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Securing the benefits: Linking ecology with marine planning policy to examine the potential of a network of Marine Protected Areas to support human wellbeing

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ABSTRACT

In line with international commitments to secure human wellbeing via conservation, many nations have set deadlines to implement ecologically coherent networks of Marine Protected Areas (MPAs). However, progress towards achieving these targets is slow. To influence the discourse on the societal need for MPA networks a matrix approach is used to determine the potential for conservation features within the UK proposed network of 127 MPAs to deliver beneficial ecosystem processes and services. The results suggest a non-uniform distribution of ecosystem services across the network, with the majority of MPAs containing conservation features with the potential to deliver ecosystem processes. Designation of the full recommended network of MPAs may provide a form of ecological insurance against further decline in the delivery of beneficial ecosystem services and may also contribute to wider ecological health by supporting broadscale ecological processes. Non designation of MPAs that contain low frequency of occurrence beneficial ecosystem processes or services could result in their loss. Given the uncertainty about the connections between ecological function and the delivery of beneficial ecosystem processes, conservation policy and management must consider an ecologically coherent MPA network to be a minimum spatial requirement to secure the future delivery of ecosystem services.

1. Introduction

Marine ecosystems provide a wide range of resources and services that contribute to human wellbeing and life on Earth [1]. The Millennium Ecosystem Assessment (MEA) established the concept of ecosystem services on the global agenda as "the benefits people obtain from ecosystems" [2] and although ecosystem services are defined in a variety of ways [3–5] the common theme is the translation of ecosystem functions and processes into direct or indirect benefits for human wellbeing [6]. The ability of marine ecosystems to provide services for human wellbeing depends on the health and functionality of its physical and biological components, yet research shows that marine ecosystem degradation and loss of marine species and population decline are critically impairing the ability of marine systems to continue to provide these services [1,2,7–10]. From an ecosystem services perspective, when human impacts on natural capital have exceeded a carrying capacity threshold then society is living in a state where there is a deficit in the flows of ecosystem services and consequently, a risk to human wellbeing [11].

Marine Protected Areas (MPAs) are regarded as an important tool for the maintenance of marine ecosystem functionality, health, and ecosystem integrity through the conservation of significant species, habitats, or entire ecosystems [12]. They are also noted to have a broader ecological significance in supporting goals for the sustainable use of marine resources in a marine spatial planning context [13,14]. However, given the high level of functional and spatial connectivity within marine ecosystems [15–18] individual MPAs are not considered to be adequate to safeguard the important ecosystem processes and services they underpin [4]. In recognition of this, international policy has developed to consider broader spatial requirements for marine conservation. As a result, a number of international and regional agreements require the establishment

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of ecologically coherent MPA networks [19–23]. An ecologically coherent network of MPAs:

(i) interacts and supports the wider environment;
(ii) maintains the processes, functions, and structures of the intended protected features across their natural range;
(iii) functions synergistically as a whole, such that the individual protected sites benefit from each other to achieve the above two objectives; and
(iv) may be designed to be resilient to changing conditions [24].

The evidence that MPA networks provide significantly greater benefits for marine conservation and ecosystem resilience than single MPAs is strong [25]. As noted by the International Union for Conservation of Nature – World Commission on Protected Areas (IUCN-WCPA 2008) "networks of MPAs, when well planned, can add up to more than the sum of their individual MPA parts". Many countries around the world are working towards international targets for designating ecologically coherent networks of MPAs for example, The California Channel Island [26], Kimbe Bay, Papua New Guinea [27], and the Australia Commonwealth Marine Reserves Networks [28]. However, in general, progress towards achieving international targets for ecologically coherent networks of MPAs is considered to be slow and the present rate of MPA designation is unlikely to meet set international treaty deadlines [29]. It can be considered that delays may partly be due to the fact that individuals are known to base their decisions within a social context [30]. Therefore, current reliance on a purely ecological approach to MPA network designation, without a clear understanding of how ecological and social systems interact, may not prove to be successful in driving forward the necessary policy measures and ignite the political will necessary to designate networks. An alternative suggestion to more successfully advance conservation policy is to move the discourse into the social domain by taking an ecosystem service approach in order to "restore and reemphasise the fundamental links between nature and human wellbeing" [31]. Therefore, to influence the discourse on the societal need for MPA networks as opposed to individual adhoc MPAs, an analysis that aims to assess the potential for a network of MPAs to deliver ecosystem service benefits is undertaken. Reference to ecosystem service benefits infers the direct and indirect contributions of ecosystems to human wellbeing [5]. The results of this analysis are considered important to determine whether a proposed network of MPAs, where the design was based on ecological coherence criteria, can also have the potential to meet societal needs in terms of beneficial ecosystem service delivery.

2. Materials and methods

2.1. Policy context and region

The United Kingdom (UK) administrations were tasked to substantially complete an ecologically coherent network of MPAs by 2012 [32]. The Marine and Coastal Access Act [33] provides the legal tool for the designation of a new type of MPA in English and offshore Welsh Areas called a Marine Conservation Zone (MCZ). The design of the network is based on the 'Ecological Network Guidance' (ENG) [34] developed by the UK Government's statutory nature conservation bodies, the Joint Nature Conservation Council (JNCC) and Natural England (NE). The ENG aims for ecological coherence and sets targets for a series of conservation features to be included in the network design. Percentage targets were set for broad scale habitats classified at the European Nature Information System (EUNIS) level 3 and for species and habitats identified for protection in existing conservation legislation [35,36].

Designed according to the ENG [34] and with extensive input from regional marine user groups, recommendations for the UK Government to designate 127 MCZs in English and offshore Welsh waters were published in September 2011 [37–40], (Fig. 1). In December 2012, subject to a public consultation process, 31 of the 127 sites were recommended by the UK Government as "good candidates for designation" [41] (Fig. 1). Whether these 31 sites are ultimately designated will depend a further government led public consultation exercise (closing the 30th March 2013) and on a detailed impact assessment for each recommended MPA site that analyses of the costs and benefits of designation in relation to the capital costs of establishing the MPA and the predicted changes in the delivery of ecosystem services according to management measures. No timescale had been set for the onward designation of the remaining 96 MPAs, thus raising concerns that these sites will never be designated and an ecologically coherent network of MPAs will never be achieved in UK waters.

Fig. 1. Map showing the proposed ecologically coherent network of 127 MPAs proposed to UK Government in 2012 and those proposed for designation in 2013.

2.2. Ecosystem service classification

For the purpose of this research the ecosystem service classification developed by 'The Economics of Ecosystems and Biodiversity' (TEEB) project that built upon the ecosystem service classification of the Millennium Ecosystem Assessment is used [2]. This distinguishes between core ecosystem processes (biophysical structures and processes) that support beneficial ecosystem processes (ecosystem functions) and which, in turn, deliver beneficial ecosystem services in the form of material or non-material benefits for human wellbeing (Fig. 2) [5].

2.3. Data analysis

To undertake an analysis of the potential beneficial ecosystem services available from the proposed MPA network, a matrix was created to combine information regarding the ENG conservation