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Valuing the health benefits of physical activities in the marine environment and their importance for marine spatial planning

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ABSTRACT

The marine environment provides a number of services which contribute to human well-being including the provision of food, regulation of climate and the provision of settings for cultural gains. To ensure these services continue to be provided, effective management is required and is being strategically implemented through the development of marine spatial plans. These plans require an understanding of the costs and benefits associated with alternative marine uses and how they contribute to human well-being. One benefit which is often difficult to quantify is the health benefit of engaging with the marine environment. To address this, the research develops an approach which can estimate the contribution aquatic physical activities makes to quality adjusted life years (QALYs) in monetary and non-monetary terms. Using data from the Health Survey for England, the research estimates that physical activities undertaken in aquatic environments at a national level provides a total gain of 24,853 QALYs. A conservative estimate of the monetary value of a QALY gain of this magnitude is £176 million. This approach provides estimates of health benefits which can be used in more comprehensive impact assessments, such as cost-benefit analysis, to compare alternative marine spatial plans. The paper concludes by discussing future steps.

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1. Introduction

1.1. Ecosystem based management

The marine environment provides a number of services which contribute to human well-being [1,2]. The provision of fish for food, for example, contributes to well-being by providing basic materials for a good life, while the use of marine settings for recreational activities contributes to well-being through health benefits [1]. Managing the marine environment to optimise these well-being benefits requires balancing often competing maritime activities. This is becoming ever more challenging due to increasing demand for marine resources by different sectors (e.g. shipping, renewable energy, and recreation). Historically, the marine environment has been managed on a sector-by-sector, case-by-case basis ignoring the interactions and feedbacks of

impacts between industries and uses. The result has been conflict between users and the environment [3, p. 19].

The requirement for integrated and joined-up management of the marine environment has been recognised by the international community through, for example, the adoption of the Integrated Maritime Policy for the EU [4] and the National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes for the USA [5]. Such policies aim to ensure holistic and integrated management of the seas through ecosystem based management (EBM) which considers sector impacts on the marine ecosystem, the ecosystem services they provide and ultimately the affects on human wellbeing [6]. Marine spatial planning (MSP) is being used as a tool to improve decision making in line with EBM by including within its analysis the impacts of alternative marine uses in time and space along the ecosystem, ecosystem service, human well-being continuum to manage conflicts and compatibilities while meeting ecological, economic and social objectives [3,7–10].

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1.2. Marine spatial planning and cost-benefit analysis

Developing marine spatial plans requires a number of steps including: defining and analysing existing conditions as well as identifying future options [3]. Assessing the economic, social and environmental impacts of current and future options is a key step in informing the management of marine space [8,11,12] and appropriate decision tools can be used to structure and compare these different states to inform marine spatial plans. In order to inform their Coastal and Marine Spatial Planning (CMSP) objective, NOAA reviewed 17¹ MSP from around the world focussing on a number of issues including decision support. They noted that a range of tools were used in facilitating decision making including GIS-based tools (such as MarineMap, MARXAN); quantitative time series; quantitative snapshots; qualitative information and expert opinion on issues such as physical, geological, chemical, biological, economic and social impacts [13]. Furthermore, targets and principles were also used to direct decision making.

The recently published East Coast Inshore and Offshore plans for England assessed the current state and future marine plan options' impacts on issues such as: air and climate; communities and health; cultural heritage; marine ecology; economy; geology and coastal processes; landscape and seascape; and water environment [14]. The assessments were completed qualitatively recording current and anticipated impacts according to whether they would be positive, negative, neutral, permanent or temporary [14, p. 26]. Combining qualitative assessments with quantitative measures can further assist in clarifying the direction and the magnitude of impact and allow comparisons within and across various topic areas to be more explicit [15].

Quantitative comparative analyses of planning options are yet to be formalised in MSP. Currently, the information gathered and analysed are predominantly used in consensus building processes which provide qualitative outputs. Cost-benefit analysis (CBA) is one of the approaches that can be used to quantify, in monetary terms, the costs and benefits of alternative marine management decisions and plans enabling comparative analysis of available options to be undertaken. To date, CBAs of marine plan options have not been carried out partially due to: (i) lack of data, (ii) lack of spatial resolution, and (iii) inability to value some non-market benefits [16]. On this latter point, non-market benefits are the benefits gained by humans from ecosystem services but which are not valued directly by the market [17]. An example of a non-market benefit is the health benefit gained by an individual undertaking physical activities in nature. Quantifying health benefits of engaging with the marine environment is one of the more difficult benefits to quantify [18] however, quantifying them and valuing them in a monetary unit would allow these benefits to be more readily used in quantitative comparative impact assessments such as cost-benefit analysis.

