Cyfoeth Naturiol Cymru
Natural Resources Wales

Assessing the socio-economic benefits of marine protected areas

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Contents

Abbreviations……4

Executive Summary……5

1. Introduction……12
- 1.1 Purpose of the Report ……12
- 1.2 Marine ecosystem services……12
- 1.3 Socio-economic benefits of MPAs……16
- 1.4 Marine conservation in Wales……17

2. Methods……18
- 2.1 Literature review……18
- 2.2 Workshop with NRW Staff……19

3. Review of methods to assess the socio-economic benefits of MPAs……20
- 3.1 **Monetary assessment methods……20**
  - 3.1.1. Direct Market Valuation Approaches……20
  - 3.1.2. Revealed Preference Methods……32
  - 3.1.3. Stated Preference Methods……55
- 3.2 **Non-monetary assessment methods……79**
  - 3.2.1. Deliberative Approaches……79
  - 3.2.2. Survey Approaches……82

4. Analysis……105
- 4.1 Synthesis analysis of methods……105
- 4.2 Applicability to Welsh MPAs……113
- 4.3 Framing future research……115

5. Conclusion……121

References……122

Cyfoeth Naturiol Cymru
Natural Resources Wales

Abbreviations

BES	Beneficial Ecosystem Service
CM	Choice Modelling
CPUE	Catch Per Unit Effort
CVM	Contingent Valuation Method
EU	European Union
ES	Ecosystem Service
HABs	Harmful Algae Blooms
ICES	International Council for the Exploration of the Sea
MPA	Marine Protected Area
MCZ	Marine Conservation Zones
NTZ	No Take Zones
OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
rMCZ	Recommended Marine Conservation Zones
SAC	Special Area of Conservation
SCI	Sites of Community Importance
SPA	Special Protection Area
TCM	Travel Cost Method
USA	United States of America
UK	United Kingdom
WTA	Willingness to Accept
WTP	Willingness to Pay

Executive Summary

The aim of this report is *to provide a comprehensive review of methods that can be used to assess the socio-economic benefits of marine protected areas in Wales*. The review is the first step in a longer process to enable Natural Resources Wales to answer the following questions:

i) What social and economic benefits are derived from Welsh marine protected areas (MPAs)?
ii) What is the potential for deriving further socio economic benefits whilst maintaining and/or enhancing the ecological condition of Welsh MPAs?
iii) To what degree do socio-economic benefits derived from Welsh MPAs rely on the favourable / improved conservation status / condition of the site?

It is increasingly recognised that the socio-economic benefits provided by the marine environment, MPA networks, and individual MPAs are potentially significant. As a result, when considering the socio-economic benefits of MPAs, it is necessary to establish plausible links between the ecosystem functions found within an MPA and the socio-economic benefits delivered from those functions. The ecosystem service approach is a mechanism to do this in which ecosystem services are "the benefits people obtain from ecosystems" (MEA, 2005). Biodiversity is critical to the generation of ecosystem services, therefore by measuring the benefits provided by ecosystem services, it is possible to determine the socio-economic importance of conserving biodiversity.

Approaches to measure the socio-economic benefits of ecosystem services can be divided into either monetary approaches or non-monetary approaches. In this report, a comprehensive review of both monetary and non-monetary methods was undertaken to establish the applicability of each method to the assessment of the socio-economic benefits of MPAs in Wales. A two stage research process was undertaken to achieve this: 1) a comprehensive review of relevant peer-reviewed and grey literature to identify relevant studies; and 2) a workshop with Natural Resources Wales staff to identify

constraints and opportunities related to the use of socio-economic assessment of MPAs in Wales.

Through the literature review, a total of 12 socio-economic assessment methods were identified as relevant to MPAs, of which seven were monetary and five non-monetary approaches. In the main section of this report, for each socio-economic assessment method identified, a concise description of the method is presented followed by examples of how the method has been applied to assess ecosystem services in the marine environment (and where applicable to MPAs). An evaluation of the strengths and weaknesses for the application of each method to MPAs is then presented. Based on discussions held during the workshop with Natural Resources Wales staff, an assessment of the constraints and opportunities associated with the potential application of each assessment method to MPAs in Wales is also presented. The strengths and weaknesses of each method are presented in Table 1.

The results of the literature review demonstrated that methods to value the socio-economic benefits of MPAs are an evolving area of research and practice. A total of 208 studies (peer-reviewed and grey literature) were identified that could be applied to the assessment of socio-economic benefits associated with MPAs, of which 91 were directly related to MPAs, and 16 applied to the UK MPAs. Out of the 12 different socio-economic assessment methods identified, 8 have been tested within the context of MPAs. It was found that there have been only three studies related to the assessment of socio-economic benefits of MPAs in Wales, of which only two are peer-reviewed. It is clear therefore that there is a lack of peer-reviewed socio-economic studies in the Welsh marine context to support MPA policy. There is also very little Welsh-specific evidence from which to answer questions i-iii identified by Natural Resources Wales. However, this research shows that there is a growing body of methods that have been used in other national settings that could be applied successfully to the Welsh context. In order that socio-economic evidence can support future marine conservation and MPA policy in Wales, the results of the literature review and discussions from the workshop were synthesised to identify proposals for a future marine socio-economic work programme in Wales.

The proposed programme adopts a nested approach with options at the following scales: the entire Welsh marine environment; the Welsh MPA network; and individual MPAs. At each scale it is recommended that Natural Resources Wales consider the application of a mixed method approach that will enable the provision of both monetary and non-monetary evidence of the socio-economic benefits of MPAs. Detailed recommendations for scale-specific studies, based on the availability of existing data and the priorities for primary data collection, are given in the report.

The report concludes that effective marine conservation policy and management measures can make an important contribution to socio-economic well-being as well as the protection marine biodiversity and ecosystem functions. However, such contributions require an understanding of the socio-economic benefits that the marine environment, MPA networks, and individual MPAs can provide, as well as the management measures most likely to deliver desirable benefits. Evidence from the literature review and workshop suggests that methods to assess the socio-economic benefits of the marine environment and MPAs are well developed, but each has specific strengths and weaknesses. As such, the application of socio-economic assessment methods must be undertaken carefully and with a clear view of the type of evidence needed to support future marine conservation management decisions and policy development.

At present, there is limited available evidence to inform the assessment of socio-economic benefits associated with the Welsh marine environment, the Welsh MPA network, or individual MPAs. This limits the potential to apply understanding of the socio-economic benefits of MPAs to decision making and management. It also limits the ability to identify where and how socio-economic benefits can be returned to the Welsh economy from the Welsh MPA network. As a result, it is recommended that consideration is given to undertaking a spatially nested multi-method work programme to identify the socio-economic benefits associated with the Welsh marine environment, MPA network, and individual MPAs. Such a work programme could focus on a combination of primary data collection and the innovative use of existing evidence, which if implemented, could place Wales at the forefront of European marine conservation policy and practice.

Table 1: Strengths and weaknesses of socio-economic assessment methods for MPAs.

Approach	Method	Strengths	Weaknesses
Monetary	**Market Valuation**	• Commonly used and well established method for assessing the economic value of services extracted from MPAs. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers. • Calculation is relatively straightforward. • Utilises pre-existing data (secondary data) and therefore is less time intensive.	• Limited availability of market data. Presence of influencing factors (taxes, subsidies, exchange rates, seasonal variation and market fluctuations) and policy failures; which must be considered to ensure data are meaningful. If proxies are used, then the values produced are not truly based on 'extractive use' of MPA resources.
	Avoidance Cost	• Highly applicable to valuation of natural coastal defences. • Utilises pre-existing data (secondary data) and is therefore less time intensive. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers.	• Lack of application to socio-economic assessments of MPAs. • Where replacement or substitute services are valued there must be feasible replacements/substitutes so that costs are relevant.
	Travel Cost Method (TCM)	• Commonly used and well established method for assessing the economic value of MPAs. • Useful for demonstrating the value of recreational activities to local economies. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers. • Method requires little adaptation to be applied to the Welsh context. • Calculation is relatively straightforward.	• Requires mathematical and statistical knowledge. • Requires an understanding of the specific location and potential variables affecting visitor use. • Lack of 'universally accepted method' makes the method subjective and dependant on the opinion of the user. • Lack of consistency in the method's application makes comparison between studies difficult.

Approach	Method	Strengths	Weaknesses
Monetary	**Hedonic Pricing**	• Applicable to a range of different ES services e.g. coastal erosion prevention, sea food and aesthetics. • Utilises pre-existing data (secondary data); and is therefore less time intensive. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers.	• Lack of application to socio-economic assessments of MPAs. • Relies on two assumptions: (1) that people will be aware of the link between environmental attributes and the benefits they experience, (2) that differences in quality will be reflected by differences in user experiences. • Requires a high degree of statistical expertise to develop a suitable method. • Influenced by external factors (e.g. inflation or changes in market prices for reasons that are unrelated to the marine environment).
	Payment for Ecosystem Services (PES)	• Where PES schemes exist this method is easily applied. • Utilises pre-existing data (secondary data) and is therefore less time intensive. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers.	• Limited application to the marine environment (used more in terrestrial valuations). • Used more commonly as a management measure than as a method to assess socio-economic impacts of MPAs. • Specific to certain beneficial ecosystem services where incentives can be provided for protection/enhancement. Requires the existence of a PES scheme.
	Contingent Valuation Method (CVM)	• Established method used to assess a range of MPAs and marine environments. • Method is capable of estimating non-use values. Applicable to the range of types of ecosystem services.	• Survey is reductionist in character where by opinions, beliefs and behaviour are condensed into a number. • Elicited CVM values can be considered meaningless as hypothetical answers to hypothetical questions are produced. • May lack relevance to the practical complexity of policy situations. Influenced by wider economics, demographics and motivations of the sample group. • Complex method with potential issues such as survey bias. Resource and time intensive (analysis requires specific econometric expertise).

Approach	Method	Strengths	Weaknesses
Monetary	**Choice Modelling (CM)**	• Flexible tool to assess value of MPAs and range of defined ES benefits. Provides a decision making platform to identify potential trade-offs between ES benefits and the amount or quality of another benefit. • Can be applied at a network, site and/or ecosystem service scale. • Suffers less from respondent bias. • Yields a large amount of information about people's preferences over a range of outcomes.	• Complexity of method may reduce participant response rate. Resource intensive (requires specific econometric expertise).
Non-Monetary	**Citizen Juries**	• Group discussion exposes participants to richer set of information; enhancing their understanding of the pertinent issues. • Measures 'social willingness to pay' rather an 'individuals willing to pay'; increasing social equity and policy legitimacy of outcomes.	• Lack of application to MPAs and the marine environment. Relatively expensive method. Resource and time intensive.
	Place based Valuation	• Useful for assessing beneficial ecosystem services such as culture and amenity; that are more intangible values. • Helps to capture deep emotional attachments and spiritual connections to a place or area in a marine or coastal ecosystem.	• Still limited number of case studies (underdeveloped method). • Difficulties in integrating and comparing social values to monetary (economic) values generated from ecosystems. • Relatively expensive method. • Time consuming.
	Health Valuation	• Aims to link human benefits (wellbeing) directly to MPAs and the marine environment.	• Limited application in developed countries (e.g. EU). • Lack of simple relationship between MPA implementation and health benefits. • MPA specific (dependant on MPA design and context variables) Influenced by independent factors (e.g. local economy and activities).

Approach	Method	Strengths	Weaknesses
Non-Monetary	**Indicator Approach**	• Multifaceted approach which combines social, economic, governance and ecological indicators. • Utilises pre-existing data (secondary data) and is therefore less time intensive.	• Lack of application to socio-economic assessments of temperate MPAs Difficulty in attributing indicator effects to MPAs.
	Q-method	• Helps to gain an understanding of stakeholder perceptions of MPAs. Provides quantitative data for statistical analysis. • Only requires a small sample size. • Enables respondents to make more holistic judgements, increasing their understanding and interpretation of issues. • Useful for assessing beneficial ecosystem services such as culture and amenity; that are more intangible values.	• Lack of application to socio-economic assessments of MPAs. • Initial stages of design are very intensive and time-consuming for the researcher.

1. Introduction

1.1 Purpose of the report

The aim of this report is *to provide a comprehensive review of methods that can be used to assess the socio-economic benefits of marine protected areas in Wales*. The review is the first step in a longer process to enable Natural Resources Wales (NRW) to answer the following questions:

iv) What social and economic benefits are derived from Welsh marine protected areas (MPAs)?
v) What is the potential for deriving further socio economic benefits whilst maintaining and/or enhancing the ecological condition of Welsh MPAs?
vi) To what degree do socio-economic benefits derived from Welsh MPAs rely on the favourable / improved conservation status / condition of the site?

The main body of the report is divided into two sections: 1) monetary valuation methods; and 2) non-monetary valuation methods. These sections are in turn subdivided into examinations of specific assessment methods potentially applicable to MPAs. Within these detailed sections, each method is defined, examples of how the method is applied are presented, and its strengths and weaknesses discussed. The final section of the report presents an analysis of the key themes within the report to identify options for framing future research into the socio-economic benefits of MPAs in Wales.

1.2 Marine ecosystem services

When considering the socio-economic benefits of MPAs, it is necessary to establish plausible links between the ecosystem functions found within an MPA and the socio-economic benefits delivered from those functions. Although many generic approaches exist to assess the social and economic benefits arising from conservation policy and management, there has been an emphasis on economic assessments that focus on

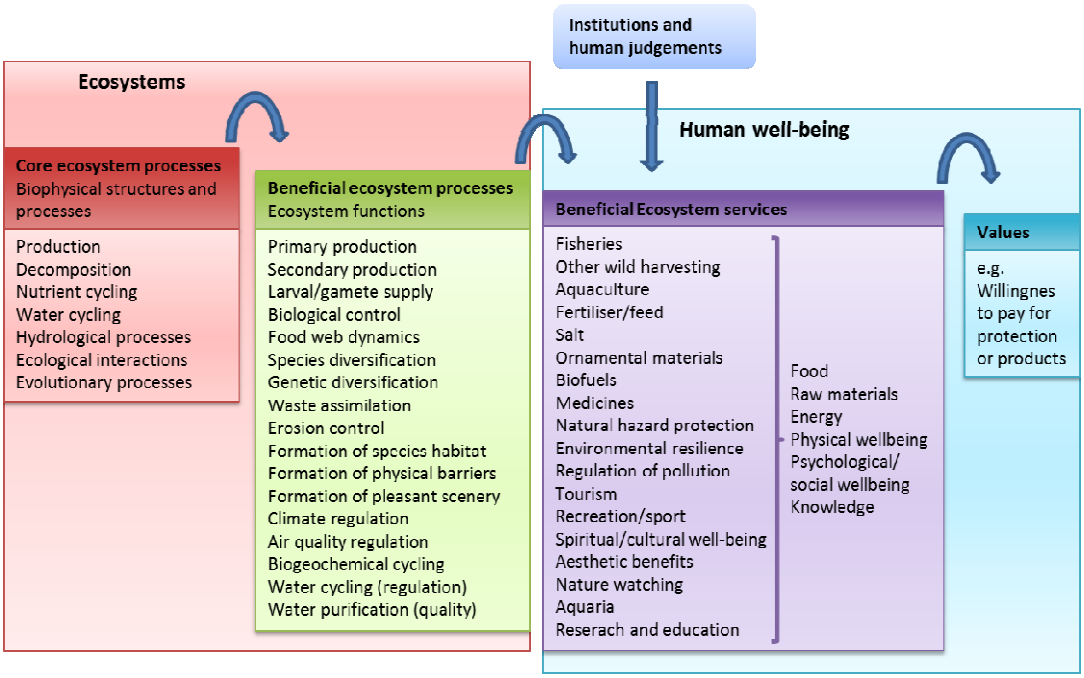
monetary valuations of marine resources (such as market prices). Monetary values are useful for policy makers; providing them with an understanding of the obvious values, such as fish landings. These valuations, however, do not generally reflect the wider importance of biodiversity and ecosystem functions in terms of benefit delivery to humans (Rees 2010). To incorporate these wider values in decision making, recent marine-related studies are beginning to adopt an ecosystem services approach

Ecosystem services were defined in the Millennium Ecosystem Assessment (MEA) as "the benefits people obtain from ecosystems" (MEA, 2005). Similarly, Defra (2007) define ecosystem services as the "services provided by the natural environment that benefit people". Services include food production, climate regulation, flood protection, pollution control, and human well-being (Defra 2007; Remoundou, et.al. 2009). These simple definitions reflect the central principle of the ecosystem service approach that human well-being is dependent upon healthy and diverse ecosystems (UNEP, 2006, Potschin & Haines-Young, 2011). The ecosystem services approach encourages society to appreciate the role of ecosystems and biodiversity in supporting human well-being by clearly displaying the connections between ecosystem functions and socio-economic benefits.

The MEA identified four categories of ecosystem services: (1) Provisioning services that supply material resources; (2) Regulating services that control ecological systems; (3) Cultural services that provide non-material aesthetic, spiritual and recreational benefits; and (4) Supporting services that provide the basic ecological functions and structures that underpin all other services such as primary production, biodiversity, oxygen production, soil formation and nutrient cycling (MEA, 2005). The Economics of Ecosystems and Biodiversity (TEEB) project built upon and adapted the MEA classification to better distinguish between ecosystem processes and services. The TEEB classification identifies core ecosystem processes that support beneficial ecosystem processes (BEP) which in turn deliver beneficial ecosystem services (BES), as shown in Figure 1 (Balmford et al., 2008). When the services experience a human intervention (e.g. fishing, tourism, recreation) this can result in a benefit being generated, such as an improvement in physical or psychological health, food, or medicine. The classification of ecosystem

services is an ongoing focus of work. There are many different classifications available, each of which may be better suited to some contexts than others.

Figure 1. The links from ecosystems to human well-being (adapted from Balmford et al., 2008 and TEEB, 2010).



While it can be argued that every application of ecosystem service assessment requires a bespoke classification (because every situation is different), there is a trend towards identifying classifications that can be applied to general situations. For example, Böhnke-Henrichs, et.al., (2013) have proposed a classification of ecosystem services to specifically support marine spatial planning (Table 1).

Table. 1. Classification of marine ecosystem services (Böhnke-Henrichs, et.al., 2013).

Category	*Ecosystem service*
Provisioning services	Sea food
	Sea water
	Raw materials
	Genetic resources
	Medical resources
	Ornamental resources
Regulating services	Air purification
	Climate regulation
	Disturbance prevention or moderation
	Regulation of water flows
	Waste treatment
	Coastal erosion protection
	Biological control
Habitat services	Life cycle maintenance
	Gene pool protection
Cultural and amenity services	Recreation and leisure
	Aesthetic information
	Inspiration for culture, art and design
	Spiritual experience
	Information for cognitive development
	Cultural heritage and identity

The link between biodiversity and ecosystem service provision is the subject of much debate, although there is general agreement that biodiversity is a critical contributor to the generation of ecosystem services, it is less clear how the benefits available from ecosystem services may change as biodiversity changes. Similarly, it is unclear whether *all* services and associated benefits change at the same rate when the underlying biodiversity changes. For example, it might be that visitors to a partially degraded MPA receive as much psychological benefit from their visit as they would from an MPA of a higher conservation status. Whereas, in an MPA where the habitat is degraded there may be a reduction in food related benefits when compared to an MPA where habitats are more effectively managed. Conversely, improvements in biodiversity might not show immediate

improvements in the extent or quality of all ecosystem services and associated benefits. These examples illustrate the complexities of determining the relationship between specific ecosystem service provision and biodiversity. At a pragmatic level, this may become a matter of determining tailored management priorities, with some services more responsive to management interventions or of a higher priority than others.

1.3 Socio-economic benefits of MPAs

MPAs and MPA networks are recognised as important mechanisms to safeguard marine biodiversity and for their role in providing wider socio-economic benefits to society. The case for MPA designation and choice of management measures to be applied within an MPA is increasingly influenced by their socio-economic costs and benefits. For example, in England, Natural England, the JNCC and the Wildlife Trusts have sought to identify the ecosystem services associated with habitats and species in proposed Marine Conservation Zone (MCZ) sites, to consider their value (in monetary terms mainly), and establish how the level of service provision (and by implication their value) might change under a range of plausible management scenarios (Rees, 2014; Fletcher, et.al., 2011; Herbert, et.al., 2011; Fletcher, et.al., 2012).

Several studies of the benefits of MPAs have been undertaken in the UK. Notable examples include the assessment of the socio-economic impacts of the Lyme Bay closed area (Mangi et al., 2012), social impacts of rMCZ designation in the North Devon Biosphere Reserve, the benefits to recreation of the Lyme Bay closed area (Rees et.al. 2013a,b) and most recently an assessment of the benefits likely to be provided by the designation of the rMCZ network in England (Rees, et.al. 2014; Fletcher, et.al., 2012;). In the latter study, a national scale assessment of ecosystem services provided by rMCZ sites was undertaken; considering four case study sites. A variety of methods were used to identify social and economic benefits, including focus groups, benefit transfer, secondary data analysis and market valuation. The study determined that in general, designation of an MCZ would have a positive effect on the ecosystem services provided by the proposed sites.

1.4 Marine conservation in Wales

Approximately 35% of Welsh seas are designated as a form of MPA (including Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest). Welsh seas, like many marine environments face increasing pressures from human activity. In light of this, delivering effective management of the existing suite of Welsh MPAs is a necessary current and on-going focus. Therefore, the efficient and effective allocation of conservation resources across the Welsh MPA network is important.

To date, marine conservation has traditionally been based upon ecological concerns and goals. However as perceptions of the values of the marine environment change and aspirations for marine resource use increases, conveying the benefits of marine conservation for the wider economy and society is a necessity. Therefore, identifying and communicating the wider social and economic benefits provided by MPA's is becoming increasingly important.

2. Methods

A two stage research process was undertaken to compile this report: 1) a comprehensive review of relevant peer-reviewed literature, grey literature and reports; and 2) a workshop with NRW staff to identify constraints and opportunities for socio-economic assessment of MPAs in Wales. Each phase will be described in detail in the following sections.

2.1 Literature review

A literature search was undertaken to identify methods which could be used to identify the social and economic benefits of MPAs in Wales. This was undertaken through searching relevant online research databases and catalogues. Peer-reviewed publications were prioritised in the searches as these offered the greatest quality assurance. Since not all peer-reviewed research databases contain the same literature, multiple databases were searched in order to ensure full coverage of the published evidence. The peer-reviewed and grey literature reviews were conducted using structured Boolean keyword searches. When peer-reviewed materials were unavailable, 'grey' literature sources were sought. These are reports that are generally published by reputable organisations but which have not been subjected to independent peer-review. Grey literature searches were conducted using meta-search engines, primarily Google Scholar.

The literature review enabled the identification of:

- The full range of social and methods that have been used or are being developed to determine the social and economic benefits derived from MPAs[1].
- Evidence of the strengths and weaknesses of each assessment method.
- Case study examples of the application of each method[2].

[1] Priority was given to examples in an MPA context, although this was not always possible due to the limited application of some methods.

[2] Priority was given to examples undertaken in a climatic and geographical context similar to Wales although this was not always possible due to the limited application of some methods.

Once a peer-reviewed and grey literature review was completed for each relevant socio-economic assessment method, the evidence was synthesised into a narrative text for inclusion in the final report. In the report, for each method, the type of evidence (peer-reviewed or grey) and the number of different sources used to compile the section, is indicated (Table 2).

