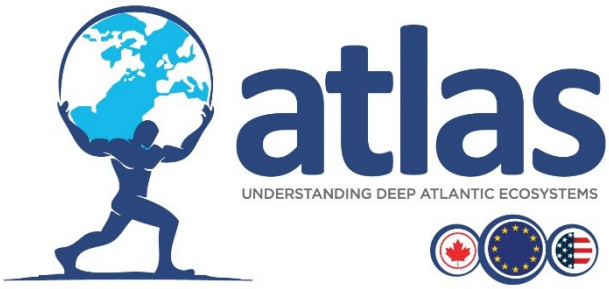

Validity, legitimacy and acceptability of ecosystem valuations

Project acronym:	ATLAS
Grant Agreement:	678760
Deliverable number:	5.3
Deliverable title:	Validity, legitimacy and acceptability of ecosystem valuations
Work Package:	5: Valuing Ecosystem Services
Date of completion:	31.12.2019
Authors:	Rob Tinch, Isaac Ankamah-Yeboah, Claire Armstrong

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678760 (ATLAS). This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.

Contents

1 Introduction

With the aim of improving decision-making processes, there is increasing interest from research providers, policy makers and private sector decision makers in economic valuation of ecosystem goods and services. Market systems and economic appraisal methods offer powerful tools for supporting decisions about the allocation of scarce resources. However there are many important aspects of human activity that are not fully reflected in market prices, including our impacts on the natural world and our dependence on the many valuable goods and services provided by ecosystems. Attempts to assess the values of these impacts, goods and services in monetary terms could help environmental management via various tools of economic analysis, accounting and appraisal.

However, this extension of economic methods to the natural world is highly controversial and viewed by some as unethical. This results in disagreements within and between research, conservation and policy communities regarding the appropriate role of valuation and appraisal methods in informing policy and decision-making. From the perspective of the ATLAS project, there is considerable scope for using the tools of environmental valuation applied to deep sea ecosystems and their services to inform marine spatial planning and conservation decision. Although it is not yet possible to estimate values for all marine services, the ecosystem services framework can help to structure information and thinking about the ways in which humans depend on marine ecosystems, and the ability to value some of these services can be useful for communicating their importance and potentially for informing decisions about trade-offs between different uses of the marine environment, including conservation. On the other hand, some reject the legitimacy of these approaches to assessing marine ecosystems, and/or see the estimates as invalid measurements that fail to capture the real values at stake. These divergent points of view make it harder to know how, whether and under what conditions valuation evidence should be generated and used in marine policy and decision-making processes.

The research presented in this report aims to address these issues by assessing the different points of view that exist in the marine research, management and policy communities regarding the estimation of monetary values for marine ecosystems and services and their use in appraisal and policy settings. A better understanding of how and why perspectives differ, and how they are similar, can provide insights into whether or not valuation approaches could be useful in practical settings, and also regarding how differences in opinion might be discussed, respected and perhaps in some cases reduced.

The report starts with an overview of the rationale for valuation, the ideas underpinning it, and the main criticisms and concerns associated with it. This is followed by an explanation of the Q-sorting

method and how it was applied to the issues discussed here. The results are presented in section 4, which is followed by a concluding discussion focussing on the implications of the results for the use of valuation in marine policy and decision processes, in particular the potential for building on areas of consensus to develop a common understanding and approach to valuation that may be more widely acceptable.

2 Background

Ongoing loss of biodiversity and ecosystems has been highlighted in studies such as the Millennium Ecosystem Assessment (MA, 2005), various National Ecosystem Assessments and The Economics of Ecosystems and Biodiversity (TEEB)[1] These studies have made a direct link between biodiversity loss and environmental damage on the one hand and economic losses and decline in human wellbeing on the other, playing a global role in "making nature's values visible". The European Commission has been particularly active in driving this agenda, for example supporting TEEB via several projects, including the Cost of Policy Inaction study (Braat and ten Brink, 2008) which gave a conservative and partial estimate that the global cost of additional biodiversity loss after 2000 would reach 7% of world GDP by 2050, and through the MAES and KIP-INCA initiatives.

The numbers of papers and projects using the ecosystem services framework have risen dramatically and the concept is now ingrained in policy across the world, at least in principle. The European Environment Agency (EEA) has led work to develop the Common International Classification of Ecosystem Services (CICES)[2] and the US Environment Protection Agency (EPA) has developed the Final Ecosystem Goods and Services Classification System (FEGS-CS)[3]. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was set up in 2012 to assess the state of biodiversity and of the ecosystem services it provides to society, in response to requests from decision makers[4].

Alongside these developments, a growing number of original economic valuation studies, meta-analyses of economic valuation studies (e.g. Brouwer et al., 1999; Brander et al., 2011) and economic valuation databases[5] has consolidated the evidence base and facilitated the transfer of economic

[1] http://www.teebweb.org/

[2] http://cices.eu/

[3] https://www.epa.gov/eco-research/final-ecosystem-goods-and-services-classification-system-fegs-cs

[4] www.ipbes.net/about

[5] See in particular the Environmental Valuation Reference Inventory (EVRI) (www.evri.ca), the TEEB valuation database (http://es-partnership.org/services/data-knowledge-sharing/ecosystem-service-valuation-database/; de

value estimates to new contexts (the validity/legitimacy of such transfer being the subject of some controversy: see e.g. Ravenscroft, 2019). The mainstreaming of economic valuation is demonstrated by the development under the environmental management systems series International Standards Organisation (ISO) 14000 (the best-selling standard in the world) of ISO 14007 "Environmental management: Determining environmental costs and benefits – Guidance"[6] and ISO 14008 "Monetary valuation of environmental impacts and related environmental aspects"[7]. But despite this progress, economic valuation of biodiversity remains challenging: the risks of unintended interpretations and undervaluation make it particularly important that both qualitative narrative and quantitative (physical) measurement is presented as well as what is possible to express in monetary terms.

