Marine Tourism and Recreation

A study assessing the spatial extent and associated socio-economic value of marine and coastal tourism and recreation in Scotland

A report on methodologies for the monetary and non-monetary assessment of values associated with marine tourism and recreation

PART 1: Literature Review and Identification of Techniques

Kate R Johnson; Sandy A Kerr
k.r.johnson@hw.ac.uk; 01856 850605
International Centre for Island Technology (ICIT)
Heriot-Watt University, Old Academy, Stromness KW16 3DQ

Preamble

The scope of this Heriot-Watt contribution to the study is described as:

1. *A review of approaches to understanding and recording recreation and tourism-related cultural ecosystem services*
2. *Drawing conclusions on:*
    a. *The efficacy of existing approaches in capturing non-monetary values associated with tourism/recreation*
    b. *The effectiveness of surveys in capturing this information from participants*
    c. *The means employed to aggregate results to provide meaningful insights on value*
    d. *The potential lessons for this project*
3. *Recommendations on an appropriate method for this project to employ, and how we might usefully reconcile information on non-monetary values with more traditional economic data.*

The purpose of this report is to review and identify a typology of values and the monetary and non-monetary techniques which could be employed in the assessment of marine tourism and recreation.

A second report draws conclusions and makes recommendations for the Marine Tourism and Recreation Study.

CONTENTS

1. Introduction

Society places value in the preservation and maintenance of the environment and the marine environment is no exception. The nature and distribution of these values is a complex matter. The marine environment is a source of valuable resources fish, shellfish, marine algae, and mineral resources etc all of which command prices on markets. As well as providing exploitable resources such as energy the marine environment is important to the functioning of the economy. It is a highway for international trade and it assimilates pollution from the production cycle. The oceans also provide life support systems upon which humanity relies - the sea controls the earth's climate and it plays an important role in nutrient cycling and helps maintain the atmosphere. Society also places value on the very presence of marine biodiversity, this may be a part of long held cultural traditions or the more modern 'culture' of conservation. Increasingly environmental legislation is used to protect the marine environment; protected status reflects the value society places in the environment. Some people question the effectiveness of environmental legislation suggesting that we under-value the environment. The media often focuses on this concern highlighting pollution and the effects of human exploitation. This concern for the marine environment is itself just another expression of value.

An expression of the value placed by people on the marine environment is its popularity as a focus for marine and coastal tourism and recreation. This may find expression in specific activities such as boating, surfing or angling which on one level are readily measureable in value. Numbers may be counted and monetary value calculated. They may also include elements of less tangible value in the level and reasons for their importance to individuals and to society at large. Similarly, there are values placed on the marine environment just for being there - seaside holidays, coastal walking or sitting and looking at the open sea with its ever changing form and light. These less tangible values require other techniques to assess and estimate. Some techniques try to apply quasi-monetary values; others try to express the value in non-monetary terms.

It is clear that the pattern of values in the marine environment is complex and that these values may conflict with each other. The active management of marine resources, including tourism and recreation will create a shift in the distribution of these values for example restrictions placed on the use of marine space and the introduction of new marine industries. Unless there is a pure *Pareto efficient* move (i.e. values are enhanced or remain the same) the management of marine resources will enhance some values and diminish others. Put simply there will be winners and losers. There is a general presumption that good environmental management decisions involve producing a net gain i.e. the benefits of the decision outweigh the costs.

The purpose of the following sections is to explore methodologies for the assessment of values in the marine environment and how these methodologies may be applied in the context of tourism and recreation. Before examining specific methodologies it is necessary to consider the nature of environmental values and how they are categorised.

1.1 Values, value expressions and utility

In economics the notion of value is closely linked to the concept of utility. Utility was first properly described by Jeremy Bentham as "*that property in any object whereby it tends to produce benefit advantage, pleasure, good or happiness*" (Bentham 1789). For Bentham good government and good legislation was about maximizing net utility and, generally speaking, this remains the implicit objective of government policy in democratic society. Building on Bentham's ideas William Jevons based his *Theory of Political Economy* on a calculus of pleasure and pain the objective being to maximise utility by purchasing pleasure at the lowest cost of pain (Jevons 1871). This laid the foundation of what we now routinely call cost benefit analysis (CBA) formalised by Pigou (1932) and specifically Kaldor (1939) and Hicks (1939). CBA examines values (generally expressed in monetary terms) to determine the changing distribution of utility produced by a proposed course of action.

What is the relevance of this discussion in the context of spatially managed areas? The discipline of economics suggests that the values that society places on the marine environment, and the resources it produces, is the sum of the utility experienced by individual people (see Nunes and van den Berg 2001). Importantly this utility is entirely *anthropocentric* in nature. This means

that all values are ultimately rooted in individual experiences. This view of utility eschews the notion of value systems outside the human condition. The possibility of *ecocentric* values (or intrinsic values) implicit in nature, suggested by some deep green ecologists (e.g. Naess 1973) is rejected by the economic model. The extension of ethics to the environment (see Leopold 1945), or the "*obligations to nature*" sometimes implied in the sustainable development debate (Dobson 1996) are equally disregarded. 'Scientific values' or 'conservation values' are often understood simply as expressions of individual human utility. Derous et al (2007(a), 2007(b)) examine the concept of biological valuation in more detail, identifying what they describe as "valuation criteria". These criteria (largely based on MPA selection criteria) are intended to assess biological value "without reference to anthropocentric use". These criteria include: (i) rarity, (ii) aggregation, (iii) fitness consequences; (iv) naturalness; (v) proportional importance. This approach has the potential to deliver a decision tool for transparent and consistent marine planning and management. However it is debatable whether this represents "intrinsic value" as claimed by the authors (Derous et al (2007a), or whether it simply represents the values of conservation biologists. From the perspective of economics all value changes generated by a spatially managed area, and its management, are human in origin and no distinction is made between the values of one stakeholder group over another.

1.2 Sustainable development

This anthropocentric interpretation of utility and value described above has important implications for the concept of sustainability. From this worldview decisions are made through the lens of the current generation and its values. The 'anticipated' values of future generations are accounted for only in-so-far as they affect the utility of the current generation. It is possible to argue that this is at odds with the post-Bruntland concept of suitability i.e. maintaining a perpetual stock of environmental capital to bequeath to future generations.

A Rawlsian approach to environmental justice suggests that environmental decision making should place equal weight on values of all generations (Rawls 1971). While it may be possible to make a strong philosophical argument why such an approach may be 'just' (unable to put ourselves in the shoes of future generations) it is of limited real practical use for decision making. When CBA includes future values they are expressed in present value terms. This is

achieved by the process of discounting (levelising) which, attempts to reflect individuals' preference for consumption now over consumption in the future, by deflating future values. Consequently in any CBA future values beyond the life of one generation are generally trivialised in the decision making process.

1.3 The search for values

The introduction to this section suggested that society holds a multiplicity of values in the various utilities provided by the environment. It is fair to say that for many decades, mainstream economics concerned itself only with values expressed on conventional markets where goods and services are traded, i.e. the cash economy. In terms of the environment this typically meant the value of resources (fisheries etc). However the idea that the environment may generate values additional to those expressed on money markets has its roots in welfare economics. Pigou (1932) discussed the use of environmental taxes to maximise social utility. Ciriacy Wantrup (1947) explored the possibility of valuing public good aspects of national parks in the USA. Interest in "environmental values" and their assessment grew in the 1970's and 1980's and a new branch of economics we now call *environmental economics* emerged into the mainstream. This was a response to a number of factors including inter alia:

- Increasing use of CBA to assess public expenditure projects
- The 'polluter pays' concept and the extension of environmental liability legislation to include non market aspects of the environment.
- A renewed enthusiasm for market driven decision making;
- A drive for market based instruments to resolve environmental problems (e.g. taxes and permits) in an attempt to internalise the external (social) costs of pollution.

1.4 A typology of values

Environmental economics uses various typologies to categorize the range of values present in the environment. Catching the mood of the times, David Pearce did much to popularise Total Economic Value (TEV) as an appropriate metric to measure the effectiveness of public policy in

the environment (Pearce 1989). TEV consists of the sum of all market values (e.g. fish catch) and non market values (e.g. aesthetic value) in a particular environment. Alternatively we can think about use-values where activity takes place in the marine environment (e.g. recreation) and non-use values where values are experienced passively (e.g. existence value). Use values may in turn be direct (e.g. recreational diving) or indirect (e.g. the economic benefits of using the sea to assimilate pollution). **Figure 1** shows the relationship between these sets of values.

The evolution of this typology of values has itself been an interesting process. The notion of non-market use value in the environment has a long history that can be traced back to the writing of John Muir who argued in favour of creating forest parks in the US to protect non-market public good values (Muir 1909). At the same time Gifford Pinchot argued that publicly owned forests in the US provided a direct market resource in the form of timber (in Turner 1997). Without using the phrase, writers like Leopold (1949) and Carson (1968) described the importance of maintaining a flow of *ecosystem services* (water, soil, assimilation of waste etc) to the formal market economy. The first attempts at valuing non-market aspects of the environment were again linked to public rights to hunt in national parks in the US (Ciriacy Wantrup 1947, Davies 1964). The possibility of Existence value – i.e. that value could exist in absence of the physical presence of the observer – was first argued by Krutilla (1967). Bishop (1982) extended the concept to include values placed on retaining an option to experience the environment or consume its resources at a later date.