2.2 Workshop with NRW staff

A workshop was held in Bangor on 6 March 2014 with 15 NRW staff, facilitated by researchers from Plymouth University. The purpose of the workshop was twofold: 1) to increase the knowledge of NRW staff about methods to assess the social and economic benefits of MPAs; and 2) to consider the potential for each socio-economic assessment method to be applied to MPAs in Wales. The format of the workshop included presentations, whole group discussions and small group discussions. All discussions were recorded and transcribed in order to accurately capture the comments and views of workshop attendees. Subsequent to the workshop, the transcripts were used to identify the constraints and opportunities associated with the potential application of each assessment method to MPAs in Wales. These results were then integrated into the analysis to provide a comment on the potential applicability of each method in a Welsh context. In addition to this, participants completed a questionnaire which enabled them to express their views towards all of the assessment methods discussed during the workshop.

3. Review of methods to assess the socio-economic benefits of MPAs

3.1 Monetary assessment methods

3.1.1 Direct Market Valuation Approaches

These approaches use direct market valuation to obtain the value of provisioning services, for example fisheries landings. They can take price based or cost based approaches. Price based approaches (market value/market price method) assume that preferences and marginal costs of production are reflected in the market price of a good, and therefore that the market price will accurately reflect its value (Irving et al., 2011; Pascual et al., 2010). Cost based approaches estimate the cost that would be incurred if provision of the beneficial ecosystem service (BES) in question needed to be replaced through artificial means (Pascual *et al.*, 2010). These cost based methods include avoidance cost, replacement cost and restoration cost. Direct market valuation approaches are well suited to input into decision support tools (e.g. cost benefit analysis) and MPA modelling tools that link the management of the environmental resource to the effects on the production of a BES (e.g. production function models).

Market values/Market price

Description:

Where data are available, assessment of market price is often considered to be the simplest way of valuing BES, as it considers the sale and purchase price of the BES in question. Market price is commonly used to value provisioning services such as food, ornamental materials and medicines. This can be applied to MPAs based on the premise that the value of a protected area can be determined from the value of the BES that are extracted from it (Kettunen et al., 2013b). Market price valuation is most useful for determining the value of natural resources, recreation and tourism, but it is dependent on

the availability of market data (Kettunen *et al.*, 2013b). The market price method estimates the economic value of BES that are bought or sold on commercial markets. Valuation is based on the quantity of BES purchased at different prices and the quantity supplied at different prices, and is calculated as total net economic benefit:

Total net economic benefit = ∑ consumer surplus + ∑ producer surplus

Consumer surplus is the difference between the price the consumer is willing to pay (WTP) and the actual price paid, and the producer surplus is the difference between the total amount earned from the sale of a BES and the production costs.

Examples:

Market values are most commonly used in relation to specific BES as they can be linked to specific benefits, e.g. fisheries landings provide the BES of sea food. Some studies are small scale, valuing specific BES, and others have taken a broader approach, valuing the suite of BES that are generated from a site or network of sites. The following examples presented have been grouped depending on the ecosystem service that they represent.

Sea Food

Market value of seafood is relatively easy to calculate if landings data (usually representing the first sale price of a whole, ungutted fish) are available. Market values for sea food can be used to calculate broad fishery values when assessing the economics of an area and provide a tangible figure for decision makers. Market values have been used for general valuation of the marine environment, and are also applied to MPAs. In South Africa, Turpie et al. (2003) used market prices to assess the economic value of terrestrial and marine biodiversity in the Cape Floristic Region. Using regional statistics they calculated the value of the fishing industry (fish, abalone and rock lobster) and the commercial seaweed industry, combining these data with other recreational uses to provide economic evidence of the value of the area and to aid the development of conservation measures.

When considering MPA specific uses, market value is often employed by studies assessing the fishery effects of MPAs. Landings data are used to provide the market price of fish landed and can be used to generate weekly, monthly, or annual turnover figures for fishing boats. These economic valuations can then be applied to an MPA, or, where fishing is prohibited within an MPA, for the area adjacent to it. Calculation can be difficult, however, as it is not always possible to isolate the percentage of landings from within the MPA, or from spillover from it. Therefore, calculations must either be presented for larger areas or methods must be developed to determine those landings that can be attributed to the MPA. For example, this could be achieved by using vessel monitoring system (VMS) data and interviews with fishers.

The UK MCZ Regional Projects valued the fisheries that were in operation within waters that were recommended MCZs as part of their economic impact assessment (Finding Sanctuary, 2012). They used a market value approach, examining landing statistics to value fisheries using a range of gear types and predicted the impact that might occur under different management scenarios. These figures were presented to show the cost of designation of the sites. Following this work, Fletcher et al. (2012) used four case study sites from the recommended MCZ network to value the benefits that might be expected to arise from designation of the sites. They used fisheries landings statistics supplemented by interviews with key stakeholders to determine the impact on fisheries. Furthermore they also then modelled potential changes that would occur following designation to predict how these impacts might change under different management scenarios. The key difference between this study and that of Finding Sanctuary (2012) was that they focussed on the benefits that might arise from designation rather than the costs.

Mangi et al. (2012) used this method to assess the impact of the implementation of an MPA in Lyme Bay (UK) on the local fishing community. This MPA specifically prohibited the use of towed gear but permitted static gear use. The study utilised landings data, VMS and interviews. These revealed that the MPA had led to decreased landings for towed gear fishermen (resulting in an economic cost) and increased landings for static gear fishermen (resulting in an economic benefit). These results were part of a larger investigation (2008-2011), which showed that profit for towed gear fishers did not diminish

over time, but that this was due to displacement of fishing effort to new areas. It was also determined, however, that there were large social costs associated with this displacement. Local fishers were concerned that the observed increase in levels of static gear might be jeopardising the ability of the MPA to meet its conservation objectives (Hattam et al., 2014). It is therefore apparent that although market value can prove helpful in an assessment of fisheries in MPA studies, a multiple method approach is required to ensure that the study captures all values.

Where MPAs restrict fishing activity through No Take Zones (NTZs) or through the restriction of some but not all fishing methods, the value of the MPA can be determined via the benefits it produces through the spillover of target species into adjacent fisheries. While numerous studies have considered spillover, using metrics such as Catch Per Unit Effort (CPUE) (e.g. Goni et al., 2008; Murawski et al., 2005; Ofiara, 2001; Russ et al., 2004), few have applied an economic analysis. Kelly et al. (2002) attempted to value spillover in their study of Leigh Marine Reserve, New Zealand for catch of spiny lobster. They determined that spillover from protected lobster populations supported the surrounding fisheries and that this reduced the long term loss of income for fishers. Their direct economic valuation was, however, limited to the pot hauls that formed part of their study, as catch data for all fishers working the area were unavailable.

McClanahan et al. (2010) took this approach in Kenya, assessing the impact of gear restrictions and fisheries closures on fishery income using per capita daily wet weight of landings. The study determined that fishing yields and incomes in areas adjacent to fisheries closures were higher than in areas away from closures. This study concluded that the price of fish is an important determinant in the effects of fisheries closures and that it can strongly influence profits. Adams et al. (2011) also used market value and CPUE data from landings to model opportunity cost and profit for a fishery in Fiji based on restriction of access for fishers. Their application, however, related to the identification of the optimum place for siting an MPA network under two scenarios (one based on the existing network and the second on starting from scratch).

Luisetti et al. (2008 and 2011) used a market value approach to value the fisheries benefits associated with salt marshes in the Blackwater and Humber estuaries. They assumed that the value of the nursery habitat provided by the saltmarsh could be determined from the market price of fish species sold at market and applied this to sea bass to give a value per hectare of salt marsh. This was incorporated into a study which determined the value of a managed realignment scheme for coastal defence.

Climate regulation

Market value can be assigned to carbon sequestration, which plays a key role in climate regulation. This relates in particular to the carbon sequestration potential of seagrass beds which are known to be important carbon sinks. Cebrian et al. (1997) calculated the carbon burial per hectare per year for four species of Mediterranean seagrass, including *Zostera marina*. This valuation was shown to be applicable as an estimate to other systems where the area coverage of a seagrass bed is known. For example, valuation is possible for UK systems based on traded and non-traded carbon values provided by DECC (2011). This approach has been taken by Fletcher et al. (2012) who valued the carbon sequestration potential of a *Zostera marina* bed in the Torbay Marine Conservation Zone, UK.

Luisetti et al. (2008) took an ecosystem services approach to valuing the Blackwater estuary, and were able to assign a market value to the cost of maintaining hard coastal defences as part of a study looking at the costs and benefits of a managed realignment scheme. Luisetti et al. (2011) used this case study and one on the Humber estuary and calculated the carbon storage that would be provided under different managed realignment scenarios to generate a value of the BES that would be provided by the saltmarsh habitat. It is also possible to calculate the carbon storage role of restored seagrass beds, and therefore the value that an MPA could provide where it is designed to restore or recover habitat. This was demonstrated by the work of Greiner et al. (2013) who evaluated the *Zostera marina* beds in Virginia (USA) and determined the societal costs of restoring 1700 hectares (ha). Both protection and restoration of seagrass beds through the implementation of MPAs may therefore be beneficial to carbon sequestration, providing an important ecosystem service.

Biological control

McArthur et al. (2006) valued seagrass habitat in Australia and its contribution to secondary production of several commercially important fish species. They used pre-existing information on the primary production rate of carbon from seagrass beds per m^2 per year and catch data (market value) from commercial and recreational fisheries as estimates of secondary production and used these figures to calculate the total production of the seagrass beds. Rönnbäck(1999) used a literature review approach of studies which had determined the secondary production of mangrove ecosystems for commercial fish species and calculated their economic value per hectare of mangrove based on market value data.

Recreation, Leisure & Tourism

It is possible to measure the economic benefits of MPAs by assessing the effect of management measures on recreation, leisure and tourism activities. Market value can be determined through use of proxies when considering these activities via an analysis of associated costs. For example the cost of diving within an MPA can provide a proxy for the market value of the recreational benefits of the MPA, in particular if fees are charged for diver entrance.

Studies applying these methods to MPAs are limited, but they have been more widely applied to larger areas to demonstrate their value. Ruiz Frau (2010), for example, assessed the economic value of recreation in Wales, by valuing scuba diving, sea kayaking, wildlife watching and seabird watching. They calculated the costs associated with each activity in terms of travel to the site, accommodation costs, and costs associated with participation to give a value for total annual expenditure for all activities. In the Cape Floristic Region in South Africa, McGrath et al. (1997) valued recreational sea angling using estimates of angler days and annual catch statistics and Findlay (1997) determined the value of the Southern Right Whale for whale watching tourism. Turpie et al. (2003) combined these studies with their assessment of fisheries in the region to provide a holistic overview of the value of the area to aid development of effective conservation measures.

Studies applying these methods to MPAs include the UK MCZ Regional Projects which valued recreational use of recommended MCZ sites as part of their economic impact assessment. They collected data through a process of interviews and focus groups throughout the course of the project period. Quantitative data collected included the value of charter boat revenues per year, user fees for boat mooring and the cost of maintenance, and the value of activities such as recreational diving, recreational sea angling, and wildlife watching and water sports (Finding Sanctuary, 2012).

Mangi et al. (2012) and Rees et al. (2010) determined the impact of the Lyme Bay MPA on recreational users. They interviewed a range of stakeholders (including dive businesses, recreational divers, recreational anglers, charter boat owners and local hotel owners) to determine the change in use of the area, and the corresponding economic impacts by assessing turnover before and after the closure. Despite not being able to attribute all impacts to the MPA, an increase in diving and angling frequency was identified. This generated an increase in angling and diving expenditure and charter boat and dive business turnover. Dicken (2010) took a similar approach, calculating related expenditure to determine the economic value of the sardine run in Pondoland MPA (South Africa) to dive and wildlife watching tourism. They conducted questionnaires with sardine run participants (divers, snorkelers and surface watchers), local indigenous communities, hoteliers and non-diving tourists, using the results to highlight the importance of the sardine run to the local economy.

Evaluation:

The generation of market value for the BES associated with MPAs is relatively straightforward. However, one of the main limitations of this method is that it can only be applied to a limited number of BES as market data does not exist for all. Where it can be produced, market values provide tangible, accessible figures that are easily presented and meaningful. They can therefore be powerful when included in presentation of data on the benefits of site designation, and are particularly appropriate for presenting to government and management organisations. They are also commonly used as headline grabbing figures, potentially providing powerful values for public engagement.

There are a number of considerations that must be made when taking this approach. In particular, when figures are presented it is essential that caveats are provided so that the values are correctly interpreted. For accurate generation of values a thorough understanding of the market is required. It is essential that the value of the goods is interpreted correctly and that any additional factors that *could* influence the price (e.g. market forces) have been accounted for. A further important consideration is that the market value of a BES may only reflect its value at a given time because of influencing factors such as taxes, subsidies, exchange rates, seasonal variation and market fluctuations. Furthermore, market value might not reflect the true value of the goods due to additional factors or policy failures (Alban et al., 2008).

Application of this method is most relevant to fisheries, where landings data can be accessed, but due to the limited availability of market data, it is recommended that this method is used in combination with other methods for MPA assessment. It is often appropriate for market values to be calculated using available data and then ground-truthed through interviews with key stakeholders to ensure that the market has been correctly interpreted and the values have true meaning.

Avoidance cost

Description:

Due to their similarities, this section incorporates avoidance cost, replacement cost, substitute cost, damage cost avoided, prevention cost and the averting behaviour method. These methods are all based on the assumption that a particular BES will be worth at least the amount that people will pay to protect, replace or substitute it. The different methods are defined as follows:

Avoidance/prevention cost

This method estimates the value of BES based on the cost of avoiding damage due to lost services. For example, cost can be calculated for coastal erosion prevention based on the cost of building coastal defences.

Damage cost avoided

This method values the cost that was avoided by not allowing the BES to degrade. For example, the cost of establishing a fisheries closure to protect fish habitat and therefore avoid the future loss of the fishery.

Replacement/substitute cost

This values the cost of replacing/providing substitutes for lost BES. It has been most commonly been used for estimating the value of watersheds, however, it may also be applied to the valuation of shoreline protection afforded by a reef or seagrass bed. As the value can be assumed to be worth at least the cost of the construction of the groynes or barriers which would be needed to protect the shoreline in its absence. This method relies on three key conditions: (1) that the substitute provides the same BES, of the same quality and magnitude as that which is being replaced, (2) that the alternative is the cheapest method possible to produce an alternative, and (3) that society has demonstrated a WTP for the services to be provided artificially (Bockstael et al., 2000).

Averting behaviour method

This considers the costs associated with changing behaviour to avoid damage to the marine environment. For example, the WTP of an individual to avoid the effects of negative environmental change, such as the purchase of bottled water as a reaction to increased water pollution. The value of decreasing environmental quality can be determined by assessing the increase in averting expenditure (AE). The method is based on three assumptions, (1) that AE and environmental quality as close substitutes, (2) that AE is only generated by the environmental change of interest and does not produce additional benefits, and (3) that it is reversible (Dosi, 2000).

Examples:

These methods are most commonly applied where action has already been or will be taken that will incur costs for damage avoidance or replacement. Predominantly, these methods have been applied to the terrestrial environment or coastal zones, and no examples could be identified in the literature where they have been used to assess the social or economic impacts of MPAs. Some examples have been identified from the marine environment, however, for some methods, and these are detailed below. As with other direct market valuation approaches these are specific to BES.

Sea Food

Sundberg (2004) valued the replacement cost for sea trout habitat in Sweden where erosion was causing a loss of suitable habitat for sea trout spawning. They calculated replacement cost based on the cost of the restoration of the stream habitat for four different streams and determined the replacement cost per smolt. Although based on the real costs associated with the restoration, the results were considered applicable to other projects. Furthermore, the study highlighted the value of the stream habitat to the sea trout fishery.

Climate regulation

Clarkson et al. (2002) calculated the social value per metric ton of sequestered carbon to give a value for the savings from damage avoidance in the UK. They used the marginal cost method to determine the difference in future damage levels that would be caused by a small change in the current level of emissions and compared this to the cost benefit approach. This can, however, be considered as a damage cost avoided approach, as they determined the cost of a change in emissions that would be required to avoid loss of the ecosystem service of climate regulation through carbon emissions.

Irving et al. (2011) determined the recovery potential of seagrass beds, saltmarshes and mangroves for carbon capture and storage under different management scenarios. The data presented could be used to inform studies aiming to value restoration. The work of Greiner et al. (2013) has already been discussed in terms of market value of seagrass

beds, but their study could also be used to determine the value of a seagrass habitat through the cost that would be associated with restoring it; restoration cost. Their study evaluated the *Zostera marina* beds in Virginia (USA) and determined the societal costs of restoring 1700 hectares (ha), thus generating a value for the seagrass habitat.

Sea Water

The replacement cost method has been proposed to assess the value of the mitigating eutrophication; a process which affects the BES provided by seawater. Kaminska et al. (2013) proposed the method for the Southern Baltic Sea. This work is not yet published but is part of a larger project assessing marine spatial planning in the Baltic.

Coastal erosion prevention

Avoidance and replacement costs may be calculated for ecosystems that fulfil the BES of coastal erosion protection. These are commonly ecosystems such as mangroves, saltmarshes and seagrass beds. Sanford (2009) calculated the coastal protection value of mangroves in South Asia, calculating that this exceeded the direct use value (e.g. harvesting) by 97 %. Titus et al. (1991) valued the cost of shoreline protection in the USA to minimise wetland loss from sea level rise under different scenarios, providing an avoidance cost for the loss of coastal protection in the country. Luisetti et al. (2008) calculated the value of seagrass habitat through a cost benefit analysis associated with a management realignment scheme in the Blackwater estuary. Their valuation included calculation of maintenance costs for existing defences and for potential re-aligned defences and could be applied to other such schemes, Fonseca et al. (1982) determined the cost associated with the replacement of seagrass via transplanting to aid the costing of replantation programmes. This approach could potentially be applied to seagrass beds in MPAs to determine their value.

Evaluation:

The methods discussed here are relatively easy to apply and produce values that are meaningful and tangible, allowing trade-offs between management options to be assessed. In terms of determining the benefits of MPAs, it is thought that these methods

would be particularly applicable when valuing natural coastal defences such as salt marshes, seagrass beds or mudflats to demonstrate their value in coastal protection and therefore the value of the MPA to this BES. It is critical that the assumptions applied in these methods are valid in order for the values produced to be meaningful. The main limitation of these methods is that due to their specific relevance to a limited number of BES, they are not as appropriate for the valuation of MPAs as other methods discussed in this report. Few examples were identified in the literature for the marine environment, and none for MPAs. It is thought, however, that they have value, and their use could be explored in the Welsh context.

A further consideration for these methods is that where services are valued that provide replacement or substitute services, the proposed replacements must be meaningful. For example, Constanza et al. (1998) calculated a value per hectare of the ocean for its nutrient cycling capacity, and this could be used to determine replacement cost for this service. Replacement of nutrient cycling is, however, impossible; hence, any value placed on it could be considered meaningless (Beaumont et al., 2008). It is crucial that costs are only calculated for services that can truly be replaced.

3.1.2 Revealed Preference Methods

Revealed preference methods can be used to value expenditure related to the BES provided by MPAs. Socio-economic indicators include: the costs that people are prepared to incur in order to visit a protected area (Kettunen *et al.*, 2013b). It can be said that their preferences are 'revealed' through their choices (Pascual *et al.*, 2010). There are two main methods that take this approach, the travel cost method (TCM) which values recreation using the costs that people incur to travel to a site; and hedonic pricing which uses statistical analysis of house prices in different areas to determine the value attributed by people to living in close proximity to protected areas.

Travel Cost Method (TCM)

Description:

The Travel Cost Method (TCM) is a revealed preference approach based on the premise that marine sites hold high value for tourists and local residents for the purpose of recreation, leisure and tourism. It is one of the most commonly applied methods for estimating the value of recreational sites (Ofiara, 2001). It assumes that the visitor must have been WTP at least the amount it cost them to travel to the site, and therefore that the site produces benefits at least equal to this amount (Chae et al., 2012). For this reason, total travel cost can be considered the purchase price of the site (Castellini et al., 2009), and is a useful way of determining site value; the further people are willing to travel to visit a site, the greater its value (Pendleton, 1995).

TCM may be applied either to single or multiple sites. For single sites, analysis focuses on the costs associated with travel and the travel time. It is also useful to include a coefficient for a number of different variables such a gender, age, income and proximity to other sites as these may affect the travel choices of an individual. For example, the closer someone lives to another site, the more likely it is that they will visit their local site rather than the site of interest, and the more income someone has, the more often they may be able to afford

to visit the site (Parsons, 2003). For multiple sites it may be desirable to know which out of a selection of sites is most attractive to visitors. Here, a random utility model is commonly applied which allows sites to be considered in terms of the trade-offs between the site selected by an individual and other possible sites (Parsons, 2003). In some instances, the actual travel cost is compared to hypothetical costs (a CVM survey), if, for example the services provided by a site improve, would the visitor make more trips? This method can be beneficial where research is needed to determine the potential demand for trips to a site if its quality were to increase as part of an impact assessment or in the development of a marine plan (Alberini et al., 2004).

Examples:

As the travel cost method considers the costs of travel related to recreation, leisure and tourism, this BES is discussed below. Extensive literature searches did not identify literature relating to other BES.

Recreation, Leisure & Tourism

The travel cost method has been applied by various studies in a marine context. It is primarily used to directly value the cost of travel to a site where recreational activities are conducted, but some studies have taken a combined approach where they have also considered WTP and consumer surplus. Where a direct approach is taken, methods for valuing travel cost usually involve visitor surveys to determine the costs incurred to reach the site (Defra, 2007). Two main methods are then employed; either the travel cost per individual/group or the travel cost per zone, where the location from which a visitor has travelled is grouped by concentric zoning with distance from the site (Alban *et al.*, 2008).TCM uses the value of travel costs, including petrol, train tickets or the cost of any other means by which the individual travelled to the site and combines this with the cost of travel time. Where visitors are from overseas this can also include the cost of their travel to the county, as well as the within country travel that was required to reach the site. Du Preez et al. (2012) for example, included the cost of air travel to reach South Africa and then the cost of travel from the tourist's point of entry to the study site, Aliwal Shoal MPA

where visitors engaged in shark dives. For domestic visitors, the cost of the round trip from their place of residence was calculated. A trip generating function (TGF) was then used to predict the number of visits that one individual would make to the recreational site. In cases where the trip lasted multiple days, accommodation costs were incorporated into the calculation of travel costs. The study concluded that recreational tiger shark diving within the MPA was highly valued by divers. This revealed that that the MPA supported a valuable recreational resource and suggesting that increased marketing of the MPA could result in substantial benefit for its management and the local economy. Similarly, Carr et al. (2003) valued the Great Barrier Reef in Australia using the TCM and compared a polynomial and a log linear model developed based on travel costs associated with domestic and international tourists visiting the reef. They used the results to highlight the importance of the reef as a resource, and the need for its ongoing protection and management.

The cost of travel time is commonly calculated based on the average annual salary for the area, with the average annual income, or a fraction of it, divided by the average number of working hours per year (Parsons, 2003). The lack of one accepted method, however, means that the fraction of the average hourly salary that is used varies between studies, with fractions between 0.25 and 0.5 most commonly applied. An average speed is applied to determine the time taken for a journey and then the cost of the travel time calculated.