2.1 Mainstream approaches to valuation

The theory behind valuation is grounded in expected utility theory (von Neumann and Morgenstern, 1944) and its more recent developments. The theory forms an analytical framework used to explain people's decisions under uncertainty, based on the assumption that decisions stem from, and therefore reveal information about, individuals' preferences. In neoclassical economics, individual 'total economic value' (TEV) represents all the ways that goods and services influence individual utility. This is revealed through the decisions or preferences of an individual, acting under a budget constraint, and expressed as their 'willingness to pay' (WTP).

For a particular ecosystem or natural 'asset', therefore, TEV can be thought of as the sum of all the ways the ecosystem functions, ecosystem services and goods influence the utility of individual humans, as reflected by their WTP values, again either as a simple sum or following a weighting scheme (Figure 1). Integrating TEV over time, using discounting to convert future values to present day equivalents, gives the net present value of these flows. Assuming calculable risk about future flows, these values are often expressed as expected values, and cost-benefit analysis (CBA) compares the expected values of different courses of action. However other treatments and decision rules may also be used, for example to implement some degree of risk-aversion in the calculations (Wegner & Pascual, 2011).

Groot et al., 2012), the Envalue database (http://marineecosystemservices.org/explore) and the Marine Ecosystem Services Partnership's (MESP) Valuation Library (http://marineecosystemservices.org/explore).

[6] https://committee.iso.org/sites/tc207sc1/home/projects/ongoing/iso-14007.html

[7] https://committee.iso.org/sites/tc207sc1/home/projects/ongoing/iso-14008.html

This approach offers a potentially useful framework for thinking about ways that humans might value aspects of nature. Although the framework is grounded in individual preferences, it nevertheless allows for non-selfish preferences. These are described in the framework as "non-use values": values an individual holds for altruistic reasons (use by others), bequest reasons (use by future generations), or existence reasons (not associated with any human use) – the common thread being that the individual is willing to pay to protect values not associated with any personal use of the resource. Furthermore, there is recognition of possible uncertainty about future preferences and uses, via option and insurance values.

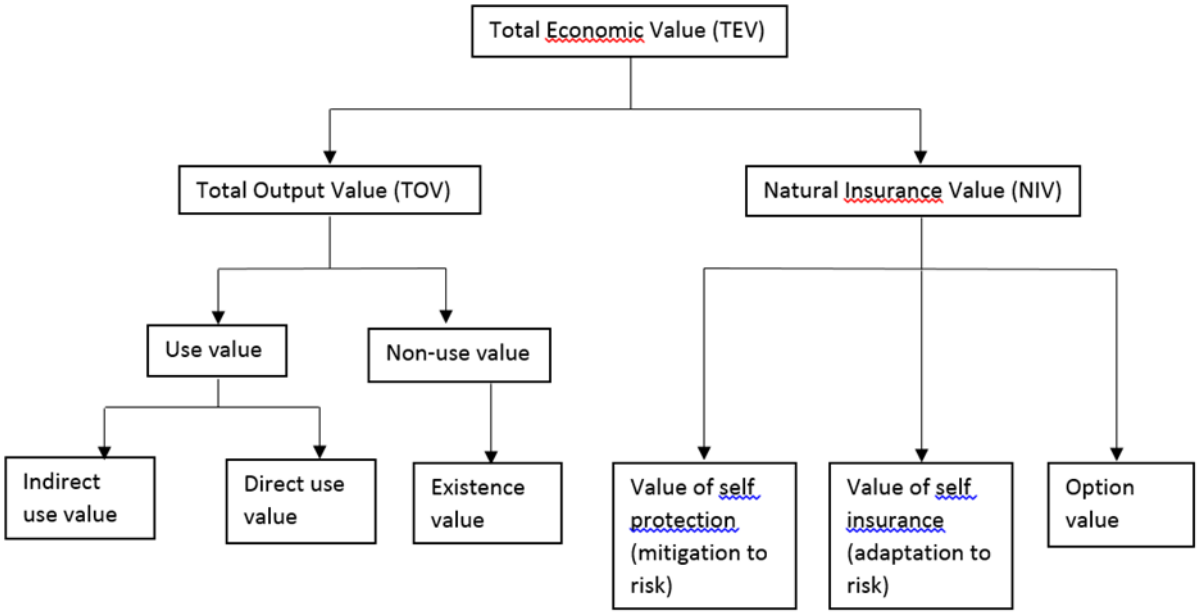

Figure 1: The TEV framework (extended to include insurance values: see e.g. Pascual et al 2015)

In a similar way, the ecosystem services framework (see e.g. Daily 1997), often combined with the TEV framework, provides a useful checklist of ways in which natural systems provide benefits to humans. There is no claim that these values and benefits are an *exhaustive* representation of natural values; rather, the frameworks provide a minimum set of things to consider.

Thus, environmental valuation is one manifestation of a model of how aspects of the natural world influence human wellbeing. Like any model, the important issue is not whether it is 'right' or 'true', but rather whether it is 'useful'. Thinking about it in terms of attempting to represent an underlying truth is not particularly useful: it makes for rather an easy straw man, but as most of the identifiable problems also apply in varying degrees to alternative approaches, this does not help much. It is much more interesting to consider whether or not valuation is useful as a decision support tool in different contexts. Here we should recognise that there are many different purposes and uses for valuation

and CBA evidence, generally in combination with other sources of evidence or decision support methods. Possible uses for valuation evidence include, in particular, the following broad categories:

- Project appraisal, policy appraisal and impact assessment
- Monitoring and review of decisions
- Demonstrating 'Value for Money', seeking funding
- Prioritisation of investments
- Planning and location decisions
- Pricing decisions: fees, payments, compensation for damages
- Understanding, communication, and advocacy

Each of these may call for different specific methods, and different requirements for accuracy and research expenditure, commensurate with the decision context and the spatial and temporal scale of application, ranging from localised, static appraisals to globalised, dynamic strategic assessments (Barton et al. 2018). Different applications in different social and political contexts may also evoke different ethical and practical objections.