Figure 1: A typology of potential economic values provided by the management of marine areas

[Adapted from, van der Bergh *et al* (2002)]

	Examples	
Use value (UV) — **Direct Use Value (DUV)**	*Aesthetic Value*: tourism and recreation benefits e.g. visits to the beach, diving, swimming etc	*Market & non- market*
	Marine resources with commercial value e.g. fisheries, sea weed collection, sand and gravel extraction, energy extraction	*Market*
	Communication e.g. shipping, pipelines cables	*Market*
Indirect Use Value (IUV)	Marine ecosystems and ecological function e.g. climate regulation, assimilation of pollution, nutrient cycling	*Market*
Non-use value (NUV) — **Bequest Value (BV) (Option Value)**	Legacy and deferred benefits: Heritage of marine living resources for future generations. Retaining option to consume/experience marine resources at a later date.	*Non-market*
Existence Value (EV)	Existence Benefits. e.g. knowledge that marine living resources exist.	*Non-market*

Use value (UV) + **Non-use value (NUV)** = **Total Economic Value (TEV)**

By the 1980's the basic typology of values described in Figure 1 had been established. This typology is particularly useful when considering the application of valuation techniques. Valuation techniques will be discussed in the next section; however it is important to note that different valuation techniques have varying abilities to capture the different values expressed in Figure 1. It is equally important to note that the distribution of the values identified in Figure 1

will vary significantly from one environment to another. We would expect the Great Barrier Reef to exhibit high levels of existence value, option value and use value associated with recreational visitors. It may have relatively lower values associated with fishery resources and other uses. The central southern North Sea is an important fishery (i.e. direct use market value) However, one could reasonably expect to see lower levels of aesthetic and existence value associated with this area.

2. Valuation techniques.

Figure 2 sets out the main valuation techniques that have been used to place monetary values on ecosystems. For the time being we are concerned with monetary valuation techniques – non-monetary approaches to assessing values will be described later in Section 3. Table 1 describes some of the generic issues surrounding these valuation techniques and their use. The following sections will look at each technique in turn in the contexts of marine ecosystems and their valuation. It is not the intention here to give a detailed description of each methodology - many other references and manuals exist to describe current best practice.

Table 1 divides valuation techniques into two broad categories
(1) Revealed preference
(2) Stated Preference

Revealed preference techniques are valuation tools which examine existing behaviour. For example the Travel Cost Method (TCM) is based on the principle that recreational users of the environment will travel further (incurring increased expenditure) to visit sites that they value most highly. The cost of travel is therefore a market expression of the utility experienced by that individual visitor. Thus the value preferences of the individual are *revealed* by examining behaviour – in this case expenditure on travel.

Stated preference techniques directly ask the opinion of stakeholders. For example, Contingent Valuation simply asks respondents what they are willing to pay (WTP) for a given change in environmental quality.

At this point it is important to reiterate that many of the valuation techniques will only capture some of the values described in Figure 1. In the following sections more time will be spent with the most commonly applied techniques.

Table 1. Main Valuation techniques [Adapted from World Bank 2004]

Methodology	Approach	Applications	Values	Data requirements	Limitations
1. Revealed Preference Methods					
Production Function	Trace impact of change in ecosystem services on produced goods	Any Impact that affects produced goods	Direct use (market)	Change in service; impact on production; net value of produced goods	Data on change in service and consequent impact on production often lacking
Cost of Illness/ Human capital	Trace impact of change in ecosystem services on morbidity and mortality	Any impact that affects health (e.g. water pollution)	Indirect use (non-market) Unclear	Change in service: impact on health (dose response functions); cost of illness or value of life	Dose-response functions linking environment to health often lacking; underestimates as omits preferences for health; value of life not easily estimated
Replacement Cost (& variants e.g. relocation cost)	Use cost of replacing the lost good or service	Any loss of good or service	Unclear	Extent of loss of goods or services, cost of replacing them	Tends to over-estimate actual value. Replacement costs and value are not directly interchangeable. Must be used with caution.
Travel Cost Method (TCM)	Derive demand curve from data on actual travel costs	Recreation	Direct use (market/non market)	Survey to collect monetary and time, costs & distance of travel to destination	Really limited to recreational benefits; hard to use for multi purpose travel
Hedonic pricing	Extract effect of environmental factors on price of goods that include those factors	Air quality, scenic beauty, cultural benefits	Direct use (market)	Prices and Characteristics of goods. Generally housing or labour markets	Requires a large volume of data, statistically complex, needs an existing (surrogate) market. Only measures values of a small segment of the population (e.g. householders employees). Rarely used in practice.

Methodology	Approach	Applications	Values	Data requirements	Limitations
2. Stated Preference Methods					
Contingent Valuation (CV)	Asks respondents directly their WTP for an environmental good or service	Wide application. In principle any good or service	Potentially all	Survey that elicits a WTP for specified good.	Many potential sources of bias. Guidance exists on how to minimise bias. Some serious unresolved issues e.g part whole bias. Difficult to apply in situations with poor respondent knowledge
Choice modelling	Asks respondents to choose their preferred option from a set of alternatives with particular attributes	Wide application. In principle any good or service	Potentially all	Survey of respondents	Similar to CV analysis of data generated is complex
3. Other methods					
Benefits transfer	Uses results obtained in one context in a different situation	Anywhere comparisons are available	Potentially all	Valuation studies at another, similar site	Data may not be directly comparable. Also validity of source data must be checked. Use with caution. However increasingly used for ecosystem valuations.

2.1 Production Function

The production function refers to the impact that a change in the ecosystem has on the net value of produced goods. The final valuation in the process is the market value of the change in production. For example is the clearance of tropical forest high in a watershed may impact on rice crops further downstream, see Figure 2.

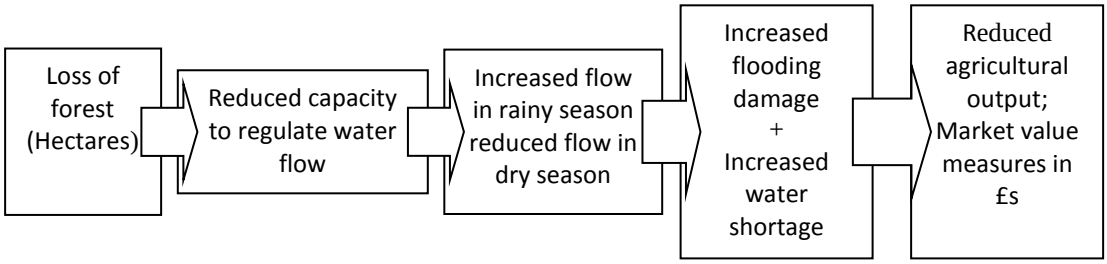

Figure 2: Production function example

The example illustrated in Figure 2 is easy to understand. However undertaking such a valuation requires a detailed (and quantifiable) understanding of the links in the chain (i.e. the dose response relationship). The final values are revealed market values. In the above case this might be tonnes of rice. However the primary difficulty is quantifying the dose response relationship i.e. how many tonnes of rice production are lost as a result of the destruction of a hectare of forest.

In the context of designation of Marine Protected Areas (MPAs), for example, the potential effect on fisheries is one of the key issues. This effect may be positive or negative. An MPA may act as a refuge for fish or shellfish helping seed surrounding waters and potentially increasing/maintaining fish catches. Alternatively if fishers lose access to an area this may result in a loss of income. Clearly the dose response relationship is critical and it is likely to vary from region to region and with the type of fishery. There are a number of factors that must be quantified before the economic impact on fishers can be established: Biomass increase; Biomass export; Egg and larvae export; Size.

2.2 Cost of Illness / Human Capital

This is effectively another dose response method but this time explicitly linked to human health or mortality. This method is widely used in the public sector in the field of road safety improvements allowing the benefits (saved lives) of public works to be compared to the costs. The measured benefits are (in the case of mortality) the statistical value of lives or (in the case of illness) treatment costs and/or loss of incomes.

In the context of the marine environment there are several examples of health effects that could potentially be valued. The method relies on establishing a clear and quantifiable link between a change in environmental quality and the health effect

Shellfish poisoning can cause severe illness and occasionally death. Paralytic, Amnesic and Diarrhetic shellfish poisoning (PSP, ASP, DSP) is associated with periodic blooms of harmful dynoflagelate plankton. In turn harmful algae blooms have been linked to nutrient enrichment of the sea. It would in theory be possible to estimate the non-market cost of a shellfish poisoning incident. However, accurately establishing the benefits of intervention to improve water quality is more problematic. The main difficulty would be determining a dose response relationship between any change in enriching input to the sea and level of illness.

Similarly sewage pollution can lead to gastrointestinal disorders associated with bathing or shellfish consumption. In extreme cases sewage pollution may be associated with cholera. Some 10,000 people are believed to have perished in Latin America between 1991 and 1995 from Cholera initially linked to the consumption of sewage contaminated seafood. Infectious hepatitis is another major concern. This disease can result in liver failure and in the worst cases can even be fatal. A World Health Organisation (WHO) study estimates that sewage contaminated sea food causes 2.5million cases of infection hepatitis annually, killing 25,000 people, with a further 25,000 being left with long term disability. It has been suggested that in the UK 25% of infectious hepatitis cases come from eating polluted shellfish (Shuval 2005). Again if the sewage/illness dose response relationship can be resolved then it would be possible to place a value on reducing sewage emissions.

2.3 Replacement Cost

Replacement cost and variants such as relocation cost (sometimes called shadow project) are based on the concept that the cost of replacement of a damaged environment is somehow a measure of the value of that environment. For example if a flood defence scheme means that an area of wetland is destroyed then the cost of recreating that wetland at another location is taken as a measure of the value of the habitat destroyed. There are several practical and theoretical problems associated with the method.