In addition to the travel costs to the site, some studies consider travel such as the boat ride to a dive site as part of the travel cost, arguing that the true recreational activity has not begun until the dive site is reached. Castellini et al. (2009) employed this method, valuing recreational diving at an MPA site in Italy. They did acknowledge that the boat trip was the start of the recreational activity, but considered it to be less important to the visitor than the time spent actually on the dive. The travel time was therefore costed at half the average salary for this portion of the journey, and at the full average salary for the land based portion of the journey. The study identified that people's distance from the site did not necessarily determine their willingness to travel to it. This showed that the MPA was unique and one of a kind in the area, a finding which would enhance the importance of effective management and maintenance of the site to ensure it kept attracting divers.

Chae et al. (2012) assessed the recreational benefits arising from the Lundy MPA, UK. In addition to the travel cost they determined consumer surplus (defined as the difference between WTP and the actual cost of travel) as this was thought to be a better indicator of the total value that individuals were placing on the BES provided by the site. They used these methods to determine the attractiveness of the site for visitors based on their opinions of the designation of a No Take Zone at the site. Interviews were conducted with two groups, those in support and those against the NTZ. This showed that those in support made 65% more trips to the island over a three year period than those against. The average consumer surplus per trip was, however not affected by the designation of the NTZ. The high estimated consumer surplus (high travel costs) exceeded similar sites in Europe; indicating the unique nature of the site.

In addition to use of TCM to value the benefits arising from an MPA, it is possible to use it to assess the demand for a particular recreational activity at a site. This approach can, for example, permit assessment of change in an activity following the implementation of an MPA and therefore an assessment of its value. Pascoe et al. (2014) took this approach to assess the impact of the re-zoning of Moreton Bay Marine Park (Australia) which reduced the availability of areas to fish for recreational sea anglers. The study concluded that despite reductions in recreational fishing areas and contrary to stakeholder expectation, economic benefits increased following the rezoning.

TCM has also been used at a network level, with a study in the UK using it to generate support for designation of the network of 127 rMCZ in England. Policy and Risk Analysts Ltd, et al. (2013) valued recreation and tourism using five case study sites. They calculated the average travel and parking spend for recreational sea anglers, recreational divers and wildlife watchers at each site and estimated the total recreational benefits based on these figures. This was then extrapolated across the rMCZ network to give a total expected recreational benefit and total expected tourism benefit for all 127 English rMCZs. Careful consideration was given to the assumptions and limitations of this work, but it is recommended that the full report be considered before these methods are applied elsewhere as extrapolation has inherent uncertainties.

Examples also exist where TCM has been employed to demonstrate the value of an unprotected area. This has occurred in the People's Republic of China, where Chen et al. (2004) determined the recreational benefits from a beach on the eastern shore of Xiamen Island. They concluded that the economic value of the beach supported the government's decision to declare 'tourism and recreation' to be the main function of the area. They also stated that should the government consider developing the area, disturbance and change would be expected to degrade the environmental quality of the area and could lead to a loss in value which would reduce visitor numbers. Therefore using TCM helped to illustrate the importance of protection of these areas to maintain economic benefits. Alberini et al. (2004) took a similar approach, valuing the consumer surplus from recreational angling in the Lagoon of Venice and comparing it to the surplus that could be expected if a 50 % improvement in catch rate were observed. They identified an increase in economic benefit and suggested that this was important for natural resource managers to consider in their policy decisions for the future of the Lagoon.

TCM is currently in use as part of the INTERREG IVA VALMER project whose broad aim is to examine how improved marine ecosystem service assessment can support effective and informed marine management and planning. Part of the approach included a TCM study in Poole Harbour, UK to attribute monetary values of cultural ecosystem services associated with recreational activities in the harbour (kitesurfing, windsurfing, bird watching, jet skiing, water skiing & kayak/canoeing). Results showed spend for the six groups on travel, accommodation, food and fuel, allowing those activities with high fuel spend e.g. jet skiing, to be fairly compared to others using travel, accommodation and food spend.[3]

In addition to those studies which use TCM as a direct method for evaluating the value of an MPA or recreational site, other studies have incorporated it as part of a larger assessment. Ruiz-Frau et al. (2013) used travel cost as one metric for their assessment of

[3] 'The 'VALMER' project was selected under the European cross-border cooperation programme INTERREG IV A France (Channel) – England, co-funded by the ERDF.' See: www.valmer.eu for more information.

the economic significance of recreational activities in Welsh waters to inform management plans. They assessed recreational scuba diving, sea kayaking, wildlife watching and seabird watching to determine the sites of most value in Welsh waters. Rather than using the TCM they incorporated the cost of travel into a calculation of the total cost of a trip (i.e. cost of food and drink, travel, accommodation and other auxiliary costs such as boat fees or gear rental) which allowed them to calculate the total annual expenditure associated with these activities. They concluded that the annual revenue in Welsh waters for recreational activities was between £21.8 and £33 million, and was similar to that generated by commercial fishing. Their results were used to highlight where potential user conflicts may occur as they could map the areas where economic benefit generated by recreational activity was greatest and compare this to areas where commercial fishing activity was greatest.

Rees et al. (2010) used the same approach, incorporating TCM into their analysis of the value of marine biodiversity to recreation and leisure in Lyme Bay, UK. Their study included interviews with recreational divers and sea anglers to determine the costs they incurred on visiting the area to undertake their activities and this contributed to the overall valuation of recreation within the site. The study concluded that recreation was very important to the area and was dependent on ecological diversity. Johnson et al. (2002) combined data on travel costs with environmental data such as water quality to estimate the consumer surplus associated with recreational activities in the Peconic Estuary System (USA). They then further combined their analysis with hedonic models (Johnston et al., 2001), wetland productivity analysis and a contingent choice modelling survey to assess the non-market value of the estuary system.

TCM is commonly combined with methods such as CVM to present a more holistic valuation of a site for recreational activities. Ahmed et al. (2007) undertook a study in the Philippines which used this combined approach. Their TCM study looked at valuing travel to the coral reef site at Bolinao, and found that visits were negatively correlated with income and travel cost, hence the site was most popular with those who lived in close proximity and had lower earnings. This, combined with the CVM study which showed a low WTP for reef quality improvements, suggested that there were other, better quality sites

which attracted those with greater disposable incomes and that more value was assigned to these areas at the expense of Bolinao.

Bhat (2003) used this approach to determine the non-market recreational benefits of reef quality improvements in the Florida Keys through development of a model. They determined that increasing the quality of the reef would result in a greater desire to travel to the sites, and therefore that the travel cost would increase, in particular in relation to the quality of the coral reef. Prayaga et al. (2010) combined TCM with the contingent behaviour method CVM, which allowed them to highlight the economic importance of recreational sea angling to the Great Barrier Reef Marine Park.

In the Welsh context, TCM has been combined with CVM in a study in Pembrokeshire to determine the impact that renewable tidal energy developments may have on visitor's enjoyment of the area (Voke et al 2013). They conducted interviews and used TCM to determine the amount people had paid to travel to the site to undertake activities such as nature watching, walking, beach use, water sports, and diving. They found that the amount people had spent to travel to the site exceeded the amount that they said they would be WTP to conserve the area as determined by the CVM study. The study concluded that only 3.5 % of visitors would not visit the site again if renewable energy developments were installed.

Park et al. (2002) combined TCM and CVM to assess the impact of water quality and reef health on recreational activities at a site in the Florida Keys, identifying high site fidelity amongst recreational users, and snorkelers in particular, suggesting that activities would not be restricted by increased access costs. They found that the combination of methods enabled them to generate a better understanding of the importance of these two variables to recreation as they differed in identifying critical variables. Nunes et al. (2004) also considered water quality, conducting a study incorporating both TCM and CVM methods to examine the effect of harmful algal blooms (HABs) on beach recreation, human health and marine ecosystems. Part of their study used TCM to determine the impact of HABs on recreational use of a site and they determined the economic loss that would be associated

with HABs closing the beach for one year and therefore preventing access for recreational activities.

The recreational activity for which TCM appears to be most commonly used is recreational sea angling. In addition to the studies already discussed (Alberini *et al.*, 2004; Pascoe *et al.*, 2014; Prayaga *et al.*, 2010; RPA *et al.*, 2013), Shrestha et al. (2002) also valued recreational sea angling, comparing 3 different approaches to the TCM in the Brazilian Pantanal, again for the purpose of highlighting the value of the activity from a resource management perspective.

Evaluation:

TCM has been widely applied to assessment of the economic value associated with recreational activities occurring in the marine environment. Its application to assessment of MPA success has been primarily in demonstrating the value of recreational activities to local economies, in particular, this is often to highlight the importance of recreational fishing in comparison to that of commercial fishing. The method is helpful for communicating the value of recreational activities provided by a site and the figures it produces are tangible and can potentially be powerful for stakeholder engagement.

There are many different methods for application of the TCM, with some involving the development of models which include different aspects of travel costs and other influencing variables to determine the economic value of a site. Where model development is required, the method is reasonably challenging, requiring mathematical and statistical knowledge, and an understanding of the specific location and potential variables. The main limitation of this method is the lack of consistency in its application which makes direct comparison between studies difficult. The main variables that may differ between studies are outlined below, with the lack of a universally accepted method making the method subjective and dependent on the opinion of the user. Development of any TCM studies must consider the following limitations and ensure that the study is as robust as possible for the data to be meaningful.

1. Costs associated with car travel - basic costs are calculated using miles from home and the cost per mile based on fuel consumption, but may also include factors such as differing levels of wear on the car. (2012), for example, calculated two different values, one based on fuel cost and tire wear and the second including service cost, replacement parts and tolls.

2. Costs associated with travel time – studies vary in their use of average annual wage. Some e.g. Castellini et al. (2009) use full average annual wage to determine travel cost, whereas others e.g. Chae et al. (2012) use a fraction of the full amount.

3. International travel costs – calculation of international travel costs is problematic. While the assumption is that the cost per mile will be constant this is not the case with air travel where there are often large fixed costs which often vary by origin meaning that the cost per mile cannot be standardised between origins (Carr *et al.*, 2003). Accurate calculation requires the consideration of individual journey costs rather than distance.

4. Multipurpose trips – these are most commonly associated with international visitors who are unlikely to have made the trip with the sole purpose of visiting one specific site. To address this it is necessary to determine the proportion of the time spent per visit undertaking the recreational activity in question. The travel cost can then be divided proportionately by the time spent conducting the recreational activity. For example, Du Preez et al. (2012) calculated the travel cost per tiger shark dive per visitor type, making the distinction between visitors who were South African nationals, and those that were overseas tourists, arguing that the purpose of the tourists visit would extend beyond that of a tiger shark dive. A second approach to this problem is illustrated by Chen et al. (2004) who determined that there were 6 potential sites that non-resident visitors could visit whilst in their study location, Xiamen Island, People's Republic of China, and they therefore used a prorating system based on visitor opinions to determine average travel cost per trip. They also calculated the costs if a round trip from the visitors place of residence or lodging on Xiamen Island to the beach, and summed these two figures, thus producing a total cost of travel to and from the island and travel within the island.

A further consideration is that of substitute sites. This is important as if the existence of other sites is not considered then it is assumed that all visitors to the site will place the same level of importance upon it, hence their travel costs reflect their affinity for the site. It is possible, however, that some visitors to the site will visit it only because there is no alternative; a lack of a substitute site. They may consequently feel no affinity for the site, but visit it only because it is the only location at which they can perform their recreational activities. It is therefore important that this is considered prior to conducting a travel cost assessment and factors such as the distance to substitute sites may be included. It is possible that there may be no feasible substitute site, in which case this does not apply, such as when the site in question offers a unique recreational experience, e.g. shark diving in Aliwal Shoal (South Africa) (Du Preez *et al.*, 2012). However, it is important that it is considered before a decision to include or discount it is made.

Studies which have used TCM have suggested that it is most useful when combined with other methods to provide a more holistic evaluation of a protected area. Castellini et al. (2009) for example concluded that it was a valid first step in assessing the social and economic benefits of protection but that additional value assessment was required to extend the assessment beyond recreational activities. If the limitations of the method can be overcome, and a robust method developed, then it appears that this method is appropriate for application across a range of sites, allowing easy comparison between them. This is, however, dependent on the assumptions made and these must be standardised across the sites studied. It is thought that TCM can be applied to the Welsh context without much need for adaptation. The underlying principles of the method could be applied to any location and any MPA so long as the assumptions were clearly stated.

Hedonic pricing

Description:

Hedonic pricing is used to estimate the economic value of BES that directly affect market prices and is most commonly applied to variation in house prices which reflect the value of local environmental attributes (Johnston *et al.*, 2001). The method is based on the premise that the value of a good will be related to its characteristics or to the services it provides. Therefore it can be valued by assessing how the price people are WTP for it changes as its characteristics change (Johnston *et al.*, 2001). In addition to its traditional use to evaluate the change in house prices (Fraser et al., 1998; Gopalakrishnan et al., 2011; Johnston *et al.*, 2001) it can be applied to other services where changes in value can be attributed to changes in quality of the service provided. Here, examples have been found for recreational fisheries (Dwyer et al., 1978), tourist accommodation (Hamilton, 2007) and tuna landings (Carroll et al., 2001; McConnell et al., 2000).

Examples:

Literature searching did not identify any examples where hedonic pricing had been used to assess MPA effectiveness. It is, however, thought that the principles would be applicable to assessment of MPAs and this is discussed in the evaluation following the examples.

Sea Food

McConnell et al (2000) used a hedonic pricing method to value tuna landings in Hawaii. They stated that as the price of an individual tuna is based on its characteristics, including species, size, fat content and type of handling, the same principles could be applied as are applied to hedonic housing prices. Similarly, Carroll et al. (2001) evaluated the factors that determine the price of US Bluefin tuna and concluded that the method was successful at providing information that could aid the management of tuna in US waters. The application of this method is potentially unique to the tuna market as its use is dependent on the running of the market, with Japanese buyers focussed on the quality of the tuna, hence the prices reflect the WTP for the quality attributes of individual fish (McConnell *et al.*, 2000).

Application to other sea food markets would rely on them having similar strict quality requirements, but it is thought that this could be developed if the factors driving the market prices were understood.

Waste Treatment

Leggett et al. (2000) used a hedonic pricing approach to assess the impact of water quality on property prices in Chesapeake Bay, USA. They calculated the potential benefits from a scheme to improve water quality and found that waterfront homeowners were WTP for improvements in water quality that resulted in a reduction in faecal coliform bacteria.

Coastal Erosion Prevention

Gopalakrishnan et al. (2011) used the hedonic pricing method to assess the value of beach erosion in North Carolina (USA). They developed a model in which the price of residential coastal property was the function of property characteristics, physical beach attributes, distance from the oceanfront, and width of the beach. Using the model they determined that residential property prices could fall by as much as 52 % if erosion rates tripled and the cost of sand for replenishment quadrupled, highlighting the importance of beach nourishment and erosion prevention.

Tourist accommodation

Similarly to valuing house prices, Hamilton (2007) used hedonic pricing to value tourist accommodation in Germany using the minimum price per night for a district and accommodation type, the attributes of the districts, and the attributes of the accommodation types. They determined that different coastlines accrue different accommodation types, and that open coasts accrue accommodation with the highest fees. Assessment of mitigation measures that would address sea level rise revealed that changes in the attractiveness of the coast would impact accommodation prices.

Aesthetic Information

Johnston et al. (2001), used hedonic pricing to estimate the amenity benefits of coastal farmland using the example of a town on the North Fork of Long Island (USA). They determined that where the value provided by a service is location sensitive there will be

observable impacts on house prices, and used the example of a view of coastal agricultural land to illustrate that while the views over farmland are desirable, the smells and noise associated with living in close proximity to farms are not. This concept could be applied in a similar manner to the coastal zone where the aesthetics of the view and seascape can impact house prices with the more desirable views commanding more expensive property prices.

Fraser et al. (1998) took a similar approach, using hedonic pricing to assess variation in the quality of residential land amenity of an ocean view between different sites. They formulated a linear equation which estimated the increment on sale price of property which was attributable to an increase in the quality of its ocean view. This provided a method which could guide decisions regarding development of residential housing. They suggested that the ocean view value could also be compared to the estimated value of land preservation when decisions were being made in the coastal strip.

Evaluation:

The methods used here may be applicable to assess MPAs since the premise of a change in quality of the ecosystem service provided may be the expected outcome from MPA designation. Traditional use of hedonic pricing to evaluate change in house price is perhaps most applicable to the BES of coastal erosion prevention. House prices can be related to the stability of the coastline, in particular to beach width and in turn MPAs can be used to enhance coastal protection through maintenance of seagrass beds, reefs and other wave attenuating features. Where the coastal zone is incorporated within an MPA they may also have dune maintenance functions.

Furthermore, the method may be applied to changes in house prices or accommodation costs due to the perceived benefits of MPAs through the principle of existence value and changes brought about by management restrictions which may have aesthetic benefits. In terms of recreation, tourism and leisure, fisheries may benefit through MPA implementation and the changes in quality of recreational fisheries and other services, and

it may also be possible to apply the method to fisheries landings as there is growing awareness that the quality of fish is an important determinant of price at fish markets (McConnell *et al.*, 2000). It is unlikely however to be easily applied to general markets and more likely to be applicable where quality is a driver for price.

Similarly to other direct valuation methods, hedonic pricing produces values which are tangible, hence they should be powerful for dissemination of MPA benefits and stakeholder engagement. Whilst this method may be appropriate for assessment of MPA effectiveness, there are some limitations associated with it which must be considered. For example, it relies on the assumption that people will be aware of the linkages between environmental attributes and the benefits that they experience (King et al., 2000) and consequently any value change can be attributed to the quality of the environmental variable rather than another, potentially unknown variable. Another assumption is that differences in quality will be reflected by differences in user experience (Dwyer *et al.*, 1978). This also presupposes that the user is aware of environmental considerations and that they have experienced different conditions to provide them with a benchmark to know whether the condition at a particular site is better or worse than at another.

Furthermore, due to its complexities, the application of this method requires a high degree of statistical expertise to develop a suitable model (King *et al.*, 2000), such as the empirical hedonic price function which links observed expenditure, area characteristics and use (Dwyer *et al.*, 1978). It must also be recognised that other factors may be influencing the change in value of the resources, such as inflation, or changes in market price which are unrelated to the marine environment. It may therefore not be possible for the observed changes to be confidently assigned to changes in the quality of resources. As with other methods, it is suggested that it is not sufficient to use the hedonic pricing method as a standalone means of evaluating MPA effectiveness, it must be combined with other methods to contribute to a full assessment of value.

Payment for ecosystem services (PES)

Description:

This method values the payments made to undertake actions that increase the quality and quantity of desired ecosystem services. It involves provision of incentives for people whose activities could or do cause damage or degradation to ecosystems. Direct but voluntary payments are given by beneficiaries to those providing BES to maintain or enhance service provision (Fujita et al., 2013; Smith et al., 2013). Therefore, the method allows a price to be put on the provision of services such as climate regulation, habitat provision and water quality regulation which might otherwise be un-priced (Smith *et al.*, 2013).

The underlying principle of PES is that it is voluntary, that it occurs where a well-defined ecosystem service is 'bought' by a minimum of one ecosystem service buyer from a minimum of one ecosystem service provider but only if the ecosystem service provider secures ecosystem service provision (Wunder, 2005). A second, less restrictive definition was developed by Muradian et al. (2013) who define PES as 'a transfer of resources between social actors which aims to create incentives to align individual and/or collective land use decisions with the social interest in management of natural resources', and it is argued that this definition is better suited to the wider implications of PES and a number of different socio-economic conditions (Lau, 2013).

One key factor is that a PES transaction can only occur if a benefit is caused to occur where it otherwise wouldn't (Forest Trend et al., 2010). It is essential that a baseline is established to determine the level of ecosystem service provision in the absence of the PES scheme in order that its success can be measured. PES relies on WTP, as the value of an ecosystem service here is determined by what the buyer is WTP for it and what the seller is WTA as its value (Forest Trend et al., 2010).

Examples:

This approach has been more commonly used to date in terrestrial ecosystems, and is for example useful in flood prevention, where householders and business owners may be prepared to pay for the establishment of a new woodland to reduce flood risk (Smith et al., 2013). It is less common in the marine environment where opportunity costs are higher and direct ownership of resources uncommon (Fujita et al., 2013). Whilst many papers mention and discuss the use of PES in the marine environment, few examples were identified. It is, however, thought that the method could be applied to services such as shoreline protection, habitat conservation and carbon sequestration. Lau et al. (2013) present a framework based on carbon sequestration, coastal protection, fish nursery habitat, water purification and marine biodiversity which can generate PES. Development of methods to allow this are, however, in development, and numerous challenges exist that need to be overcome before PES can become an established method for conserving ecosystem services.

Sea Food

Binet et al. (2013) assessed whether the European Union-Mauritania fisheries agreement which allocates a financial contribution from Europe to the conservation of marine ecosystems within a National Park could be considered as a PES scheme. They concluded that it could, providing a value for the conservation of the ecosystem and support for biodiversity conservation and the reconnection of fisheries and MPAs in the area.

Climate Regulation

Due to the existence of markets for carbon, Lau et al. (2013) hypothesised that payment for carbon credits may become established in the short term, allowing valuation of habitats where carbon storage is a key service. This approach could therefore be applied in the marine environment where carbon storage occurs such as the deep sea, seagrass beds and mangroves. Albert (2012) conducted a study in the Solomon Islands to determine the value of PES schemes for mangrove ecosystem services, particularly carbon stocks. They

identified a direct economic benefit and determined that PES can provide a valuable incentive for the protection and sustainable use of mangrove forests.

Biological control

Barr et al. (2009) used CVM to investigate the potential for development of PES in La Paz, Mexico. They calculated tourists WTP to reduce fishing pressure in an MPA and the fishers WTA compensation to cease fishing and engage in alternative employment. They calculated the costs and benefits of the scheme and determined that the money required to compensate the fishers for the introduction of the scheme was greater than the amount the tourists were WTP, highlighting the complexities of implementing such ideas. They concluded that PES schemes can provide a mechanism for some movement out of the fishing sector into other sectors, thus reducing fishing pressure and providing some ES benefits through fisheries replenishment.

Evaluation:

PES is not yet a well established method in the marine environment. Its application is less straightword than in terrestrial environments due to the lack of property rights (Binet et al., 2013). In terrestrial environments, the obvious recipient of PES would be the landowner (Fujita et al., 2013), but in the marine environment this is harder to determine, especially when considering areas distant from the coast or on the high seas. PES is also more commonly used as a management measure in its own right than as a method to assess the socio-economic impacts of an MPA. For instance, the establishment of an MPA can be a method of PES implementation, such as the case of Chumbe Marine Park (Tanzania), where land was purchased and financed by users for conservation reasons. Another example, is the establishment of a fisheries cooperative to enable better management of stocks and reduce unsustainble harvest (Forest Trend *et al.*, 2010; Lau, 2013).

Muradian et al. (2013) concluded that PES will only be applicable in some situations. For a scheme to be successful it needs to be cost effective, culturally acceptable and equitable, and if this is the case then it has the potential to achieve sustainable resource

management, poverty alleviation and clarification of use and access rights among other things (Lau, 2013). For PES to be used to value the socio-economic benefits provided by an MPA it would require a scheme to be in place or to be introduced, such as incentives for fishers to adapt their fishing habits to enhance the conservation benefits of an MPA. If such schemes were in existence then the PES values could be used as part of a wider assessment of the value of an MPA. It is however, suggested that it forms one of a number of tools used for management and the valuation of ecosystem services

Welsh Context

Usefulness and scale

Workshop participants felt that revealed preference methods could be of useful for assessment of MPAs in a Welsh context. These methods rely on data that should be accessible and are relatively easy to undertake. Furthermore, the values provided are real figures and are therefore tangible and more accessible to policy makers. Market values are often ‘headline grabbing’ and it was felt that this could be useful and appealing for publicising the value of MPAs in Welsh waters. The participants also recognised the need for transparency for appropriate caveats that must accompany such monetary figures so that they can be understood and interpreted correctly.