1.3. Valuing health benefits

Identifying and quantifying the health benefits of engaging with the environment is a growing research area with the majority of evidence being available for green space. In a review of the impacts of green space to mental health, Bird [19] concluded it has benefits for behaviour and cognitive development in children, coping with anxiety and stress, crime reduction strategies,

treatment of dementia, concentration among office workers, and a general sense of health and well-being. The most recent report from the Monitor of Engagement with the Natural Environment [20], a survey of participation in the natural environment in England, indicates that individuals, who regularly engage with the natural environment, report higher overall life satisfaction, feel that their life is more worthwhile, state that they are more happy and show lower levels of anxiety. The presence and ease of access to green space is also reported to encourage beneficial behaviours such as physical exercise, recreation and social interaction [21] and improve happiness [22]. Some research has subsequently tried to identify the optimal dose of exercise in the natural environment for improving health and well-being (e.g. [23]).

While most research has focused on the well-being and health benefits of engaging with green space, it is also hypothesised that experiencing the marine environment contributes to similar mental and physical health benefits [24]. Evidence is beginning to emerge in support of this. In a systematic review of 36 studies² exploring the health and well-being benefits of blue space, Völker and Kistemann [25] identified a number of emotional, restorative and general health benefits associated with blue space. Brereton et al. [26] found that individuals living closer to the Irish coast reported higher levels of well-being and that this declines beyond 2 km. Using cross-section data for England, Wheeler et al. [27] reported similar findings for self-reported good health and that the effect may be greater for individuals living in more deprived communities. Building on this White et al. [28] used longitudinal panel data to demonstrate that individuals' mental health and well-being was significantly better in years when they lived within 5 km of the coast compared to years when they lived inland. Engagement with the marine environment is also reported to promote well-being among families [29]. Consequently initiatives such as the Blue Gym are being promoted to stimulate engagement of the public with the marine environment with a view to improving their health and well-being [30].

1.4. Quality adjusted life years (QALYs)

The benefits of physical activities to health can be quantified using quality adjusted life year (QALY) which measures the quantity and quality of a person's life; one QALY "being equivalent to one life year spent in full health" [31, p. 5]. The National Institute for Health and Clinical Excellence (NICE) estimates that an extra 30 minutes (min) of moderate exercise per week for a year would provide a 0.0106768 QALY gain for that individual [31]. These benefits in health could subsequently translate into savings for health-care services if a person is in generally better health. The expanded Walking the Way to Health Initiative (WHI) in the UK, aimed to promote walking as an activity for people who did very little exercise or lived in areas with poor health [32]. It estimated that the benefits of such a programme, if the programme was able to attract an additional 132,000 walkers over a three year period, would equate to a total gain of 2871 QALYs [32]. The QALYs were estimated to translate into savings that would be realised by the National Health Service (NHS) not having to treat illnesses such as cardio-vascular disease (CHD), stroke and type 2 diabetes which are noted as decreasing in prevalence in more physical active individuals [33]. Using the annualised life-cost averted by participants costing approach, the report estimated that a total of £81 million would be saved over a period of three years for the 132,000 walkers [32]³. The study highlights the potential for

¹ The 17 marine and coastal plans reviewed included: Barents Sea (Norway), German EEZ in the North and Baltic Seas, Baltic Sea Action Plan, Wadden Sea Plan, Netherlands, Belgium Part of the North Sea, Shetland Isles, Canada ESSIM, Canada Beaufort Sea IOMP, Massachusetts OMP, Rhode Island SAMP, Maryland Oyster MP, St. Kitts and Nevis, California MLPA, Hawaii ORMP, China MFZ, Australia NMB, Great Barrier Reef MPZP.

² These studies include coastal, inland waterways and other experimental studies.

³ In the Woods In and Around Towns (WIAT) project, Ambrose-Oji et al. [47] estimated that with appropriate investment and promotion an additional 487,000

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