Valuing Environmental Impacts: Practical Guidelines for the Use of Value Transfer in Policy and Project Appraisal

Case Study 5 – The Benefits of Designation of Marine Conservation Sites

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CASE STUDY 5: THE BENEFITS OF DESIGNATION OF MARINE CONSERVATION SITES

- *The policy context for Case Study 5 is the recent proposals to designate offshore marine sites as Special Areas of Conservation under the EU Habitats Directive (Council Directive 92/43/EEC).*
- *The case study provides an illustration of instances where complexity in defining the policy good (Step 2) and lack of data to quantify the change in provision of the policy good (Step 3) provide significant challenges to undertaking value transfer.*
- *The coverage of the available economic valuation literature also provides a significant barrier to undertaking value transfer (Step 4).*
- *In the absence of necessary information for value transfer, a qualitative assessment of benefits is provided.*

STEP 1: ESTABLISH THE POLICY GOOD DECISION-CONTEXT

The Joint Nature Conservation Committee (JNCC) is responsible for identifying areas suitable as Special Areas of Conservation (SACs) in the UK's offshore waters (see **Box 1**). The habitat types listed in Annex I of the Habitats Directive that are relevant to the UK's offshore waters are reefs, sandbanks, and submarine structures made by leaking gases. Nomination of these sites is based on scientific criteria, but an Impact Assessment (IA) of designation is required to fully understand the costs and benefits of designation before it is finalised.

The time and resources necessary to carry out a primary study across a representative sample of the UK for a single marine sight are disproportionate to the needs of the decision-making context. As such, value transfer is the preferred method of estimating the value of benefits of conservation of a site.

As of May 2009, there are five sites that are candidate SACs (cSACs), which have been submitted to the European Commission but have not yet had formal approval (**Table**). The sites are the first group of offshore marine protected areas in UK waters to go through the process of impact assessment, formal consultation, and recommendation.

Table 1: Summary of cSAC sites as of May 2009

Site	Location	Qualifying feature(s) of interest
Braemar Pockmarks	240 km east of Orkney	Submarine structures
Darwin Mounds	160 km north of Cape Wrath	Reefs
Haig Fras	95 km northwest of Scilly	Reefs
Scanner Pockmark	185 km off northeast coast of Scotland	Submarine structures
Stanton Banks	South of Outer Hebrides	Reefs

This case study focuses on one of these sites, Haig Fras, based on the Impact Assessment carried out for the JNCC (eftec, 2008).

Box 1: Policy background to designation of marine conservation sites

- The EU is party to international agreements on biodiversity (e.g. Convention on Biological Diversity, Convention on the Conservation of Migratory Species of Wild Animals).
- Targets on halting the loss of biodiversity have been established through multiple regulations and commitments, including the Birds Directive (Council Directive 79/409/EEC), Habitats Directive, and the EU Biodiversity Strategy and Biodiversity Action Plans.
- All of the above include the marine environment, which is subject to the Natura 2000 network of Special Protection Areas (under Birds Directive) and SACs (under Habitats Directive).
- The Habitats Directive (under Article 4) requires that Member States propose a list of sites that host habitat types listed in Annex I as SACs. These are areas where conservation measures should be put in place to avoid habitat deterioration.
- Once designated, special provisions apply to the consideration of projects proposed within the site boundaries that are not directly connected with the management of the site for conservation purposes; in order to ensure that carrying out any such project does not adversely affect the integrity of the site.

STEP 2: DEFINE THE POLICY GOOD AND AFFECTED POPULATION

What is the good to be valued?

Haig Fras is an isolated, fully submarine bedrock outcrop that "supports a variety of fauna ranging from jewel anemones and Devonshire cup coral near the peak of the outcrop to encrusting sponges, crinoids and ross coral towards the base of the rock" (JNCC, 2008). It is situated within the Western English Channel and Celtic Sea Regional Sea, 95 km northwest of the Isles of Scilly. The site is 481 km^2, covering approximately 356.5 km^2 of bedrock reef.

