MB0104: Determining how and what to take into account in the planning of marine protected area networks – socio-economic data

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Executive Summary

The UK Government is committed (through OSPAR, the World Summit on Sustainable Development and the Convention on Biological Diversity) to setting up a network of Marine Protected Areas (MPAs) to contribute to the protection of marine ecosystems and biodiversity.

To support delivery of these commitments the UK Marine and Coastal Access Act 2009 (and the Marine (Scotland) Bill) make provision for the identification, designation and management of a network of MPAs for English territorial waters and waters offshore of England, Wales and Northern Ireland under the UK Act and Nature Conservation MPAs in Scottish territorial and offshore waters under the Marine (Scotland) Bill to conserve and promote the recovery of a wide range of habitats and species. Under the UK Act, in considering whether it is desirable to designate an area as a Marine Conservation Zone (MCZ), the appropriate authority may have regard to any economic or social consequences of doing so.

In January 2009, Defra commissioned a consortium led by ABPmer¹ to review and set out options on how socio-economic data could be integrated into the planning of MPA networks in UK marine waters.

The overall purpose of the study has been to review relevant international and UK experience on how socio-economic data has been integrated into planning and to identify options and lessons learnt for application to the UK MCZ planning process. The key objective of the study was to assess how socio-economic data had been taken account of in other planning exercises, what types of data were routinely used, when in the process such information was considered, and what tools were used as part of this assessment.

The review has been delivered through an examination of international MPA case studies and relevant non-MPA case studies and an expert workshop. Approximately 20 MPA case studies were initially identified of which nine were reviewed in detail. A variety of non-MPA case studies and academic research has also been reviewed in identifying a broader range of options for UK MCZ planning. Based on the findings from the review and workshop, options that could be pursued in a UK context were highlighted, including details on possible tools and approaches to analyse, interpret and present socio-economic information (the ‘how’); types and format of socio-economic data that might be required (the ‘what’) and the points within the planning process at which different types of information might be interjected (the ‘when’).

The key outcomes and conclusions from the study are summarised below.

¹ The consortium comprised ABPmer, Economics for the Environment (eftec), Jim Claydon (Independent Planning Consultant) and Peter Jones (University College, London)
Overview of Network Design Process

All of the MPA case studies have followed an iterative process in developing network options with significant involvement of, or consultation with, stakeholders. The iterative nature of the process often means that different phases of the network design process are not very distinct and MPA initiatives may cycle between phases of activity as part of the iteration process. Two main phases of activity can be distinguished as part of network design – a process of initial network design during which many designs may be put forward and rejected, followed by more detailed deliberation on a subset of preferred network options. A process of Regulatory Impact Assessment (RIA) may then subsequently be applied to one or more preferred options which, in some case studies has then led to further iteration on network design.

In presenting the findings of the review and in discussing options for application in a UK context, it was useful to distinguish between activities and information requirements for initial network design and those associated with deliberation, although we accept that in practice, the boundaries may often be blurred.

Options for the Use of Tools

MPA initiatives have used a variety of tools to assess the socio-economic implications of network proposals. Different tools have tended to be used at different stages of the network design process.

In the initial phases of network design, simple mapping and spatial analysis tools have been used to identify potential conflicts including the use of paper-based maps or electronic maps held within a geospatial database (Geographical Information System; GIS). The Californian Marine Life Protection Act (MLPA) MPA initiative made use of bespoke software – MarineMap. This tool captures socio-economic data and provides customised reports on interactions between socio-economic activities and possible network options using spatial analysis tools.

A number of MPA initiatives have used specialist mathematical optimization tools such as MarXan both as part of the formal network selection process (Great Barrier Reef, Papua New Guinea) or as an informal process alongside more formal stakeholder discussions (MLPA initiative). These tools were considered helpful in developing various network options which meet the specified criteria established relating to both ecological aspects and minimising costs (e.g. avoiding areas of human use). However, some initiatives have avoided the use of such tools because the use of complex mathematical algorithms was considered to make the approach less transparent to stakeholders.

Both simple and more complex approaches to the initial incorporation of socio-economic factors in network design have been reported as being successful.

The detailed deliberation processes applied to MPA case studies have used a range of tools to support decision-making. While such tools can be used to generate information to support decision-making, they do not provide prescriptive solutions and therefore need to be applied as part of an overall process of deliberation, consensus
building and expert judgement. In the MPA case studies, the deliberation phase has continued to make use of spatial analysis tools. In addition cost benefit analysis (CBA) tools have been applied to evaluate socio-economic impacts, although this has largely focused on the assessment of economic costs. There were only nine examples of MPA initiatives using tools to collect and assess social impacts, although such tools are widely applied to terrestrial planning initiatives (for example, the Sustainability Analysis (SA) of Yorkshire & Humberside Regional Spatial Strategy (Y&H RSS)). A number of academic studies have proposed the use of multi-criteria analysis (MCA) or trade-off analysis to support the identification and designation of MPAs but there is little evidence for the use of such formal frameworks to support MPA decision-making. In contrast, the use of a form of multi-criteria analysis is widely established within the process of Sustainability Appraisal for UK terrestrial planning.

In undertaking assessments of socio-economic impacts the MPA case studies have made use of information on the potential environmental impacts of socio-economic activities but have tended not to apply formal Environmental Impact Assessment (EIA) tools, relying on information from the wider scientific literature instead. One MPA case study - the MLPA Initiative - has made use of fisheries bioeconomic models as an EIA tool to assess the wider impacts of network designation on fisheries. The application of such a tool was considered helpful in exploring the complexities of fishing impacts and potential long-term benefits associated with short-term reductions in fishing pressure.

The majority of the MPA case studies reviewed have used CBA approaches to provide information for RIA towards the end of the process to develop an agreed network.

**Information Requirements**

The MPA case studies have made use of a wide range of socio-economic information including both spatial data and non-spatial data. A number of case studies have compiled such information within an overall 'Regional Profile' to provide an accessible resource of key information relevant to the area/region, including socio-economic information.

Many of the case studies investigated have focused on fisheries information, largely because fisheries was the main socio-economic activity occurring in those areas. Other initiatives have considered a broader range of uses where relevant (such as oil & gas, navigation, leisure and recreation). Generally, the case studies have considered all significant socio-economic uses that may interact with MPA networks within their overall assessment.

All of the case studies have compiled spatial data into data layers. This supported presentation of the information to stakeholders and facilitated spatial analysis of the data. The data layers developed within each initiative reflected the importance of particular socio-economic activities in those areas. Many of the case studies developed data layers indicating the relative importance or economic value of particular activities. Such data was found to be particularly useful in supporting network design. The scale of resolution required for some of the data layers, for
example, inshore fisheries, was often quite high. Some initiatives sought to provide a resolution of 1nm².

A number of the case studies sought to take account of possible future uses of areas (for example by collecting information on long-term fishing trends, future fishing intentions or identifying areas of potentially exploitable natural resource). However, the difficulty of accurately predicting future requirements is recognised and this needs to be dealt with as part of the development and evaluation of detailed network options.

A range of non-spatial data has been used within the case studies, including information on market structure, management and operating regimes of socio-economic activities in the marine environment, dependencies and linkages, economic value and profitability, information on the cost of specific management measures and information on pressures and impacts. Such information helps to inform further deliberation on preferred network design options.

Where specific assessments of social impacts have been undertaken (such as in the Papua New Guinea case study), this has involved primary research to collect information on social organisation (access rights), culture and community perceptions of marine conservation and management practices. Based on the wider literature review, application of more formal approaches to social impact assessment might require information on a wider range of issues including lifestyle, cultural, community, quality of life and health impacts.

The MPA case studies reviewed made little explicit use of information on socio-economic policies or priorities in developing and evaluating network options, although consideration of policy consequences is central to concepts such as Sustainability Appraisal (SA) which are routinely applied in terrestrial planning.

Information on benefits has been used to support Impact Assessments (IAs), although several of the case studies acknowledge the difficulty in obtaining quantitative data on benefits.

**Timing of Information Interjection**

All the case studies reviewed were characterised by increasing information richness as the network design process progressed. While the different case studies started at different points in terms of information richness, this was not identified as a major factor influencing the success or failure of individual initiatives, although the review highlighted the importance of taking account of socio-economic factors early on in the network design process. All the case studies collected and made use of additional information through the network design process.

In the early stages of network design, the case studies focused on using relatively simple spatial representations of socio-economic activity, based on location and, where available, relative importance or economic value. They also made simple assumptions about the potential compatibility of different socio-economic activities with likely conservation requirements.
In the deliberation phase a wider range of information was used by the case studies including both spatial and non-spatial data. In particular, the case studies sought to identify the potential costs of management measures that might be required to support achievement of conservation objectives. This ranged from simplistic assumptions that all existing value would be lost through to more detailed evaluation of the spatial extent and unit cost of specific management measures and wider consideration of behavioural responses by affected sectors.

Benefits information was only used to support IAs once preferred network options had been developed, although it should be noted that the information in the IAs often led to subsequent revisions of network proposals.

**Application to a UK Context**

The consideration of socio-economic factors within the overall UK MCZ planning process will need to reflect the legal provisions of the Marine & Coastal Access Act and integrate with the wider network planning process. It is assumed that the process of network design will be an iterative one in line with other international experiences. The figure below seeks to summarise the tools and information requirements for incorporation of socio-economic factors within the UK MPA planning process and the points at which they might be applied.

**Schematic representation of possible process for incorporating socio-economic factors within MCZ planning**

<table>
<thead>
<tr>
<th>Tools</th>
<th>Process</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Spatial analysis (mapping)</td>
<td>Prepare Design Guidance</td>
<td>Objectives, targets criteria, advice</td>
</tr>
<tr>
<td>• Network design tools</td>
<td>Initial Network Design</td>
<td>• Regional profile</td>
</tr>
<tr>
<td>[ ]</td>
<td>Identify Network Options</td>
<td>• Existing national spatial data layers on ecological features and key socio-economic activities (location, importance, economic value, compatibility (pressure))</td>
</tr>
<tr>
<td>[ ]</td>
<td>Detailed Deliberation</td>
<td>• Stakeholder proposals</td>
</tr>
<tr>
<td>• Spatial analysis</td>
<td>First cut analysis</td>
<td>Collection/collation of additional information on:</td>
</tr>
<tr>
<td>• Cost benefit analysis</td>
<td>Detailed assessment</td>
<td>• Local spatial data</td>
</tr>
<tr>
<td>• Social impact assessment</td>
<td>(with initial IA)</td>
<td>• Cost impact of possible management measures</td>
</tr>
<tr>
<td>• Multi-criteria analysis</td>
<td>Recommendations to SNCBs</td>
<td>• Benefits of MCZ network</td>
</tr>
<tr>
<td>(with further IA)</td>
<td>(with further IA)</td>
<td>• Social impacts</td>
</tr>
<tr>
<td>[ ]</td>
<td></td>
<td>• Consequences for achievement of socio-economic policy priorities</td>
</tr>
</tbody>
</table>
There is no one single assessment tool that might adequately capture all aspects of socio-economic impacts and a variety of tools are likely to be required to inform network design as part of a wider process of stakeholder discussion, consensus building and expert judgement.

In the early phases of network design, relatively simple tools are required that can be used to rapidly generate alternative network options for evaluation. These could be as simple as providing map overlays on which stakeholders might draw proposals for MCZs through to the use of sophisticated mathematical optimization network design tools. The options generated can be analysed using simple spatial analysis tools to provide stakeholders with an overview of the potential nature and extent of interaction between specific socio-economic activities and proposed MCZs, based on assumptions about the relative compatibility of the activity with conservation requirements. Stakeholders might then express preferences for particular network options based on this information with a view to taking forward a more limited number of options for more detailed evaluation.

Given the complexity of the ecological criteria for MCZ planning and the multitude of socio-economic uses in UK seas, it is unlikely that initial network design can sensibly be undertaken without recourse to network design tools. In our opinion, such tools are likely to be required as part of the initial network design process to make sense of this complexity. However, their use should only occur with the agreement of stakeholders and at such time as stakeholders understand the types of output that these tools produce. It may be appropriate to use network design tools alongside more bottom-up approaches to enable comparisons of outputs to be made.

The more detailed evaluation phase necessarily requires more complex and involved assessment of socio-economic impacts than can be provided by a simple spatial analysis. Various tools exist to inform assessments of socio-economic impacts but there is no single tool that addresses all types of impacts. To enable a comprehensive assessment to be made of all relevant socio-economic factors, the following tools are likely to be required:

- Economic cost impact analysis and benefits analysis as part of an overall CBA for qualitative and quantitative (monetised) assessment of economic costs and benefits;
- Social impact assessment for qualitative assessment of social impacts; and
- MCA for the assessment of socio-economic policy consequences.

A CBA framework is likely to be the most appropriate way of capturing and presenting information on economic costs and benefits. The use of benefits information as part of the deliberation process would also contribute to the formal IA process and we therefore support its inclusion in the network design process, although we note that this has not been done by other MPA initiatives. We consider that the CBA framework should be complemented with tools for the assessment of social impacts and socio-economic policy consequences of network proposals to ensure that the full range of socio-economic factors can be taken into account. These different elements could be integrated within a single overall assessment framework.
Various bioeconomic models have been developed for some aspects of UK fisheries. While the degree of confidence in the predictions from these tools is generally low, they may have a role to play, particularly in evaluating the effects of cumulative pressures on fisheries both as a result of MCZ proposals and other initiatives (Common Fisheries Policy (CFP) reform, quota reductions, Round 3 Offshore Wind Farms (R3 OWF) etc.). However, the use and application of such tools would need to be discussed and agreed amongst relevant stakeholders.

There is good basic spatial data available on the location of most socio-economic activities in UK seas with accurate mapping of infrastructure (oil & gas infrastructure, cables, pipelines, renewable energy installations), navigation channels, aggregate extraction sites and dredged material disposal sites. Good spatial data is also available for fishing vessels >15m based on Vessel Monitoring System (VMS) data. Some information on the spatial intensity of socio-economic activity and the environmental pressures associated with those activities is also available. This information is being compiled through a separate Defra contract MB106 and will be made available to the regional MCZ projects to support network design. There are some specific gaps in relation to spatial information for inshore fisheries and leisure and recreation activities (diving, sea angling, charter boats, watersports, wildlife), which may need to be collected by the regional projects.

It’s suggested, in line with the experiences described in the case studies, that initial network design might usefully focus on developing a range of network design options using simple spatial data to represent key socio-economic activities (activity type, location and where available importance, value, intensity and compatibility). A recommended list of data layers is presented in Appendix F. It is likely that additional spatial information will need to be collected/collated by the regional MCZ projects, particularly in relation to local fin-fisheries and recreational activities.

The focus of initial network options might usefully include consideration of sectors delivering key policy priorities or those that might be considered to be incompatible with conservation objectives. Regional Stakeholder Groups (RSGs) should be encouraged to make an input into decisions on how initial networks might be defined and thus the types of information to be used at this initial stage.

For the deliberation phase of network design, a broader range of socio-economic information will need to be accessed and evaluated. This could include information on the market structure of specific sectors, future trends, management and operating regimes within an area, economic value, the economic cost consequences of management measures and distributional impacts. In addition, to fully assess social impacts, a wider range of social information would need to be captured by primary research. The evaluation of the socio-economic policy consequences of network options will require information on existing policies and priorities.

A listing of relevant sources of information on non-spatial socio-economic data is presented in Appendix E and a listing of current socio-economic policies is presented in Appendix G. Engagement of stakeholders within the regional MCZ projects also provides an opportunity to collect additional local information on social and economic activities.
There is limited information on the valuation of environmental benefits in the marine environment. It is unlikely to be possible to collect new primary data within the time scales or resources of the regional MCZ projects. An alternative approach could be to use value transfer to provide information on the possible scale of different types of benefits, although the amount of available information is currently small and the uncertainties introduced by such an approach would need to be clearly acknowledged. Incorporation of information on benefits as part of the process of deliberation on network options should be encouraged as such information, even of a qualitative nature, can help to inform decisions on preferred options.

The process of deliberation on network design options is essentially an iterative one. To minimise information requirements at this stage, a two-phase approach to assessment has been proposed involving an initial first cut phase to provide a primarily qualitative assessment of an option followed by more detailed (quantitative) assessment where this is deemed necessary. RSGs will need to make choices about the level of information that should be sought at each stage, particularly in relation to requirements for any additional studies.
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1. Introduction

1.1 Overview

1.1 In January 2009, the Department for Environment, Food and Rural Affairs (Defra) commissioned a consortium led by ABPmer\(^2\) to review and make recommendations on how socio-economic data could be integrated into the planning of Marine Conservation Zone (MCZ) networks in United Kingdom (UK) marine waters.

1.2 This report reviews relevant international and UK experience, including detailed case studies for some of the most relevant examples. Recommendations are presented on:

- What socio-economic information is likely to be required to inform and support the design of MCZ networks;
- How such data might be integrated into the planning process; and
- When different types of information might be required to support decision-making.

1.3 The recommendations have been informed by an international workshop held in April 2009 at which requirements and options were discussed.

1.2 Background

1.4 The UK Government is committed (through OSPAR, the World Summit on Sustainable Development and the Convention on Biological Diversity) to setting up a network of marine protected areas (MPAs) to contribute to the protection of marine ecosystems and biodiversity.

1.5 To support delivery of these commitments the UK Marine and Coastal Access Act (and the Marine (Scotland) Bill in Scotland) provides for the identification, designation and management of a network of MPAs (termed Marine Conservation Zones (MCZs) under the UK Bill) to conserve, and promote the recovery of a wide range of habitats and species. The purpose of MCZs\(^3\) is to conserve or aid the recovery of:

- Rare or threatened habitats (e.g. seagrass beds and deep soft sediment habitats);
- Rare or threatened species (e.g. the sunset cup coral, the long-snouted seahorse and the native oyster);
- Globally or regionally significant areas for geographically restricted habitats or species (e.g. estuary habitats and the spiny lobster);

\(^2\) The consortium comprised ABPmer, Economics for the Environment (eftec), Jim Claydon (Independent Planning Consultant) and Peter Jones (University College, London)

• Important aggregations or communities of marine species where a large number of species occur in one area, particularly hotspots;
• Areas representing a range of biodiversity in UK waters (e.g. important habitats such as areas of muddy seabed which contain Norway lobster, Northern sea fan and Angular crab);
• Areas important for key life cycle stages of mobile species, including habitats known to be important for reproduction and nursery stages;
• Areas contributing to the maintenance of marine biodiversity and ecosystem structure and functioning in UK waters; and
• Features of particular geological and geomorphological interest.

1.6 Under the Habitats and the Offshore Marine Regulations\(^4\), the UK Government has already identified and designated a number of marine areas as Special Areas of Conservation (SAC) and Special Protection Areas (SPA) respectively. Further areas continue to be identified in order to complete the network of SACs and SPAs (collectively known as ‘European’ or ‘Natura 2000’ sites). These European marine sites will form an important component of the UK’s MPA network.

1.7 Under the UK Marine and Coastal Access Act, decisions on MCZ network design and individual site designation are able to take account of socio-economic issues. Section 117(7) of the Marine and Coastal Access Act states: ‘In considering whether it is desirable to designate an area as an MCZ, the appropriate authority may have regard to any economic or social consequences of doing so’.

1.8 The Act Explanatory Notes indicate that subsection (7) allows Ministers to take account of the economic or social consequences of designation. This ensures MCZs can be designated in such a way as to conserve biodiversity and ecosystems \textit{whilst minimising any economic and social impacts}. Where an area contains features that are rare, threatened or declining, or forms a biodiversity hotspot, greater weight is likely to be attached to ecological considerations. Where there is a choice of alternative areas which are equally suitable on ecological grounds, socio-economic factors could be more significant in deciding which areas may be designated as an MCZ.

1.9 Within England, four regional MCZ projects are underway to develop recommendations for MCZs with a high level of stakeholder engagement. The projects, which cover English territorial waters and offshore waters of England Wales and Northern Ireland are: \textit{Finding Sanctuary} (South West England), \textit{Balanced Seas} (South East England), \textit{Irish Sea Marine Conservation Zones}.

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and Net Gain (North Sea) (Figure 1). These projects will need to be able to access consistent socio-economic information to facilitate stakeholder engagement in the site selection process.

Figure 1: Boundaries of MCZ Planning Regions

1.3 Project Objectives

1.10 The overall purpose of the study was to review relevant international and UK experience and make recommendations on using socio-economic data in the planning of marine conservation zone networks in UK marine waters. Four key objectives were set for the study:
• To objectively assess how socio-economic factors have been taken account of in other planning exercises elsewhere, particularly MPAs but also including non-MPA and terrestrial examples that might be relevant (international, European and national e.g. Finding Sanctuary) and to provide the findings of this review in a succinct report which includes an assessment of applicability to the UK MCZ planning process and recommendations;
• To liaise with a range of parties and undertake an expert workshop to discuss and generate ideas on how socio-economic activities can be taken account of;
• To identify and present options for taking socio-economic factors into account when developing potential networks of MCZs, including details on any derived data layers that are considered key in helping to inform MCZ selection and for use in stakeholder engagement activities; and
• To provide details of the project approach and recommendations in a succinct and clearly presented final report.

1.11 Within the project specification a series of more detailed questions were also posed as a minimum to help guide the study:

• How have socio-economic factors been taken into account in the designation of marine protected areas elsewhere in the world and which approaches proved to be most effective?;
• What were the objectives of using socio-economic data to inform MPA selection and how successful was the approach that was adopted in achieving these objectives?;
• What format of socio-economic information is used for these approaches (such as data layers, deliberative approaches)?;
• How important is it to have economic datalayers derived for MPA selection? How much do these datalayers add to informing stakeholders involved in the selection process when compared to likely ease of creating the datalayer itself?;
• What are the key socio-economic datalayers to be developed and how should these be employed in MPA network planning?;
• How should the relative economic and social value of different activities be taken into account in the analysis? If weights could be used, what criteria should be used to weight different activities and how should this be done?;
• How do we not exclude areas where there are activities of high economic value which are compatible with the habitats being afforded protection within the MCZ?;
• What will the impact of creating an MCZ be on the identified social and economic elements? What are the interlinkages/interdependencies between social/economic and environmental elements. How can the socio-economic elements be assessed relative to the environmental benefits of MCZs?;
• How do we ensure data collected and the derived datalayers developed do not become obsolete over too short a time period in informing network design?; and
• How can future patterns of use/activities also be taken into account in datalayers derived?

1.4 Approach and Report Layout

1.12 The study has been undertaken by a consortium led by ABPmer and including expert input on economic appraisal (eftec), planning processes (Jim Claydon, Independent Consultant) and social impact assessment (Peter Jones, University College London).

1.13 Oversight of the work has been provided by a Project Steering Group chaired by Defra and including representatives from Defra, Natural England (NE) and the Joint Nature Conservation Committee (JNCC).

1.14 Section 1 of the report (this section) provides an introduction to the study, with further detail of the background and policy context for the study presented in Section 2. The approach to the study, including the literature review of relevant case studies and tools is described in Section 3. The lists of case studies and tools reviewed are detailed in Appendices A and B. Section 4 presents the outcomes of the review and incorporates insights from an expert workshop held in Reading in April 2004. Section 5 discusses the considerations for including socio-economic information in the MCZ process in the UK. Section 6 presents concluding remarks in relating to the incorporation of socio-economic factors into the overall MCZ planning process, the choice and applications of tools and methods and the socio-economic information requirements.
2. Background and Policy Context

2.1 Development of UK MCZ Planning Process

2.1 There is already a considerable body of guidance on the proposed MCZ planning process (e.g. Defra, 2009a, b, Natural England & JNCC, 2009). The proposed process has taken account of good practice principles for stakeholder engagement in environmental planning and decision-making. The process also reflects approaches adopted elsewhere in the world for MPA planning, while taking account of the particular institutional and administrative arrangements in the UK. More detailed guidance on network design principles and regional project process and governance will be published for consultation later in 2010.

2.2 An overall schematic of the process is presented in Figure 2 based on the Draft England MCZ Project Summary (Natural England (NE) and JNCC, 2009), and the process described in Defra’s draft strategy for marine protected areas and draft guidance on the selection and designation of MCZs (Defra, 2009a, b). The development of proposals for MCZs within English territorial waters and waters offshore of England, Wales and Northern Ireland will be taken forward by four Regional Stakeholder Groups (RSGs) taking account of national guidance on network requirements and criteria. The Groups will be provided with the best available information on the distribution of ecological features together with appropriate socio-economic information. It is intended that proposals for individual MCZs will emerge from an iterative process of deliberation within the Stakeholder Groups and appropriate advice from a national Scientific Advisory Panel (SAP) on the extent to which network objectives might be achieved. Recommendations from the RSGs will be collated by NE and JNCC and forwarded to Ministers. Following a public consultation, Ministers will make decisions on the final network of sites.

2.3 A key principle of the proposed process is that the four RSGs will have a high level of involvement in recommending potential MCZs, taking account of national guidance on requirements, with the final decision on sites being taken by Ministers. The proposed process thus incorporates a significant element of bottom-up planning which in turn has implications for the types of approaches that might be applied for the incorporation of socio-economic factors. Separate guidance is being prepared on the stakeholder engagement process but this was not available at the time this report was being prepared.

2.4 Additional guidance is also being prepared on the role of Impact Assessment (IA) within the regional and national MCZ planning processes. It is proposed that initial IAs will be prepared by the regional MCZ projects to help inform the iterations in network design and selection of the preferred network(s). An initial IA will accompany each network proposal that is supplied to the SAP for comment. A further IA will be prepared for informal consultation on each Regional Project’s preferred network. Formal IAs will then be prepared for each of the regional networks as part of a public consultation on the proposals, together with an assessment of potential cumulative impacts.
2.5 Defra (2009b) also includes initial advice on taking account of social and economic factors in network design and site selection. The guidance states that:

"[The] approach to selecting sites for designation as MCZs will be to conserve to ecosystems and biodiversity without causing unnecessary economic or social impacts, and in ways which seek to maximise the wider benefits to society. The existence of socio-economic interests will not automatically preclude consideration of an area for designation of an MCZ, nor compromise the setting of appropriate conservation objectives (which will determine the level of protection for the site).

The weight to be attached to socio-economic factors, will depend on a number of factors, and will need to be considered in the light of the particular circumstances which apply in each area. Where areas contain features which are rare, threatened or declining, or form biodiversity hotspots, ecological considerations are likely to carry particular weight in considering the area’s suitability for designation as MCZs. However, where there a wider choice of alternative (and equally-suitable) areas (which is likely to be the case for many representative habitats and species) socio-economic factors are likely to carry increased weight (within the constraints imposed by the network design principles and considerations relating to connectivity/spacing between MCZs, etc)."
It will generally be desirable to avoid designating MCZs with conservation objectives which are incompatible with ongoing or future anticipated socio-economic activities. In such cases it might be better to designate an alternative site elsewhere if possible. If this is not feasible (e.g. because of the rarity of a particular feature, or significance of a hot-spot) great care will need to be taken in drawing the site boundaries and setting the conservation objectives. The aim should be to reduce any conflicts to the absolute minimum necessary to achieve the conservation objectives for the site and network.

2.6 Historically, the main focus of consideration in socio-economic impact assessments has been on the economic consequences; social factors have received relatively little attention. The requirements of the IA and the greater use of social impact assessment in the evaluation of plans, programmes and policies are now leading to greater recognition of the importance of assessing the social consequences of interventions alongside economic aspects.

2.7 Social impacts can be defined as (Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003):

“The consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society”.

2.8 Although not stated in Defra’s current guidance, trade-offs may need to be made between different socio-economic activities, these are likely to be decided on the basis of the relative policy priorities. The UK Marine Policy Statement, currently in preparation, will set out policies for the UK marine area in order to contribute to the achievement of sustainable development and provide a consistent policy steer for decision makers and users. The Marine Policy Statement will sit alongside and be consistent with the suite of National Policy Statements currently being prepared and consulted on by UK Government Departments.

2.9 The current Defra guidance (Defra, 2009b) focuses largely on the extent to which socio-economic factors might be taken into account in the decision-making process, rather than how the consideration of socio-economic information might be incorporated within the MCZ planning process. While the overall planning process has effectively been set, a key aspect of this project has been to explore how the consideration of socio-economic factors might best be incorporated within this overall process. Furthermore, the project also explores how information might be best presented to enable an appropriate balance between ecological and socio-economic factors to be struck (i.e. making clear the trade-offs between ecological and socio-economic objectives).
3. **Approach**

3.1 **Introduction**

1.15 The work has been delivered through completion of a series of discrete tasks as follows:

- Literature review – a comprehensive review of available case studies where socio-economics have been incorporated within MPA planning processes has been undertaken. A listing of the case studies reviewed is provided in Appendix A. The review also considered some non-MPA and terrestrial planning examples where these provided relevant experience. Information on applicable tools for presentation and assessment of socio-economic information was also researched;
- Workshop – a workshop was held on 23rd/24th April 2009 in Reading, attended by over 50 international and UK experts and relevant stakeholders. The workshop received a number of presentations from international experts and discussed options for the incorporation of socio-economic data in the MPA planning process;
- Identification and presentation of options for taking socio-economic factors into account – options for incorporating socio-economic data into the MPA planning process were highlighted based on the literature review. These options were considered in relation to the intended process for taking forward MPA planning in the regional MCZ projects; and
- Options and Reporting – based on discussions at the workshop and a Project Steering Group meeting on 1st May 2009, a series of option considerations were developed relating to how and what socio-economic data should be taken into account in the MPA planning process.

3.2 **Case Study Review**

3.1 A number of potentially relevant international and UK case studies that have sought to incorporate socio-economic criteria into MPA planning or wider environmental decision making were identified based on an initial review of available literature (including academic papers, published reports and grey literature) and the knowledge of the Project Team and Project Steering Group. These included non-MPA planning exercises and terrestrial examples where these provided particularly relevant experience. The main focus of the review was on approaches that could be applied spatially as MCZ planning will have a strong spatial component. However, a range of wider non-spatial approaches were also reviewed as part of the overall study.

3.2 Twenty case studies were reviewed as part of this project from nine countries and three in broader European regions. While a large number of case studies were identified, only nine contained sufficient information on the inclusion of socio-economics to warrant detailed review. The case studies that were identified and the way in which they were evaluated within this project are
summarised in Table 1. The full case study reviews are presented in Appendix A.

3.3 In reviewing these relevant examples, particular attention was given to:

- The approaches and methodologies that have been developed and applied;
- The types and availability of socio-economic information that these methodologies have used (including whether basic socio-economic information has been processed into datalayers);
- The way in which socio-economic information has been taken into account (including experiences with using datalayers);
- The inclusion of social impact assessment within the overall assessment framework;
- The circumstances in which the approaches and methodologies have been applied;
- The extent to which they have already been applied or remain as conceptual tools;
- The weights attached to different socio-economic data (bearing in mind that monetary values themselves are a form of weighting), and evidence used to weight other socio-economic data; and
- Any feedback on their success (both from the perspective of the decision-maker and from other stakeholders).

3.4 Initial literature was sourced from internet searches and academic databases. This information was followed up through direct contact with individuals involved with the respective initiatives. Additional detail on a number of the case studies was also obtained through presentations and discussions at the project workshop (Section 3.4).
<table>
<thead>
<tr>
<th>Case Study</th>
<th>Geographical Location</th>
<th>Type</th>
<th>Review Type</th>
<th>Comment</th>
<th>Date MPA(s) Implemented</th>
<th>Information Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Californian Channel Islands highly protected MPAs</td>
<td>California, USA, North America</td>
<td>MPA Planning</td>
<td>Literature review &amp; expert interview</td>
<td>Reviewed as full case study</td>
<td>First phase 2002. Expanded 2006/07</td>
<td>Killpack et al., 2002; NOAA, 2008; Wing &amp; Nakagawa, 2008</td>
</tr>
<tr>
<td>Florida Tortugas highly protected MPAs</td>
<td>Florida, USA, North America</td>
<td>MPA Planning</td>
<td>Literature review &amp; expert interview</td>
<td>Reviewed as full case study</td>
<td>2001</td>
<td>Dept. of Commerce et al., 2000; Leeworthy &amp; Wiley, 2000, 2002; Shivlani, 2000; Shivlani et al., 2008</td>
</tr>
<tr>
<td>Canadian Gully Marine Protected Area (part of the ESSIM initiative)</td>
<td>Nova Scotia, Canada, North America</td>
<td>MPA Planning</td>
<td>Literature review, workshop presentation review &amp; expert interview</td>
<td>Reviewed as full case study</td>
<td>2004</td>
<td>Canada Gazette, 2003, 2004; DFO, 2004</td>
</tr>
<tr>
<td>Eastern Scotian Shelf Integrated Management (ESSIM)</td>
<td>Nova Scotia, Canada</td>
<td>MPA Planning</td>
<td>Reviewed as part of Canadian Gully case study.</td>
<td>Reviewed as part of Canadian Gully case study.</td>
<td>Not applicable – ESSIM announced in 1998</td>
<td>As above</td>
</tr>
<tr>
<td>Case Study</td>
<td>Geographical Location</td>
<td>Type</td>
<td>Review Type</td>
<td>Comment</td>
<td>Date MPA(s) Implemented</td>
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<tr>
<td>Network</td>
<td>New Britain, Papua New Guinea, Australia</td>
<td>MPA Planning</td>
<td>Literature review &amp; expert interview</td>
<td>Reviewed as full case study (bearing in mind that process is still ongoing)</td>
<td>Initiated in 2004, still ongoing</td>
<td>Green et al., 2007, 2009; Green &amp; Lokani, 2004; Hanson et al., 2001; Koczberski et al., 2006; Lipsett-Moore, 2006; Munday, 2004</td>
</tr>
<tr>
<td>Finding Sanctuary – English MPA initiative</td>
<td>Devon and Cornwall, United Kingdom, Europe</td>
<td>MPA Planning</td>
<td>Literature review &amp; workshop presentation review</td>
<td>Reviewed as full case study</td>
<td>Project established 2005, process ongoing</td>
<td>Des Clers et al., 2008; Finding Sanctuary, 2009</td>
</tr>
<tr>
<td>Grays Reef USA</td>
<td>Georgia, USA, North America</td>
<td>MPA Planning</td>
<td>Literature review, workshop presentation review &amp; expert interview (partial)</td>
<td>Socio-economics did not appear to play a major role.</td>
<td>Four year process initiated in 2004</td>
<td>Kendall &amp; Eschelbach, 2006; Ehler, 2009;</td>
</tr>
<tr>
<td>South Africa 'New Marine Protected Areas'</td>
<td>South Africa, Africa</td>
<td>MPA Planning</td>
<td>Literature review (partial)</td>
<td>Socio-economics did not appear to play a major role.</td>
<td>2004</td>
<td>Schalkwyk, 2004</td>
</tr>
<tr>
<td>Balance Project – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning</td>
<td>Baltic Sea, Europe</td>
<td>Theoretical MPA Planning Exercise</td>
<td>Literature review (partial) &amp; workshop presentation review</td>
<td>Represents a theoretical approach and socio-economics factors were not considered.</td>
<td>Project 2005 -2007</td>
<td>Ekebom et al., 2008</td>
</tr>
<tr>
<td>EMPAFISH (European MPAs as tools for Fisheries management and conservation)</td>
<td>Europe</td>
<td>Academic literature research exercise</td>
<td>Literature review (partial)</td>
<td>Academic literature research exercise, with interesting report on socio-economic impacts of MPAs.</td>
<td>Not applicable</td>
<td>Alban et al., 2008</td>
</tr>
<tr>
<td>Belgian GAUFRE</td>
<td>Belgium, Europe</td>
<td>Marine Spatial Planning</td>
<td>Literature review (partial)</td>
<td>Academic data collection exercise</td>
<td>Project 2003-2005</td>
<td>Maes et al., 2005</td>
</tr>
<tr>
<td>Case Study</td>
<td>Geographical Location</td>
<td>Type</td>
<td>Review Type</td>
<td>Comment</td>
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<td>Information Sources</td>
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<td>('towards a spatial structure plan for sustainable management of the North Sea) project</td>
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<td></td>
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<td>rather than practical MPA process.</td>
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</tr>
<tr>
<td>German ICZM</td>
<td>Germany, Europe</td>
<td>Integrated Coastal Zone Management Strategy</td>
<td>Literature review (partial)</td>
<td>Essentially an academic data collection exercise (incl. relevant socio-economic data) as opposed to practical planning/decision making tool.</td>
<td>Process undertaken between 2003-2006</td>
<td>BMU, 2006</td>
</tr>
<tr>
<td>UK Marine Environmental High Risk Areas (MEHRAs)</td>
<td>United Kingdom, Europe</td>
<td>Marine Spatial Planning (aide to ship passage planning)</td>
<td>Literature review (partial)</td>
<td>Focussed on shipping risk only.</td>
<td>MEHRAs announced in 2006.</td>
<td>DfT, 2006</td>
</tr>
<tr>
<td>Buccoo Reef Marine Park</td>
<td>Trinidad and Tobago, South America</td>
<td>MPA Planning</td>
<td>Literature review (partial)</td>
<td>Not reviewed as case study but applied trade-off analysis to management (see Appendix B)</td>
<td>Established 1973</td>
<td>Brown et al., 1999, 2001</td>
</tr>
<tr>
<td>Sustainability Appraisal</td>
<td>England and Wales</td>
<td>Terrestrial Regional Spatial</td>
<td>Literature review (partial)</td>
<td>Reviewed as planning process. Specific case</td>
<td>Not applicable</td>
<td>Levett-Therivel Sustainability Consultants &amp; EDAW, 2005; ODPM, 2005;</td>
</tr>
<tr>
<td>Case Study</td>
<td>Geographical Location</td>
<td>Type</td>
<td>Review Type</td>
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</tr>
<tr>
<td>New Zealand Marine Reserves Network</td>
<td>New Zealand, Oceania</td>
<td>MPA Planning</td>
<td>Not reviewed.</td>
<td>Researched, not chosen as case study as socio-economics did not play a formal role in initial implementation</td>
<td>New process is just beginning</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategy</td>
<td></td>
<td>examples from Yorkshire and Humberside RSS</td>
<td></td>
<td>Yorkshire &amp; Humber Assembly, 2004</td>
</tr>
</tbody>
</table>
3.3 **Tools**

3.5 A number of tools are available to assist with the presentation and assessment of socio-economic information in the design of MPA networks ranging from detailed analytical tools to simple maps to visualise options. These are:

- Spatial analysis of mapped data;
- Cost-benefit analysis (CBA);
- Cost effectiveness analysis (CEA);
- Multi criteria analysis (MCA);
- Trade-off analysis;
- Social Impact Assessment (SIA);
- Bioeconomic models; and
- Network design tools

3.6 Information on the tools was collated from the literature. In reviewing these tools, particular attention was paid to the advantages and disadvantages of each, for example, in regards to data requirements and transparency and the extent to which the various tools have previously been used to support MPA planning initiatives. The detailed review is presented in Appendix B.

3.4 **Workshop**

3.7 An expert workshop was held at the Innovation Centre in Reading on the 23rd and 24th April 2009 to build on the review work that had been undertaken. The workshop was used as a forum to discuss options on the use and applicability of socio-economic data. The workshop was also designed to gather further ideas and experiences to be used in making recommendations on the use of socio-economic derived datalayers for MPA planning in the UK. The event was well attended with representatives from government bodies, research institutions and a full range of marine stakeholders. A report summarising the workshop is included at Appendix C.

3.8 A number of international and national guest speakers were invited to present details of MPA designation projects that they have been directly involved with. These individuals were primarily identified through the review of potential case studies and previous contacts that had been made by the project team.

3.9 The specific aims of the workshop were to learn from both international and national experiences of planning and implementing MPAs whilst engaging with stakeholders as to how this might be taken forward within a UK context. This included the development and review of options and a review of their applicability within a UK setting. The workshop was used to build on the review work undertaken as part of this project and as a forum to discuss options on the use and applicability of socio-economic data. The workshop was also designed to gather further ideas and experiences to be used in making recommendations on the use of socio-economic derived datalayers for MPA planning in the UK.
4. **Review Outcomes**

4.1 **Introduction**

4.1 This section presents the findings of the review that has considered various aspects of the use of socio-economic information in MPA planning and planning in a wider context (e.g. non-MPA and terrestrial planning). This was carried out via searches of academic literature, grey literature and published reports, in depth communications with practitioners to understand more detailed aspects of their particular cases, and a workshop to discuss experiences internationally and within the UK.

4.2 The key information that has been derived from the case studies is summarised in Table 2 below. The case study sites that have been reviewed cover a range of spatial scales and a number are located within areas which are already covered by some form of environmental designation. In this respect the majority of the case studies reviewed represent the designation of a network of sites as opposed to a single MPA. There are a range of objectives that underpin the designation processes, which essentially link to the protection of the ecology and biodiversity of a region whilst recognising the importance of socio-economic considerations and sustainable development.

4.3 Detailed descriptions of the case studies that contributed to this review, a review of tools used to present and analyse socio-economic information and a workshop report are provided in Appendices A, B and C respectively.

