



## Marine ecosystem services: Linking indicators to their classification



Caroline Hattam<sup>a,\*</sup>, Jonathan P. Atkins<sup>b</sup>, Nicola Beaumont<sup>a</sup>, Tobias Börger<sup>a</sup>,  
Anne Böhnke-Henrichs<sup>c</sup>, Daryl Burdon<sup>d</sup>, Rudolf de Groot<sup>c</sup>, Ellen Hoefnagel<sup>e</sup>,  
Paulo A.L.D. Nunes<sup>f</sup>, Joanna Piwowarczyk<sup>g</sup>, Sergio Sastre<sup>h</sup>, Melanie C. Austen<sup>a</sup>

<sup>a</sup> Plymouth Marine Laboratory, The Hoe Plymouth, Prospect Place, Devon, PL1 3DH, UK

<sup>b</sup> Hull University Business School, University of Hull, Hull HU6 7RX, UK

<sup>c</sup> Environmental Systems Analysis Group, Wageningen University, PO Box 47, Wageningen 6700 AA, the Netherlands

<sup>d</sup> Institute of Estuarine & Coastal Studies, University of Hull, Hull HU6 7RX, UK

<sup>e</sup> DLO Agricultural Economics Research Institute, Wageningen University, PO Box 29703, Alexanderveuld 5, The Hague 2502LS, the Netherlands

<sup>f</sup> Global Partnership for Wealth Accounting and Valuation of Ecosystem Services (WAVES), Agriculture and Environmental Services Department, The World Bank, 1818H St., Washington, D.C. 20433, United States

<sup>g</sup> IOPASN, Powstańców Warszawy 55, P.O. Box 148, Sopot 81-712, Poland

<sup>h</sup> ICM-CSIC Passeig Marítim de la Barceloneta, 37-49, Barcelona E-08003, Spain

### ARTICLE INFO

#### Article history:

Received 6 November 2013

Received in revised form 3 September 2014

Accepted 8 September 2014

#### Keywords:

Marine ecosystem services

Classification

Indicators

Functions

Benefits

Dogger Bank

### ABSTRACT

There is a multitude of ecosystem service classifications available within the literature, each with its own advantages and drawbacks. Elements of them have been used to tailor a generic ecosystem service classification for the marine environment and then for a case study site within the North Sea: the Dogger Bank. Indicators for each of the ecosystem services, deemed relevant to the case study site, were identified. Each indicator was then assessed against a set of agreed criteria to ensure its relevance and applicability to environmental management. This paper identifies the need to distinguish between indicators of ecosystem services that are entirely ecological in nature (and largely reveal the potential of an ecosystem to provide ecosystem services), indicators for the ecological processes contributing to the delivery of these services, and indicators of benefits that reveal the realized human use or enjoyment of an ecosystem service. It highlights some of the difficulties faced in selecting meaningful indicators, such as problems of specificity, spatial disconnect and the considerable uncertainty about marine species, habitats and the processes, functions and services they contribute to.

© 2014 The Authors. Published by Elsevier Ltd.

This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/3.0/>).

### 1. Introduction

Human activities in the marine environment are extensive and few areas are now untouched by them. Competition between these activities for space and resources is increasing, especially in coastal zones, leading to growing calls for more effective management of marine ecosystems. Since the 1990s, there has been a shift in marine management thinking from a single activity ('sectoral') approach toward management focused on ecosystems, acknowledging the interactions between components of ecosystems and the position of humans within these systems (Atkins et al., 2011). This ecosystem approach to management necessitates a deeper understanding of the linkages and dynamic relationships between ecological, social and economic systems (Borja et al., 2010).

Central to the ecosystem approach is an understanding of ecosystem services, the direct and indirect contributions that ecosystems make to human well-being (de Groot et al., 2010a). By assessing the impacts of human activities on ecosystem services, a clearer understanding can be gained of the trade-offs between these activities and ecosystem services. The overall effect of human activities on human well-being, as well as on the environment, can be explored (Millennium Ecosystem Assessment, 2005). The more detailed understanding that arises can contribute to the development of more informed management plans and a more transparent decision-making process.