The least stringent requirements are for valuation for 'awareness raising', which aims to document large absolute values of natural ecosystems and services. Costanza et al. (1997) is the best-known example, combining environmental economics with an ecosystem services framework to 'value' the world's ecosystem services at US$33 trillion per year. The accuracy requirement is essentially orders of magnitude – is this service worth millions, billions, or trillions? – to give a broad feel for the relative importance of different services to humans. The approach can be considered flawed in seeking a total value for the ecosystems on which all life depends (Fisher et al. 2009 described the Costanza et al. calculation as 'a serious underestimate of infinity') but the paper successfully raised awareness of both the ecosystem services paradigm and non-market valuation, shifting them into mainstream debate. The study remains useful today, since it set a baseline for comparisons using consistent methods: a follow up (Costanza et al. 2014) updated the unit values, assessed land use/land cover change from 1997-2011, and estimated a higher total value (due to revaluation) but a substantial loss due to land use change. Thus, even if these 'total' service values have little relevance in absolute terms, analysis of how they change over time could reveal useful information. Similarly, accuracy of valuation may be less important for evaluating changes in asset value, for example for accounting purposes, where accuracy (low absolute error) may be less of a concern than reliability (consistent error) for the purposes of assessing trends.

For appraisal / cost-benefit analysis purposes, projects need to pass different levels of test. The simplest, "is it worth it?", requires demonstration that discounted benefit flows are greater than discounted costs. For many problems that is relatively straightforward; the trickier question is

determining "which option is the most efficient?" – here, valuation methods need to be accurate enough to be able to rank alternative options in terms of the absolute value of the *changes* in ecosystem services and other impacts of the projects is required. And for determining economic liability and compensation, valuation methods need to "stand up in court".

Allen & Moore (2016) note growing consensus that some form of "characterizing the value of ecosystem services is essential for designing effective policy", but controversy and uncertainty regarding how to "identify and measure the multiple values of ecosystems and incorporate these values into policy form". Below, we consider some of the criticisms of valuation and possible responses to these.

2.2 Critiques of valuation

There are many well-recognised problems, both theoretical and practical, with applications of the valuation model. Some of these are summarised in Table 1. While researchers are generally well aware of the limitations, and the results appropriately caveated (valuation and CBA guidance in particular always calls for sensitivity analysis, full reporting of assumptions, weaknesses, omissions and so on) this might not carry over to the ways in which decision-makers actually use results in decision processes.[8]

As mentioned above, it is important to recognise that many of the same criticisms apply (with varying force) to other possible decision-support and collective choice methods Furthermore, many also apply to the market institutions on which our economies depend. Markets using monetary currency as a unit of exchange and store of value are very powerful institutions for exchanging information about abilities and needs, but they only work because of regulation and intervention (for example, the force of law to enforce contracts) and economists give considerable attention to market failures, possible remedies, and the costs associated with intervention.

Table 1: Some problems arising in the valuation model

Assumption	Problem?	Generalisation	Conclusion
Individuals are the best judges of their own welfare.	Demonstrably untrue in some cases (e.g. drug addiction) and doubtful in general (e.g. myopic decisions).	Democratic societies basically reflect this view and allow wide freedom of choice within a framework	More a limit than a problem: recognise TEV focuses on individual preferences.

[8] Decision makers misusing evidence to suit their ends is hardly unique: the question is whether monetary valuation evidence makes that easier or harder…

		of rules to curb excesses.	Other moral decision rules may be considered.
Individuals have the required information and cognitive ability to have stable, well-formed preferences that they express through decisions.	Probably untrue, in particular for hypothetical decisions and unfamiliar goods and services, and preferences may be context dependent and vary over time.	Poor information also affects other methods. Market institutions consistent with assumptions, with limits (advertising, trade descriptions…).	Will reduce accuracy for some goods/services. Partial mitigation via information, time for reflection, deliberative methods.
Interpersonal comparability of utility.	Not clear that any unit of benefit to one individual represents the same 'human welfare' as the same unit to another.	A problem for any system (including voting systems) and not limited to monetary units.	Practical option is to act 'as if' comparisons reliable, using weighting to reflect priorities / distributional goals.
Values expressed are constrained by incomes / ability to pay.	Derived estimates of social value assume existing income distributions are desirable, or at least fair or that inequalities should be corrected through income policies.	Policies to redistribute incomes via taxes and benefits mean that actual market distributions can be deemed at least in part a reflection of democratic decisions.	WTP-based values for non-market goods and services are not necessarily valid measures of their social value; income weighting can help.
Smooth, continuous value functions.	Non-linearities, threshold effects and areas of highly inelastic demand / rapidly changing values.	Severity depends on scale of application: small-scale, marginal assessments less likely to suffer than large-scale, major changes.	Limits on use of valuation when dealing with critical natural capital or potentially catastrophic changes.
Inevitable data gaps, in ecological/scientific understanding, and/or in the valuation evidence base.	No valuation analysis or economic appraisal such as Cost Benefit Analysis (CBA) can be considered complete and accurate.	Applies to all methods, and CBA can include a wide range of values, sensitivity analysis, clear statements of gaps.	CBA must be viewed as an aid to deliberation, not a way of providing "the answer".

Optimism bias: tendency to underestimate future costs and overestimate benefits.	CBA likely to be biased (both ways, including underestimating the costs and overestimating the benefits).	Not specific to economic valuation methods – more about physical outcomes and timings.	Be aware of and make formal adjustment for optimism (or 'pessimism') bias.

In any event, the use of market values to account for goods and services actually traded in markets (including ecosystem services such as food or timber production) is *relatively* uncontroversial – disagreements are mostly about market rules and interventions (such as taxes, welfare payments, public spending etc.), not the use of markets per se. But the estimation and uses of economic values for services such as biodiversity protection or cultural significance – or education, or health – can evoke very strong responses from different perspectives. In effect, the use of non-market valuation methods extends market thinking and tools to areas where property rights are not fully defined. This extension varies in degree, depending on the application, and can be very contentious, both on fundamental ethical principles, and for practical reasons. For example, there is justifiable concern that valuation of the environment could support policies that are regressive, because it may appear more 'efficient' economically to cluster environmental 'bads' where people are poorer, because willingness to pay is constrained by ability to pay.