As with all marine sites, Haig Fras features a complex mix of environmental attributes which provide a range of market and non-market goods and services. An ecosystem services approach provides an appropriate framework for assessing the benefits of conservation of this site. A selection of final benefits from the marine environment to human populations that is potentially relevant to Haig Fras was identified (and is similar for other offshore marine sites) (**Table 2**). Note that these represent a mix of use and non-use values.

Table 2: Final services associated with Haig Frais	
Ecosystem services	***Final benefits to human populations***
Provisioning	Fish for human consumption
	Fish for non-human consumption
Regulating	Carbon sequestration
	Coastal protection
Cultural	Scientific Research
	Archaeology
	Scuba diving
	Sea angling
	Non-use Values: Existence, bequest, and altruistic values can be present for all of the above ecosystem service categories, but are included separately for better illustration of site value
Supporting	*(Supporting services underlie provision of all other services and are not included in valuation to avoid double-counting)*

Who is the affected population?

Given the range of ecosystem goods and services associated with the site, the affected population is broadly defined, but can be constrained for the purposes of the IA:

- The provision of the majority of these goods and services is mainly associated with the regional (i.e. south-west England) or national (i.e. England) scale.
- The site is also of European importance; however the benefits accruing to other European countries or further afield are likely to be smaller than those accruing to the UK and are not considered here.

As such, it is determined that the geographic scope of benefits matches the jurisdiction of JNCC appropriately. JNCC is the statutory adviser to Government on UK and international nature conservation and delivers the responsibilities of the four country nature conservation agencies. In total, this covers all of the approximately 25 million households in the UK.

STEP 3: DEFINE AND QUANTIFY THE CHANGE IN THE PROVISION OF THE POLICY GOOD

Qualitative assessment

The expected change in the site intended by designating it as a SAC is restoration to and maintenance at favourable conservation status[1]:

[1] Favourable conservation status is defined in Article 1 of the Habitats Directive. "The conservative status of a natural habitat will be taken as "favourable" when:
- its natural range and areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and

- The baseline comparison is business as usual (BAU), which in the context of Haig Fras and other offshore SACs, essentially means continued potential for damage from commercial fishing. The effect of continued fishing in the area would mainly be continued physical and biological disturbance from demersal fishing[2]. Over time, this would likely lead to a decrease in the provision of the ecosystem services the site provides. Additionally, there is one transatlantic cable that runs through the SAC, but its continued presence is unlikely to cause much additional impact.
- Designating the site would prohibit fishing activity at the site. This would halt further decline in the provision of ecosystem services, and potentially lead to an improvement; for example the biological productivity of fish could increase.

Overall, the benefit of designating the site is defined as the provision of environmental benefits above the BAU scenario.

Quantitative assessment

Quantifying the expected benefits is difficult due to uncertainty in ecosystem functioning which arises from its complexity and lack of defining barriers (e.g. species are not restricted to the site boundary). More specifically, the lack of data can be categorised accordingly:

- *Baseline*: there are no detailed studies on the 'business as usual' status of the site.
- *Favourable conservation status*: the level of benefits at favourable conservation status is not specifically known as the definition of this status is qualitative and open to expert interpretation.
- *Increase in environmental benefit*: with uncertainty in the baseline and uncertainty in the final state, the change in environmental benefits is difficult to quantify. Complexity of that quantification increases considering the nature of the marine habitat, which is inherently transient.

Given the lack of quantitative data the assessment of the change in provision of the policy good is limited to a qualitative determination that designation will improve conservation status and provide environmental benefits. Specifically:

- *Baseline*: the detrimental impact of demersal fishing on vulnerable habitats is well understood.
- *Favourable conservation status*: although categorical, the definition of favourable conservation status specifically requires a maintenance or augmentation of healthy habitat.
- *Increase in environmental benefit*: designation will remove damaging agents from the site, allowing it to recover to favourable conservation status, which has been shown in many similar contexts to have ecological and human value.

- the conservation status of its typical species is favourable as defined in (i);

(i) The conservation status will be taken as "favourable" when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."