The interactions between natural systems and human society are complex and their analysis calls for the establishment of a systematic assessment framework (Atkins et al., 2011). This requires a clear understanding of what is meant by ecosystem services along with a comprehensive approach for their categorization. Many ecosystem service classifications have been defined and support the identification of aspects of ecosystems that require further exploration in an ecosystem service assessment. Little

\* Corresponding author. Tel.: +44 0 1752 633100.

E-mail address: [caro4@pml.ac.uk](mailto:caro4@pml.ac.uk) (C. Hattam).

guidance is offered, however, in how to undertake this assessment. The identification and quantification of indicators of changes in ecosystem services and the benefits they provide for humans is one way of bridging this gap. What is considered an ecosystem service, and hence what makes a relevant and useful ecosystem service indicator is likely to be context specific.

This paper first reviews the state of the art of ecosystem service classifications and in the selection of their associated indicators. From this a series of research questions are derived. Building on this literature an ecosystem service classification for marine systems is proposed and distinct indicators are selected for each service. As a part of the VECTORS project ([www.marine-vectors.eu](http://www.marine-vectors.eu)), this classification is then applied and relevant indicators are specified for a case study site in the North Sea the Dogger Bank. Indicators of ecosystem functions and ecosystem benefits are also identified. The process leading to the identification of the indicators is then discussed.

## 2. State of the art

### 2.1. Ecosystem service classifications

The Millennium Ecosystem Assessment (MA) classification of ecosystem services is perhaps the most cited. It defined ecosystem services as “the benefits people obtain from ecosystems” (Millennium Ecosystem Assessment, 2005, p.v), and divided them into four ecosystem service categories: supporting, provisioning, regulating and cultural services. Although it has been widely applied, it is not without criticism. The loose definition of ecosystem services by the MA undermines the application of accounting systems to ecosystem services (Boyd and Banzhaf,

2007). As the value of supporting services is considered inherent in the value of all other services (Fisher et al., 2009), the absence of hierarchy within the classification makes it inappropriate for use with ecosystem service valuation (Wallace, 2007; Fisher and Turner, 2008) as it leads to considerable double counting (Boyd and Banzhaf, 2007). This makes it problematic to apply in a decision-making context (Fig. 1).

A number of ecosystem service classifications have subsequently been developed (e.g., Fisher et al., 2009; de Groot et al., 2010a; Balmford et al., 2011; Mace et al., 2011; EEA, 2013), some of which have been tailored specifically for the marine environment (e.g., Atkins et al., 2011; Böhnke-Henrichs et al., 2013; Liquete et al., 2013; Turner et al., 2014). Each strives for a clear distinction between ecosystem services (also known as final services), the functions that generate those services (also called intermediate services) and the benefits derived from the services. Where the boundaries are placed between services, functions and benefits varies with classification.

The inclusion of abiotic components of ecosystems into ecosystem services classifications has been disputed. Abiotic components are integral to ecosystems, determining ecological functions, and hence ecosystem services. Some classifications explicitly include water and abiotic raw materials, as well as human activities such as aggregates, energy generation, and shipping (e.g., Atkins et al., 2011; Cooper et al., 2013). Their inclusion, however, is problematic. Ecosystem services are considered to be ecological in nature (Fisher et al., 2009) and delivered by the living components of the ecosystem. The quantity and quality of abiotic components (e.g., aggregates, oil and gas) is not generally determined by the living parts of the ecosystem. Where they are (e.g., water quality), this is already captured by



Fig. 1. Location of the Dogger Bank (the white area) in the North Sea.

Download English Version:

<https://daneshyari.com/en/article/6294783>

Download Persian Version:

<https://daneshyari.com/article/6294783>

[Daneshyari.com](https://daneshyari.com)