In particular TCM and market values/market prices were favoured as most relevant to the Welsh context and most appropriate given the data available. Whilst both methods require some stakeholder engagement, they are less reliant on primary data collection (via questionnaires and interviews). Instead they utilise secondary data sources, making them more appropriate in situations where budget restrictions limit the amount of primary data collection that is possible. Existing data sources were identified and the potential advantages, disadvantages, and limitations of each were discussed. The scale at which each method was appropriate was thought to depend on the activity and site in question. However participants believed that providing some site specific and pan-Wales level values would be beneficial for all methods. The values would need to be set into context at a site specific level, but it was thought that developing methods at some case study sites

would be a good first step. The surveys could then be extended, and the benefits transfer approach could be used where appropriate for scaling up the valuations to a regional or national level.

The greatest limitations associated with the revealed preference methods were perceived to be data availability and interpretation of existing data. A common concern amongst workshop participants was how to determine the value arising specifically from an MPA rather than a broader site when using pre-existing data that has been collected for a different purpose. This was discussed, particularly in the context of fisheries landings data. Participants were concerned about how landings data from an area with an MPA could be linked back to the reef that was protected by the MPA. This is an important consideration for promoting the economic benefits of MPAs and if such links were possible then there would be opportunities for added value through marketing associated with fish sales. Participants also identified that the lack of existing studies providing examples relevant to the Welsh context makes development of methods for Wales difficult. Furthermore, as the MPAs are already in place it makes it difficult to assign benefit as it is not possible to make before and after comparisons.

Sources of relevant evidence:

The available data sources and aspects of the discussion that relate to particular methods are outlined below.

Market value

Participants could see the value of assessing MPAs using the market price approach. It was thought that, in principle, it could be most easily assigned to fisheries data. However, in the Welsh context this is limited by access to landings statistics. Welsh fisheries are predominantly shellfish, prawns and flatfish in estuaries and participants felt that fisheries data would be more applicable to these sectors of the fishing community which are particularly important in Wales. Aquaculture is also an important aspect of the fisheries, with the mussel farm in the Menai Straight the largest in Europe and other fisheries for

oysters in place around the coast. Participants were also keen to include added value through assessment of the supply chain. Discussions included how to determine the landings value for catches that could be specifically attributed to an MPA, such as evidence for 'fishing the line'. It was felt that any statistics should be supplemented by interviews as limitations exist within the data. Limitations include: catches not being landed at local ports, a lack of reliable estimates of fishing effort and the need to pair value of landings with cost data to provide a realistic estimate of fisheries value. Overall, data do exist to allow fisheries to be value, but careful interpretation will be required to ensure that data are representative.

Some participants were more hesitant about including valuation of fisheries activities. They felt that MPAs ought to be no take zones and therefore publishing information about the fisheries benefits of MPAs might provide the wrong message. Another concern was that fisheries only attribute a small percentage to the welsh economy and therefore attention should be focussed on valuing activities such as tourism which contribute a far higher percentage. The importance of fisheries from a social perspective was however, appreciated, which highlighted the importance of using other methods for assessment.

In addition to fisheries, a number of other BES were identified which may be able to be valued, for example: other extractive uses for food, aggregates (where these are extracted from within an MPA) and renewable energy where installations are located within an MPA.

Data sources that were mentioned include:

- FishMap Mon for spatial fisheries data and recreational fishers data around Anglesey.
- Fisheries landings data, by ICES rectangle for large boats and at port/harbour level for small boats.
- Value of saltmarsh lamb from Hybu Cig Cymru.
- Other extractive uses which could be valued include algae collection for laverbread, seasalt (Halen Môn), and marsh samphire.

- Data from Bangor University which might include scallop density within and outside MPAs.

Avoidance cost

Participants did not identify many instances in which avoidance cost methods would be of use in a Welsh context. However, they did feel that it would be very useful for assessing the value of natural coastal defences, including salt marshes, seagrass beds and mud flats. Previous studies have determined the amount of the Welsh coastline which is protected using hard coastal defences and how much is natural. Data on how much it costs per square meter for different types of hard deference is therefore available. It should therefore be feasible to determine the cost of coastal protection in the absence of the natural defences.

Calculation of restoration costs might also be possible for features such as biogenic reefs, including horse mussel *Modiolus modiolus* reefs, oyster beds and maerl beds. Participants thought that valuing the restoration or avoidance costs related to activities such as trawling would be beneficial. Current studies being undertaken at Herriot Watt are focusing on assessing the ecosystem services provided by *M. modiolus* beds; which may be highly applicable to MPA assessments. A third area discussed under use of the avoidance cost method was that of avoidance of infraction costs. Participants felt that this would be a very powerful value for Welsh government; for exhibiting the value of MPAs in Wales. These methods are thought to be relevant both on a pan-Wales and local scale. Small scale values would be applicable for management decisions that are site specific e.g. cost benefit analysis for managed realignment. However, pan-Wales values would also be valuable to show the benefits arising from the MPA network.

Travel cost method

Participants felt that TCM was a valid approach to valuing recreation and leisure in Wales. Many data sources already exist which may be useable, but the concern was that they are unlikely to include all the necessary data and this could require quite a large sampling effort in order to produce meaningful data.

One of the greatest concerns was whether the method required visitors to have visited the site because they knew that it was an MPA for the value of their trip to be considered representative of the value of the MPA. Discussions suggested that regardless of whether they knew the MPA existed, they were visiting the area to engage in specific activities. Therefore, they were still gaining benefits from the site; so their visit should not be discounted. This is something that would have to be considered in the development of a TCM study and a question would need to be included to determine what percentage of respondents were aware of the existence of an MPA.

Participants thought that this method was more site specific, but that it would be possible to take a case study approach and where appropriate use benefit transfer. In some instances it will be most appropriate at the feature level of a site; For example, features such as dolphins, or reefs that are specifically targeted by divers which attract visitors rather than the site as a whole. Skomer Island was suggested as a case study example for this method, as visitor number records go back 30 years and it is a well-known MPA.

Data sources that were mentioned include:

- Tourism data from local authorities and Welsh Government.
- National park visitor data.
- Cetaceans watching data – study on the economic value of dolphin watching in Cardigan Bay.
- Wildlife watching data from Cardigan Bay which is available through the boat licencing work.
- Fishmap Môn for recreational angling spatial data.
- Pembrokeshire Recreational Database.
- Pembrokeshire Coast National Park visitor data.
- Anna Ruiz-Frau PhD Thesis from Bangor University.
- Coastal path usage statistics.
- 3 Angling reports.
- Coastal and marine valuing the environment report.

Hedonic Pricing

Participants were hesitant about how useful this method would be. They identified that the existence of an MPA may impact house prices or the cost of tourist accommodation as it may prevent development of things such as wind farms. However, they were unsure how easy it would be to attribute changes in price between areas to the existence of an MPA. It was thought that there were too many potential confounding factors for the results to be meaningful and useful in a Welsh context. It may have more value in the future when MPAs are more established and well known, but for the meantime it was thought that it was unlikely to be as valuable as other methods.

Payment for Ecosystem Services

Participants did not think that this method would be as useful as others in a Welsh context; mainly because it requires an existing PES scheme. However, saltmarsh lamb might provide an opportunity to explore the method as it sells for a premium. Many farms which produce it are located on protected saltmarshes where incentives are in place for farmers to maintain them. Data should be readily available from the Welsh government for this. Participants also mentioned that this may work if any visitor payback schemes exist, such as contributions made as part of a wildlife watching trip. Considering this, the method may provide useful in a Welsh context; but is much more specific. It would mainly be used to address the provision of certain BES resulting from specific activities.

3.1.3 Stated Preference Methods

Stated preference methods are a form of valuation that aim to elicit an individuals' passive or non-use value for a natural resource. The methods utilise surveys, interviews or questionnaires to create a hypothetical market or choice scenario in order to estimate the value that an individual places on a non-market commodity. Stated preference methods may provide both quantitative and qualitative values depending on how the individuals' preference is captured. Stated preference indicators may be monetary values, the results of a vote or preferential ranking, or the results of market type choices (Holland et al., 2010). The two main types of stated preference methods are contingent valuation and choice modelling. Stated preference methods are well suited to input into decision support tools (e.g. cost benefit analysis) and MPA modelling tools that link the management of the environmental resource to the effects on the production of a BES (e.g. production function models).

Contingent Valuation Method

Description:

The Contingent Valuation Method (CVM) makes use of questionnaires to construct a hypothetical market for a non-market commodity of interest. Respondents to the questionnaire are generally presented with a scenario (or series of scenarios) on a hypothetical change in policy where the good or services which they desire will be affected. Respondents are then asked what they would be WTP to obtain the good or service or what they may be Willing to Accept (WTA) in exchange of being deprived of it. Values are provided in monetary terms.

Examples:

General CVM studies with an application to value BES

CVM surveys can be used to value areas (e.g. a National Park), particular habitats (e.g. wetlands) and particular species (e.g. whales). Surveys are often targeted at the general public. By default it could be considered that all ecosystem service benefits received from the resource are valued even if they are not specified. Such studies may be useful to understand the overall value of a resource. However, as no particular ecosystem service benefits are specified the individual ecosystem service benefits cannot be disaggregated for use in a cost benefit analysis (Willis et al., 1995). For example, inhabitants of the Philippines were asked how much they would be WTP towards a conservation trust fund to conserve the marine park for future generations. Results were then used to assess alternative funding for the Philippines marine conservation programme e.g. a local tax or entrance fees (Subade, 2005). CVM surveys can also be used to value a particular habitat. In New South Wales, Australian households were surveyed for their WTP for wetland conservation (Streever et al., 1998). Additionally, residents and visitors to St Vincent and the Grenadines in the Eastern Caribbean were invited to provide a WTP for an 'improved' scenario of MPA protection and a 'decline' scenario in which MPA protection is reduced. A choice experiment was used to further this valuation to specific ecosystem services via a series of deliberative valuation workshops (Christie et al., 2012).

For species that may be associated with MPAs, CVM studies can be used to elicit a WTP for their protection. Such surveys are often targeted at the general public with regard to charismatic species such as whales, seals, dolphins. Three examples of such studies are (1) asking the public's WTP to increase the population of grey whales in California, USA (Loomis et al., 1994) (2) asking the public's WTP to avoid increased levels of species loss and/or a reduction in species richness at three case study sites; The Azores, Portugal, Gulf of Gdansk (Poland) and Isles of Scilly (UK) (Ressurreicao et al., 2011; Ressurreicao et al., 2012); and (3) asking the public's WTP for marine turtle conservation in Asia (Jin et al., 2010). In Florida (USA) households were asked their WTP to protect manatees. The study found that the benefits of manatee protection (largely generated by eco-tourism) greatly

exceeded the development benefits where manatee habitat would be lost (Solomon et al., 2004). In the USA respondents were asked to provide a WTP a one off tax to provide a fund to protect peregrine falcons and shortnose sturgeons, both endangered species (Kotchen et al., 2000). Similarly in California (USA), a CVM mail survey was administered to determine the public's WTP to support recovery plans for endangered species (Stanley, 2005).Giraud et al (2002) examined the US public's WTP to protect the Stellar Sea Lion via higher taxes. Finally, in Canada, respondents to a WTP survey stated that they would be WTP more towards conservation programmes that contribute to a greater increase in marine mammal populations (Boxall et al., 2012).

The following sections provide examples of how CVM valuations can be applied to value individual ecosystem service benefits:

Sea Food

As with the CVM surveys that capture the public's WTP for habitats and charismatic species. The same method can be applied to MPAs, habitats and species with a particular focus on the links with the provision of sea food. For example Hall et al (2002) applied a CVM survey to determine how much visitors were WTP to provide effective enforcement and management of the MPA to avoid coastal ecosystem decay of the rocky intertidal zone at an MPA in California (USA). In this case study the coastal ecosystem decay was attributed to the collection of marine organisms by both licenced and non-licenced fishers and visiting school groups.

In terms of specific species, residents of Oregon, USA were asked what they would be WTP for salmon recovery programmes (Montgomery et al., 2006). A CVM survey has also been used to estimate the existence value of the Edible Sea Urchin to help design schemes and incentives for future conservation policy (Matsiori et al., 2012). Consumers WTP for Marine Stewardship Council certification for lobsters from the Maine fishery, USA was assessed by Goyert et al (2010). Results were used to evaluate whether the costs of the Maine lobster fishery certification were worth the presumed benefits. As part of this study lobster industry members were also interviewed to learn their opinions of MSC certification. Seafood consumers were surveyed to understand their attitudes and

purchasing preferences related to lobster and lessons learned from other MSC-certified fisheries were compiled (Goyert *et al.*, 2010).

Fisheries within an MPA can also be valued. For communities that have a strong connection with the land CVM surveys can provide a 'bequest' value which is a value that current generations put on being able to pass on the environment in a similar state to future generations. In this example a bequest value was sought from local users of the traditional fishing grounds of the Coral Coast, Fiji (O'Garra, 2009). In the Bicol Region, Philippines local residents' were surveyed as to their willingness to work (WTW) and WTP for the continued existence of the San Miguel Island (SMI) fishery reserve. A major constraint of the effectiveness of the reserve was considered to be the enforcement of MPA and fisheries regulations. The study combined WTW with WTP to assess the use of voluntary labour to support enforcement efforts as a MPA management measure (Casiwan-Launio et al., 2011). Thus, providing a value of the sea food benefit from the MPA.

Disturbance Prevention and Moderation

A CVM survey was conducted in the State of Mississippi (USA) to estimate WTP for restoration options being considered for the state's barrier islands. It was found that coastal residents and those citing storm protection, recreation impact, and environmental impact as primary decision factors, were more likely to support restoration (Petrolia et al., 2008).

Waste Treatment

Although not applied to an MPA, a study by Loomis et al (2000) applied a CVM method to determine whether households within a river catchment were WTP for an increase in the ecosystem services associated with improved water quality: dilution of wastewater, natural purification of water, erosion control, habitat for fish and wildlife, and recreation via an increase in their water bill that would pay for management initiatives necessary to increase the level of those ecosystem services.

Coastal Erosion Prevention

The presence of sand dunes in preventing coastal erosion was studied by Lindsay et al (1992) when coastal beach visitors were asked how much they would be WTP for a beach erosion control programme in Maine and New Hampshire, USA. Additionally, Loomis et al (2000) applied a CVM study to determine whether households within a river catchment were WTP for an increase in the ecosystem services of erosion control (Also see Waste Treatment).

Lifecycle maintenance

Loomis et al (2000) applied a CVM study to determine whether households in a river catchment were WTP for improved waste treatment, in order to increase the ecosystem services of habitat for fish and wildlife.

Recreation, Leisure & Tourism

CVM surveys are popular to value those in the recreation and leisure sector's WTP to continue to use a resource. For example, in Mu Ko Similan Marine National Park, (Thailand), scuba divers were asked how much they would be WTP to scuba dive in the Marine National Park. Results of the survey were aimed at improving management policies for the park to prevent deterioration of the resource (Asafu-Adjaye *et al.*, 2008). Recreation anglers have also been targeted in CVM surveys. In Loreto Bay National Park, (Mexico) anglers were asked how much they would be WTP to enter the park. The increased funds were proposed to be used to support management measures that protect the areas ecosystems from habitat destruction and over exploitation (Stamieszkin et al., 2009). In North Carolina (USA) anglers were asked how much they would be WTP for a saltwater recreational fishing licence (Whitehead et al., 2001). In Hatteras (USA) recreational anglers were also asked what they would be WTP for more restrictive management scenarios for Bluefin Tuna in order to aid stock recovery (Stoll et al., 2006). In South Africa recreational anglers were asked how much they would be WTP for a fishing permit that supported stock enhancement programmes for the Dusky Kob (Palmer et al., 2009). In Sweden recreation anglers were asked how much they would be WTP for improved cod stock via a tax or licence fee (Olsson, 2004)

Although not an MPA example WTP surveys could also be used to value MPAs in terms of stock enhancement for recreational users. For example, in Hawaii (USA), recreational anglers were targeted for a CVM survey to determine their WTP for increased catch rate resulting from a subsidised stock enhancement programme (Cantrell et al., 2004). Rudd et al. (2002) determined the value of a single species, the Nassau Grouper to the dive industry in the Turks and Caicos Islands. This was based on the premise that the Nassau Grouper held particular attraction to divers and it was calculated that they were WTP on average US$10 more a dive when they had observed larger or more abundant Nassau Grouper than when they had not. The results of the study were used to highlight the value and conservation importance of this species which is often targeted by commercial and artisanal fishers.

CVM surveys have been used at a number of marine parks to value the recreational benefits of coral reefs. In Buccoo Reef Marine Park (Tobago), respondents to a survey were asked how much they would be WTP to prevent further deterioration to the quality of the reef. Results of the WTP survey were used to estimate a consumer surplus (the additional value that protection of the reef would potentially generate) (Brown et al., 2001). Similarly in the Florida Keys marine reserve the non-market value of the recreational benefits of reef quality improvements was measured using both CVM and TCM (Bhat, 2003). Snorkelers in the Florida Keys marine reserve were also subject of another study focusing on WTP to preserve the current water quality and health of the coral reefs. The results showed that snorkelers may not shift expenditures to other sites or other recreation activities in the Florida Keys when confronted with an increase to access costs to continue to benefit from the snorkelling experience (Park *et al.*, 2002).

Divers and snorkelers visiting MPAs in Malaysia were targeted to determine if they would be WTP an increased entrance fee in exchange for management measures that would permanently limit the number of people allowed to visit the MPAs in order to reduce damage to the reef (Ahmad et al., 2009). Tourists arriving by both cruise ship and aeroplane were targeted in Bermuda to determine their WTP additional expenses to fund activities to preserve Bermuda's coral reefs. Results of this survey were combined with other economic valuation tools to provide a Total Economic Value for Bermuda's coral

reefs (Sarkis et al., 2010). Divers and snorkelers using reefs in Hawaii were interviewed regarding their WTP for coral reef management along with their travel and holiday costs to provide a non-use benefit valuation for the overall welfare value of Hawaii's coral reefs (Cesar et al., 2004). In the Bonaire National Marine Park, (Netherlands Antilles) scuba divers' were asked to provide a WTP for access to quality recreational coral reef sites. The findings indicate that the current annual diver user fee in effect at the time of the study could be increased substantially without a significant adverse effect on island tourism (Thur, 2010; Uyarra et al., 2010).

In the Lingayen Gulf, Bolinao (Philippines) tourists were asked what they were WTP (in absolute terms and as a percentage of income) for the conservation of coral reefs at Bolinao to support public investment for the conservation and management of the reefs (Ahmed *et al.*, 2007). At Whale Island (Vietnam), a survey was undertaken to determine tourists WTP extra to stay at 'Hotel Managed Marine Reserves' (Svensson et al., 2008).

Non coral reef examples of CVM surveys with the leisure and recreation sector include the valuation of wetlands in the Hara Biosphere Reserve (Iran), where the value of mangrove forests was determined using a CVM survey to ascertain tourist's WTP for ecotourism initiates (Dehghani et al., 2010). In the UK visitors to Eastbourne Beach were asked what they would be WTP for a day ticket to use the beach. Results of the study were used to assess the economic benefits of improved water and beach quality associated with the prevention of oil pollution (King, 1995).

Species specific CVM surveys target tourists WTP for the protection of a species via ecotourism initiatives (Stithou et al., 2012; Tisdell et al., 2001). For example on a CVM survey of visitors to the Great Barrier Marine Park (Australia) was undertaken to determine their WTP for a '100% guaranteed sighting' of several different marine species (Farr et al., 2013). In Crete (Greece) visitors were asked for their WTP for two policies that would support conservation measures for a loggerhead turtle nesting ground via an accommodation tax and MPA entrance fee (Jones et al., 2011). Finally, at Ningaloo Reef (Australia), surveys were undertaken to determine the willingness of participants to pay for their whale shark experience (Davis et al., 1999).

Such studies within the recreation and leisure sector have been useful to MPA managers to determine the potential for user-based funding mechanisms by charging entrance fees or local taxes to support conservation management (Arin et al., 2002; Asafu-Adjaye *et al.*, 2008; Bhat, 2003; Dharmaratne et al., 2000; Edwards, 2009; Gelcich et al., 2013; Mathieu et al., 2003; Peters et al., 2009; Ransom et al., 2010; Thur, 2010; Togridou et al., 2006; Tongson et al., 2004; Wang et al., 2012).

Recreation and leisure can be valued in terms of what people are WTP to protect the ES benefits from adverse impacts. In the Netherlands, the leisure and recreation industry have been targeted for CVM studies to determine the value people place on protection from harmful algal blooms originating from ballast water from ships. A joint TCM and CMV survey was used to determine the non-market benefits associated with beach recreation, human health and marine ecosystem impacts. The results of which were used to influence port authorities to impose stricter ballast water standards (Nunes *et al.*, 2004).

Like user based funding mechanisms another valuation mechanism of the CVM survey is to linking the provision of ecosystem services with a utility bill. For example households living with an Platt river catchment were asked how much they would be WTP in order to receive an increase in the benefits from the ecosystem service of leisure and recreation (Loomis *et al.*, 2000). The results show that households were indeed WTP for the increased costs associated with conservation programmes necessary to receive those benefits. Similarly, households in Mar Maenor (Spain) were surveyed to determine their WTP to receive increased ecosystem services from the coastal lagoon if point and diffuse pollution protective measures were put in place. (Perni et al., 2011).

Aesthetic information

To aid the management of seascapes a CVM study was used in the Jurien Bay Marine Park (Australia), to estimate aspects of the social value of these seascapes. The results show a positive net WTP to maintain seascapes in their current condition. Seascapes with coastal views had the highest social value; closely followed by ocean seascapes. Such valuations were used to influence policy that conserves such seascapes (McCartney,

2006). A CVM and TCM method was combined to assess the value of the marine environment around St David's (Wales) to assess the impact of marine renewable energy projects. The CVM survey asked respondents WTP to conserve the area. The results show that the majority of respondents were WTP a contribution to keep the area maintained at its current standard (Voke et al., 2013).

Evaluation:

The use of CVM to inform policy choices has increased over the last three decades as the methodology has been tested in both applied and academic work (Holland *et al.*, 2010). From the examples provided in this section it can be seen that CVM surveys have been used to value MPAs and general ES benefits they provide. Specifically they can also be used to value WTP for selected ES benefits e.g. sea food. Overall it is the recreation and leisure sector that are predominantly targeted for CVM surveys as the opportunities to continue to enjoy marine leisure and recreation pursuits often depends on the quality or state of the resource.

The main advantage of CVM is its capability for estimating non-use values. It is the only existing method that directly asks respondents to state their WTP or willingness to accept (WTA) for (hypothetical) changes in environmental quality or quantity. It is also is a very flexible valuation tool that can be applied to a number of ecosystem service benefits. Results of CVM surveys with the general public can be used to justify increasing the extent of publically supported protected areas and providing larger budgets for management (Dixon et al., 1991). In fact CVM surveys have increased policy makers appreciation of the asset value of recreation and has been one of the main justifications for (1) the receipt of further public funding for MPA management (Bhat, 2003) and (2) implementing user based charges to support conservation efforts (Asafu-Adjaye *et al.*, 2008).