[2] Demersal fishing targets species that live at or near the sea floor and fishing techniques employ various types of gear, including trawlers.

Data sources

No quantitative, site-specific data are available.

STEP 4: IDENTIFY AND SELECT MONETARY VALUATION EVIDENCE

The difficulty in quantifying the expected benefits of designating Haig Fras as a SAC limits the scope for estimating the monetary value of benefits, either via value transfer or an original study. However, review of existing valuation evidence identified a selection of relevant studies.

Existing valuation studies

There are numerous studies available on valuation of specific marine sites. A useful categorisation in the context of this case study is:

i). *Valuation of a single attribute* - Studies focused on a single attribute of the marine environment, such as water quality;
ii). *Valuation of a specific use* - Studies that cover multiple attributes, but are focused on the use and willingness to pay (WTP) of a very well-defined affected population (e.g. divers' WTP for a specific dive site); or
iii). *Valuation of a large area of marine habitat* – Studies focused on the benefits of a large area of marine habitat, some looking at an overall network of conservations sites, rather than a specific site.

Studies within (i) and (ii) are considered not relevant to the context of this example:

- They sample recreational users of marine sites; in contrast there is minimal recreational activity at Haig Fras and other UK offshore marine sites;
- The scope of the IA is to determine the value of benefits to the UK public in general, which is comprised of recreational use value (i.e. a small number of sea anglers) as well as other distant users and non-users who value conservation of the site; and
- No studies focus on sites that are ecologically similar; the majority focus on tropical or Mediterranean/Californian marine habitats, with very little valuation having been carried out on temperate marine habitats.

Studies within (iii) are more relevant for Haig Fras. Specifically a series of recent studies have been carried out under commission from Defra to value the benefits of UK marine habitat, focused on a network of Marine Conservation Zones (MCZs) in UK waters. These studies include:

- Beaumont et al. (2006) *Marine biodiversity: An economic valuation;*
- Richardson et al. (2006) *Developing Scenarios for a Network of Marine Protected Areas: Building the evidence base for the Marine Bill*);
- Moran et al. (2007) *The Marine Bill – Marine Nature Conservation Proposals – Valuing the Benefits;* and
- Scottish Agricultural College (2008) *Determining monetary values for use and non-use goods and services – Marine Biodiversity – primary valuation*.

Matching the study good to the policy good

There are a number of criteria for matching the study good to the policy good:

i). Similarity of the policy good and study good
ii). Similarity of the change in provision of the policy good and study good
iii). Similarity of the sites where the policy good and study good are found
iv). Similarity of the policy good and study good affected populations
v). Similarity of the policy good and study good market constructs
vi). Similarity of the number and quality of substitutes for the policy good and study good

The relevant studies deal with a network of marine sites or a large area of marine habitat that implicitly encompasses many 'sites' important to marine biodiversity. The value of a single site within such a network is only fully realised when it is actually part of a functioning network of sites. In other words, the value of a single site is dependent on positive network effects (**Box 2**).

Box 2: Positive network effects

- A network effect is a positive externality arising from the presence of one additional good in the economy. The classic example is the telephone. When one user buys a telephone it is valuable to them, but it also makes everyone else's telephone more valuable because they can now contact more people than they could before.
- Network effects are important for all ecosystems, but particularly for the marine environment which lacks many physical barriers, meaning that species are generally highly mobile and dependent on numerous sites through their lifecycle.
- Some ecosystem services do not originate from a particular source, but originate throughout the marine environment in a nearly continuous manner (e.g. carbon sequestration capacity of the open ocean).

Beaumont et al. (2006) used various methods to separately estimate the value of numerous ecosystem services arising from biodiversity in the UK marine environment. Although there was caution in that paper on aggregating the values of separate ecosystem services, the research clearly indicates that the UK marine environment is worth many billions (£).