4.4 Key findings of the review are synthesised and outlined following Table 2. Specifically this section aims to explore how, what, and when socio-economic information has been taken into account.
### Table 2: Case study summary

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Point of Socio-economic Consideration in MPA planning process</th>
<th>Socio-economic Data Types</th>
<th>Data Sources</th>
<th>Method Type</th>
<th>Success in achieving socio-economic objectives</th>
<th>Exclusion/inclusion of MPA-compatible activities of high economic value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>California Channel Islands</strong></td>
<td>• Areas of highest conservation value identified first. • After identification of areas of high conservation value, working groups then used socio-economic data and local knowledge to select a combination of sites. • Socio-economic data used within the formal impact assessment.</td>
<td>• Extant fisheries value data on the most important commercial fisheries. • Fishermen interviewed (map based). • Kelp harvesting. • Recreation – specific surveys looking at person days of activity. • Extant marine recreational fishing statistics. • Maps were created for each major use. The metric for each use varied.</td>
<td>• Socio-economic panel collected and synthesised existing studies, extant records of catch or harvest, and other public information sources. • In addition new economic data was collected through: o commissioned dedicated surveys to obtain more detailed spatial information; and o Interviews with fishermen.</td>
<td>• Areas of highest conservation value were first identified. • Socio-economic data collected by panel was used to refine the selection of sites and the associated boundaries. • An interactive GIS decision support tool was used to assess both ecological and socio-economic data. This was done using two evaluation criteria datasets. Cells were ranked as to how well they fulfilled goals.</td>
<td>• Two objectives: o develop a more co-operative working relationship with all user groups o obtain information to conduct socio-economic impact analysis of the MPA management regulations (see section A2.1.4). • Success: NOAA felt the process achieved both socio-economic objectives (Bob Leeworthy, NOAA, pers comm.)</td>
<td>• Consumptive uses (e.g. commercial fishing) considered incompatible with MPA objectives and are not allowed in no-take areas. • Activities which disturb the sea-bed (i.e. oil/gas, mining) prohibited. Some restrictions on other activities including diving, anchoring and research.</td>
</tr>
<tr>
<td><strong>Florida Tortugas</strong></td>
<td>• Included in initial design phase. • Socio-economic data used within the formal impact assessment.</td>
<td>• Extant fisheries value data on the most important commercial fisheries. • Fishermen interviewed (map based). • Recreation – specific surveys looking at person days of activity. • Extant marine recreational fishing statistics.</td>
<td>• Characterisation forum – existing studies and records of catch were collected to provide general information. In addition dedicated surveys were undertaken to obtain more detailed spatial data on fisheries and recreational use.</td>
<td>• Data used to create maps. Boundaries adjusted in a manual map interpretation exercise. When preferred alternative had been selected a formal socio-economic impact analysis of 5 alternative network designs was undertaken.</td>
<td>• Two objectives: o develop a more co-operative working relationship with all user groups o obtain information to conduct socio-economic impact analysis of the MPA management regulations (see section A2.1.4). • Success: NOAA felt the process achieved both socio-economic objectives (Bob Leeworthy, NOAA, pers comm.). This conclusion was supported by survey of key user groups indicating a significant shift towards all groups supporting the MPAs, including commercial fishermen (who had moved from ‘negative’ feelings to ‘a neutral position’ of support), due to the MPA selection process.</td>
<td>• Consumptive uses (e.g. commercial fishing) considered incompatible with MPA objectives. Comprises two separate zones, both No-Take marine Reserves. North zone - allows non-consumptive recreation. South zone - research only.</td>
</tr>
<tr>
<td><strong>California Marine Life Protection Act MPA network</strong></td>
<td>• Socio-economic data was not originally used in the attempted designation process in the first two regions. This resulted in the failure of the entire process. • In the third region socio-economic data fed into the process in several different ways: o At the outset of the process summary statistics in the form of a regional profile were supplemented with specifically gathered information. o Evaluation within the deliberation phase. o Used within the formal impact assessment.</td>
<td>• Commercial and recreational fisheries at same resolution as ecological data. Data on non-extractive uses was at a much coarser level of granularity than the commercial fisheries.</td>
<td>• Regional profile. Interviews with fishermen to generate: o Maximum extent of each fishery; and o Areas of critical economic importance within these.</td>
<td>• GIS decision support tool (stakeholders and resource managers), provides feedback on whether the design criteria are met or not. Within the deliberation phase the designs are evaluated by Scientific Advisory Team (SAT) in terms of: o 1st order impacts of closing an area to an activity (assumming permanent loss). o 2nd order assessment – dynamic bioeconomic models.</td>
<td>• Primary objective: to understand the impact on those people making a living from the ocean and thus minimise the socio-economic impacts from MPAs. • Secondary objective: create baseline information from which one could understand the effects (positive or negative) • Success: Considered successful as providing key socio-economic information to stakeholders early in the process, enabled effective ‘trade-offs’ between conservation and socio-economic values, resulting in the MPA network achieving its ecological objectives with relatively low socio-economic impacts.</td>
<td>• Three zone designations: o State Marine Reserves (SMRs) – complete no-take zones; o State Marine Parks (SMPs) – complete no-take areas and potential for (recreational) no-go areas; and o State Marine Conservation Areas (SMCA) – potential for selective no-take / no-go areas. Inclusion of MPA-compatible activities decided by stakeholder groups ‘horse trading’ e.g. shifting boundaries to ensure ecological objectives met but vital fishing areas kept in. In addition, some fishing methods using bottom gear e.g. crab pots, disallowed to protect habitat but pelagic gear allowed.</td>
</tr>
<tr>
<td><strong>Canadian gully MPA (located within ESSM Area)</strong></td>
<td>• Not included in the initial stages of designation when ecological aspirations were the prime consideration. Socio-economic considerations when regulations/ measures were being introduced to</td>
<td>• Socio-economic profiles developed which included past, present and future activities. • Key data types included: o Fisheries o Oil and gas;</td>
<td>• Users asked to validate profile and feedback on the potential implications of the network. • Fishermen – log books on catch and effort, data on vessels and licences, industry surveys, observer records,</td>
<td>• Socio-economic assessments to better understand resource values. • Socio-economic profile developed. Consultation with user groups to validate profile and general feedback.</td>
<td>• Objectives: no formal socio-economic objectives were set. • Success: DFO considered approach generally successful, supported by the perception of most stakeholders/regulators that a ‘fair’</td>
<td>• As main objective of MPA was to protect biodiversity, any activities that might disturb, damage, destroy or remove organisms/habitat were prohibited within the MPA and in close vicinity of the MPA.</td>
</tr>
<tr>
<td>Case Study</td>
<td>Point of Socio-economic Consideration in MPA planning process</td>
<td>Socio-economic Data Types</td>
<td>Data Sources</td>
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</table>
| The MPA                                                                  | Socio-economic informed design process including the consultation and required RIA phases. | o Cables  
o Shipping and  
o Regulatory frameworks (areas controlled by other government departments including navy operating areas) | Knowledge and experience.  
Hydrocarbon knowledge sources:  
- Currently mapped structures;  
- Historic seismic reflection data;  
- Significant discovery wells;  
- Additional exploration wells;  
- Adjacent reservoir parameters;  
- Standard "recovery factor" conversions for Sustain Shelf reservoirs;  
- Multibeam evidence of gas venting. | Information used to inform network design.  
RIA: largely a qualitative assessment.  
Assumed fisheries could go elsewhere (without taking account of displacement costs). | Balance between conservation, access, and economic values had been achieved and that the process had been relatively well informed and transparent. | (Hydrocarbon sub-surface rights not included in this).  
- Zonation:  
  o Zone 1 (deep zone): no resource extraction  
  o Zone 2: fishing for certain species allowed under licence  
  o Zone 3: certain activities permitted that do not cause disturbance beyond the natural variability of the ecosystem.  
- Research and monitoring permitted in all zones subject to permission.  
- DFO avoided unnecessary restrictions e.g. where main conservation objective was to conserve seabed, did not necessarily prohibited surface fishing.  
- Prohibition of fishing activity monitored by DFO using a compliance monitoring system – which provides weekly report of fishing activity from each vessel’s black box. |
| Australian Great Barrier Reef Marine Park – Representative Areas Programme | Used within the network design process.  
Additional data collected through consultation further informed the design process.  
Used within the formal RIA process. | Fisheries  
Tourism and recreation  
Additional layers created if of particular local importance. | Data was obtained from:  
- Official records;  
- Community consultation;  
- Map based questionnaires;  
- VMS data (particularly useful). | Socio-economic analysis was embedded in MarXan and GIS-based spatial analysis tools.  
The entire process was iterative.  
Deliberations held over zoning plan.  
RIA identified costs and benefits to different parts of industry and/or public. | Objective: - maximise the benefits and minimise the impact of MPAs on users.  
Success: GBRMPA felt successfully met objective, highlighting "quite radical" differences between the draft and final zoning plans, largely rising from additional, and predominantly socio-economic information, submitted during the process. | GBRMPA tried to accommodate activities of high economic value where possible, but conservation of biodiversity was the main objective.  
Operations for the recovery of minerals was prohibited within the GBRMP, unless approved by the GBRMPA for research.  
- "Zoning" was the key tool for conservation and management, however other tools included:  
  o permits for specific zones/area  
  o spatial restrictions (e.g. defence training areas, shipping areas)  
  o industry codes of practice |
| Australian Southeast Marine Region Network                                | Socio-economic uses addressed in in some zones of use/protection | Fisheries – commercial and recreational | Data was obtained from:  
- Official records;  
- Consultation | Iterative process of development  
Started with a spatial inventory of existing uses  
Taken account of in initial development of options  
Consultation provided further information  
RIA was undertaken at the end | Objective: minimise costs to communities and industries through collaboration with ocean users.  
Success: The Australian Government made approach. 20 changes to boundaries and zoning based on stakeholder input – resulting in a larger and more representative network than that originally proposed that has 'far less impact on industry'. | High-impact fishing methods (demersal trawl, Danish seine, scallop dredge and Gill-netting over 180m) banned throughout the MPA network.  
- Some methods of commercial fishing and other commercial activities allowed in some 'zones' of the network (see Section A2.5.2) with approval from the Director of National Parks. |
| Papua New Guinea Kimbe Bay MPA network                                     | Socio-economic uses are being addressed in the development of zones of use/protection | Fisheries, Tourism, Shipping  
Detailed socio-economic survey data included:  
- Household economic and demographic characteristics,  
- Cash incomes from marine resources, and  
- Subsistence production and household consumption of marine resources  
- Local management practices  
- Changes in marine resources  
- Marine resource conflicts  
- Perceptions of marine habitats  
- Cultural heritage values | Data obtained from:  
- Official records;  
- Consultation | Ongoing process but existing data was obtained from:  
- Existing best available information;  
- Consultation of a detailed socio-economic survey of six communities | The process was iterative but purely scientific.  
Collation of best available information into a GIS  
Data refined through consultation and detailed study  
Development of options or Areas of Interest (AOI) using MarXan.  
Socio-economic costs not considered in initial design stage | Objectives: socio-economic design principles aimed to maximise benefits and minimise costs to local communities and sustainable industries, including fisheries and nature based tourism.  
Success: worked reasonably well in areas for which there was prior knowledge of socio-political and cultural settings. However, collection of socio-economic data not as well developed or intense as collection of biodiversity data (Richard Hamilton, TNC, pers comm). |
| Finding Sanctuary                                                         | No information found relating to this aspect | Socio-economic information has been developed for this region, but has yet to be utilised as the project is ongoing | Distribution of human activities at sea, the relative intensity of use and the relative value of different sea areas to different sectors.  
Relative density of fishing effort for different fisheries/ gear types along | Interviews with fishermen and stakeholders using maps and questionnaires. | To date this project has focused on the collection of data.  
Process still ongoing. However, socio-economic data collection considered successful in two ways:  
- provided a wealth of information to underpin and improve MPA planning | No information found relating to this aspect. |

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Legend:
- **GBRMPA**: Great Barrier Reef Marine Park Authority
- **DFO**: Department of the Environment, Water, Heritage and the Arts
- **RIA**: Regulatory Impact Assessment
<table>
<thead>
<tr>
<th>Case Study</th>
<th>Point of Socio-economic Consideration in MPA planning process</th>
<th>Socio-economic Data Types</th>
<th>Data Sources</th>
<th>Method Type</th>
<th>Success in achieving socio-economic objectives</th>
<th>Exclusion/inclusion of MPA-compatible activities of high economic value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grays Reef</td>
<td>Considered when initially exploring potential site options (one of the three original 'siting criteria' was ‘minimising fishing displacement’ from favoured fishing areas, although this was not to compromise the other two siting criteria which maximised conservation value)</td>
<td>with their seasonality. Collated and entered into FisherMap database. Recreational datasets (particularly divers, sea anglers, charter boat owners, watersport enthusiasts and wildlife enthusiasts) collated and stored in StakMap.</td>
<td>Bottom fishing effort. Averaged boat count data – national reconnaissance systems. NOAA survey of marine debris/snagged fishing gear.</td>
<td>Dedicated GIS tool using a 'sliding windows' approach (single MPA not a network). Systematically considers placement of a series of boundary configurations throughout the entire sanctuary. This generated numerous alternatives from which the Research Area Working Group selected those with the lowest activity impacted and assessed their socio-economic impact.</td>
<td>Objective: avoid socio-economic impacts on favoured fishing areas (although conservation siting criteria took precedent). Success: Collaborative approach facilitated the process. Preferred scenario for site placement is farthest from fished areas and has the minimum of user displacement of the six options.</td>
<td>As designed to be a research-only MPA, extractive activities were prohibited and controls/limits made on boat entries.</td>
</tr>
<tr>
<td>South Africa New Marine Protected Areas</td>
<td>Used to assist in the spatial planning of conservation alongside activities. Limited information available on how or when the design process took account of socio-economic factors, but indicate that public concerns were considered during the 'top-down' MPA process.</td>
<td>Spatial distribution of fishing (commercial and recreational) and diving</td>
<td>No information</td>
<td>Public concerts were taken on board during a top-down MPA process</td>
<td>Objective &amp; Success: not found – limited information.</td>
<td>Aim was regulation not prohibition of recreational activities within MPAs. Altal shal – partitioned uses between fishing, diving and spear-fishing. Pondoland MPA: linefish and shellfish exploitation permitted in some areas. Cape Peninsula MPA – includes six areas closed to fishing (abalone, rock lobsters and linefish and diving).</td>
</tr>
<tr>
<td>Balina Project – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning</td>
<td>Point of consideration in MPA planning not directly applicable – academic exercise to develop informed marine management tools for the Baltic Sea. Socio-economic factors were not considered in great detail.</td>
<td>Spatial distribution of ○ hard structures (buildings, harbours/marinas, piers), ○ shipping lanes and boating routes.</td>
<td>No information</td>
<td>A GIS tool was developed to incorporate abiotic, biological and socio-economic data (hard structures and shipping lanes/boat routes only). Adaptive maps were to be used as discussion and decision-making tool.</td>
<td>Not applicable as no specific socio-economic objectives. Stated that inclusion of additional socio-economic data would have benefitted the project (Torben Wallach, Ministry of Environment, Denmark, pers. comm.).</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>EMPART (European MPAs as tools for fisheries management and conservation)</td>
<td>Point of consideration in MPA planning not directly applicable – focused on investigating the fishery impacts of existing MPAs</td>
<td>Literature review on fisheries management, recreational activities and distributional consequences of MPAs.</td>
<td>No information</td>
<td>A review of different tools for assessing MPA impacts</td>
<td>Not applicable - investigating impacts of existing MPAs, rather than an MPA process.</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Belgian CAUPTRE (Towards a spatial structure plan for sustainable management of the North Sea)</td>
<td>Point of consideration in MPA planning not directly applicable – project used scientific knowledge on uses of the Belgian North Sea to formulate six options reflecting different optimal allocations of relevant socio-economic activities resulting in a single 'best' vision.</td>
<td>Scientific knowledge about the uses of the Belgian North Sea and their possible effects including shipping, fisheries, aquaculture, coastal defence, tourism and recreation, sand and gravel extraction, dredging, energy production, nature protection, cables and pipelines, wrecks, offshore sea bunkering, and military use.</td>
<td>Numerous central databases Stakeholder workshops refined information</td>
<td>Socio-economic data input into a GIS to prepare maps to illustrate specifically chosen information so that planners and policy makers can easily handle the information</td>
<td>Not applicable - focus of the project was on development of a methodology for spatial planning.</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>German ICZM</td>
<td>Point of consideration in MPA planning not directly applicable – used socio-economic information to guide planners</td>
<td>Information collated on spatial distribution, future development prospects and policy drivers related to the following: shipping, port management, industry, offshore transport infrastructure, oil and natural gas production, renewable energies, transmission routes, sand and gravel extraction, fishing and mariculture, agriculture, tourism, coastal protection, maritime traffic regulations, sediment management, waste management, defence, settlement and regional development, protected areas, preservation of the cultural heritage, regional planning levels and tools, nongovernmental organizations.</td>
<td>Numerous central databases Stakeholder workshops refined information</td>
<td>Simple characterization and mapping of activities</td>
<td>No specific socio-economic objectives set – socio-economic data contributed to a national ICZM strategy, to be used as an informal aide to support sustainable development of the coast.</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Case Study</td>
<td>Point of Socio-economic Consideration in MPA planning process</td>
<td>Socio-economic Data Types</td>
<td>Data Sources</td>
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<tr>
<td>UK Marine Environmental High Risk Areas (MEHRAs)</td>
<td>No account taken of socio-economic factors</td>
<td>Education and science, monitoring in the coastal region</td>
<td>The assessment took account of ship-routing data, size and type of vessel, traffic density and analysis of past accidents to provide a spatial assessment of risk</td>
<td>Risk assessment combining information on shipping risk and environmental sensitivity</td>
<td>Not applicable – project aim was to identify areas of high environmental sensitivity with a high level of shipping pollution risk</td>
<td>Not applicable. MEHRAs to be marked in Admiralty charts to encourage mariners to take extra care in those areas.</td>
</tr>
<tr>
<td>EU Water Framework Directive and Disproportionate Costs</td>
<td>Point of consideration in MPA planning not applicable - iterative assessment of the cost effectiveness of measures and disproportionate cost</td>
<td>Includes consideration of economic costs and benefits</td>
<td>Draws on a wide range of cost information from different sectors – water industry, industry, agriculture, navigation sector</td>
<td>Uses a form of cost benefit analysis (cost effectiveness analysis)</td>
<td>Not applicable – project provides guidance for the implementation of the economic elements of the WFD.</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Sustainability Appraisal</td>
<td>Socio-economic factors integrated into sustainability assessment</td>
<td>Main focus is on policy consequences of different planning options</td>
<td>Information on existing policy objectives and targets and derived sustainability criteria</td>
<td>Uses multi-criteria analysis to compare different plan options against sustainability objectives</td>
<td>Not applicable</td>
<td>Not applicable.</td>
</tr>
</tbody>
</table>
4.2 The ‘How’ - Tools for Considering Socio-Economic Information

4.5 A number of tools have been applied in the assessment of socio-economic factors within the designation of MPAs and other planning processes (i.e. non-MPA and terrestrial), grouped into the following broad types:

- Spatial analysis
- Network design tools
- Cost Benefit Analysis
- Cost Effectiveness Analysis
- Multi-criteria Analysis
- Trade-off Analysis
- Social Impact Assessment
- Bioeconomic models

4.6 The advantages and disadvantages of each tool are summarised below in Table 3 in relation to their practical implications, information requirements and transparency and acceptability to stakeholders. The tools are reviewed in detail in Appendix B.

4.7 The review illustrated that the use of stakeholder analysis in the initial phases of the regional MCZ projects can help to identify relevant stakeholders and their respective interests in an MCZ region. This could then assist subsequent information collection and consultation processes to help underpin the tools.

4.8 Experience from the workshop illustrated that the use of tools in the process needs to be transparent to stakeholders. It was important that stakeholders understand the process, requirements and information before starting to plan.

4.9 At least five out of the nine case studies involved planning processes that included an initial network design phase followed by a later deliberation phase, although because of the iterative nature of network design processes, these phases are often not very distinct. For some studies this deliberation has resulted in agreed solutions identifying conservation networks or different zones of use. For others such as the German Integrated Coastal Zone Management (ICZM) process, deliberation is ongoing within an adaptive management framework. Most of the case studies have also undertaken a Regulatory Impact Assessment (RIA) on a preferred option. In some instances the outcome of the IA has led to further iteration on network design. The case studies illustrate that different tools tend to be used at different stages of the process.

4.10 The initial network design stages involved data collation exercises based on ‘best’ available information with subsequent use of spatial analysis tools using simple map overlaps or more sophisticated Geographical Information System (GIS) analysis of data layers (e.g. Channel Islands, Marine Life Protection Act (MLPA)). For example, MLPA made use of the MarineMap tool which enabled direct capture of stakeholder proposals for sites and provided customised
reporting of spatial analysis outputs. Some initiatives have used network
design tools as part of a formal process (Great Barrier Reef Marine Park
Authority (GBRMPA, Papua New Guinea (PNG)) or informal process (MLPA).
### Table 3: Various tools available for considering socio-economic information and their key advantages and disadvantages

<table>
<thead>
<tr>
<th>Tools</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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</table>
| Spatial Analysis             | • Provides for simple presentation of information;  
|                              | • Outputs can be rapidly generated using GIS;  
|                              | • Can only analyse data that has a spatial component and that is available in a suitable format.                                                                                                            | • Application not always trusted and accepted by stakeholders;  
|                              |                                                                                                                                                                                                             | • Requires spatial socio-economic information that may be of limited availability;  
|                              |                                                                                                                                                                                                             | • Requires little stakeholder expertise to interpret individual outputs but the number of socio-economic interests considered can make it overly complex. |
| Network design tools         | • Can develop efficient spatial solutions against a range of complex criteria;  
|                              | • The tool can be applied rapidly to generate a range of different network options.                                                                                                                     | • Full application of framework requires monetary valuation of costs and benefits;  
|                              |                                                                                                                                                                                                             | • Monetary valuation can be contentious;  
|                              |                                                                                                                                                                                                             | • Values for some impacts may be difficult or impossible to find;  
|                              |                                                                                                                                                                                                             | • Difficult to quantify social factors in monetary terms.                                                                                         |
| Cost-benefit analysis (CBA)  | • Systematic framework for collecting and presenting cost and benefit information;  
|                              | • Framework can accommodate many different social values and socio-economic datasets;  
|                              | • Framework can represent both qualitative and quantitative data;  
|                              | • Well-developed and widely accepted methodology;  
|                              | • In principle, covers all impacts;  
|                              | • Explicit adjustments for distributional impacts are possible;  
|                              | • Explicit framework for dealing with discounting and risk;  
|                              | • Can help to underpin formal Impact Assessment.                                                                                                                                                           | • Same as for CBA, plus only gives ranking of options for specific objective: does not help determine if the objective is justified, or if a greater/lesser target would be better. |
| Cost effectiveness analysis (CEA) | • Essentially the same as for CBA, but examines costs and benefits of different ways of achieving specified objective, that is not itself valued.                                                          |                                                                                                                                                                                                             |
| Multicriteria analysis (MCA) | • Can accommodate many different social values and socio-economic datasets;  
|                              | • Aims for identification of solutions that fit chosen criteria;  
|                              | • Helps stakeholders and decision makers explore implications of changing weights;  
|                              | • Focus on the most important impacts;  
|                              | • Development of agreed criteria, scores and weights can help to build consensus.                                                                                                                       | • Requires subjective choices in determining criteria to be applied;  
|                              |                                                                                                                                                                                                             | • Limited to “manageable” number of categories, therefore ignores minor impacts;  
|                              |                                                                                                                                                                                                             | • Scoring methods are often subjective;  
|                              |                                                                                                                                                                                                             | • Scoring methods often sensitive to range of options under consideration;  
|                              |                                                                                                                                                                                                             | • Often unclear why particular weights are used, and what values underpin them.                                                               |
| Trade-off analysis           | • Similar strengths to MCA;  
|                              | • More structured format for stakeholder integration and consensus building;  
|                              | • Trade-offs that decision makers are required to take are made                                                                                                                                             | • Similar to MCA;  
|                              |                                                                                                                                                                                                             | • Requires extensive work with stakeholders;  
|                              |                                                                                                                                                                                                             | • Consensus not always possible.                                                                                                                |
| Social Impact Assessment (SIA) | - Provides framework within which social factors can be explicitly identified and assessed. | - Does not capture all economic costs and benefits  
- No common unit for assessing impacts. |
|-------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Bio-economic models | - Enable evaluation of wider aspects of fisheries impacts beyond immediate site (e.g. displacement; spillover benefits). | - Confidence in model outputs is low because of uncertainties in data and relationships;  
- Complex models can be difficult for stakeholders to understand. |
4.11 The use of network design tools such as MarXan can accommodate many different social values and socio-economic datasets. These tools have generally been used to explore network options which are then subject to more detailed exploration in a deliberation phase.

4.12 However, experiences with network design tools were mixed. Proponents highlight the ability of such tools to generate network design solutions using a wide range of complex criteria. Critics comment that the tools are a ‘black box’ or purely conservation tools which are not readily understood by stakeholders (e.g. in California and the Great Barrier Reef (GBR)). Workshop participants considered that such tools could have a role to play in developing network scenarios using different criteria as a means of identifying potential issues and areas of conflict. However, it was suggested that it would be important for stakeholders to understand the requirements of the planning process and the data that was being used, before such analyses were undertaken. It was also recognised that there was a limit to the availability of suitable socio-economic information for incorporation into presentation and analysis tools. In turn this would limit the utility of outputs from such tools.

4.13 Once initial networks have been developed they have generally been subject to more detailed deliberation. Case studies vary on whether this has been carried out by experts (e.g. PNG) or a representative group of stakeholders (e.g. Tortugas and Channel Islands.). Six of the nine MPA case studies have made use of a limited form of CBA (primarily focused on economic costs) to support identification of preferred networks as part of an overall cost impact analysis. None of the case studies reviewed have made much use of economic benefits information (i.e. the perceived economic value gained by the environment or other socio-economic activities from the designations) in developing preferred network designs. The use of CBA is necessarily informed by information on the environmental impacts of socio-economic activities and assumed benefits of relocation/cessation of potentially damaging activities. Such information is usually based on scientific literature and none of the case studies made use of specific Environmental Impact Assessment (EIA) tools except the MLPA initiative which applied a fisheries bioeconomic model (see below).

4.14 Within the Californian MLPA deliberation phase the MPA proposals were evaluated against a number of criteria including the following four key aspects (personal communication, Astrid Scholz):

- “Worst case” affected area and importance;
- First order net economic impacts (profits);
- Cumulative effects with other spatial management measures; and
- Any disproportionate effects on individual or groups of fishermen or communities.
4.15 Once a final network was accepted, a more formal, regulatory impact assessment was undertaken. Klein et al. (2008) for example undertook a socio-economic assessment for the Central Coast. The authors calculated the relative importance of each planning unit for each fishery. Non-consumptive user interests were considered and the impacts of various alternatives then assessed.

4.16 In the formal IA of the Californian Channel Islands example, two levels of cost impact analysis were undertaken. The phase 1 analyses simply added up all the activities displaced from MPAs, with the assumption that all is lost, i.e., there is no mitigation or off-sets through behavioural responses. Substitution/relocation, replenishment effects, the effects of other regulations, the current and future status of fishing stocks, and the benefits of marine reserves were not addressed within these analyses. The authors labelled the phase 1 analyses as “maximum potential loss”. Phase 2 analyses used cost benefit analysis and listed all the potential benefits and costs, and quantified them where possible. Essentially, this consisted of a qualitative attempt to assess how likely the losses estimated in the phase 1 analyses were to occur.

4.17 Within the GBRMPA initiative the RIA identified financial and other costs and benefits to different parts of industry or the public using a form of cost benefit analysis. It considered the following aspects: people’s desire to protect; economic value of tourism (based on an Environmental Management Charge); recreational fishing expenditure; cost of zoning plan (mostly value of forgone fishing activity versus adaptability of each fishery to zoning); species/habitat under threat; contingent valuation and willingness to pay; and use/non use values. The IA concluded that the environmental and economic benefits far outweighed the relatively modest economic costs (Hand, 2003).

4.18 None of the MPA case studies considered in this report explicitly used SIA tools or MCA type approaches, with the exception of PNG, where a focused study by experts investigated a range of social issues, such as individual impacts of designations on households, perceptions of marine habitats and cultural heritage values. It was important that these values were obtained as local stakeholders had little or no involvement in the designation process. SIAs have been employed to assess the impacts of other MPAs, e.g. Cotgong Bay, the Philippines (Maliao and Polohan 2007), Exumas, the Bahamas (Stoffle and Minis 2007). Such communities, however, tend to be more critically dependent for their subsistence and livelihoods on exploiting marine resources, and their social cultures, values and structures thereby tend to be more closely interconnected with the marine environment. MPAs in such developing countries are therefore much more likely to generate significant and wide-scale social impacts compared to more socio-economically diverse contexts in more developed countries such as the UK. Social impact assessments have also been used in wider planning contexts, e.g. disaster risk assessment, again particularly in
developing countries, where they often serve as a substitute for a formal planning system.

4.19 Where social impact assessment has been applied to non-MPA studies, for example as part of environmental impact assessment, it is often carried out through stakeholder engagement processes to elicit the social values that people hold in relation to potential MPA locations. In more formal exercises such information may be collected through the use of more targeted surveys, for example using questionnaires.

4.20 While none of the case studies reviewed made use of formal multi-criteria analysis type approaches, the PNG case study had regard to a series of socio-economic design principles which were incorporated into the network design process by assigning different relative costs to socio-economic data layers within MarXan. MCA approaches have been used more widely in terrestrial and non-MPA planning processes, for example sustainability appraisal of Regional Spatial Strategies and Local Development Documents.

4.21 The use of multi-criteria analysis in non-MPA initiatives is usually undertaken as a qualitative evaluation of options against an agreed set of objectives and targets. The aim is to identify those options (or aspects of options) that best meet the predetermined criteria. Such processes are generally taken forward through a process of engagement with relevant stakeholders.

4.22 The California MLPA made use of bioeconomic models. Such models are also being applied increasingly to seek to address broader issues of sustainable fisheries management associated with quota changes and area closures. They necessarily make many assumptions about the behavioural responses of fishing fleets to changes in regulation as well as assumptions about the responses of fish stocks to different levels of exploitation. The confidence in outputs from these types of models is generally low.

4.23 The models are potentially useful in assessing fisheries impacts associated with MPA networks, in particular in relation to the consequences of displacement and possible spill-over benefits. The development of fisheries bioeconomic models relies on the availability of adequate data to parameterize them, requiring a significant financial investment in data collection.

4.3 The ‘What’ - Types of Socio-economic Information Utilised

4.24 Socio-economic factors have been represented in the case studies in a number of different ways including spatial data (e.g. simple locational data, economic value (including non-market and non-use values), costs of constraints, distribution of natural resources, pressures) and non-spatial data (industry market structure, profitability, operating
arrangements, types of pressures and impacts, social values). All of this information is potentially useful in supporting network design. The different types of information that have been used in the MPA case studies are outlined below.

4.25 The most common type of socio-economic information that has been used within the designation of MPAs has been fisheries data because this has been the socio-economic activity of greatest concern in many of the studies. The GBRMPA and Gully studies were initiated in areas subject to a greater range of uses and therefore included socio-economic information on a much wider range of uses. For example, the GBRMPA case study took account of:

- Commercial fishing logbook and (Vessel Monitoring System) VMS data;
- Recreational fishing logbook and survey data;
- Information on tourism operations within the Marine Park derived through permits, plans of management and Environmental Management Charge data (including, for example, boat ramps, yacht anchoring points, areas important for tourism use);
- Information on shipping activities (location of vessels derived from automated position records, and Designated Shipping Areas); and
- Information received through submissions to the Authority during the preparation of the 2003 Zoning Plan.

4.26 Hydrocarbon potential was incorporated within the Canadian Gully case study reflecting extensive historic development rights covering the area.

4.27 Information has largely been collated from official records as well as through stakeholder engagement and community consultation. More specifically, fisheries information has been collected from VMS data, log books, reported data and through interviews with fishermen including map based questionnaires and surveys. The focus of the data collection has been on resource distribution, historic use and a review of future potential.

4.28 Information on the spatial location of activities has generally been compiled into data layers to facilitate spatial analysis as part of network design. Where information is available on the economic value of activities this has also been compiled into spatial data layers where possible. For example, the GBRMPA compiled the following fisheries datalayers:

- Otter Trawl Fishery Gross Value of Production (economic value (dollars) per 6nm² reporting unit);
- Otter Trawl Fishery VMS data (showing trawl positions);
- Line Fishery Gross Value of Production (economic value per 6nm² reporting unit);
- Net Fishery Gross Value of Production (economic value per 6nm^2 reporting unit); and
- Recreational fishing diary data (showing locations).

4.29 In the Florida Tortugas and Californian Channel Islands examples maps were created for each major use, using a common spatial scale, although the metric for each use varied. These metrics were then considered in the context of other socio-economic parameters including how many people are directly impacted, how much they are impacted, what is the socio-economic profile of those that are impacted and how this impact translates into impacts on the surrounding community and their economies.

4.30 Several of the case studies (e.g. Channel Islands and California MLPA) have highlighted the need for highly resolved spatial data, particularly in relation to local fisheries and leisure and recreation activities, in some instances at a spatial scale as low as 1nm. The requirements have included information on the different types of fisheries (which informs evaluations of relevant incompatibility with conservation objectives), intensity of activity (either as dollar value or stated importance) together with ancillary information on the dependence of groups of fishermen on specific fishing grounds and the proximity of fishing grounds to home ports. The need for data at this level of detail highlights the complexity of the issues associated with assessing socio-economic impacts and benefits of MPAs.

4.31 In the Finding Sanctuary Project, existing spatial data describing human activities at sea was found to be patchy and coarse and as such a regional data collection exercise was initiated under the auspices of the FisherMap project to map the nature and extent of fishing activities and fishermen’s knowledge of marine ecosystems. The FisherMap approach used a team of liaison officers (all ex-commercial fishermen) to interview individual fishermen and draw on maps the areas that they use and complete a questionnaire on the nature of their activity, i.e. fishing methods and gear type used, species targeted, and months of the year when the activity was carried out. Five spatial scales were used for these maps, with the most detailed scale used for close-ups on small, complex and intensively used parts of the coast (e.g. Poole Harbour), and the coarser scale to cover the entirety of the Finding Sanctuary region. A key limitation of the study is that the assessment has not captured information on the relative importance (or value) of different fishing areas. Such information has been found to be very important in other studies (Channel Islands, MLPA).

4.32 Although the FisherMap project was completed in 2008, Finding Sanctuary continues to map human activity at sea, based on the methodology developed for FisherMap. The aim is to build up as complete a picture for South West England as possible, including areas which FisherMap was not able to cover, and also to extend the work to
other types of human activity (such as recreational sea angling, watersports, and others) (des Clers et al., 2008). Finding Sanctuary is currently in the process of conducting interviews with recreational stakeholder groups (specifically: divers, sea anglers, charter boat owners, watersport enthusiasts and wildlife enthusiasts) in order to obtain spatial activity information. This work package has been termed ‘StakMap’; its methodology is similar to that used for professional fishermen, although stakeholder validation may differ (personal communication Shaun Lewin, Finding Sanctuary).

4.33 Several of the case studies (Channel Islands, MLPA, GBRMPA) have highlighted the benefits of collecting information on the relative importance or relative economic value of activities such as fisheries rather than just locational data. Such information is seen as being particularly helpful in supporting network designs that minimise socio-economic costs.

4.34 Alongside the collection and use of spatial data, the case studies also identify the use of a variety of non-spatial data. This includes information on market structure, management and operating regimes for activities, economic value and profitability, environmental pressures and impacts and the costs of management measures. In a number of instances a socio-economic profile has been developed for the area under consideration at the start of the respective designation process. The profile has been designed to collate and identify present historic, current and potential future use of an area. The need to tailor the regional profile to the specific uses within the area of interest has also been identified within a number of the case studies. In some instances regional overview data has been supplemented with more detailed local information where required.

4.35 The information that has been collated has been both quantitative and qualitative in nature. While the majority of the data that has been used in the decision making processes has been translated into some kind of map based format other data types have also been used. For example in the PNG case study, a range on non-spatial data were acquired:

- Detailed socio-economic survey data included;
- Household economic and demographic characteristics;
- Cash incomes from marine resources;
- Subsistence production and household consumption of marine resources;
- Local management practices;
- Changes in marine resources;
- Marine resource conflicts;
- Perceptions of marine habitats; and
- Cultural heritage values.
4.36 In other case studies detailed information on the dependencies and inter-relationships of various fishing activities have been collated (e.g. Channel Islands and MLPA).

4.37 To take account of future uses and to ensure that information does not become obsolete a number of the case studies have employed post implementation monitoring strategies. These have acknowledged that the data may be collected using new methodologies in the future and that the designated areas may also change. The baseline data collated within the designation process can also be used to assess future monitoring data and compliance.

4.38 In the Florida Tortugas and Californian Channel Islands studies stakeholders were asked questions about future patterns of activity e.g. where might fishermen go in the future. With regard to expanding fisheries, Fisheries and Oceans Canada (DFO) investigated exploratory actions by industry to identify future threats. Similarly hydrocarbon exploration areas were reviewed and consideration was given to the potential for future increase in interest in scientific research. Within the GBR known future growth areas of tourism were also identified within the designation process.

4.39 The use of long term datasets within the designation process was also undertaken in an attempt to take account of future patterns of use. In the California MLPA Network the fishing data that was used in the analysis was based on a 30 year average to seek to ensure that it did not become obsolete.

4.40 In all the case studies, the process of network design took account of the potential compatibility of individual socio-economic uses with site conservation objectives. The views on compatibility were informed by scientific understanding of the pressures and impacts associated with each activity, although none of the case studies undertook a formal analysis of pressures and impacts. Several of the case studies highlighted the importance of differentiating between different types of fishing gears and methods when creating data layers, where these activities were likely to generate different levels of pressure and impact.

4.41 Stakeholders stressed how important it is that sufficient information on which to base decisions is available. Bob Leeworthy of the US National Oceanic and Atmospheric Administration (NOAA) stressed that for stakeholders that are displaced it was extremely important to demonstrate potential losses or opportunity costs and that their interests had been fairly represented.

4.42 To support the development of RIAs additional information was generally collated. For example for the Tortugas IA, the following additional factors needed to be considered:
- Issues of substitution and mitigation;
- Other regulations;
- The state of economies and markets for the goods and services impacted; and
- the benefits of the alternative options, including non-use values, and environmental variations.

4.43 Several of the case studies acknowledged the difficulty of obtaining quantified information on the potential benefits of MPA networks.

4.44 None of the case studies had a specific focus on the collection of information on the social or policy consequences of network options, although some specific social information was collected as part of the PNG study. Based on experiences with the application of social impact assessment to other projects, plans and programmes the main types of information that might be collected to inform social impacts include (after Centre for Good Governance, 2006):

- Lifestyle impacts – on the way people behave and relate to family, friends and cohorts on a day-to-day basis;
- Cultural impacts – on shared customs, obligations, values, language, religious belief and other elements which make a social or ethnic group distinct;
- Community impacts – on infrastructure, services, voluntary organisations, activity networks and cohesion;
- Quality of life impacts – on sense of place, aesthetics and heritage, perception of belonging, security and liveability, and aspirations for the future; and
- Health impacts – on mental, physical and social well being, although these aspects are also the subject of health impact assessment.

4.45 Such information can be obtained through stakeholder engagement or targeted surveys.

4.46 Information on existing policies for the marine environment is readily available. Evaluation of network design options against policy criteria generally involves a qualitative evaluation against multiple objectives and targets to identify options that most closely deliver requirements.

4.4 The ‘When’ – Considering Socio-economic Information in the Process

4.47 All of the case studies reviewed are characterised by increasing information richness over time. The process of incorporating socio-economic factors within MPA network design is essentially an iterative one, although various different phases of design can be identified which make use of different types of socio-economic information. For example, initial explorations of network design within the case studies are often based on relatively simple spatial criteria (such as location of
an activity or its economic value) but increasingly detailed and sophisticated information and analyses may be required in subsequent and more detailed deliberation phases to reliably inform estimates of potential socio-economic impacts.

4.48 The consensus, from consultation with practitioners, is that the inclusion of socio-economic information is necessary from the outset, as part of the initial phases of network design. In the Californian case studies for example, socio-economic parameters were not taken account of in the early planning processes that were attempted. This resulted in the perceived failure of the process and as such socio-economics are now fully integrated into the designation process. However, the point at which socio-economic information is introduced within the initial network design process does not appear to be critical. For example both the Channel Islands and Gully case studies started with pure ecological network designs but then incorporated socio-economic factors in the development of subsequent network designs. In contrast, other processes such as GBRMPA incorporated socio-economic factors into the earliest network designs.

4.49 Some differences occur in the stages at which information is introduced into the process and by whom. For example, some processes (e.g. Channel Islands) have focused more effort on up-front data collection and collation before planning commences, whereas other processes have started with existing information and sought to acquire additional information through consultation and stakeholder engagement as part of the overall process (e.g. GBR, South East Marine Region). However, all processes involve some element of data acquisition through and as part of the planning process and the (minor) differences to some extent reflect differences in the amount of information initially available, available time scales and specific aspects of the planning process. For example, in the GBR case study, initial proposals for the MPA network were developed in a top-down manner by the GBRPA using nationally available ecological data and socio-economic data and supported by use of a network design tool. These proposals were then subject to two public consultations and two associated public data collection exercises which led to revisions to the network and the development of zoning proposals for individual sites.

4.50 The consensus from the case studies is that it is preferable to initiate planning using existing available data rather than seeking to acquire comprehensive data prior to planning. In particular, the process of planning can help to identify additional data/information requirements. One reviewer highlighted the possible ‘moral hazard’ issue associated with commencing network design before all relevant information is available and the risk that stakeholders might seek to subvert the process by introducing new information at late stages of the planning process. However, the evidence suggests that the MPA initiatives examined in this study have continued to collect and apply new
information throughout the planning process without experiencing major issues.

4.51 The deliberation phase has typically taken account of more detailed socio-economic information, for example, impacts at a fishery or industry level. It provides the opportunity to apply techniques such as CBA (both qualitative and quantitative approaches depending on the issues). CBA also provides the opportunity to present information on benefits of designation as well as costs. In this context the case studies have highlighted that not all socio-economic information is necessarily required at the start of the designation process. In contrast the view of one individual involved in the designation of the Californian Channel Islands (Bob Leeworthy, NOAA) was that once lines are drawn on maps the collection of additional information should stop. This was to avoid the moral hazard problem where once people are aware of boundaries they will have an incentive to claim more activity within those boundaries than is the case in order to raise the opportunity cost.

4.52 Within virtually all of the case studies once a preferred alternative network design was identified a formal RIA was undertaken. These IAs have taken account of both costs and benefits of network proposals using cost benefit analysis approaches, requiring additional information on benefits to be collated for this exercise.
5. Considerations for Taking Forward Inclusion of Socio-economic Factors

5.1 Introduction

Based on the findings of the literature review and discussions at the stakeholder workshop, this section discusses possible options for taking account of socio-economic factors in MPA network planning and seeks to identify good practice that might be appropriate to apply in a UK context. In particular, the section explores possible tools and approaches that could be used to analyse, interpret and present socio-economic information (the ‘how’), the types and format of socio-economic data that might be required (the ‘what’) and the points at which different types of information might be interjected (the ‘when’).

5.2 The consideration of options takes account of the proposed process for UK MCZ planning (section 2.1). The process of developing network options that has been applied in the MPA case studies is essentially an iterative one with network proposals being subject to deliberation and subsequent revision until one or more solutions broadly acceptable to stakeholders has been developed. However, within this process of iterative design, it is possible to distinguish between activities associated with the development of initial network design (drawing initial lines on maps) and activities associated with more detailed deliberation of options (evaluation of conformance with ecological, social and economic objectives).

5.3 In discussing possible approaches below, we have found it helpful to distinguish between activities associated with initial network design and those associated with deliberation, although we accept that, in practice, the boundaries may often be blurred.

5.2 How to Take Account of Socio-Economic Factors – The Tools

Section 4 described a range of tools that have been used to present and assess socio-economic factors in MPA planning and non-MPA planning initiatives.

All the MPA initiatives reviewed have used simple forms of spatial analysis to support initial network design. In some cases such as the GBRMPA initiative, more sophisticated network design tools have also been used both to support ecological design and to take account of socio-economic factors. This initial network design stage has then been followed by more detailed qualitative and quantitative assessment of particular network design options or aspects of options through a process of iterative deliberation. Such assessments in the MPA case studies reviewed have largely focused on economic costs with limited effort directed towards evaluating economic benefits, and this has
primarily been in support of Regulatory Impact Assessments (RIAs) rather than to support network design. Few, if any, of the MPA case studies reviewed made use of tools for the explicit consideration of social factors, although there are examples of the application of social impact assessment to non-MPA initiatives. The MPA case studies assessed in this report have made limited use of tools such as multi-criteria analysis (MCA) or trade-off analysis, though other MPAs have employed such tools, e.g. Buccoo Reef Marine Park, Tobago (Brown et al, 2001), Egadi Islands, Sicily (Himes, 2001). The actual impacts of such approaches on the management of these MPAs, however, appears to have been very limited. A small number of MPA initiatives have used bioeconomic models to assess fisheries impacts and benefits, for example, the MLPA initiative. Sustainability appraisal provides a good example of the application of MCA in terrestrial planning.

5.6 At the broadest level, the tools required to support socio-economic assessment need to be able to identify the potential for interaction between different socio-economic activities and potential MPAs, to determine the extent of the interaction (where it occurs) and to quantify (where possible) the possible consequences of introducing management measures where necessary. The potential for interaction is primarily an issue of the spatial distribution of socio-economic activities and potential MPAs. Thus spatial analysis is an important tool for identifying potential interaction. Quantification of the interaction can also be undertaken using forms of spatial analysis, where supported by relevant data. The quantification of the consequences of possible changes in management measures is a more complex task and requires the application of other types of assessment tools and the use of non-spatial data as part of an overall evaluation including expert judgement.

5.2.1 Consideration of Options

Initial Network Design Phase

5.7 In the initial network design phase the focus is on developing possible network designs that fulfil some or all of the ecological, social and economic criteria. The broad options for initial network design include:

- Bottom-up process involving stakeholders drawing lines on maps; and/or
- Use of specialist mathematical optimization network design tools.

5.8 Both approaches (and combinations of approaches) have been used in the MPA case studies and claimed to have been successful. The MLPA initiative has developed a specific tool for capturing stakeholder views on possible locations of MPAs as part of MarineMap software. Finding Sanctuary has developed a similar system for data capture. The bottom-up process is simple and easy for stakeholders to
understand and helps to facilitate engagement and buy-in. Network design tools can be good at developing overall network solutions that conform to specific sets of criteria, although they can suffer from a lack of transparency. Increasingly, such tools are also able to incorporate representations of socio-economic interests as well as ecological factors.

5.9 In a UK context, we would note that the ecological criteria that will need to be applied are quite complex compared to some of the MPA case studies reviewed. In particular, there is a requirement to consider a large number of separate features for inclusion in the network and to take account of other factors such as replication and connectivity, for example. The diversity and intensity of human activities in UK seas is also greater than many of the areas considered in the MPA case studies. Consequently, it may be difficult to develop network options that comply with relevant criteria based on a bottom-up process alone.

5.10 Recourse to network design tools may assist with the development of possible network solutions. Furthermore, the use of such tools is likely to develop more efficient solutions (in terms of the space occupied) as they provide for optimization of network designs against a range of user-specified criteria. Given that the size of the network has been shown to be an important driver of costs to industry (ABPmer et al., 2007), such tools may also assist in minimising the socio-economic costs of network options compared to bottom-up approaches. However, because network design tools are complex, great care would need to be taken in gaining stakeholder acceptance prior to their use in Regional projects. It would be important that RSGs are familiar with how such tools work and the limitations of their use before they are applied. If such tools are used, this should be done in conjunction with an element of bottom-up network development to enable stakeholders to compare both methods. For example, any preferred locations for MCZ identified by stakeholders could be locked in to network designs.

5.11 As noted above, both approaches and combinations of approaches have been claimed (and with some support from stakeholders) to have been applied successfully, although this is largely a matter of perception rather than science. Possibly the most important thing is that there is a clear process for network design which is understood by stakeholders and opportunities are provided for stakeholders to contribute to decision making. In the UK context, the relative complexity of the ecological criteria and the multiplicity of socio-economic interests and interactions suggest to us that if network design tools are introduced and used sensitively within the process, they will facilitate the design of a network that is both ecologically coherent and which helps to minimise socio-economic impacts.

5.12 Whichever approach (or combination of approaches) that is adopted to network design, initial evaluation of resulting network design options can be undertaken using simple spatial analysis tools within a GIS.
These analyses might include assessments of the spatial overlap between socio-economic activities and potential MPAs both at a site and network level. Where information exists on how the importance or value of an activity varies spatially, this might also be reported as part of any analysis. These types of analysis are those that have typically been presented in other MPA initiatives. Such reporting has been considerably developed by the MLPA initiative through the use of MarineMap. This tool can be used to rapidly generate (in real time) customised outputs from spatial analysis for consideration by regional stakeholders. Similar functionality exists in standard GIS packages, but these do not have equivalent customised reporting.

5.13 Such spatial analysis tools can be used to explore high-level implications of possible interactions between socio-economic activities and potential MPAs. However, because they are dependent on the availability of spatial data, they are not generally able to generate detailed assessments of cost consequences for particular socio-economic activities or to inform assessments of benefits. Nevertheless, in some MPA case studies such as Channel Islands and MLPA, spatial analysis of data layers has gone a considerable way to defining acceptable network proposals.

5.14 In undertaking spatial analysis, assumptions necessarily have to be made about the likely compatibility of different socio-economic activities with conservation objectives for specific features. Within the case studies, these assumptions have tended to be based on scientific literature and expert judgement, for example, making an assumption that bed-disturbing fishing gear is incompatible with conservation objectives for biogenic reef habitats.

**Deliberation Phase**

5.15 The deliberation phase is essentially an iterative process of refinement of initial network design options which may be more or less distinct from the process of initial network design. The deliberation phase makes use of similar tools to those applied in initial network design but may also include a range of additional tools to support more complex and detailed evaluation. The tools inform and support decision-making and necessarily have to be applied as part of a wider decision-making process that relies on discussion amongst stakeholders and evaluation and review using expert judgement. Thus while tools can be helpful in informing decision-making, clarity in the overall decision-making process and engagement of stakeholders are critical to the successful development of the overall network.

5.16 All the case studies have made use of simple spatial analysis tools in seeking to refine initial network designs, for example, redrawing potential MPA boundaries to improve compliance with ecological criteria or to avoid potential conflicts with socio-economic activities.
In virtually all of the MPA case studies, detailed network proposals have been developed based on some form of simplified cost benefit analysis (largely focusing on relative economic costs). While cost-benefit analysis is often primarily aimed at monetisation of costs and benefits, an overall cost-benefit framework can also be used to describe the relative scale of costs and benefits in qualitative terms where quantification is not feasible. Such flexibility is likely to be helpful in the context of MCZ network design where monetisation of all costs and benefits is unlikely to be practicable.

None of the MPA case studies reviewed took account of benefits information as part of network design, although a few included such information for the purposes of formal IA. From a UK perspective there are several advantages in seeking to take account of benefits information in the development of network proposals. In particular, good practice in IA requires that information is collected and evaluated throughout the process of developing interventions and not simply at the end. Furthermore, it is helpful to include a consideration of the potential benefits associated with different network options as part of the deliberation process because the types and scale of benefits may vary between options. Some of the benefits may also provide greater opportunity for the sustainable exploitation of ecosystem goods and services compared to others. On this basis it would seem more appropriate in a UK context to require the deliberation phase to consider benefits as well as costs, accepting that the availability of information on benefits may be poor. Nevertheless, even identifying benefits qualitatively during the deliberation process may assist stakeholders in differentiating between alternative network options.

The assessment of costs and benefits makes implicit assumptions about the compatibility of different socio-economic activities with the conservation objectives for specific conservation features and within the case studies reviewed, little if any new work has been undertaken to validate assumptions on environmental impact.

Some MPA case studies, notably the MLPA initiative, have sought to make use of fisheries bioeconomic models to assist with the modelling of fisheries costs and benefits. Such models can be used to assess the consequences of displacement and also to make an evaluation of long-term fisheries benefits from possible spill-over effects. As with any model, bioeconomic models are only as good as the information and scientific understanding that contribute to their development. While experience is continually developing with the application of such models, confidence in current model outputs is generally low. Where there are pre-existing models for UK waters they may provide a mechanism for exploring the implications of cumulative pressures on the fishing industry. It is unlikely that the time scales or resources available to MCZ projects would permit the development of new models.
5.21 Somewhat surprisingly, the MPA case studies appear to have made little use of other socio-economic assessment tools. For example, SIA is increasingly well established in UK terrestrial planning processes and in the assessment of projects, plans and programmes and is an important element of IAs. From a UK perspective, it will be important that social impacts of proposed network options are adequately understood in line with the requirements of the Marine & Coastal Access Act and for the purposes of the IA. It would therefore be appropriate for social impact assessment to be included within the overall assessment framework for the deliberation phase.