In many of the case studies cited in this section the CVM survey results do not stand alone. CVM is combined with other valuation methods such as TCM (Ahmed *et al.*, 2007; Park *et al.*, 2002; Peters *et al.*, 2009) and attitude and behaviour surveys (Goyert *et al.*,

2010; Kotchen *et al.*, 2000). CVM surveys often provide a distinct value for part of a much broader ecological, social and economic assessment (including choice experiments, multi criteria analysis, stakeholder interviews and focus groups) to inform MPA management e.g. (Brown *et al.*, 2001; Stamieszkin *et al.*, 2009).

The disadvantages of CVM are both theoretical and practical. Some would argue that CVM surveys are reductionist in character where by opinions, beliefs and behaviour are condensed into a number (Ledoux et al., 2002). Elicited CVM values can also be considered meaningless as hypothetical answers to hypothetical questions are produced often with little relevance to the practical complexity of policy situations (Cummings et al., 1997). Some participants may also refuse the suggested scenarios on moral, ethical or practical grounds leading to a 'protest response' and a zero value applied. It is then up to the researcher to decide if this interpreted as a valueless answer. It has been shown that the values provided by participants can be influenced by wider economics and the demographics of the sample group (Montgomery *et al.*, 2006). Participants may also be motivated to provide strategic or untruthful answers if it is in their interest to do so (Holland *et al.*, 2010).

Criticisms of CVM lie mainly in the design and implementation phase. As surveys and questionnaires are predominantly used as the method by which data are collected there are potential issues with survey bias influencing preference based decisions. For example, the WTP values can be affected by the a coercive interview or influenced by a need to 'please' the interviewer (Hall *et al.*, 2002). Rigorous survey design and testing can go some way to reducing survey bias. As CVM surveys have become influential in informing policy choices many government organisations have issues guidelines as to how CVM surveys should be undertaken to reduce bias (Arrow et al., 1993; Pearce et al., 2002).

It has also been shown that stakeholders at different spatial scales can have very different interests in ecosystem services. Therefore the spatial scale of the ES at which the surveys are targeted is important to support conservation planning and management (Hein et al., 2006). Unless the survey is specifically targeted to define the ES and the special scale to which those ES relate then there is a risk of aggregation and double counting of values

(Ledoux *et al.*, 2002). From a practical angle CVM surveys are considered to be both resource and time intensive and the analysis of the data requires specific econometric expertise.

Choice modelling

Description:

Choice modelling (CM) is an economic valuation approach that uses surveys to present policy options (e.g. proposals for management of an MPA) as a collection of policy attributes (such as BES). Respondents are invited to make a choice between different combinations of the options and attributes or rank their preference for different combinations. To provide an economic value, each configuration of options and attributes has an associated price which indicates a WTP for the choice or WTA compensation for costs associated with that choice. CM is also referred to in the literature as choice experiments.

Examples:

General choice modelling studies with an application to value all BES

Like CVM surveys, CM can also be used to value areas (e.g. a National Park), particular habitats (e.g. salt marshes) and particular species (e.g. sea lions). Surveys are often targeted at the general public. The key difference though is that CM enables a range of policy options to be considered, with a corresponding WTP. Again, such experiments consider that all of the BES received from the resource are valued even if they are not specified. Such studies may be useful to understand the overall value of a resource. However, as no particular BES are specified, the individual BES cannot be disaggregated for use in a cost benefit analysis (Willis *et al.*, 1995). For example, in terms of the value of all the benefits provided by a network of MCZs, a CM experiment to determine the non-market BES derived by UK residents from the creation of MCZs was undertaken by McVittie et al (2010). The UK public were asked to choose between various levels of

attributes linked to biodiversity, BES and restrictions on resource extraction and development. The payment vehicle was presented as an annual tax payable per household. The results revealed that the UK public show a preference for both halting the loss of, and increasing, marine biodiversity. Respondents also prefer to maintain the provision of BES though were indifferent to the levels of restrictions on activities needed to achieve these outcomes (McVittie *et al.*, 2010). Based on the aggregate median WTP over a 20 year time horizon the non-market benefits of marine conservation are worth £16.6billion to the UK public. A figure that is considered to outweigh the cost estimates of implementing MCZs (McVittie *et al.*, 2010).

In a Welsh example, a CM experiment was used to determine how much society was WTP for a network of MPAs in Wales (UK). Questionnaires were used to determine preferences for the attributes of MPA location, size of the network, levels of protection, the proportion of areas with different levels of protection and the economic cost associated with enforcing protection payable via an annual contribution to a neutral charity. The results show that the public had a positive and supportive attitude towards MPAs, particularly favouring Highly Protected Marine Reserves combined with adjacent areas with differing levels of user access (Ruiz Frau, 2010). Overall, the annual costs for managing and enforcing MPAs in Wales is considerably lower than the public's WTP for welsh MPAs per year (Ruiz Frau, 2010). In Scotland, a CM survey asked Scottish households WTP for additional MPAs in the Scottish deep-sea that would protect deep-sea species and maintain the option-use value of deep-sea organisms as a source for future medicinal products. The payment vehicle was presented as an additional household tax per household with choice attributes related to deep sea fishing and the oil and gas sector. The results show that Scottish participants supported the idea of deep-sea protection despite limited knowledge of the resource (Hanley et al., 2013).

CM experiments have also been used to value MPAs or areas of conservation. For example, CM experiments have been used to determine the value of protecting the Great Barrier Reef (Australia). CM experiments focussed on the public's WTP for management scenarios (e.g. increases conservation zones, improvements to water quality and reduced greenhouse gas emissions). The public's WTP was measured using increased taxes or a

higher payment for BES that utilise the marine resources and impact on the reef. The results showed that the public favoured increased protection. The values that they were WTP varied for each policy option (Rolfe et al., 2010). Similarly, a CM experiment was used in Gocek Bay (Turkey) to determine tourists and visitors WTP for a series of environmental investments that would improve water quality and restore the marine ecosystem (Can et al., 2012). Communities living close to the Ningaloo Reef marine park (Australia), were asked to provide a WTP value that would payable as an environmental levy on general income for management measures that would influence ecological attributes (e.g. coral cover, fish stocks, marine turtles and whale sharks) The results showed that respondents indeed have a preference for management that impact upon conservation and that they are WTP for the changes (Rogers, 2013). Residents and visitors to St Vincent and the Grenadines in the Eastern Caribbean were invited to provide a WTP for an 'improved' scenario of MPA protection and a 'decline' scenario in which MPA protection is reduced. A CM experiment was used to further this valuation to specific ecosystem services via a series of deliberative valuation workshops (Christie *et al.*, 2012). In Malaysia, two studies have focussed on valuing MPAs via CM experiments that analyse visitors WTP for scenarios of ecotourism initiatives that subsequently support MPA conservation (Yacob et al., 2009a; Yacob et al., 2009b).

CM has also been used to value specific habitats associated with MPAs, in order to derive an economic value for a diverse array of ES benefits. For example, a CM experiment was carried out in the UK to determine whether the public derived an economic benefit from sustainable management of Severn Estuary wetlands. Respondents were presented with a series of wetland management programme attributes and a related cost presented as a one off payment towards water bills. Results showed that the public placed the highest value on the creation of habitat for otters and they were willing to trade-off between the use of water for sustainable management of the wetland against jobs reliant on irrigation e.g. farming (Birol et al., 2007).

Similarly, in the Shadegan International Wetland (Iran), a CM experiment was used to value the nonmarket attributes of a wetland. The results show that the majority of respondents were WTP to improve wetland conservation with the ecosystem service of

water quality considered to be the most highly valued attribute (Kaffashi et al., 2012). Additionally, the public's WTP for programs that would protect and/or restore coral reefs around the main Hawaiian Islands from damage due to overfishing and ship wrecks was studied by Bishop et al. (2010). A CM experiment asked respondents to choose their most preferred program out of four potential programs: a status quo program (no change to existing procedures), a no fishing zones program, a reef repair program, and a combined program consisting of both the no fishing zones and the reef repair programs (Bishop *et al.*, 2010).

In Germany, CM experiments were used to determine the value that the public placed on coastal resources associated with MPAs (e.g. beaches, eider ducks and coastal water). The CM experiment utilised a hypothetical oil pollution scenario; to provide an overall public valuation of the resource. The study showed that there was significant support for oil spill contingency measures (Liu et al., 2010). Similarly, beaches (as a coastal resource) have also been valued by Taylor et al. (2010) Respondents were asked how much they would be WTP as a one of tax to for a programme that provided beaches free from algal blooms (Taylor *et al.*, 2010). The non-market value of an estuary was determined using a choice modelling experiment in Georges Bay (Tasmania). Households were asked to choose between the attributes of; the length of native riverside vegetation (reducing the risk of erosion); the number of rare native animal and plant species in the George catchment; and area of healthy seagrass beds (providing habitat for fish) as a proxy measure for estuary condition. The payment vehicle was presented as a one off levy on rates collected by the government (Kragt et al., 2011).

CM studies can be used to elicit a WTP and policy options for protection of species associated with MPAs. Such surveys are often targeted at the general public, with regard to charismatic species (whales, seals, dolphins etc.). Examples of such studies include asking the public's preferences for enhancements to the protection of the western stock of Steller sea lions in California (Lew et al., 2010). Boxall et al (2012) also used CM to determine the Canadian public's WTP for multiple marine species recovery. This was carried out via a series of choice experiments relating to payment for an MPA, restrictions on whale watching and restrictions on the shipping industry. The CM experiment revealed

that the public would be WTP more for programs that contribute to greater increases in marine mammal populations (Boxall *et al.*, 2012).

Although CM is predominantly used as a quantitative technique, the method has also been used to qualitatively value BES. This may occur when monetisation is not possible or appropriate (Kenter et al., 2013). A paired comparison method was used by Nurul Islam et al. (2013) in the context of a no-take Marine Protected Area (MPA) in Malaysia. The study showed that local stakeholders were predominantly concerned about the level of littering and fishing in the area and the damaging impact on coral reefs in the MPA. Overall, it suggested that stakeholder concern should be considered in the planning and designing stages of MPAs in Malaysia.

CM has also been used to evaluate the success of protection approaches. Atik (2010) carried out choice experiments to examine the degrees of success of environmental protection at coastal sites in or around Antalya (Turkey). The study showed that there was a clear motivation for authorities to prioritise environmental protection, water and energy conservation and the protection of the natural environment. However, there was less prioritisation of waste management in coastal recreation sites in and around the area. This research identified that a more pro-active approach in Antalya was required to better protect recreation sites; particularly in areas lacking effective site planning.

Sea Food

The value of fishing resources was subject to a CM survey in the MPA of Asinara Island, Sardinia, Italy. The results show that local stakeholders are WTP for an increase in sustainable yields of commercial species, to reduce conflicts and increase profits from the fishery (Meleddu et al., 2010). Additionally, in Arcachon Bay (France), a CM experiment was used to determine tourists' preferences for oyster farming. The payment vehicle was specified as an increase to accommodation costs. The results show that the amenity dimension of oyster farming is valued as much as the productive dimension of this industry (Dachary-Bernard et al., 2013).

CM has also been used to qualitatively measure the socio-economic benefits of MPAs. Pulina et al. (2012) used a CM framework to gain stakeholder opinions towards alternative fisheries management and their effects on the Asimar MPA (Italy). Discrete choice experiments were used to obtain qualitative information on perceptions, due to the lack of quantitative data available for this area. Face-to-face interviews and questionnaires techniques were used to identify socio-economic attributes of the MPA including employment, profits and safety. The study identified the socio-economic benefits of the fisheries management under differing scenarios and preferred management priorities. Overall, Asinara stakeholders would prefer to increase sustainable yields of commercial species, reduce inner conflicts and increase profits from the fishery. Bacalso et al. (2013) also administered a stated CM survey to 422 small-scale fishers in the Danajon Bank (Philippines). Choice studies were used to test specific attributes representing the economic, social and ecological objectives of fisheries management that are likely to influence the fishers' attitudes towards a management strategy. The attitudes of fishermen were elicited from the fishers' preference for a particular hypothetical management scenario over another in a series of choice games. The study identified that fisherman are highly dependent on the MPA resources for food and livelihood. This was indicated by the economic objectives of fisheries management strategies being the strongest motivators of fisherman's choice decisions. Further to this, immediate catch, not profits, were shown to be the most significant variable. This reflected the interdependence of addressing poverty issues and pursing the ecological objectives of fisheries management. Overall, this work identified the high resource dependence of fishers on the MPA and the need to incorporate stakeholder perspectives into fisheries management.

Climate Regulation

A valuation of BES provided by re-created saltmarsh habitat in Essex, Norfolk and Suffolk, UK (such as carbon storage, fish nurseries, and recreation and amenity) was undertaken by Luisetti et al (2008). Results of the surveys were applied to a cost benefit analysis to assess the economic efficiency of managed realignment projects to create saltmarsh (Luisetti *et al.*, 2008; Luisetti *et al.*, 2011)

Waste Treatment

In the Shadegan International Wetland (Iran), a CM experiment was used to value the nonmarket attributes of a wetland. The results show that the majority of respondents were WTP to improve wetland conservation with the BES of water quality (regulated by the wetland habitat) considered to be the most highly valued attribute (Kaffashi *et al.*, 2012).

Coastal Erosion Prevention

The non-market value of an estuary was determined using a CM experiment in Georges Bay (Tasmania). Households were asked to choose between the attributes of; the length of native riverside vegetation (reducing the risk of erosion); the number of rare native animal and plant species in the George catchment; and area of healthy seagrass beds (providing habitat for fish) as a proxy measure for estuary condition. The payment vehicle was presented as a one off levy on rates collected by the government (Kragt *et al.*, 2011).

Lifecycle maintenance and Gene Pool Protection (habitat services)

A CM experiment was used by Glen at al (2010) and Wattage et al (2011) to determine the preference and WTP of the Irish public for the protection of cold water coral reefs (*Lophelia*), as habitat supporting fisheries, though a choice of MPA scenarios. By presenting a payment method as a yearly tax, respondents were asked to choose between MPA scenarios with varying levels of fishing activity allowed within the MPA, different MPA sizes and different area coverage of coral protected (Glenn *et al.*, 2010; Wattage *et al.*, 2011). A valuation of BES provided by re-created saltmarsh habitat in Essex, Norfolk and Suffolk (UK) (such as carbon storage, fish nurseries, and recreation and amenity) was undertaken by Luisetti et al (2008). Results of the surveys were applied to a cost benefit analysis to assess the economic efficiency of managed realignment projects to create saltmarsh. In the USA, a CM experiment was conducted to estimate the value of protecting habitats and species diversity on the sea floor in relation to the size of the MPA and MPA management measures. The payment vehicle was specified as an annual contribution to an environmental organisation. Results show that small MPAs with liberal use policies were most valued by respondents (Wallmo et al., 2008).

The non-market value of an estuary was determined using a CM experiment in Georges Bay (Tasmania). Households were asked to choose between the attributes of; the length of native riverside vegetation (reducing the risk of erosion); the number of rare native animal and plant species in the George catchment; and area of healthy seagrass beds (providing habitat for fish) as a proxy measure for estuary condition. The payment vehicle was presented as a one off levy on rates collected by the government (Kragt *et al.*, 2011).

Recreation, Leisure & Tourism

CM has also been used to determine the cultural value (recreation and leisure) that UK divers, sea anglers and snorkelers place on MPAs in England and Scotland. Respondents were presented with hypothetical diving or angling sites with a range of environmental and recreational attributes (including travel distance, which was used as a cost-proxy). The following choice attributes were used: (1) marine landscape and underwater heritage, marine organisms (number of species found at site that would be protected), restricted activities, access, MPA characteristics (size of protected area) and travel distance to the site (Kenter et al., 2013). Participants were then asked how much they would be WTP in a one off donation for the protection and the dive/angling site. Both anglers and divers demonstrated a WTP for marine conservation with shipwrecks, presence of specimen fish, and management restrictions representing the most influential site-based parameters. There was particularly high WTP to restrict dredging and trawling activities (Kenter *et al.*, 2013). The recreational value of the sea in Ireland, relating to the EU Bathing Directive was studied by Hynes et al. (2013). The study was used to determine the value that active recreationalists (surfers, swimmer and sea kayakers) placed on improvements to bathing waters. Choice attributes focussed on coastal water quality: benthic health, human health risks, and beach debris. Travel cost was used as the price attribute to determine WTP for different scenarios (Hynes *et al.*, 2013).

In Eilat (Israel), CM was used to value coral reef degradation (caused by diffuse and point source pollution) as well as intensive scuba diving. A CM experiment with divers explored the potential economic consequences of a decline in the attributes of the coral reef. Results were used to provide an annual social cost (in US$) of the continued degradation of the reef (Wielgus et al., 2003). Similarly, in the USA, a CM experiment was used to

target all divers in the Bonaire National Marine Park. Divers were asked how much their trip choice would be altered by the quality of the reef site to determine a social cost of reef degradation (Parsons et al., 2008).

In Tobago, snorkelers and non-snorkelers were invited to take part on a CM experiment designed to determine their WTP a contribution fee to a beach authority for an improvement in coastal water quality. The results showed a significant WTP difference between snorkelers and non-snorkelers with snorkelers WTP more for use of the resource (Beharry-Borg et al., 2010). Divers also took part in a CM experiment in at the Flower Gardens Banks National Marine Sanctuary (USA) to determine management options to mitigate for the negative impacts associated with scuba diving. Management attributes assessed as part of the CM experiment included the number of people diving at a site, the area of an MPA available for divers, levels of underwater supervision, levels of educational provision, the amount of marine life and a fee for accessing the park. Results of this experiment were considered useful for valuing the non-use benefits of the park as well as identifying the trade-offs divers are willing to make in order to support management objectives for reef improvement (Sorice et al., 2005; Sorice et al., 2007).

The economic value of Barbados's coral reefs for recreational divers was undertaken by Schuhmann et al. (2013). Divers WTP for management scenarios (e.g. that improve coral cover, increase fish diversity and increase the number of sea turtles) has provided valuable information for management policies that maximise the returns from diving whilst reducing impacts associated with dive tourism (Schuhmann *et al.*, 2013). CM experiments were used as part of a study on the recreational value of marine resources in Loreto Bay National Park (Mexico). Divers and anglers were asked their WTP for different management scenarios that would lead to increases in the number or size of fish caught (anglers) or observed (divers) by each stakeholder group. Results showed that visitors would be WTP higher park entrance fees to obtain improvements to the park's recreational attributes (Wielgus et al., 2009).

Wildlife tourism to the Stingray City Sandbar (Cayman Islands) has been valued by Semeniuk et al (2009). Infrastructure to support tourism is considered to potentially impact

upon the ecological integrity of the site. Visitors to the sandbar were presented with a series of management options that could be realised by paying a conservation access fee. The majority of visitors to the site were in favour of payment for stricter management rules (Semeniuk *et al.*, 2009). Additionally passengers of whale watching cruises to the Hawaiian Island Humpback Whale National Marine Sanctuary,(USA) were asked to provide a WTP for increased measures for Whale conservation and awareness. Participants were provided with a series of choice attributes that focused on speed limits for all boats, tougher regulations and increased penalties, sewage disposal at the harbours, and on board education (Shapiro, 2006).

Aesthetic Information

In Iran, CM experiments were used to value the non-market attributes of the Shadegan International Wetland. One part of the study focused specifically on the value placed on maintaining the scenery as close as possible to its natural state (undisturbed by construction activities Whilst water quality (regulated by the wetland habitat) was considered to be the most highly valued attribute, ecological functions and biodiversity were also important non-use values. Results were used to influence policy in order to counter the economic demand for major development projects (Kaffashi *et al.*, 2012).

Cultural Heritage and Identity

Chhun et al (2013) used a CM experiment in New Zealand to assess public's values towards the establishment of "Customary Management Areas" (taiāpure and mātaitai) and Marine Reserves. These conservation measures aim to support Māori cultural practices and restore declining biodiversity and fish stocks. The results show that the general public share a concern for the maintenance of biodiversity. In terms of management measures they are WTP a tax for restrictions on recreational and commercial fishing in order to preserve biodiversity. Additionally the public considered that an increase in MPAs in combination with carefully managed taiāpure and mātaitai; provide a net social benefit by restoring declining biodiversity and protecting Māori cultural practices (Chhun *et al.*, 2013).

Evaluation:

Hanley et al (1998) summarise that CVM essentially values the overall policy and CE evaluates the individual characteristics that make up the policy. Like CVM, surveys that employ CM have increased in the last 10 years. CM experiments have effectively evolved from CVM with the 'choice' enabling respondents to show preference for different levels of attributes in the survey design (Adamowicz et al., 1998). This presentation of options for management or policy means that CM in an increasingly popular valuation tool. Specifically, CM has high flexibility in order to determine the welfare benefits associated with change (Farber et al., 2002).

From the examples provided in this section it can be seen that CM experiments have been used to value MPAs (including networks of MPAs) and the general BES they provide. However, they can also be used to value specific BES when these are defined prior to assessment. CM experiments are predominantly used to provide a decision making platform to identify potential trade-offs between BES and the amount or quality of that benefit that the respondent would be WTP to receive. In the case of MPAs this had largely been applied at a network level (Frau, 2010; Hanley *et al.*, 2013; McVittie *et al.*, 2010). Predominantly cultural and amenity services of recreation and leisure have been assessed as individual ES during assessments due to the direct link between the pursuit of recreation and leisure activities and the quality or state of the resource.

In many of the cases described in this section, CM experiments do not stand alone as a valuation technique. CM are often bound with CVM (Boxall *et al.*, 2012). Several studies apply the travel cost method (TCM) to the choice experiment (Kenter *et al.*, 2013). Focus groups and structured interviews are essential to the development of the CM experiment to develop practical 'choices' and reduce the variability of the value estimates (Beharry-Borg *et al.*, 2010; Birol *et al.*, 2007; Frau, 2010; McVittie *et al.*, 2010; Wielgus *et al.*, 2009).

At a MPA network level the predominant advantage of CM is that the method provides policy makers with information on the societal preferences for MPAs over a range of

potential outcomes. At the MPA and ES level the method can be tuned to measure the effects of changes to MPA management and the marginal economic benefits. It is also considered that CM experiments suffer less from respondent bias than CVM; as the range of choices provides scope for the respondent to answer meaningfully. Additionally when not faced with a single choice the researcher learns more about preferences and resulting respondents answers are considered to be more in line with real policy situations. Choice experiments have several advantages relative to contingent valuation. Choice experiments provide more-detailed information about people's preferences over a range of outcomes, are less prone to biases caused by respondents answering questions strategically, and yield a greater amount of information than a contingent valuation survey for the same cost. As such, human behaviour is integrated with the economic valuation (Birol *et al.*, 2007).

Like CVM, CM suffers from many of the disadvantages incurred at the design and implementation stage. Only rigorous survey design and testing can go some way to reducing survey bias. It can also be considered that because CE surveys are more detailed, it can be more difficult for people to respond or they may be less likely to respond. Spatial scale of the CM survey is also an issue, particularly for valuing ES benefits. Unless the survey is specifically targeted to define the ES and the special scale to which those ES relate, then there is a risk of aggregation and double counting of values (Ledoux *et al.*, 2002). From a practical angle CM surveys are considered to be both resource and time intensive and the analysis of the data requires specific econometric expertise.