Criticism that monetary values provide an inadequate proxy for the multitude of values underlying ecosystem services, as well as the multitude of services produced by healthy functioning ecosystems, leads for some authors to outright rejection of economic valuation, or at least rejection of its usefulness in environmental management (McCauley, 2006). For others, the solution may be to attempt "to incorporate a multitude of methods and knowledge systems into ecosystem service valuation for the sake of informing policy" (Brondízio et al., 2010). For many, valuation is seen as problematic in its simpler forms as a stand-alone tool, but nevertheless having some potential as part of a broader process (Felipe-Lucia et al., 2015; Spangenberg and Settele, 2010; Suter and Cormier, 2015). Hence, there is a flourishing literature on value pluralism, the role of institutional structures in the expression of values, and the importance of participation and inclusivity in valuation and decision-making processes.

Ainscough et al (2018 p98) note that the institutional structures in valuation play a significant role in how values are expressed (Raymond et al., 2014; Sarkki et al., 2016; Spash and Vatn, 2006; Vatn, 2009) and that the inclusivity and rigour of participation can strongly influence the types of values expressed and the degree to which value plurality is realised (Ranger et al., 2016). The complexity of ecosystem

services (both ecological and in terms of human relationships with them), and the potential for incommensurability of different value types, mean that attention must be given not merely to the elicitation of values, but to the ways in which people form and express their values under different contexts. Vatn (2009) calls for institutional arrangements geared towards social learning and communicative action, while Kenter and co-authors call for rigorous processes of deliberative value formation that allow for consideration of the nature of the good/service and its relationship with people's broad principles or 'transcendental values' (Kenter et al., 2015; Raymond and Kenter, 2016).

Ainscough et al (2018) consider three conditions under which a "post-normal" approach to valuation research may be appropriate for managing participation, dealing with multiple knowledge claims, and managing uncertainty:

- high levels of uncertainty
- many stakeholders with conflicting interests
- research is likely to inform decision processes or policy

But such an approach would place environmental decision making in a unique class compared to other forms of collective decision making, which rely primarily on expert judgement, with public input limited to market forces and democratic processes. This may be feasible for major changes at a local scale, where it is unlikely in any case that any decision process in a modern, democratic society would rely solely on monetary valuation and exclude consultation and engagement. But for broad scale assessments, strategic appraisals, ongoing monitoring and accounting and so on, the level of consultation, engagement and deliberation envisaged in the 'post-normal science' model would often be disproportionate.

The question of whether or not valuation 'helps' in any particular use or decision context seems to be the most important one. Valuation is certainly not essential: there are alternative ways of carrying out appraisal (MCA, collective decision methods), for example, and even environmental taxation could be implemented without necessarily using valuation to set the tax rates. But does it make these processes easier, more defensible, more transparent, more (cost-)effective? In particular, are arguments for recognising the importance of the natural world more convincing (for some decision makers, in some contexts) if they're expressed in monetary value terms? Does valuation evidence help decision makers to take full account of environmental factors, and does this result in better decisions about trade-off?

Alongside that, we need to consider whether there are any unintended results, in particular over time. This is where concerns about 'crowding out' of non-market motives and values are important (see e.g.

Rode et al 2015). Similarly, is there a risk that expressing values in monetary terms provides a drive for those values to be 'captured' via market creation (i.e. defining new property rights and bringing the environmental goods and services inside the 'productive boundary' of national accounts) and/or introduction of new environmental tax bases? And what would be the distributional impacts of that? And/or, does use of valuation evidence create further demand for such evidence, locking decision processes in to a particular approach (see e.g. Mathieu et al, 2016 for an example in the UK water industry)?

These questions probably don't have single answers: rather, the extent to which valuation is useful will be dependent on environmental, economic, and social/political contexts, and there will always be bounds on the appropriate uses of values. Hence the key issue is not whether monetary valuation is 'accurate', 'complete' or 'true', but rather "under what conditions is monetary valuation useful?"

As an example, the Costanza et al (1997) global valuation exercise cited above has been widely criticised, perhaps unfairly in that the authors never claimed to be establishing a price or value of the natural world. Rather, they did largely achieve their aim of demonstrating that even a partial accounting of nature's gifts would show huge sums. Furthermore, Costanza et al. (2014) provide an update and comparison: where the 1997 estimate for the global value of ecosystem services was c.$46 trillion/year in 2007 $US, the 2014 study updated the unit values and took account of land use/land cover change from 1997-2011. The new estimate was c.$125 trillion/year, but this did not imply that things had improved – it derived from an increase in unit values, not physical services. Rising values are not necessarily a good sign: unit values will increase when a good or service becomes scarcer, and the net impact depends on elasticities. A revaluation of the 1997 services using 2011 values would be c.$145 trillion/year. So the repeated exercise showed the loss of eco-services from 1997 to 2011 due to land use change could be estimated at about $20 trillion/year. While some consider this to be a meaningless number, others see it as a powerful way of combining and communicating the combined impacts of a wide range of degradations that might otherwise be difficult to grasp and compare with other priorities.

3 Q method

To recap, environmental valuation is increasingly called for, and the evidence base has grown rapidly over recent years. However, so far actual integration into policy and decision processes is very patchy. This can partly be explained by the contentious nature of various aspects of valuation, and fears about possibly undesirable implications of using it. Divergent views on these aspects may be an important

barrier to attempts to use valuation to improve decision processes, and understanding these views may help to overcome these barriers, whether by assuaging fears or designing improved methods.

Q-method is a statistical approach to understanding the ways that different people think about a particular issue, in this case the uses and abuses of monetary valuation of environmental goods and services in environmental and especially marine and deep sea management. It is a form of "discourse analysis" which identifies the ways in which people think about an issue and looks for shared perceptions and common ground between individuals, as well as key differences in perspectives. The analysis is used to group individuals into distinct 'social discourses' based on their shared perceptions and commonalities (Barry and Proops, 1999). A particular discourse "rests on assumptions, judgements, and contentions that provide the basic terms for analysis, debates, agreements, and disagreements" (Dryzek, 2005):

Reed et al (2009) consider Q method within the tools of stakeholder analysis, a process they see as comprising three main components:

1. Defining aspects of a social and natural phenomenon affected by a decision or action
2. Identifying individuals, groups and organisations who are affected by or can affect those parts of the phenomenon
3. Prioritising these individuals and groups for involvement in the decision-making process.