5.22 The MPA case studies have made limited use of MCA. However, such approaches have been widely used in terrestrial planning, for example, in undertaking Sustainability Appraisal (SA) for Regional Spatial Strategies and Local Development Documents. The SA process uses sustainability objectives and targets to compare the performance of different plan options against these criteria with strong links to policy requirements. The use of MCA could prove useful in clarifying the extent to which different network options might affect the achievement of socio-economic policy priorities for the marine environment and the trade-offs that might need to be made between different socio-economic interests. In particular, it could be helpful in demonstrating conformance with the Marine Policy Statement when this is issued.

5.2.2 Key Points

5.23 The key points are:

- The use of simple map-based tools and/or network design tools is likely to be important, underpinned by spatial analysis tools in early stages of network design; such tools require assumptions to be made about the likely compatibility between different socio-economic activities and conservation objectives for specific features;
- The complexity of UK ecological criteria and number and type of socio-economic activities will require tools that can process and simplify information for use by stakeholders;
- If it is decided to make use of network design tools, these will need to be introduced and applied sensitively within the overall network design process. RSGs would need to understand and agree to the use of such tools before they are applied;
- In the deliberation phase, there is a choice to be made about the extent to which assessments might also take account of benefits rather than simply focus on cost impacts. In our view, the overall assessment framework should encompass both cost impact assessment and benefits assessment (at least qualitative benefits assessment) as part of an overall CBA. The assessment framework should also incorporate SIA to evaluate social impacts and multi-criteria analysis to identify socio-economic policy consequences;
- The use of fisheries bioeconomic models may assist with identifying fisheries impacts, but it may not be possible to develop new tools for UK application within the timescales and resources available to the Regional Projects.

5.3 Information Requirements - What

5.24 Compiling general socio-economic information within an overall regional profile, as has been undertaken by a number of the MPA case studies reviewed, would be a useful exercise and provide a resource on which the MCZ projects might draw upon and further develop. An illustrative content for such a profile is provided in Appendix D based on the draft Regional Profile for the North Coast Region of the MLPA (California MLPA Initiative, 2009). The content could be readily adapted for MCZs principally to take account of the greater range of economic interests and to include a greater focus on social factors.

5.25 There is a need for highly resolved spatial data, particularly in relation to local fisheries and leisure and recreation activities including information on the different types of fisheries (which informs evaluations of relevant incompatibility with conservation objectives), intensity of activity (either as financial (first sale) value or stated importance) together with ancillary information on the dependence of groups of fishermen on specific fishing grounds and the proximity of fishing grounds to home ports. The need for data at this level of detail highlights the complexity of the issues associated with assessing socio-economic impacts and benefits of MPAs.

5.26 Accounting for possible future uses of areas (for example by collecting information on future fishing intentions or identifying areas of exploitable natural resource) should be sought, although it is generally recognised that it can be difficult to accurately predict such requirements and these issues generally need to be dealt with as part of the development and evaluation of detailed network options.

5.27 The socio-economic impacts of MCZ proposals will depend significantly on decisions about the likely compatibility of activities with the requirements of conservation objectives for specific features. Various studies have sought to assess and present information on the spatial impact of human pressures using assumptions about the links between pressures and impacts and the sensitivity of receptors (e.g. Eastwood et al 2007). Such approaches are intuitively attractive but are limited by the assumptions implicit within them. While it will continue to be necessary to make such assumptions based on available scientific evidence and expert judgment, in order to evaluate the potential socio-economic impacts of different network options, it is important that the assumptions are transparent within the network design process and are subject to more detailed evaluation and review within the deliberation phase of network design.
5.28 The detailed assessment of socio-economic impacts requires that many assumptions are made. For example, some case studies have used simplistic ‘worst case’ assumptions that all the value associated with a fishing area would be lost as a result of designation whereas it is possible that some or all of the activity might simply be displaced. While initial information on economic value or stated importance of areas is useful in the initial stages of network design/site selection, a wide range of additional (and more detailed) information is likely to be required during deliberation processes to develop an overall understanding of the potential costs and benefits of alternative network designs. Such deliberations tend to involve wider discussions about the types of measures that different industries might need to apply to support achievement of particular conservation objectives and the regional scale impacts of networks (rather than simply the impacts of individual sites). Discussions in relation to fisheries can be particularly complex because fishermen’s livelihoods may be dependent on accessing a number of different but specific fishing grounds over the course of a year for such activity to be economically viable and alternative fishing locations may be heavily constrained by factors such as distance from home port, or historical access to particular fishing grounds.

5.29 All of the case studies have recognised the relative lack of quantified information on the potential benefits of MPAs. Such benefits have tended to be described qualitatively or estimated based on literature values for the purposes of preparing required IAs. Few primary valuation studies have been undertaken as part of network design processes.

5.30 Few of the MPA case studies have sought to collate explicit information on social impacts, although such information has been collated by non-MPA initiatives. Specific consideration of social impacts is likely to be required to support delivery of the Marine & Coastal Access Act 2009I duty and also to support the required Impact Assessments (IAs). The key types of information that might be collected are described in section 4.3.

5.31 Many of the case studies have had implicit regard to information on socio-economic policies and priorities, for example, in seeking to minimise socio-economic impacts. However, few if any studies have undertaken any systematic assessment of the impact of MPA network proposals on the achievement of these socio-economic policies, although this is a central concept in UK terrestrial planning. The consideration of the impact of MCZ network proposals on the ability to achieve socio-economic policies and priorities is likely to be required, particularly in relation to the Marine Policy Statement as failure to achieve these priorities would clearly be a socio-economic consequence of some significance in terms of the Marine & Coastal Access Act provisions. Such an assessment could be undertaken through evaluation of the extent to which MCZ network proposals
supported achievement of key socio-economic policies and priorities, for example in relation to energy security, energy supply and renewable energy.

5.3.1 Existing UK Information

5.32 There is a wide range of socio-economic information on human activities in UK waters and a listing of spatial data sets available is included in Appendix F (including details on its source). Socio-economic activities in the UK have recently been reviewed for Charting Progress 2 (CP2) (ABPmer & eftec, in press) in relation to the following principal activities:

- Aquaculture – including fish and shellfish farming, growing of laver and seaweeds, reseeding of ‘natural’ beds, grooming of beds with clutch;
- Coastal defence and flood protection;
- Defence – Military;
- Education;
- Fisheries – capture of fish and shellfish, harvesting of wild seaweeds, sponges;
- Leisure and recreation;
- Mining & Quarrying – including marine aggregate dredging and sea salt extraction;
- Oil and Gas – including pipeline networks as an ancillary activity.
- Pipelines – interconnectors transporting liquids between bodies of land, e.g. the UK and mainland Europe, the UK and Northern Ireland;
- Power transmission – interconnectors;
- Renewable energy – including power transmission to land;
- Research and development;
- Storage – gas storage of foreign imports and carbon capture and storage;
- Telecommunications – subsea cables;
- Waste disposal – including wastewater;
- Water abstraction – particularly for power stations;
- Water transport – of people and freight, includes development of ports, navigation aids such as lighthouses, and ship building.

5.33 The report describes (where practicable) the economic value of activities (and the regional and temporal characteristics) and the nature of pressures from the activities (spatial extent, intensity, frequency). The information provides a useful starting point for the preparation of regional socio-economic profiles alongside sources such as Pugh (2008), river basin district characterization reports etc. Information will also be available from other sources, for example, from stakeholder representatives.

5.34 Alongside this information, various studies have sought to identify and evaluate the costs of potential management measures on socio-
economic activities that might be necessary to support the achievement of conservation objectives within protected areas (e.g. ABPmer et al, 2007; ongoing work to assess the cost impacts of offshore and inshore SACs e.g. eftec, 2009a). These studies have recognised the difficulty of estimating the costs of potential MPA management measures, because they are significantly dependent on judgements concerning the extent to which socio-economic activities conflict with conservation objectives or can adapt or relocate to an alternative area.

5.35 A summary of existing sources of non-spatial information on socio-economic activities that may be of use to MCZ Regional Projects is presented in Appendix F.

5.36 A large volume of information is also available on socio-economic policies relevant to the marine environment. These are contained in various documents including White Papers, the forthcoming Marine Policy Statement and National Policy Statements, Planning Policy Statements and related guidance, various plans with a marine or coastal interest. A summary listing of relevant policies is presented in Appendix G. Existing guidance for terrestrial planning also includes summaries of key relevant policy documents.

5.37 There are at least two key gaps in socio-economic information availability that have been identified - local fisheries activities and leisure and recreation activities. The approaches adopted by Finding Sanctuary to these issues – FisherMap and StakMap – are generating valuable information and could usefully be replicated in the other MCZ regions. The current outputs from FisherMap identify the relative usage of areas for different types of fishery in terms of the number of fishermen identifying an area as one that they fish. While this provides an indication of importance, the information should be developed further to identify relative importance (either in terms of economic value or stated importance).

5.38 There is necessarily limited information available on future socio-economic uses and the level of certainty of future use varies within and between different sectors. In certain instances, future use areas can be identified in some detail, for example where development consents have been applied for or obtained but not yet implemented. In other cases, areas of potential future use may simply be identified as areas of potentially suitable resource to which a lower level of certainty of future exploitation might attach. Differences in the level of certainty of future use could be taken into account in developing network options, but the appropriate trade-offs should be made by the relevant stakeholders as part of the detailed deliberation process rather than being prescribed centrally.
Defra is also funding (through MB0102 and MB0106) research to develop spatial information on some human pressures and potential vulnerability of species and habitats to those pressures. However, this work is unlikely to provide a comprehensive picture of all human pressures and impacts. While work under MB0102 may lead to improved information on the sensitivity of marine biotopes to a range of human pressures, the lack of a detailed biotope map for UK seas and the lack of detailed pressures information for some pressures mean that it is unlikely to be possible to develop comprehensive spatial vulnerability maps in the near future.

Various studies have been undertaken to identify and evaluate potential benefits in the marine environment (e.g. Beaumont et al, 2006; SAC Ltd, 2008) which recognise the difficulties of assigning meaningful quantitative values.

Consideration of Options

The main choices concerning the types of information and their use in MPA planning in a UK context relate to:

- The types of initial information used to compile data layers to describe human activities (location of existing and/or future activities, the intensity of activity, economic value, stated importance, pressures and impacts);
- The scale of resolution of spatial data;
- The scope of information used to inform the more detailed deliberation process;
- The nature and form of information on potential costs (qualitative (relative importance); quantitative (estimates of economic value (turnover, Gross Value Added (GVA)) or the costs of management measures); and
- The type of information used to assess benefits.

Most MPA planning projects have taken a pragmatic view in relation to information requirements and initiated planning processes using existing information while collecting additional data as planning progresses. In the MPA case studies, information on the absolute or relative importance of areas has generally been seen as being the most helpful in terms of data layers to inform initial network design. While such approaches provide only a simplistic representation of what can be very complex issues, stakeholders appear to have accepted these approaches, particularly for the initial phases of network design. Generally, such data layers are likely to be required for all significant human activities in a planning region, although layers on nationally important economic activities are likely to be more readily available and influential in initial stages of network design. Where different types of activity within a socio-economic sector may give rise to different levels of impact (e.g. different fisheries), these need to be described separately.
5.43 Ideally, initial network design might be informed by spatial information on the pressures and impacts associated with socio-economic activities and clear policies on the compatibility or incompatibility of socio-economic pressures in relation to site conservation objectives. However, there is currently limited information on many of the key pressures, nor are there absolute policies on their compatibility with conservation objectives. In other MPA planning initiatives, extractive and significantly bed disturbing activities have generally been considered to be incompatible with the achievement of the more stringent conservation objectives (for example, in highly protected sites) although in multiple use sites, some extractive activities (e.g. limited fishing) has been accepted.

5.44 The likely impacts on socio-economic activities are very much dependent on judgements concerning the compatibility of individual activities with conservation objectives and the nature and extent of management measures that might need to be applied. There is a danger that in focusing primarily on the location, importance or economic value of socio-economic activities in the development of initial network design that issues of compatibility may get overlooked. However, this could be addressed by ensuring that at least some of the initial network designs take account of potential conflicts for those socio-economic activities that might be considered to be more incompatible with conservation objectives (e.g. extractive activities and seabed-related detrimental activities).

5.45 Collecting and presenting socio-economic activity data at an appropriate spatial scale can be important in spatially defining the importance of particular areas. Where reasonably accurate vector, point or polygon data is available this can generally be presented at whatever level of resolution is required. Where gridded data is collected, the size of the grid needs to take account of how an activity varies spatially so that information on variations in the location and intensity of that activity are not lost. Generally data should be gridded at the greatest resolution possible, but in order to be able to superimpose different types of data, some level of standardisation will be required.

5.46 The development and evaluation of detailed network design options and their socio-economic costs and benefits will occur as part of an iterative deliberation process within the RSGs and in consultation with the SAP. It is not possible to be prescriptive about the information which might be required to inform these deliberations. At a broad level the Regional projects will need to access information on the importance and/or economic value of socio-economic activities and the cost impact of potential management measures. Information on social costs and benefits would need to be collected through primary research, although much of this information could be collected simply as a result of engagement with stakeholders. Additional information on existing
socio-economic policies and objectives would also be useful (see Appendix G).

5.47 Where detailed issues arise, it may be necessary to understand the market structure of key industries, their profitability, the wider dependencies as part of supply chains and typical operating regimes in the marine environment.

5.48 Some of the issues to be addressed are likely to be very complex. For example, there are a wide range of factors to be considered in evaluating local fisheries impacts of MCZ as previously described. Furthermore, the overall impact of MCZ proposals on fisheries interests will also be influenced by other cumulative pressures on the fishing industry, in particular CFP reforms, changing quotas and R3 OWFs. It is likely to be particularly challenging for the MCZ projects to take account of these issues, which effectively are related to broader marine spatial planning, but such issues cannot be ignored in evaluating the socio-economic consequences of MCZs. Similarly a range of other socio-economic activities exist within a global marketplace and changes in relative competitiveness of these industries can have long-term implications for their viability in UK waters. While it may not be possible to accurately quantify such issues they should be identified within the overall assessment framework and taken into account in the decision-making process. Solutions will need to be developed that take account of wider socio-economic policies and objectives. While a final Marine Policy Statement is not expected to be published until late 2011, an initial draft may be available from April 2010. This could be helpful in clarifying priorities and providing RSGs with a steer on how to make trade-offs where they are required.

5.49 The relative lack of benefits information is widely recognised and none of the case studies reviewed undertook any rigorous analysis of benefits information to inform network design, although some studies took account of benefits information for the IA. Such information can either be collected through new primary valuation studies (using revealed or stated preference methods) or through value transfer (the transposition of economic values estimated at one site (the ‘study’ site) to another site (the ‘policy’ site)). Primary data collection can be expensive and time consuming. The use of the value transfer approach is therefore intrinsically attractive although the availability of suitable information is limited. It is important that the application of such an approach, if adopted, acknowledges and reflects the greater inherent uncertainties associated with the method. Value transfer is not covered in detail in this report because another ongoing Defra-funded project is producing guidelines for applying value transfer in the UK,
and that work includes a marine case-study “The Benefits of Designation of Marine Conservation Sites”.

5.3.3 Key Points

The key points are:

- MPA planning processes have generally made use of existing (national) socio-economic data and collected additional more detailed data through the course of the planning process where required to inform the development of network design options; additional data collection has largely focused on local information such as inshore fisheries and recreational activities;
- Information on the spatial distribution of socio-economic activities has generally been compiled as data layers. The information has been represented in terms of activity location, intensity, economic value and stated importance. Information on the absolute or relative importance of areas has generally been seen as being the most helpful in terms of data layers to inform initial network design. Such information is used to inform initial network design options either directly or through the use of network design tools;
- Few if any studies have sought to develop spatial data layers on pressures and impacts or their compatibility with conservation objectives. Instead they have tended to use generalised assumptions about the compatibility or incompatibility of particular socio-economic activities to inform initial network designs;
- While some previous MPA planning exercises have sought to take account of future-use activities, it is recognised that this is difficult to achieve because of uncertainties about future requirements. Generally such considerations need to be reflected in the development and evaluation of detailed proposals;
- The spatial scale at which socio-economic data should be represented depends on the spatial variation in the distribution and intensity of an activity; to adequately describe inshore fisheries activities, some previous planning processes have needed to use spatial resolutions of the order of 1nm;
- The UK has good data on the location of national activities and some information on the economic value of such activities; these data have recently been summarised for CP2. The main gaps in spatial data on human activities relate to the distribution and value of inshore fisheries and leisure and recreation activities; the regional MCZ projects provide an opportunity to collect this data;

The FisherMap and Stakmap initiatives being undertaken by Finding Sanctuary provide a useful model for other Regional projects for the collection of local fisheries and recreational data. Where possible the Regional projects should also seek to collect information on relative importance of the areas used;

There is currently inadequate information on pressures and impacts and compatibility with conservation objectives to create meaningful data layers that could be used to support initial network design. However, the development of initial network options could take account of the potentially more significant incompatibilities (e.g. extractive and bed disturbing activities);

Refinement of network options occurs through an iterative deliberation process which can involve the acquisition and collation of a range of detailed and specific information relevant to the issues at hand. Such issues can be very complex and it is not possible to fully specify what information might be required to adequately inform decision-making. The broad types of information that are likely to be required include:

- the importance and/or economic value of socio-economic activities;
- the cost impact of potential management measures;
- qualitative or quantitative description of social impacts;
- evaluation of consequences for achievement of socio-economic policy priorities;
- information on benefits.

Where detailed issues arise, it may also be necessary to understand the market structure of key industries, their profitability, the wider dependencies as part of supply chains and typical management and operating regimes for key activities in the marine environment;

All previous MPA planning processes have recognised the limited information available to inform assessments of benefits and it remains difficult to present meaningful quantified estimates. Value transfer provides a potential mechanism for providing benefits information although it is important that uncertainties associated with such an approach are acknowledged and reflected.

5.4 When to Take Account of Socio-economics

5.4.1 Introduction

The case studies indicate that most MPA planning processes now seek to incorporate socio-economic factors from the outset, following failure of some initiatives that did not incorporate socio-economic interests. All the case studies have tended to initiate site/network design using existing information and collect additional (more detailed) data as the process proceeds. A range of different approaches have been used to incorporate socio-economic considerations into MPA planning
processes common characteristics viz: objective setting, deliberation, development of recommendations and an approvals process.

5.52 The different approaches adopted in the case studies tend to reflect characteristics of the institutional arrangements and administrative approach for MPA planning, the tools utilised and available time scales. For example, initiatives such as GBRMPA that have used network design tools have a minimum information requirement to support the use of such tools. This includes having access to relevant spatial data on at least the key socio-economic activities and particularly those that may give rise to conflicts with conservation objectives.

5.53 While some initiatives have suggested that comprehensive information is required before MPA planning can commence (to avoid the moral hazard problem), the evidence suggests that most if not all MPA planning processes have collected additional information as part of the planning process.

5.4.2 Consideration of Options

5.54 The detail and timing of interjection of socio-economic information in UK MCZ planning will depend on the planning process adopted, the tools that are used and information availability. Assuming that the process will include a phase of initial network design followed by a more detailed deliberation phase, this section sets out the options for when different types of socio-economic data might be introduced to the planning process.

5.55 To support the process of initial network design, spatial information on the location of the more significant socio-economic activities is required, particularly for extractive industries or those activities that cause significant disturbance of the sea bed. This information is primarily national information that will be available early in 2010 from the Defra funded project MB0106 (which will deliver the spatial data identified in Appendix F). Additional regional information, particularly for inshore fin-fisheries and leisure and recreation is expected to be collected by the regional projects and is likely to be available later in 2010.

5.56 The main choices here relate to the amount and type of spatial data that might be used to support initial network design. At a simple level, initial network options might be developed to meet the ecological criteria which also take account of specific socio-economic policy priorities or which generally seek to avoid locations of activities that are likely to be incompatible with conservation objectives. Such options could readily be generated using network design tools to ‘steer’ site selection away from such locations. Outputs of this type might be useful in identifying the extent to which pursuing individual policy priorities might or might not compromise achievement of the ecological
or other socio-economic goals and thus help to focus subsequent deliberations. If network design tools were not to be used, a similar process might be followed but simply inviting stakeholders to identify possible locations for MCZs that would meet the broad criteria for different policy options.

5.57 At a more complex level, it would be possible to use more detailed information on socio-economic activities, including weighting of data layers (for example, by value and/or importance; by intensity etc) as well as more specific criteria relating to compatibility with conservation objectives, for example, differentiating between different types of extractive fishing. However, it should be recognised that there are significant limitations in the data that might be used to support initial network design options. The RSGs will need to take a view on the benefits of attempting to refine initial network designs using such limited information.

5.58 A large number of initial network design options may be generated. They can be analysed using simple spatial analysis tools to identify relative overlaps and potential extent of conflicts with conservation objectives. Using such information, the RSGs might then identify a smaller number of options for more detailed deliberation.

5.59 Alongside this initial spatial information, the regional projects might usefully seek to collect a range of non-spatial information on socio-economic uses, for example, information on the types of pressures and impacts associated with different socio-economic activities, the economic value of these activities and an understanding of the operating regimes for different sectors. Much of this information has recently been summarised for CP2 (ABPmer & eftec, 2009) and relevant information sources are identified in Appendix F. The establishment of the RSGs provide a good opportunity to involve stakeholders in the provision of relevant information for their sector. This information is likely to be particularly important in the more detailed deliberation phases of network design.

5.60 The development and evaluation of detailed network design options is anticipated to occur as part of an iterative deliberation process within the RSGs and in consultation with the SAP. This phase is likely to draw on a wide range of socio-economic information, the detail of which will depend on the specific issues to be considered. A key choice to be made is whether to include information on benefits within the deliberation process on network options or leave this to the IA. As noted in section 5.3, in a UK context we think it is preferable for benefits information to be included in the deliberation phase of network design.
5.61 While the general information identified above will provide a starting point for aspects of this assessment, it is very likely that additional information will need to be collected to inform the deliberation phase. Such information might include:

- More detailed (site-based) assessments of potential costs to specific sectors and assessments of overall cumulative impacts of MCZ proposals in combination with other pressures on individual sectors (e.g. commercial fishing);
- Information on social impacts of possible network options – this is likely to be qualitative information provided by stakeholders in commenting on network options, though it could be presented quantitatively using Likert scales. These simply assign a number to a qualitative response, e.g. very good = 5, very poor = 1. The resulting data must, however, be analysed and presented with caution, as it represents assigned data rather than actual data.
- Evaluation of the potential socio-economic policy consequences of possible network options against key policy priorities – Regional projects might usefully collate information on existing relevant policies and priorities and work with stakeholder groups to agree a policy framework against which network proposals might also be tested.

5.62 In addition to these information requirements, in some circumstances it may be appropriate to commission additional targeted research on the potential benefits of particular proposals and/or to seek to apply bioeconomic models in relation to the assessment of fisheries impacts.

5.63 Decisions on the level of detail necessary to support decision-making will need to be made by the RSGs. The general principle to which the Group’s should work ought to be to collect just sufficient information to inform the decision at hand. This will permit targeting of effort and information collection towards the more complex and contentious issues.

5.64 To support this approach, it is suggested that a two-phase assessment process should be applied to assessing socio-economic impacts within the deliberation phase. An outline methodology for achieving this proportionality is provided in Appendix H. The methodology presented is illustrative and focuses primarily on the consideration of economic costs and benefits. However, it can be readily adapted to more fully incorporate social and policy interests as required. The two main stages proposed comprise:

- A qualitative/first cut assessment which summarise the available social and economic evidence, the location of socio-economic activities, the policies that apply (and their priority), any market values available e.g. value of current fish catch, and any valuation evidence from published and grey literature. The main purpose of the first cut approach is to provide an input to the initial
consideration of the list of potential sites for consideration as MPAs. It can provide an indication of the magnitude of socio-economic value evidence from the literature, which may be used to highlight possible orders of magnitudes of socio-economic benefits and costs and to focus on the most important impacts. As part of this process, listing those who stand to win/lose from any site designation can also be a valuable way of checking that all relevant stakeholders are included in the process and that social aspects are adequately captured.

- A more detailed assessment which provides for the capture of new primary data or collation of additional existing information on social or economic factors. Given the time scales for MCZ identification, it is unlikely that significant amounts of new primary data can be collected. On this basis approaches such as value transfer may be the most appropriate means of developing quantitative assessments to inform decision-making.

5.65 An overall representation of the points at which different types of socio-economic information might be introduced into the MCZ planning process is presented in Figure 3.
Figure 3: Points at which different types of socio-economic information might be introduced into the MCZ planning process
5.4.3 Key Points

5.66 The key points are:

- Initial network design options can be generated using relatively simple national spatial data on the location of key socio-economic activities. There are choices in the level of complexity that might be applied to initial network design, although the limitations of the data need to be recognised;
- Additional regional data can be collected to inform discussions as part of detailed deliberation on preferred network options;
- A large number of alternative options might be developed in the initial network design. These can be evaluated at a high level using simple spatial analysis tools. RSGs will need to decide which options might be taken forward for more detailed consideration;
- More detailed consideration of options is likely to require assessment of a broad range of socio-economic information, some of which can be collated from existing sources and some which will need to be acquired from stakeholders or from new primary research;
- Detailed evaluation should be undertaken in a proportionate way. This might be achieved by having a two-stage evaluation process involving an initial stage that summarises existing information (both qualitative and quantitative) and a second more detailed assessment stage (involving the collection of additional quantitative information) where necessary.
6. Concluding Remarks

6.1 Introduction

6.1 The MPA case study review and collation of wider information on non-MPA initiatives and assessment tools have provided useful insights into possible approaches to incorporating socio-economic factors into UK MCZ network planning. Experience of incorporating socio-economic considerations into MPA planning is limited and information on success is largely self-reported. Most initiatives have used data layers representing key socio-economic interests to develop initial network designs with subsequent more detailed assessments using cost benefit assessment approaches to support final network selection. The information on costs and benefits has often also been required to support RIAs. Few of the MPA case studies have explicitly assessed social impacts or the implications of network proposals for wider socio-economic policy interests. However, relevant experience on these aspects is available from other types of planning initiatives.

6.2 In a UK context, the approach to incorporating socio-economic factors in MCZ network design needs to take account of the availability of relevant socio-economic information, the time scales and resources available to the Regional projects and stakeholder capacity. In particular, the UK MCZ process is seeking to promote a high level of stakeholder involvement in developing recommendations on regional MCZ networks. This necessarily means that stakeholders will need to have a significant involvement in contributing to the detail of the socio-economic assessment process.

6.2 Tools

6.3 All of the case studies have used an iterative process to develop network options with significant involvement of, or consultation with, stakeholders. The iterative nature of the process often means that different phases of the network design process are not very distinct and MPA initiatives may cycle between phases of activity as part of the iteration process.

6.4 There is no one single assessment tool that might adequately capture all aspects of socio-economic impacts. In the initial network design phase, relatively simple tools are required that can be used to rapidly generate alternative network design options for evaluation. These could be as simple as providing map overlays on which stakeholders might draw proposals for MCZs through to the use of sophisticated network design tools. The options generated can be analysed using simple spatial analysis tools to provide stakeholders with an overview of the potential nature and extent of interaction between specific socio-economic activities and proposed MCZs. Stakeholders can express
preferences for particular network options based on this information with a view to taking forward a more limited number of options for more detailed evaluation.

6.5 Given the complexity of the ecological criteria for MCZ planning and the multitude of socio-economic uses in UK seas, it is unclear whether initial network design can sensibly be undertaken without recourse to network design tools. In our opinion, such tools are likely to be required as part of the initial network design process to make sense of this complexity. However, their use should only occur with the agreement of stakeholders and at such time as stakeholders understand the types of output that these tools produce. It may be appropriate to use network design tools alongside more bottom-up approaches to enable comparisons of outputs to be made. Furthermore, while the sophistication of network design tools is continually increasing, they nevertheless make use of simplistic representations of socio-economic activities such that the outputs tend only to inform subsequent deliberations rather than providing acceptable network solutions.

6.6 The more detailed evaluation phase necessarily requires more complex and involved assessment of socio-economic impacts than can be provided by a simple spatial analysis. Various tools exist to inform assessments of socio-economic impacts but there is no single tool that addresses all types of impacts and overall decision-making will still require extensive discussion, consensus building and application of expert judgement. To address the likely requirements a number of different tools will be required to inform socio-economic assessments as part of an overall assessment framework including:

- Economic cost impact analysis and benefits analysis as part of an overall CBA for qualitative and quantitative (monetised) assessment of economic costs and benefits;
- SIA for qualitative and/or quantitative assessment of social impacts;
- MCA to assess potential consequences for the achievement of socio-economic policy priorities.

6.7 A CBA framework is likely to be the most appropriate way of capturing and presenting information on economic costs and benefits. The inclusion of benefits information as part of the deliberation process would also contribute to many of the requirement for formal IA and the wider IA process. The CBA approach has the advantage that it is scalable to different types of problem ranging from particular issues associated with individual sites through to overall consideration at regional or national network level. It can also be applied flexibly at different stages in the process of developing a network design with an initial focus on qualitative descriptions of the full range of costs and benefits through to more targeted (monetised) assessment of key costs and benefits as part of detailed evaluation.
6.8 The CBA framework should be complemented with information on social and policy impacts. It may be convenient to seek to present this information within a single assessment framework rather than as three separate frameworks. For example, the CBA framework (presented in Appendix H) could be further developed to accommodate social impact and socio-economic policy aspects, by applying economic valuation techniques to social impacts wherever possible, and/or by developing protocols for reporting monetised and non-monetised impacts in a consistent and systematic fashion.

6.9 Various bioeconomic models have been developed for some aspects of UK fisheries. While the degree of confidence in the predictions from these tools is generally low, they may have a role to play, particularly in evaluating the effects of cumulative pressures on fisheries both as a result of MCZ proposals and other initiatives (CFP reform, quota reductions, R3 OWF etc.). The application of such tools would need to be discussed and agreed amongst regional stakeholders.

6.10 The outcomes of the more detailed deliberation may give rise to further iterations of network design, including reconfiguration of network options either through the direct redrawing of one or more site boundaries or through further use of network design tools.

6.3 Information Requirements

6.11 The MPA case studies have used a variety of information to support socio-economic assessments. In the initial network design phase this has included relatively simple spatial data on the type, location, intensity, value and importance of socio-economic activities and broad information on the compatibility of individual activities with site-based conservation objectives. In the deliberation phase more detailed spatial and non-spatial information has been used including detailed assessments of cost impacts and evaluations of benefits. Complex assessments of fisheries impacts have been undertaken by some initiatives using bioeconomic models to seek to assess displacement and to assess potential spillover benefits. The information used has reflected information availability and the types of tools used in the assessment process.

6.12 The MPA case studies have not made little explicit use of information on social impacts or the implications of network options for the achievement of socio-economic policies. Experience of the use of such information is available from terrestrial planning examples.

6.13 A wide range of spatial data on the location of different types of marine socio-economic activities is available for UK waters. Some information on the spatial intensity of socio-economic activity and the environmental pressures associated with those activities is also available. However, the lack of available information currently limits the development of comprehensive pressure or vulnerability layers. An
initial list of potentially useful spatial data layers, including information on potential future uses where this can be identified has been compiled and is presented in Appendix F. The majority of this information (with the exception of inshore fin-fisheries data and recreational data) will be provided to the MCZ regional projects by early 2010.

6.14 The work already undertaken by Finding Sanctuary to develop local information on fisheries and recreational activities provides a good template on which other regional MCZ projects can build. However, as far as possible, attempts should be made to collect information on the relative importance as well as the locations of the areas used.

6.15 Adequate spatial resolution of data is important in defining areas of socio-economic interest. Many of the existing spatial data for socio-economic activities are represented as geo-referenced points, lines or polygons providing relatively well defined locational data. Other types of data can be presented on grids. The spatial scale at which such data layers should be represented depends on the spatial variation in the distribution and intensity of an activity. To adequately describe inshore fisheries activities, some previous planning processes have needed to use grids at a scale of 1nm.

6.16 Initial network design might usefully focus on developing a range of network design options using simple spatial data to represent key socio-economic activities (activity type, location and possibly importance, value, intensity and compatibility). The specific information requirements would depend on how initial network design was pursued. The focus of initial network options might usefully include consideration of sectors delivering key policy priorities or those that might be considered to be incompatible with conservation objectives. RSGs should be encouraged to make an input into decisions on how initial networks might be defined and thus the types of information to be used at this initial stage.

6.17 A variety of non-spatial data is also available to support network planning. Appendix E provides a summary of relevant information sources. Some MPA initiatives have compiled such information into a socio-economic profile which is available to stakeholders for reference and to support detailed evaluation of network options in the deliberation phase. It is likely that additional information will need to be collected/collated by the regional MCZ projects, particularly in relation to social impacts and additional stakeholder data on regional activities. To address more complex issues it may be necessary to commission new primary research to better assess costs and benefits. For example, assessments may need to consider issues of the cumulative effects of MCZ proposals in combination with other policy initiatives and/or implications for international competitiveness.
6.18 The process of deliberation on network design options is essentially an iterative one. To minimise information requirements at this stage, a two-phase approach to assessment has been proposed involving an initial first cut phase to provide a primarily qualitative assessment of an option followed by more detailed (quantitative) assessment where this is deemed necessary. RSGs will need to make choices about the level of information that should be sought at each stage, particularly in relation to requirements for any additional studies.

6.19 There is limited information on the valuation of environmental benefits in the marine environment. It is unlikely to be possible to collect new primary data within the time scales or resources of the regional MCZ projects. An alternative approach could be to use value transfer to provide information on the possible scale of different types of benefits, although the uncertainties introduced by such an approach would need to be clearly acknowledged.

6.4 Timing of Information Provision

6.20 It is now generally accepted that MPA planning should take account of socio-economic factors from the outset of the initiative. In the initial network design phase, only relatively simple types of spatial information may be required to assist with network design options as described in section 6.3. Where more complex approaches are pursued, the limitations of the underlying data need to be recognised.

6.21 The RSGs will play an important role in determining which network options might be taken forward for more detailed deliberation. The process of deliberation is likely to involve collection and presentation of a wide range of socio-economic information relating to economic costs and benefits, social impacts and policy implications. To ensure that the assessment process is proportionate, the initial focus should be on the collation and presentation of existing qualitative and quantitative information. In many cases this may be sufficient to enable stakeholders to make a decision on whether to progress an option further. In more complex cases, it may be necessary to collect specific additional information through primary research or the use of modelling tools.
## Abbreviations

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABPmer</td>
<td>ABP Marine Environmental Research Ltd</td>
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<tr>
<td>AOI</td>
<td>Areas of Interest</td>
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<tr>
<td>AUD</td>
<td>Australian dollar(s)</td>
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<tr>
<td>Balance</td>
<td>Baltic Sea Management - Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning</td>
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<tr>
<td>BGS</td>
<td>British Geological Survey</td>
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<tr>
<td>BLM</td>
<td>Boundary Length Modifier</td>
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<tr>
<td>BMU</td>
<td>Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit</td>
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<tr>
<td>BODC</td>
<td>British Oceanographic Data Centre</td>
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<td>BRTF</td>
<td>Blue Ribbon Task Force</td>
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<td>BSA</td>
<td>British Surfers Association</td>
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<td>BSAC</td>
<td>British Sub Aqua Club</td>
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<td>CAD</td>
<td>Canadian dollar(s)</td>
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<td>CAN</td>
<td>Conservation Area Network</td>
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<td>CBA</td>
<td>Cost Benefit Analysis</td>
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<td>CCSA</td>
<td>Carbon Capture and Storage Association</td>
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<td>CD</td>
<td>Chart Datum</td>
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<td>CDFG</td>
<td>California Department of Fish and Game</td>
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<tr>
<td>CEA</td>
<td>Cost Effectiveness Analysis</td>
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<tr>
<td>Cefas</td>
<td>Centre for Environment, Fisheries and Aquaculture Science</td>
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<td>CFP</td>
<td>Common Fisheries Policy</td>
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<td>CINMS</td>
<td>Channel Islands National Marine Sanctuary</td>
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<td>CI-SSAT</td>
<td>Channel Islands Spatial Support and Analysis Tool</td>
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<td>CP2</td>
<td>Charting Progress 2</td>
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<td>CPFV</td>
<td>Commercial Passenger Fishing Vessel</td>
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<td>CPUE</td>
<td>Catch per unit effort</td>
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<td>CRFS</td>
<td>California Recreational Fisheries Survey</td>
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<td>DARDNI</td>
<td>Department of Agriculture and Rural Development - Northern Ireland</td>
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<td>DECC</td>
<td>Department of Energy and Climate Change</td>
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<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
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<td>DFG</td>
<td>California Department of Fish and Game</td>
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<td>DFO</td>
<td>Fisheries and Oceans Canada</td>
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<td>DfT</td>
<td>Department of Transport</td>
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<td>DOENI</td>
<td>Department of Environment Northern Ireland</td>
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<td>DPD</td>
<td>Development Plan Documents</td>
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<td>E&amp;W</td>
<td>England &amp; Wales</td>
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<td>EA</td>
<td>Environment Agency</td>
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<td>EC</td>
<td>European Community</td>
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<td>Eftec</td>
<td>Economics for the Environment Consultancy Limited</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>EMEC</td>
<td>European Marine Energy Centre</td>
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<td>EMPAFISH</td>
<td>European Marine Protected Areas as tools for Fisheries management and conservation</td>
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<td>EMU</td>
<td>Environmental Monitoring Unit</td>
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<td>Encams</td>
<td>Environmental Campaigns</td>
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<td>ESSIM</td>
<td>Eastern Scotian Shelf Oceans Management Area</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>EUNIS</td>
<td>European Universal Information Systems</td>
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<td>FGC</td>
<td>Fish and Game Commission</td>
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<td>FKNMS</td>
<td>Florida Keys National Marine Sanctuary</td>
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<td>FPSO</td>
<td>Floating Production Storage and Offloading</td>
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<tr>
<td>GAUFRE</td>
<td>Towards a Spatial Structure Plan for Sustainable Management of the Sea (not an acronym per se; GAUFRE stands for this)</td>
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<tr>
<td>GBR</td>
<td>Great Barrier Reef</td>
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<td>GBRMP</td>
<td>Great Barrier Reef Marine Park</td>
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<td>GBRMPA</td>
<td>Great Barrier Reef Marine Park Authority</td>
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<tr>
<td>GEBCO</td>
<td>General Bathymetric Chart of the Oceans</td>
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<td>GIS</td>
<td>Geographical Information System</td>
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<td>GVA</td>
<td>Gross Value Added</td>
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<td>Haskoning</td>
<td>Royal Haskoning</td>
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<td>HSE</td>
<td>Health and Safety Executive</td>
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<td>IA</td>
<td>Impact Assessment</td>
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<td>ICES</td>
<td>International Council for the Exploration of the Sea</td>
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<td>ICZM</td>
<td>Integrated Coastal Zone Management</td>
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<td>IDW</td>
<td>Inverse Distance Weighted</td>
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<td>IHO</td>
<td>International Hydrographic Organisation</td>
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<td>IRR</td>
<td>Internal Rates of Return</td>
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<td>JNCC</td>
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<td>KIS-CA</td>
<td>Kingfisher Information Service - Cable Awareness</td>
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<tr>
<td>Km</td>
<td>kilometre(s)</td>
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<tr>
<td>km²</td>
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<td>m/s</td>
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<td>Offshore Wind Farm</td>
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<td>Professional Association of Diving Instructors</td>
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<tr>
<td>PDF</td>
<td>Probability density function</td>
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<td>Sea-viewing Wide field-of-view Sensor</td>
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<td>SeaZone Solutions Ltd</td>
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<td>Scottish Executive Environment and Rural Affairs Department</td>
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<td>Scottish Environment Protection Agency</td>
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<td>Special Protection Area</td>
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<td>The Crown Estate</td>
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<td>Tortugas Integrated Assessment</td>
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<td>The Nature Conservancy</td>
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<td>UC</td>
<td>Under Construction</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<td>UKCS</td>
<td>UK Continental Shelf</td>
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<td>UKHO</td>
<td>United Kingdom Hydrographic Office</td>
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<td>UKMMAS</td>
<td>UK Marine Monitoring Assessment Strategy</td>
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<td>UKWA</td>
<td>UK Windsurfers Association</td>
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<td>United States</td>
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<td>VMS</td>
<td>Vessel Monitoring System</td>
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<tr>
<td>WFD</td>
<td>Water Framework Directive</td>
</tr>
<tr>
<td>WTA W</td>
<td>Willingness to accept compensation</td>
</tr>
<tr>
<td>WTP</td>
<td>Willing to pay</td>
</tr>
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<td>Y&amp;H RSS</td>
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</table>
References


Acknowledgements

The authors would like to thank all those that provided information to support the literature component of this work. In addition, thanks are due to all workshop participants and members of the Project Steering Group for their valuable input to the project.
## Appendix A. Case Study Review

### Abbreviations (for Appendix A Case Studies)

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOI</td>
<td>Areas of Interest</td>
</tr>
<tr>
<td>AUD</td>
<td>Australian dollar(s)</td>
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<td>Balance</td>
<td>Baltic Sea Management - Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning</td>
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<td>BMU</td>
<td>Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit</td>
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<tr>
<td>BRTF</td>
<td>Blue Ribbon Task Force</td>
</tr>
<tr>
<td>CAD</td>
<td>Canadian dollar(s)</td>
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<td>California Department of Fish and Game</td>
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<td>Channel Islands National Marine Sanctuary</td>
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<td>Channel Islands Spatial Support and Analysis Tool</td>
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<td>Disproportionate Cost Assessment</td>
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<td>Fisheries and Oceans Canada</td>
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<td>DfT</td>
<td>Department of Transport</td>
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<td>Development Plan Documents</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EMPAFISH</td>
<td>European Marine Protected Areas as tools for Fisheries management and conservation</td>
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<td>ESSIM</td>
<td>Eastern Scotian Shelf Oceans Management Area</td>
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<td>EU</td>
<td>European Union</td>
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<td>FGC</td>
<td>California Fish and Game Commission</td>
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<td>FKNMS</td>
<td>Florida Keys National Marine Sanctuary</td>
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<tr>
<td>GAUFRE</td>
<td>Towards a Spatial Structure Plan for Sustainable Management of the Sea (not an acronym <em>per se</em>; GAUFRE stands for this)</td>
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<tr>
<td>GBR</td>
<td>Great Barrier Reef</td>
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<td>GBRMP</td>
<td>Great Barrier Reef Marine Park</td>
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<td>GBRMPA</td>
<td>Great Barrier Reef Marine Park Authority</td>
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<td>Geographical Information System</td>
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<td>ICZM</td>
<td>Integrated Coastal Zone Management</td>
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<tr>
<td>km</td>
<td>kilometre(s)</td>
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<tr>
<td>km²</td>
<td>Kilometre(s) (1km² is equivalent to 0.292nm²)</td>
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<td>LMMA</td>
<td>Locally Managed Marine Area</td>
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<td>MCA</td>
<td>Mulit Criteria Analysis</td>
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<td>MCZ</td>
<td>Marine Conservation Zone</td>
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<td>Marine Environmental High Risk Areas</td>
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<td>Marine Protected Area</td>
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<td>Marine Reserves Working Group</td>
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<td>NGOs</td>
<td>Non-Governmental Organisations</td>
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<tr>
<td>nm</td>
<td>nautical mile(s) (1nm² is equivalent to 3.43 km²)</td>
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<tr>
<td>NOAA</td>
<td>US National Oceanic and Atmospheric Administration</td>
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<td>National Science Advisory Panel</td>
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<td>ODPM</td>
<td>Office of the Deputy Prime Minister</td>
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<td>PNG</td>
<td>Papua New Guinea</td>
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<td>Representative Areas Programme</td>
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<td>RAWG</td>
<td>Research Area Working Group</td>
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<td>Regulatory Impact Assessment</td>
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<td>Regional Stakeholder Group</td>
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<td>Regional Spatial Strategies</td>
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<td>Sustainability Appraisal</td>
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<td>Water Framework Directive</td>
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<td>World Wildlife Fund</td>
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<tr>
<td>Y&amp;H RSS</td>
<td>Yorkshire &amp; Humberside Regional Spatial Strategy</td>
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</table>
Appendix A. Case Study Review

A1 Introduction

A comprehensive review of international and UK experience of incorporating socio-economic information in marine protected area (MPA) planning processes has been undertaken. The process by which relevant case studies were identified for review, and the way in which they were evaluated, are described in Section 3.2. The case studies identified are listed in Table 1.

As discussed in Section 3.2, whilst a large number of potentially relevant case studies were identified (see Table 1), only a limited number contained sufficient information on the inclusion of socio-economics to warrant detailed review and this appendix provides the full review of these case studies. The literature obtained for each of the case studies identified for detailed review was supplemented with information obtained through direct contact with individuals involved with the respective initiatives. Additional detail on a number of the case studies was also obtained through presentations and discussions at the project workshop (Section 3.2 and Appendix C). The information derived from the case studies has been reviewed and synthesised within Section 4.1 of the main report. It has also been used to illustrate particular points of relevance throughout the main text.

Please note that a separate list of references and acronyms has been provided for this Appendix.

A2 In-depth Case Studies

A2.1 The Californian Channel Islands and Florida Tortugas Keys Marine Sanctuaries

A2.1.1 Background information

The implementation of the network of MPAs in the Californian Channel Islands National Marine Sanctuary (CINMS) and the Tortugas Ecological Reserve (TER) of the Florida Keys National Marine Sanctuary (FKNMS) was led by the United States (US) National Oceanic and Atmospheric Administration (NOAA), with input from relevant state authorities.

The TER consists of two separate areas (zones) which are located in the state of Florida, USA. They were implemented in 2001 and measure 518km² (1km² is equivalent to 0.292nm²). They consist of reef and fish spawning aggregation habitats. Both areas are no-take marine reserves and are highly protected in their entirety. The TER North (312 km²) allows all non-consumptive recreation, while TER South (206 km²) is designated as ‘research only’. Both areas are located within the FKNMS and are part of the overall zoning strategy for the Sanctuary (Leeworthy and Wiley, 2000).
The Californian Channel Islands MPA network is located in the state of California, USA, and measures 823km². The first phase of the network was implemented in 2002, which included only the State waters portions of the network. The establishment of the complete network was a joint process led by national and state bodies (specifically the California Fish and Game Commission (FGC) and NOAA), to establish MPAs within the CINMS. The initial aim, as determined by a scientific advisory panel (SAP), was to incorporate 30-50% of the Sanctuary within the network; the final coverage achieved was 25%. However, it is important to note that the percent of each type of important habitat protected was greater than 25%. In 2006/07 the network was expanded into the deeper US federal waters by NOAA. It is important to distinguish the design of the network of MPAs from the administrative processes and jurisdictions. The MPAs were designed in one process but each agency (FGC and NOAA) had to go through separate processes to create the regulations to implement the MPAs. The MPA network consists of a network of individual areas or zones which are highly protected, located within the CINMS, and are part of the overall zoning strategy for the CINMS (NOAA, 2008).

A2.1.2 Main objectives and conservation measures

The main objectives of both MPA networks were to protect biodiversity/ecosystems, provide refugia, and to provide research/educational opportunities. Consumptive activities and activities which disturb the seabed (i.e. oil/gas, mining) are prohibited, and some restrictions are placed on other activities such as diving, anchoring, and research.

In the Tortugas site selection process, nine objectives were presented (US Department of Commerce et al., 2000):

- Reduce stresses from human activities;
- Protect biological diversity and the quality of resources;
- Minimize conflicting uses;
- Protect Sanctuary resources and separate conflicting uses;
- Disperse concentrated harvests of marine organisms;
- Prevent heavy concentrations of uses that degrade Sanctuary resources;
- Provide undisturbed monitoring sites for research activities; and
- Provide control sites to help determine the effects of human activities on resources.