Welsh context considerations

The workshop participants felt that stated preference methodologies could potentially be useful in a Welsh context as they are relatively simple to use. Participants did not discuss CVM studies and choice modelling separately rather they showed a preference for choice modelling with a WTP opportunity. Participants felt that WTP scenarios set against policy or management 'choices' based on the BES of MPAs can potentially provide an opportunity to engage with stakeholders, raise awareness of MPAs and initiate discussions regarding future use and MPA management options. Participants noted that stated

preference methodologies could be useful to value tourism and determine site based MPA management scenarios (choice modelling). WTP scenarios could also provide realistic management scenarios to determine future site based levies (e.g. a parking charge) that could be used to fund MPA management and enforcement activities.

The participants raised a number of concerns regarding stated preference methodologies. Such concerns centred on potential biases arising from the survey design and delivery (e.g. respondents giving 'political' or 'guilt' responses). Participants recognised that such biases can influence preference based decisions and lead to unrealistic results. Participants also raised concerns over how scenarios may be framed in the WTP scenarios as it could have 'side effects'. For example, if a stated preference survey asked recreational divers how much they would be WTP to dive in a Highly Protected Marine Reserve (HPMR) then it may ignite discussions regarding HPMR amongst wider stakeholder groups. Participants felt that if stated preference methodologies were used to determine the public's WTP for MPAs then the results may be useful to justify resources being focussed upon MPA management.

At a network level the workshop participants felt that it could be useful to apply a stated preference survey via the 'Visit Wales' website to determine visitors WTP for MPAs in Wales. The majority of discussions though focussed on the use of stated preference surveys at an individual MPA site level. The workshop participants came up with a number of examples of how such stated preference surveys could be targeted in the Welsh context.

- Diver's WTP to dive in protected sites e.g. Skomer.
- The public's WTP for sea food harvested from an MPA. For example if an MPA associated fishery could attain Marine Stewardship Council (MSC) for operating sustainably within an MPA.
- Angler's WTP slipway fees to fish MPA sites.
- Bait digger's WTA payment not to operate within MPAs.
- Visitor's WTP a 'tourist tax' for visiting MPA sites. Such WTP that could be used to determine potential levies for undertaking activities within an MPA. For example an

MPA levy could be realised through a 'visitor payback scheme' at hotels where divers stay.

- The public's WTP for MPAs that enhance habitat or management for 'charismatic species' could be useful at several MPA sites. For example, grey seals in Pembrokeshire and dolphins, porpoise and seals in Cardigan Bay and Tremadog Bay. It was noted that a stated preference survey could determine the public's WTP for enforcement or permits to regulate recreation activities that potentially impact upon dolphins in Cardigan Bay. It was noted that there are several MPA sites where there are already wildlife watching businesses. A stated preference survey would be useful to determine how much more they would be WTP for management that increases the chance of wildlife sightings
- The public's WTP to maintain seascapes in their current state or choice modelling (including WTP) for different aesthetic options would be useful valuation studies at MPA sites that are subject to development proposals e.g. Pen llyn a'r Sarnau, all estuaries (particularly Mawddach) and AONBs.
- A WTP and/or choice modelling survey would be useful to instigate discussions regarding the management of seagrass beds at Porth Dinllaen.
- The local stakeholder's WTP for maintaining bird habitat could provide a cultural value for the Burry inlet MPA.
- In order to potentially provide market research for future revenue streams for Skomer Marine Reserve a WTP survey could explore the value of the site to the research and education sector (particularly if enhanced field facilities were available) and the commercial and oceanographic sector (testing appliances away from commercial fishing activity).

3.2 Non-monetary methods

The benefits and socio-economic values related to MPAs are manifold and cannot always be captured in monetary terms (Kettunen et al., 2013a). MPAs have several wider welfare (non-economic) values that cannot be easily captured in monetary terms and are therefore mainly subject to qualitative valuation (Kettunen *et al.*, 2013b). It is considered that the socio-economic benefits of MPAs should be assessed through qualitative non-monetary estimates, in combination with economic methods. Deliberative and survey approaches are two methods that enable qualitative assessments of BES (Fish et al., 2011). Non-monetary methods provide valuable qualitative evidence for all MPA decision support tools particularly those that require extensive stakeholder input (e.g. scenario analysis).

3.2.1 Deliberative Approaches

Deliberative democracy approaches to valuation have emerged recently, combining stated preference methods with the discourse-based techniques of political science (Spash, 2008). In a deliberative approach, values are elicited through a process of extended discussion, debate and learning (Fish et al., 2011). Deliberative methods have been used less frequently in comparison to other methods (Dalton et al., 2012). Research has focused on the democratic legitimacy; with a lack of information on their applicability to case studies and their effectiveness as replacement for other valuation techniques (Blamey et al., 2000). It is theorised that deliberative approaches could provide participants with an opportunity to deliberate on the value of a good (e.g. fisheries) and arrive at a mutually agreed value. Values derived in this form can then be used to guide environmental policy (Wilson et al., 2002)

Citizen Juries

Description:

The most commonly type of deliberative approach are Citizen Juries (CJ) (Dalton *et al.*, 2012). CJ are a way of involving the public in the decisions of public authorities. The jury is typically comprised of between 5-20 members of the public, selected to represent a cross-section of the community (Turner, 2007). The jury are provided with information about BES values, which they discuss and formally deliberate in a transparent process (Lockwood, 2005). Previously, UK CJ have considered questions of local planning issues and health policy (Evans et al., 2001). However, there has been less focus on marine conservation and planning issues. Most commonly, CJ have employed the use of CVM and choice experiments. This is described as Deliberative Monetary Valuation (DMV) which provides a quantitative valuation of the environment (Spash 2008).

Examples:

General uses of CJ with an application to value BES

Although not specific examples to MPAs, two studies have adopted the use of CJ's to measure the value of habitats. Robinson et al. (2002) conducted a choice modelling survey, via a 23-person CJ to estimate the quantitative value (WTP) for improvements in water quality in the Bremer River (Australia). The study identified that in terms of WTP; riparian vegetation was attributed the highest value by the CJ; indicating its importance as an ecosystem attribute. Aldred et al. (2000) utilised also used CJ, this time as a forum to gain public opinion on plans to create a wetland area in Cambridgeshire (UK). The jury was composed of 16 members of the public and they were presented with an agenda structured around four 'options' for wetland creation. These options ranged from the development of a wetland to no deliberative action; whereby the wetland creation should not be positively encouraged by public authorities and public money. The study revealed the public's support for the nature reserve and helped to gain thematic information on the

value of the proposed wetland. Principally, the public placed value on the wetlands future biodiversity.

Evaluation:

Deliberative democracy moves away from the standard economic assumption of preformed and stable preferences, which have been questioned by recent empirical evidence (Robinson *et al.*, 2002). CJ overcome the limitations of WTP surveys and mail out questionnaires, which may provide respondents with a lack of information and limited opportunity to deliberate about their WTP (Robinson *et al.*, 2002). Many studies suggest that a more appropriate way to make decisions is to use deliberative methods such as CJ (Cox et al., 2004).

Deliberative democracy involves group discussion, in which individuals are believed to be exposed to a richer set of information, attitudes and experiences; which enhances their understanding of pertinent issues (Turner, 2007) (Turner 2007). In comparison to other methods, it also allows more time for participants to process and assimilate information (Lockwood, 2005; Turner, 2007). The process of deliberation also requires citizens to go beyond private self-interest; increasing social equity and political legitimacy of outcomes. For example, derived values would be discussed in terms of social WTP, rather than in the form of an individual's WTP (Wilson *et al.*, 2002). Another benefit is that it allows for the consideration of multiple objectives, one of these objectives (and often is) monetary. Quantitative valuations (e.g. revealed and stated preference methods) can be easily input into CJ (Blamey *et al.*, 2000). However the techniques can also use qualitative data from a range of disciplines (Cox *et al.*, 2004). Overall, it has been suggested that ethical dimensions of natural area values are best considered in a deliberative environment (Wilson *et al.*, 2002).

Many of the hypotheses surrounding the benefits of deliberative valuation have yet to be fully tested. A number of limitations have previously been envisaged such as the cost and the considerable amount of time required performing this method (Turner, 2007). As

stated by (Huitema, 2009), the cost effectiveness of the CJ tends to be an issue of concern, for example costs in some cases can be considerable (e.g. a minimum of 50,000 euros). It is therefore argued that citizen' juries should only be used in situations with a high level of complexity and controversiality (Huitema, 2009). Also, CJ are also not fully representative; therefore there may be difficulties in applying the resulting values to the wider population (Lockwood, 2005; Turner, 2007). Also, the value domain in the process is dependent on the interests and diligence of the participants and may be circumscribed by the organisers, so that some values may not be considered or may be inadequately considered (Lockwood, 2005).

2.2 Survey Approaches:

Survey approaches involve the elicitation of BES values through the direct questioning of people. Survey-based techniques tend to be employed in the earlier stages in the policy cycle and can be deployed to inform an understanding of stakeholder priorities as options are being formulated. The approach has an exploratory element which enables analysts and policy makers to discern the likely costs and benefits of change and how particular stakeholders stand to win and lose. A number of recent studies have explored the perceptions on the effects of MPAs on local welfare and livelihoods (Rodriguez-Rodriguez et al., 2014). These studies provide a valuable and necessary insight into the views and feelings of local societies about the different social and economic aspects of MPAs (Rodriguez-Rodriguez *et al.*, 2014). A variety of methods can be used to gain social perceptions, these include: structured questionnaires, semi-structured interviews and focus groups (Fish *et al.*, 2011). To gain non-monetary data on BES, these different survey methods are often integrated. These methodologies support the following valuation techniques: Place Based Valuation, Health Valuation, indicator approach and Q-methodology.

Place Based Valuation

Description:

Place Based Valuation focuses specifically on identifying the value that communities place on features and areas within marine and coastal environments. This methodology has emerged in response to concerns surrounding the use of monetary valuation to assess socio-cultural ecosystem services. As stated previously, many ecosystems are valued precisely on the non-market benefits they provide; therefore monetary valuation may only represent a partial valuation of ecosystems (Gee et al., 2010; Johns et al., 2013) Place Based Valuation techniques aim to overcome the emphasis on 'biophysical considerations' that can result in 'intangible cultural and social values' being ignored or unevenly represented (Haggan, 2012). Studies suggest the use of methods such as Place Based Valuation for trade-off analyses that inform marine spatial planning (MSP) and for vulnerability and risk assessments (Milcu et al., 2013; Tengberg et al., 2012).

Examples:

General uses of Place Based Valuation with an application to value BES

Plymouth University have used a range of survey techniques to examine the social impacts and perceptions of stakeholders towards the MPA establishment in Lyme Bay (Dorset, UK). Rees et al. (2013a) employed a cost benefit analysis to gain information on the perceptions and levels of support of the Lyme Bay Stakeholder Group towards the closure. A range of methods were employed, including emails, postal surveys, web forms, face to face interviews and telephone interviews. The study identified that Lyme Bay stakeholders perceive the social, economic and environmental benefits of the MPA to outweigh the costs. Social benefits included: improved recreational experience, decreased social tensions and increased environmental awareness. Whilst economic benefits for stakeholders included more fish, increased tourism and increased spending in local businesses. However, the research also indicated that there had also been social costs and these have been borne by mobile and static gear fishermen and charter boat

operators. Hattam et al. (2014) also used semi-structured interviews to examine the social impacts of MPA establishment in Lyme Bay (Dorset, UK). Fishermen (mobile and static gear), recreational users and recreation service providers were interviewed and the thematic analysis was used to draw out social themes. The study identified that MPA establishment had both positive and negative impacts on stakeholders. Negative social themes included lengthened fishing trips, tension and conflict, equity and uncertainty in the long term. Positive social themes (benefits) on the other hand, included improved experiences for both commercial fishermen and recreational users and expectations for long term benefits. This study highlighted that social impacts must be identified alongside the economic and environmental effects of MPAs.

Interviews, questionnaires, participant observations and archival and literature review have also been used to assess stakeholders perception of three MPAs in Spain (Jentoft et al., 2012). Stakeholders were asked to discuss the value (the significance of MPAs for conservation use), relevance and effectiveness of the three MPAs. The study identified that the MPA stakeholder did not differ significantly in how they valued marine resources and MPAs. They all acknowledged the need for conservation that the MPA promised. In all three cases, the main stakeholders supported the MPA proposals and saw the MPA as an opportunity to diversify their livelihoods into tourism, whilst maintaining traditional culture and identity.

Focus groups and workshops have been used in the Philippines to investigate the socio-economic impact of MPAs and Marine Sanctuaries on local communities (Brown et al., 2008; Crawford et al., 2000). Brown et al. (2008) used focus groups to establish any impacts of MPA establishment on the local community. The study identified that MPA establishment may have increased the flow of BES through maintenance of biodiversity, ecosystem integrity, resilience and tourism. However MPA establishment may not cater to the poor's short term priorities; for example the provision of fish production. Crawford et al (2000) on the other hand used focus groups, (involving practitioners and experts) to gain information on the experiences and lessons learnt from the establishment of community-based marine sanctuaries in the Philippines. The study established that primary community benefits from MPAs were linked to improved fisheries production and greater

community empowerment. Although tourism could be viewed as beneficial, it could also cause socioeconomic equity between the community and external business (Crawford et al., 2000).

Since the establishment of marine reserves in New Zealand, national scale valuation studies have been conducted to monitor the public's attitudes towards them (Cocklin et al., 1998). A systematic social impact assessment was conducted at the first Marine Reserve, Leigh in 1992 (Flood and Cocklin 1992; cited in Cocklin et al., 1998). Questionnaires were administered on site to visitors, local residents and local businesses. The study identified that the reserve was supported by the three user groups; with perceived benefits including: increases in visitation, benefits to the local economy and enhanced environmental awareness. Further to this, the reserve had increased the role of fisherman in governance, who now play a critical and vigilant role in policing fishing and other illegal activities inside the reserves.

Subsequent to this, community questionnaires were carried out in the Te Whanganui-a-Hei Marine Reserve in New Zealand (Cocklin *et al.*, 1998). Questionnaires were used to assess whether the marine reserve had a positive, negative or no discernible effect upon the community. The study assessed social and economic benefit themes such as accessibility, education, environmental awareness and tourism attraction. The study identified that the marine reserve had both positive and negative effects on the local community. Positive effects included enhanced protection and increased respect for the community, whereas negative effects included: restricted fishing and polarisation of the community. Overall, monitoring of attitudes to and the social impacts of these two reserves provided a useful insight into the social impacts of marine reserves and aided the development of further MPAs in New Zealand and local management plans (Cocklin *et al.*, 1998).

Although not specific to MPAs, Ezebilo et al. (2010) conducted household interviews to assess the contribution of the Okwangwo Cross River National park (Nigeria) to the social and economic wellbeing of people. The study identified that the park contributed to the provision of infrastructure and a localised economic benefit from tourism, in the form of

village income. However, that tourism income was unequally distributed among local people and geographical location of the villages also influenced the respondent's income from tourism. This research identified that further work was required to develop sustainable development and tourism projects, in order to benefit locals on a wider geographical scale.

At a larger scale, Leisher et al. (2007) used focus groups and interviews to analyse the socio-economic benefits of four MPAs. The study consulted 1,100 local residents to determine whether the four MPAs in Fiji, Solomon Islands, Indonesia and the Philippines have contributed to poverty reduction in the local community. The study established that MPAs have contributed to poverty reduction in the local communities, by improving fish catches, increasing employment, improving local governance, benefitting local health services and enhancing economic benefits to women.

Sea Food

In the case of Lyme Bay, Plymouth University used semi-structured interviews to gain qualitative and quantitative data relating to: fishing activity, social impacts and options for management, economic sustainability of the fleet and the socio-demographics of Lyme Bay fishermen (Rees et al., 2013b). The study demonstrated that Lyme Bay supports a small scale, profitable fishing industry providing socio-economic benefits to fishermen. The well-being of fishermen is linked directly to fishing activity; therefore there is a need to align the objectives of the new proposed MPAs (MCZs) with fishery objectives. This study suggested the use of collaborative monitoring to aid the co-management of marine resources.

Russ et al. (2004) also used a semi-structured interview technique to assess the potential effect of the Apo Island MPA (Philippines), considering fisheries catches (1986, 1992 and 2000). The study revealed that over time, benefits of the reserve to local fisheries was an increased catch rate and a reduction in fishing effort. Subsequently, the fisheries and tourism benefits generated by the reserve enhanced the living standard of the fishing community. Himes (2003) also used interviews and literature searches to identify how artisanal fishers were impacted by two marine reserves in Sicily (Italy). Fishermen were interviewed in order to determine the success of the reserve and the perceived impacts of

the MPA on catch rates. The results indicate that while fishers in the two case studies were aware of the marine reserves where they fish, most fishers were not well informed of the associated regulations. Furthermore, the study showed that the perceived benefits and impacts of reserves can differ significantly between case studies, even in the same region. In one region, fisherman believed that the reserve had been successful and since its establishment has resulted in benefits such as increased average daily catch. However, in the second region, there was a negative perception associated with the MPA, with most fishermen expressing a lack of positive benefits from the reserve.

Interviews were also utilised by McClanahan et al. (2008) to elicit perceptions of villagers and managers on the socio-economic benefits of the Mafia Island Marine Park (Tanzania). The study identified that minimum fish lengths and gear restrictions in the marine park were perceived to be beneficial and these benefits increased along the scale of the individual community and national government. However, that most negative perceptions were found in villages near fisheries closures, where there was a heavy reliance on marine resources and employment. Overall, this research helped to identify socio-economic impacts but also to establish two potential management solutions to remedy the negative impacts on neighbouring villages. Proposed solutions included (1) the use of gear and minimum size restrictions (instead of fisheries closures) and (2) increasing access to tourism, cash crops, animal husbandry and salaried employment.

Abunge et al. (2013) conducted a series of qualitative focus groups with stakeholder groups connected to a small-scale Kenyan coastal fishery (adjacent to a Marine Park and Reserve). Focus groups were used to identify the state of community well-being (using wellbeing indicators) and to identify any impacts to community well-being over a 10 year period. Focus group discussions identified the following benefit themes: employability, education, health, religion and personal security. Furthermore, it established that fish availability and conflict between fisheries and tourism were the main impacts to the Kenyan communities' ability to achieve well-being. Overall this research provided implications for fisheries management approaches in areas and around marine parks and reserves.

Culture and Amenity Services

Place Based Valuation has been used to assess the cultural services and benefits provided by marine protected areas. Pike et al. (2010) conducted structured interviews with coastal MPA practitioners to establish the social value of marine and coastal protected areas in the U.K. Stakeholders were asked to rank the importance of nine 'social criteria' including spirituality, activities, research and education and the natural environment. This study identified key interlinking themes of social value that connected through the management of MPAs. The study also demonstrated the disparity of opinions between different stakeholders and the need for a fuller understanding of all social values in MPA management (Haggan, 2012; Pike et al., 2010).

Current research conducted by the Centre for Marine and Coastal Policy Research, Plymouth University, aims to assess the cultural value and significance of the Dart Estuary (Devon, UK) a recommended MCZ (rMCZ). An integrated method of semi-structured interviews, mapping and videos are being used to test the 'Cultural Significance' criteria developed by an ICES workshop in 2013, entitled 'Mapping Cultural dimensions of Ecosystem Services' (Shellock, R. pers.comm). Porter et al. (2004) carried out visitor interviews and observational surveys to quantify recreational user activity and to assess the awareness and support for an MPA in Point Lonsdale (Australia). Results indicated that the marine reserve provides benefits to visitors in the form of aesthetics ('places for people to enjoy nature'). The study also identified the activity and distribution of recreation and leisure users; indicating the marine reserve's wider cultural value.

Place Based Valuations have also been largely used for cultural ecosystem service assessments, for example in the context of wind farm development. For example, Gee et al. (2010) used questionnaires to identify the cultural ecosystem services provided by the German North Sea and the intangible BES values associated with them. This research aided impact assessments of regional offshore wind farm development on cultural ecosystem services (Gee et al., 2010) .The aforementioned research effectively increased the visibility of cultural and amenity services; as well as identifying the current challenges with cultural ecosystem service assessments (Gee et al., 2010; Klain et al., 2012). In Courseulles-sur-Mer (France), Foquet (2012) used a multi-method approach coupling

questionnaires, interviews and volunteer employed photography to identify cultural ecosystem services and assess social attitudes towards the installation of offshore wind farms. This research helped to identify the area's cultural value and establish culturally important areas in the region (via place-attachment). Overall, this research developed methods useful for informing marine spatial planning and management of the region.

Although not applied in the context of MPAs, map-based interview techniques were integrated with quantitative valuations to elicit both the monetary and non-monetary values associated with Vancouver Island (Canada) (Satterfield et al., 2013). Users actively engaged in the marine-ecosystem based management or making a living from Vancouver Island's natural resources were interviewed in order to: (1) identify and map areas of importance, (2) value the area (monetary or non-monetary), (3) establish the provision of cultural ecosystem services (heritage, identity, leisure and recreation) and (4) identify any risks/threats to the ecosystem services (Haggan, 2012).

Evaluation:

The use of Place Based Valuation has emerged over the past decade, to address the challenges of gaining information to value cultural and amenity services (Haggan, 2012). As seen from the examples, Place Based Valuations have had initial success in gaining more qualitative data on the provision of cultural and amenity ecosystem service benefits. There is considerable impetus for using Place Based Valuation to better integrate cultural ecosystem service values into marine spatial planning. Map-based interviews, for example, enable participants to express both verbally and spatially the value of places, for other reasons than income generation. This enables participants to discuss their emotional attachments and spiritual connections to a place or area in a marine or coastal ecosystem. Place Based Valuation helps to assess many kinds of non-monetary values tied to marine and coastal ecosystems that many planning processes do not explicitly assess (Klain *et al.*, 2012). It has been suggested that Place Based Valuations would be suitably effective in a planning and decision-making context.

Although, Places Based Valuation offers useful insights into the non-tangible values ascribed to marine and coastal ecosystems, problems still remain in the application of this method. Place Based Valuation offers only a snap-shot in time and may produce a potential mismatch between the spatial scales of ecosystems and cultural ecosystem services (Gee *et al.*, 2010). Further to this, the greatest difficulty is to integrate and compare the intangibles to the economic values generated from ecosystems. Additionally, as social surveys rely on primary data collection they are relatively expensive and time consuming.

Health Valuation

Description:

Health Valuations are assessments that aim to qualify and quantify the estimated increase in physical and mental health and quality of life related to the access to a protected area (PA). The method utilises surveys, statistics and research on restorative effects such as decreased levels of stress and mental fatigue, increased levels of physical activity, lower levels of aggression, criminality and substance abuse, increased social integration and improved motoric development in children (Gantioler et al., 2013)

Examples:

Health Valuations have been used to measure the socio-benefits of MPAs on culture and amenity benefits, particularly mental and physical health.

Human Wellbeing

Various assessments have been carried out the Roviana Lagoon (Solomon Islands) to determine whether MPAs establishment (e.g. Community-based MPAs) lead to improvements in human health and wellbeing. A combination of qualitative techniques to measure nutrition (e.g. food diaries) and health (e.g. body height, weight and Body Mass Index) have been adopted to assess the social impacts of MPAs on local communities.