It is true that on a conventional market there is a close relationship between the cost of production and value. It is irrational for the equilibrium price of a product to be less than the cost of production. Theory also tells us that in competitive markets profits are minimised to the extent that price can only be marginally above cost. However, when dealing with environmental goods there is no market. Consequently market logic cannot be expected to govern the relationships between cost, price and value. There is absolutely no reason why the replacement cost of an environmental good should be correlated to value. It is also unclear how replacement cost relates to the values sets described in Figure 1.

At a more practical level the method assumes that we can recreate or replace existing environments in another location. It is not at all clear that this is possible for any but the simplest of ecosystems. Perhaps an artificial reef could recreate some lost inshore reef habitat for the benefit of fish or shellfish. However it is fanciful to think that a more extensive and complex habitat (e.g. cold water coral) could be recreated.

In practice the method may have very limited applications in the case of artificial reefs or flood defence where environmental remediation is actually required to limit the net impacts of a development. In many marine situations it will simply not be possible to produce a value. It is also doubtful whether the method actually values the environment or the services it provides.

2.4 Travel Cost Method (TCM)

The TCM is based on the assumption that people will be willing to incur travel costs in order to experience environmental quality. First proposed by Hotelling (1947) the method was initially applied to valuation of amenity services from US lakes and rivers. The method is almost exclusively associated with the valuation of recreational sites. The amount that consumers are willing to pay (WTP) will be reflected in the distance that they are willing to travel. In theory the number of people willing to visit a site should be inversely proportional to the travel distance. What the TCM is in effect trying to do is determine the demand curve for a particular facility. The demand curve will be downward sloping, demand decreasing as distance (cost) increases, (Dixon et al 1988).

To undertake a TCM analysis it is necessary to conduct a survey and discover the origin of visitors to the site. This can take the form of a survey of visitors at the site or of residents at potential origins. The latter is preferable as it is less likely to be affected by temporal factors, it is however likely to prove more costly. If the survey is conducted at the site, samples must be taken over an extended period of time.

It is likely that there will be distinguishable differences between the preferences of different socio-economic groups within each origin zone. It is necessary to take this into account when aggregating WTP figures for each zone, thus data concerning the socio-economic profile of each zone will be required.

Visitor rates are a function of several factors:

- Vi = f (Ci, Ti, Ai, Si, Yi) where Vi = visitation rate with zero entrance fee; Ci = round trip travel costs between zone i and site; Ti = total time for the round trip; Ai = taste; Si = attractiveness of alternative sites Yi = average income in zone i.
- To take account of the multi-colinearity between travel cost and time spent in travel the model may be simplified to: Vi = f(TCi, STCi, Yi) where TCi = monetary, time and travel cost of round trip from zone I; STCi = monetary, time and travel cost of round trip to alternative site from zone i.

Simple regression analysis can be used to determine the relationship between Vi and TC. A consumer only travels to a site if he is receiving a surplus in terms of utility, i.e. there is a net benefit from the visit. Having discovered the relationship between TCi and Vi it is possible to inflate TC to a point where demand is choked off. The increase in cost and decrease in demand can be plotted, producing a downward sloping demand curve. If this is done for each zone, the results can be summed horizontally to produce a demand curve for the whole population. From this the consumer surplus can be derived.

While the TCM is used to value recreational sites the method is not without its drawbacks. The cost of travel is assumed to be a combination of the "resource cost" of travelling (i.e. cost of fuel etc.), and the "cost of time" spent travelling. The valuation of journey time is very problematic, as the disutility of travel time will vary from individual to individual. Some individuals may even derive positive utility from time spent travelling. The resource cost of travelling is also difficult to estimate and should include factors such as tolls, and additional costs due to congestion and vehicle depreciation. It is also unclear how local visitors, who travel on foot or cycle to the site, should be included.

The TCM also assumes that perfect knowledge regarding products exists - if costs of a visit were higher than expected, or enjoyment from the visit less than expected, then results will be flawed. There may be significant proportions of zone inhabitants who are unfamiliar with a site and would visit if they had knowledge of the facility. It is also difficult to take account of people who have a number of reasons for making the journey or of people who are on holiday and are living locally.

The TCM can only deal with very specific locations; it cannot value environmental impacts over a wide area. The TCM is also unable to value the day to day environmental quality of individuals, at work or at home. The TCM completely fails to take into account either existence or option values (or ecosystem services). The TCM is only really applicable to the valuation of recreational sites and even then it will not give a complete valuation, simply a value of the WTP for utility associated with physical participation. It must be concluded that, as a means of valuing the wider benefits of the environment pollution control measures, the TCM has little to offer.

2.5 Hedonic Valuation Method (HVM)

The HVM of valuing environmental quality relies on the examination of surrogate markets. The method is underpinned by the theory that the value of any good is the sum of the value of bundles of attributes held by that good.

The most commonly studied market is the housing market. The value of a house is determined by a number of attributes held by that house, size, age, physical condition etc. One of these attributes will be the environmental quality of the surrounding area. If one can determine the variation in property value attributable to a fixed reduction/ increase in environmental quality, either at a single location or between areas, then we have a monetary measure of that environmental quality change. The change in value is a market expression of the value of that environmental factor which has changed, this difference is termed the "rent differential".

While it is obvious that environmental quality is an important determinant of rent differentials between locations, it is hard to assess exactly which attributes cause what change in value. There are many determinants of house value including size, age, condition, proximity to areas of economic activity, accessibility, planning restrictions, socio-economic profile of district, regional economic factors, national economic consideration etc. It is very difficult to assign values to each attribute.

The HVM also assumes perfect market conditions, where prices reflect all factors and information is perfect. In reality housing market are far from perfect, the very fact that it is possible to speculate making money from buying and selling land is *a priori* evidence that the property market is imperfect. Property markets also tend to be sticky, not reacting immediately to factors affecting price. High transaction costs increase the effect. An alternative hedonic approach is to examine wage differentials, between areas of differing environmental quality. Dixon et al (1988) noted that: "The method rests on the theory that in a perfectly competitive equilibrium, the demand for labour equals the value of the marginal product of the workers and the supply of the labour varies not only with wages but also with working and living conditions".

This suggests that, in order to attract labour, companies may have to compensate workers with additional wages in areas of poor environmental quality. This being the case the wage differential between areas of differing environmental quality, *ceteris paribus*, is a measure of WTP for that differential in environmental quality. Clark and Khan (1989), claim that hedonic approaches, the hedonic wage approach in particular, have the advantage of dealing with real data sets "based on actual utility maximising behaviour of individuals". All hedonic approaches however suffer from complexity; it is difficult to assess how much each of the determinant variables contributes to the commodity price. The methods are also subject to the imperfections of existing surrogate markets. The other significant failure of hedonic approaches to valuing environmental quality is their inherent failure to take any existence or option value into account. The HVM can only measure what is already internalised in existing markets which means option and existence values will not be included.

It is possible to imagine hedonic valuation being used to assess the uplift in property values associated with coastal locations. However no account is taken of other environmental values or ecosystem services.

2.6 Contingent Valuation (CV)

Of all the environmental valuation methods described in this section Contingent Valuation (CV) is arguably the most important. It is certainly the most widely applied environmental valuation technique it also highly controversial with several unresolved methodological and theoretical problems. The basic principle behind CV is simple. A questionnaire survey asks a sample of the population what their Willingness to Pay (WTP) is for the provision of an environmental good or service. The survey sample results are averaged and then aggregated across the population to give a total WTP value for the environmental good in question. A fuller description of the methodology is presented in Appendix 1.

Contingent valuation is a controversial technique but it is also the method which, in principle, can be applied to the widest variety of situations valuing aesthetic, option and existence values.

The highest profile use of CV followed the Exxon Valdez oil spill. On March the 24th 1989 the oil tanker Exxon Valdez ran aground in Prince William Sound of the coast of Alaska spilling over 11,000,000 gallons of crude oil. The spill resulted in considerable damage to the coastal environment. The State of Alaska commissioned a CVM study with the aim of using the results as the basis for a claim in respect of damage to non-use environmental values. The study resulted in an estimated damage claim of $2.8 billion. Damages were eventually settled out of court at $1.5 billion (Hanneman 1994). This case led directly to the standardisation of rules for implementing CV in the case of oil spills and wider institutional acceptance of the methodology in the US (NOOA 1993). This process of standardisation and development of best practice guidance has continued (e.g. Bateman *et al* 2002).

Of all the valuation techniques CV is, in principle, able to measure all the values identified in Figure 1. For this reason more than any other it is the most widely used technique. It is always possible to conduct a CV study and get a *prima facia* valid result. We will discuss problems with the technique below but the ability to always produce a result is a strong motivator behind its use.

The technique has a number of limitations and opinion remains sharply divided about the validity of CV results. The main difficulties in relation to the marine environment are detailed below:

- Lack of knowledge in the respondent population. It is possible to ask respondents to comment on aspects of the environment for which they have little or no knowledge and still obtain a result. However one must question the validity of this or at least the stability of this value which is likely to change (Reiling et al 1990). Providing information in order to overcome a lack of knowledge can bias results. Arguably CV is more reliable, the more familiar the respondent is with the environmental good in question. Respondents may have a clear understanding of recreational values of bathing water or beaches. However deep sea benthic ecosystems may be harder for respondents to conceptualise and value.

- Part whole bias. Using CV the sum of the values of individually valued goods tends to be higher than the value of these goods if valued together (Boyle et al 1994). If we ask WTP for preservation of one species of fish and then 100 species of fish the second answer may only be marginally higher than the first. This appears to go against market logic. In conventional markets the value of a basket of goods is the sum of the value of the individual purchases. There are several possible explanations of part / whole bias. One explanation is linked to the fact that CV creates a hypothetical market which internalizes a single environmental good. The respondent considers what utility he receives from this good and then relocates their budget to accommodate this new expenditure; however, all other environmental goods remain free. The consequence is that whatever good the CV is attempting to internalise the respondent is making a broadly similar calculation (i.e. "what can I afford to spend on this new good?") and this results in similar WTP values. Put simply the respondent allocates what they can afford in the knowledge that the rest of the environment is still free.

