating, cultural) are evident throughout the majority of these frameworks. Benefits associated with cultural identity, heritage and sense of place (belonging) are included within cultural ecosystem services, which has been characterized as the 'joint product' of natural and human/cultural capital (Dudley & Coates, 2014). Burdon (2016) compared the key ecosystem service categories identified within the literature, and provided a comparative summary of their structures. A comparison in relation to cultural ecosystem services is provided in Table 3. In addition, further classification systems have been cited within the literature, for example the Common International Classification of Ecosystem Services (CICES), developed by Haines-Young & Potschin (2013), formed part of the analytical framework for ecosystem service assessments under Action 5 of the EU Biodiversity Strategy (Maes et al., 2014) and was also adapted for application at a local level within Belgium (Turkelboom et al., 2013). It was the CICES framework that was applied by Hooper et al. (2019) as they considered that it clearly identifies and categorises the ecosystem endpoints (thus supporting valuation), it has the potential to include abiotic services (where required), and represents the most concerted focus of intellectual effort on ecosystem service classification across Europe. However, despite being under construction for some time, there is not currently a marine-specific CICES framework available for use. Given the focus of this review on indicators, rather than ecosystem service frameworks, then examples from a range of frameworks will be discussed below.

A number of reviews have recently been published which address cultural ecosystem services (e.g. Milcu et al., 2014; Martin et al., 2016; Garcia Rodriguez et al., 2017) and therefore it is not the purpose of this report to reproduce this work but to draw out some of the key findings from these and other papers with a particular focus on indicators (quantitative and qualitative) and measurements. There is currently much debate around where cultural aspects are placed in terms of marine policy and management and in practice as to whether they fit within ecosystem service frameworks. Many authors are advocating that cultural ecosystem services deserve attention beyond the label of a MEA category (MA, 2005), but nevertheless fail to address this problem convincingly (Milcu et al., 2013). This argument is supported by Firth (2016) who acknowledges that although cultural ecosystem services are included conceptually within the ecosystem services approaches, there is broad acknowledgement that methods of addressing cultural ecosystem services are currently underdeveloped.

A study by Garcia Rodriguez et al. (2017) undertook a systematic review on marine and coastal cultural ecosystem services, with the aim to analyse the current state of research, to identify knowledge gaps, and to pinpoint research priorities and the way forward. They demonstrate clearly that research on marine and coastal cultural ecosystem services is slowly gaining traction in the scientific literature, identifying 72 peer-reviewed scientific papers which meet their defined criteria. Within their review they identified the number of publications which focussed on each marine and coastal cultural ecosystem service class, using the CICES framework for overall structure (Figure 3). These findings compliment work of others (Russell et al. 2013; Milcu et al., 2013; Bell et al., 2015; Martin et al., 2016) who all identify a range of cultural ecosystem services within the literature. It is not surprising that the greatest number of studies focus on recreation/leisure and aesthetic values, as these are often considered to be the 'easiest' to measure. Whilst Garcia Rodriguez et al. (2017) did not identify specific indicators within their review, they identified areas for future research which have been listed in Section 4.

Table 3: Comparison of cultural ecosystem service categories (after Burdon, 2016).

Paper	MA (2005) Millennium Ecosystem Assessment	Beaumont et al. (2007) Marine biodiversity across Europe	de Groot et al. (2010) The Economics of Ecosystems and Biodiversity (TEEB)	Atkins et al. (2011a) Management of the marine environment	Mace et al. (2011) UK NEA - generic framework (Final Ecosystem Services)	Potts et al. (2014) VNN - marine framework (Goods/Benefits)	Turner et al. (2015) UK NEAFO - marine framework (Goods/Benefits)	Hattam et al. (2015a) VECTORS - marine framework	
Cultural Services	Spiritual and religious values	Cultural heritage and identity	Spiritual experience	Cultural heritage and identity	Environmental settings (spiritual/religious)	Spiritual / cultural well-being	Spiritual and cultural well-being	Spiritual experience	
	Cultural heritage								Cultural heritage
									Cultural diversity
		Cognitive benefits	Information for cognitive development	Cognitive benefits		Education	Education, research	Information for cognitive development	
	Recreation / tourism	Leisure and recreation	Opportunities for recreation & tourism	Leisure and recreation	Wild species diversity (recreation) Environmental settings (recreation/tourism)	Tourism/nature watching	Tourism and nature watching	Leisure, recreation and tourism	
		Feel good or warm glow		Feel good or warm glow					
	Inspiration		Inspiration for culture, art and design					Inspiration for culture art and design	
	Aesthetic value		Aesthetic information			Aesthetic benefits	Aesthetic benefits	Aesthetic experience	
Social relations									
						Health benefits			

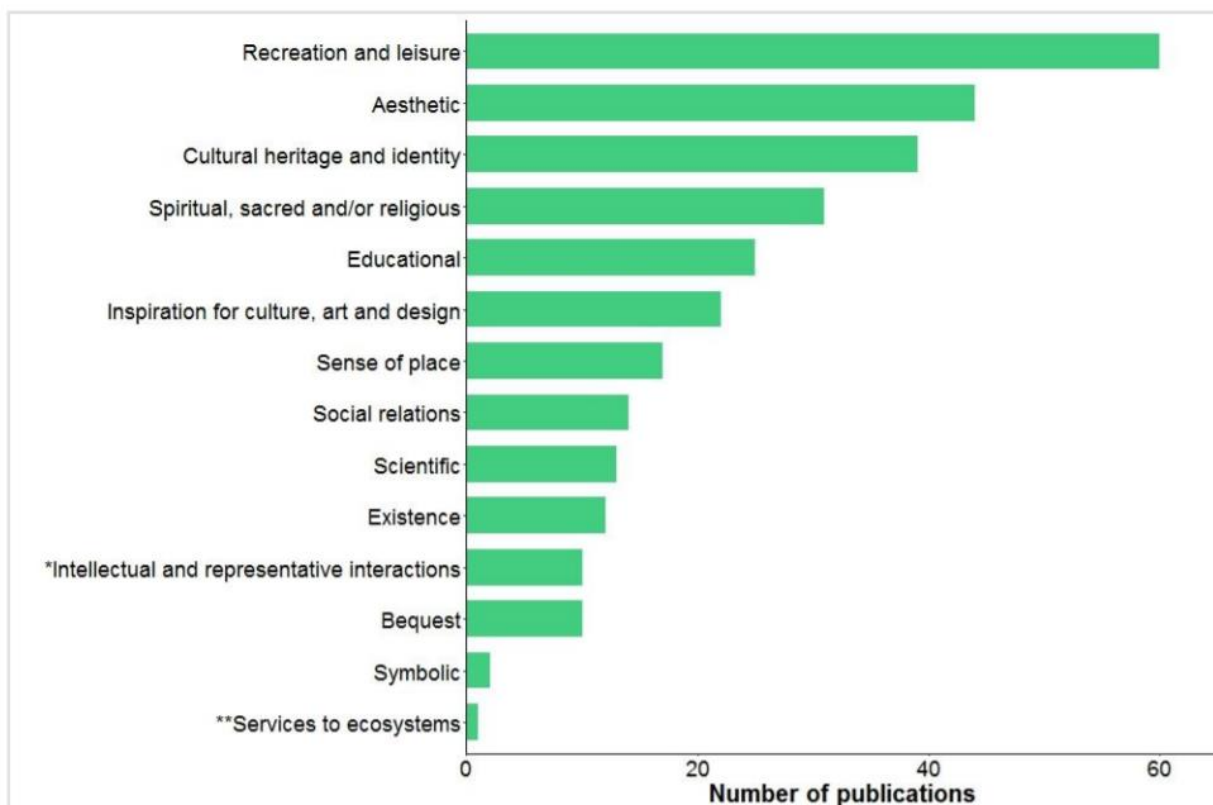


Figure 3: Number of publications investigating subcategories of cultural ecosystem services (Garcia Rodriguez et al., 2017).

With regard to cultural ecosystem service indicators, Böhnke-Henrichs et al. (2013) developed a typology for the inclusion of ecosystem service approaches into marine spatial planning and management and provide guidance to select appropriate indicators for all relevant ecosystem services. Six main categories of cultural ecosystem services were identified and included recreation and leisure, aesthetic information, Inspiration for Culture, Art and Design, Spiritual Experience, Information for Cognitive Development and Cultural Heritage and Identity. In a further study, a practicable set of ecosystem service indicators was proposed by Atkins et al. (2015) that meet operational requirements and are grounded within the UK NEAFO marine ecosystem services framework (Figure 1). Example indicators and UK data sources for cultural ecosystem services were identified by Atkins et al. (2015) for the following cultural ecosystem services: Leisure, recreation and tourism; Aesthetic benefits; Spiritual and cultural well-being; Education, Research; and Health benefits. Using a similar approach, Hattam et al. (2015) identify a comparative suite of cultural ecosystem service indicators including: Leisure, recreation and tourism; Aesthetic experience; Inspiration for culture, art and design; Cultural heritage; Spiritual experience; and Information for cognitive development. Each indicator was assessed for its relevance and applicability to the environmental management of the Dogger Bank (North Sea) using an agreed set of criteria, including measurability, sensitivity, specificity, scalability and transferability. Finally, a scoping study by the Office for National Statistics (ONS, 2016) investigated the development of a coastal margins ecosystem account and discussed several methodological challenges arising from the unique characteristics of coastal margin habitats. Within this scoping study the importance of cultural services is recognised, in the form of aesthetics, tourism and outdoor recreation, but given that these services cannot easily be split from the marine environment (as defined by the UK NEA, 2011) the study recommends a composite account for cultural services. A summary of the cultural ecosystem service indicators and societal benefits identified by all three studies are provided in Tables 4-22 below.