For the Californian Channel Islands, the following main goals were established (NOAA, 2008):

- Ecosystem Biodiversity - To protect representative and unique marine habitats, ecological processes, and populations of interest.
- Socio-economic - To maintain long-term socio-economic viability while minimizing short-term socio-economic losses to all users and dependent parties.
• Sustainable Fisheries - To achieve sustainable fisheries by integrating marine reserves into fisheries management.
• Natural and Cultural Heritage - To maintain areas for visitor, spiritual, and recreational opportunities which include cultural and ecological features and their associated values.
• Education - To foster stewardship of the marine environment by providing educational opportunities to increase awareness and encourage responsible use of resources.

The Tortugas Sanctuary consists of two areas or zones; one which allows all non-consumptive recreation and one which is designated for research only. At the Channel Islands, the entire MPA network consists of 11 marine reserves where all take and harvest is prohibited, and two marine conservation areas where limited take of lobster and pelagic fish is allowed. The 2006 extension into deep waters prohibits bottom fishing (i.e. trawling). Non-consumptive recreational uses are permitted (NOAA, 2008).

A2.1.3 Site selection process

The site selection process that was implemented at the Californian Channel Islands and Florida Tortugas National Marine Sanctuaries were very different despite both being led by NOAA (see Figure A2 and A3). This was true of both the network selection process and the overall perceived success of the process (personal communication Bob Leeworthy, NOAA).

![Flowchart of the Tortugas process](image-url)

**Figure A2: Flowchart of the Tortugas process**
Figure A3: Flowchart of the Californian Channel Island process

In the Tortugas, the network was established through a 3-year collaborative design and planning process which centred around a 25 member working group. This included major stakeholders (commercial and recreational fishers, divers, conservationists, concerned citizens), regulators and scientists, and was informed by both scientific information (three white papers and relevant ecological and socio-economic maps) and traditional knowledge from fishermen. Five public scoping meetings and two public forums were held to assist in ecological and socio-economic characterization. A total of 12 boundary alternatives were designed in a workshop by the working group using an interactive Geographical Information System (GIS) tool with both biophysical and socio-economic information. The commercial fishermen offered a 13th alternative at the meeting where the preferred alternative was to be chosen. The working group came to consensus on the 13th alternative and recommended this alternative as their preferred option which was accepted by the final decision making body, the (Florida Marine) Sanctuary Advisory Council and thus implemented (US Department of Commerce et al., 2000).

For the Channel Islands, a 17 member Marine Reserves Working Group (MRWG) (including representatives from fisheries, non-governmental organisations (NGOs), state agencies and recreation bodies) was created, and supported by two SAPs. Firstly, a 16 member general SAP was set up to assist the MRWG by evaluating ecological and physical data and providing advice on reserve design. The general SAP excluded scientists that had published papers on marine reserves, due to fishermen’s concerns about ‘bias’. A five member socio-economic SAP was also convened (Wing and Nakagawa, 2008). The site selection process took 2 years, with monthly
MRWG meetings managed by two professional facilitators. After identifying areas with the highest conservation value and a range of ecological features using reserve design software, the MRWG used socio-economic data and local knowledge to select a combination of sites using an interactive GIS tool. The MRWG could not agree on the size of each MPA, so the Reserve Advisory Council and FGC determined the final design based on various options that had been investigated by the MRWG (NOAA, 2008).

A2.1.4 Socio-economic methodology

Overall approach

The data collected for the Florida Tortugas and Californian Channel Islands MPA selection processes were similar, however the way they were integrated into the processes differed. The overall mechanism in which socio-economics were included in the network selection process is summarised below before considering more specifically which data layers were collected and how these were incorporated within the process.

Florida Tortugas

Socio-economic data for use in the Florida Tortugas Network was primarily derived from two sources:

- A Characterization Forum, whereby existing studies and records of catch were collected to provide general information; and
- Dedicated surveys to obtain more detailed spatial data on fisheries and recreational use in order to inform the stakeholder working group.

The data was then used to create maps. All commercial fishing and recreational activity was mapped at 1-minute by 1-minute grid cells and placed in a GIS. Socio-economic data was then organized in a set of Excel spreadsheets that connected to the GIS-based map data. This allowed for assessment as to who might be impacted and to what extent, thus allowing for estimates of the total impacts and their distribution. Assisted by the extensive knowledge of the working group members, potential MPA boundaries were essentially adjusted by the working group members in a manual map interpretation exercise with the assistance of the GIS-based tool.

When a preferred alternative had been decided upon, a socio-economic impact analysis of 5 alternative network designs was undertaken, which concluded that ‘the cumulative impacts of establishing no fishing areas would have moderate long-term beneficial impacts on marine populations, recreational and commercial fishing, and the regional economy’ (Leeeworthy and Wiley, 2002).

Channel Islands

The Socio-economic Panel consisted of experts in fisheries socio-economics and was led by two economists from NOAA (one of which was Bob
Leeworthy, who was interviewed for the purpose of this case study review and was the Leader of the Socio-economic Panels in both case studies presented here. The panel collected and synthesized existing studies, extant records of catch or harvest, and other public information sources, as well new economic data. It also commissioned dedicated surveys to obtain more detailed spatial data on fisheries and recreational use. Commercial fishermen were asked to identify their favourite fishing areas and this data was aggregated into a generalised map for each major fishery, as was done in the Tortugas case. The panel also interviewed long-time fishermen and other local mariners (Wing and Nakagawa, 2008).

The socio-economic data collected by the Panel was used to refine the selection of sites and the associated boundaries. All data sets were referenced to a common study area base map consisting of a grid of 1-nautical-mile resolution. All datalayers were rasterised, and the planning units were used as the common extent for all the datalayers. Socio-economic maps and data were only made available to the Socio-economic Panel for analysis and to the MRWG in closed sessions (Leeworthy and Wiley, 2002). During the MRWG process, stakeholders were allowed to submit alternatives to the Socio-economic Panel for analysis. A GIS technician at the CINMS would make a shape file of the alternative and e-mail it to NOAA economists in Silver Spring, Maryland (Leeworthy and Wiley) and they would run the alternative through the socio-economic models which detailed both the total and distribution of potential impacts. They then e-mailed tables of results which stakeholders could then discuss with their membership. Over 40 alternatives were analyzed for commercial fishermen.

As a separate effort, an interactive GIS decision support tool, the Channel Islands Spatial Support and Analysis Tool (CI-SSAT), was developed to assess both ecological and socio-economic data using multiple criterion analysis. The tool was not, however, well received by stakeholders who did not consider the approach to be sufficiently transparent, and the working group’s approach in the end mirrored that of the Tortugas process, whereby personal knowledge was combined with the GIS-based socio-economic interactive tool to design an alternative (Bob Leeworthy personal communication).

For CI-SSAT, two ‘evaluation criteria datalayers’ were created, one ecological and one socio-economic. Each evaluation criterion datalayer was compiled from many individual data sets representing the likelihood that the evaluation criterion’s goal would be met. Each cell was ranked on a scale from 0 to 100 according to how well it fulfilled its goal, where 100 represented the highest ranking or location for that criterion. With regard to socio-economic layers areas scoring ‘0’ represented areas with high economic activity, whereas ‘100’ represented areas with low economic activity. The socio-economic criterion was based on raw revenue and usage datalayers, including total revenue per

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6 Bob Leeworthy explained that commercial fishermen were concerned that the bio-physical Science Panel might use the data that had been provided to designate areas that are fished most intensely.
species fished, and total usage by recreational, commercial, and private fishermen and divers. Each datalayer was normalised from 0 to 100 (with these numbers representing relative ranking indicating areas of high income or usage). Once the two evaluation criterion datalayers were in place, the MRWG was then given the opportunity to weight these within the tool, as set out in Figure A1 below (Killpack et al., 2002).

![Figure A1: Criteria weighting window](image)

As a final step in the process, the Socio-economic panel conducted an economic impact assessment study which followed a similar methodology to that undertaken for the Tortugas MPAs. This analysed six alternative networks, including one which had been identified as the preferred alternative by the MRWG, in two phases. The phase 1 analyses simply added up all the activities displaced from MPAs, with the assumption that all is lost, i.e., there is no mitigation or off-sets through behavioural responses. Substitution/relocation, replenishment effects, the effects of other regulations, the current and future status of fishing stocks, and the benefits of marine reserves were not addressed within these analyses. The authors labelled the phase 1 analyses as “maximum potential loss”. Phase 1 analysis was used by the working groups in designing alternatives. Phase 2 analyses used the benefit-cost framework and listed all the potential benefits and costs, and quantified them where possible. Essentially, this consisted of a qualitative attempt to assess how likely the losses estimated in the phase 1 were to occur. The assessment concluded that the final design would only have a very small impact on existing consumptive activities, whilst providing benefits to non-consumptive users (particularly sport divers and wildlife viewers). The impact assessment was viewed as the first component in an adaptive management process including monitoring and assessments (Leeworthy and Wiley, 2002).

**Objectives of using socio-economic data, and success in achieving these**

There were two main objectives associated with using socio-economic information in both the Florida Tortugas and Channel Islands designation processes. Firstly, the NOAA wanted to develop a more cooperative working
relationship with all user groups. By giving each user group a fair representation of their interests in the process, the NOAA built on this cooperative working relationship post implementation of the network. This promoted a willingness to work for compromises in finding solutions and a greater likelihood of compliance with the resulting regulations. This could potentially reduce costs of enforcement and administrative tasks as well as fighting the regulations in the courts. The second objective was to get the necessary information to conduct socio-economic impact analyses of the MPA management regulations to fulfil US administrative requirements under the National Environmental Policy Act, Regulatory Impact Review as defined by Executive Orders from the President, and the Regulatory Flexibility Act (impact on small entities - primarily small businesses) (personal communication, Bob Leeworthy, NOAA).

For the Channel Islands process, the MRWG furthermore identified the following four objectives of the Socio-economic goal:

1. To provide long-term benefits for all users and dependent parties;
2. To minimize and equitably share short-term loss in activity for all users and dependent parties;
3. To maintain the social and economic diversity of marine resources harvest by equitably sharing the loss of access to harvest grounds among all parties to the extent practical when designing reserves; and
4. To address unavoidable socio-economic losses created by reserve placement through social programs and management policy.

In both the TER and the Marine Reserves in the Channel Islands, Bob Leeworthy stated that the NOAA feels it has successfully achieved both objectives set out in the first paragraph of this section. With respect to the Tortugas process, this perception is supported by a survey recently undertaken amongst three key user groups (commercial fishermen, dive operators and environmental group members) within the FKNMS. Compared to a survey undertaken 10 years previously, the NOAA found statistically significant movements towards support by all three groups. Commercial fishermen, who initially had very negative feelings for both the Marine Sanctuary and the highly protected MPAs within have now moved to ‘a neutral position of a plurality of support’ (Shivlani et al., 2008). All commercial fishermen that moved from the negative position cite the Tortugas process as their reason for a change in attitude. With regards to the Tortugas, one working group member, Felicia Coleman, a biologist at Florida State University, noted that it was the socio-economic information that enabled the group to design an alternative that was socio-economically acceptable whilst also meeting the criteria for ecosystem protection (personal communication, Bob Leeworthy). Another indicator of the success of the Tortugas process is that compliance here has been high with low administrative costs.

In contrast the Channel Island process had mixed success. As previously mentioned, the MRWG did not come to consensus on an alternative (so the Reserve Advisory Council and FGC used the network options developed by the MRWG and developed an alternative final design). According to Bob
Leeworthy, the main reason for this was a mistake in the process. The biophysical Science Panel was allowed to develop their own alternatives rather than simply advise and analyse alternatives developed by the working group. Under rules that said the alternative developed had to be ‘science-based’, the working group members were left to conclude that anything that the Science Panel did was ‘science-based’ and anything they developed was not. This left many user groups to go outside the process to try and protect their interests. Lawsuits were filed to get injunctions on the implementation of the no-take areas. Many stakeholders went to the California Fish and Game Commission and the Pacific Fishery Management Council to use their influence with these bodies to defeat implementation. All of these efforts failed with both the courts and the administrative bodies noting that each user group was fairly represented with socio-economic information in the process. Monitoring is in place but NOAA does not yet know the rate of compliance within the Channel Islands (personal communication, Bob Leeworthy).

A2.1.5 The use of datalayers

The importance of using datalayers

Bob Leeworthy of the NOAA described the use of datalayers in the processes undertaken at both sites as very important. He stressed that for stakeholders that are displaced, it was extremely important to be able to demonstrate ‘potential losses’ or ‘potential opportunity costs’. Stakeholders are interested in the impacts and distribution of impacts on their group directly and the ripple or multiplier impacts on the surrounding community’s economy in terms of sales/output, income, employment, and tax revenues. A regional economic impact model was used for the Florida Keys to illustrate this. The GIS-based model connected to Excel spreadsheets with socio-economic data which allowed the assessment of the impact on each individual commercial fishing operation and each ‘for hire’ recreational operation that took people out to the Tortugas for recreation activity (no one accessed the Tortugas via private household boats). Detailed costs-and-earnings data for each commercial fishing operation and each ‘for hire’ recreation operation combined with socio-economic/demographic information allowed for assessments of the impacts on profits of each operation.

The net economic values (e.g. consumer’s surplus or producer’s surplus/economic rent) are of less importance to local decision makers, but these are the appropriate measures to use in a benefit-cost analysis of a regulation, and thus in justifying the regulation. This is because they are net values based on economic efficiency where the costs of resources used in the production and consumption of a good or service are subtracted from total value to arrive at net economic value for a given use of society’s resources. For consumer’s, net economic value is the value they receive over and above what they actually pay for a good or service and for producer’s the amount they receive in revenue over and above what is required to supply the good or service. The actual spending and associated impacts on the local and regional economy are not net values. If someone does not spend money on a particular item in a particular place they’ll spend the money on something

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somewhere else. The total impacts on sales/output, income, jobs and tax revenues may not be different, only the distribution will change. From a National perspective, there may be no change in economic impact on the economy, it may just be different businesses or businesses in other locations may benefit (personal communication, Bob Leeworthy).

Within these two case studies it was considered important for marine users, especially those that would be impacted through network implementation, to see that their interests were fairly represented as this increased the likelihood of data provision. It was important for user groups to understand how they would benefit from providing the information. As such they had to believe that the information would be used to design a regulatory alternative that achieves the various ecosystem protection objectives, while minimizing the socio-economic impacts (personal communication, Bob Leeworthy).

In the CINMS, the commercial fishermen were concerned that the bio-physical Science Panel might use the data that had been provided to designate areas that are fished most intensely. A Fishermen’s Data Committee was therefore created that had to approve each map before the NOAA could release them for use by the MRWG. In addition, the information could not be made public and each map had to be collected after each Working Group session. In practice, this limited the use of the maps by the working group, which consequently prevented them from efficiently minimizing the impacts on the fishermen (personal communication, Bob Leeworthy).

The key socio-economic datalayers developed

The following data was collected and translated into data layers for both case studies discussed in this section (Shivlani, 2000; Leeworthy and Wiley, 2002; personal communication Bob Leeworthy):

- Extant state fisheries per vessel value data (revenue received by commercial fishermen) on the most important commercial fisheries (location and landing port with a resolution of 10 by 10nm) (permission had to be obtained from the fishermen).
- Through specific surveys; commercial fishermen were then asked to identify areas of activity per 1nm² cell (1nm² is equivalent to 3.43 km²). For the Tortugas, some 85% of local fishermen were surveyed (94 in total); these were also asked about their level of engagement, who they perceived the main beneficiaries of the MPA to be, and support for the MPA (this data was displayed as graphs, rather than data layers). In the CINMS, the following fisheries were surveyed: squid, kelp, urchin, spiny lobster, rockfish, prawn, crab, sheepshead, wetfish, flatfish, sea cucumber, sculpin and bass, tuna, and shark. The data was then combined with the coarser state fisheries ex vessel value data and maps created (using 4-year average values).
- For the CINMS, data on kelp harvesting and processing was requested from the main producer (specifically the 4-year average of the processed value of kelp).
- Detailed data on the operation of recreational charter/party/guide services was collected using specific surveys which queried person-days of activity (i.e. one person undertaking an activity for any part of a day or a whole day). For example, the following operators were interviewed in the CINMS process and asked to map activities per 1-nm\(^2\) cells: charter/ party boat fishing; consumptive diving; whale watching; non-consumptive diving; sailing; kayaking, island sightseeing. Customers of these for hire operations were not surveyed separately, instead surveys of passengers from other studies were used.

- Extant Marine Recreational Fishing Statistics were derived from annual National Marine Fisheries Service surveys, providing data on intercept/access points\(^7\) for those fishing from private household boats.

These layers were used to assess alternative boundary configurations in understanding who benefits and who suffers costs and the nature of the trade-offs involved. They were also used in establishing baselines for monitoring efforts to determine what actually happens and to support adaptive management.

One individual was responsible for all of the GIS shape files, to ensure that the bio-physical scientists and the social scientists were using the same spatial framework in organizing information (personal communication, Bob Leeworthy).

*Data formats*

For the working groups that were designing the alternative MPA designs, maps were the main information provided for evaluating the boundary configurations. Maps were created for each major use, using the common spatial unit of resolution of 1- nautical square mile by 1- nautical square mile grid cells. The metric for each use varied. For commercial fisheries, the unit was catch in pounds and/or dollar value of the catch to the fisherman. For recreational uses, a person-day was used as the basic unit of measurement. These units of measurement were then considered in the context of other socio-economic parameters including how many people are directly impacted, how much are they impacted, what is the socio-economic profile of those who are impacted and how this impact translates into impacts on the surrounding community and their economies. This information was presented in a set of spreadsheets. Typically, information was also provided on the bio-physical features that were protected by each alternative network design. This enabled identification of what was being achieved according to the bio-physical protection criteria (personal communication Bob Leeworthy).

\(^7\) The access-point angler intercept survey is conducted at public marine fishing access points (boat ramps, piers, beaches, jetties, bridges, marinas, etc.) to collect individual catch data, including species identification, total number of each species, and length and weight measurements of individual fishes, as well as some angler-specific information about the fishing trip and the angler's fishing behaviour.
To complete the regulatory impact assessment additional factors also required consideration including:

- Issues of substitution and mitigation;
- Other regulations;
- The state of economies and markets for the goods and services impacted; and
- What are the benefits of the alternative, including non-use values, and environmental variations?

To undertake this analysis value transfer methods have sometimes been used which utilise existing studies of sites with similar resources and users to predict the impact of a particular scenario. Benefits transfer methods were used in both case studies, however, in the case of the Tortugas, studies were available for the Florida Keys. Where comparable site data is not available (specifically non use or passive economic use values and quality elasticities of how demand and value for a good or service change with changes in the quality of a good or service) simulations of potential impacts have been run using a range of potential benefits and costs. In the case of non use or passive economic use values there were no estimates of non use value for the types of resources in either the Tortugas or the Channel Islands, and especially for no-take areas. Thus benefits transfer methods were not possible, instead a policy analysis was conducted using the low end of the distribution of estimated non use values from all known studies which simulate the potential benefits (personal communication Bob Leeworthy).

*Taking future patterns of use/activities into account*

According to Bob Leeworthy, taking account of future patterns of use, and the impact that is expected to occur in the future, is the key issue to address in developing the baseline for an impact assessment. Hence, the amount of activity used as the baseline has to be sustainable in the future. He furthermore stated that there were two basic components in building such a baseline; the quantitative total of each activity and the percentage distribution across space. For NOAA’s impact assessments of the two case studies, both scientific peer review and consensus by the user groups were considered important in establishing the baseline to assess future impacts. Trends in each activity need to be assessed, as well as the forces behind these trends (markets, economies, the environment, regulations, etc.). This would then allow a determination of what is the ‘best’ estimate of what is sustainable in the future. In order to assess percentage distribution across space, a forward looking approach was used. Commercial fishermen and owners/operators of the ‘for hire’ recreational operations were asked for both historical and anticipated use patterns. For example, a fisherman may have historically fished on the eastern portion of the study area, but that area is close to being overexploited and he expects to move his activity west (personal communication, Bob Leeworthy).
Taking account of the relative economic and social value of different activities

The only metric the NOAA used that was comparable across different uses was the dollar metric. Economists prefer the net economic value measures because they focus on efficiency. But issues of distribution of impacts and equity/fairness are also important. Other metrics involving the use of socio-economic/demographic profiles of users help address issues of whether people have the capability to adapt to changes. This could be important in designing assistance or compensation programs (personal communication, Bob Leeworthy).

Weights were never used in the actual analyses for either MPA process because they were considered a political decision and it was considered inappropriate for social scientists to say whose uses and values are more important. Thus the working groups could not come up with a set of weights that could be implemented in the socio-economic analysis. The CI-SSAT tool (developed by the NOAA Coastal Services Center) was an attempt at implementing a multi-criteria analysis (MCA) within the CINMS process, and applied weights. As previously mentioned, this failed because the tool was not considered transparent to the Working Group. The Working Group could not see the potential impacts on themselves or others; the model simply evaluated an alternative and came to a conclusion that the alternative met all the criteria according to the weights provided. This did not provide comfort to anyone involved and was rejected (personal communication, Bob Leeworthy).

Weighting was, however, used in the data collection process to ensure sample information could be properly extrapolated to population estimates. People were asked for both historical and anticipated use patterns. These were captured by asking the interviewees to give a percentage distribution over the study area that adds to 100. This distribution was then applied in the GIS to the control totals for the measure of activity which were determined as sustainable (e.g. an average of the past three-four years (personal communication, Bob Leeworthy).

The inclusion of MPA-compatible activities

The Working Groups tried to create alternatives that met the ecosystem protection criteria, while minimizing socio-economic impacts. Hence, non-consumptive uses were still allowed in no-take areas. It is thought that the protected areas might change in the future ensuring the flow of ecosystem services which non-consumptive users would value (personal communication, Bob Leeworthy).

Ensuring datalayers do not become obsolete

For all its past, current and future Marine Sanctuary implementation processes, the NOAA intends to be able to accomplish all data collections, data compilation and development of tools within about a six month period. A key feature of this for socio-economic information is avoiding the Moral hazard problem. Once lines are put on a map for an alternative boundary all
information collection must stop. If people know where boundary lines are to be put, they will have an incentive to claim more activity within those boundaries than is the case to raise the opportunity cost. As previously mentioned, in the Channel Islands, the federal waters section of the MPAs were implemented several years after those within state water. Throughout this later process, opponents tried to make the argument that the data was now out dated, hence some updating was undertaken (personal communication, Bob Leeworthy).

A2.1.6 The impact of MPA creation on the identified socio-economic elements

During the design/regulatory impact assessment process, predictions of potential future impact were also made. The NOAA recently concluded two five-year post assessments of what actually occurred in both MPA areas for both the commercial fishing operations and the recreation operations. The Tortugas Integrated Assessment (TIA) involved 26 bio-physical scientists and six social scientists to assess the monitoring data that was collected. The assessment concluded that there were no short-term economic losses for fishermen associated with the Tortugas, which was contrary to expectations. The reason was that the NOAA’s assumption of perfect information was not true. This assumption assumes that there will be some opportunity costs (losses) because people are assumed to be maximizing their utility or maximizing their profits. If they could be more successful in catching fish at another location for less cost, they would already be doing that. However, it was found that the biologists’ assessment of overfishing of reef fish was based on a lack of sampling in areas the fishermen had never fished. In practice when they were displaced from their normal fishing areas, they found new areas that they had never fished before and catch increased, not decreased. Hence, in two of the largest MPA networks created in the USA to date, there have been no or very small short-term opportunity costs (personal communication, Bob Leeworthy).

A2.2 Californian Marine Life Protection Act (MLPA) MPA Network

A2.2.1 Background information

This MPA network is located in the USA state of California. In 1999, the California Marine Life Protection Act (MLPA) tasked the California FGC with creating a network of MPAs in Californian state waters (up to 3nm). The current stakeholder-driven implementation process commenced in 2004, and is still ongoing.

The Californian marine area has been split into five areas, with the MPA process to run sequentially. The process has been completed for the first and second regions (Central Coast and North Central Coast), commenced for the South Coast region, and yet to be started for the others. The Central Coast network measures 528km²; this comprises 18% of state waters (Lieberknecht, 2008) – thus coming close to achieving the 20% international consensus statistic considered necessary for effective MPAs; however, this had never
been prescribed as a target *per se* (personal communication Astrid Scholz, Ecotrust).

### A2.2.2 Main objectives and conservation measures

The MLPA legislation is purely focused on the protection of biodiversity and the achievement of sustainability, including the replenishment of economically exploited species. Economic sustainability is not referred to directly within the legislation, however it is implied through one of the six goals which guide the developments of MPAs, which aims to 'help sustain, conserve and protect marine life populations, including those of economic value' (CDFG, 2009). Economic sustainability was also taken account of later on by the Blue Ribbon Task Force (BRTF; composed of seven public leaders selected by the secretary of the California Natural Resources Agency for their knowledge, vision, public policy experience, and diversity of professional expertise) due to substantial objections from FGC and stakeholders (Lieberknecht, 2008; personal communication Astrid Scholz). In short, they are assessing more in relation to economic sustainability than they are legally required to do as a matter of good policy (personal communication Astrid Scholz).

The MPA networks *per se* will be zoned; there are three different designations:

- State marine reserves (SMRs): complete no-take zones;
- State marine parks (SMPs): complete no-take areas and potential for (recreational) no-go areas; and
- State marine conservation area (SMCAs): potential for selective no-take / no-go areas.

Along the Central Coast, 7.5% have been designated as ‘no-take’ SMRs (14 in total); there are also 14 SMCAs where certain commercial and/or recreational takes are allowed, and one State Marine Recreational Management Area (SMRMA), where certain take is allowed in the northern zone (CDFG, 2007). Along the North Central coast, the implementation of 11 SMRs, 2 SMPs and 9 SMCAs was proposed in April 2008 (adoption is expected in summer 2009) (CDFG, 2008a).

### A2.2.3 Site selection process

For each region, the process, which is set out in a Master Plan (CDFG, 2008b), tends to last 3 years (Figure A4). Supported by staff from the MLPA Initiative (a public-private partnership tasked with helping the state of California implement the MLPA), a Regional Stakeholder Group (RSG) develops the proposals for MPA networks. This RSG consists of 40-50 representatives of regional maritime stakeholders, which are carefully selected by the MLPA Initiative to represent a fair balance of interests, but also on the basis of the forcefulness of ‘personalities’. The RSG follows clear design guidelines (re. habitats to be represented, size and spacing) developed by a Scientific Advisory Team (SAT). The latter consists of a group of well-respected scientists (mostly of international renown). The
CDFG and the SAT then evaluate the proposals and provide feedback. After iterative refinements, the RSG ultimately arrives at a small number (around three) of MPA alternatives. According to Astrid Scholz, this is based on the full set of ecological and socio-economic characteristics of each MPA alternative and each MPA within it, down to whether a specific boundary would impede boat transit to/from the harbour. In the eventual ‘horsetrading’ in rounds 2 and 3 of the process, the selection process then comes down to mitigating socio-economic impacts and achieving the maximum ecological benefit (personal communication Astrid Scholz).

**A2.2.4 Socio-economic methodology**

**Overall approach**

The recent MLPA process was preceded by two previous, unsuccessful, attempts at implementing an MPA network in California. As previously
mentioned, the MLPA legislation does not refer to economic sustainability, and there was hence no requirement per se for socio-economic data to be taken into consideration (or for socio-economic impact assessments to be undertaken). However, these earlier processes did to a large part fail due to intense stakeholder opposition, and hence it was decided to take socio-economics into account for this third attempt (Lieberknecht, 2008; personal communication Astrid Scholz, Ecotrust).

Socio-economic information feeds into the process(es) in several different ways. At the start of each process, CDFG and MLPA initiative staff compile the ‘regional profile’\(^8\) providing summary statistics on socio-economics that are made available to RSG decision makers at the outset of each new process. At the same time contractors, notably Ecotrust, are out on the coast collecting supplementary information. Ecotrust for example was tasked with determining the extent and relative importance of fishing grounds from commercial and recreational fishing communities (the exact types depend on the regions, i.e. surveys are tailored to those which are important to each region). Astrid Scholz (personal communication) stressed that providing information on fisheries was particularly important in the MLPA process as commercial and recreational fisheries support many coastal communities and economies in California. Fishing is carried out by vessels of all sizes and shapes over a large area of the coastal ocean, using a variety of strategies and gear types, but in general this spatial extent of fishing activities is relatively poorly understood. Building on existing approaches, expert knowledge about fishing grounds was collected from fishermen with the goal of redressing spatial information gaps in commercial fisheries in the context of the MLPA, and its implementation in the Central Coast Study region. Collection of this information is designed to augment official statistics and enable the creation of datalayers which depict the extent and relative importance of commercial and recreational fishing grounds (personal communication, Astrid Scholz).

Datalayers are then developed and fed into an interactive GIS decision support software tool which provides feedback on social and economic impacts. For example, fishing ground maps are actively used by RSG design teams who literally toggle between those layers and layers describing ecological features. Formerly called ‘Doris’, this software tool has now been superseded by MarineMap, which allows stakeholders in the design process and resource managers in the evaluation process to experiment with different MPA designs/networks on their own computers, at their own pace. For example, it provides SAT members with data for evaluation of MPA alternatives. MarineMap is made available to the RSG at their first meeting, and is updated throughout the process (personal communication, Astrid Scholz). During the design phase it also provides basic feedback on whether the design criteria are met or not. For example, stakeholders can experiment with different constellations and get reports on the size, habitat characteristics

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\(^8\) Lieberknecht (2008) describes this as: ‘a large A4 ringbinder full of background information and maps about the environment, biology, geography, and socio-economics of the region’.
etc. of an alternative. However, MarineMap does not currently contain functionality that compares such drafts in real time to design criteria such as sizing and spacing. That is a much more involved process undertaken iteratively by subteams of the SAT and staff. Those evaluation teams all receive the shape files and descriptions, including intent and what goals stakeholders were trying to meet, of MPA alternatives after each round of RSG meetings, which the SAT then analyse in terms of their performance (Astrid Scholz, personal communication).

Throughout the iterative decision making process, each proposal is assessed by the SAT, both in terms of the ecological objectives but also in terms of the socio-economic impacts. Three economists now sit on the SAT for the Southern Coast process, when initially only two were present for the Central Coast process. The economic assessments consist of a static analysis, whereby the first order impacts which would result from closing an area to an activity (assuming permanent loss), are investigated. ‘First order impacts’ refer to the ‘worst-case scenario’ or maximum potential economic impact. The analysis process for the North Central Coast was as follows (Ecotrust, 2009):

- Generation of a baseline estimate using gross fishing revenues from the landing receipts in the region (7 years).
- Scaling of gross base case revenues by factors that represent the share of the costs in gross revenues.
- Comparison of net economic values for the various MPA package alternatives using weighted stated importance indices from the fishing grounds (derived from interviews; methodology outlined in subsequent section).
- Determination of total community impacts using primary net revenue losses (‘multiplier effect’) in conjunction with estimated secondary and tertiary effects (such as net benefits/costs to supporting businesses and consumption service industries).
- Determination of induced impacts based on the spending of net benefits in the community. The sum of the local expenditures that the fishermen (i.e. vessel owner and crew) generate in their community.

For the first two processes (i.e. Central Coast and North Central Coast), the assessment did not proceed beyond the first step just described. For the third, i.e. the Southern Coast process, a second order assessment is now being undertaken using dynamic bioeconomic models developed by the University of Santa Barbara. These try to anticipate the effect on the fishing fleet from MPA arrays. Assumptions are made as to how both people and fish stocks may respond to a particular reserve design over a 20-year period. After

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9 In some cases, where highly site-specific fisheries were found to be significantly impacted, informal compensatory mechanisms are now being considered in California.

10 At the time of the interview with Astrid Scholz (beginning of April 2009), the SAT was still reviewing the first round of evaluations for the Southern Coast process, and the RSG had yet to receive the results of this dynamic, more sophisticated modelling – hence it was not clear how the stakeholders would react.
undertaking the analysis, the SAT produces the impact assessments undertaken for every proposal both as reports\(^\text{11}\) and handouts, i.e. provides the RSG with fishery-by-fishery and port-by-port data and maps for each proposal (for an actual set of evaluations prepared by the SAT, please refer to CDFG, 2009). The RSG/BRTF are most interested in the following four aspects (personal communication, Astrid Scholz):

- “Worst case” affected area and stated importance indices (using a normalized budget constraint approach – see Ecotrust (2009) for details on the methods),
- First order net economic impacts (on profits),
- Cumulative effects with other spatial management measures, and
- Any disproportionate effects on individual or groups of fishermen or communities.

Furthermore, once a final network is accepted by the FGC, a formal Environmental Impact Assessment (EIA) is undertaken. The Draft Environmental Impact Report for the North Central Coast (ICF Jones and Stokes, 2009) for example considered the following socio-economic related topics: consumptive uses and socio-economic considerations; and physical, biological and social recourses (including recreation and research) (amongst environment related topics such as air quality and ecosystem and habitats). With respect to consumptive uses and socio-economic considerations, it investigated the likely indirect physical effects on the environment resulting from displacement of consumptive uses.

**Objectives of using socio-economic data, and success in achieving these**

The main objective of using socio-economic data to inform MPA selection was to understand the impact on those people making a living from the ocean, and thus enable the minimisation of socio-economic impacts from MPAs. The secondary goal was to create a baseline of information to then understand what effects, positive or negative, the MPA may have. In general, the socio-economic understanding of coastal activities was found to lag behind the ecological understanding, and a significant amount of new data thus had to be collected (personal communication, Astrid Scholz).

As previously mentioned, economic fisheries data was not a legal requirement, but data collected through one-on-one interviews proved invaluable to the RSG. Ecotrust undertook interviews and analysis for all the regions, which was available for inclusion in the Central and North Central Coast processes, although more refined in the North Central Coast process.

\(^{11}\) For example, for the North Central Coast, this socio-economic impact analysis was as follows: using the normalized data (spatial extent and relative stated importance), the SAT first assessed the effects of the Integrated Preferred Alternative for both commercial and recreational fisheries relative to the RSG’s MPA three proposals. Results were reported at both the study region and port group levels for the commercial fisheries. Recreational fishery results were reported by user group and sub-region (Scholz et al., 2008).
This information was also available to stakeholders during their deliberations in the North Central Coast, which made for better results. For the latter process, Ecotrust interviewed 174 commercial and 101 recreational fishermen, focusing on the key fisheries found in this region. A common interview guide was followed, using a custom-built ArcView interface known as OceanMap where appropriate. Firstly, fishermen were asked to identify the maximum area they would fish in for a particular species. Secondly, they were asked to identify areas of critical economic importance within the maximum extent. They were told to rank these using a weighted percentage - an imaginary ‘bag of 100 pennies’ that they distributed over the fishing grounds (‘an intuitive common sum scale for scoring the relative importance of sub-areas identified within the larger fishing grounds’). Non-spatial information pertaining to demographics and fishery specific operating costs were also collected (Ecotrust, 2008). These data were then delivered to the MLPA Initiative for integration into a central geodatabase. Ecotrust furthermore also analysed the fishery data in combination with additional data provided by the CDFG.

Thus, a socio-economic impact analysis on commercial fisheries of the alternative proposals could be undertaken (i.e. dollar amount per port and percentage impact on the value of each sector (assuming no displacement effort – see previous section). A consequent comparative impact analysis concluded that negative economic impacts of the final MPA network were only half as significant on the North Central Coast when compared with the Central Coast, as in the North Central Coast region the RSG had been given access to the information upfront (Lieberknecht, 2008; Ecotrust, 2008).

Accordingly, Astrid Scholz (Ecotrust), described the approach that was adopted as very successful to date in terms of bringing key socio-economic information to the stakeholders early on, allowing them to make more effective trade-offs, with the resulting MPAs achieving ecological objectives at (relatively to the impacts experienced in the central coast) lower economic impacts.

**A2.2.5 The use of datalayers**

The importance of using datalayers

Whilst admitting that she would be biased, Astrid Scholz of the Ecotrust considered datalayers to be ‘hugely important’. At the outset of the first round of the process (i.e. the Central Coast process), policy makers did not think it was necessary to collect more detailed socio-economic data as it was not required by law, and as it was perceived that the data would be too hard to collect. Now it has become an integral part of the process, and sets of information and tools are being developed that allow stakeholders to make explicit tradeoffs between ecology and socio-economics (personal communication, Astrid Scholz).
The key socio-economic datalayers developed

Datalayers were mainly developed for commercial and recreational fisheries. Datalayers were not developed on activities other than fisheries due to limited funding to support MLPA Initiative’s data collection, (personal communication, Astrid Scholz). Whilst the fisheries varied according to region, the methodology for collecting the data is broadly similar. As previously mentioned, for the North Central Coast process for example, Ecotrust (2008) undertook interviews to characterize the spatial extent and relative stated importance of fishing grounds for 8 commercial fisheries and 5 recreational fisheries. Circa 40% of fishermen were interviewed; commercial ones were selected on the basis of extant Department of Fish and Game data and RSG recommendations. Data were entered into a custom-built online survey interface (‘OceanMap’) – identifying (1) Maximum extent of each fishery ‘forage area’, and (2) areas of critical economic importance within these (using an imaginary ‘bag of 100 pennies’ for weighting). OceanMap was used for both collecting information and for verifying/validating it during follow-up meetings with fishermen.

According to Astrid Scholz (Ecotrust), there is a related effort conducted in parallel with the North Central Coast project, out of NOAA’s MPA Science Center in conjunction with a conservation organisation, to collect data on non-extractive uses. This data is at a much coarser level of granularity than that of the commercial fisheries data, and not used as actively by the stakeholders as the fisheries information for detailed MPA design (NB: non-consumptive uses are not prohibited in all the MPAs). However, it does provide a useful bird’s eye view of the importance of the coastal ocean for non-consumptive uses.

Astrid stressed that having such data and being able to address people’s concern for their livelihood, was a very powerful tool.

Data formats

The main format of socio-economic information used was data layers/maps, presented at the same spatial granularity as the ecological data – thus it could all sit in one big GIS support system (now MarineMap, formerly Doris). For further information on the metrics, which were reported on in addition to the area affected and stated importance indices, please refer to Ecotrust (2009) (personal communication, Astrid Scholz).

For the purpose of the MLPA process, the decision makers decided not to use site selection tools like MarXan, although the data layers developed would have lent themselves very directly for use in those tools (Lieberknecht, 2008). This was due to stakeholders concerns about ‘black box’ models which they perceived as pure conservation tools. Hence, the stakeholders essentially select the sites using ‘their computers between their ears’ (personal communication, Astrid Scholz). Astrid Scholz (Ecotrust) attributed this distrust of MarXan to the negative perception stakeholders gained on such models during the Californian Channel Island process. Astrid highlighted that at the time, the tools were not as sophisticated as they are now, as MarXan could
only make ‘in or out’ decisions, for fully protected areas only, and had no way
to trade off the socio-economic costs. It should be noted however that several
parallel academic research projects used MarXan, or its successor MarZone.
These were often led by members of the SAT (incl. Ecotrust), and would thus
have had an indirect influence (Lieberknecht, 2008).

Taking future patterns of use/activities into account

Ecotrust decided to interview fishermen based on their cumulative experience,
and thus identified the most knowledgeable fishermen, most of which had
some 30 years of experience. This cumulative experience led to the
development of a baseline through descriptions from the fishermen of the
extent and relative importance of the fishing grounds off California utilized by
all the important commercial and recreational fisheries. Data was also
collected on cost-earnings, demographic and operational data. From this
baseline information continuous monitoring, enforcement or data collection
could be enabled. For example, it is conceivable that new data collection
methodologies could be set up using onboard electronics.

For the bioeconomic modelling, some fairly simplistic assumptions on human
behaviour were made, including ‘fishermen go where the fish are’, but the
monitoring post implementation will then be used to help calibrate those
models. Fishermen were purposely not asked where they would go instead if
there was an MPA in a certain area, as this was viewed as a futile exercise
which would lend itself to ‘a lot of strategic recording’ (personal
communication, Astrid Scholz).

Taking account of the relative economic and social value of different activities

Astrid Scholz (Ecotrust) stated that this can be achieved by determining the
different competing users and their importance. In the US, the fisheries law
states that the seas are public resources that should be managed for the
greatest benefit of the nation. How it should be done or what should be most
important heavily depends on the cultural and political context. In the
Californian processes, there was a focus on commercial and recreational
fisheries, which were treated as equally important by the stakeholders.
Equitable distribution of impacts was not a consideration for the RSG. In fact,
there is typically a gradient in each study region, with, e.g., ports in the north
of the North Central Coast experiencing higher impacts than those in the
south..

Commercial fisheries land fish, which generates landed values in each port
and business profits for the fishing businesses; this gives a dollar figure for
these impacts. By contrast, the recreational fisheries, with the exception of
charter operations, by definition do not generate business income, and while
their participants also spend money in ports (e.g. on bait, food and drink),
these are, in economic terms, secondary effects that were not part of the
Ecotrust study. Hence, dollar impacts were available for the commercial
fisheries sector only. In terms of the methodology used here however, they
both share the common currency of ‘stated importance’; this was used as the
‘common denominator’ so Ecotrust could compare impacts on both sectors given the constraints on the study imposed by the MLPA Initiative resource constraints (personal communication, Astrid Scholz).

The inclusion of MPA-compatible activities

According to Astrid Scholz (Ecotrust), the stakeholder groups decided this by horsetrading, whereby they would shift lines back and forth until they arrived at a solution they could live with. For example, the RSG would shift lines to maintain enough of a rocky reef to achieve an ecological goal, but keep some vital fishing area open. Alternatively, the stakeholders would disallow bottom gear in an area of particular interest, in habitat terms, but allow other gear. For example, many conservation areas allow pelagic gear but not crab pots. Furthermore, as previously mentioned, some non-consumptive uses are allowed in some of the MPAs.

Ensuring datalayers do not become obsolete

When interviewing the most knowledgeable fishermen, Ecotrust captured a portfolio of their fishing strategies over their (on average) 30 years of experience. Astrid Scholz (Ecotrust) hence perceived their maps as ‘just about timeless’.

The impact of MPA creation on the identified socio-economic elements

The assessment of these impacts was described above (i.e. the iterative first order impact assessments, and the use of bioeconomic models). With respect to assessing socio-economic elements relative to the environmental benefits of MPAs, Astrid Scholz stressed that the science regarding the latter was not very well progressed yet, as baseline data was often lacking. Hence, this ‘becomes a much more social and political conversation about what’s important’ - i.e. whether or not the concepts of sustainability and the precautionary principle are given weight, and society is hence prepared to bear some economic pain. In California, there appears to be a quantitative pattern in that there seems to be a willingness to accept about 10% economic pain for setting aside about 20% of the coastal waters for the MPAs (personal communication, Astrid Scholz).

A2.3 Canadian Gully Marine Protected Area (Located within the Eastern Scotian Shelf Integrated Management Area (ESSIM))

A2.3.1 Background information

This zoned offshore MPA is located in the Canadian province of Nova Scotia (near Sable Island). It was legally declared in 2004 and measures 2,364 km². Fisheries and Oceans Canada (DFO) pursued the designation of this area, which contains a rich diversity of marine habitats and species, including deep-sea corals and northern bottlenose whales.
A2.3.2 Main objectives and conservation measures

The MPA is zoned, with Zone 1 comprising the deepest parts of a canyon, and this being preserved in a near-natural state with full ecosystem protection. Zone 2 imposes strict protection for the canyon head and sides, feeder canyons and the continental slope. The adjacent sand banks, which are prone to regular natural disturbance, comprise Zone 3 (DFO, 2004).

The main objective of implementing this MPA was to conserve and protect the natural biological diversity of the Gully and to ensure its long-term health (while providing for sustainable use). To achieve this, disturbance, damage, destruction or removal of any living marine organism/part of its habitat (up to a depth of 15m from the seabed) is generally prohibited. Any activities which could contravene these provisions in close vicinity of the MPA are also prohibited, although hydrocarbon sub-surface rights are not affected. No resource extraction of any kind is allowed in the deep zone, i.e. Zone 1. Within Zones 2 and 3, fishing for halibut, tuna, shark and swordfish are allowed under licence. Scientific research and monitoring is permitted everywhere, subject to permission. Within Zone 3, certain activities may be allowed provided they do not cause disturbance beyond the natural variability of the ecosystem (Canada Gazette, 2004).

A2.3.3 Site selection process

Whilst the Gully MPA evolved out of pre-existing aspirations of ecosystem protection, not from a more systematic/analytical process, socio-economics played a limited role when deciding the zones/restrictions within the predetermined extent of the MPA (personal communication Paul Macnab, DFO).

There had been earlier and extensive consultation on a draft conservation strategy in 1997/98. In the years that followed the strategy, and before developing conservation measures/regulations for the MPA, DFO undertook a series of socio-economic assessments to better understand the current values and historical patterns of human use, including the cultural values (i.e. were there any communities who have made use of an area for generations). This led to the development of a socio-economic profile of the Gully. This profile provided the DFO with insights into which stakeholders should be engaged for the purpose of the consultation process, but also fed into the design process. The Gully MPA design strove to maximize conservation benefits while providing for sustainable use (DFO, 2004).

DFO met with stakeholder groups and individuals, representing oil and gas industry, regulators, NGOs, the shipping sector, and the science and academic community, between 1999 and 2003 to present and verify the results of the assessments and profiling exercises. These exercises included detailed studies of fisheries (conducted by DFO with the assistance of a Fisheries Working Group) and mineral and hydrocarbon potential (completed by Natural Resources Canada and the Canada-Nova Scotia Offshore Petroleum Board) (DFO, 2004). This was followed by a broad consultation of the regulatory proposal document during 2002/03. Presentations and
discussions were also held with the oil and gas industry, regulators, NGOs, the shipping sector, and the science and academic community. In 2003, a multi-stakeholder Advisory Committee\textsuperscript{12} was formed to provide focused input and advice. The Committee reviewed and commented on the regulatory proposal in the Spring and Summer of 2003. Input from fisheries organisations led to some adjustment to the management of the less protected zones (e.g. provisions for additional future fisheries to be considered for Zones 2 and 3) (DFO, 2004). However, the basic design intent remained unaltered, despite representations from groups asking otherwise. For example, some environmental organizations sought a complete ban on all commercial fisheries. The swordfish fleet objected to exclusion from the deep waters of Zone 1 while crab interests requested a change in the western boundary to allow for exploratory access to untested fishing grounds. In the more conceptual stage, the DFO had proposed a large buffer zone surrounding the MPA within which all activities would have been subject to plan submission and review. This proposal was flatly rejected by industry group and regulators, and hence it was discarded (personal communication Paul Macnab, DFO). The Entire process took 5 years (Figure A5).