- Boundaries and equity. CV estimates an average WTP for a sample and then aggregated the result across the whole population. Deciding what the whole population should be is not always easy. The size of the population will have a major influence on the result. Inter- and intra- regional income distribution will affect results. *Ceteris paribus* we would expect wealthy people to have higher WTPs. Consequently their preferences receive higher weight in any analysis. This may be an issue where there are large disparities in incomes across the respondent groups (e.g. regional scale studies, tourists & locals). This issue is at odds with the concept of environmental justice. However it is worth noting that markets are not 'fair', and it is the ability to pay that determines the distribution of resources in real markets.

- There is a final and more philosophical concern. A systems approach to conceptualising the economy and the global environment suggests that the economy is a subset of the global system. The economy uses ecosystem services. The size of the economy (GDP) is largely determined by the rate at which resources are consumed and goods and services produced (see figure 3).

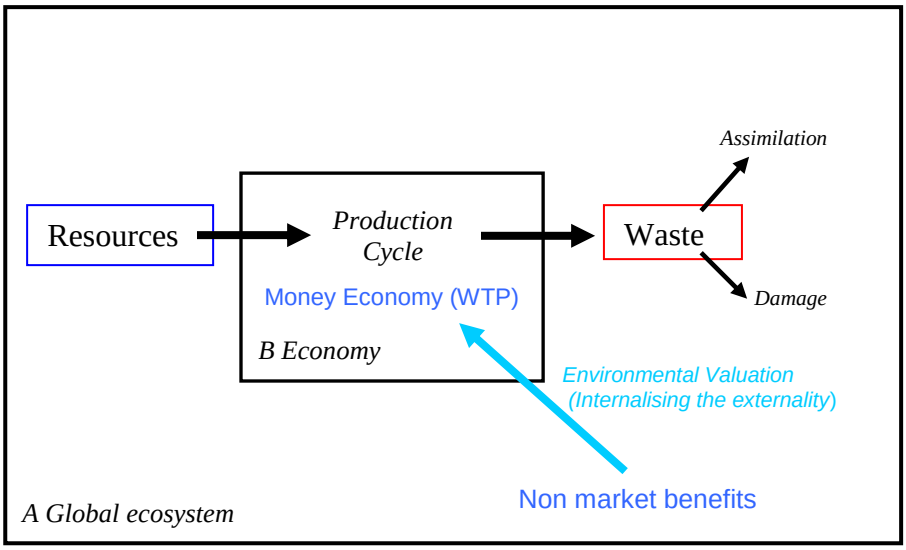

Figure 3. A systems perspective of environmental valuation/economy/environment

WTP values (and revealed preference values) are expressed in the money economy (A). The size of the money economy and consequently WTP values is determined by the vigour of the production process (i.e. the state of the economy). Non-market values are experienced outside the money economy in the wider ecosystem. By using a money measure like (WTP) which is bounded by incomes we are limiting the values we place on aspects of the *Global ecosystem* (A) by the size of the subset B (i.e. the economy). There is no *a priori* reason to believe that the utility derived from non-market benefits could not be greater than the value of the economy. However WTPs are constrained by the size of the economy.

The extent to which these methodological and philosophical arguments rule environmental valuation in or out is likely to vary from case to case. If boundaries are clear, the environmental good is well understood, and the benefit has to be paid for (e.g. reduction in sewage related pollution) then it is easier to justify the use of CV. If the environment is not well understood, boundaries are unclear, and we are valuing damage to the environment (e.g species extinction) it is much harder to ignore the problems outlined above.

2.7 Choice modelling

The term choice modelling (CM) encompasses a range of methods, including: Choice experiments – usually choosing between two alternatives; Contingent ranking – rank a series of alternatives; Contingent rating – score alternatives on a scale; Paired comparison – score pairs of alternatives on similar scale.

CM relies on the identification of attributes or characteristics that people value in the environment. Choices are then constructed with different levels of these attributes associated with different monetary values. Respondents are then presented with these choices. One choice may be selected or alternatives ranked. The selected choice, or ranking, indicates preferences for specific attributes. If there are many variable attributes then it is not possible to ask respondents to rank or rate them all. Generally the more familiar respondents are with the subject in question the more alternatives it is possible to offer. Imagine we have 3 attributes each with 3 potential states eg:

Fish stocks	1 Degraded	2 No change	3 Enhanced
Sea birds	1 Degraded	2 No change	3 Enhanced
Seals	1 Degraded	2 No change	3 Enhanced
Cost	1 No cost	2 Current cost	3 Increased cost

In the above case there are $3^4 = 81$ different combinations available to offer respondents. It is not possible to consider al the possible combinations in a questionnaire. Statistical design theory (*fractional factorial design*) is used to produce a smaller set of alternatives. Individual questionnaires may then present smaller subsets of choices to respondents. WTPs from CM experiments is statistically demanding though procedures are well documented (e.g. Bateman et al 2002). The presentation of alternative scenarios in choice modelling means that it is potentially subject to the irrational behaviour discussed in consumer choice literature (Huber et al 1982, Loomes et al 1989).

CM methods have the advantage the respondents are not being asked values but rather presented with options. This can make it easier to elicit a response. Further more the analysis of the results can allocate values to different attributes without valuing them independently. CM methods are subject to most of the same problems as CV in terms of good familiarity, part whole bias etc.

2.8 Benefits transfer

Benefits transfer (BT) is not itself a direct valuation technique. BT refers to the use of valuation evidence from completed studies at other locations to derive a value for a new location. Environmental valuation studies particularly those involving lengthy questionnaires can be both expensive and time consuming. Using data from existing studies of similar habitats is cost effective when compared to the cost of commissioning a new study. In order to facilitate this process, several databases collate environmental valuation data. The best known of these is the Environmental Valuation Reference Inventory (EVRI) (www.evri.ca). The EVRI is a searchable database of environmental valuation studies. The valuation studies in question use the methods outlined above and are therefore subject to the limitations of these individual methodologies. The simplest form of benefits transfer involves identifying a unit value for the good in question (e.g. $/hectare of mangrove) and using this at new locations. While the attractions of BT are easy to see there are many drawbacks to the approach including: The environments in question may not be identical; Differences in socio-economic characteristics of the populations between the sites may be significant; Different cultural attitudes to the environment; Difference in prevailing market conditions and the economy; Different in the purpose of the valuation and the proposed chance in utility; Quality of the original survey.

The direct transfer of values from one location to another may be viable in closely similar situations (Piper & Martin 2001). However some research indicates that very large errors can occur if this condition is not met (Brouwer et al 1999). Other sciences use meta-analysis to collate data from different studies. This is a statistical process which identifies a common measure of effect size and should result in more powerful results than individual results from a single study under a single set of assumptions and conditions. Meta-analysis is common in the

medical sciences where experiments or tests may be repeated many times by different research groups. However, meta-analytical techniques rely on high standardisation of experimental techniques which does not exist in valuation studies.

2.9 Ecosystem Valuation

It is possible to regard the environment as a provider of services upon which the economy and human wellbeing relies. This worldview builds upon the early systems thinking of Boulding (1968), Shumacher (1973) and others.

In 1997 a group of economists lead by Bob Costanza published a controversial paper which claimed to have placed a value on the world's total ecosystem services (Costanza 1997). There are 4 stages to this approach (i) identify ecosystem services (17 in total), (ii) identify global biomes and the services they provide and their extent (16 biomes were identified), (iii) valuation of the services provided by each biome, (iv) aggregation. The Costanza team estimated that the value of global ecosystem services was US$33trillion yr^{-1}. The team reviewed over 100 valuation studies to produce a value per hectare for each biome. This is therefore essentially a benefits transfer study on large scale. All the issues and problems of BT remain intact. This work was both high profile and controversial in equal measure. While Costanza's results have been widely quoted by scientists and environmentalists they are also regarded by many economists as being fatally flawed (IUCN 2004). Despite methodological concerns various other studies have followed the Costanza approach. Pimentel et al (1997) and Patterson (1999) valued biodiversity in the US and New Zealand using this approach while Williams *et al* (2003) estimated the value for the Scottish environment.

The basic concept of maintaining and managing ecosystem services (if not their valuation) is now firmly established as a key driver of international and UN environmental policy (IUCN 2004). The Millennium Ecosystem Assessment (MEA) in particular has been critical in advancing institutional acceptance of ecosystem approaches (MEA 2003). The National Environmental Assessment (NEA) project in the UK is one example of the application of the MEA approach on a

national level. (http://lwec.org.uk/activities/nea). In simple terms the ecosystem valuation approach now emerging involves four stages:

1. Description of core ecosystem processes (e.g. nutrient cycling)
2. Identification of beneficial ecosystem processes (e.g. biomass production)
3. Identification of specific benefits (fisheries)
4. Valuation of benefits (value of catch)

While the identification of beneficial services is possible the main difficulty in following the process to its conclusion arises in the monetary assessment of benefits as the valuation difficulties described above (and in 2.10 below) still apply. In addition to concerns over the veracity of the valuation process there is a wider debate about reliance upon ecosystem valuation for policy making. Redford and Adams (2009) suggest ecosystem service approaches are a useful means of explaining the dependence of the human economy upon nature. However, there is a risk that over emphasis on the valuation of ecosystem services will lead to the undervaluation, or disregard, of aspects of biodiversity which provide no direct economic services (Redford and Adams 2009). Mark Sagoff, a long standing critic of environmental valuation, suggests that ecosystem valuation confuses 'prices' with 'values', and that market price (or WTP) "*does not correlate with value, benefit or utility*" (Sagoff 2008). Even Adam Smith noted that "*the things which have the greatest value in use have frequently little of no value in exchange"* (Smith 1776). Sagoff argues that the real 'value' of ecosystem services is their use value which in many is not fully reflected in market prices.