2.1.1 Recreation, Leisure and Tourism

Table 4: Indicators and examples of human benefits associated with recreation and leisure (adapted from Böhnke-Henrichs et al., 2013).

Ecosystem Services	Indicators (e.g. references)	Direct benefits: Examples
Recreation and leisure	No of visits to an area (Dehghani et al., 2010). No. of trips per site per year/per season (Gao & Hailu, 2011). No. of days used for particular activity per person (Tapsuwan & Asafu-Adjaye, 2008). No. of overnight stays (Ruijgrok et al., 2006). No. hotel rooms in a region (Lange & Jiddawi, 2009). Area of beach/beach days (Bell, 1986). Amount or catch rate of target fish species (Cameron & James, 1987; Bockstael et al., 1989). No. of visitors per season, No. of boats involved in trips, No. of diver operators offering trips (Dicken, 2010). No of annual access days (Cameron, 1988).	Feelings of relaxation, pleasure and enjoyment, health and well-being, happiness, rejuvenation and employment

Table 5: Indicators of tourism and nature watching. Examples of UK data sources are provided (adapted from Atkins et al., 2015).

COASTAL AND MARINE ECOSYSTEMS	EXAMPLE INDICATORS (UNITS)	EXAMPLES OF UK DATA SOURCES
Tourism and nature watching	Number of participants (number per yr); Number of facilities (number visitors per facility/yr); Amount of time spent participating (hours/days).	Office for National Statistics; UK Centre for Economic & Environmental Development (CEED); Great Britain Tourism Survey; OBIS SEAMAP; RSPB statistics; Royal Yachting Association.

Table 6: Indicators of leisure, recreation and tourism (adapted from Hattam et al., 2015).

Cultural ecosystem services	Indicators of benefits and their measurement (Units)	Examples of cultural ecosystem service benefits
Leisure, recreation and tourism	Number of sick days avoided	Number of rested people
	Number of participants	Coastline and seascape watching
	Number of wildlife watchers	Wildlife watching
	Number of beach visits	Beach usage
	Number of swimmers, divers, surfers, boaters	Water usage

Table 7: Proposed indicators for including cultural ecosystem services within coastal margin and marine ecosystem accounts – tourism and outdoor recreation (ONS, 2016).

Cultural Ecosystem Service	Flow	Data	Valuation
Tourism	Further research required into the calculation of the ‘resource rent’ or ‘hedonic pricing’		
Outdoor recreation	131 million visits per year (daytrips)	Monitor of Engagement with the Natural Environment Willingness to Pay values (Sen et al., 2014)	£558 million per year (2014 prices) Discounted net present value over 50 years of £14.24 billion

2.1.2 Aesthetic Benefits

Table 8: Indicators for aesthetic information (adapted from Böhnke-Henrichs et al., 2013).

Ecosystem Services	Indicators (e.g. references)	Direct benefits: Examples
Aesthetic Information	Area of beach/beach days (Bell, 1986). Beach day (Bell & Leeworthy, 1986).	Pleasure, feelings of stimulation, relaxation, rejuvenation and enjoyment.

Table 9: Indicators for aesthetic benefits. Examples of UK data sources are provided (adapted from Atkins et al., 2015).

COASTAL AND MARINE ECOSYSTEMS	EXAMPLE INDICATORS (UNITS)	EXAMPLES OF UK DATA SOURCES
Aesthetic benefits	Number and/or area of marine features of given stated appreciation; Length of Heritage Coast (km).	Office for National Statistics; Economic and Social Data Service (ESDS).

Table 10: Indicators for aesthetic experience (adapted from Hattam et al., 2015).

Cultural ecosystem services	Indicators of benefits and their measurement (Units)	Examples of cultural ecosystem service benefits
Aesthetic experience	Number of tourist photos taken	Extent of a site to be watched and enjoyed
	Number of visits to a site	
	Number of scuba-divers	
	(Hedonic) property prices	

Table 11: Proposed indicators for including cultural ecosystem services within coastal margin and marine ecosystem accounts - aesthetics (ONS, 2016).

Cultural Ecosystem Service	Flow	Data	Valuation
Aesthetics	Number of photos uploaded	Panoramio website	No method yet

2.1.3 Inspiration for Culture, Art and Design

Table 12: Indicators for inspiration for culture, art and design (adapted from Böhnke-Henrichs et al., 2013).

Ecosystem Services	Indicators (e.g. references)	Direct benefits: Examples
Inspiration for Culture, Art and Design	Amount of time dedicated to culture, art and design per year No. of people engaged with culture, art and design per year	Inspiration and the promotion of creativity, enjoyment, satisfaction and livelihood.

Table 13: Indicators for inspiration for culture, art and design (adapted from Hattam et al., 2015).

Cultural ecosystem services	Indicators of benefits and their measurement (Units)	Examples of cultural ecosystem service benefits
Inspiration for culture, art and design	Number of films, revenue generated (e.g. in £, \$ or €)	Marine themed media (e.g. films)
	Number of films, revenue generated (e.g. in £, \$ or €)	Marine themes artwork and installations
	Number of products developed and revenues generated	Use of marine themes in design (bionics, biomimetics)
	Number of jobs	Employment

2.1.4 Spiritual Experience

Table 14: Indicators and examples for spiritual experience (adapted from Böhnke-Henrichs et al., 2013).

Ecosystem Services	Indicators (e.g. references)	Direct benefits: Examples
Spiritual Experience	Amount of time dedicated for formal religious ceremonies that involve coast/marine per year	Feelings of spirituality, the ability to perform religious ceremonies.

Table 15: Indicators for spiritual and cultural well-being. Examples of UK data sources are provided (adapted from Atkins et al., 2015).

COASTAL AND MARINE ECOSYSTEMS	EXAMPLE INDICATORS (UNITS)	EXAMPLES OF UK DATA SOURCES
Spiritual and cultural well-being	Sites with cultural heritage/well-being (usage rates by people, degree of importance); Sites with spiritual and/or religious significance/well-being (number of people who attach significance, degree of significance attached).	Office for National Statistics; Economic and Social Data Service (ESDS).

Table 16: Indicators for spiritual experience (adapted from Hattam et al., 2015)

Cultural ecosystem services	Indicators of benefits and their measurement (Units)	Examples of cultural ecosystem service benefits
Spiritual experience	Number of people that attach spiritual and religious significance to the marine environment, discourse analysis	Spiritual and religious significance to the marine environment

2.1.5 Cognitive Development, Education, Research

Table 17: Indicators and examples for information for cognitive development (adapted from Böhnke-Henrichs et al., 2013).

Ecosystem Services	Indicators (e.g. references)	Direct benefits: Examples
Information for Cognitive Development	Amount of time spent in education related to coast/marine per year	Intellectual inspiration to pursue knowledge, satisfaction of curiosity, education.

Table 18: Indicators for education and research. Examples of UK data sources are provided (adapted from Atkins et al., 2015).

COASTAL AND MARINE ECOSYSTEMS	EXAMPLE INDICATORS (UNITS)	EXAMPLES OF UK DATA SOURCES
Education, Research	Field trips (number and number of people involved); Classes (numbers and number of people involved); Scientific studies (number of research papers, subscriptions, library borrowing, on-line downloads); Books (number, print run, library usage, e-book downloads); other publications including newspaper articles (circulation including on-line accessing); works of art (number of works, number of people viewing work).	Office for National Statistics; UK Directory of the Marine Observing Systems (UKDMOS); School and University Reports; Charting Progress 2.

Table 19: Indicators for information for cognitive development (adapted from Hattam et al., 2015)

Cultural ecosystem services	Indicators of benefits and their measurement (Units)	Examples of cultural ecosystem service benefits
Information for cognitive development	Number of documentaries / movies / paintings / advertisements derived from a particular site / ecosystem. Number of research articles and scientific findings	Knowledge generated from natural patterns / prototypes

2.1.6 Cultural Heritage and Identity

Table 20: Indicators and examples for cultural heritage and identity (adapted from Böhnke-Henrichs et al., 2013).

Ecosystem Services	Indicators (e.g. references)	Direct benefits: Examples
Cultural Heritage and Identity	No. of households that consider an area or aspects of an area as cultural heritage (Ruijgrok et al., 2006).	Cultural practices which define the heritage, sense of community, sense of place, belonging, health and well-being.

Table 21: Indicators for cultural heritage (adapted from Hattam et al., 2015).