Following that initial research, and specifically building the evidence base for the Marine Bill, Richardson et al. (2006) developed hypothetical scenarios for a network of MCZs in UK waters that were used as the basis for two separate valuation studies to value the benefits of the Marine Bill. This study suggests that the benefit of the MCZ network to the entire UK population is £0.5bn to £1.2bn per year.

Beaumont et al. used the ecosystem approach across the entirety of UK waters. The evidence for the Marine Bill built on this and looked specifically at a network of sites within UK waters. The second is a much smaller area, but would be selected to make an effective contribution to protecting "areas important for rare, threatened and representative habitats and species."[3] The scenarios used in those

[3] Paragraph 1, Part 5, Marine and Coastal Access Bill Policy Document, last updated 29 June 2009.

valuation studies included designation of Haig Fras as one of the Special Area of Conservation within the MCZ network.

It is tempting to scale the benefits of the entire UK marine environment or MCZ network to a single site. However, there are two main reasons why this would be a difficult, if not inappropriate use of value transfer, one methodological and one conceptual:

- Methodological - The relevant literature only provides aggregate values of ecosystem services, meaning that assumptions have to be made on apportioning a given level of ecosystem service to a particular marine habitat type (e.g. reefs compared to sandbanks) or sites, for which no relevant quantitative data was identified, and
- Conceptual - The value of a single site standing alone is incommensurate with the value of that site within a network due to network effects.

In the case of the UK marine environment, the importance of accounting for network effects has already been clearly illustrated in the studies related to the Marine Bill. The value of a single site carried out through value transfer could be a huge under-estimate, which looked at in isolation would seem negligible. Perhaps an even bigger concern is that the value would be very uncertain. A network of sites covers all areas deemed scientifically necessary to conserve, but this raises the question as to whether some are more important than others. For example, if a site that is lost provided important spawning grounds for a few species of fish, would those species find another suitable site or would the stocks decline (**Box 3**)?

Box 3: Uncertainty in other ecologically dynamic marine habitats

- The UK marine habitat contains a number of sandbanks that are included in the category of 'slightly covered by seawater at all times,' which is a habitat type of European importance as defined under Annex 1 of the Habitats Directive.
- Such sandbanks in the North Sea are known to provide important spawning grounds for demersal fish species, such as plaice (Munka et al, 2002).
- Their destruction or conservation could provide disproportionate costs or benefits due to network effects. Continued destruction of a single site that provides important spawning habitat could push a fish stock towards collapse if suitable alternative sites are not available and within reach.
- Alternatively, improved conservation of a single site could have significant positive effects on the stock as a whole, by allowing greater survival of spawning adults and young individuals.
- The extent of both outcomes, however, remains uncertain.

With a high likelihood of arriving at a significantly underestimated value for a single site and under scientific uncertainty of the importance of that site, value transfer could not be applied in this case.

STEP 5: TRANSFER EVIDENCE AND ESTIMATE MONETARY VALUE OF POLICY GOOD

In place of value transfer and monetary valuation a qualitative approach was used to categorise the change in ecosystem service provision if the site were designated or business as usual remained. Based on expert judgement, including information received during discussions with key stakeholders and consultations on the designation of the site, the change in ecosystem service under each designation scenario was assigned a level: 'nil', 'minimal', 'low', 'moderate', or 'high' (**Table 3**). The analysis included consideration of:

- The relevance of each ecosystem service to the site;
- A value weighting (i.e. categorical valuation of ecosystem service);
- The scale of benefits geographically; and
- The level of confidence in our knowledge of each ecosystem service.

At this point, ecosystem services that were considered but deemed only marginally relevant were removed from the analysis. The change in each ecosystem service was evaluated separately. An overall impact was then decided upon through expert guidance and was subject to public consultation.

Additionally, from the process of attempting value transfer and then rejecting this as an appropriate application, one very important lesson was learned: the need to explain the value of a single marine site within the context of a network of sites. As such, currently developing IAs of proposed SACs include discussions on the designation of any given site in the context of the cumulative impacts of site designation, which may be negative as well as positive. For example, as fishermen are excluded from more areas, they are squeezed into smaller areas of desirable fishing waters and may have to consider alternate livelihoods. At the same time, strictly conserving more and more areas will improve the environmental benefits, and could increase fish populations, resulting in higher yields in the areas that are still available for fishing. However, evidence of these 'spillover' effects is controversial and varies between habitats and fish species.