Human nutrition and health were measured in communities adjacent to five MPA and non-MPA locations in conjunction with measurements of ecosystem health (Aswani et al., 2007; Weiant et al., 2006). Studies identified that MPAs may have socio-economic impacts on residents of villages with effective MPAs, reflected by higher energy and protein intake than residents from villages with no MPAs or ineffective ones.

Gjertsen (2005) also carried out socio-economic and ecological assessments to determine whether MPAs lead to improvements in human wellbeing (child nutritional status) via the provision of more sea food. Assessments were carried out in 40 community based MPAs in the Philippines. Specifically, the weight of pre-school children was used to assess the social impacts of MPAs on communities. Overall, this was study helped to evaluate whether MPAs in the Philippines, were meeting both conservation and development objectives simultaneously.

Although not applied directly to MPAs, Wyles et al. (2014) used questionnaires to explore the social benefits and environmental costs associates with recreational visits to rocky shores in the UK and internationally. Recreational users and experts were asked to (1) rate how each recreational activity affected their wellbeing (mood, excitement and environmental awareness) and (2) rate the perceived overall impact of the activities on the environment. The study identified that visits to rocky shores improved visitors' awareness of the marine environment, as well as increasing their well-being (with some activities being calming and others exciting). However, a number of these activities were also perceived to have detrimental effects on the rocky shore habitat (e.g. walking and rock-pooling). This study highlighted the need to prioritise management schemes that benefit both the environment and recreational users.

Evaluation:

As reflected by the limited case studies, Health Valuation in the context of BES is in its early stages of development. As stated by Weiant et al. (2006), the effects of MPAs and other protected areas on human health and wellbeing of have seldom been measured. In

tropical ecosystems, the technique has offered an initial insight into the nutrition, health and wellbeing of communities, linking them to the provision of fish protein (Aswani *et al.*, 2007). Studies have suggested that MPA governance combined with good sea tenure have had positive effects on MPA communities. However, research has mainly focused on tropical coastal communities that are highly reliant on marine resources, e.g. fisheries. The limited application of this method to temperate areas reflects the large difficulty in drawing links between health and MPAs in a developed EU context.

One of the main disadvantages is the lack of a simple relationship between MPA implementation and health-based benefits (Gjertsen, 2005). There are large difficulties in controlling for all the potential independent variables in the study (Aswani *et al.*, 2007). As stated previously, confounding variables such as alternative income generating activities may also have an influence on community health (Aswani *et al.*, 2007; Gjertsen, 2005). Aswani (2007) identified that health benefits may also be initiated by logging activities paired with endogenous marine resource management. Health benefits are dependent on factors relating to MPA design and context variables specific to MPAs (Gjertsen, 2005). Health-based valuation offers a snap-shot into the effects of MPA implementation on health. However, a need remains for further research into quantifying the tenuous links between marine and coastal diversity and human health and wellbeing, particularly in a temperate context (Reyers et al., 2010).

Indicator approach

Description:

A number of studies in the last decade have discussed the use of ‘performance’ indicators for MPAs and Marine Reserves. Indicators are variables that estimate complex parameters, that cannot be measured directly (Rodriguez-Rodriguez *et al.*, 2014). Data can be translated from primary data, for example household surveys which produce mainly qualitative indicators. As well as from secondary data, which can save time and costs

when compared to other methods indicators can be selected by researchers or can be selected by stakeholders, following a participatory process (Rodriguez-Rodriguez *et al.*, 2014). These indicators can then be integrated into indexes to assess the extent to which MPAs are achieving policy objectives (Mascia, 2004). Indexes are then used to facilitate communication and decision-making processes (Rodriguez-Rodriguez *et al.*, 2014). Examples include the integration of indicators into the IUCN-WCPA framework, at biophysical, socio-economic and governance levels of organisation (Pomeroy et al., 2005).

Socio-economic indicators include quality of human health, community infrastructure and business, distribution of formal knowledge to community and household income distribution. Mascia (2004) has also discussed the use of social and economic performance indicators for marine reserves. These include economic equity indicators (income, wealth and distribution) and sociocultural indicators (employment levels, crime rates, demographic attributes and perceptions of well-being. Another example is the development of French MPA indicator dashboards by the Agence des Aires Marine Protégées (AAMP) (Rodriguez-Rodriguez *et al.*, 2014). Although a number of studies have discussed the usefulness of socio-economic indicators for assessing MPA benefits, there is still a lack of completed studies. In particular there is a lack of information on the socio-cultural dimensions of marine reserve performance, which frequently limits policy discussions to largely conceptual terms (Mascia, 2004).

General uses of Indicator Approaches with an application to value BES

Through the INTERREG IVA Channel Program, PANACHE (Protected Area Network Across the Channel Ecosystem)[4], Plymouth University have been developing the SEMMPA system to monitor the social and economic effects of MPAs. SEMMPA is a simple statistical method that utilises 64 social and economic indicators, including: . cultural heritage, population size, life expectancy and environmental education of local populations, employment rate, house prices, number of visitors and fishing effort. These indicators are being used to assess the social and economic effects of four case studies

[4] The 'PANACHE project was selected under the European cross-border cooperation programme INTERREG IV A France (Channel) – England, co-funded by the ERDF.'

on both sides of the Channel: (1) Lyme Bay and Torbay SIC and OSPAR site (western part), (2) Plymouth Sound SCI and OSPAR, (3) Banc des Flandres SAC, SPA & OSPAR site and (4) Iroise Parc Naturel Marin & OSPAR site (Rodriguez-Rodriguez *et al.*, 2014).

Socio-cultural indicators have also been used to assess the impacts of marine reserves on the community. In Fiji, ecological measurements were used alongside socio-economic indicators of marine reserve efficiency, to determine any benefits to the local community. Catch rates were combined with household surveys to collect household information and income from the scale of marine products (e.g. kaikoso). The study identified that in some cases closed areas may have caused spillover effects and economic benefits reflected by 59% increases in household incomes. This was in part due to increased sales of clams and in part from income generated by the bio-prospecting element of the project. Within this project, communities were involved in monitoring of resources and being part of committees; making joint management decisions. This active participation of people in management and monitoring, subsequently led to increased community harmony, reduced conflicts between user groups and managers and increased environmental awareness (Tawake et al., 2002; Tawake et al., 2001).

McClanahan et al. (2006) also used biological (reef health) and socio-economic indicators to examine the benefits at four national parks, four co-managed reserves and three traditionally managed areas in Indonesia and Papua New Guinea. Socio-economic indicators (e.g. immigration, involvement in community organisation, years of education and household salaried employment) were measured using a combination of household surveys, interviews and participant observation. The study suggested that the average size and biomass of fish was higher in managed areas, in comparison to unmanaged areas. In combination with this, socio-economic assessments revealed that protected sites had less dependence on fisheries (market influence) and instead had greater involvement in teaching, government employment and lower population sizes. Additionally, that more traditionally managed sites provide individuals and communities with greater benefits. Overall, the study suggested that although large permanent MPAs may provide the best protection for species, a combination of MPAs and alternative systems of management

(e.g. traditional systems) may provide the best overall solution for meeting conservation and community (social-economic) goals.

Glew et al. (2013) utilised 15 human well-being indicators to assess the social effects of six MPAs in the Bird's Head Seascape (Papua, Indonesia). Human well-being indicators were themed across 5 domains: economic wellbeing (e.g. source of livelihood), health (e.g. food security and mortality), political empowerment (e.g. community organisation), education (e.g. school enrolment) and culture (e.g. place attachment). So far the work has shown that the Bird's Head Seascape community are highly dependent on marine resources, with fishing acting as the primary occupation and the protein source for the majority of local households. Furthermore, the Bird's head seascape also offers place culture benefits in the form of aesthetics from place attachment (strong emotional connection to the local marine environment). This work has provided insights on the short term social impacts of MPA establishment; informing planning and implementation in the immediate area. Further to this, it will help to document how marine resource governance shapes the impacts of MPAs on human well-being; informing policymakers.

Recent studies have focused on assessing the costs to fishermen resulting from the creation of MPAs (e.g. displacement) (Mascia 2004). McClanahan et al. (2000) identified that there was a 60-80% decline in the number of fishermen at the Jomo Kenyatta Beach fish landing sites following establishment of the no-take zone Mombasa Marine Park (Kenya).

Recreation, Leisure & Tourism

In Belize, social-economic assessments were used to assess the effects of establishing the Hol Chan Marine Reserve (Mascia 2000; cited in Mascia 2004). The study identified that the reserve had far reaching impacts in the adjacent town of San Pedro. Reserve establishment catalysed the transition of San Pedro from a fishing community into a tourism based economy. Mascia (2000) identified a diversification in the local community (resulting from migration) and increases in the standard of living in San Pedro. The benefit of tourism resulting from marine reserve establishment has also been identified research in St Lucia. Gell et al. (2002) identified that in St Lucia reserves have opened up economic

opportunities for fishers to use their boats as water taxis (unpublished data). This in turn has reduced pressure on the fishery, providing alternative employment for people who would otherwise have to fish.

Malleret-King (2000) utilised focus groups and interviews to investigate if and how Marine Protected Areas in the South Coast Kenya, benefit the socio-economic status of the surrounding fishing communities. Specifically, the food security status of five fishing communities surrounding the Kitsite Marine National Park was examined. The study identified that households surrounding protected reefs were more food secure than other communities. However, this socio-economic influence was constrained by the distance of the communities from the marine national park. Furthermore, that the community benefitted from enhanced income from increased tourism. Malleret-King (2000) also identified the income and opportunity fluctuations associated with communities reliant on seasonal tourism. This study identified the urgent need to consider environmental and social impacts in the process of tourism development in protected areas.

Evaluation:

The main advantages of the indicator approach is that it combines a range of social indicators with indicators of governance and biological effect; providing a more multifaceted approach. Furthermore, it is hypothesised that this approach can link interventions to impacts, providing policymakers with evidence necessary to ensure that MPAs realise their full potential as a conservation strategy (Mascia et al., 2011). The weakness of this technique is the lack of published evidence on the uses of many socio-economic indicators. As stated by Fox et al. (2012) despite widespread evidence of the in the social impacts of MPAs, few peer-reviewed studies using the indicator approach exists. In particular, there is a paucity of evidence regarding socio-economic effects such as community organisation, employment, health and income (Fox *et al.*, 2012). Subsequently, there is a lack of detailed information describing the methodology and practicalities required to carry out assessments. Further limitations of indicator methods relate to the difficulty of attributing effects and practical issues associated with data collection and

producing an effective MPA evaluation (Rodriguez-Rodriguez *et al.*, 2014) . More work is required to study the magnitude of social impacts, across spatial scales, levels of organisation, social domains and within and among social groups.

Q-methodology

Description:

Q-methodology (Stephenson 1953) combines the benefits of both qualitative and quantitative research. Originally developed for use in the field of psychology, it has since been recognised as a useful tool in other disciplines, and its use in the environmental sciences is growing (Bacher et al., 2014). It is commonly used to assess stakeholder opinion, allowing the delineation of perspectives and the identification of areas where opinion converges and diverges (Mangi et al., 2008). In terms of its use for BES valuation, it uses interviews as a technique to investigate the in-depth perspectives of stakeholders allowing amenity values to be explored and the environments for which stakeholders have most affinity to be identified (Bacher *et al.*, 2014; Empringham, 2013; Kerr et al., 2007).

The methodology involves the generation of a series of statements on the topic under investigation which is representative of the breadth of the argument. These statements are ranked by participants using a forced-choice frequency distribution and factor analysis is conducted to identify key themes characterising stakeholder views. This enables the identification of several key themes which can then be explored in greater detail through assessment of supporting statements provided by the participants during the interview process which explain their choices. The results from such studies can provide an important socio-cultural basis on which to base future management and policy decisions (Mangi *et al.*, 2008).

Examples:

General Q-methodology studies with an application to value BES

In concurrence with focus groups, Crimian (2013) utilised Q-methodology to determine community perceptions of changes in ecosystem services from the restoration of a saltmarsh in South Carolina (USA). This integrated method provided a general consensus that restored ecosystem services of the saltmarsh could lead to improvement social, economic and environmental improvement in the area and an overall positive impact on the wellbeing of the adjacent community.

Sea Food

Although not applied directly to MPAs, a number of studies have utilised Q-methodology to assess stakeholder perspectives on seafood, as a provisioning ecosystem benefit. Falk-Petersen (2012) utilised Q-methodology to identify the value that the community placed on the red king crab, as a fisheries resource and invasive alien species. Perceptions collected by this technique were integrated and organised using the Millennium Ecosystem (MEA) Assessment Framework (Millennium Ecosystem Assessment 2005). Q-methodology has also been used to identify the socio-cultural value of European and international aquaculture fisheries. Murray et al. (2014) adopted Q-methodology to identify the socio-cultural role value of salmon aquaculture for communities on Vancouver Island (British Columbia). Q-methodology captured the full range of perspectives on the value of seafood in the region; which related to stewardship, education, tradition and prosperity. Bacher et al. (2014) also adopted this method in Catalonia, to explore the perceptions of stakeholder groups towards marine fish aquaculture, Participants in this study were asked to sort statements about the environmental, social and economic aspects of marine fish farming; revealing limitations, challenges and opportunities of the aquaculture industry.

This method is also being employed by Plymouth University where it will be utilised to investigate stakeholder acceptance of MPAs in Devon. Two case study sites, one in North Devon and one in South Devon will be used to compare opinion and acceptance in an area with very few MPAs to one where many MPAs exist. The results will be combined with economic analysis of MPA impacts to inform MPA management and stakeholder

engagement (Gall et al. unpublished). Mangi et al. (2008) also used Q-methodology, in order to evaluate marine biodiversity from a socio-cultural perspective in two European case study areas: Isle of Scilly and Pico-Faial. Socio-cultural perspectives of stakeholders were delineated and enabled similarities across stakeholder groups to be uncovered. Socio-cultural data was then combined with economic and biological values to produce decision support system for European seas and future management policies.

Regulation of Water Flows

Q-methodology was also used by Kerr et al. (2007), to assess the value of ground water allocation (springs and rivers) to stakeholders in New Zealand. Q sort methodology and the use of photographs, helped researchers to understand the perceptions of stakeholders and to identify attributes in the catchment that provided benefits to stakeholders.

Evaluation:

Q-methodology has predominantly been used to study a range of contentious environmental management issues, including ocean policy and fisheries (Empringham, 2013; Haggan, 2012). As seen from the examples provided, Q-methodology has been lacking in application to assessments of MPAs values and their corresponding ES benefits. Although limited, this technique has been applied to assess the benefits of provisioning and regulatory ecosystem services of the marine and freshwater environment.

The main advantage of Q-methodology is it enables researchers to identify immeasurable values (Haggan, 2012) and to gain an understanding of stakeholder perceptions of MPAs. This is a critical component of assessing the success of MPAs and management effectiveness. This is enabled by the face to face interviews which help researchers to effectively structure the technique and to more fully analyse perceptions and opinions. (Gall et al., In press). The methodology also only requires a small sample size of participants to generate statistically significant results. As stated previously, numbers should be limited to 40 or 50 participants (Brown et al., 2011; cited in Haggan 2012). Further to this, Q-methodology provides quantitative data for statistical analysis of

perceptions data and this is enabled by specialist software (PQMethod) (Frantzi et al., 2009). This software enables opinions to be clustered and helps to analyse patterns of agreement (Haggan, 2012).

One of the main disadvantages of this methodology is the time consuming and administrative nature of Q-methodology (Kettunen *et al.*, 2013b; Previte et al., 2007). Q-methodology involves two phases: research design and statistical analysis. Statistical analysis of the data are relatively easy to perform, however the initial stages of research design (interviews and generating carefully selected statements) is very intensive and time consuming for the researcher (Frantzi *et al.*, 2009). Further to this, the use of Q-methodology alone has been deemed less effective, providing only partial evaluations of community and key stakeholder perceptions (Frantzi *et al.*, 2009). Therefore in many cases, Q-methodology is combined with other valuation techniques including choice experiments. Although time consuming, this method, enables respondents to make more holistic judgements, utilising their understanding and interpretation of issues (Kerr *et al.*, 2007).

Welsh context considerations

Overall, workshop participants felt that non-monetary methods could potentially be useful in a Welsh context. Qualitative methods were described as beneficial in that they could provide values of marine and coastal areas which go beyond that of a monetary assessment. Benefits included the engaging nature of qualitative methods, which would provide useful valuation data based on both experience and local knowledge. Furthermore, this approach may promote more sustainable engagement of the public with individual MPAs. Participants also discussed the conditions in which to use qualitative valuation. It was agreed that, qualitative valuation could be used in isolation or in combination with economic assessments. Further to this, there was a general consensus that qualitative methods should be applied on a local/community scale, relating to difficulties associated with its application at a national scale. The participants also discussed the usefulness of each method on an individual basis, relative to a welsh context.

Citizen Juries

Citizen Juries (CJ) were described as a useful method for discussing new regulations and policies relating to fisheries and marine protected areas (prior to implementation). The use of this method may help to side-step problematic debates that may occur during consultation periods. Further to this, participants identified that CJ would help to engage stakeholders, in the aim of achieving valuations based on local knowledge. Stakeholder engagement, overall, was described as the 'broader benefit' of this technique. Furthermore, CJ (as a narrative technique) could be used to increase awareness and act as an 'icebreaker' at the initial stages of an MPA project. Specifically, participants stated that this methodology could provide locals with a sense of ownership and help to raise awareness of MPAs and other related issues. This would potentially provide sustainable engagement; for example CJ could meet over 1 week every 5 years and eventually become a focus group.

A number of concerns were also highlighted, relating to subjectivity, representation, credibility, effectiveness and practicality. Participants mentioned that CJs have small sample sizes (< 20), which may reduce the credibility of this method when communicated to policy makers. The method would also require a large number of participants; coming from a range of backgrounds to be able to answer different valuation questions. Furthermore, there would be difficulties in representing certain stakeholder groups within CJs. For example, it would be difficult to schedule in order for fishermen to attend; considering their working hours. Overall, the use of CJ was predominantly discussed as an exploratory technique, rather than a standalone method. CJ could be followed up by other methods e.g. place-based valuations and trade-off analysis.

Place Based Valuation

Place-based valuation was also described as a useful method to focus on specific places, areas and features within MPAs (e.g. seascapes and biodiversity). Participants discussed its potential use for assessing place-based attachment and wellbeing associated with the marine environment, largely considering benefits for coastal communities. This method would enable links to be drawn between features and the benefits they provide; potentially

acting as a lever to stop damaging activity. For example, Cardigan Bay could be used in future assessments, to investigate well-being benefits provided by activities such as dolphin watching. Participants identified that place-based valuation could be used to provide an overview of the value as well as an indication of how well an MPA is doing. For example, comparing ecosystem service values before and after MPA implementation. Participants also discussed the use of place-based valuation in combination with citizen juries, providing beneficial branding/marketing for MPA at a local level. Issues associated with this method mainly focused around its scale of use. Specifically there would be difficulties in applying place-based valuation to a large scale and/or offshore MPA ('Out of sight, out of mind').

Health Valuation

Participants felt that health valuations could be used to assess the benefits provided by the marine environment as a whole (e.g. effect of coastal paths on well-being); however they lacked usefulness for direct assessments of MPAs. They identified that it may be difficult to entangle the values related to the overall marine environment and those benefits related directly to MPA designation. Participants also highlighted the complexities relating to measuring health benefits (with the exception of physical activity) and questioned how it would be incorporated into an overall assessment. The use of health valuation was discussed largely in the context of assessing management approaches. For example, assessing the health benefits provided by the implementation of swimming access points in MPAs.

Indicator Approach

Participants largely discussed concerns relating to this methodology considering the time consuming nature and the assumptions surrounding the method. However, participants agreed on the usefulness of employment and education indicators in MPA assessments. Useful economic indicators would focus on jobs dependant on MPAs, for example conservation employees and volunteers. Educational benefits would be measured using indicators such as the number of school visits to an MPA or the numbers of MPA themed classroom lessons in schools. Skomer Island (Marine Nature Reserve) was largely used

as a case study, considering employability figures and the presence of a Field Studies Council. Three hundred students have studied the Island at a Field Studies Council Site.

Q-methodology

Participants highlighted concerns relating to the theory of Q-methodology. It was felt that the method forced the conversion of values into quantitative data; making the method less credible. Furthermore, that the approach is largely scientific and would be too complicated for the general public.

In general, there was a lack of identified evidence sources that could inform a number of the qualitative methods; with the exception of place-based valuation and citizen juries. Participants highlighted two particular case studies (Pembrokeshire and Skomer) that could inform Place-based valuation methods. In Pembrokeshire, previous studies have carried out mapping work to identify wildlife hotspots around the Pembrokeshire coastline. This project identified and mapped areas which have the most sensitive wildlife areas, including areas which are seasonally restricted to protect wildlife. In the case of Skomer Island, there is a large database containing spatial data on marine based- activities in the area (recreation and fishing use). Participants also identified that established advisory committees; could be useful groups for citizen juries or could help advise the process.

The workshop also provided an opportunity for participants to discuss any other methods that could be used to assess socio-economic assessments of MPAs. There was large consensus that existing documents (originating from Welsh study sites) could be used as an alternative approach to assess MPA benefits. Specifically, archived minutes and recordings could be used to draw out socio-economic values; through text analysis of the data. Participants identified that minutes and management documents from a 20 year period from Skomer Island would be highly useful. Documents could be used to capture perceptions of socio-economic importance and ecosystem values (e.g. cultural ecosystem services).

Participants also thought that responses to recent consultations (e.g. Welsh MCZ Project and SPA extensions), consents (SSSIs and MPAs) and minutes from coastal forums and

meetings (stakeholder, public and advisory group meetings) could also be analysed. In particular, participants highlighted the usefulness of the Welsh MCZ consultation in providing an initial evidence base for the socio-economic benefits of MCZs as many stakeholder views on this matter were collected as part of the consultation process. Analysis of responses and attitudes (sometimes contentious) could also help to capture information on ecosystem service values relating to (1) conservation designations (2) the overall value of the marine environment. Furthermore, the method could be used to measure social indicators relating to social tensions and perceptions; investigating any change over time.

Overall, the main sources of information were deemed to originate from the following sites: Pembrokeshire (e.g. Milford Haven), Pen Llyn A'r Sarnan and Skomer. For example, Pen Llyn A'r Sarnau would provide a large evidence base considering its status as the first SAC. Pen Llyn A'r Sarnau has a liaison group with local council and fisheries representatives and could be used to gain public data on activities, education and perceptions.

4. Analysis

4.1 Synthesis analysis of methods

The results of the literature review demonstrated that methods to value the socio-economic benefits of MPAs are an evolving area of research. The research team identified 208 studies (peer reviewed and grey literature) that can be applied to assessing the social and economic benefits of MPAs. Of these studies 91 were directly related to MPAs, 16 applied to the UK MPAs and 3 tested in the Welsh MPA context. Out of the 12 methodologies identified; 8 have been tested within the context of MPAs (Table 2).

Revealed Preference (CVM and CM):

The most commonly used methods for valuing ecosystem service benefits are stated preference methods, Contingent Valuation Method and Choice Modelling (n = 97). Of those stated preference valuations, the majority of the studies (n = 38) focus on valuing the beneficial ecosystem service of recreation, leisure and tourism. Overall, 49 of these studies were applied in the context of MPAs (CVM: n = 28, CM: n = 21). This is not a surprising result as stated preference methods generally make use of surveys to present a scenario (or a series of scenarios) on a hypothetical change in policy. This is useful to determine the potential socio-economic benefits of MPA management scenarios. Additionally, stakeholders in the recreation, leisure and tourism sector are easy to target, their activity is spatially explicit and activities can be directly related to the MPA. Despite the popularity of this research method, however, the limitations (Table 3) must be taken into account.