Cultural ecosystem services	Indicators of benefits and their measurement (Units)	Examples of cultural ecosystem service benefits
Cultural heritage	Discourse analysis to identify associations between relevant themes	Cultural importance of a site

2.1.7 Health Benefits

Table 22: Indicators for health benefits. Examples of UK data sources are provided (adapted from Atkins et al., 2015).

COASTAL AND MARINE ECOSYSTEMS	EXAMPLE INDICATORS (UNITS)	EXAMPLES OF UK DATA SOURCES
Health benefits	% cover of coastal and marine environments; % cover of designated coastal and marine spaces (SACs, SPAs, EMS, MPAs, MCZs); Time spent in the coastal/marine environment (hours); Participation in particular activities in the coastal/marine environment (type and duration).	Natural England's 'Monitor of Engagement with the Natural Environment' (MENE) survey data.

2.2 Social Indicators

As society is considered one of the three pillars of sustainable management, it is important to ensure that social values are included within all marine management and planning decisions. There is an increasing call for effective public involvement in marine and coastal management (McKinley & Fletcher, 2012) and a need to develop improved understandings and conceptualisations of societal relationships and interactions with the sea (McKinley et al., 2019). In addition, given the increasing focus of applying a natural capital approach within the UK, evidence gaps have been identified in relation to how benefits are identified at the local (community) scale, where benefits are provided and to whom, trade-offs in development decisions, and understanding how benefits support well-being (Burdon et al., 2019). Given the policy focus of the UK Government's 25 YEP is 'Connecting people with the environment to improve health and wellbeing', this clearly emphasises the importance of developing social indicators to assess whether the goals of the plan are being achieved. Grimm et al. (2019) identify a number of social dimensions in marine spatial planning including the concepts of social sustainability, social responsibility, social license, cultural valuation, social justice, equity and ethics. Within the context of the current review, these papers identify a number of streams of research which are highly relevant but do not identify indicators or case studies. McKinley et al. (2019) also identify a range of socio-cultural dimensions within the context of marine spatial planning.

The MMO commissioned a number of studies which have investigated marine social indicators and their potential application within UK marine spatial planning (MMO, 2014a, 2014b, 2014c). When assessing the relevance of ONS data series and the requirements of the MMO for marine planning and management, a number of economic and social indicators were identified which could be applied to marine plan areas (Table 23, MMO, 2014b). There is an evident disjuncture between these relatively easily accessible measures from social statistics versus the complexity of social dimensions identified by Grimm et al. (2019) and McKinley et al. (2019) mentioned above.

Table 23: Economic and social indicators from ONS which are of relevance for marine plan areas (MMO, 2014b).

Economic Indicators	Social Indicators
<ul style="list-style-type: none"> • Direct employment • Number of businesses • GVA • Gross household disposable income 	<ul style="list-style-type: none"> • Age and gender balance • Population not UK born • Qualifications • Economically inactive • Benefits claimant count

Of particular relevance here is MMO1061 which identified the indicators that are relevant to monitor the social outcomes of marine plans and to ascertain the data requirements (MMO, 2014b). This research project was focussed on the 'social' outcomes of marine plans. Through a scoping exercise of relevant datasets, potential indicator types were identified from the available data, and were bundled under the following categories: employment-based indicators, labour market indicators, deprivation-based indicators, and coastal visit-based indicators. Each of the indicators identified (see below) were included given that they can be constructed for a range of scales from local coastal community areas covering the whole of the coastal community of a plan area, or for a number of spatially explicit coastal communities in a plan area, or at a national level, covering the whole of England or UK and for the combined coastal communities of all plan areas. The scale the indicator applies depends on the broader structure of the plan and its individual monitoring framework.

2.2.1 Marine sector employment

This indicator monitors the absolute and percentage change in marine sector employment.

2.2.2 Marine sector employment as a proportion of total coastal community employment

This indicator monitors the change in the proportion of employment of a coastal community that is in marine sectors.

2.2.3 Coastal community employment deprivation

This indicator is a relative measure of employment deprivation. Number of coastal Lower Super Output Areas (LSOAs) that are amongst the 10 per cent most employment deprived in England.

2.2.4 Coastal community employment rate

This indicator reflects the change in the employment rate (%) of 16 to 64 year olds in plan area coastal communities.

2.2.5 Coastal community income deprivation

This indicator is a relative measure of income deprivation. Number of coastal Lower Super Output Areas (LSOAs) that are amongst the 10 per cent most income deprived in England.

2.2.6 Number of recreation visits to the coast

This indicator monitors the quantity of outdoor leisure activity occurring at a beach or at other types of coastline.

2.2.7 Health deprivation

This indicator is a relative measure of health deprivation. Number of coastal Lower Super Output Areas (LSOAs) that are amongst the 10 per cent most deprived in England.

2.2.8 (Subjective) mental health benefits of visiting the coast

This indicator provides the average rank (1 to 5) of mental health benefits of a coastal visit.

2.2.9 (Subjective) learning about the natural environment during visits to the coast

This indicator provides an average rank (1 to 5) of whether learning about the natural world took place during the visit.

2.2.10 Coastal community multiple deprivation

This indicator provides the relative level of multiple deprivation. Number of coastal Lower Super Output Areas (LSOAs) that are amongst the 10 per cent most deprived in England for multiple deprivations.

With respect to the last indicator, coastal deprivation, a number of studies have been identified within the literature which further investigate this issue e.g. 'Living on the edge: Britain's coastal communities' (SMF, 2017) and 'Falling off a cliff: Economic and social decline by the coast' (SMF, 2019). These studies report on coastal community deprivation using a number of indicators including economic growth (GVA per capita), earnings and employment (mean employee gross salaries, unemployment rate), health (% of population in bad or very bad health) and education (% of 16+ population with level 4 and above qualifications).

A number of weaknesses were highlighted within the indicator list above given the general lack of regularly produced, geographically comprehensive quantitative data on social issues (MMO, 2014b). These include: poor definition of the marine sector through Standard Industrial Classification (SIC) codes for generating employment indicators; partial coverage of environmental amenity impacts, notably the lack of information that relates to the amenity value derived from an individual visit to the coast; lack of directly relevant community cohesion measures; lack of comprehensive data on marine ecosystem services; and as outcome indicators, they are subject to a variety of marine plan and non-marine plan derived forces (MMO, 2014b).

A key finding of the UK National Ecosystem Assessment (2011) was that the paucity of knowledge around shared values constrained our understanding of how to incorporate them in decisions. Kenter et al. (2016) recognise that ecosystem service approaches to date have generally focussed on biophysical measurements and individual values and therefore a range of research papers were presented in a Special Issue of the journal *Ecosystem Services* which focus around shared, plural and cultural values. For example, the work of Bryce et al. (2016) is presented in Section 3.1 below.

As part of the UK Government's 25YEP, a framework of 66 indicators has been developed to assess trends and progress towards achieving the goals of the plan (Figure 4). However, it is of note that no social indicators are currently identified within the seas and estuaries theme under the framework.