\textbf{Figure A5: Flowchart of the Canadian Gully process}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Information requirements/analysis} & \textbf{Process} & \textbf{Stakeholder} \\
\hline
Socio-economic assessments: to better understand resource values and historical patterns & Regulatory proposal presented (i.e. area determined) & Fisheries & Oceans Canada \\
& & Canada \hline
Detailed Fisheries studies & Extensive public consultation & Multi-stakeholder advisory group \\
& meetings with key stakeholders & \\
& & Fisheries & Oceans Canada \\
& Multi-stakeholder advisory meetings & \\
& Final regulatory package prepared & Fisheries & Oceans Canada \\
& Approval of restrictions & \\
\hline
\end{tabular}
\end{table}

\textsuperscript{12} This comprised a ‘core group of key government and non-government interests’ with ‘skills, knowledge, and experience relating to the ecology, management, conservation and use of the area’ (Canada Gazette, 2003).
A series of desk-based socio-economic assessments was firstly undertaken to better understand current values and historical patterns of human use. In 1999, DFO completed a preliminary socio-economic profile describing past, present, and future activities in the Gully. Using this profile, and the more detailed sectoral assessments for fisheries, minerals and hydrocarbons that followed, user groups from the fishing, shipping and hydrocarbon industries were then approached for feedback, but also for the purpose of validating the data (i.e. extant data, including log book data on fisheries) (DFO, 2004). Through the course of these discussions, the MPA planning team obtained an enhanced understanding and appreciation for the socio-cultural significance of the Gully. Users were also able to qualitatively point out economically important areas to the DFO, and to highlight areas of ecological value; this data was subsequently merged with pre-existing data. The process of obtaining feedback also proved positive as this helped build rapport with stakeholders and furthermore levelled the 'information playing field' from a socio-economic perspective. When the regulatory proposal was finally presented, the planners were in a much better position to predict and accurately describe any impacts likely to arise from restrictions in the MPA (personal communication, Paul Macnab).

The resulting socio-economic information showed the DFO where human use had the potential for damaging the ecology, and at the same time where there could be some scope for compromising on the conservation objectives (personal communication, Paul Macnab).

Once a regulatory proposal had been developed, the socio-economic data fed into the regulatory impact analysis statement (RIAS), which was required by law. By this point, DFO had received extensive feedback from industry representatives and government specialists on the potential costs/displacement, which aided in detailing the economic costs and benefits. The MPA planning team worked with DFO colleagues in both the Fisheries Management and Science Branches to assess the fisheries data and respond to industry concerns. The RIAS was undertaken in a qualitative fashion, assuming that many of the fisheries could go elsewhere (without taking full account of displacement costs such as additional fuel/subsistence requirements) (Canada Gazette, 2004).

Impacts on hydrocarbon rights and at-sea operations, along with concerns raised by the oil and gas industry (e.g., environmental assessment burden and mitigation costs) were assessed and addressed by DFO working in partnership with the industry regulator, the Canada-Nova Scotia Offshore Petroleum Board, and Natural Resources Canada, the lead federal department for marine geoscience and energy policy.
No formal socio-economic objectives were set, as the Gully represented an early test and developmental trial of the MPA process for the DFO. However, the DFO collected socio-economic data mainly in order to inform the design process and the required RIAS. Furthermore, there was also a desire to allow compatible/sustainable uses to continue where possible. Paul Macnab (DFO) judged the approach taken as generally successful. This statement was supported by a perception that most stakeholders and regulators involved in the process seemed to think that a ‘fair balance had been struck between conservation and access/economic values’, and that the process had been reasonably well informed and relatively transparent. This was despite the observation that there would never be complete consensus on the final design (e.g. some ecologists thought that it should have been declared a complete no-take area, whilst some fisheries groups thought the final design was too restrictive).

**A2.3.5 The use of datalayers**

**The importance of using datalayers**

For the purpose of the Gully site planning process, the developed datalayers (e.g. fish landings, hydrocarbon tenure and shipping routes) were important in profiling and characterising the marine uses for the purpose of consultation, design and the RIAS. During consultation, the datalayers demonstrated to marine industries that their interests were captured and acknowledged - whether or not they were accommodated in the MPA. For planning staff charged with MPA design, the datalayers supported risk assessments and conflict analyses (e.g. examining potential impacts and prescriptions for negative fishing gear interactions in space and time with endangered whale distributions). When the time came to draft the RIAS, the datalayers helped distinguish legitimate claims from spurious and unsupported objections (e.g. while it was true that the Zone 1 closure displaced swordfish effort, it was erroneous to suggest, as one organization did, that the Gully was a proven crab ground). If employed for a wider MPA network planning exercise (as is currently taking place in Canada), such datalayers are vital in coming up with a shortlist of conflicts/legal challenges that may be encountered, as well as looking at an MPA’s viability and feasibility (personal communication, Paul Macnab).

**The key socio-economic datalayers developed**

The following key socio-economic datalayers were developed (personal communication, Paul Macnab):

- Affected fisheries derived from: log books on catch and effort, data on vessels and licences, industry surveys, observer records, as well as knowledge and experience (revenue data is not collected in Canada) (e.g. layers on: gross number of tonnes caught per annum per fishery/landing port, fishing tracks, trawling tracks, longline fishing trips). Third party
rights, including extant and potential minerals/hydrocarbon extraction areas and cables (e.g. layers on: seismic acquisition on the Eastern Scotian Shelf between 1999-2001; commercial prospectivity within the MPA, significant discovery licences in/around the MPA);

- Shipping lanes;
- Regulatory frameworks (e.g. areas controlled by different government departments, including navy operating areas).

All these data layers were created for larger areas than the study areas itself, to ensure encroaching uses (e.g. adjacent oil and gas licences) were not overlooked (personal communication, Paul Macnab).

An atlas on human use and management activities was furthermore created for the whole Scotian Shelf under the Eastern Scotian Shelf Oceans Management Area (ESSIM) initiative (DFO, 2004).

Data formats

In addition to data layers/maps, much data was also held in lists and tables, including quantitative and qualitative data derived from the consultation process. With regards to fisheries for example, in order to embellish the context, this included information about gear used, about fishing strategies of the captains. The DFO also tried to correlate (“tie back”) fisheries data (tonnes caught, year to year landings) with any fishing area closures or restrictions that had occurred. (personal communication, Paul Macnab).

Taking future patterns of use/activities into account

To inform management decisions, the DFO looked into historical fisheries which had been closed and considered whether there would be pressure to reopen. With regards to expanding fisheries, the DFO investigated exploratory actions by industry to identify future threats. Furthermore, the hydrocarbon industry was looked at in significant detail with regards to areas where there had been exploratory activity, and where there could hence be exploitation in the future. This would have implications for the MPA in terms of noise, contamination and increased ship traffic. During the course of the investigation, the DFO discovered that Shell held a ‘significant discovery licence’ for a small section of the Gully MPA. Such licences are a particular form of perpetual hydrocarbon leasehold (which are no longer issued). This proven discovery of oil and gas had to be considered quite seriously, even though it had not been recently revisited since being discovered in the 1960s/70s. DFO had to determine whether the Crown would become liable to compensation. This issue was essentially laid to rest when industry representatives stated that by the time the field would be economically viable, horizontal reach drilling up to 20km would be viable, and access would thus be feasible without ever having to put a boat into the MPA. The DFO also had to consider the likelihood that there would be an increased interest in scientific research once the MPA was designated (personal communication, Paul Macnab).
Taking account of the relative economic and social value of different activities

This process did not take account of the relative economic and social value of different activities. All sectors were regarded as important and given similar treatment. During the planning process, there was no explicit weighting of datalayers or sectors, though generally, the information preparations and subsequent industry engagements were commensurate with the potential impact of the MPA. For example, with the regulatory exception granted for ‘innocent passage’ vessel transits through the MPA, there was little reason to perform complex analyses on shipping data. By comparison, it was critical to assemble and assess geophysical and economic data for the hydrocarbon accumulation described above. Historical development rights associated with the discovery were also examined in preparation for bilateral meetings with the licence holders (personal communication, Paul Macnab).

The inclusion of MPA-compatible activities

Although not formally articulated in policy, the DFO had a general principle of trying to avoid unnecessary restrictions. For example, in parts of the MPA where the main conservation objective was to protect the seabed, the DFO would try not to prohibit surface fishing. So the socio-economics were looked at in terms of space and time, and in terms of whether or not they really compromised the conservation objectives. For example, a decision was made not to prohibit small boat hook and line fishing for halibut in Zones 2 and 3, as there were only a very limited number of participants, which were mostly from one community (where a fish plant was dependent on the catch). This fishery had furthermore been ongoing for 140 years. The DFO decided to accommodate this amongst others due to fishermen confirming that they tended to avoid fishing in or near patches of coral (i.e. had good local knowledge of the ground) (personal communication, Paul Macnab).

Ensuring datalayers do not become obsolete

Post designation, the DFO undertook programs of ecosystem and activity monitoring in and near the MPA. For those industries over which DFO has direct regulatory authority, namely fisheries, the Gully datalayers are maintained and updated frequently. Weekly fishing reports are produced for the managers as part of the surveillance and enforcement program. Annual landings and effort data for the MPA have also been mapped since declaration to see if and how the MPA may have altered fishing patterns and total catch. Datalayers for most other marine activities have been maintained at a regional scale as regular updates to the Scotian Shelf Atlas of Human Use (personal communication, Paul Macnab).

The impact of MPA creation on the identified socio-economic elements

For the purpose of the RIAS, detailed studies of fisheries were undertaken (with the assistance of a Fisheries Working Group). These concluded that the economic impact would be minimal, due to regulatory exceptions (i.e. the zoned approach, and major pelagic fisheries being permitted in Zones 2
and 3) and the potential for excluded fleets, like swordfish in Zone 1, to catch their quota elsewhere (Canada Gazette, 2004).

With regards to the interlinkages/interdependencies between socio-economic and environmental elements, this is at the intersection between what the ecological data would dictate in terms of how the MPA should be designed, and what the impact would be on the socio-economics. Assessing the socio-economic elements relative to the environmental benefits of MPAs is an issue which is difficult to resolve. The DFO had to be able to go to their parliamentarians, and justify the conservation overriding future economic potential. When compared to the hydrocarbon potential (with at least $300million Canadian Dollars (CAD) worth of reserves inside the MPA and billions being spent on adjacent exploration), the potential fisheries impact would be minor, as this essentially only truly impacted a handful of boats. Hence, DFO had to make implicit in their decision that there would have to be certain trade offs, but that there was a good case with respect to the ecosystem/environmental aspects.

In retrospect, it would have strengthened the conservation argument for Canadian lawmakers if the non-market MPA benefits (e.g. biodiversity protection, ecosystem services or existence values) could have been quantified for the Gully in a manner that was compatible and comparable with the kind of hard costs readily produced for and by industry. Fortunately for the Gully, DFO had in its favour many pre-existing environmental sensitivities13 in the area, whereby environmental assessment procedures would probably not have allowed such activities anyway. Thus the actual ecosystem elements rather than necessarily the MPA per se would foreclose on certain opportunities (personal communication, Paul Macnab).

### A2.4 Australian Great Barrier Reef Marine Park – Representative Areas Programme (RAP)

#### A2.4.1 Background information

The Great Barrier Reef Marine Park (GBRMP), located on the NE coast of Australia, adjoins the State of Queensland and covers 344,400km². The GBRMP is a single very large MPA declared under Australian (Federal) legislation; it is also:

- One of the world’s better known MPAs and one of the largest (it currently contains the largest network of no-take areas);
- Arguably the most methodically planned and comprehensively managed, particularly over such a large scale.

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13 The Gully has been described as ‘one-of-a-kind’, due to its ‘biodiverse and highly productive’ nature; it is home to ‘a tremendous variety of habitats for fish, mammals, seabirds and bottom dwellers’. For example, it contains the highest known diversity of coral in Atlantic Canada; its abundant food supply attracts fourteen species of marine mammals (particularly the endangered northern bottlenose whales) (DFO, 2004).
The GBRMP extends seaward from low water mark along the coastline of Queensland, with most of the Marine Park occurring offshore; at its widest point it extends 280 km offshore. The GBRMP ranges from shallow inshore waters to deep offshore waters and includes diverse array of habitats and species including 2,900 individual coral reefs. Within the outer boundaries of the GBRMP are about 900 islands; however most are these are not part of the Federal Marine Park as they are part of Queensland.

The GBRMP has always been a multiple-use MPA in which a wide range of commercial and recreational activities and uses are allowed, including many extractive industries (but not mining nor drilling for oil), while still protecting one of the world’s most diverse ecosystems. The multiple-use zoning system provides high levels of protection for specific areas, whilst allowing a variety of other uses to occur in certain zones. These include such diverse uses as shipping, dredging, aquaculture, tourism, boating, diving, military training, commercial fishing and recreational fishing.

Table A2 details the different zone types of the GBRMP, as well as their area.

**Table A2: Total Area of zone types within the Great Barrier Reef Marine Park (Great Barrier Reef Marine Park Authority (GBRMPA, 2004)**

<table>
<thead>
<tr>
<th>Zone Type</th>
<th>Area (km²)</th>
<th>% of GBRMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservation</td>
<td>710</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Marine National Park</td>
<td>114530</td>
<td>33</td>
</tr>
<tr>
<td>Scientific Research</td>
<td>155</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Buffer</td>
<td>9880</td>
<td>3</td>
</tr>
<tr>
<td>Conservation Park</td>
<td>5160</td>
<td>2</td>
</tr>
<tr>
<td>Habitat Protection</td>
<td>97250</td>
<td>28</td>
</tr>
<tr>
<td>General Use</td>
<td>116530</td>
<td>34</td>
</tr>
<tr>
<td>Islands (Commonwealth)</td>
<td>185</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>344,400</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The direct use activities supported by the GBRMP contribute an estimated $5.4 billion Australian Dollars (AUD) per annum to the Australian economy (2006-07 figures). The tourism industry generates the majority of that income with commercial fishing and recreational activities contributing a smaller amount to the overall total (Access Economics Pty Ltd, 2008).

The Representative Areas Programme (RAP), initiated in the late 1990s and completed in 2003, aimed to include representative examples of all 70 bioregions throughout the GBRMP in a new network of ‘green zones’ (i.e. highly protected no take zones). The 2004 zoning plan now protects 33% of the GBRMP from extractive activities, with a further 33% protected in zones that preclude activities that might otherwise impact the seabed or any benthic habitats (Innes *et al*, 2003; Jon Day, GBRMP Authority, personal communication).
A2.4.2 Main objectives and conservation measures

When the Great Barrier Reef Marine Park Act 1975 (the Act) was first proclaimed in 1975, the legislation included provisions that *inter alia* (GBRMPA, 2009a):

- Provided for 'the establishment, control, care and development of a marine park';
- Defined the area known as Great Barrier Reef Region;
- Established the GBRMPA, a Commonwealth authority responsible for the management of the GBRMP;
- Provided a framework for planning and management of the GBRMP, including through Zoning Plans, Plans of Management and permits;
- Prohibited operations for the recovery of minerals (which includes prospecting or exploration for minerals) in the Marine Park (unless approved by the GBRMPA for research); and
- Provided for regulations, enforcement etc.

Following a comprehensive review in 2006, the objects of the Act were amended and today Section 2 of the Act reads:

1) **The main object of this Act is to provide for the long-term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region.**

2) **The other objects of this Act are to do the following, so far as is consistent with the main object:**
   a) **allow ecologically sustainable use of the Great Barrier Reef Region for purposes including the following:**
      i. public enjoyment and appreciation;
      ii. public education about and understanding of the Region;
      iii. recreational, economic and cultural activities;
      iv. research in relation to the natural, social, economic and cultural systems and value of the Great Barrier Reef Region;
   b) **encourage engagement in the protection and management of the Great Barrier Reef Region by interested persons and groups, including Queensland and local governments, communities, Indigenous persons, business and industry;**
   c) **assist in meeting Australia’s international responsibilities (especially the World Heritage Convention).**

A wide range of management measures are used in the GBRMP; one of the key management measures is the Great Barrier Reef Marine Park Zoning Plan 2003 (this constitutes statutory and subordinate legislation under the Act). The Zoning Plan provides details on what, and where, specific activities are allowed, and which activities require a permit (for a zoning map and activities matrix, please refer to GBRMPA, 2004).

Initial Zoning Plans were sequentially developed for the entire GBRMP between 1983 and 1988; by the mid-late 1990s there was a realization that these zoning plans were inadequate for the protection of the range of
biodiversity across the GBRMP. The RAP process therefore commenced which aimed at maximising the protection of the full range of biodiversity while minimising negative social, economic or cultural impacts (personal communication Belinda Jago, Jon Day, GBRMP Authority (GBRMPA)).

The underlying objectives of the RAP were (Commonwealth of Australia, 2006):

- Maintaining biological diversity of the ecosystem, habitat, species, population and genes,
- Allowing species to evolve and function undisturbed,
- Providing an ecological safety margin against human-induced disasters,
- Providing a solid ecological base from which threatened species or habitats can recover or repair themselves, and
- Maintaining ecological processes and systems.

A2.4.3 Site selection process

There were various distinctive planning phases to the RAP, which were publicised before and during the process: Classification, Review, Identification, Selection, Formal Input Public Phase 1, Draft Zoning Plan, Formal Input Public Phase 2, Final Zoning Plan, Ministerial and Parliamentary Approval, and Monitoring (Commonwealth of Australia, 2006; for a timing/sequence flow-chart of these, please refer the GBRMPA, 2009b).

Between 1998 and 1999, the GBRMPA collated 40 datasets; between 1999 and 2000 GBRMPA used this information to work with scientists to develop a map of 70 bioregions. Key stakeholders (incl. commercial fishermen, tourism operators) were consulted during these phases. A combination of expert opinion, stakeholder involvement and analytical approaches were then used to identify options for zoning networks. Subsequently, external scientific and socio-economic/cultural advisory committees were employed to develop 11 biophysical principles and 4 socio-economic principles to inform the zoning process (Commonwealth of Australia, 2006); these principles were drawn up between 2000 and 2001.

Public engagement occurred throughout the RAP; however GBRMPA is also required by legislation to have a minimum of two formal phases of community participation. The first Community Participation Phase was undertaken in 2002 – this included more than 200 formal meetings and led to 10,000 public submissions. It was aimed at informing the community of the purpose of, and process for, the rezoning, and also at gaining a broad set of information from the community about Marine Park uses and values.

In June 2003, a Draft Zoning Plan was published. Between June and August 2003, the second formal Community Participation Phase took place, this encompassed more than 360 formal meetings and focused community comment on the Draft Zoning Plan. Over 21,000 public submissions were received commenting on the Draft Zoning Plan. Once the submissions had been processed, these were input into a web-based query tool developed to
aid the GBRMPA Planning teams in revising the Zoning Plan. The planning teams were divided into regional groups, which considered each proposed zone in the Marine Park against the range of information available to them (including the information presented by submissions). In November 2003, the revised Zoning Plan was put to the Minister along with a Regulatory Impact Assessment (RIA). After a statutory period in Parliament, the new Zoning Plan came into effect on 01 July 2004 (Innes et al., 2003).

**Figure A6: Flowchart of the Great Barrier Reef representative areas program**

**A2.4.4 Socio-economic methodology**

**Overall approach**

During the RAP process, socio-economic information was taken into account in a number of ways. The underlying legislation required ‘reasonable use’ be allowed in certain zones, and hence the consideration of the social and economic implications was fundamental. The RAP was guided by four socio-economic, cultural, and management feasibility/operational principles (developed by advisory committees), which included (personal communication Belinda Jago, Jon Day):

- Maximising complementarily of the no take areas with human values,
- Maximising public understanding and acceptance of those areas,
- Facilitating enforcement, and
- Ensuring that the final selection of the no take areas recognises the social costs and benefits of those areas, (personal communication Belinda Jago, Jon Day).
Some socio-economic information was also considered in a marine reserve design software tool (MarXan), which was adapted for use in the RAP, and a suite of GIS-based spatial analysis tools. MarXan enabled the integration of a number of datalayers (primarily biophysical but also some socio-economic) and the assessment/generation of a number of options (GBRMPA, 2005).

Some MarXan/GIS input data were derived from official records, but a large amount of information was derived from both community consultation phases, including a map-based questionnaire in the first phase. During the 1st phase users/stakeholders were asked to mark areas of interest (e.g. fishing, unique value). During the 2nd phase, they were invited to comment on the Draft Zoning Plan. The questionnaire prompted people to ‘identify draft zones they did not support and requested them to provide alternative options and to state their reasons’. People were also asked to nominate those new zones they did support, state their reasons for this, and provide general comments on the draft zoning provisions. A large number of the c.31,000 submissions included spatial information (at least 5,800 included actual maps). Each submission was scanned by GBRMPA staff, analysed, codified and the contents entered into a database. This information could then be sorted and recalled in different groupings such as geographical location, affiliations, user groups, expertise or points of view (Innes et al., 2003).

A range of datalayers (some 20 ecological and 30 socio-economic layers) were considered in the planning. Iterative analytical planning meetings involving GBRMPA staff considered various outputs derived using MarXan. While MarXan provided some initial options for possible representative areas, it provided only a guide in the early planning stages, i.e. MarXan generated an initial output which the planners then looked at and used other tools/processes to refine. A process of deliberation then began that utilised the submissions, human knowledge, overlay/static maps and expertise within the GBRMPA to further develop the Zoning Plan (Lewis et al., 2003).

The analytical decision support tools (e.g. MarXan) were not considered useful to develop the overall zoning network or actual zone boundaries, but they were very useful in post hoc accounting to assess options against the planning principles (i.e. primarily against 11 biophysical principles). Each time a shortlist of possible no-take areas was developed for a certain area, GBRMPA staff were able to undertake such post hoc accounting. This enabled possible options to be carefully assessed against the planning principles (and then ‘tweaked’ if necessary) as well as comparing the likely implications for a variety of options. This helped move toward a recommended final version of the Zoning Plan and ensured the most ‘cost-effective’ outcomes which would still meet the key planning principles. It is important to note that current analytical tools such as MarXan cannot take account of all available information, much of which is not in a spatial data

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14 including alternatives to MarXan such as ReST (Reserve Selection Tool) and TRADER (a method based on randomisation combined with multivariate regression trees); standard GIS software such as ArcInfo GRID and ArcMap, but also, specifically written ArcInfo AML programmes (Lewis et al., 2003).
form, so more traditional planning approaches are also required (personal communication Belinda Jago, Jon Day).

The Regulatory Impact Statement (RIS), undertaken as part of the process for submission to Parliament, identified costs and benefits to different parts of industry or the public, be they financial or otherwise. It considered the following aspects: people’s desire to protect; economic value of tourism (based on an Environmental Management Charge\(^{15}\)); recreational fishing expenditure; cost of zoning plan (mostly value of forgone fishing activity versus adaptability of each fishery to zoning); species/habitat under threat; contingent valuation/willingness to pay; and use/non use values. The impact assessment concluded that the environmental and economic benefits far outweighed the economic costs (Hand, 2003).

**Objectives of using socio-economic data, and success in achieving these**

The GBRMP is understood to be a multiple use marine park, i.e. allow for reasonable use provided such use is ecologically sustainable, but always with an overriding approach to conservation. A clear objective of the RAP was to undertake it in a way that would minimise the impact on the users. It was felt that if the community was not brought along, then enforcement would be very difficult in an area the size of the GBRMP. Hence it was important to demonstrate to the community that their input was listened to, and that the GBRMPA staff would try to maximise the benefits and minimise the impacts (personal communication Belinda Jago, Jon Day).

Whilst admitting that they would be biased, Jon Day and Belinda Jago of the GBRMPA thought they had been extremely successful in achieving these objectives. The difference between the draft and the final plan was given as one indication of this success. The significant changes between the initial zoning, the Draft Zoning Plan and the final Zoning Plan, as accepted by Parliament, are readily seen in Commonwealth of Australia (2006), a review of the Great Barrier Reef Marine Park Act (Maps 9, 10 and 11 on pages 69-71 of that report highlight the differences between the draft and final Zoning Plans; the Capricorn-Bunker case study illustrates them in more detail on pages 78-90). These changes are largely the result of additional information received either in public submissions or in another ways. This difference was described as ‘quite radical’ due to the GBRMPA taking on board the issues raised in the submissions, many of which were of a socio-economic nature.

**A2.4.5 The use of datalayers**

**The importance of using datalayers**

The GIS/spatial analysis infrastructure developed for the RAP was described as ‘vital to mesh analytical reserve design methods such as MarXan with the

\(^{15}\) This is a charge paid by most commercial operators granted permits by the GBRMPA (incl. operators conducting tourist programmes and non-tourist commercial charters plus those operating facilities in the GBRMP (GBRMPA, 2009c).
human expertise needed to reach a final draft plan’ (Lewis et al., 2003). Fisheries data, and data on tourism and recreational use were furthermore described as ‘essential in placing the zones to also help minimise the potential impact on known users’ (GBRMPA, 2005). In numerous instances, more detailed spatial and temporal data enabled more effective outcomes that maximised the benefits while minimising the socio-economic costs. Jon Davy, GBRMPA (personal communication) highlighted that Vessel Monitoring System (VMS) fishing data in particular was incredibly powerful in demonstrating to the industry and ministers how areas of high use had been avoided wherever possible, without compromising the biodiversity objective. Where it could, the GBRMPA would ‘shave off’ small areas of a green zone, and thereby often markedly reduce the fisheries impacts while still achieving a satisfactory planning outcome.

The key socio-economic datalayers developed

The GBRMPA collected socio-economic data belonging to the following broad categories, and displayed these in datalayers (Commonwealth of Australia, 2006):

- Commercial fishing logbook and VMS data,
- Recreational fishing logbook and survey data,
- Information on tourism operations within the Marine Park derived through permits, plans of management and Environmental Management Charge data (including, for example, boat ramps, yacht anchoring points, areas important for tourism use),
- Information on shipping activities provided by the Australian Maritime Safety Authority (location of vessels derived from automated position records, and Designated Shipping Areas), and
- Information received through submissions to the Authority during the preparation of the 2003 Zoning Plan.

For fisheries for example, the following key datalayers were developed (Commonwealth of Australia, 2006):

- Otter Trawl Fishery Gross Value of Production (dollars per 6nm$^2$ reporting unit),
- Otter Trawl Fishery VMS data (showing trawl positions),
- Line Fishery Gross Value of Production (dollars per 6nm$^2$ reporting unit),
- Net Fishery Gross Value of Production (dollars per 6nm$^2$ reporting unit),
- Recreational fishing diary data (showing locations).

For the individual regions, other layers were created if an activity was of local importance. For example, in the Capricorn Bunker Region (located between Rockhampton and Gladstone), the following layer was also developed (Commonwealth of Australia, 2006):

- Spanner Crab Fishery Gross Value of Production
The consultation phases resulted in the submission of a lot of data, much of which was of a spatial nature; such maps were scanned and digitised by GBRMPA staff. The questionnaires were analysed with a coding system, based on 7 key themes. For example, one of these was ‘primary interest’ coding, which had the following categories: recreational fishing, commercial fishing, resident of the area, nature enjoyment, conservation, swimming and snorkelling, recreational boating and sailing, SCUBA diving, motor water sports, research, tourism industry, indigenous interests, and commercial shipping and ports) (Innes et al., 2003). The key datalayers produced from the public consultation were (Commonwealth of Australia, 2006):

- Areas of importance to stakeholders raised in the first round of public consultation (for example, in the Capricorn Bunker Region, these depicted key areas for respective commercial fisheries, e.g. trawl, line fishing, spanner crab), and
- Areas of importance to stakeholders raised in the second round of public consultation (for example, in the Capricorn Bunker Region, these depicted key areas for commercial and recreational fisheries, and tourism activities).

The GBRMPA also gathered a wide range of additional information and data to inform the Draft Zoning Plan, including State fisheries closures within the Marine Park, State zoning of adjacent land and waters, native title claims, Aboriginal and Torres Strait islander databases for the register of the national estate, historic heritage places and historic shipwrecks, shell collecting areas and Coastwatch aerial surveillance data.

With regards to data processing, spatial analysis was generally considered necessary to manipulate raw data into more relevant information. For example, boat ramp data were processed into a density surface extending 20km from the nearest boat ramp; hence each planning unit had a value of ‘boat ramps’ attached to it. This analysis ensured that ‘planning units were aware of any boat ramps within 20km, rather than just the boat ramps that fell within the planning unit’ per se. Commercial fisheries data, which was ‘a critical input’, required careful pre-processing. Logbooks data, which consisted of daily records which fishermen are required to collect as part of their fishery licence, were then collated by the Queensland Fisheries Service. Different fisheries information required different approaches, but most fisheries data was processed in three steps: (1) aggregation of several years of data, (2) choice of units (Gross Value of Product in standardised dollars, or days of fishing effort), and (3) spatial allocation (the value data is reported in cells of 6 or 30nm², with some fisheries it was possible to spatially refine this data by assuming that fishing activity does not occur where it is not permitted, or where the physical environment is unsuitable – e.g. bottom trawling does not occur on coral reefs, so those areas could be excluded ) (Lewis et al., 2003).

Data formats

Spatial data was received from many stakeholders, and held in several formats, including tabular form, maps, datalayers, and MarXan.
As previously mentioned, MarXan was mainly used during the first phases of the process, and for the purpose of post-hoc accounting against the planning principles. For MarXan, various planning units were defined; large 30km² hexagons were used in off shore areas (as here, spatial scales of environmental change were thought to be broad, and there are no reefs), and smaller 10km² hexagons closer to the coastline in non-reef areas. In reef areas, the actual extent of reefs, and the areas around reefs were used. Existing Marine Park boundaries, the coastline, and bioregion boundaries were also incorporated.

MarXan input files consisted of the following four components:

1. A target file, which specified how much of each conservation feature/species was sought in the network,
2. A planning unit file, which specified the cost should a particular planning unit be selected, and the status of that planning unit (with respect to its status),
3. An amounts file, which detailed how much of each conservation feature was to be found in each planning unit,
4. A boundary file, which specifies the adjacency of planning units, and the boundary length between two units.

One of the fundamental drawbacks with MarXan that inhibited its ability as a planning tool was that it could only consider a single 'cost'; considerable effort was therefore required to consolidate the known range of activities into a single cost for use in this planning unit file (personal communication, Jon Day).

An automated process ensured that input files could be directly generated from ArcGIS as the underlying datalayers changed due to more up-to-date information being continually received (Lewis et al., 2003).

Belinda Jago of the GBRMPA stressed that people became very concerned about MarXan because 'they didn't understand how it worked'. They perceived it as 'a big black box whereby you just enter information and miraculously without anyone actually looking at it to make any sense of it [something is] spat out at the other side, and they would have to live with it'. Hence, the GBRMPA consciously did not talk about it to the public, but used it behind the scenes as a decision support tool. When talking to the public, staff talked in more generic terms, referring to the package of principles identified at the outset. Staff also continually stressed that if information were to be provided, it would be considered if at all possible (without giving rise to false expectations).

Taking future patterns of use/activities into account

Where past changes were well known, or where current use was low but considered likely to change, expected future patterns were taken into account. For example, likely growth patterns for tourism were considered; similarly the
remote areas in deep sea areas at the eastern edge of the GBRMP were also carefully considered. These offshore areas were zoned as large no-take zones, even though relatively little was known about the habitats and there were low levels of current use; this was done primarily to meet the principle of representation of all bioregions but was also done in a precautionary way, as GBRMPA thought these areas might be considered for mid-water trawling or similar activities at some point in the future. Recent research investigations have since shown these areas contain species and habitats that are unique and not found elsewhere in the Great Barrier Reef (GBR), so taking a precautionary approach was not only justified but entirely appropriate (personal communication Belinda Jago, Jon Day).

Taking account of the relative economic and social value of different activities

There were many different social values and socio-economic datasets (for example, see Technical Information Sheets such as GBRMPA, 2002), that were used during the planning process. The public submissions also provided the GBRMPA with ‘a lot of good information’. Once these had been mapped, the GBRMPA’s internal planning teams overlaid those with other information and came up with outcomes that, as far as was possible, achieved the principles but had a minimum impact. The planning teams were aided by the GBRMPA’s experts on fisheries, tourism, and indigenous/cultural aspects to collate and interpret of all of the datasets (personal communication Belinda Jago, Jon Day).

Weightings were not used in the process, because as ‘as soon as you get into weighting, it comes down to who made the call on what’s worth more than others’. Whilst the overall value of the industries was known, this was not generally the case for the regions. The GBRMPA made a clear decision not to talk about weighting, as the planning principles stated that all information would be considered. Similarly not ‘playing a numbers game’ in terms of the numbers of submissions was perceived as very important to stakeholders/members (i.e. 10 submissions saying ‘X’ was not considered better than 2 submissions saying ‘Y’; rather it was the quality of the information provided and not about numbers). Whilst an exclusion may not have an actual economic impact on a community, it may have a very big impact on their lifestyle/social aspects. If a community could make that case to the GBRMPA, this was considered ‘extremely valuable’ (personal communication Belinda Jago, Jon Day).

The quantitative total value of the tourism industry being significantly higher (approximately $5 billion AUD) compared to that of the fishing industries (around $200 million AUD) was an important consideration when the Minister considered the final Zoning Plan (personal communication Belinda Jago, Jon Day).

The inclusion of MPA-compatible activities

As indicated above, biodiversity was the overriding principle of the RAP (see Section 2.4.2) (personal communication Belinda Jago, Jon Day).
While zoning is a key management instrument for the conservation and management over the entire GBRMP, there are many misconceptions about the role that zoning alone plays in the GBRMP. Zoning does provide a spatial basis for determining where many activities can occur, but zoning is only one of many spatial management tools used in the GBR. Furthermore zoning is not necessarily the most effective way to manage all ocean activities, and some are better managed using other spatial and temporal management tools (personal communication Belinda Jago, Jon Day).

Some of the other management ‘tools’ or strategies applied in the GBRMP include:

- Permits (often tied to specific zones or smaller areas within zones, and providing a detailed level of management arrangement not possible by zoning alone);
- Statutory ‘Plans of Management’;
- Site Management Plans;
- Special Management Areas\(^{16}\);
- Other spatial restrictions (e.g. Defence Training Areas, shipping areas, Agreements with Traditional Owners);
- Best Environmental Practices;
- Industry Codes of Practice; and
- Partnerships with Industry (for example the GBRMPA and the commercial fishing industry have recently commenced a partnership relating to ‘future proofing’ the industry in the face of climate change).

**Ensuring datalayers do not become obsolete**

The interviewed GBRMPA staff conceded that datalayers would always become obsolete eventually, and some datasets would be more up-to-date than others. Hence, all those involved in an MPA process can do is use the best available datasets. By talking to the public and stakeholders, the most up-to-date, real-time information can be gathered. The process should furthermore be set up in a way so that new/emerging data can be taken into account throughout the planning process as happened during the RAP (personal communication Belinda Jago, Jon Day).

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\(^{16}\) Special Management Areas (SMAs) restrict use or access within specific areas of the Marine Park, providing a responsive and flexible management approach at a site-specific level. SMAs may be declared on a temporary, seasonal or permanent basis for a number of reasons including:

- conservation of a species or natural resource, e.g. turtles, dugong, bird nesting sites or fish spawning aggregation sites;
- protection of cultural or heritage values;
- public safety;
- appreciation by the public;
- in response to emergency situations requiring immediate management action (e.g. a ship grounding, oil spill or marine pest outbreak).
The impact of MPA creation on the identified socio-economic elements

As previously mentioned, the RIS concluded that economic costs were lower than the environmental and economic benefits. It was anticipated that the RAP would provide a positive stimulus for some commercial fisheries (through safeguarding/enhancing fish stocks), for recreational fisheries, and for the tourism industry in general (which would furthermore be safeguarded through protecting the environmental amenity tourists visit). This stimulus would in turn deliver positive economic flow-on benefits for regional economies. The benefits were not translated into monetary values for the purpose of the RIS (Hand, 2003) especially as in many cases these were ecosystem services that are difficult to quantify.

After the Zoning Plan and RIS were introduced into the Parliament, a structural adjustment package was initiated for fishers, their employees and other businesses/workers who were significantly negatively impacted by the rezoning of the GBRMP. This package is still (September 2009) being finalised and only some components have been completed (e.g. the Licence Buyout Component of the GBRMP Structural Adjustment Package; see FERM, 2007) but the level of economic adjustment has been significant (personal communication Belinda Jago, Jon Day).

When it comes to assessing socio-economic elements relative to the environmental benefits of MPAs, the GBRMPA had a clear objective of protecting and conserving biodiversity and minimising socio-economic impacts. However, the principal objective was biodiversity. At the end of the day, the politicians had to make the decisions (they were kept informed throughout, e.g. of public concerns), and hence political realities made socio-economics the primacy in some regions. It was important to recognise that there would be economic costs; hence GBRMPA staff needed to be upfront with the public and decision makers. However, the GBRMPA was able to demonstrate that the process had been undertaken in a way that minimised costs as far as possible, in a transparent and accountable fashion (personal communication Belinda Jago, Jon Day).

A2.5 Australian South East Marine Region Network

Please note that several attempts were made to obtain further information on the socio-economic methodology, and data layers employed, from Australian officials; however, this proved unsuccessful. Hence the information provided in this Section is not as detailed as that provided for the other full case studies.

A2.5.1 Background information

This MPA network is located off the coasts of the Australian states of New South Wales, Tasmania and Victoria. It was implemented in 2007 and measures 226,458km². This is the first temperate deep-sea network of marine reserves in the world; it covers representative examples of the diverse
seafloor features and associated habitats found in the South-east Marine Region. It was designed to contribute to the National Representative System of Marine Protected Areas (Australian Government, 2008).

A2.5.2 Main objectives and conservation measures

The network’s main objective was to ensure that the network contained representative examples of the major seafloor features of the region. Specifically, the goals were (Kiessling, 2009):

- Each provincial bioregion should be represented
- All depth ranges should be represented
- Known benthic/demersal biological features should be represented
- All types of seafloor features should be represented

However, the exercise also set out to minimise costs to communities and industries, through collaboration with people who use and care about the oceans (Kiessling, 2009).

There are 5 zones:

1. The Sanctuary Zone: No commercial or recreational fishing or mining permitted.
2. The Benthic Sanctuary Zone: Some commercial/recreational fishing permitted (except 100-500m depth zone).
3. The Recreational Use Zone: recreational/charter fishing allowed.
4. The Special Purpose Zone: Recreational fishing and mining permitted. Charter fishing subject to approval. No commercial fishing.
5. The Multiple Use Zone: Recreational fishing and mining allowed. Some forms of commercial fishing allowed subject to approval.

Some high-impact fishing methods are banned throughout the network specifically: demersal trawl, Danish seine, scallop dredge and gillnetting deeper than 183 metres (Australian Government, 2007; for more details, see Australian Government, 2008). Some types of commercial fishing and other commercial activities are allowed in some parts of the network under an approval from the Director of National Parks (this includes transit). 42% of the area is a sanctuary zone; 36% a special purpose zone and 21% is classified multiple use (Australian Government, 2008).

A2.5.3 Site selection process

The MPAs were chosen through a 4-year iterative, 4-step process (Figure A7, Australian Government, 2008):

1. An inventory of the relevant mapping and research was undertaken.
2. Broad Areas of Interest were developed by a scientific panel.
3. The Australian Government and scientists developed a set of specifications/guidelines (stakeholders had input). This included guidance on the location, size, number/type of features, and boundary design.
4. The Government identified the Reserves using these specifications and best available scientific knowledge, while at the same time seeking to minimise the impacts on industry. A shortlist was consulted on in 2005; the Department of the Environment, Water, Heritage and the Arts met with key stakeholder groups to discuss the proposals and received a number of submissions from industry, conservation groups, scientists and members of the community (Australian Government, 2008).

As a final step in the process, a RIA was undertaken (personal communication government official).

![Figure A7: Flowchart of the Australian South East Marine Region network process](image)

**A2.5.4 Socio-economic methodology**

**Overall approach**

The Australian Government made around 20 changes to boundaries and zoning based on stakeholder inputs. The result is ‘a network that is both larger and more representative of the region than was the original proposed and has far less impact on industry’.

Socio-economic criteria were part of the ‘scientific information’. Fishermen were being asked to contribute to the management planning process (Australian Government, 2008). A management plan for the network was still being prepared in April 2009 (Kiessling, 2009).
A2.6 Papua New Guinea – Kimbe Bay and Madang Lagoon MPA Systems

A2.6.1 Background information

MPA systems in Papua New Guinea (PNG) are being developed using scientific ecological and socio-economic design principles, supported by The Nature Conservancy (TNC) (an NGO working on a global basis), a local NGO (Mahonia Na Dari), the World Wildlife Fund (WWF) and Wetlands International.

Kimbe Bay lies within the Bismarck Sea on the north coast of the island of New Britain and is recognised as a globally important area for high coral diversity, cetaceans and pelagic fish (particularly tuna). An MPA network for the Bay that has been specifically designed to address resilience to climate change has been developed by the TNC, with the aid of funding from the David and Lucille Packard Foundation and the US Aid’s Global Conservation Programme, among others. The aim is that at least 20% of the high priority areas across the bay are effectively protected. Due to there being a low level of commercial fishing/marine resource use in the area, it was felt that Kimbe Bay provided an excellent opportunity to establish an MPA network, before fishing pressure became a more serious problem. The development of an MPA network in Kimbe Bay is a preliminary step towards the development of a larger MPA network for the Bismarck Sea (Green et al., 2007).

The implementation process was initiated in 2004, and is still ongoing. Currently (2009), the community based planning process is under way, whereby 14 potential areas suggested by a scientific design process (covering 19,080 km² and encompassing the full range of biodiversity in the Bay) are being considered by the communities. Plans of management and agreement have to date been signed for two areas, and negotiations for six others are under way (Green et al., 2009).

A2.6.2 Main objectives and conservation measures

There are two main objectives for the Kimbe Bay MPA network (Green et al. 2007):

- To conserve marine biodiversity and the natural resources of the bay in perpetuity; and
- To address local marine resource management needs.

Conservation targets in Kimbe Bay include protecting the full range of marine biodiversity, including key habitats and associated flora and fauna. This includes deep as well as shallow water habitats (seagrass beds, coral reefs, etc.) and rare and threatened species of sea turtles, dugong, cetaceans and fish (such as a goby known to only occur in one lagoon) (Green et al., 2007; Munday 2004).
The MPA network at Kimbe Bay will be zoned with the assumption that it will be a multiple use MPA network. Different types of use will be permitted in different areas, e.g. tourism, fishing, etc., with certain areas identified as needing the highest level of protection being no-take areas, which will prohibit all extractive uses (Green and Lokani, 2004).

### A2.6.3 Site selection process

In 2004, a six-step process to aid the development of the design of the Kimbe Bay MPA was initiated. This process was purely science driven and comprised a series of three scientific workshops, targeted research, data processing and data analysis (Table A3) (Green et al., 2007). The process was led by Alison Green, and Kimbe TNC staff, whilst others collected scientific data that fed in to the process as data layers (incl. mangrove surveys, fish spawning aggregation surveys, and a socio-economic survey) (personal communication Richard Hamilton, TNC).

#### Table A3: Kimbe Bay MPA network scientific design process

<table>
<thead>
<tr>
<th>Steps</th>
<th>Timing</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. First scientific workshop</td>
<td>February 2004</td>
<td>MPA network objectives, conservation targets, boundaries, network design principles and research priorities</td>
</tr>
<tr>
<td>2. High priority research</td>
<td>2004–2005</td>
<td>Minimum information required for MPA network design (biological field surveys, a hydrodynamic study, and a detailed socio-economic survey of six communities)</td>
</tr>
<tr>
<td>3. Data processing</td>
<td>Jan–April 2006</td>
<td>Best available information summarised in GIS data layers</td>
</tr>
<tr>
<td>4. Second scientific workshop</td>
<td>April 2006</td>
<td>Revised and refined GIS data layers</td>
</tr>
<tr>
<td>5. Data analysis using MarXan</td>
<td>May–June 2006</td>
<td>MPA network design options</td>
</tr>
<tr>
<td>6. Third scientific workshop</td>
<td>July 2006</td>
<td>Scientific design of MPA network – selection of 14 Areas of Interest</td>
</tr>
</tbody>
</table>

During step 5, TNC identified 14 priority conservation areas or broad Areas of Interest (AOI) using MarXan for inclusion within the MPA network. These AOIs were to serve as a starting point for discussions with local communities regarding the development of actual MPAs. Manual accounting was used during the third workshop to refine the AOIs identified by MarXan; for example, the boundaries were modified where socio-economic, biological and cultural interests needed to be taken into account. At least 20% of each habitat type is included in the AOIs; these range in size from 6 to 724 km² with only one below the recommended minimum size of 10 km² (Green et al., 2007). During the Third Scientific Design Workshop in Kimbe Bay in July 2006 the scientific design of the Kimbe Bay MPA network was produced (Green et al., 2007).

The actual implementation of this network (i.e. the community based planning process) began after the design process was complete in 2006, and is likely to take five years to complete. While various members of the public were informed and involved along the way, the design process was not a
stakeholder driven process, but a scientific design process. The idea being 
that the AOI identified through the design process would set the direction of 
where to work with communities to begin to implement the design (personal 
communication Richard Hamilton, TNC).

A2.6.4  
Socio-economic methodology

Overall approach

During the second step (high priority research) of the scientific design 
process, a socio-economic research team went to PNG between August 2005 
and February 2006 to gain information to aid the design and implementation 
of the Kimbe Bay MPA network and to give direction for future marine 
education and awareness campaigns for Kimbe Bay’s communities (this is the 
‘detailed socio-economic survey of six communities’ referred to in Table A3) 
(Koczberski et al. 2006). Prior to the study the socio-economic team made 
sure that local people were aware of their arrival and the program of meetings 
through radio broadcasts. In each village an initial community meeting was 
held to inform local people of the aims of the study, solicit their main views 
and concerns regarding the marine environment of the village and to confirm 
their willingness to participate in the research. Two surveys of households 
were then undertaken. The first was conducted in 40 randomly selected 
households in each of the six villages and gathered information on:

- Household economic and demographic characteristics,
- Cash incomes from marine resources, and
- Subsistence production and household consumption of marine resources.

Following the completion of this first survey, a second was conducted 
amongst a 10-household subset of the original based on their reliance on 
marine and terrestrial resources. This aimed to gain an understanding of the 
factors influencing the day-to-day decisions involved in marine activities and 
to collect data on recent utilisation of marine resources (for sale and 
consumption). More qualitative information was gained on issues such as 
perceptions of marine habitats and resources, rights to marine resources, 
management issues and local knowledge on conservation issues through 
informal interviews with family members, both men and women. Two focus 
groups by the male and female research teams were also held in each village 
which gathered information on:

- Local marine conservation and management practices,
- Changes in the abundance and size of commonly utilised marine 
resources,
- Marine resource use conflicts,
- Perceptions of marine habitats, changes in the marine environment 
through time, including qualitative assessments of the extent of 
environmental change, and
- Customary marine tenure and marine cultural heritage.
Most of the survey data were entered into Microsoft Excel spreadsheets, from which tables and graphs were generated, to enable this information and knowledge to be incorporated into the MPA design and implementation process (Koczberski et al. 2006).

Following on from these community surveys it was ultimately decided that the most effective strategy was to engage communities after the design process had been completed (i.e. 2006 onwards). This was due to a number of reasons, including (Green et al. 2007):

- The large number of culturally diverse communities in the local area (over 100),
- The complex and overlapping traditional rights to sea resources held by many of the communities, and the potentially high costs associated with capturing these
- Communities tend to focus on the areas they own immediately around their communities and would be motivated by a perceived benefit to include their areas in the MPA network

However, whilst a full community engagement process was not undertaken, several steps were taken to understand and incorporate the needs and interests of communities, as far as practicable, within the scientific design process. Considerable informal community engagement took place whilst field staff collected biological data for the design process. For example, field staff recorded special areas that communities expressed an interest in protecting. The information gained in the six socio-economic community studies provided valuable background information on the variety of socio-economic situations in the Bay (Green et al. 2007).