2.10 Environmental Valuation of Marine resources

The discussion above has described the principal valuation techniques together with their strengths and weaknesses. There is a modest but growing body of work which has applied these techniques in the marine environment. Ledoux and Turner (2002) undertook a review of valuation studies on ocean and coastal resources, the results of this survey are summarised in

the table below. The majority of the studies identified by Ledoux and Turner are contingent valuation studies of beaches with the majority of work being done in the US, see table 2.

Table 2 Summary of valuation studies (adapted from Ledoux and Turner 2002)

	Total[1]	US	CV	TC	HV	MV	Other
Beaches	30	22	21	8	2	0	0
Storm Protection	1	1	0	3	0	0	1
Water Quality	8	4	6	0	0	0	0
Fish	6	3	0	0	0	6	2
Habitats	6	4	6	0	0	0	0
Multiple function	6	6	1	0	0	5	0
Total Economic Value	2	1	1	0	0	1	1

[1]Rows do not all add up as some studies used two valuation techniques.
US – United States, CV- contingent valuation, TC - travel cost,
HV- Hedonic valuation, MV - Market Value

In a more recent review Pendelton et al (2007), focusing on the US, identified a total of 91 studies covering marine assets, see Figure 4.

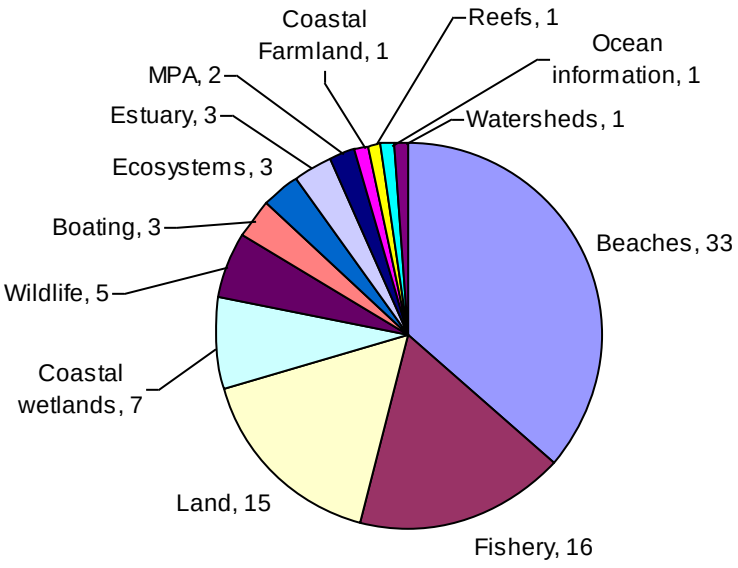

Figure 4. US Marine Valuation Studies 1977-2005 (after Pendelton 2007)

Again this survey reveals a strong emphasis on the assessment of recreational values of beaches with travel cost hedonic, valuation and contingent valuation accounting for most of the studies identified. A recent European Union review involved an international call for environmental valuation studies, this generated 291 responses only 4 of which referred to marine and coastal valuation studies (Markandya et al 2008).

2.11 Marine Ecosystem Services

Following in the footsteps of Costanza ecosystem valuation approaches have been applied in the marine environment. In the UK Firn & McGlashan (2001) estimated the value of the ecosystem services from the coastal zone. Beaumont et al (2008) attempted to value the goods and services provided by marine biodiversity in the UK. This study attempted to capture market and non market values and ascribe these to goods and services delivered by biodiversity. However the study suffered from a lack of available or reliable data. The tabulation of services and corresponding values may help illustrate the range of services provided by the marine environment and their relative importance thus helping "raise awareness of the importance of marine biodiversity" (Beaumont et al 2008). However the authors question the practice of aggregating these results into one value (as done by Constanza and others). In a statement, echoing many other studies, the authors note that the monetary values presented in the study cannot be aggregate "*as different methods have been used to calculate values and hence they are not directly comparable*" (Beaumont et al 2008). There is an irony here as arguably the only purpose of reducing values to a common monetary metric is exactly to facilitate direct comparison. Equally if environmental values cannot be compared with each other how is it possible to justify comparing any individual value to other money measures (e.g. the cost of undertaking management measures)?

Hussain et al (2010) attempt to assess the value of ecosystem services from a proposed network of UK marine MPAs. Interestingly this work uses several of the values derived by Beaumont et al (2008) despite concerns raised in this earlier work. Furthermore it is interesting to note that the criteria for selecting the potential network of MPAs is the protection of OSPAR (Oslo and Paris Convention) habitats and species and not ecosystem services. It seems inconsistent to evaluate

management regimes for this MPA network on the basis on ecosystem services which were not the rationale for the initial designation. In a recent development in the UK the Crown Estate (who own and manage the sea bed in UK waters) have commissioned ecosystem valuation work (Saunders et al 2010) which it hopes to incorporate into a GIS based decision support tool known as MaRS.

2.12 Some observations on monetary valuation.

There is a clear rational which underpins the desire to place monetary values on environmental change. Monetary values should allow us to compare environmental costs and benefits (improved or degraded environments) with market costs and benefits (management expenditure, incomes lost profits etc). Great advances have been made in the development of valuation techniques. However all of the environmental valuation techniques (particularly non-market) have methodological limitations and some serious theoretical issues remain unresolved. Valuation techniques appear to be most robust where:

- The environment is well understood as are the services it provides
- Boundaries are clear (effects and beneficiary groups) and
- Relationships are clear (dose response etc)
- Where change is incremental
- Where environmental improvements must be paid for
- There is an existing market

It is also worth noting that many of these techniques involve careful design and extensive questionnaire survey followed by detailed statistical analysis. Consequently valuations may be both time consuming and expensive.

It is worth considering for a moment the policy environment within which valuation studies are supposed to support decision making. Environmental economists are quick to justify valuation studies by suggesting that the results are an aid to policy makers. Even where results are clearly unreliable it is often suggested that they are a 'useful guide' or some how "indicative" of relative values. However we are not aware of any research examining how environmental valuation

studies actually influence policy decisions. This raises important issues about the nature of policy decisions and the ability of the policy making landscape to take account of monetary values.

Monetary valuation processes are about reducing attributes of a goods or services to a single metric. This allows us to compare costs and benefits and make decisions about the best future course of actions. Such an approach is possible where an individual has absolute control over resources e.g. personal investment decisions; making choices on markets; or where an authority is able to dictate outcomes. However, in a situation where individual winners and losers hold rights in the environment (fishing, navigation, access etc) or where decisions have to be reached on the basis of consensus, reducing values to a single monetary metric (even if it is possible) may be of limited actual use to decision makers. Valuation processes which reveal the pattern of values across stakeholder groups identify potential sources of conflict and potential areas for consensus may be more useful. O'Niel (1993) suggests that "cost benefit analysis provides policy without debate". If policy makers are required to develop management strategies which require collaboration with stakeholders then a single monetary value might not help this process.

3. Non-Monetary Assessments of Value.

3.1 Background

The circumstances where monetary valuation techniques appear to be most robust were summarised in section 2.12. They can be seen to be a relatively rare set of conditions. A more general situation could be described by the opposites

- The environment and the services it provides are poorly understood
- Boundaries are unclear
- Relationships are unclear
- Change is rapid
- Environmental improvements are not paid for
- There are no established markets

These conditions are especially applicable to the marine environment. As measures to enclose the marine commons gather pace there is a great need for understanding about who the stakeholders are and how, and to what extent, their diverse values can be a accommodated within a coherent policy of planning and regulation. The EU Marine Strategy Framework Directive requires the achievement of 'Good Environmental Standards' (GES) by 2020. It calls for an eco-system led approach at a time when new human activities, such as marine renewables, in the EEZs are set to expand rapidly and the prospect of conflict with traditional activities has seldom been greater. Both new and traditional activities are in potentially greater conflict with the marine eco-system. Among the many 'unknowns' are the values placed on the marine commons by coastal communities and the public at large who may not be regular users of the marine environment but currently have freedom of potential access which is to be curtailed. In the absence of knowledge about the environment, boundaries and relationships it is hard to see how monetary methods of valuation can be applied.

Alternatives to monetary valuation have been sought. Non-monetary methods do not lead to a single metric or permit individual control over resources. The results of non-monetary assessments guide policy makers with a framework for debate and negotiation between interested groups and individuals allowing weight to be given as necessary to potential areas of conflict and consensus. Methodologies of non monetary assessment include Environmental Impact Assessment (EIA), Opinion Polling (OP) and Multi-Criteria Analysis (MCA). Opinion polling has recently been employed in Oregon, USA to sound out public knowledge about marine renewable energy, their source of knowledge and feelings about it [Conway et al. 2009].

3.2 Multi-Criteria Analysis (MCA)

Various MCA techniques are widely used in government to inform policy development. However, in the UK they are largely seen only as a complement to CBA and part of a conventional top down normative approach [DCLG 2009]. MCA is described:

"Multi-cultural analysis establishes preferences between options by reference to an explicit set of objectives that the decision making body has identified, and for which it has established measurable criteria to assess the extent to which objectives have been achieved."