AIR	A1	<i>Emissions for five key air pollutants (headline 1)</i>	NATURAL RESOURCES	E6	<i>Volume of timber brought to market per annum from English sources</i>	
	A2	Emissions of greenhouse gases from natural resources (headline 2)		E7	Healthy soils (headline 8)	
	A3	<i>Concentrations of fine particulate matter (PM_{2.5}) in the air (headline 1)</i>		E8	Sustainable use of water	
	A4	<i>Rural background concentrations of ozone (O₃)</i>		E9	<i>Percentage of our seafood coming from healthy ecosystems, produced sustainably (headline 8)</i>	
	A5	<i>Roadside nitrogen dioxide (NO₂) concentrations</i>		RESILIENCE	F1	Disruption or unwanted impacts from flooding or coastal erosion (headline 9)
	A6	<i>Exceedance of damaging levels of nutrient nitrogen deposition on ecosystems (headline 1)</i>			F2	Communities resilient to flooding and coastal erosion (headline 9)
	A7	<i>Area of sensitive habitats exposed to damaging levels of ammonia (NH₃) in the atmosphere</i>			F3	Disruption or unwanted impacts caused by drought (headline 9)
WATER	B1	Pollution loads entering waters		NATURAL BEAUTY AND ENGAGEMENT	G1	Changes in landscape and waterscape character (headline 10)
	B2	<i>Serious pollution incidents to water</i>			G2	Condition of heritage features including designated geological sites and scheduled monuments (headline 10)
	B3	<i>State of the water environment (headline 3)</i>	G3		Enhancement of green/blue infrastructure (headline 10)	
	B4	<i>Condition of bathing waters (headline 3)</i>	G4		<i>Engagement with the natural environment (headline 11)</i>	
	B5	Water bodies achieving sustainable abstraction criteria (headline 3)	G5		<i>People engaged in social action for the environment (headline 11)</i>	
	B6	Natural functions of water and wetland ecosystems	G6		Environmental attitudes and behaviours (headline 11)	
	B7	Health of freshwaters assessed through fish stocks	G7		Health and wellbeing benefits (headline 11)	
SEAS AND ESTUARIES	C1	Clean seas: marine litter	BIOSECURITY, CHEMICALS AND NOISE	H1	<i>Abatement of the number of invasive non-native species entering and establishing against a baseline (headline 12)</i>	
	C2	<i>Seabed subject to high pressure from human activity</i>		H2	<i>Distribution of invasive non-native species and plant pests and diseases (headline 12)</i>	
	C3	Diverse seas: status of mammals, birds and fish (headline 4)		H3	Emissions of mercury and persistent organic pollutants to the environment (headline 13)	
	C4	Diverse seas: condition of seafloor habitats (headline 4)		H4	Exposure and adverse effects of chemicals on wildlife in the environment (headline 13)	
	C5	Diverse seas: condition of pelagic habitats (headline 4)		H5	Exposure to transportation noise	
	C6	Diverse seas: status of threatened and declining features	RESOURCE USE AND WASTE	J1	Carbon footprint and consumer buying choices	
	C7	Healthy seas: fish and shellfish populations (headline 5)		J2	<i>Raw material consumption (headline 14)</i>	
	C8	Healthy seas: marine food webs functioning (headline 5)		J3	<i>Municipal waste recycling rates</i>	
	C9	Healthy seas: seafloor habitats functioning		J4	Residual waste arising by type and sector (headline 14)	
	C10	Productive seas: fish and shellfish stocks safe and environmentally sustainable		J5	Prevent harmful chemicals from being recycled (headline 14)	
	C11	Productive seas: status of sensitive fish and shellfish stocks		J6	Waste crime (headline 14)	
WILDLIFE	D1	Quantity, quality and connectivity of habitats (headline 7)	INTERNATIONAL	K1	Overseas environmental impacts of UK consumption of key commodities (headline 15)	
	D2	<i>Extent and condition of protected sites – land, water and sea (headline 6)</i>		K2	Developing countries better able to protect and improve the environment with UK support (headline 16)	
	D3	<i>Area of woodland in England</i>		K3	Status of endemic and globally threatened species in the UK Overseas Territories (headline 16)	
	D4	<i>Relative abundance and/or distribution of widespread species (headline 7)</i>		K4	Extent and condition of terrestrial and marine protected areas in the UK Overseas Territories (headline 16)	
	D5	Conservation status of our native species (headline 6)				
	D6	<i>Abundance and distribution of priority species in England</i>				
	D7	<i>Species supporting ecosystem functions (headline 7)</i>				
NATURAL RESOURCES	E1	<i>Area of productive agricultural land</i>				
	E2	<i>Volume of agricultural production</i>				
	E3	<i>Volume of inputs used in agricultural production</i>				
	E4	<i>Efficiency of agricultural production measured by Total Factor Productivity (headline 8)</i>				
	E5	<i>Percentage of the annual growth of trees in English woodlands that is harvested (headline 8)</i>				

Figure 4: Full list of indicators by theme. Those highlighted in green are part of headlines, those in italics have data trends described for them this year (based on already published data) (Defra, 2019).

2.3 Heritage Indicators

The definition of 'cultural heritage' has changed considerably in recent decades, for example (UNESCO, 2019) state that it does not end at monuments and collections of objects but also includes traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts. A number of studies have been identified within the literature which relate to the conservation of marine cultural heritage, for example in 2009 there was a Special Issue dedicated to this topic in *Conservation and Management of Archaeological Sites*. For example, Flatman (2009) highlighted the threats, risks and future priorities for conserving marine cultural heritage across the globe. The importance of including marine cultural heritage in the sustainable management of our oceans and seas has been raised by a number of authors (Firth, 2015; Henderson, 2019; Trakadas et al., 2019). Marine management decisions based on natural capital and/or ecosystem service approaches (e.g. the UK Government's 25 Year Environment Plan) that take insufficient note of the historic environment may lead directly or indirectly to damage to heritage assets and loss of significance (Firth, 2019). Such approaches are gaining increasing support from policy and decision-makers, however there is concern over whether marine cultural heritage is included within these approaches, and if so how. It is of note that the condition of heritage features including designated geological sites and scheduled monuments is identified as a headline indicator within the 25YEP (Figure 4 above).

To implement the ecosystem approach in the marine environment, biotic and abiotic factors and their interrelationships need to be considered which requires a truly integrated and interdisciplinary approach (Burdon, 2016). This creates challenges for researchers, policy-makers and planners especially relating to language and terminology. For example, Hooper et al. (2019) recognise the importance of language between ecologists, economists and social scientists and this issue is central to ensuring that heritage is appropriately included within marine assessments.

Following on from the Millennium Ecosystem Assessment (MA, 2005), the inclusion of cultural ecosystem services, specifically encompassing cultural heritage, might be seen as an opportunity to integrate benefits arising from the marine and maritime historic environment, however, the relationship between heritage and ecosystem services is considered by Firth (2015) to be ambiguous. This becomes clear when the ecosystem services approach is often conceptualised around the benefits from biodiversity. A recent marine study by Willis et al. (2014) illustrates the need for reorientation when assessing cultural ecosystem services given that community and societal cultural connection to the coastal and marine environment arises from its historic character, i.e. that some cultural ecosystem services arise from the cultural inputs of previous centuries, rather than from natural processes. The importance of cultural heritage was also identified during a participatory mapping workshop with local stakeholders in Wick who identified a range of benefits which were directly or indirectly related to their local marine cultural heritage and was considered as important as local ecosystems and protected sites (Burdon et al., 2019).

There has been a shift within the UK to embed ecosystem services approaches into marine planning and licensing, and therefore despite the fact that cultural ecosystem services, at present, does not fully incorporate marine and maritime heritage, Firth (2016) proposes that there is a need to elaborate the relationship between cultural ecosystem services and the marine and maritime historic environment. For example, at present cultural heritage is not considered within the assessment of Good Environmental Status (GES) for the UK marine environment. This was recently highlighted within the response of the Honor Frost Foundation (HFF) Steering Committee on Underwater Cultural Heritage to Defra's consultation on the UK Marine Strategy (HFF, 2019) who stated that the marine

framework is “flawed by the omission of the historic environment, and that this flaw detracts from the proper protection of the UK marine environment whilst inhibiting the achievement of sustainable economic and social uses”. They go on to request that “an express descriptor on the historic environment should be added to the scope of GES, complete with objective, targets and indicators” which would ensure that UK marine cultural heritage would be protected as outlined in the Marine Policy Statement. This would ensure that that social values and benefits, public perceptions, and societal relationships with the sea, are effectively grounded in an understanding of past, present and future (Firth, 2015).

Bryce et al. (2016) state that our cultural heritage, such as traditional land and sea use, or the iconic status of certain species (e.g. popularity of whale watching) demonstrates the significant inter-relationships between wider society and the environment. Whilst marine cultural heritage is often considered as part of the marine historical ‘environment’, Firth (2015) argues that marine and maritime heritage should also be considered in terms of society and economics, as per the three pillars of sustainable management, if there is a requirement to present an evidence-based rationale to support policymakers or heritage practitioners. In his review of the social and economic value of marine cultural heritage, Firth (2015) states that as well as its role in sense of place and visiting, it is important to recognise that the historic environment gives rise to a range of other, substantial benefits that can be expressed as ecosystem services. Notably, shipwrecks are an important focus for certain forms of commercial fishing, for sea angling, and for recreational diving. Firth (2015) recognises that marine and maritime cultural heritage also gives rise to a series of social and economic benefits beyond its own immediate value, and concludes that further research, including quantification, should be carried out on the social and economic benefits of marine and maritime heritage, equivalent to the research and quantification that is being carried out for culture and heritage on land and for the marine environment. For example, there is some evidence within the literature on cultural dimensions of small fishing communities which reflect a sense of place (e.g. Urquhart & Acott, 2013) but more research is required to quantify/qualify intangible cultural heritage, particularly in coastal communities. Evidence from the literature demonstrates that the marine historic environment has social and economic value however the main sources of data on the social and economic value of heritage do not address the marine and maritime sphere or they lack the granularity through which its distinct contribution can be identified (Firth, 2015, 2016).

Henderson (2019) emphasises the importance that marine cultural heritage plays in sustainable ocean management initiatives and in the wider success of coastal and marine development. In particular his study focuses on the role that marine cultural heritage should play in achieving the UN Sustainable Development Goal 14. Henderson (2019) envisages marine cultural heritage having a clear role to play in informing the effective management of marine and coastal ecosystems (SDG 14.2 and 14.5); in the development of sustainable fishing strategies (SDG 14.4; 14.B); in ‘the sustainable use of marine resources, including through sustainable management of tourism’ (SDG 14.7); in the push to ‘increase scientific knowledge, develop research capacity and transfer marine technology’ (SDG 14.A); and in strategies to ‘enhance the conservation and sustainable use of oceans and their resources by implementing international law’ (SDG 14.C), particularly through the ratification and implementation of the 2001 Convention on the Protection of the Underwater Cultural Heritage. Henderson (2019) concludes by stating that “Marine cultural heritage is not simply about archaeology, history, ecology, geography, natural science, coastal management or climate change, it is about all of these aspects and how societies can come together, negotiate and mediate these different approaches into real solutions”.