STEP 6: AGGREGATE VALUE OF POLICY GOOD

Without quantified values for the ecosystem services provided by the site, aggregation is not carried out.

STEP 7: CONDUCT SENSITIVITY ANALYSIS

In the qualitative analysis of change in ecosystem service provision some qualitative sensitivity analysis can also be carried out. Within the designation scenario, two options are considered: a minimum and a maximum scenario (**Table 2**). The minimum scenario assumed that there would be a ban on all forms of demersal fishing over all areas of reef within the site boundaries and that businesses are likely to spend about 10 percent more on assessment of proposed non-fishing activities in the site (e.g. cables or oil and gas exploration). The maximum scenario assumed a ban on all demersal fishing within the entire SAC site boundary (reef and non-reef) and that business would have to spend 50 percent more on assessment and adjustment of project proposals for other activities.

STEP 8: REPORTING

Use of evidence

After public consultation and revision, the results were reported in the IA that was submitted for ministerial review and then on to the European Commission. The qualitative changes in ecosystem services were presented in table format for transparent comparison and understanding of the 'aggregate' impact (**Table 2**).

Earlier studies highlight the limitations of using value transfer to value a network of marine protected areas in UK waters. Scaling from valuation of a network of protected sites to a single site highlights additional limitations, specifically valuing a component of a network under uncertainty of the importance of that component within the network. Value transfer was not carried out due to these limitations and the question of whether it was even appropriate in the given policy context.

An alternative, qualitative approach to evaluating the change in ecosystem services under different policy scenarios was used. It relied on expert knowledge gained from key informants and through stakeholder consultation. Additionally, it is recommended that future impact assessments for conservation areas in the UK marine habitat should highlight the cumulative conservation benefits (and potential economic costs) of the entire network of sites.

Limits of value transfer in the marine environment

As illustrated in this case study, there are two primary issues with value transfer from studies of the UK marine environment to a single marine site: (i) network effects; and (ii) a non-spatially explicit environment. The ability to carry out value transfer would be one step closer if studies valuing single sites in the UK marine environment were available. These two issues, however, are not just a problem for value transfer, but for valuation of the marine environment in general.

The issue of network effects in the marine environment is primarily related to valuing species and biodiversity. These effects cause many issues in valuation of the marine environment, for example:

- How to value a fish stock's spawning site compared to its nursery site?
- If a stock's lifecycle is divided between two sites, should each site be attributed half the value of the fish stock?
- But without one or the other, there would be no fish stock, so should they each be attributed the full value?

Then there are also questions of what substitute sites are available and would the fish stock be able to adapt to substitute sites if the primary sites were degraded. Moving on to consider other species (fish and non-fish) that may use one of these sites for a portion of their lifecycle, but also use other sites, and with the overarching context that biodiversity is important to maintain a healthy and resilient ecosystem, the importance of network effects in the marine environment becomes rapidly apparent.

The other major issue in valuing the marine environment is that it is not spatially explicit, which is particularly an issue for valuing regulating ecosystem services (e.g. carbon sequestration, contamination remediation). Taking the example of carbon sequestration, in terrestrial ecosystems it is relatively straightforward to attribute a specific amount of carbon sequestration to one tree or hectare

of soil. That is because the carbon is fixed in biomass that is essentially non-mobile, making the ecosystem spatially explicit. Carbon sequestration by the marine ecosystem is partially due to fixation in biomass (phytoplankton) and partially due to chemical processes (i.e. solubility of CO_2 in the ocean). It is tempting to assign an average level of carbon sequestration in a given volume of sea water, but that would ignore a large number of complexities arising from a lack of spatial boundaries:

- How variable is carbon sequestration capacity over even small areas of marine environment?
- How does capacity vary with depth?
- How does capacity vary over time with movement of phytoplankton?
- How does capacity vary based on climatic conditions that can readily change solubility?
- Does capacity vary based on features present (e.g. sandbank versus reef sites)?