The UK government MCA manual lists the steps as:

1. Establish the decision context. What are the aims of the MCA, and who are the decision makers and key players?
2. Identify the options
3. Identify the objectives and criteria that reflect the value associated with the consequences of each option
4. Describe the expected performance of each option against the criteria. Score the options (i.e. assess the value associated with the consequence of each option)
5. Assign weights for each of the criteria to reflect their relative importance to the decision
6. Combine the weights and scores for each of the options to derive overall value
7. Conduct a sensitivity analysis of the results to changes in scores or weights

A development of MCA is MCDA (multi-attribute decision analysis) which addresses complex problems characterised by a mix of monetary and non-monetary objectives.

3.3 AGORA - a participatory conflict management algorithm

Plans to extend planning and management to the marine commons prompted further development of MCA techniques which are truly 'bottom-up' and not normative. They were first developed around the complexities of the land/sea frontier and Coastal Zone Management (CZM) then extended to other marine issues including the capture of value expressions about the creation of Marine Protected Areas (MPAs). Davos et al. (2007) reported results of an analysis of the conflicts hHi that the zoning of MPAs might generate, in this case in the Galapagos and San Andreas archipelagos. They preface discussion with acknowledgement that *"...formulating a cooperation strategy requires an array of information in addition to such other attributes as intuition, experience, familiarity with established institutional structures, and political savvy."* They point out that a large number of stakeholders with diverse interests faced

with a common problem must think strategically and act cooperatively. The elements of the information needed to assist stakeholders are:

- The issues - criteria
- The comparative significance - priority
- The similarities among the priorities of several stakeholders that might point to potential cooperation allies - potential coalitions or cooperation strategies
- The extent to which members of a cohort group of stakeholders agree on their priorities - solidarity

In the Galapagos/San Andreas project the method used to gather, analyse and manage the data from the study area is known as AGORA (Assessment of Group Options with Reasonable Accord) - a participatory conflict management algorithm. AGORA uses Multi-Criteria Evaluation Methods, Core Theory and Game Theory [Santorineau et al. 2008]. Rather than waiting for 'top down' normative decisions, a group of stakeholders agree to participate in a 'bottom up' process. Issues around a collective problem are addressed through answers to a questionnaire designed to an agenda set by the stakeholders in participation.

"The participants are asked to first rank the criteria in order of significance and then to indicate for each pair of consecutively ranked criteria how much more significant is the top ranked criterion over that ranked below it. The potential coalitions are identified by a k-means Cluster analysis (Euclidean distance) and the solidarity of cohort groups of participants with ANOVA." [Davos et al. 2007]

The focus is to help stakeholders develop cooperation strategies by analysing their priorities - no effort is made to identify a single statistical representation of all priorities; the objective is to expose potential conflict and consensus. The VALCOAST project set out to ascertain stakeholder willingness to participate and cooperate in coastal management [Davos et al. 2002]. It used AGORA and argued that a greater emphasis should be placed on policy process as opposed to policies focused on achieving outcomes based on value laden agendas imposed from the top down [EU 1997]. Another marine research project to use AGORA was Project Fisher in the ESRC

funded 'Science and Society' programme. It set out to identify the relationship of fishers with science [Kerr et al. 2006].

An extension to the AGORA methodology has come about by integrating elements of the participatory conflict management algorithm with GIS (Geographic Information Systems) and CA (Cellular Automata) to create Spatial-AGORA. This has been used in the urban coastal region of Perama in Athens, Greece to focus on the management of spatial conflicts related to interest, use and values created by land use change planning options. The objective was to facilitate cooperative decisions supportive of sustainable development. The participatory conflict management rules applied use elements from Core Theory [Tesler 1994] and the MAXMIN Theory of Justice [Rawls 1971].

Appendix 1: Five Stages of a Contingent Valuation

Stage One: Hypothetical market.

Contingent valuation attempts to create a hypothetical market, it tries to find out what the respondent would be willing to pay if they really did have to pay for the good.

- **Establish the scenario reason for payment.** The scenario should be as realistic and plausible as possible. For example if trying to estimate the environmental damage costs of an oil spill one could ask the question:
- "What would you be prepared to pay towards the provision of a standby tug which would prevent a repeat of the oil spill."
- **Identify bid vehicle.** How payments would be made in any hypothetical scenario must be indicated. This can be a sensitive issue. For example if the scenario asks "what would you be prepared to pay in additional tax ....." this may provoke a response to the fact that there is an additional tax rather than a careful consideration of the environmental good in question.
- **Identify the information to be given to the respondents: framing the good.** Additional information may be required about the particular good in question. For example if you are examining the environmental costs of a development project you will clearly need to describe the project and the impacts it will have on the environment. However in general it is better to avoid introducing too much additional information as this may inadvertently bias the response.

Stage Two: Obtaining bids.

- **Design questionnaire.** A questionnaire must be designed which asks the payment question. However the questionnaire will need to ask for any other information required to complete the assessment. You will need to gather information on any variables that might affect the results given (eg age, income, education etc)
- **Willingness to pay / Willingness to accept.** A decision must be made about whether the questionnaire will ask whether the respondent is willing to Accept (WTA) for loss of a good

or 'Willing to Pay' (WTP) for an improvement in the environment. However in general questions will use the WTP format. This is because of WTP/WTA divergence see below.

- **Dichotomous Choice or Open Ended questions.** There are several ways to frame the WTP question in the questionnaire. However the two principle methods are to as an open-ended (OE) question and record the result. Or alternatively to offer a randomly selected value (from within a reasonable range) and record whether the responded would or would not be willing to pay this figure This is called a dichotomous choice (DC) question.
- **Identify sample.** The sample for the survey must be identified. The aim is to get a representative sample of the whole population. If a DC question is asked the sample will have to be large (several hundreds).
- **Conducts survey (face to face, telephone, postal).** The survey can be conducted in various ways. Telephone and postal are cheaper however they get very low responses rates and face to face interview are very much the preferred option. It is essential that any survey is given a trial with a small number of respondents. This will help identify any flaws in the questionnaire. Also in the case of DC questions a pre survey will reveal the likely range of answers from which offers should be made.

Stage Three: Estimating average WTP

- **Estimate mean and median WTP.** Once the survey is completed the average WTP must be estimated for the sample. This is considered in more detail below.

Stage Four: Identify the effect of variables

- **Regression analysis on variables -** Regression analysis should be undertaken to identify the key variables which are driving the answers given. It is essential that this is done to check the sample is taken is representative of the population as a whole. For example if the regression analysis indicates that age is a key determinant of WTP then the age structure of the sample must reflect the age structure of the population as a whole.

Stage Five: Aggregating data

- **Aggregate up data to whole population, (if required adjust for any inconsistencies in sample).** The sample average is multiplied by the relevant population to get a total value. Clearly the size of the population will have a significant influence on the result. It is not always easy to decide what the whole population is. As noted above it is also important that the sample is representative of the whole particularly in respect of those variables which influence the WTP.

One particular problem is dealing with apparently anomalous results in the data set. It is common to find that a small number of answers are far in excess of the others. This may be because the questionnaire has not been well understood or perhaps the respondent is making some sort of protest, is not engaging with the process or is acting strategically and trying to influence the result of the study. Such outliners are usually noted but excluded from the calculation.

Estimation of Mean and Median WTP from CV data

To help us understand how mean and median are estimated it is worth considering fig A1 and A2.

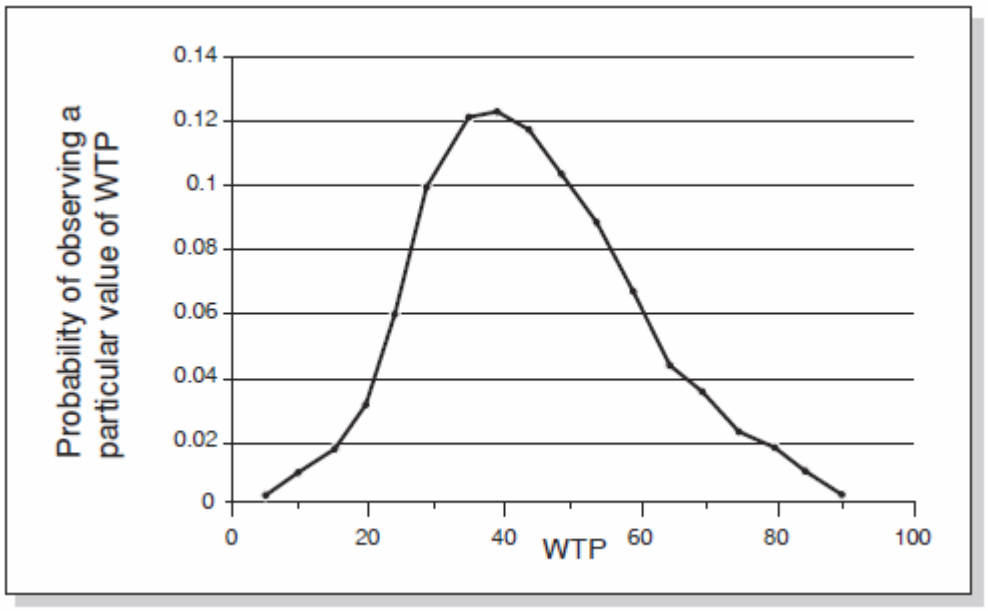

Figure A1. Probability density Function PDF

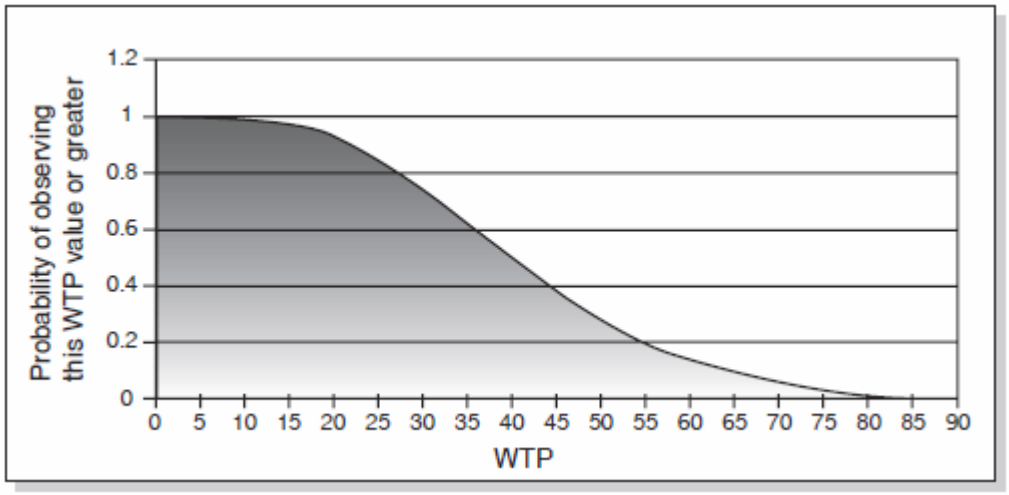

Figure A2 Probability of Survivor Function

The probability density function (PDF) in Figure A1 maps out the probability of getting any one WTP answer. This can be estimated from the range of answers given in a OE WTP survey. The