Heritage Counts (2014) explores the value and impact of cultural heritage on many factors including growth, the economy, our wellbeing and sense of place, through various pieces of research which are

summarised in the national Heritage Counts report (Heritage Coast, 2018). Despite the report including seven measures, only two indicators are considered by Firth (2016) to be specific to marine and maritime heritage: the number of protected historic wrecks sites and the number of protected historic wreck sites on the heritage at risk register, with the area (hectares) of Heritage Coasts arguably being a third indicator which could be applied. The data are collected at a national level and therefore have limited scope for the current project given that there is no way to disaggregate the data specifically for the marine environment. Indicators of marine/maritime heritage that could be included within Heritage at Risk fall into five groups (Firth, 2016):

- indicators that **parallel measures** already included for the historic environment on land e.g. it would be possible to enumerate the number of licence applications made under the Marine and Coastal Access Act 2009 and the number of applications for which Historic England provides advice to the Marine Management Organisation;
- indicators that are more **fine-grained** than existing indicators e.g. the indicators in Heritage Counts for education and lifelong learning, digital participation, social media, and membership of historic environment organisations are also examples for which finer-grained reporting to distinguish a maritime component should be possible.

A good example found within the literature which is try to address this issue is the Scotland's Coastal Heritage at Risk Project (SCAPE) which works with the public to research the archaeology of Scotland's coast and coastal change (<http://ssharp.co.uk/about/>).

- indicators that are **more comprehensive** than existing indicators e.g. the National Record of the Historic Environment (NRHE) already comprises an inventory of known assets, from which a much more representative indicator of marine heritage assets could be derived;
- indicators that could be **developed from existing information** e.g. visitor number for coastal/marine/maritime attractions can simply be summed and interrogated as a sub-set in the same manner as is applied to the whole dataset; and
- indicators that would require **additional data** gathering e.g. additional data could be collected on visits by divers and anglers, probably in collaboration with diving and angling organisations (see for example the work of Bryce et al., 2016 in Case study 2 below).

The same is true for the Heritage Index, which draws together data on natural and cultural heritage from a range of sources and reports them under seven main themes (Historic Built Environment Museums; Archives and Artefacts; Industrial Heritage; Parks and Open Space; Landscape and Natural Heritage; Cultures and Memories; and General / Infrastructure). Despite some of the underpinning datasets being marine/maritime in character, the indicators cannot currently be appropriately disaggregated for the marine cultural heritage context. In order to provide indicators of specific relevance to the marine environment, Firth (2016) proposes a number of potential enhancements which could include:

- Adding Protected Wreck data (other forms of designation are already included).
- Reviewing sources that are already included (the total number of 'Historical Ships' is given by Heritage Index as 15, but there are over 1000 vessels registered in the National Register of Historic Vessels, of which 200 are identified as being of such significance that they comprise the National Historic Fleet. In addition, there are more than 700 vessels in the National Small Boat Register).

- Adding a domain for marine, maritime and waterway heritage (there is already a domain for Industrial Heritage; adding a domain that encompassed waterway heritage alongside marine and maritime heritage would reduce any perceived imbalance of adding this domain to local authorities that have no coast).
- Adding Marine Plan Areas as a set of mapped entities to which heritage data could be attached, as an equivalent to local authority areas. As an example, the Scottish Marine Atlas includes substantive heritage data sets however the granularity at the local scale is an issue.
- Adding further sources of marine/maritime/waterway heritage data such as, for example, maritime/waterway projects supported by HLF.

A range of potential indicators which could be used to assess the value of cultural heritage in a marine context was proposed by Firth (2015). These included:

2.3.1 Employees Working in Sector

Employment figures for employees working in the cultural heritage sector are included in Heritage Counts (English Heritage, 2014) however at present these cannot be disaggregated specifically for the marine environment.

2.3.2 Participation in Marine Cultural Heritage

This could be gauged from memberships of societies and associations specialising in marine and maritime cultural heritage, both nationally and locally.

2.3.3 Academic engagement

This could be used as an indicator across disciplines such as history and archaeology which encompass both research and teaching.

2.3.4 Number of Volunteers Engaged

Establishing the overall role and benefits of volunteers in marine and maritime cultural heritage in the UK would make a significant contribution to understanding and expanding participation.

2.3.5 Visit Numbers to Cultural Heritage Attractions

Visitor numbers to marine and maritime cultural heritage attractions, e.g. Beattie-Edwards (2013) estimated that 1700 visits (2011-2012) to the dive trail on the Coronation (offshore) wreck was worth over £42k to the local economy in 2012, or £60 per visit.

2.3.6 Digital Engagement Numbers

Digital engagement with marine and maritime cultural heritage could also be equated with visiting.

2.3.7 Viewing Figures for Broadcast Media

Viewing figures for broadcast media – including downloadable video and audio content – might also be quantified for marine and maritime cultural heritage.

2.3.8 Social Media Engagement

Social media is also clearly having an impact on levels of engagement with marine and maritime cultural heritage, and again could be encompassed within an assessment of social and economic benefits.

3. Selected UK Case Studies

Three case studies are presented below which have identified and applied social and cultural indicators within the UK marine and coastal context. These case studies are not exhaustive but provide a flavour of the type of projects which have attempted to incorporate social and cultural values into assessments of the marine environment.

3.1 Subjective well-being linked to cultural ecosystem services

3.1.1 Background

Bryce et al. (2016) present an assessment of subjective well-being linked to cultural ecosystem services reported by key groups of recreational users of 151 potential Marine Protected Areas (MPAs) across the UK. This study was specifically undertaken to inform decision-making on the designation of MPAs in the UK and therefore is highly relevant within the scope of the current report. Building on the cultural ecosystem services framework developed by Church et al. (2014) and Fish et al. (2016), this study aims to operationalise the conceptual links between ecosystems and cultural ecosystem service benefits to wellbeing through development of a novel set of subjective well-being indicators (Figure 5). Their study presents a new method which recognises the plural, multi-faceted, and place-based nature of cultural ecosystem service values. In order to assess subjective well-being, 15 indicator statements were developed to reflect constructs of well-being which were identified as potentially relevant for recreational uses of marine sites. The indicators were refined using stakeholder input from an online public survey on attitudes towards designation of MPAs and four focus groups with recreational marine users.

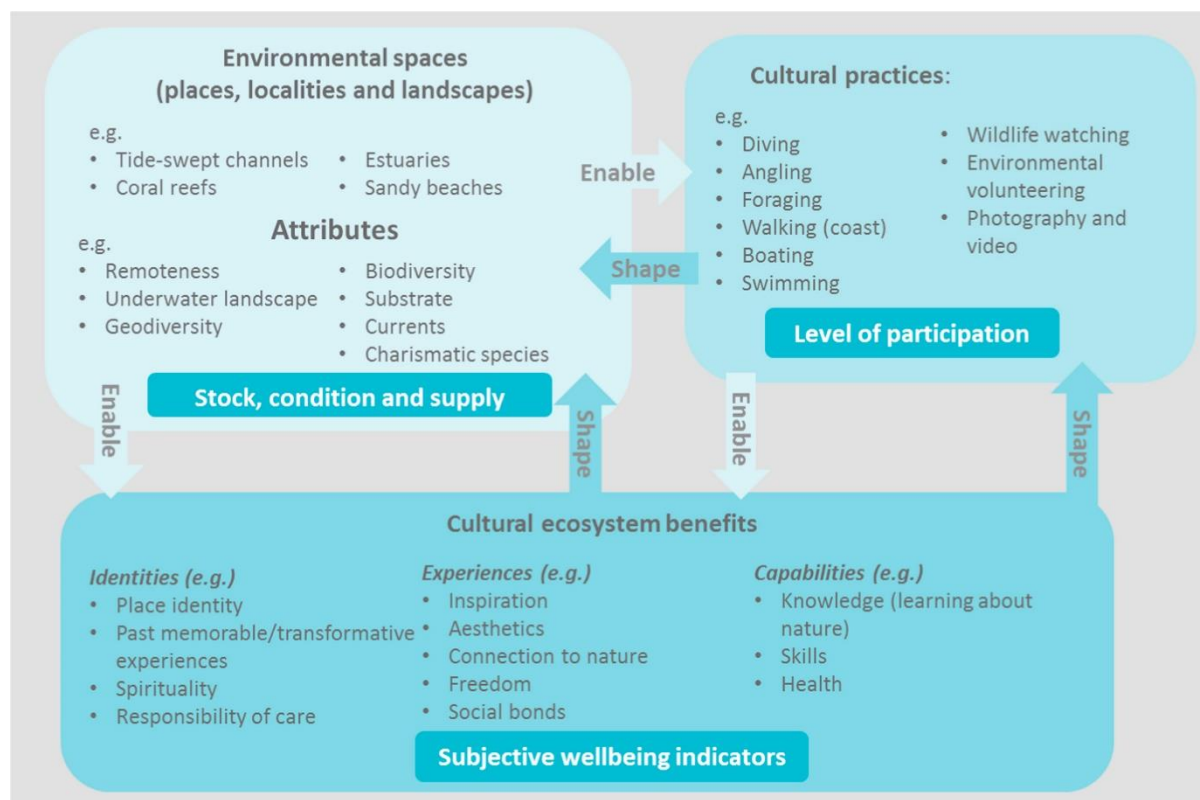


Figure 5: Cultural ecosystem services framework for recreational users of marine areas (Bryce et al., 2016).