Our approach is slightly different in that we are rather seeking to understand how individuals perceive valuation and related tools, with a view to understanding barriers to and opportunities for the use of valuation evidence, and possible ways to build trust and ensure that valuation can contribute to developing sustainable marine planning if and when appropriate, though this could be interpreted in terms of Reed et al.'s third component. Previous applications in environmental policy research have included, for example, forest management (Steelman & Maguire, 1999), climate change (Lorenzoni et al., 2007), values in conservation (Sandbrook et al., 2011) and the appropriate role of private land in conservation policy (Kamal& Grodzinska-Jurcak, 2014).

3.1 Defining the "concourse" and Q-sample

Q-method is based on the idea of the "concourse", which is the overall set of concepts, ideas, or ways of thinking about the issue(s) under consideration (Albala 2015) – in this case, the usefulness or otherwise of environmental valuation as a support for decision making. The first step in Q is to assess or develop the concourse, whether through interviews with particular actors, or through written sources, which can help to ensure that the broadest possible range of viewpoints is considered (Barry and Proops 1999, McKeown and Thomas 2013). In the present case, informal discussions and

interviews were used to guide the broad areas for analysis, with the bulk of the concourse being based on a wide range of published material, including academic papers, 'grey' reports, websites and journalism, regarding the strengths and weaknesses of environmental valuation in a practical context.

The next step is to develop a set of statements that are broadly speaking "representative" of the breadth of views represented in the concourse (Brown 1980). This can be done through structured or unstructured sampling, though in practice this is more a continuum than a binary choice (Albala 2015). Unstructured Q-samples compile statements considered to be relevant, without particular focus on covering all possible sub-issues (Watts and Stenner 2012). This is an inductive process in the sense that the dimensions guiding statement selection are not clarified prior to the statement collection, leading to a risk of bias through under- or over-sampling certain aspects (McKeown and Thomas 2013). Structured Q-samples are composed and gathered systematically by clustering statements according to different categories and subcategories, aiming to represent each combination in a theoretical conceptualisation of the topic (du Plessis 2005). Here, we adopted a fairly structured approach in which quoted arguments from the literature were collected in a spreadsheet then classified according to the main themes identified in the review as interesting and suitable for inclusion. After the clustering, representative statements were developed – in some cases these were direct quotes from the literature/database, in others we edited the quotes or combined the essence of several quotes into a single statement. Clarity in drafting statements was important, in particular because that for many participants English is a second language, and several iterations were used to refine and simplify the statements and iron out any ambiguities.

There are divergent views on the ideal number of statements in the final set, ranging as high as 100 (Barry and Proops 1999) but since the number "should not overwhelm participants, and the Q-sorting process should not be too time-consuming" (Albala 2015), lower numbers are called for. Based on previous experience, we used 34 statements, with an estimated time to complete the online survey of 15-20 minutes[9] The final set of statements (Table 2) sought to cover the identified themes with an even balance of 'pro' and 'anti' valuation perspectives and a gradient including some more extreme views as well as milder formulations.

[9] This appears to be broadly correct, though many participants took a little longer. It is hard to be precise about this however: the software recorded time to complete, but we cannot know if respondents took a break for other tasks during the time measured.

3.2 Recruiting participants

The selection of participants in Q studies should seek to cover a wide diversity of backgrounds and roles in order to increase the chances of covering as wide as possible a range of perspectives and views, provided they have some views on, or interest in, the area under analysis. For our purposes we needed people with some involvement in marine environmental or conservation research, management, or policy. We wanted a good minority of the respondents to have involvement with valuation or appraisal, but also a good number who had no direct experience with valuation; nevertheless, all respondents should at least have awareness of the basic ideas of ecosystem services, valuation in monetary terms, and economic appraisal, in order to understand the statements.

There is no agreed ideal number of participants in a Q-study, beyond ensuring enough variability to capture enough range of thoughts, beliefs, and viewpoints. The idea is not to sample large numbers (and there is no attempt to quantify what proportion of people think in any particular way), and some researchers (e.g. Valenta and Wigger 1997, Watts and Stenner 2012) suggest working with a smaller number of participants than items in the Q-set, however usually there are slightly more participants. For this study, we combined some targeted invitations, including partners within the ATLAS consortium to cover the research community as well as specific individuals involved in European marine management and policy, as well as more widely through marine management mailing lists. Not everyone who agreed to participate was actually able to complete the survey, but a final sample of 61 completed Q-sorts was achieved, covering a wide range of academic backgrounds, nationalities, roles and experience, with the common thread of involvement in marine environmental management, research, economics and/or policy. Almost all respondents expressed interest in receiving the results of the analysis.

3.3 Implementing the Q-sort

The Q sort can be based on a forced-choice or a free sort distribution (du Plessis 2005). A forced-choice requires sorting the statements into a pre-determined set of categories with a specified number of statements for each category. Free sorting does not impose this restriction. However the analysis and comparison of typical sorts are facilitated by a forced-sort approach, and this we adopted:

- 2 each in “least agree” & “most agree”
- 3 each in “much less agree” & “much more agree”
- 4 each in “less agree” & “more agree”
- 5 each in “little less agree” & “little more agree”

- 6 in “intermediate”
- Total: 34 statements

The Q-sorting process involves each participant independently sorting the statements into the above categories under the constraints according to how much they agree/disagree with the views expressed - a subjective exercise based on their own points of view (Brown 1980). The survey was implemented using QSortWare (http://www.qsortware.net/), a free package for conducting a Q survey online. The survey started with three introductory screens: text to explain the ATLAS project and the purpose of the survey; an explanation of data protection issues (including GDPR data privacy regulations compliance, and the fact that the survey had passed ethical approval procedures via the University of Edinburgh); and detailed instructions for completing the survey.

The Q-sort proper was conducted in two stages. The first was a rough sort of the 34 statements into three categories: tend to agree, tend to disagree, and neutral. The second sorted the statements from those three columns into the final Q-sort with 9 categories ranging from “most disagree” to “most agree”. This was followed by a number of debriefing questions with free text entry, both to check any issues relating to statements that respondents found unclear, ambiguous or difficult to classify (and how they had dealt with that), and more general commentary on the procedure and reactions to the issues raised. Brief information was also requested on the extent of educational background in economics, and on professional role(s) and experience.