Place Based Valuation, Travel Cost Method and Market Valuation:

Other popular valuation methods are Place Based Valuations (n = 19), Market Valuation (n = 29) and the Travel Cost Method (n = 20) all of which have been tested within the marine environment, and some of which have been tested in the context of MPAs; Place Based Valuation (n = 13), TCM (n = 7) and Market Valuation (n = 9). TCM has been widely applied to assess the economic value associated with recreational activities occurring in

the marine environment with all 20 studies identified relating to BES. Its application to the assessment of socio-economic benefits of MPAs has primarily been in demonstrating the value of recreational activities to local economies, often to highlight the economic importance of recreational fishing in comparison to commercial fishing in a decision making context. Market Valuations for assessing the socio-economic benefits of MPAs are restricted to those BES where a market exists. The methodology has been most consistently applied to value the beneficial ecosystem services of recreation, leisure and tourism (n = 9) and sea food (n = 10). It is noted that market values only directly relate to the point of sale chosen by the researcher (e.g. first sale price from fishermen to fish market). Other influencing factors such as taxes, subsidies, exchange rates, seasonal variation and market fluctuations may not be taken into account. Therefore, the mixture of market price methods with a robust qualitative valuation method (e.g. Place Based Valuation) provides the essential mixture of economic data tempered with an analysis of the social issues. This potentially provides MPA managers and policy makers with a more informed vision of the context within which decisions regarding resource use can be made.

Hedonic Pricing, Indicator Approach, Q-methodology, Avoidance Cost and PES:
Methods such as Hedonic Pricing (n = 8), the Indicator Approach (n = 9), Q-methodology (n = 7), Avoidance Cost (n = 9) and Payment for Ecosystem Services (n = 4) are, at present, underdeveloped as methods for valuing the social and economic benefits derived from MPAs. Hedonic pricing is most consistently used for valuing the beneficial ecosystem services of sea food (n = 2), recreation, leisure and tourism (n = 2) and aesthetic information (n = 2). Although none of these have been applied in an MPA context the principles of the methodology could easily be applied to value the social and economic benefits of MPAs. Avoidance Cost method is predominantly used to value the BES of coastal erosion prevention (n = 4) provided by specific marine and coastal habitats. No specific MPA examples were found but the method is directly applicable to MPA conservation features such as saltmarshes, reefs and seagrass beds.

The Indicator Approach, particularly in relation to monitoring the success of MPA policy and management is a rapidly evolving field of research. The explicit linking of changes in biological indicators (fish diversity) to those occurring in socio-economic indicators

(number of recreational anglers) may well prove to be a useful tool for MPA managers. This would permit them to determine the socio-ecological effectiveness of MPAs once management regimes have become more established and more long term datasets become available. The Payment for Ecosystem Services methodology is most commonly used to date in terrestrial ecosystems. Its use as a valuation methodology is less common in the marine environment due to a lack of clearly defined property rights. However, given the application of this method to determine equitable trade-offs between stakeholders it may be more useful to inform MPA management measures than providing a valuation of the socio-economic benefits of MPAs.

Health Valuation and Citizen Juries:

Health Valuations (n = 4) and Citizens juries (n = 2) were the two valuation methods where there was the least evidence of use to determine the socio-economic benefits of MPAs. In terms of Health Valuations, determining the value of an MPA by measuring impacts on human health requires long term data sets. To date this methodology has only been applied to an MPA in a developing country where the coastal community rely on sea food as the main source of protein. The limited application of this method to temperate MPAs reflects the large difficulty in drawing links between health and MPAs in a developed EU context. The use of Citizens Juries to determine socio economic benefits in the coastal and marine environment has only been applied in the context of watershed management and combined with WTP scenarios. Because the method enables a deliberative group process its future use as a tool to determine management solutions in complex and contested MPA management scenarios may be useful.

Finally a point must be made regarding which beneficial ecosystem services are most commonly valued in order to assess the social and economic benefits of the marine environment. Sea food (n = 34) and recreation, leisure and tourism (n = 72) are the most consistently valued beneficial ecosystem services. This is probably due to the availability of market data and the availability of resident or spatially explicit MPA groups that can be used in the process of gaining primary data on beneficial ecosystem service values. Additionally, it can also be assumed that many of the cultural and amenity service values are also captured via this form of direct valuation. For example, the cultural heritage and

identity of fishermen may be inextricably linked to his/her fishing enterprise. Anglers have also reported a health benefit of stress reduction linked to the meditative nature of fishing. It is possible therefore that by only considering economic data then broader contexts and values may be left out of the decision making process.

Table 2: Literature search results by approach and ecosystem service

KEY X = total number of studies (peer-reviewed literature and grey literature) per approach and ecosystem service. (Y) = number of peer-reviewed studies only per approach and ecosystem service.	Monetary							Non-monetary				
	Market Valuation	Avoidance Cost	Travel Cost method	Hedonic Pricing	Payment for ES	Contingent Valuation	Choice Modelling	Citizen Juries	Place based Valuation	Health based Valuation	Indicator Approach	Q-methodology
General Ecosystem Services	3 (1)					12 (10)	19 (12)	2 (1)	7 (5)		6 (2)	1 (0)
Seafood	10 (6)	1 (0)		2 (2)	1 (1)	6 (6)	4 (2)		5 (5)			5 (1)
Sea Water		1 (0)		1 (1)								
Climate Regulation	5 (3)	3 (2)			2 (1)		2 (1)					
Disturbance Prevention						1 (1)						
Regulation of Water Flows												1 (0)
Waste Treatment						1 (1)	1 (1)					
Coastal Erosion Prevention		4 (3)		1 (1)		2 (2)	1 (1)					
Biological Control	2 (2)				1 (1)							
Lifecycle Maintenance						1 (1)	5 (4)					
Recreation, Leisure and Tourism	9 (5)		20 (17)	2 (2)		28 (26)	10 (7)				3 (0)	
Cultural Heritage and Identity							1 (1)					
Human Well-being										4 (3)		
Aesthetic Information				2 (2)		2 (2)	1 (1)					
General Cultural Ecosystem Services									7 (5)			
Total Examples	29 (17)	9 (5)	20 (17)	8 (8)	4 (3)	53 (49)	44 (30)	2 (1)	19 (15)	4 (3)	9 (2)	7 (1)
MPA Examples	9 (6)		7 (6)			28 (27)	21 (14)		13 (10)	3 (2)	9 (3)	1 (0)
UK MPA Examples	4 (1)		3 (2)				5 (3)		4 (4)			
Welsh MPA Examples							3 (2)					
Welsh Non-MPA Examples			2 (1)			1 (1)						

Table 3: Strengths and weaknesses of socio-economic assessment methods for MPAs.

Approach	Method	Strengths	Weaknesses
Monetary	**Market Valuation**	• Commonly used and well established method for assessing the economic value of services extracted from MPAs. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers. • Calculation is relatively straightforward. • Utilises pre-existing data (secondary data) and therefore is less time intensive.	• Limited availability of market data. Presence of influencing factors (taxes, subsidies, exchange rates, seasonal variation and market fluctuations) and policy failures; which must be considered to ensure data are meaningful. If proxies are used, then the values produced are not truly based on 'extractive use' of MPA resources.
	Avoidance Cost	• Highly applicable to valuation of natural coastal defences. • Utilises pre-existing data (secondary data) and is therefore less time intensive. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers.	• Lack of application to socio-economic assessments of MPAs. • Where replacement or substitute services are valued there must be feasible replacements/substitutes so that costs are relevant.
	Travel Cost Method (TCM)	• Commonly used and well established method for assessing the economic value of MPAs. • Useful for demonstrating the value of recreational activities to local economies. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers. • Method requires little adaptation to be applied to the Welsh context. • Calculation is relatively straightforward.	• Requires mathematical and statistical knowledge. • Requires an understanding of the specific location and potential variables affecting visitor use. • Lack of 'universally accepted method' makes the method subjective and dependant on the opinion of the user. • Lack of consistency in the method's application makes comparison between studies difficult.

Approach	Method	Strengths	Weaknesses
Monetary	**Hedonic Pricing**	• Applicable to a range of different ES services e.g. coastal erosion prevention, sea food and aesthetics. • Utilises pre-existing data (secondary data); and is therefore less time intensive. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers.	• Lack of application to socio-economic assessments of MPAs. • Relies on two assumptions: (1) that people will be aware of the link between environmental attributes and the benefits they experience, (2) that differences in quality will be reflected by differences in user experiences. • Requires a high degree of statistical expertise to develop a suitable method. • Influenced by external factors (e.g. inflation or changes in market prices for reasons that are unrelated to the marine environment).
	Payment for Ecosystem Services (PES)	• Where PES schemes exist this method is easily applied. • Utilises pre-existing data (secondary data) and is therefore less time intensive. • Based on 'real' values and therefore provides tangible and accessible figures for stakeholders, government and policy makers.	• Limited application to the marine environment (used more in terrestrial valuations). • Used more commonly as a management measure than as a method to assess socio-economic impacts of MPAs. • Specific to certain beneficial ecosystem services where incentives can be provided for protection/enhancement. Requires the existence of a PES scheme.
	Contingent Valuation Method (CVM)	• Established method used to assess a range of MPAs and marine environments. • Method is capable of estimating non-use values. Applicable to the range of types of ecosystem services.	• Survey is reductionist in character where by opinions, beliefs and behaviour are condensed into a number. • Elicited CVM values can be considered meaningless as hypothetical answers to hypothetical questions are produced. • May lack relevance to the practical complexity of policy situations. Influenced by wider economics, demographics and motivations of the sample group. • Complex method with potential issues such as survey bias. Resource and time intensive (analysis requires specific econometric expertise).

Approach	Method	Strengths	Weaknesses
Monetary	**Choice Modelling (CM)**	• Flexible tool to assess value of MPAs and range of defined ES benefits. Provides a decision making platform to identify potential trade-offs between ES benefits and the amount or quality of another benefit. • Can be applied at a network, site and/or ecosystem service scale. • Suffers less from respondent bias. • Yields a large amount of information about people's preferences over a range of outcomes.	• Complexity of method may reduce participant response rate. Resource intensive (requires specific econometric expertise).
Non-Monetary	**Citizen Juries**	• Group discussion exposes participants to richer set of information; enhancing their understanding of the pertinent issues. • Measures 'social willingness to pay' rather an 'individuals willing to pay'; increasing social equity and policy legitimacy of outcomes.	• Lack of application to MPAs and the marine environment. Relatively expensive method. Resource and time intensive.
	Place based Valuation	• Useful for assessing beneficial ecosystem services such as culture and amenity; that are more intangible values. • Helps to capture deep emotional attachments and spiritual connections to a place or area in a marine or coastal ecosystem.	• Still limited number of case studies (underdeveloped method). • Difficulties in integrating and comparing social values to monetary (economic) values generated from ecosystems. • Relatively expensive method. • Time consuming.
	Health Valuation	• Aims to link human benefits (wellbeing) directly to MPAs and the marine environment.	• Limited application in developed countries (e.g. EU). • Lack of simple relationship between MPA implementation and health benefits. • MPA specific (dependant on MPA design and context variables) Influenced by independent factors (e.g. local economy and activities).

Non-Monetary	**Indicator Approach**	• Multifaceted approach which combines social, economic, governance and ecological indicators. • Utilises pre-existing data (secondary data) and is therefore less time intensive.	• Lack of application to socio-economic assessments of temperate MPAs Difficulty in attributing indicator effects to MPAs.
	Q-method	• Helps to gain an understanding of stakeholder perceptions of MPAs. Provides quantitative data for statistical analysis. • Only requires a small sample size. • Enables respondents to make more holistic judgements, increasing their understanding and interpretation of issues. • Useful for assessing beneficial ecosystem services such as culture and amenity; that are more intangible values.	• Lack of application to socio-economic assessments of MPAs. • Initial stages of design are very intensive and time-consuming for the researcher.

4.2 Applicability to Welsh MPAs

To date, three studies were identified that have already attempted to assess the socio-economic benefits of the Welsh marine environment; predominantly MPAs. These studies were focussed on recreation, MPAs and potential for marine renewables:

1. **The value of recreation**. Questionnaires were used to assess the economic value of recreation in Wales, by valuing scuba diving, sea kayaking, wildlife watching and seabird watching (Ruiz Frau (2010). Costs associated with each activity in terms of travel to the site, accommodation costs, and costs associated with participation were calculated to give a value for total annual expenditure for all activities. The study revealed that non-extractive recreational users spent between £21.8 and £33 million in 2008 in Wales (Ruiz Frau (2010).

2. **The value of MPAs**. Ruiz Frau (2010) also conducted a CM experiment to determine how much society was WTP for a network of MPAs in Wales. Questionnaires were used to determine preferences for the attributes of MPA location, size of the network, levels of protection, the proportion of areas with

different levels of protection and the economic cost associated with enforcing protection payable via an annual contribution to a neutral charity. The results show that the public had a positive and supportive attitude towards MPAs, particularly favouring Highly Protected Marine Reserves combined with adjacent areas with differing levels of user access (Ruiz Frau (2010).

3. **The value of the marine environment and renewables**. A combined CVM and TCM method was used to assess the value of the marine environment around St David's, Pembrokeshire to determine the impact of marine renewable energy projects (Voke *et al.*, 2013). The CVM survey asked respondents how much they were WTP to conserve the area. The results show that the marine environment contributed, on average, to 78% of visitors' total enjoyment of the area. The median WTP value of £5.00 gives an overall aggregated 'Contingent Valuation' value of £15.5 million per annum for the case study area. Just 3.5% of visitors would be put off visiting the area again due to marine renewable energy developments Overall, the majority of respondents were WTP a contribution to keep the area maintained at its current standard.

As only three marine-related socio-economic assessment studies have been conducted in Wales, it is clear that there is a lack of primary peer-reviewed socio-economic studies in the Welsh marine context to support MPA policy. There is also very little Welsh-specific evidence from which to answer the three main questions posed by NRW:

1. What social and economic benefits are derived from our MPAs?
2. What is the potential for deriving further socio economic benefits whilst maintaining and/or enhancing the ecological condition of the site?
3. To what degree do socio economic benefits derived from MPAs rely on the favourable/improved conservation status/condition of the site?

This research shows however that there is a growing body of methodologies that have been used in other national settings that can be applied to the Welsh context.

4.3 Framing future work

Based on the results of this literature review and the discussions from the NRW workshop we would like to provide suggestions as to how a future work programme could be framed to address the three main questions posed by NRW. We present options at a variety of scales; The Welsh Marine Environment, The Welsh MPA Network and individual MPAs (Figure 2). At each scale we recommend that NRW apply a mixed method approach to achieve both monetary and non-monetary evidence. We would also recommend that NRW apply a nested approach to future work, whereby site specific MPA research is developed to better inform an assessment of MPA benefits for both the Welsh MPA network and the Welsh Marine Environment.

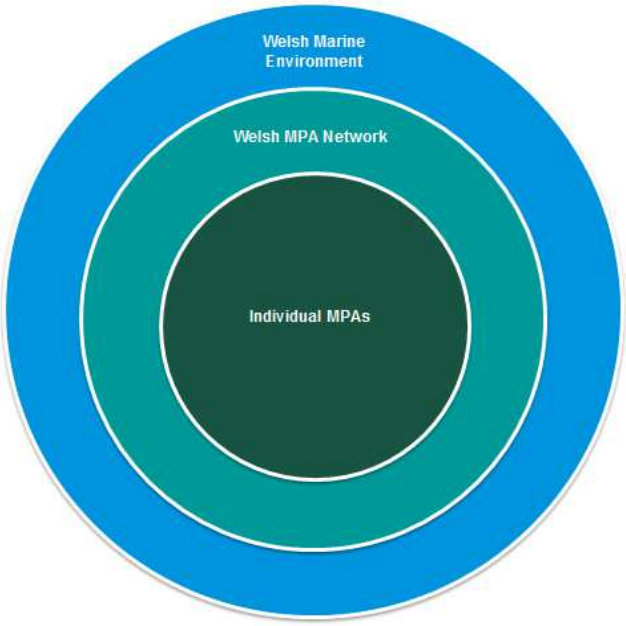


Figure 2: Diagrammatic of NRW research options at a variety of scales: (1) The Welsh Marine Environment, (2) The Welsh MPA Network and (3) Individual MPAs.

The Welsh Marine Environment

This programme of work would examine the social and economic benefits derived from the whole Welsh Marine Environment. Future work programmes may include (and is not limited to) the following:

Revealed Preference Methods

- Market valuations of sea food, recreation, leisure and tourism.
- A valuation of other extractive uses of the marine environment, such as aggregates, and renewables.
- Avoidance cost valuations for marine and coastal habitats that are associated with coastal erosion prevention.

Stated Preference Methods

- Incorporation of the CM valuation studies by Ruiz Frau (2010) for recreation, leisure and tourism and CVM from Volke et al (2013) for aesthetic values.

Non-Economic or Qualitative Methods

- A nationwide Place Based Study to determine the public's social and economic values associated with the Welsh marine environment.
- A Health Valuation Study to assess the health benefits provided by the marine environment as a whole. For example, the effects of coastal paths or swimming access points on health and well-being.
- A text analysis of existing documents from Welsh Case study sites (SAC/MCZ/MPA) could be used to capture perceptions on the value of the marine environment. Existing documents include consultations, consents and minutes from management, stakeholder, public and advisory group meetings.

The Welsh MPA Network

This programme of work would examine the social and economic benefits derived from the Welsh MPA network. Future work may include (and is not limited to) the following:

Revealed Preference Methods

- Spatial analysis and modelling of the market values of sea food derived from MPAs combined with a series of focus groups.
- Avoidance cost valuations for damage cost avoided and replacement cost for marine and coastal habitats within MPAs that are associated with coastal erosion prevention. For example, biogenic reefs within MPAs.
- Avoidance cost valuations for infraction costs which are avoided through MPA designation.
- Potential for investigating saltmarsh lamb as a PES scheme to add to the valuation of saltmarshes in MPAs.

Stated Preference Methods

- A stated preference survey via the 'Visit Wales' website to determine visitors WTP for MPAs in Wales.
- Incorporation of the CM valuation study by Ruiz Frau (2010) to determine how much society is WTP for a network of MPAs in Wales.
- Incorporation of the valuation studies by Ruiz Frau (2010) for recreation, leisure and tourism.
- A stated preference survey to determine the public's WTP for MPAs that enhance habitat or management for 'charismatic species'. For example, grey seals in Pembrokeshire and dolphins, porpoise and seals in Cardigan Bay and Tremadog Bay.

Non-Economic or Qualitative Methods

- A nationwide Place Based Study to determine the public's social and economic values associated with the Welsh MPAs.Health Valuation of sites such as Cardigan Bay; which act as case studies for investigating well-being benefits provided by marine activities such as dolphin watching.

Site Specific MPAs

This programme of work would examine the social and economic benefits derived from individual MPAs. The advantage of a series of site based studies is that a database of valuations can be accumulated. Such valuations could also be used to provide robust benefit transfer values to determine a more accurate picture of the socio-economic benefits of Welsh MPAs. Additionally, at an MPA site level the 'degree to which socio-economic benefits derived from MPAs rely on the favourable/improved conservation status/condition of the site' and 'the potential for deriving further socio economic benefits from MPAs whilst maintaining and/or enhancing the ecological condition of the site' can be accurately informed by the biological monitoring of the MPA. For example, future work at the scale of an individual MPA might include (and is not limited to) the following:

Revealed Preference Methods

- Market valuation of sea food extraction from the site, including benefits of 'fishing the line' and extraction other than fisheries such as aquaculture.
- TCM study of site visitors combined with valuation of tourist operations such as dive businesses, charter boats, and wildlife watching establishments which are used by tourists at the site
- Valuation of site specific conservation features using a combination of methods including market values, avoidance cost and TCM to provide a holistic valuation.

Stated Preference Methods

- A CM survey to determine divers and anglers WTP to dive or fish in protected sites.
- The publics WTP for sea food harvested from an MPA. For example if an MPA associated fishery could attain Marine Stewardship Council (MSC) for operating sustainably within an MPA.
- Visitors WTP a 'tourist tax' for visiting MPA sites. Such WTP that could be used to determine potential levies for undertaking activities within an MPA. For example an MPA levy could be realised through a 'visitor payback scheme' at hotels where divers stay.
- The public's WTP for management measures that enhance habitat for 'charismatic species'. A stated preference survey would be useful to determine how much more they would be WTP for management that increases the chance of wildlife sightings.
- In order to potentially provide market research for future revenue streams for HPMR (e.g. Skomer) a WTP survey could explore the value of a HPMR to the research and education sector (particularly if enhanced field facilities were available) and the commercial and oceanographic sector (testing appliances away from commercial fishing activity).

Non-monetary methods

- A text analysis of existing documents; recording the site since it's designation in 1990 (1990-2014). Historical documents include: responses to consultations, consents and minutes from meetings (e.g. management, stakeholder, public and advisory group meetings). This will help to capture the value of the MPA designation and any social and economic changes over the 20 year period (e.g. social tensions and perceptions).
- Organisation of Citizen Juries in order to establish site-specific socio-economic value of an MPA; providing outputs such as a public narrative for use in documents and media.
- Place-Based valuation of an MPA; utilising existing databases of marine-based activities (fisheries and recreation) and spatial resources. This would enable links to be drawn between features and the benefits they provide.

- Integration of Citizen Juries with Place Based Valuation of an MPA; providing locals with a sense of ownership and helping to raise awareness of the MPA. This would be useful for gaining ‘beneficial branding/marketing’ for an MPA at a local scale.
- Implementation of an indicator approach to assess the site-based benefits of an MPA. Economic indicators would focus on the jobs dependant on the MPA (e.g. conservation and management jobs). Social indicators would theme around education, for example the number of schools that visit the MPA and the number of linked educational facilities.

5. Conclusion

Globally, it is increasingly recognised that the socio-economic benefits available from the marine environment, MPA networks, and individual MPAs are potentially significant. Effective marine conservation policy and management measures can therefore make an important contribution to socio-economic well-being as well as the protection marine biodiversity and ecosystem functions. However, such contributions require an understanding of the socio-economic benefits that the marine environment, MPA networks, and individual MPAs can provide, and the management measures most likely to deliver these benefits. Evidence from the literature review and workshop suggests that methods to assess the socio-economic benefits of the marine environment and MPAs are well developed, but each has specific strengths and weaknesses. As such, the application of socio-economic assessment methods must be undertaken carefully and with a clear view of the type of evidence needed to support future marine conservation management decisions and policy development.

At present, there is limited available evidence to inform the assessment of socio-economic benefits associated with the Welsh marine environment, the Welsh MPA network, or individual MPAs. This limits the potential to apply understanding of the socio-economic benefits of MPAs to decision making and management. It also limits the ability to identify where and how socio-economic benefits can be returned to the Welsh economy from the Welsh MPA network. As a result, it is recommended that consideration is given to undertaking a spatially nested multi-method work programme to identify the socio-economic benefits associated with the Welsh marine environment, MPA network, and individual MPAs. Such a work programme could focus on a combination of primary data collection and the innovative use of existing evidence, which if implemented, would place Wales at the forefront of European marine conservation policy and practice.

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Natural Resources Wales

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