The final fifteen indicator statements used within the study were:

1. Visiting these sites clears my head.
2. I gain perspective on life during my visits to these sites.
3. Visiting these sites makes me feel more connected to nature.
4. At these sites I feel part of something that is greater than myself.
5. These sites feel almost like a part of me.
6. I feel a sense of belonging in these sites.
7. I've had a lot of memorable experiences in these sites.
8. I miss these sites when I have been away from them for a long time.
9. Visiting these sites has made me learn more about nature.
10. I have made or strengthened bonds with others through visiting these sites.
11. I feel like I can contribute to taking care of these sites.
12. I have felt touched by the beauty of these sites.
13. These sites inspire me.
14. Visiting these sites leaves me feeling more healthy.
15. Visiting these sites gives me a sense of freedom.

Indicator statements 1-8 were drawn from previous research whilst indicator statements 9-15 were developed specifically for the study. Recreational anglers and divers were specifically targeted for this study, with 1,220 online questionnaires being completed, with participants responding to the all 15 statements using a 5-point Likert scale (1=strongly disagree; 5=strongly agree).

3.1.2 Results

The results from the study indicate that biophysical assessments alone will not predict the range of cultural ecosystem services provided, which supports the UK NEA conceptualisation that cultural benefits arise from a complex interaction between the characteristics of environmental spaces, practices, and transcendental cultural values. Factor analysis of the questionnaire responses revealed multiple cultural ecosystem service benefits that contribute to human wellbeing e.g. including 'engagement with nature', 'place identity' and 'therapeutic value' (Table 24). In addition to regional differences, the study also identified that biophysical attributes of sites, such as the presence of charismatic species and species diversity, were positively associated with benefits provided by cultural ecosystem services.

3.1.3 Lessons Learned

The study provides evidence that could be used specifically to inform the designation of protected areas but could also be adapted for use across a range of marine (and terrestrial spaces) for improved integration of cultural ecosystem services in environmental decision-making.

Table 24: Sample results of exploratory factor analysis for well-being indicators (adapted from Bryce et al., 2016).

Factor Theme	Factor Mean (\pm SD)	Indicator	Loading
Engagement and interaction with nature	4.04 \pm 0.6	Visiting these sites has made me learn more about nature	0.86
		Visiting these sites makes me feel more connected to nature	0.71
		I have felt touched by the beauty of these sites	0.60
		I feel like I can contribute to taking care of these sites	0.49
		These sites inspire me	0.48
Place Identity	3.63 \pm 0.81	These sites feel almost part of me	0.92
		I feel a sense of belonging in these sites	0.68
		I miss these sites when I have been away from them for a long time	0.46
Therapeutic Value	4.02 \pm 0.74	Visiting these sites clears my head	0.84
		Visiting these sites gives me a sense of freedom	0.58
		Visiting these sites leaves me feeling more healthy	0.52

3.2 Heritage, natural capital & ecosystem services

3.2.1 Background

Firth (2019) illustrates how the historic environment might be accommodated within natural capital and ecosystem service approaches through two case studies on the Dorset Stour and the Tyne to Tees marine area. Given the focus of the current project, the Tyne to Tees case study is presented here as it relates specifically to the marine and coastal environment. Given the increasing importance of applying natural capital and ecosystem service approaches in management and decision-making, there is concern that the historic environment is currently not dealt with appropriately within these approaches, as they often focus on biotic factors and omit the inclusion of abiotic factors. There is concern that such decisions may lead directly or indirectly to damage to heritage assets and loss of significance (Firth, 2019). Firth used the CICES (v 5.1) classification to identify particular cultural ecosystem services which can be derived from heritage assets in the marine environment (Table 25). The cultural ecosystem services identified below can be seen to arise from the three main types of heritage in the Tyne to Tees marine area: historic marine structures; submerged forests; and wreck sites. Firth (2019) attempts to quantify the importance of cultural heritage in delivering the range of cultural ecosystem services and benefits as listed above for the east coast between the Tyne and the Tees.

Table 25: Biotic and abiotic cultural ecosystem services (CICES, v.5.1)

Division	Group	Biotic		Abiotic	
		Code	Simple Descriptor	Code	Simple Descriptor
Direct	Physical, experiential	3.1.1.1	Using the environment for sport and recreation; using nature to help stay fit	6.1.1.1	Things in the physical environment that we can experience actively or passively
		3.1.1.2	Watching plants and animals where they live; using nature to destress		
	Intellectual, representative	3.1.2.1	Researching nature	6.1.2.1	Things in the physical environment that we can study or think about
		3.1.2.2	Studying nature		
		3.1.2.3	The things in nature that help people identify with the history or culture of where they live or come from		
		3.1.2.4	The beauty of nature		
	Indirect	Spiritual, symbolic	3.2.1.1	Using nature to as a national or local emblem	6.2.1.1
3.2.1.2			The things in nature that have spiritual importance for people		
3.2.1.3			The things in nature used to make films or to write books		
Other		3.2.2.1	The things in nature that we think should be conserved	6.2.2.1	Things in the physical environment that we think are important to others and future generations
		3.2.2.2	The things in nature that we want future generations to enjoy or use		

3.2.2 Results

Historic environment data for the Tyne to Tees case study comprised data from Historic England’s Listing Data Download Area and the National Heritage List for England (NHLE); from Historic England’s National Record of the Historic Environment (NRHE); and from the Historic Environment Records for South Tyneside, Sunderland, County Durham and Hartlepool. A summary of the potential indicators are listed below:

- **The number of heritage assets.** This indicator was used to identify the number of heritage assets that are currently listed between the Tyne and the Tees.
- **The number of users of historic marine structures.** There are currently no data sources to populate this indicator however proxies have been identified, for example, visitor numbers to individual historic buildings (e.g. Tynemouth Priory and Castle) or the number of sea anglers using marine structures (e.g. piers, harbours).
- **User survey.** In order to assess the value of cultural ecosystem services (as identified in Table 25) a bespoke user survey would be required which asked participants about their use of marine structures for marine-based recreation, de-stressing, appreciating aesthetics, symbolising the region, inspiring creativity and so on. Such a study should encompass the cultural ecosystem services derived directly from historic marine structures (from their

immediate spatial extent and setting) but also from the wider marine environment that is accessed from heritage assets such as slipways, harbours and jetties.

- **Number of people researching (CICES 3.1.2.1) or studying (CICES 3.1.2.2) submerged forests.** The heritage interest of submerged forests arises from evidence of human inhabitation of the former landsurface, either directly in the form of artefacts, cut marks on timber or footprints, or indirectly in the rich palaeo-environmental record often associated with these deposits that can show changes caused to the environment by the presence of people.
- **Number of people indirectly engaging with historic wrecks from books, documentaries, paintings and television (CICES 3.2.1.3).**
- **Number of divers on wrecks (CICES 3.1.1.2).**
- **Number of recreational anglers using wreck sites (CICES 3.1.1.1).**
- **Number of people participating in underwater photography of wrecks (CICES 3.1.2.4).**
- **Biomass of fish landed from wreck sites.** The contribution of wrecks to commercial fisheries is unknown for this stretch of coastline but the provisioning function of fish from wreck sites may be significant.

3.2.3 Lessons Learned

This study highlights the importance of cultural heritage in providing a range of ecosystem services and identifies a range of indicators which could be used to quantify these. Although this study did not attempt to quantify or value ecosystem services, Firth (2019) concludes that both the cultural and non-cultural ecosystem services arising from marine heritage assets should be recognised and quantified. The study concludes with a number of recommendations for Historic England, including:

- to persist with seeking integration of heritage into natural capital and ecosystem services approaches;
- to continue to promote the full range of cultural ecosystem services arising from heritage assets, drawing attention to the role of heritage in enabling physical and intellectual access to freshwater and marine environments;
- to engage with research into the role of marine structures in the marine environment, to identify the provisioning and regulatory ecosystem services that arise from historic marine structures;
- that Heritage Counts starts to address marine-related heritage explicitly in its surveys, research and reports, and that Historic England collaborates with other agencies collating data relating to cultural ecosystem services in marine environments to ensure that the contribution of heritage is properly accounted for; and
- that Historic England engages directly in public debate about the need for people's relationship to the environment to change – especially on urgent topics such as flooding, renewable energy, fisheries policy and so on – using heritage assets to stimulate and inform discussion.

3.3 Cultural ecosystem service indicators for the Dogger Bank

3.3.1 Background

A study by Hattam et al. (2015a) identified a range of ecosystem service indicators within a workshop of 63 marine scientists. The indicators identified during the workshop were then assessed for the relevance to the Dogger Bank, a large sandbank in the southern North Sea. Of particular relevance to the current review, is the assessment that was undertaken on the cultural ecosystem services. A summary of the cultural ecosystem service identified and their relevance to Dogger Bank is presented in Table 26.