3.4 Analysing data: Q-sort

The analysis seeks to cluster the ways people think about and perceive the issues as revealed by their sorts (van Exel and de Graaf 2005). Factor analysis is used to find relatively homogeneous groups of variables representing clusters of perspectives or beliefs. The correlation matrix expressing the overall variability of the Q-sorts is calculated, and factor analysis is used to extract factors with eigenvalues higher than 1.00. The factors show where each statement was placed on the Q-sort concerning the perception of the group. This often reveals several possible factors with small numbers of associated Q-sorts, and several sources recommend that the ideal number of factors to be extracted for final analysis should not exceed 3 or 4 (Brown 2004, du Plessis 2005, Watts and Stenner 2012, McKeown and Thomas 2013). The researchers now need to interpret the factors, assessing the commonalities within factors, and the key differences between them, based on factor scores that reveal the extent of agreement among perceptions related to the individual Q-Sort statements.

Table 2: Final list of statements

1	Beneficiaries should pay money for the services they receive from natural ecosystems.
2	Biodiversity should be protected for its intrinsic worth, irrespective of any value for humans.
3	Cost-benefit analysis organises disparate information coherently and can improve policy analysis and outcomes.
4	Commoditization of nature reinforces existing extractive, exploitative and unjust neoliberal capitalist relations.
5	Decision makers need good information about the value of ecosystem services to evaluate possible policy actions.
6	Deliberative methods that focus on negotiation and consensus provide greater legitimacy in assessing values.
7	Despite decades of valuation evidence, monetary values for environmental services are little used by decision makers.
8	Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity.
9	Economic arguments lead decision makers to give less attention to impacts not expressed in monetary terms.
10	Individual preferences are of very little relevance to decisions about societal norms and values.
11	Monetary valuation can only contribute to informing, not determining, policy decisions.
12	Estimating the total economic value of the goods and services provided by oceans would support their conservation.
13	Monetary values are inadequate proxies for the many values underlying the services produced by healthy ecosystems.
14	Given the dominance of the neoliberal economy, monetary valuation of nature may – alas – be one of the most effective ways of saving biodiversity.
15	If policy makers demand theoretically meaningless monetary values, on grounds of pragmatism, they need to be challenged rather than pandered to.
16	Lack of public understanding of marine ecosystems means stated preference estimates of non-use values for marine biodiversity are largely meaningless.
17	Failure to use valuation is a key cause of the observed degradation of ecosystems and the loss of biodiversity.
18	Laypersons cannot judge the importance of biodiversity–ecosystems–functions–services relationships: decisions are better left to experts.
19	Many environmental entities belong to a moral category beyond monetary relations: to offer a price is an act of bribery, to accept a price is an act of betrayal.
20	Markets are not sources of human freedom and prosperity, but rather of alienation, exploitation, and impoverishment.
21	There is increasing recognition that ecosystems can be viewed as economic assets that produce a flow of beneficial goods and services over time.
22	Monetary valuation will encourage policies that place the impacts of environmental damage disproportionately on the poor.
23	Thinking in terms of ecosystem services will weaken non-economic and intrinsic motivations for protecting nature.
24	Most decision-makers give little or no attention to arguments based on emotional, cultural or spiritual values of nature.
25	Stated preference surveys have an important role in revealing values held by the average citizen for marine ecosystems.
26	The belief that environmental outcomes will improve if we can only produce better and more convincing value evidence is very naïve.
27	The need to understand the benefits of marine ecosystems in economic terms has never been more pressing.
28	The protection and long-term sustainability of diverse ecosystems will only be possible if all ecosystem services are economically accounted for.
29	The values that inform environmental choices are plural and incommensurable and cannot be captured by any single monetary or non-monetary measure.
30	Framing discussion around the values of ecosystem services supports awareness, learning and exchanges of perception that lead to a deeper understanding of important issues.
31	Any particular component of an ecosystem cannot be understood - or valued - separately from its contribution to the functioning whole.
32	There is reasonable scientific understanding of the supporting and regulatory services provided by marine ecosystems.
33	Too little is known about the ecosystems of the deep sea to determine what is sustainable and resource-efficient, and what is not.
34	Monetary valuation of environmental goods and services is neither necessary nor sufficient for making good decisions about environmental management.

4 Results

The statistical analysis is able to extract up to 6 factors from the data (Table 3). However the fifth and sixth factors have only three and two loading Q-sorts (i.e. participants who 'correspond' with the factor) respectively, and have high standard errors for the factor scores. It is not possible to draw useful conclusions about how these small groups differ from the others.

Table 3: Results of analysis to 6 factors

	f1	f2	f3	f4	f5	f6	Sum
Average reliability coefficient	0.8	0.8	0.8	0.8	0.8	0.8	
Number of loading Q-sorts	12	13	6	5	3	2	41
Eigenvalues	9.76	8.72	6.28	5.51	4.23	3.07	
Explained variance (%)	16	14.29	10.29	9.04	6.93	5.04	61.59
Composite reliability	0.98	0.98	0.96	0.95	0.92	0.89	
Standard error of factor scores	0.14	0.14	0.2	0.22	0.28	0.33	

To a certain extent the same holds for the third and fourth factors, although with six loading sorts each it becomes possible to discuss the typical perspectives (Table 4). The three-factor version (Table 5) is also attractive in having a larger number of loading sorts in the third factor (and more overall: 56 vs 52) and lower standard errors. In all models, the clearest distinction is from factor 1, with factors 3 and 4 being in some respects variants on factor 2, principally in terms of divergent views on a small number of contentious items. So there is an element of judgement in determining how many groups to retain for analysis. Overall the most interesting results can be obtained from the three-factor model, with some additional nuance obtainable by considering four factors as a possible extension.