Potential for value transfer in the marine environment

Having outlined the issues with valuation and value transfer of the marine environment, there is still some scope to use both tools for specific marine conservation zones. They would only be applicable, however, to attributes of sites that are not substantially affected by network effects and that are (at least relatively) spatially explicit. These attributes would require studies (or one large study) that address categories (i) and (ii) as described in the Step 4 above: i.e. valuation of a single attribute, and valuation of a specific use.

The types of attributes that could potentially be valued and subjected to value transfer can broadly be defined as those that provide cultural services, such as physical attributes and recreation potential of site. Although some such studies are currently available, the present literature does not include studies in temperate marine environments.

In order to advance the practice of using value transfer for specific sites in the UK marine environment, at least one significant primary study should be carried out to determine transferable values of relatively generic site attributes. It could focus on values such as: scuba diving, angling and archaeology. The recommended outcome would be transferable average values of a type of site (e.g. sandbank) of a specific size (categorical or quantitative depending on primary study). Crucially, since these are cultural services, the study should take distance of site from land into consideration.

Although this study would only allow value transfer based on a portion of the ecosystem services provided by a marine site, it would start to provide some quantitative support to the qualitative benefits assessment approach currently carried out. Value transfer in this context would still not represent the full value of the site, but would be an improvement in the availability of evidence.

Table 3: Significance of change for ecosystem services (from eftec, 2008)							
Services	*Relevance to site*	*Option 1 Decline*	*Option 2 Min improvement*	*Option 2 Max improvement*	*Value weighting*	***Scale of benefits***	*Confidence*
Fish for human consumption	**Low.** Many vessels avoid reef structure but there is evidence that some mobile gear might be used over it.	**Moderate.** Interruption of lifecycle processes could mean that decline is significant	**Nil.** Improvement on site offset by corresponding decline as fishing is displaced. Alternatively risk measures will not be effective	**Nil.** Improvement on site offset by corresponding decline as fishing is displaced.	**Moderate.** Not higher value than other sites in region	**Nil.** An increase in fish stocks at the site is likely to be offset by declines elsewhere	**Moderate.** Possible that taking same catch level outside site is not neutral on stocks overall
Fish for non-human consumption		**Low.** Probably not demersal so less affected by bottom trawling.					
Carbon sequestration	**Minimal.** The features are likely to have a low effect and small area	**Minimal.** Unlikely to affect biological pump.	**Minimal.** Unlikely to affect biological pump	**Minimal.** Unlikely to affect biological pump	**Moderate**. – CS is of high value but site plays minimal role	**Minimal.**	**Moderate** – biological pump not well understood
Non-use value	**Moderate.** Evidence that public has preferences for rare/unusual features and visually appealing features	**Low/moderate.** Fisherman reported to avoid reef although evidence suggests not all do	**Low/moderate** Reef reportedly avoided	**Low/moderate.** Reef reportedly avoided	**Moderate.** All UK population is relevant but relatively low value per capita	**Low/moderate**	**Moderate.** No evidence on non-use values for specific features.
Scientific research	**Moderate.** Can be studied and unique combination of parameters within the regional sea but expensive	**Low/moderate.** Fisherman reported to avoid reef although evidence suggests not all do	**Low/moderate** Reef reportedly avoided	**Low/moderate.** Reef reportedly avoided	**Low.** Not unique	**Low/moderate**	**Moderate/high**
Archaeology	**Minimal.** UKHO have one record for area	**Nil.** Vessels avoid wrecks.	**Nil.** Avoided wrecks before	**Nil.** Avoided wrecks before	**Moderate.** Interest to public.	**Nil.** Not affected by designation	**Moderate.** Little known of Paleo-archaeology
Total value of changes in ecosystem services			**Low/moderate for both scenarios**				**Moderate.**

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