The first scientific workshop was attended by TNC staff, scientists with expertise in biological, physical and social sciences, local conservation organisations and representatives of local communities, government agencies and industries. During this workshop, the general design principles, objectives and targets were agreed, target species and habitats identified, and general boundaries defined. In addition to the numerous biophysical design principles, the following socio-economic design principles, which were specifically aimed at maximising benefits and minimising costs to local communities and sustainable industries, were agreed upon (Green et al. 2007):

General
- Recognise and respect local resource owners and customary marine tenure systems,
- Recognise that local communities are the decision makers and custodians over marine resources,
- Understand and incorporate local knowledge and traditional fisheries management and conservation practices,
- Minimise negative impacts on existing livelihood strategies,
- Protect areas of cultural importance to traditional owners,
Ensure costs and benefits are fairly distributed within and between communities,
Minimise conflicting uses, such as tourism and extractive use, and
Consider current and future population trends and changing resource use.

**Fisheries**
- Ensure MPA supports sustainable subsistence and artisanal fisheries for local communities by recognising diverse livelihood strategies, and spatial and temporal variations in resource use and value,
- Consider costs and benefits to local communities (and sustainable industries) in management of commercial fisheries,
- Conserve marine resources which local communities identify as important to their livelihood,
- Conserve marine resources for local communities by prohibiting destructive fishing methods, and
- Conserve marine resources for local communities by prohibiting unsustainable commercial fisheries, particularly the live reef food fish trade and other fisheries for species particularly vulnerable to overexploitation (sharks and rays).

**Nature Based Tourism**
- Protect high priority tourism sites from conflicting (extractive or destructive) uses.

**Shipping**
- Accommodate existing shipping infrastructure (wharves, channels) in MPA design (avoid placing highly protected areas in the vicinity of these areas).

Once priority areas for conservation had been identified through the design process, the TNC initiated a community-based planning process in 2006, whereby staff sought to work with the communities that own and manage marine resources within these areas (Green *et al.*, 2009).

This community based planning system comprises of six steps:

- Community engagement to introduce the concept of the MPA Network and the planning process to the communities,
- Community visioning to develop consensus within communities regarding a realistic vision for managing their marine resources, and to identify boundaries for Locally Managed Marine Areas (LMMA),
- Participatory conservation planning to identify biological or ecological systems that represent community priorities, and refine this information based on community knowledge,
- Community development of an LMMA plan and agreement to help the community achieve their vision for the management of their area in the long term,
- Preparation of a draft LMMA plan and agreement, and
- Stakeholder consultation and finalisation of an LMMA plan (Lipsett-Moore, 2006).
As previously mentioned, by 2009, plans of management and agreement had been signed for two of the 14 areas, and negotiations for six others were under way (Green et al., 2009).

**Objectives of using socio-economic data, and success in achieving these**

The PNG constitution recognises indigenous Papua New Guineans own land and sea resources, and also own user rights in areas where the state owns the sea on behalf of the people. Land and sea resources are generally communally owned by families, sub-clans, clans or communities. It is therefore critically important to engage communities in all conservation and resource management activities in order to successfully implement conservation and management strategies. This is especially the case as coastal village communities rely on both land and marine resources to meet their everyday subsistence and cash income needs, and much of their cultural identity, beliefs, and ancestral stories are drawn from elements of the marine environment. Despite a decreasing reliance on a subsistence-based economy, fish and shellfish remain major dietary items for coastal communities (Koczberski et al., 2006). Approximately 100,000 people live in the Kimbe Bay watershed, which has a relatively high population density (around 130 persons/km) (Hanson et al., 2001). Many local communities are aware that the resulting growing pressures are having detrimental effects on the marine ecosystems in Kimbe Bay, and are receptive to ideas of how to better manage their marine resources. Koczberski et al. (2006) reported that throughout all of the villages they surveyed, there was a common perception that there had been a reduction in the abundance of commonly harvested marine resources throughout the Bay, which communities attributed to the overexploitation of marine resources, the use of destructive fishing methods, and changes to marine habitats.

With regards to achieving the socio-economic objectives, Richard Hamilton (personal communication) stated that the TNC’s approach worked reasonably well for some areas where they had prior knowledge of the socio-political and cultural settings. However, the socio-economic data collection process was not as clearly developed or as intense as the collection of biodiversity data.

**A2.6.5 The use of data layers**

**The importance of using data layers**

Richard Hamilton (personal communication) noted that it was important to have economic datalayers derived for the MPA selection, but that these were of secondary importance to the biodiversity data. The intention of the scientific design process was to provide a blueprint (design) that could be used to 1) direct where to engage and 2) indicate what to seek to conserve in each AOI. The design should be seen as a ‘living’ document that directs the work. Richard acknowledged that the final Kimbe Bay MPA network may look different from the design, and that some of the AOIs might change.
**The key socio-economic datalayers developed**

According to Richard Hamilton (TNC, personal communication), the key socio-economic data layers, considering that nearly all land and sea is under customary ownership in the area, were:

- Community interest in conservation, and
- Communities’ ability to do effective community based conservation (which relates to a host of factors like existence of robust tenure systems, traditional governance, poverty, etc).

As outlined in Table A3, MarXan was used during the scientific design process in order to aid the identification of the broad AOI. Green *et al.* (2007) stated that it ‘provided an excellent tool for processing the enormous amount of information used in this analysis’ - 32,834 planning units (consisting of hexagons), 51 conservation targets, 51 goals (percentage of targets to be protected), and 10 socio-economic values. A ‘total cost’ layer was developed for MarXan, which was derived from 15 data layers (see Figure A8). High cost areas were those in or adjacent to ports and shipping channels, major towns and large river mouths with industry (i.e. areas where it would be expensive to protect and manage an area). Low cost areas were places where there was strong community interest in conservation, areas that already receive some degree of protection, and conservation areas recommended by rapid ecological assessments. The TNC team furthermore included fish spawning sites because local communities recognise the need to manage these critical areas. Each of the threats and opportunities was mapped spatially, and assigned a numerical value that represented their relative importance (see Figure A8). Negative values (low cost) were assigned to those layers considered to be positive for conservation, and positive values (high cost) to those layers considered to be negative for conservation. MarXan would then tend to avoid negative areas and preferentially select positive areas. Values were summed across all cost layers to provide a total cost for each MarXan hexagon. Economic costs commonly used in systematic conservation planning exercises (e.g. foregone revenue) were not used because they were not available at the required resolution and TNC staff considered other factors to be more important indicators of conservation success (Green *et al.*, 2009).
Figure A8: Cost surface showing relative costs assigned to each layer (Source: Green et al., 2009).

It should be noted that during the ongoing community planning process, TNC staff used MarXan to see how negotiated changes in AOI extent affect the meeting of conservation targets (Richard Hamilton, personal communication).

Data formats

In early 2006, once research had been completed, the best available information was digitised into GIS layers, where possible, for spatial data analysis. Socio-economic information and conservation targets were included in primary layers of information. When processing was complete the second scientific workshop was held to review and refine the data layers and to identify and address additional information requirements (Richard Hamilton, personal communication). Important information that could not be represented spatially was also recorded so it could be taken into account manually during the design process (Green et al., 2007).

Taking future patterns of use/activities into account

Proposed mining areas were avoided (Richard Hamilton, personal communication).

Taking account of the relative economic and social value of different activities

Limited information could be obtained on this aspect. However, Section A2.6.5 above (see ‘The key socio-economic data layers developed’) and
Figure A8 describe how ‘high’ relative costs were assigned to areas in or adjacent to ports, shipping channels, major towns and areas with industry.

The inclusion of MPA compatible activities

No information could be obtained on this aspect.

Ensuring datalayers do not become obsolete

No information could be obtained on this aspect

The impact of MPA creation on the identified socio-economic elements

According to Richard Hamilton (personal communication), the impacts vary by region. Some of the interest in MPA development is related to the use of MPAs as a resource management tool (in recognition of some resource declines) and also as a way of reinserting traditional ownership.

A2.7 Finding Sanctuary – An English MPA Project

A2.7.1 Background information

Finding Sanctuary was established in 2005 and started out as a pilot Marine Conservation Zone (MCZ) project for the South West. It initially had no formal mandate, but is now part of the national process for identifying MPAs (des Clerfs et al., 2008). The project is still laying the groundwork for ultimately undertaking a site selection process for MPAs in the South West of England by 2012 (Finding Sanctuary, 2009). Within this case study, information is provided on regional data collection, but not on the process of MCZ network identification (as this has not yet started).

A2.7.2 Main objectives and conservation measures

Please refer to Section 1 of the main report for a description of the main aims and objectives of the English MCZ process, which also apply to the Finding Sanctuary project. Conservation measures have yet to be decided, it is however likely that the MPAs will be zoned (Finding Sanctuary, 2009).

A2.7.3 Site selection process

The Project Partnership was established in 2004 and forms the Project Board. It consists of national regulators and advisors, nature conservation NGOs and relevant County Councils, and is responsible for managing the project (des Clerfs et al., 2008).

The responsibility for designing the MPA network will lie with the stakeholder representatives on the Steering Group, which was set up in September 2007. It brings together representatives of the 15 main regional marine stakeholder sectors, including commercial fishing, recreation, tourism, renewable energy development, science and conservation. The Steering Group will take an
active role in designing the regional network of MPAs, supported by design guidelines produced by national policymakers and the National Science Advisory Panel (NSAP), and a regional profile of information collated by the project team. The NSAP, whilst not strictly speaking a component of the Finding Sanctuary project itself, is a component of the project because its role and outputs will play an important part within the planning process. The NSAP will bring together independent scientists to provide scientific advice and guidance to the MCZ planning process for the duration of the planning. Initially, the NSAP will be tasked with advising policymakers on design guidelines, which will be produced to guide the planning towards a national network that achieves basic ecological criteria (des Clers et al., 2008). It has not yet been agreed how socio-economic advice will be provided (personal communication, anon. reviewer).

The Finding Sanctuary Project Team provides the necessary support for the Steering Group to be able to carry out its functions in planning the MPA network. The team provides the information base for planning, including mapping stakeholders’ knowledge, developing a fair/transparent planning process, and providing technical support tools. Further to that, it is the project team’s responsibility to provide communication and outreach to the wider public and stakeholder community. The team consists of stakeholder liaison officers, GIS and data analysts, a communications officer and a project manager; volunteers and paid contractors have taken on specific tasks (des Clers et al., 2008).

No figure outlining the process has been provided here as the initiative is still developing but it is likely to reflect the process outlined for the UK MCZ process as illustrated in Figure 1 in Section 2 of the main report.

**A2.7.4 Socio-economic methodology**

*Overall approach*

The Finding Sanctuary Project Team is currently in the process of drawing together information for a regional profile, essentially a folder full of maps and information. This will include extensive spatial information on biodiversity/the environment, as well as on the socio-economics of the area. The latter will include information on the distribution of human activities at sea, the relative intensity of use, and the relative value of different sea areas to different sectors (where such information is available) (des Clers et al., 2008).

For the purpose of informing the stakeholder group once the process is underway, other existing spatial data on human activities at sea will also be collated on a regional level. As the existing spatial data describing human activities at sea was found to be patchy and coarse, a regional data collection exercise was initiated under the auspices of the FisherMap project; two data layers resulted from this project, which concluded at the end of 2008 (des Clers et al., 2008). These data layers will be two amongst the many that will be used in the network design (personal communication, anon. reviewer).
Objectives of using socio-economic data, and success in achieving these

With regards to the main socio-economic data collection exercise undertaken to date, FisherMap, this has been described as successful in two ways. Firstly, it has delivered a wealth of information which will underpin and improve MPA planning by Finding Sanctuary. The project has demonstrated not only the wealth and detail of local knowledge in existence, but also that it is possible to capture this knowledge in a rigorous and consistent manner and then create a GIS database capable of analysing spatial and temporal patterns of fishing activity at a regional scale. The level of detail and resolution of the data captured in this way far exceeds any other sort of fisheries information in existence (e.g. VMS data, landings), and therefore forms a valuable complement to existing information (des Clers et al., 2008). Secondly, it has provided a platform for constructive engagement with the fishing industry, which often tends to be sceptical about the value of MPAs. By approaching them at the outset, and asking them to contribute their own knowledge to the process, Finding Sanctuary has been able to provide a more neutral platform for engagement. Furthermore, the project was able to offer the fishing industry something in return for their contribution of knowledge, by making map outputs available to interview participants, so they themselves are able to better understand how fishing activities are distributed, how their own activities fit within a wider context of different activities and spatial scale, and to demonstrate that to others (des Clers et al., 2008).

A2.7.5 The use of datalayers

The importance of using datalayers

As proposals for MPAs have yet to be developed for this region, no information on this aspect was available.

The key socio-economic datalayers developed

As mentioned above, the existing spatial data describing human activities at sea was found to be patchy and coarse, and the FisherMap project was hence undertaken to map the nature and extent of fishing activities and fishermen’s knowledge of marine ecosystems. The FisherMap work was carried out through a process of representative interviews, during which a team of liaison officers asked individual fishers to draw the areas that they used on maps, and fill in a questionnaire on the nature of their activity, i.e. fishing methods and gear type used, species targeted, and months of the year when the activity was carried out. The information was entered into a database, and passed on to a GIS analyst, who digitised the data and linked it to the corresponding questionnaires. The data were subsequently validated through group validation meetings. An interactive webGIS tool was developed (Finding Sanctuary’s Web-GIS) to enable the project to reach out to a wider range and number of people, who are able to enter their knowledge remotely using an intuitive map interface on their computer, accompanied by an online questionnaire (des Clers et al., 2008). Although the FisherMap project is now complete, Finding Sanctuary will continue to map human
activity at sea, based on the methodology developed for FisherMap. The aim is to build up as complete a picture for South West England as possible, including areas which FisherMap was not able to cover, and also extending the work to other types of human activity (such as recreational sea angling, water sports, and others) (des Clers et al., 2008). Finding Sanctuary is currently in the process of conducting interviews with recreational stakeholder groups (specifically: divers, sea anglers, charter boat owners, watersport enthusiasts and wildlife enthusiasts) in order to obtain spatial activity information. This work package has been termed 'StakMap'; its methodology is similar to that used for professional fishermen, although stakeholder validation may differ (personal communication Shaun Lewin, Finding Sanctuary).

FisherMap data layers include (des Clers et al., 2008):

- Maps showing the relative density of fishing effort across the region for different fisheries/gear types, alongside information about their seasonality. Gears were split into two broad categories, static and mobile, depending on whether the gear moves across the seabed or water column, or not. Pots, nets and lines were all considered to be static gear, while trawls and dredges were considered mobile gear. Mobile gears were further grouped into pelagic and demersal, depending on their distance from the seabed.

- Maps showing the fishing grounds of different size vessels according to home port. This was split into inshore (vessels under 12m) and coastal fleet (vessels from 12 to 20m). The following fisheries were considered: shellfish, molluscs, flatfish, sharks and rays, bass, cod, mackerel, monkfish, congers, and line bait.

Data formats

With regards to FisherMap, information was entered into the database through three major routes: Spatial data drawn on acetates during the course of an interview, spatial data drawn onto paper maps during a validation meeting and non-spatial data collected on the questionnaire during an individual interview. The spatial data were transferred onto a GIS using a large format digitising table and ESRI ArcGIS (des Clers et al., 2008).

Taking future patterns of use/activities into account

As proposals for MPAs have yet to be developed for this region, no information on this aspect was available.

Taking account of the relative economic and social value of different activities

As proposals for MPAs have yet to be developed for this region, no information on this aspect was available.
The inclusion of MPA-compatible activities

As proposals for MPAs have yet to be developed for this region, no information on this aspect was available.

Ensuring datalayers do not become obsolete

As proposals for MPAs have yet to be developed for this region, no information on this aspect was available.

The impact of MPA creation on the identified socio-economic elements

As proposals for MPAs have yet to be developed for this region, no information on this aspect was available.

The following case studies are ‘partial’ case studies, due to the fact that either socio-economics did not appear to play a major or formal role in the planning of MPA networks or because they were academic data collection exercises rather than a practical MPA process. However, they have been included as relevant examples of how socio-economic factors have been taken into account, to varying degrees, in such processes.

A2.8 Grays Reef National Marine Sanctuary – Research-Only MPA

In 2004, the NOAA initiated a four-year process which aimed at establishing a research-only MPA within the existing Grays Reef National Marine Sanctuary. The sanctuary is located some 32km off the coast of the US state of Georgia and measures 60km². It consists of reef communities, limestone ledges, flat hard bottoms and sand plains. A research-only MPA was desired in order to enable controlled scientific studies in the absence of confounding factors such as recreational or commercial fishing. This also encompassed the prohibition of any extractive activities and limits/controls to boat entry. In order to advise the Sanctuary Advisory Council, a Research Area Working Group (RAWG) was set up in 2004, consisting of commercial, scientific, conservation and management/enforcement stakeholders. Three siting criteria were developed for the research area, with criteria (1) and (2) taking precedence over (3): (1) Maximize protection of limestone ledges (approx. 20% of all); (2) Include all bottom types; (3) Minimize user displacement (i.e. avoid socio-economic impacts/favoured fishing areas). Designation is expected for 2009 (Ehler, 2009).

As existing software tools were focused on the identification of MPA networks, rather than one single MPA, a dedicated GIS tool was developed which adopted a ‘sliding windows’ approach (Kendall and Eschelbach, 2006). This approach systematically considered placement of the various boundary configurations throughout the entire sanctuary. The sliding window was drawn at a size considered to be the minimum requirement for the research-only area. The window was moved around the larger ‘Study Area’ and alternatives were developed that meet all the criteria developed by scientists. This process used the computer to develop thousands of alternatives.
Amongst the resulting alternatives, the RAWG then selected those (six) with the lowest activity impacted and assessed their socio-economic impact (Bob Leeworthy, personal communication). For each scenario, ‘person days’ of use were estimated based on boat location data. Their economic contribution was approximated using recreational fishery statistics. It was assumed that all economic value associated with the areas that were closed would be lost (with no mitigation, hence the estimated impacts were thought of as ‘maximum potential losses’). The final option selected had the lowest impact of any other alternative analyzed (maximum potential loss of state-wide (Georgia) saltwater recreational fishing expenditures of 0.11%) (Ehler, 2009).

With respect to input data, four categories of variables were collected, specifically data on: (1) the amount and diversity of ledge habitat, (2) the amount of all other bottom types, (3) the number of research sites, and (4) the amount of bottom fishing effort (as the aim was to protect bottom habitats) (Ehler, 2009). (4) included averaged boat count data compiled from multiple sources including national reconnaissance systems, boat location data and the results of a recently completed NOAA survey of marine debris/snagged fishing gear (Kendall and Eschelbach, 2006). Bob Leeworthy (NOAA) feels that this process was successful in building a cooperative management relationship with all user groups (i.e. NGOs, universities and recreational fishermen (Ehler, 2009)) and gathering all the necessary information to conduct analyses required in the NOAA’s administrative process to finalize the regulations. The NOAA thus expects high compliance and low enforcement costs.

A2.9 South African MPAs

The intention to designate five new MPAs to complement and consolidate South Africa’s existing marine and coastal conservation areas was announced in February 2004; the public then had 90 days to comment. The proclamation of the MPAs followed in June 2004; the MPAs are: the Aliwal Shoal (adjacent to Umkomaas, KwaZulu-Natal), the coastal and marine environment adjacent to the Pondoland (Eastern Cape), Bird Island (Algoa Bay), Cape Peninsula (Western Cape) and Namaqualand (Northern Cape). The five proposed MPAs will result in 19% of South Africa’s coastline falling within protected areas.

The aims of this MPA process were as follows:

- Protect the marine environment and the marine biodiversity;
- Allow overexploited and commercially collapsed species of fish stocks a sanctuary in which to recover and breed; and
- Promote and regulate tourist-related activities, other commercial activities and scientific research in a way that does not adversely affect the marine environment and biodiversity.

Hence, the MPAs regulate rather than prohibit recreational activities such as diving. Aliwal Shoal has been a site of great conflict in the past between user groups. Agreements were reached with respect to partitioning of use between
fishing, diving and spear-fishing. The MPA will serve many functions, including the conservation of the unique reef fauna, control of user-conflict and the development of a world-renowned diving site. In the Pondoland MPA (covering 1300 km²), linefish and shellfish exploitation is permitted in some areas. The Cape Peninsula MPA will include six areas (not making up the majority of the MPA) that are closed to fishing and diving (abalone, rock lobster, linefish) (Schalkwyk, 2004).

Limited information was available as to how the design process for these zoned MPAs took account of socio-economic factors, and no information could be obtained on data layers (despite repeated attempts at making contact). The indication however is that public concerns were taken on board during a top-down MPA process. Consequently, original proposals were altered to a seemingly limited extent; some zone boundaries were adjusted and some uses permitted. For example, in the Table Mountain National Park MPA, the boundaries of the Cape of Good Hope Sanctuary were changed to accommodate small-scale rock lobster fishermen. A concession was also made for snoek fishermen off Llundudno. After receiving many comments and objections to the permitting of access to recreational divers, this requirement was only adopted for Restricted zones in the case of Table Mountain National Park. (Schalkwyk, 2004)

A2.10 The Balance Project (Baltic Sea)

The European Union (EU) co-funded Balance project (‘Baltic Sea Management – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning’) strove to develop informed marine management tools for the Baltic Sea based on spatial planning and cross-sectoral and transnational co-operation. In doing so, it aimed to introduce a regional, systematic, transparent and ecologically based approach to select and protect a representative network of sites in the Baltic Sea. It had been found that whilst a systematic approach to site selection had been recommended by conservation experts, this had been lacking in the Baltic Sea region, where the designation process had been very slow and often done on an ad-hoc basis. It represents a theoretical approach and socio-economic factors were not considered in great detail. A GIS tool was developed to incorporate abiotic, biological and socio-economic data. The latter included the following marine data layers only: hard structures (buildings, harbours/marinas, pier), shipping lanes and boat/ferry routes. The proposed approach advocated tailored stakeholder engagement (e.g. different spatial scales), and the development of GIS-based information material for public information, adapted to the target groups. Adaptive maps were to be used as discussion and decision-making tool (Ekebom et al., 2008).

A2.11 The EMPAfish Project (European MPAs)

The EU co-funded EMPAFISH project (European Marine Protected Areas as tools for Fisheries management and conservation) largely focussed on investigating the impacts of existing MPAs (funded under the auspices of the specific programme ‘integrating and strengthening the European Research
Two reports were published when the project finished in 2008, focusing on the following aspects of implemented MPAs: 1) ecological effects, and 2) fishery regimes (i.e. evaluation of fishery effects of MPAs, including the impact of different management regimes on population parameters). Furthermore, a literature review investigating the economic analysis of MPAs was produced; this firstly described socio-economic literature dedicated to various aspects of MPAs (ecosystem preservation, fisheries management, recreational activities and distributional consequences), and secondly investigated methodological issues, such as cost-benefit analysis and the valuation of non-market values (see EMPAFISH website - http://www.um.es/empafish/).

A2.12 The Belgium GAUFRE project

This national project (GAUFRE stands for ‘Towards a Spatial Structure Plan for Sustainable Management of the Sea’), was led by university and consultancy research teams (three teams from the University of Gent, and one from an environmental consulting group).

The main aim of the project was the delivery and synthesis of scientific knowledge on the use and possible impacts of different activities in order to formulate a first proposal of possible optimal allocations of all relevant use functions in the Belgian North Sea zone in the framework of its sustainable management. It was divided into three main steps:

- The making of an accessible and scientific knowledge module
- The making of impact maps
- A first proposal for optimal allocation

It collected scientific knowledge about the uses of the Belgian North Sea and their possible effects.

In order to aid this process, previously collected spatial information was collated from a plethora of sources on human activities, biological resources and ecosystems in the Belgian sector of the North Sea. This was input into a GIS tool and transformed into simplifying structural maps (which illustrate the spatial structure of an area, for example showing the location of major infrastructure, activity zones and sandbanks in relation to each other, in a schematic form). These structural maps were described as ‘not geographically accurate down to the last detail’, but they ‘illustrate specifically chosen information so that planners and policy makers can easily handle the information’ (Maes et al, 2005). Structural maps were created for the following socio-economic aspects: shipping, fisheries, aquaculture, coastal defence, tourism and recreation, sand and gravel extraction, dredging, energy production, nature protection, cables and pipelines, wrecks, off-shore bunkering, and military use.

During the course of the project, two workshops were organised. One workshop involved international experts and another dealt with stakeholders that were directly involved as ‘actors’ in the process (both policy makers and
the public). Local ecological and use knowledge described at the latter workshop provided important information on values for which extant spatial information was found to be lacking (including recreational uses and cultural associations). This workshop also highlighted areas of conflicts between stakeholders.

Following the workshops, six scenarios were then developed for the Belgium marine zone. These were based on three key values (the value of well-being, ecological and landscape value, and economic value), the relative dominance of which had earlier been identified as determining each use within the North Sea. Three of the scenarios strongly focussed on one of the key values (‘the Relaxed Sea’, ‘the Natural Sea’, ‘the Rich Sea’), the other three (‘the Playful Sea’, ‘the Mobile Sea’, ‘the Sailing Sea’) scenarios were based on crossovers between two of the key values. Lastly, a single (‘best’) vision and spatial plan was formulated based on the differing scenarios (Maes et al., 2005).

A2.13 Establishment of UK Marine Environmental High Risk Areas (MEHRAs)

In 2006, the UK Department of Transport (DfT) announced 32 locations around the UK coast that had been identified as Marine Environmental High Risk Areas (MEHRAs). These are areas of high environmental sensitivity, which are also at risk from shipping. Their primary purpose was ‘... to inform [ships’] Masters of areas where there is a real prospect of a problem arising. This prime purpose stands alone and regardless of any consequential defensive measures’. MEHRAs are to be marked on Admiralty charts, as an encouragement to mariners to take extra care in those areas. They are, essentially, an aid to passage planning (DfT, 2006).

For the purposes of identifying the MEHRAs, the UK coast and proximate sea areas were divided up into a large number of cells on a chart. Two parallel exercises were then carried out (DfT, 2006):
(a) One exercise identified the shipping risk to which each cell was subject, taking into account ship routeing data, size and type of vessel, traffic density and analysis of past accidents resulting in pollution from ships (such as collisions, groundings and fires). A model was then created to combine this information and generate a measure of the risk per cell, taking into account the potential for an oil spill to drift from sea to shore.
(b) The second exercise identified the environmental sensitivity of each cell, taking into account a number of different criteria, predominantly of an ecological and scientific nature. In particular, the sensitivity exercise took account of the statutory designations which were in place in each cell. The environmental sensitivity of each cell was scored on the basis of the number of such sites in each cell and their sensitivity to marine pollution.

The two sets of data for each cell - shipping risk and environmental sensitivity - were then brought together to produce an overall ranking. The cells which were eventually identified as MEHRAs were those which manifested a combination of both high sensitivity and a high level of shipping pollution risk. They represent approximately 9% of the UK coastline. The main emphasis
for the exercise has been on coastal areas, since most of the available data related to coastal areas, rather than areas ‘at sea’ (DfT, 2006).

**A2.14 German Integrated Coastal Zone Management (ICZM) Project**

In order to aid the development of a national Integrated Coastal Zone Management (ICZM) strategy, Germany undertook a 3-year stocktaking exercise between 2003 and 2006. A national strategy was published in 2006, having been largely developed in a top-down manner, with stakeholders consulted at two one-day workshops in 2005. The stocktaking exercise incorporated an assessment of the economic, social and ecological situation of the German coastal zones as well as of the legal, political and administrative structures and institutions that have an influence on the conditional framework for taking action in the coastal regions (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), 2006).

A myriad of extant socio-economic information was collected, including data on the following existing activities: shipping, port management, industry, overland transport infrastructure, oil and natural gas production, renewable energies, transmission routes, sand and gravel extraction, fishing and mariculture, agriculture, tourism, coastal protection, maritime traffic regulations, sediment management, waste management, defence, settlement and regional development, protected areas, preservation of the cultural heritage, regional planning levels and tools, nongovernmental organizations, education and science, monitoring in the coastal region. The status quo as well as the development prospects and central strategies were then briefly characterized for each of these activities. After providing a summary of the respective governing legal frameworks, the economic, ecological and social relevance of the activities above was outlined. On this basis the main interactions and conflicts with other activities and actors in the coastal region were identified. Then, the current state of the environment was described; the following factors were identified as the main stressors: intensive fishing, inputs of contaminants and nutrients, environmental risks and pollution due to maritime shipping. Changing problems and varying risk potentials were identified for the input of nutrients and contaminants. In addition, likely future biodiversity developments for various areas and species were investigated for both the North and Baltic Sea areas (BMU, 2006).

A national ICZM strategy was consequently ratified in 2006. It is viewed as an informal aide to good integration, coordination, communication and participation in order to support the sustainable development of the coastal zone. It is not understood to be a stand alone planning and decision making instrument, but is to guide planners when using existing instruments (due to the subsidiary principle, many decisions related to the coastal zones are made at the federal state level, not the national level) (BMU, 2006).
A2.15 Water Framework Directive - Assessment of Disproportionate Cost

The EC Water Framework Directive (WFD) (2000/60/EC) provides a framework for setting environmental objectives for surface and groundwaters and implementing actions to achieve those objectives where appropriate. As part of the sustainable development provisions of the Directive, less stringent environmental objectives may be proposed where achievement of the Directive’s default objectives is assessed as being disproportionately costly. To support application of the Directive in the UK, Jacobs (2007) proposed an approach that could be used to do this, described as ‘Disproportionate Cost Assessment’ (DCA).

While the approach is focused on the specific circumstances of the WFD, it nevertheless provides some useful principles in seeking to make use of information on the costs and benefits of actions to achieve environmental objectives within a wider decision-making context.

In particular, the guidance emphasises:

- Analysis should be undertaken using the minimum amount of evidence (i.e. lowest level of detail) required to make a decision within acceptable limits of risk and uncertainty;
- The initial focus should be on collecting readily available information only – this may be a mix of qualitative, quantitative and monetary information;
- The assessment should take account of both the costs of implementing measures but also the benefits of achieving WFD objectives;
- The uncertainty associated with the assessment process (and particularly in relation to non-use values) must be recognised. It will be necessary to make judgements about whether uncertainty affects the assessments to a sufficient extent that the collection of more evidence is justified.

A2.16 Sustainability Appraisal

A2.16.1 Introduction

Sustainability appraisal (SA) is a formal process introduced under the Planning and Compulsory Purchase Act 2004. It seeks to promote sustainable development through the integration of social, environmental and economic considerations into the preparation of revisions of Regional Spatial Strategies (RSS) and for new or revised Development Plan Documents (DPDs) and Supplementary Planning Documents (SPDs). SA also incorporates the requirements for Strategic Environmental Assessment (SEA). Guidance on the use of SA by Regional Planning Bodies and Local Planning Authorities has been published by the Office of the Deputy Prime Minister (ODPM, 2005).

The process comprises 5 main stages which broadly mirror the stages involved in SEA as follows (see also Figure A9):
• Stage A: Setting the context and objectives, establishing the baseline and deciding on the scope:
  o A1: Identifying other relevant policies, plans, programmes and sustainability objectives.
  o A2: Collecting baseline information.
  o A3: Identifying sustainability issues and problems.
  o A4: Developing the SA framework.
  o A5: Consulting on the scope of the SA.
• Stage B: Developing and refining options and assessing effects
  o B1: Testing the plan objectives against the SA framework.
  o B2: Developing the plan options.
  o B3: Predicting the effects of the plan.
  o B4: Evaluating the effects of the plan.
  o B5: Considering ways of mitigating adverse effects and maximising beneficial effects.
  o B6: Proposing measures to monitor the significant effects of implementing the plan.
• Stage C: Preparing the SA Report
  o C1: Preparing the SA Report.
• Stage D: Consulting on the draft plan and the SA Report
  o D1: Consulting on the draft plan and SA Report.
  o D2: Appraising significant changes.
  o D3: Decision-making and providing information.
• Stage E: Monitoring the significant effects of implementing the plan
  o E1: Finalising aims and methods for monitoring.
  o E2: Responding to adverse effects.

Stages A and B provide the main basis for the appraisal process. Relevant elements of these stages are discussed in more detail below. The practical application of these stages is illustrated using a case study (SA of revisions to Yorkshire & Humberside Regional Spatial Strategy (Y&H RSS) (Levett-Therivel Sustainability Consultants and EDAW, 2005).
A2.16.2 Stage A

Identifying other relevant policies, plans, programmes and sustainability objectives
Identifying relationships with relevant policies, plans, programmes, and sustainability objectives helps:

- To identify any external social, environmental or economic objectives that should be taken into account in the SA of the plan;
- To identify other external factors, including sustainability issues that might influence the preparation of the plan; and
- To determine whether other policies, plans and programmes might give rise to cumulative effects when combined with the plan that is subject to the SA.

For the Y&H RSS SA, a wide range of international, national and regional policies, plans, programmes and environmental protection objectives reviewed and summarised in tabular form against the following headings:

- Document title
- Relevant objectives
- Relevant targets and indicators
- Implications for RSS

The collation of this information was important in supporting the development of the appraisal framework in task A4.

Collecting baseline information

SA draws on a potentially wide range of social, economic and environmental data. For the Y&H RSS SA, much of the required information was available from Yorkshire Futures and Yorkshire and Humber Environment Hub.

The SA guidance (ODPM, 2005) recognises that it is not possible to be prescriptive about information requirements. Both quantitative and qualitative information can be helpful. However, it is useful to obtain quantified information where possible in relation to key indicators and for comparison (e.g. against national averages). Information on trends helps analysis against the ‘do nothing’ option. Identification of key information gaps early in the process can assist the prioritisation of new data collection.

Identifying sustainability issues and problems.

The identification of sustainability issues (including environmental problems as required by the SEA Directive) is an opportunity to define key issues for the plan and to develop sustainable objectives and options.

Key sustainability issues and problems for the Y&H RSS SA were identified early in the SA/SEA process, both from the baseline data and through consultation with a range of stakeholders. These issues/problems helped to focus the assessment stage (Stage B) of the evolving draft RSS. An example of an identified issue is presented in Figure A10.
Developing the Plan Framework

The SA framework provides a way in which sustainability effects can be described, analysed and compared. It is central to the SA process. The framework consists of sustainability objectives which, where practicable, may be expressed in the form of targets, the achievement of which is measured using indicators.

Sustainability objectives are distinct from the objectives of the plan, though they may in some cases overlap with them. They provide a way of checking whether plan objectives are the best possible ones for sustainability and can be seen as a methodological yardstick against which the social, environmental and economic effects of the plan can be tested. The number of sustainability objectives, indicators and targets needs to be manageable and developed with input from relevant stakeholders.

For the Y&H RSS SA, the sustainability objectives were derived from the Regional Sustainable Development Framework and included 15 headline objectives supported by a series of more detailed appraisal questions:

1. Good quality employment opportunities available to all
2. Conditions for business success, economic growth & investment
3. Education & training opportunities which build the skills & capacity of the population
4. Conditions & services to engender good health
5. Safety & security for people & property
6. Vibrant communities which participate in decision making
7. Culture, leisure & recreation activities to all
8. Local needs met locally
9. A transport network which maximises access whilst minimising detrimental impacts
10. A quality built environment & efficient land use patterns, that make good use of derelict sites, minimise travel & promote balanced development
11. Quality housing available to everyone
12. Bio-diverse & attractive natural environment
13. Minimal pollution levels. If environmental impacts are a significant result of the activity consider an EIA
14. Minimise greenhouse gas emissions & a managed response to the effects of climate change. If environmental impacts are a significant result of the activity consider EIA
15. Prudent & efficient use of energy and natural resources with minimal production of waste:
   (i) Social inclusion & equity across all sectors
   (ii) A partnership & participative approach
   (iii) Geographic adaptation to the needs of rural & urban communities
   (iv) Creativity, innovation & the appropriate use of technology
   (v) Global sustainability

A2.16.3 Stage B

B1 Testing Plan Objectives

Testing the internal compatibility of SA objectives may be useful for identifying tensions between objectives that cannot be resolved: the compatibility assessment will clarify these so that subsequent decisions are well based, and mitigation or alternatives can be considered. Some objectives may be more important than others and it may be appropriate to give a rough ranking of objectives, or to highlight those which are judged to be particularly important to help focus the later stages of the SA.

An example of a compatibility matrix prepared for the Y&H RSS SA is presented in Figure A11 below.
B2: Developing Plan Options

In preparing plans, a large number of options may be generated. Generally it is appropriate to focus on broad strategic options are considered as opposed to detailed policy wording variants. Options need to be sufficiently distinct to highlight the different sustainability implications of each, so that meaningful comparisons can be made. The options need to be compared with each other and with the current social, environmental and economic characteristics of the plan area.

For the Y&H RSS SA three main scenarios were evaluated:

- Scenario A – responding to market forces emphasises market interest and particular regional strengths as the driving forces for future development and change – along the lines of a ‘growth poles’ approach.
- Scenario B – matching need with opportunity emphasises meeting needs – which could be social, economic or environmental.
- Scenario C – managing the environment as a key resource places more recognition on the significance of our environment to our future, including to our economic and social well-being.

The scenarios suggested different relative growth focuses between the sub-areas, and different ways in which development could take place in each sub-area.

B3: Predicting Effects

The purpose of this task is to predict the social, environmental and economic effects of the options being considered in the RSS revision process. The potential effects need to be quantified where appropriate, or a judgement made where this is not possible, with reference to the baseline situation. Prediction of effects involves:

- Identifying the changes to the sustainability baseline which are predicted to arise from the plan, including options. The predicted effects of options can be compared both with each other, with 'no plan' and/or 'business as usual' scenarios, and against the SA objectives; and
- Describing these changes in terms of their magnitude, their geographical scale, the time period over which they will occur, whether they are permanent or temporary, positive or negative, probable or improbable, frequent or rare, and whether or not there are secondary, cumulative and/or synergistic effects.

Predictions do not have to be expressed in quantitative terms. Hard data may enable detailed quantitative predictions to be made, and this can be particularly useful where a plan’s effects are uncertain, close to a threshold, or cumulative. However, quantification is not always practicable, and broad based and qualitative predictions can be equally valid and appropriate. In current practice, these are often expressed in easily understood terms such as ‘getting better or worse’ or a scale from ++ (very positive) to - - (very negative).

The SA Report must document any uncertainties or limitations in the information underlying both qualitative and quantitative predictions. Assumptions, for instance about underlying trends, should be clearly stated.

The revisions to the Y&H RSS were assessed using the sustainability appraisal criteria. Given the large scale and strategic nature of the draft RSS, and the uncertainties surrounding its implementation over 20 years, the assessment was qualitative (‘getting better’, ‘getting worse’) rather than quantitative.

B4: Evaluating the effects

Having identified and described the likely effects of the RSS, an evaluation of their
significance needs to be made. When forming a judgement on whether a predicted effect will be significant, assessors need to consider the probability, duration, frequency and reversibility of the effects, including secondary, cumulative and synergistic effects.

The magnitude and spatial extent of the effects (geographical area and size of the population likely to be affected) need to be considered. The value and vulnerability of certain areas and populations may also influence the appraisal, particularly where thresholds or standards may be exceeded.

ODPM (2005) identified the following principles in assessing the significance of effects:

- Significance has to be determined individually in each case. Effects which are significant in one situation are not necessarily significant in another;
- Analysis of significance needs to be proportionate, carried out in reasonable time, and effort expended to assess significance should be proportionate to the expected severity of the effect;
- Flexibility is important so that individual cases can be assessed. Criteria should be used as guidelines, not rules; and
- Mathematical models are difficult to use in determining significance. Many aspects can be covered by descriptions. The use of numeric models could give rise to fictitious precision. An attempt at quantifying qualitative and semi-quantitative aspects will not necessarily lead to an increase in objectivity.

The findings from the assessment of the revisions to the Y&H RSS were summarised in tabular form (see Figure A12). This provided a useful means of comparing the different scenarios and identifying areas where the sustainability of different scenarios might be improved. The outcome of the analysis significantly influenced the scenario on which the revisions to the RSS were based, with a greater emphasis placed on elements of Scenarios B and C rather than A.
Table 4.1 Summary of assessment, by RSS policy (see Table 1.5 for key)

<table>
<thead>
<tr>
<th>RSS policy:</th>
<th>4. Core strategic approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>YH1. Overall</td>
<td></td>
</tr>
<tr>
<td>YH2. Climate change</td>
<td></td>
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<tr>
<td>YH3. Spatial priority</td>
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<tr>
<td>YH4. Working together</td>
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<tr>
<td>YH5. Urban focus</td>
<td></td>
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<tr>
<td>YH6. Better towns</td>
<td></td>
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<tr>
<td>YH7. Rural/coastal</td>
<td></td>
</tr>
<tr>
<td>YH8. Location</td>
<td></td>
</tr>
<tr>
<td>YH9. Green Belts</td>
<td></td>
</tr>
</tbody>
</table>

Sub-areas

| 6. LCR1. Leeds |  |
| LCR2. Investment |  |
| 7. SY1. S Yorkshire |  |
| 8. NE1. Humberside |  |
| Y1. York |  |
| VT1. Wales/Teess |  |
| 11. C1. Coastal |  |
| 12. RR1. Rem. rural |  |
| 13. Holsway |  |
| H1. Provision/distrib. |  |
| H2. Failing markets |  |
| H3. Affordable hous. |  |
| H4. Mixed development |  |
| H5. Gypsies |  |

14. Economy

| E1. Regional economy |  |
| E2. Town centres |  |
| E3. Employm. land |  |
| E4. Priority sectors |  |
| E5. Safeguard |  |
| E6. Sustain. tourism |  |
| E7. Rural economy |  |

15. Environment

| Env1. Floods |  |
| Env2. Water resource |  |
| Env3. Water quality |  |
| Env4. Minerals |  |
| Env5. Energy |  |
| Env6. Forestry |  |
| Env7. Agriculture |  |
| Env8. Biodiversity |  |
| Env9. Cultural herit. |  |
| Env10. Landscape |  |
| Env11. Health rec |  |
| Env12. Waste object. |  |
| Env13. Waste facil. |  |
| Env14. Locational crit. |  |

16. Transport

| T1. Personal travel |  |
| T2. Parking policy |  |
| T3. Public transport |  |
| T4. Freight |  |
| T5. Transp. & tourism |  |
| T6. Airports |  |
| T7. Ports, waterways |  |
| T8. Rural transport |  |
| T9. Investment |  |

Total impact

| Generic comments provided |  |

Figure A12: Evaluation of Effects of Options (from Levett-Therival and EDAW, 2005)
SA provides a clear appraisal process and framework within which sustainability can be considered. It has been used successfully to assess many RSS and LPD’s. The framework can cope well with a variety of different types of information including both qualitative and quantitative data. It can encompass other types of appraisal such as Social Impact Assessment (SIA), Equality Impact Assessment, Integrated Impact Assessment or Health Impact Assessment. Assessment proportionate to issues under investigation.

SA is strongly linked to policy requirements objectives and targets and seeks to develop solutions that best meet a range of key criteria based around policy objectives and targets. It works well in focusing on the required direction for change.

The core principles of SA could usefully be applied to the Regional MCZ process. They include for example:

- Early engagement of stakeholders in defining the objectives of the process;
- A logical and rational process;
- Seeks to build consensus around a preferred option;
- Feedback – the assessment should inform and where necessary change the policy, plan or programme;
- Front loading planning – feeding ideas in early and testing them against the objective;
- Transparency about what happens to ideas fed in and taken forward;

However, SA requires sufficient clarity on policy requirements, objectives and targets to establish a clear framework. This may be problematic for the marine environment, particularly in advance of publication of the Marine Policy Statement. Difficulties have also been encountered in undertaking quantitative assessments due to the complexity of issues and lack of detailed data. The approach has a greater focus on policies rather than economic impacts and as such would need to be customised to fit the requirements of the MCZ project.
Appendix A References


California Department of Fish and Game (CDFG), 2008a. Fish and Game Commission Considering MPA Alternatives for Adoption in the North Central Coast [Online]. Available at: http://www.dfg.ca.gov/MLPA/regulatoryprocess.asp [Accessed 16/09/09]


Levett-Therivel Sustainability Consultants and EDAW, 2005. Sustainability appraisal (integrating strategic environmental assessment) of the Yorkshire and Humber draft RSS
20 December 2005


## Appendix A Interviewee Table

### Table: Contact log for full case studies

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Interviewee</th>
<th>Date</th>
<th>Further material/information provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Californian Marine Life Protection Act MPA network</td>
<td>Astrid Scholz, Ecotrust</td>
<td>01.04.2009</td>
<td>26.03, 18.09.2009 (verification &amp; comments)</td>
</tr>
<tr>
<td>Californian Channel Islands highly protected MPAs; Florida Tortugas highly protected MPAs; Grays Reef (USA)</td>
<td>Bob Leeworthy, NOAA</td>
<td>01.04.2009</td>
<td>26.03, 30.03, 22.09.2009 (verification &amp; comments)</td>
</tr>
<tr>
<td>Australian Southeast Marine Region Network</td>
<td>Several attempts (phone &amp; email) throughout April &amp; September 2009 to obtain comments from the Department of the Environment and Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canadian Gully Marine Protected Area (part of the ESSIM initiative)</td>
<td>Paul Macnab, DFO</td>
<td>09.04.2009</td>
<td>09.04, 25.09 (verification &amp; comments)</td>
</tr>
<tr>
<td>Papua New Guinea Kimbe Bay MPA network</td>
<td>Richard Hamilton, TNC</td>
<td>23.09.2009</td>
<td>23.09.2009 (provided written comments &amp; verified case study which had been written based on extant report/papers)</td>
</tr>
</tbody>
</table>
Appendix B. Review of Tools

B1 Intro

This appendix reviews the various tools, methods and approaches that have been applied or proposed for application in Marine Protected Area (MPA) planning processes that can be used to support the presentation and assessment of socio-economic factors. These range from simple techniques such as map overlays and spatial analysis through to the application of detailed cost-benefit assessment or multicriteria analysis frameworks. MPA planning processes are generally characterised by a reliance on simple tools in the early stages of network design with more detailed quantitative assessment carried out for refine options and preferred networks.

B2 Tools

B2.1 Spatial Analysis of Datalayers

All of the MPA planning case studies have made use of spatial analysis of datalayers indicating the presence, importance or economic value of socio-economic activities. Modern Geographical Information System (GIS) tools provide an environment within which spatial analysis can be undertaken rapidly and used to generate summary outputs. All the case studies confirmed that the use and analysis of datalayers was very important in identifying and evaluating potential conflicts. Spatial analysis has been undertaken in a number of different ways in the different case studies, with the complexity of the analysis reflecting the type and quality of spatial data available.

In simple cases, the datalayers have been used to provide simple map overlays to identify where socio-economic activities may overlap with possible MPA locations. Such information provides a powerful visual representation of possible conflicts between socio-economic activity and MPA objectives and provides a good basis for initial discussions amongst stakeholders. For example, in the Papua New Guinea (PNG) case study, a decision was made to avoid designating MPAs in locations close to urban areas to minimise possible conflicts with socio-economic objectives.