following rule can estimate the mean under the PDF: mean = (each observed WTP x probability of its occurrence)

The probability survivor function (PSF) in Figure A2 presents the data in a different way showing the probability of observing a WTP greater than a particular value. With the PSF the area under the curve represents the mean WTP. The median can also be calculated as the WTP where there is a 50% chance of getting a higher or lower value. This translates as a probability of 0.5 on the PSF y-axis, the value can then be read from the x-axis.

Open-ended CVM Data.

To make the calculation we can construct a survivor function. This has been done below in Figure A3 for a hypothetical data set. The function is represented by a series of steps. The height of the step is the probability of observing a WTP greater than the one identified on the x-axis. The median is the WTP value, which has a 0.5 probability and can be read from the graph. The mean is the area under the graph, which can be easily calculated (the sum of the areas under each step). With continuous WTP data from an open-ended (OE) CV the mean can also be simply calculated by summing all WTP values and dividing by the sample number. The survivor function becomes more important when one considers data from dichotomous choice questionnaires.

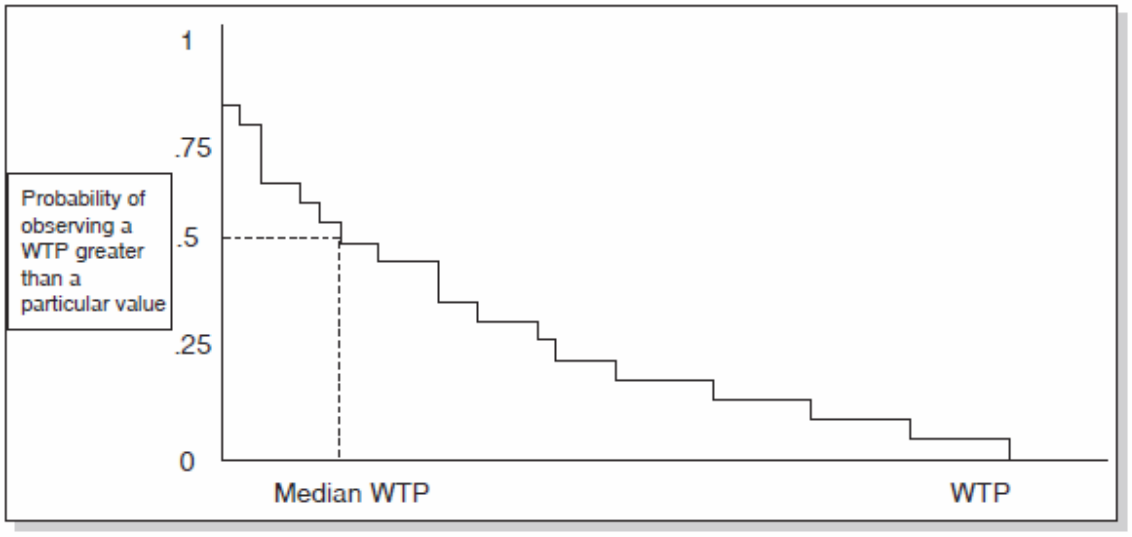

Figure A3 Survivor function for continuous WTP data.

Dichotomous Choice Data.

While mean can be calculated simply for OE data it is not so easy for DC. We cannot use a simple arithmetic calculation of mean because we do not know what the individual WTPs are. However we can construct a survivor function using DC data and estimate the area under the function and in this way arrive at the mean. This process is illustrated in Table 16 and the corresponding Figure A4 below. Remember in DC questionnaire respondents are offered a value (a bid) and asked if they would be WTP this or more.

Economic theory tells us that the function should slope from left to right. Fewer people WTP each successively higher bid. The estimated survivor function values for £20 and £30 bids do not correspond to this theory. We can correct this potential error by pooling the data over the two bids to produce an average result, which is then used in the graph:

(25+30)/(0.31+0.35) = 0.34

In the Figure A4 a stepped line joins the point estimates. If we could map out the function for all values we would expect to see a smooth curve. However we only have discrete data points so these must be connected some how. We could use regression analysis (linear or log) to estimate the curve. One conservative approach (used here) is allocating the lower survivor probability to values lying between two points. This maps out the stepped line on graph A4.

As before the median WTP can be read from the graph. The mean (which, in the case of DC data, cannot be calculated simply as the sum of values divided by the number of observations) can be estimated as the area under the schedule in Figure A4. Of course the more bids we have data for the more accurate our graph will be. However, any increase in the number of bids offered requires a corresponding increase in sample size and hence survey cost.

(a) Bid offer	(b) Number of respondents to bid	(c) Number answering 'yes' to bid	(d) Point estimate of survivor function (b/c) (raw data)	(e) Point estimate of survivor function pooled data	(f) Area under each bid/ section
0	-	-	1	-	-
5	80	70	0.88	-	4.38
10	98	72	0.74	-	3.68
20	74	25	0.31	0.34	3.4
30	85	30	0.35	0.34	3.4
40	86	15	0.17	-	1.7
50	87	6	0.07	-	.7
				Estimated mean value	17.26

Estimation of survivor data with DC.

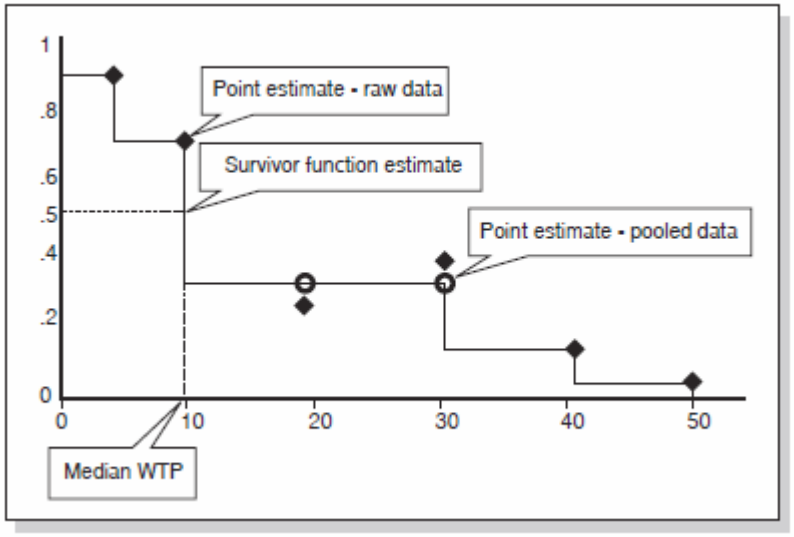

Figure A4 Estimated survivor function for DC CVM

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A study assessing the spatial extent and associated socio-economic value of marine and coastal tourism and recreation in Scotland

A report on methodologies for the monetary and non-monetary assessment of values associated with marine tourism and recreation

PART 2: Economic Valuation Methodologies and the Methodology for the Scottish Survey of Marine Tourism and Recreation.

Sandy A Kerr
s.kerr@hw.ac.uk; 01856 850605
International Centre for Island Technology (ICIT)
Heriot-Watt University, Old Academy, Stromness KW16 3DQ

1. Sources of Economic Value - Recreation and Leisure.

The previous report discussed the concept of values in the environment at some length before exploring various specific valuation techniques. The concept of Total Economic Value (TEV) is well understood. TEV derives from of the various forms of utility (or benefits) that flow from a particular environment. TEV can be subdivided into 'market and non-market' values or alternatively 'use and non-use' values. We also discussed how non-market values are generally accepted as being the most challenging to assess. Different forms of non-market values can be identified (i) Aesthetic value - associated with first-hand experience, (ii) Option value - in retaining an option to visit a location in the future; and (iii) Existence value - associated with knowledge that an environment exists or is protected.