Table 4: Results of analysis to 4 factors

	f1	f2	f3	f4	Sum
Average reliability coefficient	0.8	0.8	0.8	0.8	
Number of loading Q-sorts	20	20	6	6	52
Eigenvalues	10.5	10.42	5.83	5.41	
Explained variance (%)	17.21	17.08	9.56	8.86	52.71
Composite reliability	0.99	0.99	0.96	0.96	
Standard error of factor scores	0.11	0.11	0.2	0.2	

Table 5: Results of analysis to 3 factors

	f1	f2	f3	**Sum**
Average reliability coefficient	0.8	0.8	0.8	
Number of loading Q-sorts	22	20	14	56
Eigenvalues	10.81	10.66	7.4	
Explained variance (%)	17.71	17.48	12.14	47.33
Composite reliability	0.99	0.99	0.98	
Standard error of factor scores	0.11	0.11	0.13	

4.1 Principal perspectives

The one-sentence summary of the results is that there is a clear distinction between a group that is highly sceptical of the framing of human-environment relations in terms of ecosystem services and of the use of economic appraisal and valuation tools in this context, and two or three other groups that are broadly favourable towards that paradigm and its methods, but with slightly different reasons for supporting valuation in practice. As might be expected, the latter group includes a large proportion of people with a background in studying economics, though by no means exclusively. Indeed several respondents with economics backgrounds in the sample were more closely identified with the first factor, while several people without economics backgrounds nevertheless express views supportive of economics methods (Figure 2).

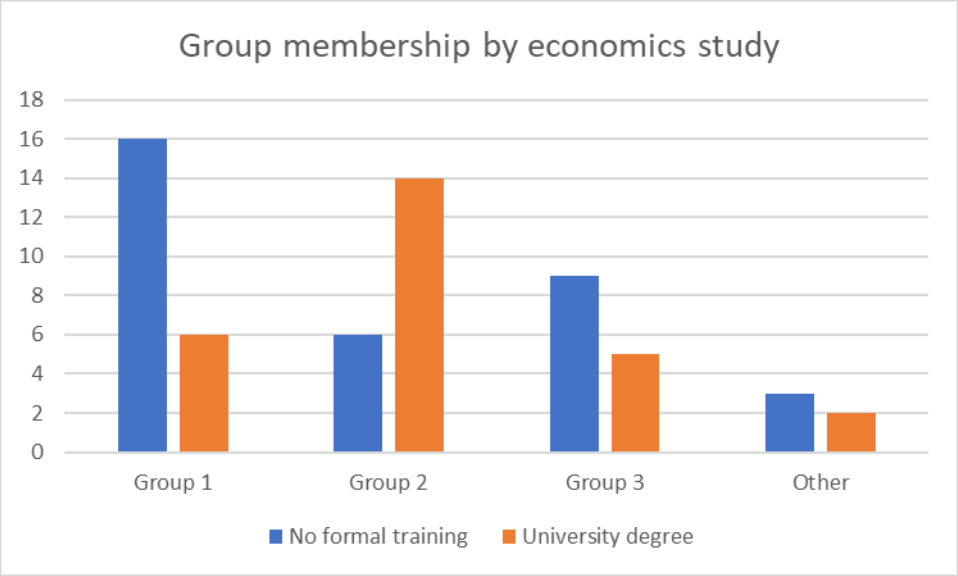

Figure 2: Group membership split by study of economics

4.1.1 Characteristics of Group 1

The statements most strongly agreed with for this group are as follows (strongest first):

- Biodiversity should be protected for its intrinsic worth, irrespective of any value for humans.
- Monetary values are inadequate proxies for the many values underlying the services produced by healthy ecosystems.
- Economic arguments lead decision makers to give less attention to impacts not expressed in monetary terms.
- The values that inform environmental choices are plural and incommensurable and cannot be captured by any single monetary or non-monetary measure.
- If policy makers demand theoretically meaningless monetary values, on grounds of pragmatism, they need to be challenged rather than pandered to.

The statements most strongly disagreed with are (strongest disagreement first):

- Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity.
- Failure to use valuation is a key cause of the observed degradation of ecosystems and the loss of biodiversity.
- The protection and long-term sustainability of diverse ecosystems will only be possible if all ecosystem services are economically accounted for.
- Given the dominance of the neoliberal economy, monetary valuation of nature may – alas – be one of the most effective ways of saving biodiversity.

- The need to understand the benefits of marine ecosystems in economic terms has never been more pressing.

Here we find very strong support for protecting biodiversity irrespective of its instrumental value to humans, and furthermore that damage to the marine environment cannot be rendered acceptable by compensating and ensuring no net loss of biodiversity. The second statement is quite a strong conservation approach, but nevertheless strong agreement with these views is common finding across all the groups (see below).

In terms of valuation, we find the view that monetary values are not able to capture the many values of ecosystem services, and furthermore that the values cannot all be traded off or reduced to any single measure. The idea that the absence of valuation could itself be a cause of environmental damage or loss is strongly rejected, as is the idea that accounting for ecosystem services in economic terms is a prerequisite for sustainable management. The idea that beneficiaries should pay for ecosystem services tends to be rejected.

Consequently, there is strong rejection of the idea that monetary valuation could be an effective tool for saving biodiversity. On the contrary, people from this perspective feel that using monetary values would crowd out or distract attention from other aspects, and that any policy-maker demand to ascribe monetary values to marine environments or services should be resisted. The group also tends to agree that "the belief that environmental outcomes will improve if we can only produce better and more convincing value evidence is very naïve" and that "deliberative methods that focus on negotiation and consensus provide greater legitimacy in assessing values".

4.1.2 Characteristics of Group 2

The statements most strongly agreed with for this group are as follows (strongest first):

- Framing discussion around the values of ecosystem services supports awareness, learning and exchanges of perception that lead to a deeper understanding of important issues
- Biodiversity should be protected for its intrinsic worth, irrespective of any value for humans.
- Cost-benefit analysis organises disparate information coherently and can improve policy analysis and outcomes.
- There is increasing recognition that ecosystems can be viewed as economic assets that produce a flow of beneficial goods and services over time.
- Monetary valuation can only contribute to informing, not determining, policy decisions.

The statements most strongly disagreed with are (strongest disagreement first):

- Markets are not sources of human freedom and prosperity, but rather of alienation, exploitation, and impoverishment.
- Many environmental entities belong to a moral category beyond monetary relations: to offer a price is an act of bribery, to accept a price is an act of betrayal.
- Commoditization of nature reinforces existing extractive, exploitative and unjust neoliberal capitalist relations.
- Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity.
- Individual preferences are of very little relevance to decisions about societal norms and values.