Table 26: Proposed classification of marine ecosystem services, their description and relevance to the Dogger Bank (Hattam et al, 2015a).

Ecosystem service		Description	Relevance to the Dogger Bank
CULTURAL SERVICES			
12	Leisure, recreation & tourism	The provision of opportunities for tourism, recreation and leisure that depend on a particular state of marine ecosystems	✓ limited to some sailing, diving and recreational angling
13	Aesthetic experience	The contribution that a marine ecosystem makes to the existence of a surface or subsurface landscape that generates a noticeable emotional response within the individual observer. This includes informal spiritual individual experiences but excludes that covered by service 17	✓ limited to those who go there
14	Inspiration for culture, art and design	The contribution that a marine ecosystem makes to the existence of environmental features that inspire elements of culture, art, and/or design. This excludes that covered by services 2c, 13, and 16	✓ extent unknown
15	Cultural heritage	The contribution of marine ecosystems to the maintenance of cultural heritage, and providing a 'sense of place'	✓ extent unknown but links to Palaeolithic man
16	Cultural diversity	The contribution of marine ecosystems to social and cultural values and adaptations that pertain to living at coasts and exploiting marine resources	✓ extent unknown
17	Spiritual experience	The contribution that a marine ecosystem makes to formal and informal collective religious experiences. This excludes that covered by services 13 and 14	✓ extent unknown
18	Information for cognitive development	The contribution that a marine ecosystem makes to education, research, and individual and collective cognitive development	✓ extent unknown

✓ = relevant, X = not relevant, ? = relevance unknown

Each indicator identified at the workshop was then assessed for its relevance to environmental management against a set of criteria:

- **Measurability:** are there data available for the measurement and quantification of the indicator?
- **Sensitivity:** does the indicator detect change in the ecosystem service over time?

- **Specificity:** can the indicator respond over time to changes in management as opposed to natural variability? Is this response predictable and does it have low variability?
- **Scalability:** can the indicator be aggregated or disaggregated to a different spatial scale and still retain its ability to indicate the change of interest?
- **Transferability:** is the indicator useful for other locations and hence studies?

3.3.2 Results

With respect to cultural ecosystem services, the results in Table 27 show that it is difficult to identify the specific contributory role of an ecosystem to many cultural services, and hence to identify indicators of these services. For example, aesthetic experiences are inherent to an individual, but to identify indicators of the service of 'aesthetic experiences' the specific elements of a marine ecosystem that contribute to that experience must be known.

3.3.3 Lessons Learned

Hattam et al. (2015a) recognised the importance of identifying indicators of ecosystem functions, ecosystem services and benefits. The study concluded that it is challenging to select meaningful indicators, given problems of specificity, spatial disconnect and the considerable uncertainty about marine species, habitats and the processes, functions and services they contribute to. While ecological data are available for the Dogger Bank, they were deemed largely unsuitable for indicator assessments being either insufficiently resolved spatially, incomplete, or poorly resolved and understood in that area (Hattam et al., 2015b). Quantitative data were only available to assess the current state of 20 indicators corresponding to six ecosystem services (Hattam et al., 2015b).

Table 27: Indicators for each of the ecosystem services identified in Table 10 as relevant to the Dogger Bank (Hattam et al., 2015).

Ecosystem services	Generic marine ecosystem service indicators	Measurement (Units) - measured over time	Dogger Bank specific indicators	Issues related to assessment criteria
12: Leisure, recreation and tourism	Seaspace available for recreation	Number of km ² of sea with safe water quality available for recreational use	As per generic indicators scaled to the area covered by the Dogger Bank	May not necessarily reflect change in ecosystem service; for example it could reflect changing levels of risk aversion of consumers, producers or regulators
	Number and quality of beaches	Number and size of blue flag beaches	N/A	May not necessarily reflect change in ecosystem service; for example it could reflect changing levels of risk aversion by consumers, producers or regulators
	Water quality	Chemical analysis (contaminant concentrations) and visual analysis; total coliforms or other pathogens (quantity per ml of water)	As per generic indicators scaled to the area covered by the Dogger Bank	
	Abundance and diversity of key species of recreational interest	Count data	Species of recreational interest e.g. harbour porpoise, grey seal, seabirds, fish	
	Area of biotopes of key interest to recreational users	For example, extent of seagrass, maerl or kelp beds (km ²)	As per generic indicators scaled to the area covered by the Dogger Bank	
13: Aesthetic experience	Uniqueness of a site	1/(Number of sites with similar features)	Insufficient information to define indicators	Uniqueness would increase if all other similar ecosystems degrade
	Abundance of key species of individual interest	Count data	Species of individual interest e.g. harbour porpoise, grey seal, seabirds, fish	
	Area of biotopes of key interest to individuals	For example, extent of seagrass, maerl or kelp beds (km ²)	As per generic indicators scaled to the area covered by the Dogger Bank	

Ecosystem services	Generic marine ecosystem service indicators	Measurement (Units) - measured over time	Dogger Bank specific indicators	Issues related to assessment criteria
14: Inspiration for culture, art and design	Species, habitat or ecosystems that have or can potentially inspire any piece of artwork	Insufficient information to define indicators	Insufficient information to define indicators	Generic indicators cannot be developed
15: Cultural heritage	Species, habitats or ecosystems that can potentially form the core or contribute to a cultural custom, rite or way of life	Insufficient information to define indicators	Insufficient information to define indicators. Some links to Palaeolithic people	Generic indicators cannot be developed
16: Cultural diversity	Generic indicator cannot be developed	Insufficient information to define indicators	Insufficient information to define indicators	Generic indicators cannot be developed
17: Spiritual experience	Species, habitats or ecosystems that is being or can potentially be worshipped or be of significance to a religious belief	Insufficient information to define indicators	Insufficient information to define indicators	Generic indicators cannot be developed
18: Information for cognitive development	Species, habitats or ecosystems that is being or can potentially be studied to increase scientific knowledge	Number of such species, habitats, ecosystems	Insufficient information to define indicators	Generic indicators cannot be developed
	Species, habitats or ecosystems that is being or can potentially be studied for educational purposes	Number of such species, habitats, ecosystems	Insufficient information to define indicators	Generic indicators cannot be developed

4. Concluding Comments and Suggestions for Further Work

The need for the development and application of a natural capital approach, which takes into account the full value of the marine environment, is called for under the UK Government's 25YEP. As such there is a requirement for social and cultural values to be taken into account alongside economic values. A relative lack of marine-focussed studies have been identified within the literature, compared to other ecosystems, which have developed and applied cultural, social and heritage indicators.

A relatively small number of studies (both published and grey literature) have developed indicators which may be appropriate for use in the marine environment, however data availability has been identified as one of the major challenges for their application. In some circumstances there is data available at the national level, but this data cannot be disaggregated to only capture the coastal and marine data, or in other cases appropriate data sets do not currently exist. This therefore highlights a key area for future research.

There is a certain degree of overlap between the three indicator categories (cultural, social and heritage), for example, cultural heritage indicators have been identified under both the cultural and heritage sections (Table 2). This review focussed on these three categories of indicators independently, however, given the potential overlap between these categories and their indicators, there needs to be more cross-cutting studies which bridge this divide. For this to be successful, there is a requirement for standardised terminology within the UK as cultural, social and heritage indicators cover multiple disciplines within academia and often cross multiple Government departments with respect to policy.

There has been a broad range of indicators identified which address marine cultural, social and heritage values, however, only limited studies have been identified where indicators have been developed and successfully applied within the UK marine environment (see example case studies in Section 3). It is recognised that this review is by no means exhaustive and therefore there is a requirement for further consultation with academic and policy experts, within each discipline, to identify other potential exemplar UK marine case studies.

This report provides an initial scoping of the literature and identifies the current state of play with respect to the development and application of cultural, social and heritage indicators in the UK marine environment. It is recommended that further work is required within this field to continue the development and application of cultural, social and heritage indicators and to ensure that data are collected and reported in an appropriate way to populate the indicators. A number of evidence gaps and further research requirements have been highlighted within the literature. These are summarised in Table 28, with further details provided below.

Table 28: Summary of gaps in evidence and recommendations for future research.

Cultural	Social	Heritage
Improved definitions of cultural ecosystem services.	Develop robust ecosystem service indicators to feed into marine national natural capital accounting.	Develop datasets on marine cultural heritage, or an accepted means of attributing a proportion of overall national figures to the marine component of heritage.
Further development of valuation methods for cultural ecosystem services.	UK Standard Industrial Classification of Economic Activities (SIC) codes to better fit marine industries.	Clearer understanding of how marine cultural heritage is perceived by and contributes to coastal communities.
More studies on cultural ecosystem services in the context of ecosystem service bundles.	Establish the most appropriate spatial delineation of marine plans for which	Establish where marine cultural heritage fits within ecosystem service frameworks.