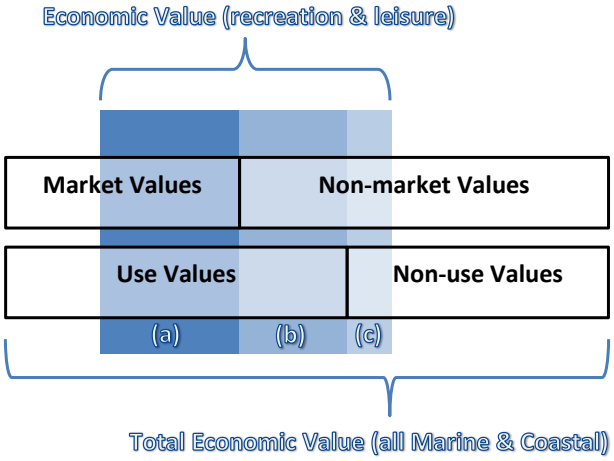

Figure 1. Economic Values at the coast

Figure 1 illustrates the components of TEV associated with the marine and coastal environment (MCE). Figure 1 also illustrates how values associated with recreation and leisure (R&L) are a subset of this larger total. Clearly the MCE has use values which are not associated with R&L. Transport, aggregate extraction and commercial fishing are obvious examples. Equally there is significant non-use value in the form of existence value that is not associated with R&L. For example society places value on the knowledge that rare species and habitats are protected.

However we can identify range of values directly associated with R&L (see Fig 1).

(a) Market, Use Values. These are best characterised by spending directly associated with R&L activities at the coast, this includes: accommodation; food, equipment hire; entry fees; or other paid for services (guiding, instruction etc).

(b) Non-market, Use Value. This best understood as the utility generated by unpaid for (but experienced) public good. For example the enjoyment of fresh air, the land/seascape or viewing wildlife. Many paid for services also rely on public goods. We may pay for a fishing trip (boat, tackle hire, guiding services) but the fish in the sea are free (i.e. a public good). In this case the public good is providing a level of benefit which produces a surplus over and above the monetary cost of the day's activity.

It is likely the most R&L values will fall into categories (a) or (b) as they are associated with actual physical presence and/or participation in R&L activities at the coast. However another category exists.

(c) Non-Market, Non-Use. These are either Option or Existence values. It is clearly possible that individuals may place value on retaining the option for themselves (or future generations) to visit a location to undertake R&L activity at some point in the future. It is also possible that individuals may place existence value in certain iconic R&E locations. Perhaps an iconic rock climb, dive or surf location. Even if there is no aspiration to ever visit and participate in this activity.

The above values are associated with utility that is experienced at or associated with specific coastal locations. There is, however, another tranche of market additional to the above. A significant amount of recreation and leisure expenditure is non-location specific. For example an enthusiasm for activities, like shore angling or sailing, may lead to significant expenditure on related goods and services (e.g. sporting equipment, magazines, videos, instruction etc). This expenditure will generally not take place at the coast. Indeed increasing use of internet shopping means that this expenditure may be highly dispersed. Thus a high quality coastal environment, providing good leisure opportunities, will contribute to a wider leisure industry with no specific physical locus.

Notwithstanding the comments above (a), (b), and (c) give us the range of values that we should seek to represent in this study.

2. Monetizing values

Having identified the values that we seek to represent in the study, the next question is how this should be done and specifically should they be monetized (expressed in £'s). Clearly market values ((a) above) already exist in monetary form. This expenditure creates employment and stimulates further expenditure in the real economy. It is clear that wherever practicable these should be expressed in monetary terms.

Non-market values are more problematic. Huge strides have been made in the field of environmental valuation in an attempt to monetize these values (see previous report). These approaches are most helpful where the cost and benefits of specific project of policies are being considered. However, these methods are often challenging to implement and major

methodological issues remain regarding there validity, execution and the meaning of the data they produce.

It is clear that this study does not form part of a cost benefit assessment. Understanding real market expenditure and its implications for employment etc is important. In the case of non-market values understanding what locations are important to different user groups; understanding the relative importance of different locations and the spread of different types of value may be the more important that reducing this information to a single monetized measure.

It is possible to use the taxonomy of values, emerging from the literature (see Fig 1) and make sure these values are captured in the survey results without the application of complex valuation techniques.

3. Some potential approaches and the Draft LUC methodology

We shall consider each of the value types identified above in turn with options for their assessment:

(a) Market, Use Values. These and values already expressed in monetary terms on existing markets. The obvious way to assess this being to look at expenditure by visitors to the coast; this has been included in the LUC Draft methodology. It will be important to have a survey strategy which will achieve two things; (i) identify the typical expenditure of different groups of visitor; (ii) explains visitor rates at different locations. Put simply we need to be able to turn an average, derived from our sample of questionnaires, into a total for the whole population. Determining the total numbers of users is critical. This may be available from existing recreational studies but this need to be checked. It will also be important to check that the geographic distribution of activity is captured.

In principle a detailed Input-Output model (IO) could have to determine the regional level impacts of this expenditure. IO modelling is labour and data intensive process beyond the scope of this study. While this would be an interesting exercise it would only look at regional scale impacts and not describe the relative importance of specific coastal locations. A more manageable approach will be to make an estimate of employment based on total expenditure

and average earnings (within the leisure and tourism sector) in the region. Second order impacts may be estimated by applying employment and income multipliers.

(b) Non -Market Use Value.

The previous briefing document spent some time examining valuation techniques for assessing non-market values. This indicates two potential approaches

(i) Contingent Valuation is the most widely used method for assessing non-market environmental values. However it is a tool generally applied a specific location not an entire country. However it would be possible to ask respondents what they would be willing to pay (WTP) for an activity that they currently enjoy for free. The principle behind this is based on two assumptions (i) at the moment users benefit free of charge, and (ii) if a charge was levied for access they would be prepared to pay. This is potentially a reasonable approach. However there remains the challenge of allocating this value to specific areas of coast. This may be a difficulty where individual respondents use a number of different locations over the course of a year. If it were adopted it would require surveys in each location for each user group. The valuation question may take the following form:

If it was necessary to pay for an access fee for your days [… activity type…] what would you be prepared to pay?

There is always the possibility of protest votes where respondents feel they should not have to pay. Any survey would need to explain that there were no plans to introduce a charge.

While this method will produce a monetary value it is not appropriate to calculate FTEs or apply local multipliers based on this value as there is no actual expenditure.

(ii) Travel Cost Method (TCM); this examines the cumulative money spent travelling to a location by all users. The underlying hypothesis being that; if a site is more highly valued then people will be prepared to travel further to visit the location. This cumulative expenditure is then statistically manipulated to estimate the consumer surplus over and above actual spend. While the method has been used successfully, particularly in the US, it requires intensive data collection which is beyond the scope of this study. Furthermore difficulties arise when individual respondents have multiple reasons for making the trip (not just the recreational activity). It is also difficult to account for local residents, who may be the largest visitor group

but spend no money, visiting a location on their doorstep. Both of these are significant issues in a small country like Scotland.

Nevertheless distance travelled is a useful indicator of non-market values. A measure of cumulative distance travelled would be a reasonable proxy for this non-market value. Ideally this measure would include all visits to a location. Local visitors may travel less but more frequently. So once again data on total visitor use will be important. This approach would allow the relative comparison of locations highlighting sites that are particularly important for different activities. While the means of presenting this data will need to be considered carefully this may provide a relatively straightforward solution. It will not give a monetary value, however this may not matter as the study is not intended to make cost-benefit decisions about specific projects. It will let us understand the nature of coastal leisure and recreation and see the relative importance of different locations.

The draft LUC methodology does ask how far users have travelled to get to the coast. This information may provide the basis for an assessment of non-market value. However it will be important to understand: (i) the total number of visitors (i.e. visits) by location; (ii) the distances travelled and (iii) be able to disaggregate this by category; and (iv) consider carefully how the final results will be presented in order to illustrate preferences between regions and locations.

(c) Non-Market, Non-Use.

These are the most challenging values to conceptualise, i.e. value placed on retaining an option to visit a location in the future. This value exists irrespective of whether the option is ever exercised. It is not possible to observe this value from existing behaviour. The only way to assess this value is to directly ask respondents. A Contingent Valuation approach would require a separate question about all locations and this is hardly feasible.

However it may however be possible to identify locations that exhibit high option value by asking where respondents would like to visit. An appropriate question may take the form:

Ignoring existing personal constraints and consider where in Scotland you would like to keep the chance to visit to [….. undertake specific leisure activity…] in the future.

Rank your top three locations. 1. …… 2. …… 3……..

Results would allow us to identify locations that hold option value for specific groups or leisure and recreational users. Once again though needs to be given as how to represent this data.

4. Wider Economic issues

At some point in the course of the project it will be necessary to look at the structure of coastal economies. Visitor rates and expenditure only tell part of the economic picture. It is possible that locations with the highest visitor rates and expenditure will be adjacent to large centres of population (Firths of Forth and Clyde, Aberdeen Sea front, etc). However, other lesser used locations, may have a higher dependency on tourism and be more vulnerable to changes in demand.

Seasonality is another important issue. High seasonal tourism can produce structural challenges with high offseason unemployment.

High demand for buy-to-let property or second homes can push the price of housing beyond the budget of locals (often employed in the tourism sector). Clearly it is not within the scope of this study to do a detailed analysis. However questionnaire surveys and workshops provide the opportunity to gather useful qualitative data.

It is very important that the study tries to identify trends in each of the sectors. The leisure and recreation sector is highly dynamic. Leisure activity exhibits high income elasticity; this means that changes in demand is highly sensitive to changes in income. Furthermore leisure and tourism is a sector which is strongly influenced by fashions and trends. Demand for an activity in Scotland is also influenced by what is happening elsewhere. For example demand for mountain biking is a relatively recent phenomenon, which is now a major source of leisure spend in parts of Scotland. Surfing is another activity which has seen dramatic growth in popularity. Demand for traditional activities like golf may be more stable; in many areas participation in shore angling has declined (with fish stocks); and in Scotland the conventional 'beach holiday' is arguably a thing of the past. Identifying these trends will add appreciable value to an analysis which could otherwise be a snapshot of a rapidly changing picture. Questionnaire surveys and focus groups are an excellent opportunity to explore these issues.