Where more detailed information has existed on socio-economic activities (beyond simply location), more advanced forms of spatial analysis have been undertaken. For example, in the Californian Marine Life Protection Act (MLPA) case study, where information was available on the stated importance and value of commercial fishing activities, a spatial analysis was carried out to estimate the potential relative impact of MPA proposals on fishing, based on assumptions about the compatibility of that activity with the MPA objectives.

Such spatial analyses can also be used to take account of specific weightings to be applied to different socio-economic activities. For example in the MLPA case study, there was a focus on commercial and recreational fisheries, which were treated as equally important by the stakeholders.
The relative importance of different socio-economic activities were not taken account of within the Canadian Gully designation process (personal communication with Paul Macnab, DFO). Similarly weighting was not used in any of the Great Barrier Reef Marine Park Authority (GBRMPA), Florida Tortugas or Californian Channel Islands planning processes. The only metric the United States (US) National Oceanic and Atmospheric Administration (NOAA) used that was comparable across different uses was the dollar metric but issues of distribution of impacts and equity/fairness were also important. The GBRMPA made a clear decision not to talk about weighting, as the planning principles stated that all information would be considered. Not ‘playing a numbers game’ was perceived as very important to stakeholders/members. Whilst an exclusion may not have an actual economic impact on a community, it may have a very big impact on their lifestyle/social aspects.

Where information is available on the pressures of a socio-economic activity and the intensity of those pressures, it would be possible to perform a spatial analysis to identify the spatial extent of the incompatibility of that activity with the conservation objectives of a site or series of sites. However, none of the case studies reviewed used explicit information on pressure or pressure intensity to inform spatial analysis, but simply made assumptions about compatibility. For example in the Tortugas and Channel Islands case studies, consumptive uses such as commercial fishing were considered to be incompatible with MPA objectives. In the Canadian Gully case study, a decision was made to allow certain types of fishing activity within the less restricted parts of the MPA.

B2.2 Cost Benefit Analysis

Cost Benefit Analysis (CBA) is a decision support method which aims to compare in monetary terms all the benefits and costs of a proposal (project, policy or programme) including impacts on non-market environmental goods and services. CBA is designed with two main questions in mind: determining whether an option is worth undertaking, via calculation of its Net Present Value (NPV) (i.e. does the value of the benefits outweigh the value of the costs?); and, where there are competing alternatives that have net benefits, ranking the alternatives in terms of their Internal Rates of Return (IRR) or NPV to address the question of which alternative provides the highest benefits per pound of cost. CBA is a well-established and widely-accepted method, but there are known difficulties in its use, and it can also be contentious due to rejection of the principle of ascribing monetary values to non-market impacts. The UK government has guidelines for public sector applications of CBA, including its use in Impact Assessment (IA), set out in the “Green Book” (HM Treasury, 2003).

CBA is essentially focused on identifying the most economically efficient option on the basis of comparing the aggregate costs and benefits. So long as benefits outweigh costs, CBA is not concerned who benefits and who loses. However, if there is the desire to address questions of ‘fairness’, CBA is in
fact capable of dealing with distributional impacts. Costs and benefits can be adjusted to normalise, say, the effect of income distribution. An income adjustment ratio (Ya/Yi) could be estimated, where Yi is the average income of social group i and Ya is the average income of the whole affected population (or the society as a whole as applicable). The ratio is larger than one for groups with lower than average incomes and multiplying this ratio with costs and benefits affecting this group results in inflated costs and benefits. The opposite applies for groups with greater than average income. More ad hoc weighting adjustments, to reflect whatever distributional concerns the decision maker may have, are also possible, although the use of distributional weighting can result in a loss of transparency of the CBA. The Green Book (HM Treasury 2003) covers distributional impacts in Annex 5. A “rigorous analysis of how the costs and benefits of a proposal are spread across different socio-economic groups is recommended”, however it is recognised that information necessary for calculating distributional weights may be costly to acquire and the outputs may lack transparency, and the guidance allows for presentation of a fully justified decision not to use explicit weighting.

An alternative approach is to assess and report separately the distribution of costs and benefits, flagging up “winners” and “losers” for decision makers. A formal approach to this, the “Sugden approach”, is under consideration in the UK (Defra 2007) but is not currently official policy.

CBA is not a valuation methodology, but rather a decision support framework that is based on underlying efficiency principles of economic analysis. The CBA framework is ideally suited for use with estimates of total economic value (TEV) derived from market and non-market studies, but where monetary values are not available for all impacts, “constrained” CBA may nevertheless be a useful way of taking into account those values which can be/have been monetised, alongside additional analysis of the non-monetary values. In the case of MPA site designation CBA as a decision support framework can be used to account for all costs and benefits at the societal level including the effects that impact on a particular population (sometimes referred to as social CBA).

In the case of MPA site designation process the net present value is not the primary concern, although this information will be needed in the IA that needs to be undertaken for the MPAs. The main uses are for aiding the ‘ranking’ of alternative site options where one of many sites could be designated to be part of the network, and for setting down in a clear and logical framework all the different types of cost and benefit (qualitative assessment), what is known about their magnitudes (quantitative assessment) and how these figures translate into economic value (monetary assessment). An additional very important feature is the ability to combine the assessment with the identification of “winners” and “losers” from the proposals.

Many of the more advanced MPA planning processes have incorporated cost benefit analysis both to inform network design and also as part of regulatory requirements for formal IA. These assessments have used a mixture of both qualitative and quantitative CBA. All the processes have recognised the
difficulty of accurately quantifying both costs and benefits and that there are particularly large uncertainties surrounding the benefits estimates. Where monitoring of MPA implementation has occurred (e.g. Tortugas), the experience has been that the impact assessments overestimated the potential costs of network implementation (largely because fishermen identified and exploited alternative fisheries resources which were not captured in the initial assessment, thus avoiding impacts to their income).

**B2.3 Cost Effectiveness Analysis**

Cost-effectiveness analysis (CEA) is a decision support method closely related to CBA. CEA aims to assess the costs of alternative ways of producing the same or similar outcomes. An MPA designation process focusing on socio-economic costs of achieving the network objectives, without assessing the ecological and socio-economic benefits of the network, is really using CEA rather than CBA. As with CBA the ‘ranking’ of alternative sites for MPAs can be achieved. The approach has recently been developed to support implementation of the EC Water Framework Directive (2000/60/EC) although it has seen limited application in the development of the draft first round River Basin Management Plans. The approach has not yet been applied to MPA network planning.

The main shortcoming of CEA is that it is limited to cost comparisons of options that deliver different quantities/qualities of the same single outcome. For MPA designations, this outcome is "contribution to network objectives", whether in terms of area, or in terms of some index of importance in the context of the coherent ecological network. In principle, all designations may have wider impacts on socio-economic activities and the environment, other than the simple achievement of the ecologically coherent network. Since there is an obligation to provide an ecologically coherent network, assessment of the benefits of doing so are of secondary importance, although that will be necessary for the IA. Nevertheless to the extent that the environmental benefits could differ from one potential coherent network to another, CBA would allow a more efficient decision support process than CEA, by taking such differences into account. But the ability to determine differences in benefits may be limited, and the complexities of the decision and consultation process may make such fine distinctions between CEA and CBA irrelevant in practice.

**B2.4 Multi Criteria Assessment**

Multi Criteria Assessment (MCA) seeks to rank different options or site designations in terms of their weighted performance against a variety of criteria. There are many variants of MCA, with various terminologies. For example, multi-criteria decision making, multi-criteria decision aid, participative multi-criteria analysis and social multi-criteria evaluation. As Burgess et al. (2005) describe, the distinctions made by practitioners can be sharp, but also sometimes spurious. Here we consider MCA to involve the ‘scoring’ and ‘weighting’ of information based on the structured articulation of ‘options’ and ‘criteria’ in some form of grid. Further discussion of MCA
methods can be found, for example, in eftec and Environmental Futures (2006).

MCA aims to account for all the different dimensions of effects of different options (various environmental, social and economic impacts). This is in principle also true of CBA, which seeks to convert all impacts on human welfare to monetary equivalents. However in practice CBA is generally limited by the ability to derive monetary values for impacts. But MCA is generally also limited to consideration of those impacts identified as most significant, because of the limits on the number of distinct criteria that can be scored and weighted.

In principle, MCA can encapsulate any values which humans can express, but in practice it is not always clear what values are being expressed, since subjective weights are being applied to scores that are themselves often subjective, rather than direct measurements of impacts. Initially the impacts are measured in different units, and generally options are "scored" in terms of their relative impacts under each category. The overall evaluation stage is then implemented via weights applied to the different attributes (these weights are analogous to the monetary values used in CBA, and in certain respects CBA is a special case of MCA in which monetary values are used as weights). However in MCA the weights may often be applied to a subjective index of an effect (e.g. ‘air pollution’) rather than a precise level of that effect. This can make it difficult to understand exactly what has been valued, and how.

No examples of MPA planning have been identified where MCA has been applied in a structured way, although criteria have been used to weight particular activities (for example, in the Californian MLPA case study), equal weight was given to commercial and recreational fisheries reflecting fisheries law and policy.

MCA has also been used in some instances to support terrestrial protected area planning. For example the process of Sustainability Appraisal (SA) applied to Regional Spatial Strategies (RSS) in England is a form of multi-criteria analysis that compares plan options against a set of sustainability objectives derived from the full range of relevant policy objectives.

Uncertainties pertaining to what exactly individuals are valuing, weighting and so on can limit the robustness and replicability of MCA. However, as a tool for helping people to understand their values and their practical implications, MCA may be very useful, and could be used in MPA planning to reflect socio-economic policy objectives and priorities.

Assumptions about the commensurability and comparability of values can be weaker in MCA than in CBA. MCA allows the examination of impacts separately at first, so it can be used where values are incommensurable. However whenever a final weighting scheme is applied, either the impacts are weighted commensurately, or a lexicographic ordering places all the emphasis on one set of criteria. In some cases, weighting is not applied, and the scores for different criteria are presented separately. This avoids some of
the problems discussed above, but of course does not face up to the key question of how to balance and trade-off very different categories of impacts.

B2.5 Trade-off Analysis

Trade-off analysis is a decision support tool that provides an interdisciplinary approach to natural resource management and can be used where there are multiple objectives and/or resource use conflicts (Figure B1).

Figure B1: Elements of Trade-off Analysis

Trade-off analysis provides for the integration of qualitative inquiry with quantitative research in a transparent structure. This is achieved through the integration of three particular techniques: stakeholder analysis, multi-criteria analysis and consensus building (Figure B2).
The trade-off analysis technique involves:

- Identifying the interests and importance of all stakeholders (formal stakeholder analysis);
- Engaging with key stakeholder groups through scenario development;
- Iterative weighting of information within participatory multi-criteria analysis; and
- Consensus building among stakeholders towards common goals.

It has been applied to the management of various open access natural resource management issues. A detailed account of its application to the management of the Buccoo Reef Marine Park in Tobago is provided in Brown et al (1999).

While the approach has been applied to the management of individual MPAs, it does not appear to have been applied to the selection of MPA networks. However, many elements of trade-off analysis are potentially helpful in MPA planning, in particular, stakeholder analysis, stakeholder engagement, scenario analysis, clear identification of the trade-offs and consensus building. The stakeholder analysis process provides an opportunity to ensure that stakeholder voices are heard and included.

### B2.6 Social Impact Assessment

Social impact assessment (SIA) is an approach that is widely used in and alongside EIAs to capture social impacts, providing for a balanced assessment, alongside environmental and economic impact information, in
keeping with the three priorities of sustainable development. Social impacts can be defined as:

“The consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society” (Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003).

SIA can be defined as a process to assess, appraise or estimate, in advance, the social consequences that are likely to follow from proposed actions. It is a process that:

- Provides information to agencies and communities about social and cultural factors that need to be considered in any decision;
- Provides a mechanism for incorporating local knowledge and values into the decision; and
- Can help a decision-maker identify the most socially beneficial course of action for local, regional, and national interests (adapted from Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003)

As well as capturing negative social impacts related to excluding or restricting certain activities and the indirect social consequences of particular projects, it also provides for positive social impacts to be captured related to the promotion of certain activities and the values people may derive from particular projects. The aim of SIA is essentially to capture positive and negative social impacts in order to inform project planning and implementation in a manner that provides for negative social impacts to be minimised and positive social impacts to be maximised. SIA can also be considered as being a means of taking account of and promoting social justice. Where social impacts occur as a result of positive or negative environmental impacts related to a project, this might also be considered in terms of environmental justice.

Social impacts include a very wide diversity of potential human consequences of a given project that can be grouped into five overlapping categories (Centre for Good Governance, 2006):

- Lifestyle impacts – on the way people behave and relate to family, friends and cohorts on a day-to-day basis.
- Cultural impacts – on shared customs, obligations, values, language, religious belief and other elements which make a social or ethnic group distinct.
- Community impacts – on infrastructure, services, voluntary organisations, activity networks and cohesion.
• Quality of life impacts – on sense of place, aesthetics and heritage, perception of belonging, security and liveability, and aspirations for the future.
• Health impacts – on mental, physical and social well being, although these aspects are also the subject of health impact assessment.

Many potential social impacts may be considered and it is important to consider such impacts in terms of their significance, using criteria such as the following from the Interorganizational Committee on Principles and Guidelines for Social Impact Assessment (2003):

• Probability of the event occurring;
• Number of people that will be affected;
• Duration of impact (long term vs. short term);
• Value of benefits and/or costs (benefits and burdens) to impacted groups (intensity of impacts);
• Extent to which identified social impacts are reversible or can be mitigated;
• Likelihood that an identified impact will lead to secondary or cumulative impacts;
• Relevance for present and future policy decisions;
• Uncertainty over possible effects; and
• Presence or absence of controversy over the issue.

Certain principles and guidelines have been agreed that set out the key elements of an SIA (Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003) as follows:

• Achieve extensive understanding of local and regional settings to be affected by the action or policy:
  o Identify and describe interested and affected stakeholders and other parties.
  o Develop baseline information (profiles) of local and regional communities.
• Focus on key elements of the human environment
  o Identify the key social and cultural issues related to the action or policy from the community and stakeholder profiles.
  o Select social and cultural variables which measure and explain the issues identified.
• Identify research methods, assumptions and significance
  o Research methods should be holistic in scope, i.e. they should describe all aspects of social impacts related to the action or policy.
  o Research methods must describe cumulative social effects related to the action or policy.
  o Ensure that methods and assumptions are transparent and replicable.
  o Select forms and levels of data collection analysis which are appropriate to the significance of the action or policy.
• Provide quality information for use in decision-making
Collect qualitative and quantitative social, economic and cultural data sufficient to usefully describe and analyze all reasonable alternatives to the action.

- Ensure that the data collection methods and forms of analysis are scientifically robust.
- Ensure the integrity of collected data.

- Ensure that any environmental justice issues are fully described and analyzed
  - Ensure that research methods, data, and analysis consider underrepresented and vulnerable stakeholders and populations.
  - Consider the distribution all impacts (whether social, economic, air quality, noise, or potential health effects) to different social groups (including ethnic/racial and income groups).

- Undertake evaluation/monitoring and mitigation
  - Establish mechanisms for evaluation and monitoring of the action, policy or program.
  - Where mitigation of impacts may be required, provide a mechanism and plan for assuring effective mitigation takes place.
  - Identify data gaps and plan for filling these data needs.

These guidelines can be considered as a methodological framework for SIA. The following steps (Figure B3) are also recognised as being typical for SIA processes:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Develop public involvement program</td>
</tr>
<tr>
<td>2.</td>
<td>Describe proposed action and alternatives</td>
</tr>
<tr>
<td>3.</td>
<td>Describe relevant human environment and zones of influence</td>
</tr>
<tr>
<td>4.</td>
<td>Identify probable impacts</td>
</tr>
<tr>
<td>5.</td>
<td>Investigate probable impacts</td>
</tr>
<tr>
<td>6.</td>
<td>Determine probable response of affected parties</td>
</tr>
<tr>
<td>7.</td>
<td>Estimate secondary &amp; cumulative impacts</td>
</tr>
<tr>
<td>8.</td>
<td>Recommend changes in proposed action or alternatives</td>
</tr>
<tr>
<td>9.</td>
<td>Mitigation, remediation, and enhancement plan</td>
</tr>
<tr>
<td>10.</td>
<td>Develop and implement monitoring program</td>
</tr>
</tbody>
</table>

(Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003)

Figure B3: Steps in the Social Impact Assessment Process

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One of the characteristics of SIAs is that there is no methodological ‘silver bullet’ for capturing potential social impacts other than saying you should ask questions and engage in deliberations specifically designed to elicit responses that include positive and negative social impacts and carefully listen and record where such social impacts emerge in discussions. The discussions on methods above reveal that a full, specifically tailored SIA amounts to a major research project, but the regional consultation, deliberation and interview processes can include questions that will provide for illustrative examples of the key social impacts amongst key stakeholder groups to be captured. Such social impacts should then be systematically recorded within the overall assessment framework and taken into account in decision making processes at a regional and national level. It is not realistic to specifically design and undertake a full SIA protocol within the financial context of regional Marine Conservation Zones (MCZ) projects but actively seeking, recording and taking account of different peoples’ views on potential positive and negative social impacts is very likely to yield enough information to provide for informed trade-offs in decision-making processes that take account of the potential for such social impacts. Subsequent similar assessments and selective fuller research projects should then be undertaken several years after MCZ designations to capture the actual social impacts of MCZs, again recognising that such impacts will largely be represented on a qualitative basis.

B2.6.1 SIAs and Marine Protected Areas

The International Union for the Conservation of Nature (IUCN) have published a checklist of criteria for consideration in MPA planning, including various social criteria (Salm et al, 2000):

- Social acceptance: the degree to which the support of local people is assured.
- Public health: the degree to which the creation of a marine protected area may serve to diminish pollution or other disease agents that contribute to public health problems.
- Recreation: the degree to which the area is, or could be, used for recreation by country residents.
- Culture: the religious, historic, artistic, or other cultural value of the site.
- Aesthetics: a seascape, landscape, or other area of exceptional scenic beauty.
- Conflicts of interest: the degree to which area protection would affect the activities of local residents.
- Safety: the degree of danger to people from strong currents, surf, submerged obstacles, waves, and other hazards.
- Accessibility: the ease of access across both land and sea.
- Research and education: the degree to which an area represents various ecological characteristics and can serve for research and demonstration of scientific methods.
- Public awareness: the degree to which monitoring, research, education, or training within the area can contribute knowledge and appreciation of environmental values and conservation objectives.
Conflict and compatibility: the degree to which an area may help to resolve conflicts between natural resource values and human activities, or the degree to which compatibility between them may be enhanced.

Benchmark: the degree to which the area may serve as a “control site” for scientific research, i.e., a largely undisturbed site in which natural processes can proceed without manipulation and which can be used to measure changes elsewhere.

A detailed search, however, revealed only three papers that explicitly address the social impacts of MPAs (Aswani & Furusawa, 2007; Stoffle & Minnis, 2007; Maliao & Polohan, 2008) and these were all in the context of traditional communities on tropical islands in developing countries (Philippines, Bahamas and Solomon Islands). While traditional coastal communities in developing countries tend to be more critically dependent for their subsistence and livelihoods on exploiting marine resources (and their social cultures, values and structures thereby tend to be more closely interconnected with the marine environment), existing checklists such as Salm et al (2000) are still helpful in considering the range of possible issues for UK MCZ planning.

Cherrett (2006) also noted a lack of incorporation of social criteria in MPA site selection based on a study of 30 marine MPAs in the US and wider Caribbean. She argued that MPA site selection needed to be more clearly set within the context of sustainable development and suggested that a clearer framework for consideration of social aspects was required, for example, based on the Sustainable Rural Livelihoods Framework (SLRF) (DFID, 1999). Such a framework might be used to provide greater focus to and clarity for social factors in MPA planning.

In the context of MCZs in England, Jones (2009) has explored some of the social and environmental justice issues raised by MPA proposals in South West England from fishing industry and related perspectives, as it is this group that will bear most of the negative social impacts of MCZs. This research reveals that, at a general level, there are significant concerns about the potential social impacts of MPAs:

- Loss of fishing as a way of life.
- Loss of traditional inshore fishing communities and social networks.
- Disempowerment through growing dominance of environmentalist agenda.
- Loss of traditional knowledge gained through fishing.
- Loss of infrastructure related to fishing.
- Loss of customary tenure of inshore fishing grounds.
- Potential for increased poverty and alienation amongst fishing communities and increased potential for suicide, mental health problems, drug addiction, etc.

Whilst some interviewees recognised the wider societal benefits that might be generated through the reduction of the environmental impact of fishing, most considered that it would be unfair if the fishing industry and related stakeholders should bear the socio-economic costs of any thinly spread
general societal benefits. This preliminary research therefore reveals that MCZ proposals are likely to generate significant negative socio-economic impacts that will be distributed particularly amongst fishing and related groups. More positively, this research also revealed a willingness amongst the industry to engage constructively in MCZ design processes in order to minimise the negative socio-economic impacts on commercial fishing interests.

B2.7 Bioeconomic Models

Bioeconomic models have a long pedigree in analysis of fisheries, and have more recently been used to explore many aspects of marine protected areas. The models make various simplifying assumptions in order to explore key features of interest through simulation of management scenarios, and analysis of interactions between key variables. Most bioeconomic models of MPAs focus on fisheries benefits, although there is also some work on tourism benefits and non-use values. Benefits are considered primarily in terms of biomass and catches: price impacts are little studied, with most models assuming constant ex-vessel prices (Alban et al., 2008); some models consider impacts on harvesting costs.

Bioeconomic models can inform assessments of potential fisheries impacts although confidence in most model outputs is generally low. The timetable for UK MCZ network planning may not permit the development of new bioeconomic models to inform network design. However, some existing bioeconomic models, for example for the South West and the English Channel (Pascoe et al., 2006) may help to inform fisheries assessments in those areas.

A key issue in the use of bioeconomic models for analysis of MPAs is the need to account for spatial impacts; most standard bioeconomic models are not explicitly spatial. Spatial considerations can be introduced in a number of ways: some models just have “inside” and “outside” the MPA, while others have finer grids within and around the area, and take more detailed account of spatial interactions.

Most (but not all) bioeconomic models focus on a single species or stock, and though the principle of multispecies / ecosystem management is increasingly recognised, this has not been fully incorporated in mainstream bioeconomic modelling (Armstrong, 2007). MPA models tend to focus on adult stocks, though larval dispersal is sometimes considered. Most models are driven by density dependent migration. In general, models of single-species population dynamics indicate that the effectiveness of MPAs in rebuilding or maintaining populations depends on the rates of immigration and emigration, and on the fishing effort outside the reserve (Gerber et al., 2003); heterogeneity between the reserve and non-reserve areas can also be important (Schnier, 2005).

Armstrong (2007) notes that economic analysis is generally more pessimistic regarding the fisheries benefits of marine reserves than purely ecological studies, because discounting, economic incentives and fisher behaviour are
taken into account. For example, Holland (2000) presents a case in which rational behaviour among fishers leads to greater risk of stock depletion when MPAs are present. On the other hand, even the most spatially complex economic analyses tend to be simplistic regarding potentially important ecological features associated with ecosystem and habitat.

**B2.7.1 Dependence on wider management**

Generally, the fisheries benefits (or costs) of marine reserves will depend on management outside the reserves. Sanchirico and Wilen (1999, 2001) show that with open access outside reserve patches, there may be biological benefits from reserves, but few combinations of biological and economic parameters give both increased total harvests and total biomass. Generally, benefits arise in particular where there is high fishing effort prior to reserve implementation; if there are effective effort control mechanisms in place, fisheries' benefits from reserves may be small. This complicates assessment, not least because fisheries management is dynamic: in particular, it is difficult to estimate how successful current attempts to reform the Common Fisheries Policy (CFP), and allow European fisheries to recover from decades of overexploitation, may be. Some authors have examined how “traditional” management metrics and indicators such as catch per unit effort (CPUE) may be influenced by spatial modelling. Babcock et al. (2005) note that non-spatial population models can be adequate if the impact on the overall population is the feature of interest – for example, measures aimed at protecting spawning grounds can be modelled without explicit spatial factors. But where sub-populations need to be considered as spatially distinct, and where migration between areas is limited, spatially explicit models are required that model stocks within each spatial area, and specify migration coefficients and area-based fishing rates (whether based on Maximum Sustainable Yield (MSY) or other reference points, or on explicit modelling of distribution of fishing effort).

**B2.7.2 Uncertainty**

Uncertainty is studied in several models, with results suggesting that one benefit of MPAs may be to buffer stocks and fishing returns against environmental variability or shocks. For example, Conrad (1999) uses a simple model subject to external shocks and shows that marine reserves reduce biomass variation, but also reduce harvests and profits compared to “sole owner” management without a reserve. However this result does not hold with open access outside the reserve. Grafton et al. (2005) report studies suggesting that, in the presence of uncertainty, marine reserves increase persistence by maintaining higher levels of spawner biomass and by raising recruitment success with high rates of exploitation. Generally, MPAs can be expected to buffer against shocks, though not necessarily to increase expected returns. Details will depend on other management and ecological factors, but where uncertainty is thought to be important (which is probably true for most fisheries) then this could be an important source of benefit.
B2.7.3 Models considering habitat

Most models of MPAs focus on stocks and associated parameters without directly considering the role of habitat. However a key impact of MPAs can be recovery or enhancement of habitat supporting fish populations. Armstrong (2007) presents a model including ("relatively limited") carrying capacity improvements due to habitat improvements within a reserve, resulting in increases in stock and harvest. Armstrong and Skonhoft (2006) examine asymmetry in the migration coefficients resulting from different habitat conditions, showing that over-harvesting could arise if this is not taken into account.

B2.7.4 Site Selection

Spatially explicit bioeconomic models represent a discrete number of subpopulations in different patches, linked by biological and/or economic relations. These models are often multispecies and often focus on site-selection issues (Alban et al. 2008), attempting to integrate oceanographic processes, ecological parameters, adult and/or larval dispersal, and socio-economic factors. The spatial distribution of fishing effort can be modelled in various ways, including agent-based modelling, game theory, gravity models and random utility models.

With multi-patch models with different ecological and/or economic coefficients, bioeconomic modelling can be used to prioritise areas for protection. Such models have suggested that a network of marine reserves could yield greater fisheries benefits than a single reserve of comparable size (Grafton et al 2005). Some seemingly counter-intuitive results have been proposed. Sanchirico and Wilen (2001) find that, under open access conditions, closing the most productive/profitable patch provides the greatest chance of increased aggregate harvests. This is due to rational behaviour from fishers: this patch is most over-exploited under open access. Again, this result weakens when effort is controlled: with efficient limited-entry management, closing the least productive areas is preferred (Sanchirico and Wilen, 2002). These findings suggest that a simple "avoid high productivity areas" rule may not give the best results for fisheries, depending on other management measures and effort levels.

Stewart and Possingham (2005) demonstrate how output from bioeconomic models can be included in site-selection tools such as MarXan. In their study, the incorporation of socio-economic costs does not significantly increase the reserve proportion (compared to simple objective of minimising total reserve area consistent with ecological objectives). However the cost function they use is very simple and does not take account of fisheries spill-over effects. A more general finding of bioeconomic models focusing on fisheries benefits is that the reserve size is a key determinant of benefits, and that smaller is not necessarily better. Sumaila (1998) for example models Barents sea cod and finds that marine reserves bring benefits and protection from external shocks provided that: (a) net transfer rates for cod are "reasonably high" and (b) reserve sizes are large. If fisheries' benefits of reserves are important, then
minimising total reserve size may not be an optimal approach.

**B2.7.5 Distribution of benefits**

Sumaila and Armstrong (2003) examine the distribution of benefits between different fleets, trawlers and coastal fishers. The result of MPA designation depends on both the ex ante status quo and the ex post management and behaviour: win-win, lose-lose or win-lose situations are all possible. Best results are achieved with cooperative outcomes between the fleets, but the absence of cooperation does not mean that the fleets would prefer a "no reserve" option. There may also be distributional impacts associated with costs: Boncoeur (2004) notes that small boats are usually more impacted by area closures than large boats, since their relative costs of reallocating effort are greater.

Going further to examine more complex issues of distribution and technical interactions amongst fleets and gears requires rather elaborate simulation modelling. For example, Ulrich et al (2002) present a complex model treating the English Channel as "one large and diverse multi-country, multi-gear and multi-species artisanal fishery". To be useful in MPA design, such models would need to be extended to take into account detailed spatial factors and ecological interactions.

**B2.7.6 Bioeconomic Models - summary**

Bioeconomic models can provide interesting and useful insights into the costs and benefits of MPA networks and site selection. Some findings are initially counter-intuitive: for example, minimising total reserve area, and avoiding areas of high fisheries value, might not be good approaches to minimising the socio-economic costs of reserves. Actual costs and benefits depend on the specifics of each case, including ecological and economic factors, and also existing (and future) management structures; so each case requires specific modelling. The literature reviewed here suggests that such modelling exercises may well be worthwhile, and that the results can not be assumed in advance. This information may well be of interest to stakeholders in considering the designation process.

**B2.8 Network Design Tools**

There are a range of numerical optimisation tools that have been used to inform the network design process. Early versions of such tools include an interactive decision support tool that was developed as part of the Californian Channel Islands designation process (the Channel Islands Spatial Support and Analysis Tool (CI-SSAT)) which was used to assess both ecological and socio-economic data. For CI-SSAT, two ‘evaluation criteria datalayers’ were created, one ecological and one socio-economic. Each evaluation criterion datalayer was compiled from many individual data sets representing the likelihood that the evaluation criterion's goal would be met. Similarly within the Californian MLPA network datalayers were developed and fed into an interactive GIS decision support software tool. Formally called ‘Doris’, this
has now been superseded by MarineMap, which allows stakeholders and resource managers to experiment with different MPA designs/networks on their own computers, at their own pace. It provides basic feedback on whether the design criteria are met or not (Astrid Scholz, personal communication).

Within the designation of the Grays Reef Marine Sanctuary a dedicated GIS tool using a ‘sliding windows’ approach was used to assist in the selection of an MPA (Kendall and Eschelbach, 2006). This approach systematically considered placement of the various boundary configurations throughout the entire sanctuary. The sliding window was drawn at a size considered to be the minimum requirement for the research-only area. The window was moved around the larger ‘Study Area’ and alternatives were developed that met all the criteria developed by scientists. This process used the computer to develop thousands of alternatives. Amongst the resulting alternatives, the options with the lowest activity impacted were assessed for their socio-economic impact (Bob Leeworthy, personal communication). The final option selected had the lowest impact of any other alternative analyzed.

Numerical optimisation tools that have been applied to assist in network design in the UK, Australia, Canada and Papua New Guinea include MarXan, which can take account of conservation and socio-economic criteria to evaluate options for networks of protected areas. MarXan was developed by Ball & Possingham (2002) and is specifically based on a spatial site selection algorithm. The process is best described as a series of steps:

- The first step is to assign a planning unit. These may be different in different regions of the planning area, e.g. larger offshore and smaller inshore;
- Each of these units is then assigned a ‘value’ based on how many conservation objectives are met (e.g. how many conservation features are contained within the unit).
- The algorithm selects a random set of planning units and assesses how well or poorly this configuration performs in terms of meeting the target for the representation of each conservation objective (e.g. feature).
- The algorithm also seeks to minimise ‘costs’. Costs may simply reflect the size of the network (with the result that the smallest sized network that meets the conservation objectives is selected) or, more specifically, may refer to the economic value of the planning environment (with the result that the cost-optimisation process will avoid areas of high economic value).
- The algorithm will run a set number of times to produce a number of permutations of possible solutions, analyse each for value and cost and identify the optimal solution.

The tool has a number of options including:

- The ability to lock in particular layers so that units that contain these layers are consistently selected.
The setting of the Boundary Length Modifier (BLM) that determines the compactness of the network (i.e. a range from small but fragmented sites to large but compacted sites).

It was first used in the UK in an initial development of theoretical protected sites (Richardson et al., 2006) to understand the possible extent and spatial distribution of an MPA network. This study investigated a number of potential scenarios that highlight the flexibility of the MarXan tool including:

- Varying representation targets of threatened and declining species and habitats and marine landscape types;
- Locking in existing Special Areas of Conservation (SACs) (and not);
- Reducing the number of threatened and declining species included;
- Changing the sub-regions within which networks were optimised (e.g. UK regional seas or OSPAR regions);
- Adding a preference for the selection of sites that included nursery grounds for commercial fishery species;
- Adding a preference for the selection of sites that included protected wreck sites;
- Locking out sites for marine aggregate extraction, dredging and dredge disposal;
- Bias against selecting sites within 6nm of the coast by making them relatively more ‘expensive’ than offshore sites.

MarXan has recently been further developed into MarZone which incorporates an additional option enabling users to configure systems of ‘zones’ permitting a range of different activities, with different spatial configurations (using the BLM criteria), and to explore the ‘costs’ for activities across these zones.

It should be noted that site selection algorithms are highly dependent on the quality of the data employed in the analysis.

Planning tools such as MarXan have also been used to support the design of reserve sites both within the terrestrial and marine environment. Within the GBRMPA designation process socio-economic analysis was embedded in MarXan and a suite of GIS-based spatial analysis tools. MarXan enabled the integration of a number of datalayers (biophysical and socio-economic) and the assessment and generation of a number of options (GBRMPA, 2005). MarXan can incorporate socio-economic data such as catch per unit effort (Babcock et al., 2005), fishing pressure (Sala et al., 2002), the local knowledge of fishers (Davis 2005) and catch values (Babcock et al., 2005). Furthermore, other variables such as the costs of forgone catches within proposed MPAs have also been calculated and used (Richardson et al., 2006). However, authors have cited issues with this ‘single variable’ approach, for example in the case of fishermen, where a single variable cannot account well for the choices that fishermen actually make when deciding where to fish (Babcock et al., 2005).

The main technical issues with planning tools such as MarXan stem from these ‘single variable’ issues. However, MarZone, an extended version of
MarXan, can account for more than a single variable; alternatively the compression of several GIS layers into a single measure that can be incorporated within Marxan can help to address this. Furthermore, either of these planning tools can be used within the broader context of an alternative decision support framework such as CBA or MCA, and may help with issues relating to particular stakeholder groups e.g. fishermen.

Alternatives to MarXan/ MarZone include C-Plan (used in the planning of marine protected areas for the Prince Edward Islands, South Africa, see Pressey et al., 2008), Zonation (used to identify potential MPAs in New Zealand’s EEZ, see Leathwick et al., 2006 and Moilanen and Kujala. 2006) and ConsNet (Ciarleglio et al., 2008). Zonation produces a hierarchical zoning of a landscape by looking for priority sites for conservation, aiming at species persistence and using large grids. Features of Zonation include Species prioritization (weighting), costs, species-specific connectivity, uncertainty analysis, replacement cost analysis for current or proposed conservation areas. There is a direct link from GIS to distribution modelling to zonation plans (Moilanen and Kujala. 2006).

C-Plan is based on the concept of irreplaceability to selecting indicative sets of sites to achieve quantitative targets for features such as vegetation types or species. Irreplaceability is a measure of the likelihood of needing any sites within a planning regions for achieving targets and as such presents planners with a map of spatial options for achieving targets. C-Plan was developed to facilitate negotiation amongst conflicting interest groups but can be used also by individuals or planning teams from single or affiliated organisations. There is now no limit on the size of C-Plan data sets and large regional data sets can be analysed in a few seconds.

ConsNet is a comprehensive software package for the design and analysis of Conservation Area Networks (CANs) to represent biodiversity (http://uts.cc.utexas.edu/%7Econsbio/Cons/consnet_home.html). The CAN design problem has many variations which depend on the specific goals of the planner but the basic problem assumes a common structure. The study region is partitioned into "cells." For each cell, there are data on the expected presence or abundance of appropriate biodiversity surrogates, the potential costs (or benefits) of placing each cell under a conservation plan, and the spatial properties of the cell. A CAN is assembled as a collection of cells which best meets the goals of the planner (Margules & Sarkar, 2007). ConsNet contains new search techniques for designing conservation area networks using multiple criteria. In particular, ConsNet can also handle a variety of spatial criteria including size, compactness, connectivity, replication, and alignment. These spatial criteria are integral to the planning process, but have been difficult to address in the past due to the computational and modeling difficulties of including them. Additionally, ConsNet allows users to introduce an arbitrary number of other criteria, including socio-economic criteria, for example, to steer site selection away from areas of high potential conflict between socio-economic activities and conservation objectives.
Appendix B References


Appendix C. Workshop Report (23-24 April 2009)

C1 Project Information

The United Kingdom (UK) Government is committed (through OSPAR and the World Summit on Sustainable Development) to setting up a network of Marine Protected Areas (MPAs) to contribute to the protection of marine ecosystems and biodiversity.

Key aims and objectives of the study were:

1. To objectively assess how socio-economic factors have been taken account of in other MPA planning exercises elsewhere (international, European and national) and identify lessons that can be learnt;

2. To liaise with a range of parties and undertake an expert workshop to discuss and generate ideas on how socio-economic activities can be taken account of;

3. To identify and present options and recommendations for taking socio-economic factors into account when developing potential networks of Marine Conservation Zones (MCZs), including details on any derived data layers that are considered key in helping to inform MCZ selection and for use in stakeholder engagement activities.

This document presents a summary of the workshop component of the project, which was held at the Innovation Centre in Reading on the 23rd and 24th April 2009. The agenda for the event can be found in Annex 1 of this appendix with a listing of participants provided in Annex 2. A summary of each presentation is provided within the main text of this report along with the key outputs of the discussion groups.

The specific aims of the workshop were to learn from both international and national experiences of planning and implementing MPAs whilst engaging with stakeholders as to how this might be taken forward within a UK context. The workshop was used to build on the review work undertaken as part of this project and as a forum to discuss options on the use and applicability of socio-economic data. The workshop was also designed to gather further ideas and experiences to be used in making recommendations on the use of socio-economic derived datalayers for MPA planning in the UK. A series of presentations were provided by key speakers on Day 1 and a breakout group session was carried out to canvass further views on a series of key questions on Day 2 followed by a wrap-up session for the workshop event. The international guest speakers were identified based on their involvement with initiatives that have been implemented elsewhere.
C2  Summary of Workshop Presentations

A summary of the key points from each presentation is summarised according to the objectives of the MPAs, the designation process and the tools and data applied within the respective socio-economic assessments. An electronic copy of the workshop presentations is provided on the DVD accompanying the hard copy report or can be downloaded alongside the electronic version of the report from the Defra website.

C2.1  Day 1, Session 1:

John Clorely, Defra, started the workshop by providing the policy context for UK MPA network planning including clear specification of current thinking of how consideration may be taken of socio-economic consequences.

C2.1.1  Marine Protected Areas 2012 - Chris Davis, Natural England

The Government is aiming to have a well managed ecologically coherent network of marine protected areas that is well understood and supported by 2012. The network will consist of four designations:

- National Marine Sites
  - Sites of Special Scientific Interest (SSSIs)
  - Marine Conservation Zones
- European Marine Sites
  - Special Areas of Conservation (SACs)
  - Special Protection Areas (SPAs)

The MCZ Delivery Process will be integrated with inshore /offshore planning and delivered through four regional projects. It is intended that the process is both open and transparent with stakeholders centrally involved in the decision making, generating a bottom up, top guided process. With specific reference to socio-economic considerations it will be desirable to avoid ongoing or planned activities using a prioritisation based approach depending on ecological options. In this respect the guidance states that a series of alternatives should be explored with the aim to reduce conflicts to a minimum whilst delivering the ecologically coherent network. Impact Assessments (IAs) will be undertaken to support the option analysis process.

An overview of the MCZ timetable is summarised below:

- 2010 – Regional option analysis
- 2011 – Finalise options. Recommendation to Government. Complete IAs
• 2012 – National consultation and Network designation.
• 2012+ - Network management

C2.1.2 International Case Studies

A number of international guest speakers presented at the conference a summary of the material is presented in Table 1. Additional detail and further explanation on the case studies can be found within Appendix A, alongside the other initiatives reviewed as part of this project.
### Table C1. Summary of Case-studies Presented at the Workshop

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Objectives of network of marine protected areas</th>
<th>Site designation process and tools utilised</th>
<th>Socio-economic considerations given &amp; data layers employed</th>
<th>Lessons learnt</th>
</tr>
</thead>
</table>
| **Australia's Marine Bioregional Planning program** | • Protect marine conservation values around Australia.  
• Identify new MPAs in Commonwealth Waters.                                                                                  | • Government led process  
• Collaborate with people who use and care about the oceans  
• Bioregional profile developed for each region.                                             | • Costs to communities and industries will be minimised.  
• Minister was presented with 3 options to consider:  
  o Least displacement costs;  
  o Middle option in terms of costs and conservation; and  
  o Best conservation option.  
• A displacement activity policy is being developed (potentially including provisions to compensate affected interests).  
• Zoning for multiple-use but inclusion of highly protected zones within each MPA.  
• Include areas that are already being protected by other groups.  
• Socio-economic data and objectives are important even when not legally required.  
• Gathering new data in real time is daunting, but generates buy-in from stakeholders.  
• Data collection methods generalize to other non-fishing uses of the ocean. | • There are difficult decisions to be made.                                                                                             |
| **California Marine Life Protection Act**       | • To protect the natural diversity and abundance of marine life, and the structure, function and integrity of marine ecosystems.  
• To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted. | • Stakeholder-driven transparent process  
• Supported by staff from the Marine Life Protection Act Initiative. A Regional Stakeholder Group is responsible for developing the proposals for the MPA networks.  
• Design guidelines are produced by a Scientific Advisory                                                                                     | • Collected a lot of data from commercial and recreational fishermen which was used in the design of the network.  
• Four metrics used to evaluate MPA proposals  
  o “Worst case” affected area (i.e. maximum potential economic impact) and importance.  
  o First order net economic impacts (profits).  
  o Cumulative effects with other spatial management measures.  
  o Any disproportionate effects on                                                                                                           |                                                                                                                                     |
<table>
<thead>
<tr>
<th>Case Study</th>
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<th>Lessons learnt</th>
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</table>
|            | • To improve recreational, educational and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.  
  • To protect marine natural heritage, including protection of representative and unique marine life habitats.  
  • To ensure clearly defined objectives, effective management measures, and adequate enforcement, based on sound scientific guidelines.  
  • To ensure that the state’s MPAs are designed and managed as a network. | Team.  
• Proposals are iteratively evaluated by the regulators and Scientific Advisory Team (including first order economic impact assessments) and refined to produce a short list of final alternative network designs.  
• A Blue Ribbon Task Force of respected elders consider the alternatives and accept 1 proposal or elements of each to form an integrated preferred alternative.  
• Tools used included Marxan and Marxan with zones. | individual or groups of fishermen or communities. | and can be modified to collect more social and cultural information. |
### Case Study

**Establishing the Gully MPA: Socio-Economic Considerations**

Paul Macnab, Fisheries and Oceans (DFO), Canada.

<table>
<thead>
<tr>
<th>Objectives of network of marine protected areas</th>
<th>Site designation process and tools utilised</th>
<th>Socio-economic considerations given &amp; data layers employed</th>
<th>Lessons learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conserve and protect the natural biodiversity of the gully and to ensure its long term health. The Gully MPA design strove to maximise conservation benefits while providing for sustainable use.</td>
<td>Identify Area of Interest. Initial screening of AOI. Evaluation &amp; assessment - ecological, socio-economic, technical. Management plan development. Designation by regulation. Operational management. Stakeholder involvement throughout.</td>
<td>A series of socio-economic assessments was undertaken to better understand values of extant resources and historical patterns of human use. Detailed studies of fisheries undertaken.</td>
<td>The collaborative approach facilitated the process (the DFO met with stakeholder groups and individuals, representing oil and gas industry, regulators, NGOs, the shipping sector, and the science and academic community)</td>
</tr>
</tbody>
</table>

**Datalayers**
- Aggregates potential in the shallows
- Hydrocarbon exploration
- Historical, ongoing and developing fisheries
- International shipping routes
- Telecommunications cable
- Focal area for marine scientific research
- Military zones
- Tourism and traditional aboriginal rights

**MPA Design: A Potential Research Area Within Gray's Reef National Marine Sanctuary**

**Presenter** – Rod Ehler – National Oceanic and Atmospheric Administration (due to illness, this presentation)

<p>| Research area - type of MPA or zone within an MPA in which to conduct controlled scientific studies in the absence of confounding factors. | Site designation process Consensus driven process. Investigated 18 boundary configurations (shape, size, rotation). Explore placement options within | Primarily focused on fishing effort. Analyses assumed that all economic (fishing) values associated with the areas closed to fishing would be lost. Any factor that could mitigate or offset the level of impact was not addressed. The estimated impacts were thought of as “maximum potential losses.” Estimated “person days” of use for | The collaborative approach facilitated the process. |</p>
<table>
<thead>
<tr>
<th>Case Study</th>
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<tbody>
<tr>
<td>BALANCE - Towards an ecosystem-based approach to management of the Baltic Sea</td>
</tr>
<tr>
<td>Presenter</td>
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<tr>
<td>To develop transnational marine spatial planning tools and an agreed template for marine management planning and decision-making.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives of network of marine protected areas</th>
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<tbody>
<tr>
<td>Site designation process and tools utilised</td>
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<tr>
<td>Socio-economic considerations given &amp; data layers employed</td>
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<tr>
<td>Lessons learnt</td>
</tr>
<tr>
<td>was not made at the workshop but has been included here for information</td>
</tr>
<tr>
<td>6 options investigated further:</td>
</tr>
<tr>
<td>Preferred scientific option;</td>
</tr>
<tr>
<td>Minimize fishing displacement;</td>
</tr>
<tr>
<td>Compromise option;</td>
</tr>
<tr>
<td>and 3 options provided by the public.</td>
</tr>
<tr>
<td>Final Recommendations, July 2008</td>
</tr>
<tr>
<td>Estimated economic contribution using Recreational Fishery Statistics.</td>
</tr>
<tr>
<td>Predicted displacement for each scenario.</td>
</tr>
<tr>
<td>Calculated maximum potential economic losses.</td>
</tr>
<tr>
<td>Recreational fishing boat locations during annual tournament.</td>
</tr>
<tr>
<td>Fishing effort.</td>
</tr>
<tr>
<td>The project was based on a review of existing information. It represents a theoretical approach.</td>
</tr>
<tr>
<td>Case Study</td>
</tr>
<tr>
<td>-----------------------------</td>
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<tr>
<td>Environment, Denmark</td>
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</table>

Planning Protected Areas N/A (presentation drew N/A N/A N/A
### Case Study

<table>
<thead>
<tr>
<th>Presenter – Jeff Ardron, Director High Seas Program, Marine Conservation Biology Institute, Washington DC.</th>
<th>Objectives of network of marine protected areas</th>
<th>Site designation process and tools utilised</th>
<th>Socio-economic considerations given &amp; data layers employed</th>
<th>Lessons learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>on various previous experiences, rather than one process per se).</td>
<td></td>
<td></td>
<td>processes have proved successful.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Must integrate fisheries into ecosystem management.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Align research, monitoring and management.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Transparency and public debate are important.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Effective communication, build bridges and mutual respect.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Management requires public support.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Community participation and ownership</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Knowledge has to include social, economic as well as ecological dimensions</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Approaches that could be successful vary according to culture</td>
</tr>
<tr>
<td>Case Study</td>
<td>Objectives of network of marine protected areas</td>
<td>Site designation process and tools utilised</td>
<td>Socio-economic considerations given &amp; data layers employed</td>
<td>Lessons learnt</td>
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</tbody>
</table>
| **Case Study** – Elements of Finding Sanctuary | Delivery of southwest region MCZ network. | Network will be designed by stakeholder representatives on the Project Steering Group. Process supported by design guidelines produced by national policy makers and National Science Advisory Panel. | FisherMap data layers include:  
- Maps showing the relative density of fishing effort across the region for different fisheries/gear types, alongside information about their seasonality.  
- Maps showing the fishing grounds of different size vessels according to home port and fisheries. This was split into inshore (vessels under 12m) and coastal fleet (vessels from 12 to 20m). | • Separate “social” from “economic” in the analysis.  
• Develop common currencies by which to compare values.  
• Do not be blinded in the quest for the “perfect” model / solution when good practical solutions are close at hand. Simplicity is not “unscientific.”  
• MCZs are more likely to be successful if they have support and collaboration of stakeholders. |
| **Presenter** – Tom Hooper. | | | | |
C3 Day Two: Session II

Day two focussed on a review of available tools, information and processes that could be used to take account of socio-economics in the designation of MCZs.