Cultural	Social	Heritage
	it will be appropriate to monitor social outcomes.	
More clearly articulating policy implications.	Data on how society values changes in amenity supply over time.	Need for marine cultural heritage questions in existing data gathering exercises.
Testing and developing integrated marine cultural ecosystem service assessments, which require closer interactions with stakeholders.	Amendments to water-sports participation surveys are required to be used in marine planning.	Sharing of knowledge and practice between marine cultural heritage practitioners and others.
More focus on subjective and intangible classes of cultural ecosystem services such as existence, bequest, and symbolic services.	Development of quantitative indicators for seascape character area assessments.	Develop materials and workshops that identify data, research and practical outcomes across the full range of marine heritage and its audiences.
Further development of indicators to measure trade-offs between cultural ecosystem services and human wellbeing.	Social survey data to analyse coastal communities and marine and coastal activities.	Interdisciplinary workshop to propel the social and economic value of the marine historic environment onto the research agendas of others.
Better understanding of the role of non-natural capital in the co-production of marine and coastal cultural ecosystem services.	Designation of MPAs and spatial management needs to take account of social, cultural and economic issues.	There is a need for acquiring data, engaging in debate, joining-up, stimulating research and enabling outcomes that make more of the social and economic benefits of marine cultural heritage.
Identifying the role of open ocean and deep-sea areas in providing cultural ecosystem services.	Research needs to take account of the diversity of communities across the UK - values and perceptions will differ spatially and temporally – need for long-term data.	Develop toolkits on best practice in planning, in using existing social and economic indicators, and in gathering new data.

4.1 Cultural Indicators

The review has highlighted that despite the growth in research on ecosystem services, relatively less studies have focussed on cultural ecosystem services. Those studies which have addressed cultural ecosystem services have tended to focus on the services which are more tangible and marketable (e.g. leisure and recreation, aesthetic benefits) and therefore have been restricted in their scope. A number of studies have attempted to identify indicators for cultural ecosystem services although data is often the limiting factor when it comes to their application for marine planning and management. This is supported by Hooper et al. (2019) who report that although cultural ecosystem services were the most frequently valued, there is a lack of values for certain cultural services, particularly marine and maritime heritage, some forms of recreation (e.g. sailing and kayaking) spiritual and inspirational interactions, and health and well-being.

Garcia Rodriguez et al. (2017) acknowledge that cultural ecosystem services are strong motivations for people to embrace sustainability, and hence their inclusion in environmental decision-supporting mechanisms and can contribute to a more sustainable future for marine and coastal ecosystems. This is supported by Potts et al. (2014) who state that as society seeks to protect and restore habitats to ensure both biodiversity conservation and the provision of multiple ecosystem services more attention needs to be given to cultural ecosystem services in marine planning and management plans. At present, in general, most marine and coastal cultural ecosystem service classes are missing quantitative and qualitative assessments and therefore there is a need for testing and developing suitable methodologies and indicators to assess them (Garcia Rodriguez et al., 2017). The review has identified a number of areas for further research on marine cultural ecosystem services:

Milcu et al. (2013) identified a number of emerging themes in cultural ecosystem services research relating to:

- improving definitions of cultural ecosystem services;
- need to further develop valuation methods for cultural ecosystem services;
- there is a need for more studies on cultural ecosystem services in the context of ecosystem service bundles; and
- more clearly articulating policy implications.

Garcia Rodriguez et al., (2017) identify a number of knowledge gaps which future research needs to fill, including:

- research priorities should be directed at testing and developing integrated marine and coastal cultural ecosystem service assessments, which require closer interactions with stakeholders;
- how to mitigate conflicts and manage trade-offs inherent to decision-making connections between cultural ecosystem services and human wellbeing are often mentioned in the literature, but they are hardly measured, and indicators are lacking;
- more tangible and commensurable cultural ecosystem service classes such as recreation and leisure, and aesthetic services, receive comparatively more attention in the literature than more subjective and intangible classes such as existence, bequest, and symbolic services;
- identifying the role of open ocean and deep-sea areas in providing cultural ecosystem services; and
- understanding the role of non-natural capital in the co-production of marine and coastal cultural ecosystem services. The studies by Burdon et al. (2019) have started to address this latter issue.

4.2 Social Indicators

The review has identified a number of studies which have attempted to develop social indicators for application in the UK marine environment. Whilst the indicators have been identified there was very little evidence available within the literature of their application within the UK. A number of areas for future research were identified by the MMO (2014b):

- **Marine National Natural Capital Accounts:** pilot accounts are currently being developed by Defra. If successful these have the potential to provide a robust system for monitoring social outcomes that are linked to environmental change and ecosystem services. However it should be noted that robust ecosystem service indicators, particularly those which could be established at the level of a marine plan, may be some time in development.
- **UK Standard Industrial Classification of Economic Activities (SIC) codes to better fit marine industries:** the current set up of SICs does not allow a good definition of a number of marine sectors to be constructed. The most pressing of these, particularly for the East Plan areas, is offshore renewable energy. An approach to improve the degree to which particular marine sectors, and the marine sector overall, can be defined through SICs should be advanced with the ONS (expected via research project MMO1075).

- **Plan area coastal communities:** early analytical work for each marine plan should establish the most appropriate spatial delineation of the plan coastal community for which it will be appropriate to monitor social outcomes. Where there are particular differences in the economic and/or social geography, or where spatially explicit/targeted objectives and policies are anticipated, it may be appropriate to identify more than one community group. This work can also be used to start to develop a comprehensive baseline position and understanding. More recently, McKinley et al. (2019) also address the inclusion of socio-economic dimensions in marine spatial planning, focussing on cultural ecosystem services, societies connection with the sea and well-being.
- **Environmental quality:** there is a lack of data available for monitoring how people's environmental amenity changes over time in response to changes in the underlying environmental (natural or otherwise) characteristics (i.e. quality) of an area. Research should review the extent to which it may be feasible to design a question or set of questions that could provide an indication of this.
- **Watersports participation survey:** changes are required to the survey questions to make the data outputs more useful for marine planning purposes. Most notably, the data on participation is currently presented by area of residence of the participant and says nothing about where geographically the participants undertake the activities. It is therefore of little use for a marine plan focused on a particular area.
- **Seascape character area assessments:** such an assessment was undertaken for the East Plans and the South Plans. The methodology employment currently provides qualitative descriptions only. Minor amendments to the methodology should be considered that enable quantitative indicators for certain attributes to be established during the assessments, which could then be updated for the purposes of marine plan monitoring.

Similar work has also been undertaken with Scotland which focusses on coastal character assessments (<https://www.nature.scot/professional-advice/landscape/coastal-character-assessment>).

- **Marine social surveys:** there is a lack of social survey data which can be utilised for analysis of coastal communities and marine and coastal activities. Further primary research could usefully be carried out across a broad number of social issues in order to better inform and monitor marine plans.

A number of recommendations for future research were identified by the MSCC Social Science Task Group (UK Marine Online Assessment Tool, 2019) in relation to social indicators:

- There is a need for the designation of protected areas and spatial management to take account of social, cultural and economic issues, complementing the current focus on natural and physical science-based evidence.
- Research needs to take account of the diversity of communities across the UK, recognising that the values and perceptions will differ spatially as well as temporally, further emphasising the need for long-term evidence collection.

4.3 Heritage Indicators

There is clear evidence within the literature that engagement and activity relating to marine and maritime cultural heritage can be quantified in principle, however there is currently a lack of evidence of such data except on a small scale (Firth, 2015). There is a reasonable amount of quantitative data

being generated on heritage in general, however at present it is difficult to disaggregate the marine component from these data sets. The review has identified a number of areas for further research on marine cultural heritage and its indicators (Firth, 2015, 2016, 2019):

- There is a strong need to develop either a dataset on marine and maritime cultural heritage, or an accepted means of attributing a proportion of overall national figures to the marine and maritime component of heritage;
- Obtaining a clearer understanding of how marine and maritime cultural heritage is perceived by and contributes to coastal communities is an important area for further research;
- Further work on the relationship between marine and maritime cultural heritage on one hand, and cultural heritage as conceived of in the ecosystems services approach on the other, could be a productive avenue in higher level assessment in the UK and internationally;
- It would be beneficial to introduce questions and categories relating to marine and maritime cultural heritage into existing data gathering exercises, such as Taking Part, major tourism surveys, the Monitor of Engagement with the Natural Environment (MENE) (Natural England 2014) and any successor to Charting Progress 2;
- Existing benefits could be recognised and enhanced by equipping marine and maritime cultural heritage practitioners with information, concepts and terminology that they can apply themselves in their own context;
- There is a strong case for developing materials and workshops that identify data, research and practical outcomes across the full range of marine and maritime cultural heritage and its audiences;
- There is a need for an interdisciplinary workshop which might help to propel the social and economic value of the marine historic environment onto the research agendas of others;
- There is a need for acquiring data, engaging in debate, joining-up, stimulating research and enabling outcomes that make more of the social and economic benefits of marine and maritime cultural heritage;
- Develop toolkits on best practice in planning, in using existing social and economic indicators, and in gathering new data; and
- Two distinct toolkits are required: one on using existing (indirect) data relating to the social and economic benefits of the marine and maritime historic environment; the other on gathering new (direct) data.

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