C3.1 Measuring socio-economic activity Presenter - Rob Tinch, Economics for the Environment Consultancy Limited (eftec)

Economic appraisal methods, and particularly cost-benefit analysis (CBA), need to be used for the IA that will be required for the designation policy. Treasury guidance in the "Green Book" sets out how CBA should be undertaken in the UK’s public sector. CBA is a necessary component of the analysis needed for an IA, and is needed for assessing the socio-economic consequences of MPA network design, but is not in itself sufficient for either purpose. There is no obligation to use CBA earlier in the designation process, but the Marine Bill explicitly allows that socio-economic consequences may be taken into account in the designation, and economic appraisal methods are well-suited to this. Since CBA will be needed for the IA, it is sensible to consider using it from the outset.

Both economic valuation and CBA draw on the "Total Economic Value" framework. This considers economic value as deriving from individual "willingness to pay" for goods and services - including both marketed and non-marketed (environmental, social) goods and services. Willingness to pay - i.e. to give up other things in exchange - ensures that scarcity and trade-off are considered: we can't have everything, and that's the whole point of economic analysis. The framework is individualistic but not selfish: value is broken down into categories that include direct and indirect (personal) use values, and "option values" for unplanned but conceivable future uses, but also "non-use" values including altruistic values, bequest values and existence values. Values can be estimated using a wide range of techniques, depending on the good/service under consideration, covering market-base methods, revealed preference methods, and stated preference methods. Primary studies can be time consuming and expensive, but values from previous studies can often be used via techniques of benefits transfer.

There are many different levels at which socio-economic impacts could be represented in the designation process:

- Location: simple assessment of what activities are present or absent in each area;
- Market value: measurement of the market values of products arising from each area;
- Profits: correcting market values by taking account of the costs of provision;
- Resource scarcity: as above, but taking account of changing prices due to the overall dynamic impact of the MPA network on availability of marine resources; and
- Full economic valuation: as above, but using non-market valuation methods to take account of non-market impacts on ecosystem goods and services.

None of these options is perfect: there is a trade-off between simplicity and accuracy. It may be that initial stages of assessment should use simpler methods, with the
more detailed and accurate methods being reserved for fine-tuning. But this depends on what the stakeholders involved in network design want and find useful, and on what data are already available. Where monetary valuation evidence exists and can be collected easily, it would seem odd not to offer this to stakeholders for possible use in their deliberations. Where benefits transfer techniques might be used, this should be brought to stakeholders’ attention. Where primary valuation studies would be required, their significant costs in time and resources would need to be taken into account prior to any decision to conduct valuation.17

The process we suggest is the initial use of a cost-benefit framework, setting out clearly the individual costs and benefits, and the winners and losers, of each option. This should draw on such information as is readily available - in some cases, this will include economic or market values, while in others it will be quantitative or qualitative measures of other kinds. If this is enough for stakeholders to reach agreement, and if the scientific or other arguments, plus socio-economic benefits, are sufficient to justify the socio-economic costs, then there is no need for further valuation efforts. However if either of these conditions is not met, then we need to consider how to proceed. Options include attempts to find further information on (a) potential impacts, (b) economic valuation evidence and (c) alternative network designs, and those involved in the decision process would need to consider which of these could help, how they could be derived, and at what cost.

There are likely to be three key problems here: lack of data; accounting for additionality and displacement; and accounting for relationships between different activities in the same or adjacent areas. However, except for lack of valuation data, these problems are not specific to economic appraisal methods: additionality, displacement and interactions are reflections of the complex reality of human use of marine environments, not artefacts of any particular assessment approach. The CBA framework can at least set out clearly the conditions under which these problems are likely to come into play, and identify (via sensitivity analysis) how likely they are materially to influence the outcomes of analysis.

C3.2 Available Information

There is a wide range of socio-economic information available on human use activities in the UK marine area including:

- Spatial data sets on the location of existing and planned infrastructure and human use activities;
- Spatial information on possible locations for future human use activities;
- Data on natural resource distributions (which can provide an indication of areas of future development potential);

17 A review of benefits transfer methods and source studies was explicitly excluded from the current work in order to avoid replicating work being carried out by Economics for the Environment Consultancy Ltd (eftec), for Defra on benefits transfer guidelines, which includes a marine case study. See eftec (2009b).
The development of the concept of marine planning in the UK has heightened interest in spatial data on human use activities as a key aid in the management of potential conflicts between different activities and conflicts with marine environmental objectives.

C3.3 Process Options

The purpose of the workshop was to enable participants to influence the process that this study will recommend for incorporating socio-economic factors in the determination of MPA networks and comment on the types of data that might help inform that process (data layers, deliberation). A number of possibilities for the overall process were presented, as summarised below, followed by a series of discussion outputs from four break-out groups. The findings from the breakout groups were then discussed in an open forum to identify common themes and differences.

C3.3.1 Options presented

In relation to process options, there is the question of whether a ‘one-step’ (deliberation only) or ‘two-step’ approach (initial network design using design tool followed by deliberation) is adopted in considering socio-economic issues. The one-step process would essentially be a ‘bottom-up’ approach to developing the network using socio-economic information based on local knowledge and preferences. A two-step approach to the consideration of socio-economic issues would include the application of simple socio-economic criteria in the initial network design phase. These initial network designs would then be further refined using more detailed/local knowledge on socio-economic factors in the deliberation phase.

The second set of questions related to the way in which socio-economic information might be accommodated in an initial network design phase. Four alternative approaches were posed relating to, value, costs, scarcity of resources and the avoidance of pressures. These alternatives are not necessarily mutually exclusive but represent different ways of using the socio-economic data.

The third set of choices relates to the role of socio-economic assessment tools in supporting network design in the deliberation phase, for example the application of cost-benefit analysis or sustainability appraisal and how these tools might facilitate the formal IA that will be required to accompany recommendations to Ministers for each regional network.

C3.4 Workshop Breakout Session Outcomes

The workshop attendees were organised into 4 discussion groups to discuss 3 key questions regarding the designation process:
1. What are the potential benefits of including socio-economic considerations in an initial network design phase? If socio-economic information is included as part of initial network design, what types of information and data layers might be considered to be key? Do the benefits outweigh the effort associated with collecting and providing the necessary socio-economic data?

2. For the deliberation phase what types and format of socio-economic information might be used?

3. What tools might be applied to the consideration of socio-economics in the deliberation phase and how might any analyses best link to the formal Impact Assessment that is required to accompany site recommendations?

The combined viewpoints of the four groups are outlined below.

**Q1 What are the potential benefits of including socio-economic considerations in an initial network design phase?**

- The overall network design is better informed and can potentially increase delivery against objectives.
- Facilitate stakeholder engagement and build up relationships.
- Build confidence in the process, which will ultimately facilitate implementation of the network and increase the likelihood of compliance.
- Make use of existing datasets.
- Define at the outset of the network design process what is important.
- The data that is used in the deliberation phase can also be used in the IA which could avoid a duplication of effort.

**Q1 cont. If socio-economic information is included as part of initial network design, what types of information and data layers might be considered to be key?**

- Start with national / relatively coarse level datasets.
- Refine options with more detailed/ local information.
- Data – needs some form of quality assurance.
- Need to understand limitations of data, e.g. gaps and spatial limitations.
- Need to be clear in what form data is needed.
- Additional data may be required in areas of conflict.
- Requirements may differ between regions.
- Will need to prioritise data that will be used in design process.
- There is a requirement for both social and economic data.

**Types of socio-economic information considered useful in the initial stages of network design were summarised as follows:**

- Planning blocks
- Fishing effort
- Cables and pipelines
- Navigation
- Consumptive uses
- Employment
• Income
• Cables
• Oil and gas
• Proposed infrastructure/developments
• Shoreline Management Plan proposals
• Offshore wind
• Ministry Of Defence (MOD) exercise areas
• Point source pollution
• Tourism (including land based infrastructure)
• Social deprivation

Participants had varying views as to the priority that should be attached to each of these sector types.

**Potential sources of additional data identified by the participants includes:**

• Crown Estate
  o Cost surfaces
  o Marine Resource System (MaRS)
• Vessel Monitoring System (VMS)
• Royal National Lifeboat Institute (RNLI)
• Royal Yachting Association (RYA) – recreational activities – quantified
• Ports
• Department for Environment Food and Rural Affairs (DEFRA)/Marine and Fisheries Agency (MFA) – economic fish data
• STAKMAP – recreational users (similar methodology to fishermap)

Data Formats that might be useful in the design phase

• Values – qualitative and qualify where gaps.
• Costs of measures/mitigation.
• Pressures
  - not all are spatial,
  - compatibilities – can rationalise data collection and analysis of costs.
• Not all information is spatial.
• Verbal information.
• Require specific local information as well as broader strategic assessments of activity.
• Spatial and temporal scale at which data is required.

**Socio-economic considerations**

• Sectoral discussions required as to how you value industries.
• Could work backwards – if no effects of designation, no need to get additional data.
• Look at information that exists now, if there are gaps can try and fill later.
• Not all activities are non-compatible. Some can put in design features to optimise environmental benefits.
• Analysis of resource availability.
• What are the requirements of each sector?
• Presence/absence? Market value? Costs?
• Future uses of an area.
• Industry plans.
• Consideration of multiplier effects.
• Danger of gathering detailed socio-economic data only to find very little is actually used.
• Look at stakeholder objectives alongside ecological objectives.
• Political sensitivities about ranking different sectors in terms of relative importance.
• Marine policy statement – give guidance of priorities, however, these decisions/trade offs will need to be made at some point.
• How will the analysis take account of international activities such as fishing.

Q3. What tools might be applied to the consideration of socio-economics in the deliberation phase and how might any analyses best link to the formal IA that is required to accompany site recommendations?

• There are lots of tools available and need to research how best to apply current methodologies.
• Matrix of requirements.
• MARXAN is a decision support tool.
• There are range of visualisation tools available, not just maps.
• Outputs need to be clearly presented with consideration of level of detail.
• CBA can be highly complex and can deter stakeholders.
• Conflict manager and provision of negotiation space.
• Meetings and stakeholder engagement.
• Could consider entire area as MPA and allow stakeholders to remove areas they consider to be most important to them.

Other issues raised at the workshop – the process & stakeholder engagement

Design guidelines and specific objectives for the network, which are fully understood by stakeholders, need to be available from the outset of the designation process. In this context there are concerns over the timescales available to implement the UK network which are shorter than those that have been conducted elsewhere. Consensus may not be the best overall aim (lowest common denominator) and some hard decisions will have to be made.

Discussions were held as to the value of a 1 or 2 step process for the designation of MCZs (See Section C3.3.1). A two-step process could be important for clarifying objectives and provide something on which to base discussions/deliberations. In contrast initial lines on maps (as part of 2-step) can antagonise stakeholders upfront. Uncertainty in the process for industry can deter involvement, but an open flexible process also allows potential to shape outcomes. It is also important to recognise that information is still required to produce the initial network design within a two step process. There is also uncertainty over how open the process would be and when the public will get involved.
The engagement with stakeholders will be essential throughout the designation process. The choice of an appropriate representative stakeholder for each sector would be essential and the individual selected would need to be respected and trusted to represent the interests of the sector as a whole. The relative costs to stakeholder groups are different and in this context stakeholders will need to respect each other. It is also important to highlight that stakeholders can be over burdened in terms of both time and resources when participating in consultation processes.

**C4 Conclusions**

- The consensus at the meeting was that the inclusion of socio-economic information should be as early in the process as possible;
- The use and application of tools in the process needed to be transparent to stakeholders. It was important that stakeholders understood the process, requirements and information before starting to plan.
- The use of datalayers and initial network design tools were seen as helpful to inform initial discussions and give stakeholders a ‘base’ to work form rather than a ‘blank sheet’. These would help to focus the work of the regional stakeholder groups. In contrast initial lines on maps could potentially antagonise stakeholders at the start of the process. Socio-economic factors, including non-spatial information, could be represented in a number of different ways (e.g. simple locational data, economic value, costs of constraints, distribution of natural resources), all of which could potentially be useful in supporting initial network design.
- It was preferable to initiate planning using existing available data rather than seeking to acquire comprehensive data prior to planning; the process of planning could help to identify additional data/information requirements.
- There was support for the use of national information in the initial design process followed by refinement with locally collected information.
Annex 1 – Outline Agenda

Day 1

13.00 Introduction and Welcome
13.10 MPA planning process – Chris Davis, Natural England
13.30 International case studies
   - Australia – Northern Territory, Ilse Kiessling
   - California – Ecotrust, Astrid Scholz
   - USA (including Florida, California, Georgia and Hawaiian Islands) – NOAA, Rod Ehler
   - Canada – Department of Fisheries and Oceans, Paul Macnab
   - Denmark - Agency of Spatial and Environmental Planning, Torben Wallach
15.30 Refreshments
15.45 MPA planning - Marine Conservation Biology Institute, Jeff Ardron
   UK Case Study - Finding Sanctuary – Tom Hooper
16.30 Summary of case study experiences
16.50 Discussion
17.15 Close of Day 1

Day 2

9.00 Introduction and welcome back
9.10 Measuring Socio-economic activity, eftec:
   - Approaches to measuring socio-economic activity.
   - The use of socio-economic information to support environmental decision making.
10.00 Available information, ABPmer
   - Locations of existing activities
   - Limitations of existing data
10.45 Refreshments
11.15 Possible process options, Jim Claydon
   - Review of possible process options
   - Working groups
   - Feedback and discussion
12.45 Lunch
13.30 Towards a possible process and information requirements, ABPmer and Peter Jones
14.15 Discussion and next steps
15.00 Close of Day 2
## Annex 2 – Attendees

<table>
<thead>
<tr>
<th>Attendee</th>
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<tr>
<td>Stephen Hull</td>
<td>ABP Marine Environmental Research Ltd</td>
</tr>
<tr>
<td>Justine Saunders</td>
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<tr>
<td>Natalie Frost</td>
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<td>Ilse Kiessling</td>
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<tr>
<td>Torben Wallach</td>
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<tr>
<td>Richard Hill</td>
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<tr>
<td>Paul Macnab</td>
<td>Canada</td>
</tr>
<tr>
<td>Andy Hill</td>
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<tr>
<td>Andy South</td>
<td>Centre for Environment, Fisheries &amp; Aquaculture Science</td>
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<td>Trond bjornd</td>
<td>The Centre for the Economics and Management of Aquatic Resources</td>
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<td>Adrian Lester</td>
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<td>Astrid Scholz</td>
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<td>Stephanie Hime</td>
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<td>Alan Storer</td>
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Appendix C Reference

Appendix D. Illustrative Contents of Regional Profile

This appendix illustrates the outline contents of the Draft Regional Profile for the North Coast California Marine Life Protection Act (MLPA) Initiative (California MLPA Initiative, 2009) and highlights the types and nature of information included within the socio-economic chapter. The draft profile also includes information on jurisdiction and management. This information is also important for socio-economic activities. The format could be adapted for the UK, particularly to take account of the wider range of economic activities but also to highlight social values.

1 Introduction

2 Overview of the MLPA North Coast Study Region

3 Ecological Setting

3.1 Marine Habitats and Communities
   3.1.1 Depth Categories
   3.1.2 Intertidal Zones
   3.1.3 Estuaries and Lagoons
   3.1.4 Seagrass Beds
   3.1.5 Kelp Forests
   3.1.6 Hard Bottom and Rocky Reefs
   3.1.7 Sandy and Soft Bottoms
   3.1.8 Underwater Pinnacles
   3.1.9 Submarine Canyons
   3.1.10 Offshore Rocks and Islands
   3.1.11 Oceanographic Habitats

3.2 Important Regional Species
   3.2.1 Depleted and Overfished Species
   3.2.2 Fished Species of Interest
   3.2.3 Special-Status Species

4 Land-Sea Interactions

4.1 Ecological Linkages

4.2 Coastal Watersheds and Land Use

4.3 Coastal Water Quality
   4.3.1 Point Sources
   4.3.2 Nonpoint Sources
   4.3.3 Impaired Water Bodies in the North Coast Study Region
   4.3.4 Existing Water Quality Protection Designations

4.4 Coastal Energy Projects
5 Socio-economic Setting

5.1 Coastal Counties

- *basic quantified information and trends on jobs and employment in coastal areas, together with population trends;*

  5.1.1 Del Norte County
  5.1.2 Humboldt County
  5.1.3 Mendocino County
  5.1.4 Population Projections

5.2 Native American Coastal Communities

  5.2.1 Native American Resource Use

5.3 Commercial Fisheries

  5.3.1 Port Complexes
  5.3.2 Description of Commercial Fisheries
  5.3.3 Commercial Landings

    - *time series information on numbers of vessels and fishermen and target species by port*
    - *time series (10 year) information on landings (tonnage and first sale value) by species, gear type;*

5.4 Kelp Harvesting and Aquaculture Leases

  5.4.1 Synopsis of Kelp Bed Lease Status, Kelp Harvest Regulations, and Algae Harvest
  5.4.2 Edible Algae Harvest
  5.4.3 Aquaculture Leases

    - *Time series information on landings and locations of activities*

5.5 Recreational Fisheries

  5.5.1 Modes of Fishing
  5.5.2 Recreational Fishing Effort

    - *Information on methods (shore/boat (commercial, rental), tactics, effort, catches (time series)*

5.6 Coastal Tourism

    - *Information on the location, intensity (numbers) of visitors) and value of coastal tourism*

5.7 Non-consumptive Uses

  5.7.1 Recreational Beach Use
  5.7.2 Boating
5.7.3 Scuba Diving and Kayaking

- Information on recreational uses (including beach-going, swimming, surfing, sailing, kayaking, diving, wildlife viewing, photography) including intensity (numbers of people) location and economic value

5.8 Dredging and Vessel Traffic
- 5.8.1 Dredging
- 5.8.2 Vessel Traffic

- Information on the location of dredging and disposal activities
- Information on port activity (throughput) and cargo types

6 Academic Institutions, Research, Public Outreach and Education

- 6.1 Marine Research Institutions in the North Coast Study Region
  - 6.1.1 Scientific Research and Collecting

- 6.2 Public Education and Outreach

7 Jurisdiction and Management

- 7.1 Federal, State, Local and Native American Jurisdiction and Programs
  - 7.1.1 Federal Agencies and Programs
  - 7.1.2 State Agencies and Programs
  - 7.1.3 Local Government Programs
  - 7.1.4 Native American Jurisdiction and Treaty Rights

8 Existing Marine Protected Areas (MPAs), Coastal Protected Areas and Federally Managed Areas

- 8.1 Existing State MPAs in the Study Region

- 8.2 Federally Managed Areas and Fishery Closures
  - 8.2.1 Federally Managed Areas
  - 8.2.2 Fishery Closures Within and Adjacent to the North Coast Study Region

- 8.3 Terrestrial Protected Areas in Coastal Watersheds

- 8.4 MPAs in Oregon

9 Conclusion

Appendix A: Spatial Data Layers Available
Appendix B: Profile of Commercial Fisheries
   B.1 Summaries of Commercial Fisheries by County
   B.2 Profiles of Major Commercial Fisheries in the North Coast Study Region
      B.2.1 Coonstripe Shrimp
      B.2.2 Dungeness Crab
      B.2.3 Hagfish
      B.2.4 Nearshore Finfish
      B.2.5 Salmon
      B.2.6 Sea Urchin
      B.2.7 Smelt
      B.2.8 Surfperch

Appendix C: Profile of the Recreational Fishery
   C.1 Data Used to Characterize the Recreational Fishery
   C.2 California Recreational Fisheries Survey (CRFS) Fishery Statistics, 2005 to 2008
      C.2.1 Catch and Effort by CRFS Sampling District for the North Coast of California
      C.2.2 CRFS Catch Estimates by Species and Fishing Mode
      C.2.3 CRFS Angler Reported Finfish Target Species
   C.3 California Department of Fish and Game (DFG) Ocean Salmon Catch Statistics, 2005-2008
   C.4 Commercial Passenger Fishing Vessel (CPFV) CPFV Logbook Data, 1999 to 2008: Dungeness Crab Catch Statistics

Appendix D: Special-Status Species Likely to Occur in the Study Region
   D.1 List of Special-Status Species
   D.2 Index of the Listing Codes Used In Table D-1
Appendix D Reference

Appendix E. Sources of Non-Spatial Socio-economic Information

The sources below provide non-spatial information relevant to socio-economic activities in the marine environment including some of the policy drivers, economic values of activities (e.g. turnover, investment), cost-benefit information (e.g. expenditure), and social aspects related to activities (e.g. regional sensitivities of related employment).

General Sources


Aquaculture


Coastal Defence


Defence


Education


Field Study Council. 2002. Teaching biology outside the classroom: Is it heading for extinction?

SEMPTA. 2006. Sector Skills Agreement for the UK Marine Sector.

Fisheries

Blackadder, A., Clayton, P., Copus, A., Mitchell, M., Petrie, S. and Sutherland, R. 2009. Lot 20: Scotland and Northern Ireland. In: Regional socio-economic studies on employment and the level of dependency on fishing. Final report to DGXIV European Commission (note that the content of this Final Report is the sole responsibility of its publisher(s) and it in no way represents the views of the Commission).


Leisure and Recreation


BMF. 2008. UK Leisure and Small Commercial Marine Industry Key Performance Indicators 2006/7


Nautilus consultants, 2005. The Motivation, Demographics and Views of South West Recreational Sea Anglers and their Socio economic Impact on the Region. Invest in Fish South west report.


Mining


Oil and Gas


Pipelines


Power Transmission


219
Scottish Executive. 2007. Scottish Marine Renewables: Strategic Environmental Assessment (SEA). Report prepared for the Scottish Executive by Faber Maunsell and Metoc PLC.

**Renewable Energy**


ODE. 2007. Study of the costs of offshore wind generation. A Report to the Renewables Advisory Board (RAB) & DTI.


Research and Development


Defra. 2004. Evidence and innovation: Defra’s needs from the sciences over the next 10 years.


**Gas Storage**


Telecommunications


Scottish Executive. 2007. Scottish Marine Renewables: Strategic Environmental Assessment (SEA). Report prepared for the Scottish Executive by Faber Maunsell and Metoc PLC.

Waste Disposal


Water Abstraction

DECC. 2009. Towards a nuclear national policy statement: Government response to consultations on the Strategic Siting Assessment process and siting criteria for new nuclear power stations in the UK; and to the study on the potential environmental and sustainability effects of applying the criteria. Office for Nuclear Development.


**Water Transport**


# Appendix F. Spatial Information Sources

## Key to Table F1

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<td>Spatial data exists but not yet compiled or the data may not be accessible or may need to be compiled from multiple sources</td>
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<tr>
<td>Red</td>
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## Abbreviations to Table F1

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<td>regions</td>
<td>closed areas, specific for individual species</td>
</tr>
<tr>
<td>restricted shell</td>
<td>areas where fishing is restricted, specific for</td>
</tr>
<tr>
<td>fishing regions</td>
<td>individual species</td>
</tr>
<tr>
<td>Classified Bivalve</td>
<td>areas where shell fishing takes place, specific</td>
</tr>
<tr>
<td>Harvesting Areas</td>
<td>for individual species</td>
</tr>
<tr>
<td>EC Classified Shellfish</td>
<td>location and classification of shellfish beds</td>
</tr>
<tr>
<td>waters Directive</td>
<td></td>
</tr>
<tr>
<td>Effort - VMS</td>
<td>Effort (and value) by gear type within UKCS</td>
</tr>
<tr>
<td></td>
<td>- Dredges</td>
</tr>
<tr>
<td></td>
<td>- Hooks and Lines</td>
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<td></td>
<td>- Nets</td>
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<td>- Seines</td>
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<td></td>
<td>- Traps</td>
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<td></td>
<td>- Trawls (Pelagic/Bottom)</td>
</tr>
<tr>
<td>Effort - non-VMS</td>
<td>Effort (and value) by gear type</td>
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<td>- Dredges</td>
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<td>- Hooks and Lines</td>
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<td>- Trawls (Pelagic/Bottom)</td>
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<tr>
<td>Activity</td>
<td>Sub-Activity</td>
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<tr>
<td>Shell fishing areas</td>
<td></td>
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<tr>
<td>Inshore Fisheries</td>
<td>Local fishing areas</td>
</tr>
<tr>
<td>Inshore fisheries</td>
<td>Value of key fishing grounds (by species e.g. various crustacean and molluscan shellfish, specific finfish grounds (sole, plaice etc))</td>
</tr>
<tr>
<td>Marina Developments</td>
<td>Location of marinas developments</td>
</tr>
<tr>
<td>Marinas Locations</td>
<td>Locations of existing and proposed marinas and numbers of berths</td>
</tr>
<tr>
<td>Slipway Locations</td>
<td>Location of slipways</td>
</tr>
<tr>
<td>Recreational Sailing Routes</td>
<td>Indicative location of coastal Recreational Sailing Routes</td>
</tr>
<tr>
<td>Recreational Sailing and Racing Areas</td>
<td>Indicative location of recreational Sailing and Racing Areas</td>
</tr>
<tr>
<td>Sailing Clubs</td>
<td>Indicative location of coastal Sailing Clubs</td>
</tr>
<tr>
<td>Watersports Centres</td>
<td>Indicative location of coastal Watersports Centres</td>
</tr>
<tr>
<td>Recreational fishing - shore</td>
<td>Shore fishing locations</td>
</tr>
<tr>
<td>Recreation fishing - boat</td>
<td>Private and charter recreational angling areas</td>
</tr>
<tr>
<td>Diving areas</td>
<td>Indicative location of coastal diving areas (Recreational and otherwise)</td>
</tr>
<tr>
<td>EC Bathing waters</td>
<td>Designated bathing beaches showing classification levels of 1) Not classified, 2) Closed, 3) Fail, 4.5) Imperative, 5) Guideline</td>
</tr>
<tr>
<td>EC Bathing waters NI</td>
<td>Designated bathing beaches showing classification levels of 1) Not classified, 2) Closed, 3) Fail, 4.5) Imperative, 5) Guideline</td>
</tr>
<tr>
<td>Blue Flag Beaches</td>
<td>Indicative location of Blue Flag Beaches - Blue Flag is a prestigious, international award scheme which acts as a guarantee to tourists that a beach or marina they are visiting is one of the best in the world. It is awarded to coastal destinations which have achieved the highest quality in water, facilities, safety, environmental education and management</td>
</tr>
<tr>
<td>Restricted Sailing Areas</td>
<td>Indicative location of coastal Restricted Sailing Areas</td>
</tr>
<tr>
<td>Power Boat Racing Zones</td>
<td>Indicative location of coastal Power Boat Racing Zones</td>
</tr>
<tr>
<td>Surfing Areas</td>
<td>Indicative location of coastal Surfing Areas</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>Sand &amp; Gravel extraction</td>
</tr>
<tr>
<td>Aggregates</td>
<td>Designing Application Areas (Government view areas)</td>
</tr>
<tr>
<td>Dredging Option Areas</td>
<td>Location and Attributes of Dredging Option areas</td>
</tr>
<tr>
<td>Active Dredging Areas</td>
<td>Location and Attributes of Active Dredging Zones (by year)</td>
</tr>
<tr>
<td>Dredging Prospecting Areas</td>
<td>Precursor to fully licensed dredge area</td>
</tr>
<tr>
<td>Extraction</td>
<td>Sea salt extraction</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>Oil &amp; gas production and development sites</td>
</tr>
<tr>
<td>Activity</td>
<td>Sub-Activity</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>Indicative value</td>
</tr>
<tr>
<td>Interconnectors</td>
<td>Interconnectors</td>
</tr>
<tr>
<td>Hydro Blocks</td>
<td>Hydrocarbon Blocks</td>
</tr>
<tr>
<td>Licences</td>
<td>Current licence blocks</td>
</tr>
<tr>
<td>Surface infrastructure (Oil &amp; Gas)</td>
<td>Platforms, FPSOs, buoys etc.</td>
</tr>
<tr>
<td>Subsea infrastructure (Oil &amp; Gas)</td>
<td>Locations of manifolds, tees, anchors etc.</td>
</tr>
<tr>
<td>Safety zones (Oil &amp; Gas)</td>
<td>Shipping exclusion areas</td>
</tr>
<tr>
<td>Pipelines</td>
<td>Pipelines</td>
</tr>
<tr>
<td>Power transmission</td>
<td>Submarine cables</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>Wave power generation existing sites</td>
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<td></td>
<td>Wave power generation proposed sites</td>
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<td></td>
<td>Wave power generation potential sites</td>
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<td></td>
<td>Pentland Firth Strategic Area</td>
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<tr>
<td></td>
<td>Wave power resources</td>
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<td></td>
<td>Tidal power generation existing sites</td>
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<td></td>
<td>Tidal Power indicative value layer</td>
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<td></td>
<td>Tidal power generation proposed sites</td>
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<tr>
<td></td>
<td>Tidal power generation potential sites</td>
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<td></td>
<td>Pentland Firth Strategic Area</td>
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<tr>
<td></td>
<td>Potentially exploitable tidal stream areas</td>
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<tr>
<td></td>
<td>Tidal stream power resources</td>
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<tr>
<td></td>
<td>Indicative value of tidal stream power generation</td>
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<td></td>
<td>Potential tidal range locations</td>
</tr>
<tr>
<td>Wind</td>
<td>Producing Wind Farm Developments</td>
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<tr>
<td>Activity</td>
<td>Sub-Activity</td>
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<tr>
<td>Producing Wind Farm Developments</td>
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<td></td>
<td>WF Lease R1</td>
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<td></td>
<td>WF Tender R1</td>
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<td></td>
<td>WF Lease R2</td>
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<td></td>
<td>WF Tender R2</td>
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<td>WF Turbines</td>
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<td></td>
<td>WF cables</td>
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<td></td>
<td>WF Proposed</td>
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<tr>
<td>Storage</td>
<td>Carbon capture and storage</td>
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<td></td>
<td>Gas storage</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>Cables UC</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>Outfalls &amp; Discharges</td>
</tr>
<tr>
<td>Water Abstraction</td>
<td>Cooling Water Intakes</td>
</tr>
<tr>
<td>Water transport</td>
<td>Dredging Areas maintained for</td>
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<tr>
<td></td>
<td>Navigation</td>
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<tr>
<td></td>
<td>Barge &amp; Spot Disposal Sites</td>
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<tr>
<td></td>
<td>Shipping</td>
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<td></td>
<td>Shipping routes, intensity of</td>
</tr>
<tr>
<td></td>
<td>use by vessel type &amp; size.</td>
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<td></td>
<td>Port, harbour &amp; marine boundaries. Navigational aids</td>
</tr>
<tr>
<td></td>
<td>Shipping Separation zones</td>
</tr>
<tr>
<td></td>
<td>Indicative location of shipping separation lanes</td>
</tr>
<tr>
<td></td>
<td>Mooring &amp; Anchorage areas</td>
</tr>
<tr>
<td></td>
<td>The indicative location of Mooring and anchorage areas</td>
</tr>
<tr>
<td>Ports</td>
<td>Locations of ports</td>
</tr>
<tr>
<td></td>
<td>Indicative locations of ports</td>
</tr>
<tr>
<td>Archaeological</td>
<td>Protected Wrecks</td>
</tr>
<tr>
<td></td>
<td>Potentially Polluting wrecks</td>
</tr>
<tr>
<td></td>
<td>NMR Records</td>
</tr>
<tr>
<td></td>
<td>Historic landforms shaped by glacial, fluvial, marine and geological processes</td>
</tr>
</tbody>
</table>

Appendix G. Indicative List of Relevant Policies

This appendix provides an indicative list of current international and national policy documents relevant to marine areas within which Marine Conservation Zones will be designated. Additional policies may apply at regional and local level, for example, contained within Regional Spatial Strategies and Local Development Documents and in other local management plans (for example, Shoreline Management Plans, Port Master Plans, Beach Management Plans etc).

General Policies


European Commission, 2005a. European Employment Strategy

European Commission, 2005b. Second European Climate Change Programme – ECCP II


European Commission, 2007a. Adapting to Climate Change in Europe – Options for EU Action


United Nations, 2007. UN Framework Convention on Climate Change
Aquaculture


Coastal Defence and Flood Protection

Department of the Environment, Food and Rural Affairs, 2004. Making Space for Water

Defence


Fisheries


European Commission 1983, Common Fisheries Policy


Leisure and Recreation


Mining


Oil & Gas


Pipelines


Power Transmission


Renewable Energy


Department of Energy and Climate Change, 2009d. Draft National Policy Statement for Electricity Networks Infrastructure (EN-5)


Research

Department of the Environment, Food and Rural Affairs, 2004. Evidence and innovation: Defra’s needs from the sciences over the next 10 years.

Department of the Environment, Food and Rural Affairs, 2006. Our approach to evidence and innovation.

Storage


Telecommunications


Waste Disposal


Water Abstraction

Department for Energy and Climate Change, 2009. Towards a nuclear national policy statement: Government response to consultations on the Strategic Siting Assessment process and siting criteria for new nuclear power stations in the UK; and to the study on the potential environmental and sustainability effects of applying the criteria. Office for Nuclear Development.


Water Transport

Department for Transport, 2000a. 10 Year Transport Plan.


Appendix H. Outline Methodology for the Proportionate Application of a Cost Benefit Analysis Framework to Marine Protected Area Network Section

H1. Qualitative/First-cut Analysis

The initial step in incorporating socio-economic evidence should be a qualitative or first cut analysis. This should summarise the available social and economic evidence, the location of socio-economic activities, relevant policies pertaining to those activities, any market values available e.g. value of current fish catch, and any valuation evidence from published and grey literature. The main purpose of the first cut approach is to provide an input to the initial consideration of the list of potential sites for consideration as Marine Protected Areas (MPAs). It can provide an indication of the magnitude of socio-economic value evidence from the literature, which may be used to highlight possible orders of magnitudes of socio-economic benefits and costs and to focus on the most important impacts. It can also help to identify policy priorities amongst impacted sectors. As part of this process listing those who stand to win/lose from any site designation can also be a valuable way of checking that all relevant stakeholders are included in the process and that social aspects are adequately captured.

The first step of this approach within the context of MPA network design is to establish the type of socio-economic effects the MPA network is likely to have and the possible policy consequences. The most obvious impacts will be the first-round / direct effects of excluding certain activities. Further second- and third-round indirect effects can also be expected, due to displacement of activities to other areas, and due to the environmental impacts of designation and the effect that these have on ecosystem services within and around the designated area. Where possible this should be informed by Environmental Impact Assessment (EIA) and/or Strategic Environmental Assessment (SEA) outputs However, this is unlikely to be available during a first cut analysis and may dependent on more qualitative estimates of damage.

H1.1 Designation Against a Baseline

Establishing a consistent and appropriate baseline (counterfactual case) is crucial to providing an accurate assessment of the ecosystem service impacts the designation of a MPA may have. In principle, we want to compare the "with MPA network" scenario with a scenario of what would happen if MPAs are not designated: a "business as usual" scenario. However, changing conditions, in particular climate change, but also social and economic changes, mean that the baseline is not static. This may be difficult to take into account, which may lead us to consider a “status quo” scenario instead.

For each proposed MPA, additional considerations arise concerning the determination of system boundaries in space and time (i.e. the area to be included in
the analysis and the time period over which the assessment is to be made). Impacts may occur well outside the area under consideration, and the communities currently using the area, due for example to movements of fish stocks, displacement of fishing effort and so on. Essentially, all changes between the baseline and the potential MPA under analysis need to be taken into account, and guidelines will be needed to ensure the boundaries are set appropriately to allow for this.

Based on ecosystem services framework defined above and an understanding of how different MPA site designations can affect ecosystem service provision, a qualitative assessment of these changes can be used to show the potential socio-economic effects of designation (See Table H1 for an example) and possible policy implications. Table H1 identifies the changes in final ecosystem service provision qualitatively when considering the designation of an MPA at site ‘x’ using the following categories to describe the direction of the affect on ecosystem services and the scale of the impact.

Table H1: Example of how the designation of Site ‘x’ as an MPA might change ecosystem service provision (the list included is not exhaustive)

<table>
<thead>
<tr>
<th>Ecosystem Services</th>
<th>Marine env</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>Commercial fish catch (F)</td>
<td>Use of catch data and fish prices to determine any potential loss as a result of designation</td>
</tr>
<tr>
<td></td>
<td>Shellfish catch (F)</td>
<td>As for commercial fish</td>
</tr>
<tr>
<td></td>
<td>Local small-scale fishing (F)</td>
<td>Data likely to be unavailable, potentially need to gather data from local fishermen</td>
</tr>
<tr>
<td>Fibre/materials</td>
<td>Aggregate extraction(F)</td>
<td>Dependent on where the designation of the MPA is i.e. will aggregate extraction need to stop? If so data relating to the amount of any aggregate left along with the price for such aggregates enable the identification of the costs</td>
</tr>
<tr>
<td>Fuel</td>
<td>Renewable energy (F)</td>
<td>Value of changed capacity for renewable generation + the cost of such generation</td>
</tr>
<tr>
<td>Water -</td>
<td>Regenerative services (re-filling rock pools etc.)</td>
<td>This will only need to be considered if a change in the current situation results in a change or loss of the associated habitat types (if yes, data will be needed relating to these habitats specifically) – this could be through the use of benefits transfer, but care is needed to avoid double counting</td>
</tr>
<tr>
<td>Natural medicines</td>
<td>Plant used for natural medicine or other products (F)</td>
<td>Value of lost input into the production of the products involved i.e. cost of going elsewhere for ingredients. This data is unlikely to be available</td>
</tr>
<tr>
<td>Biochemicals and genetics</td>
<td>-</td>
<td>This would relate to the opportunity cost of future resources for the biochemical and genetics industries (no data available for this)</td>
</tr>
<tr>
<td>Ornamental resources</td>
<td>Shell collection, beach souvenirs</td>
<td>If this is stopped as a result of designation, consideration should be given to the cost of obtaining inputs i.e. shells from elsewhere (in the case of traded souvenirs) and the value to individuals of shell collection (data is unlikely to be available for this part)</td>
</tr>
<tr>
<td>Regulating services</td>
<td>C sequestration (F)</td>
<td>+</td>
</tr>
<tr>
<td>Ecosystem Services</td>
<td>Marine env</td>
<td>Notes</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
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</tr>
<tr>
<td>Water regulation</td>
<td>E.g. flood prevention (F)</td>
<td>0</td>
</tr>
<tr>
<td>Water purification</td>
<td>Detoxification of water</td>
<td>-</td>
</tr>
<tr>
<td>Erosion regulation</td>
<td>0</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>Cultural services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spiritual, religious, cultural heritage</td>
<td>E.g. archaeological ruins</td>
<td>0</td>
</tr>
<tr>
<td>Recreation &amp; ecotourism, bird watching (F) &amp; water sports</td>
<td>E.g. estuarine &amp; sea angling</td>
<td>+</td>
</tr>
<tr>
<td><strong>Supporting services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil form. &amp; retention</td>
<td>0</td>
<td>Some or all of these services are likely to be included within other final services values listed above – therefore care as to how much value is associated with each of these services is needed</td>
</tr>
<tr>
<td>Cycling processes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Primary production</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Habitat provision</td>
<td>++</td>
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</tr>
</tbody>
</table>

F = Final service

This initial qualitative assessment helps to illustrate the magnitude of benefits and costs of MPA site designation and policy implications and can be used to inform the overall designation process. As the assessment is intended to be a quick look at the available evidence the information used can cover some or all of Total Economic Value (TEV) depending on easy availability of data. Likewise the type of data presented is not restricted to that based solely on valuation but can include other data such as the location of economic activities within the proposed MPA.

**H1.2 Is the First Cut Sufficient?**

The main purpose of the first cut is to provide an input to the initial consideration of the list of potential MPA options, where there is a choice between sites, as easily and quickly as possible. It provides an indication of the magnitude of social impact and economic value evidence from the literature along with an understanding of the relative magnitude of the costs and benefits relating to designation.

But the first cut is just that – it is a quick look at the social impact and economic value evidence available in the literature. In most if not all cases, it will not be sufficient for direct use in a Cost Benefit Analysis (CBA) and will not be sufficient to solve problems where conflicts exist between different stakeholder groups. In this sort of situation additional economic evidence can be gathered and submitted into the deliberation process; however, this will be dependent on the time and resources available and the nature of conflicts. The next section gives a brief overview of the more detailed efforts that can be used where further social assessment or valuation evidence may be required.

**H2. Options for More Detailed Work**

**H2.1 Economic Valuation Methods**

The following valuation methods have been developed to quantify TEV (or parts of it) in monetary units, and can be used to obtain more detail of the socio-economic
impacts associated with MPA site designation:

- Market values;
- Revealed preference methods; and
- Stated preference methods.

These methods are more or less applicable to different categories of good/service and of TEV, as outlined briefly below. It is important to note that the “Total” in TEV does not imply the “value of the totality of the resource”, but rather the “sum of all types of economic value” for this resource. In the Impact Assessments the need is to value the changes in resources, not the total value of resources: the measure sought is therefore the Total Economic Value of the changes under consideration.

- **Market values:** Many goods and services, including some provided by the ecosystem services of the coastal and marine environment, are market goods (e.g. commercial fish catch). The market price at which a good is exchanged reveals information on its marginal economic value. However this can not be used directly to value big changes in provision, because many buyers may be willing to pay more than the market price to obtain the good; and many sellers may be prepared to accept lower prices to sell the good. The difference between the maximum amount a buyer is willing to pay and the actual price paid is termed **consumer surplus**; similarly difference between the minimum amount a seller is willing to accept and the actual price received is termed **producer surplus**. Full economic value is the sum of **consumer and producer surplus** for all units traded. Estimating this requires several observations of price-quantity combinations, enabling the estimation of a demand curve for the good, and data on the (opportunity) costs of providing the good.

- **Non-market goods:** Many uses and services supported by environmental resources are not traded in markets and are consequently ‘un-priced’, but this does not mean "un-valued". For these non-market goods the metrics of ‘willing to pay’ (WTP) and ‘willingness to accept compensation’ (WTA) are the relevant measures: depending on the starting point, their value is the maximum amount that an individual would give up to secure them (WTP) or minimum she would accept as compensation for losing them (WTA). The contrast with market goods is that since there is no price paid for the non-market resource, WTP and WTA are composed wholly of consumer surplus.

The following paragraphs describe the types of valuation that can be used along with how they might be applied in the context of the designation of the Marine Protected Area Network (MPAN).

- **Revealed preference methods:** Indirectly estimate the use value of non-market goods and services by observing behaviour related to market goods and services. A classic example is valuing the water environment through the cost (both money and time) incurred in undertaking water-based or water-affected recreation activities. Specific valuation methods include:
  - **Hedonic pricing method:** estimates the use value of a non-market good or service by examining the relationship between the non-market good and the demand for some market-priced complementary good. For example, statistical
comparison of the prices of properties located in the area affected by the designation of an MPA (e.g. change in value of waterfront properties if water pollution dropped to levels that were safe for bathing) with identical properties located in another location where there are high levels of pollution could show the effect of MPA designation on house prices.

- **Travel cost method:** is a survey based technique that uses the cost incurred by individuals travelling and gaining access to a recreation site for example, travel costs of individuals visiting and participating in recreation (e.g. sea angling in the marine environment) as a proxy for the recreational use value of that site. In part, travel costs determine the number of visits an individual may undertake and may be seen as the ‘price’ of a recreational visit to a particular site; comparing visitation rates from populations facing different travel costs allows estimation of a demand curve for the resource.

- **Stated preference methods:** Can estimate the TEV of a change in the provision of non-market goods and services by directly asking individuals, via questionnaire surveys, what they would be willing to pay or accept for a specified change in the provision of the good. Valuation methods include:
  - **Contingent valuation:** a survey-based approach to valuing non-market goods and services. The approach entails the construction of a hypothetical, or ‘simulated’, market via a questionnaire where respondents answer questions concerning what they are willing to pay (or willing to accept) for a specified environmental change (the trade-offs respondents make constitute the simulated market). In the case of the marine environment one might ask respondents what they would be willing to pay to protect part of the marine environment, or particular goods and services of the marine environment.
  - **Choice modelling:** covers a variety of questionnaire based methods that infer WTP (or WTA) indirectly from responses stated by respondents. Instead of directly asking WTP (or WTA) questions as in a contingent valuation survey, choice modelling questionnaires present respondents with choices between different options for delivery of a good or service characterised by different levels of a set of ‘attributes’. If each option has a ‘price’ attached (e.g. in terms of increased bills, taxes, entrance fees, etc.), subsequent analysis of respondents’ choices reveal their willingness to pay (or accept) for each of the attributes presented to them. For example one might ask respondents to trade-off different ‘future’ marine management scenarios in an area in which different options for MPA designations are available.

An alternative to these methods that can be used for primary research is value transfer which makes use of previous studies’ TEV estimates.

### H2.2 Value Transfer

**Value transfer** is defined as the transposition of economic values estimated at one site (the ‘study’ site) to another site (the ‘policy’ site). The study site refers to the site where the original study took place, while the policy site is a new site where information is needed about the economic value of similar benefits. In the context of this project, the policy site is the potential MPA. The rationale for benefits transfer is that using previous research results saves effort and expenditure involved in undertaking original research. The result will never be as good as an original
valuation study, and the key to its application therefore is to assess acceptable errors and the impact thereof on the CBA outcome.

In practice, there are several approaches to value transfer, which differ in the degree of complexity, the data requirements and the reliability of the results, namely:

(i) Unit value transfer

| value estimate [e.g. £/ha] | MPA option appraisal [£/ha] |

(ii) Function transfer

| valuation function [e.g. £/ha = f (X_{SS})] | MPA option appraisal [£/ha = f (X_{PS})] |

Where X is a set of factors that are found to statistically influence economic value, PS is the policy site i.e. the potential MPA and SS is the study site.

Although value transfer is used extensively in practice and is certainly a valuable input to appraisal, its limitations should be recognised. The robustness of value transfer will be dependent on the success of ‘matching’ the potential MPA in terms of it’s environmental and socio-economic circumstances to an appropriate study site and the quality of the original economic valuation study.

However, where there are significant differences between the study site and the potential MPA, a number of strategies may be employed that ‘adjust’ economic value estimates accordingly including for example accounting for differences in income.