This group agrees with the first group regarding the need to protect biodiversity irrespective of human uses of the environment, and in rejecting the idea that damage is acceptable if compensated for. Views on markets and valuation are very different, however, with strong rejection of the idea that markets in general, and their extension to environmental services in particular, lead to unfair outcomes. Ecosystems can be viewed as economic assets, using price mechanisms for environmental goods and services is acceptable, and individual preferences are relevant to societal decisions and values. Consequently, there is strong agreement that the tools of monetary valuation and appraisal can be useful, both in organising information about human uses of ecosystems, and as a way of promoting learning, understanding and debate about human-environment relations.

Importantly, however, this group also strongly agreed with the statement “Monetary valuation can only contribute to informing, not determining, policy decisions” – slightly more strongly than with, for example, “Estimating the total economic value of the goods and services provided by oceans would support their conservation” and “Decision makers need good information about the value of ecosystem services to evaluate possible policy actions”. There is a tendency to reject the idea that decisions are better left to experts. Hence while this group clearly sees valuation as a useful tool, it is not seen as a panacea.

4.1.3 Characteristics of Group 3

The statements most strongly agreed with for this group are as follows (strongest first):

- Decision makers need good information about the value of ecosystem services to evaluate possible policy actions.

- Biodiversity should be protected for its intrinsic worth, irrespective of any value for humans.
- Estimating the total economic value of the goods and services provided by oceans would support their conservation.
- Beneficiaries should pay money for the services they receive from natural ecosystems.
- Cost-benefit analysis organises disparate information coherently and can improve policy analysis and outcomes.

The statements most strongly disagreed with are (strongest disagreement first):

- Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity.
- Monetary valuation of environmental goods and services is neither necessary nor sufficient for making good decisions about environmental management.
- Individual preferences are of very little relevance to decisions about societal norms and values.
- Thinking in terms of ecosystem services will weaken non-economic and intrinsic motivations for protecting nature.
- Monetary valuation can only contribute to informing, not determining, policy decisions.

Again we observe the strong views on consensus areas: biodiversity should be protected for its own sake, and damage to the marine environment is not rendered acceptable by compensation. Beyond that, this group is strongly in favour of valuation methods: these are seen as necessary to achieving sustainability, as essential tools to enable decision-makers to understand and evaluate the results of policies and decisions. At the same time, this group thinks that beneficiaries should pay for ecosystem services, and rejects the "crowding out" idea that ecosystem services thinking will weaken other motives for conservation.

Like group 2, however, the group is not without reservations regarding valuation. While tending to reject the idea that "the belief that environmental outcomes will improve if we can only produce better and more convincing value evidence is very naïve", the group nevertheless tends to agree that "the values that inform environmental choices are plural and incommensurable and cannot be captured by any single monetary or non-monetary measure" and also that "any particular component of an ecosystem cannot be understood - or valued - separately from its contribution to the functioning whole." The fairly enthusiastic acceptance of valuation and appraisal methods seems to be a

pragmatic issue, perhaps best summarised by the agreement with "Given the dominance of the neoliberal economy, monetary valuation of nature may – alas – be one of the most effective ways of saving biodiversity."

4.1.4 Considering a 4-factor model

As noted above, there is some nuance possible in moving to a 4-factor model. This nuance relates essentially to a deeper understanding of variability within the third factor – moving from the 3-factor to 4-factor model leaves the first two factors largely unchanged, with the sum of squared differences between the Z-scores just 0.10 for factor 1 and 0.28 for factor 2. The differences between the 3rd and 4th factor in the 4-factor model and the 3rd factor in the 3-factor model are 7.0 and 18.6 respectively. For comparison, the difference between factor 1 and 2 is 61.5. Essentially, the 3rd factor can be split into two groups that agree on many things, but with some specific differences relating to how and why they believe environmental valuation is "a good thing". We will refer to the 3rd factor here as 3b to keep a clear distinction from the 3rd factor in the 3-factor model.

Characteristics of Group 3b

The statements most strongly agreed with for this group are as follows (strongest first):

- Biodiversity should be protected for its intrinsic worth, irrespective of any value for humans.
- Commoditization of nature reinforces existing extractive, exploitative and unjust neoliberal capitalist relations.
- Decision makers need good information about the value of ecosystem services to evaluate possible policy actions.
- Estimating the total economic value of the goods and services provided by oceans would support their conservation.
- Given the dominance of the neoliberal economy, monetary valuation of nature may – alas – be one of the most effective ways of saving biodiversity.

The statements most strongly disagreed with are (strongest disagreement first):

- Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity.
- Individual preferences are of very little relevance to decisions about societal norms and values.

- Monetary valuation of environmental goods and services is neither necessary nor sufficient for making good decisions about environmental management.
- Monetary valuation can only contribute to informing, not determining, policy decisions.
- Monetary values are inadequate proxies for the many values underlying the services produced by healthy ecosystems.

This group is on the "pragmatic" side of the argument – despite considering that commoditisation of nature reinforces unfair outcomes, valuation and appraisal tools are seen as necessary in order to achieve sustainable management of oceans. The group tends to agree that "failure to use valuation is a key cause of the observed degradation of ecosystems and the loss of biodiversity". This is also the only group that tends to disagree with the statement "despite decades of valuation evidence, monetary values for environmental services are little used by decision makers."

Characteristics of Group 4

The statements most strongly agreed with for this group are as follows (strongest first):

- Economic arguments lead decision makers to give less attention to impacts not expressed in monetary terms.
- Beneficiaries should pay money for the services they receive from natural ecosystems.
- The values that inform environmental choices are plural and incommensurable and cannot be captured by any single monetary or non-monetary measure.
- Despite decades of valuation evidence, monetary values for environmental services are little used by decision makers.
- Decision makers need good information about the value of ecosystem services to evaluate possible policy actions.

The statements most strongly disagreed with are (strongest disagreement first):

- Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity.
- Thinking in terms of ecosystem services will weaken non-economic and intrinsic motivations for protecting nature.

- Monetary valuation of environmental goods and services is neither necessary nor sufficient for making good decisions about environmental management.
- Many environmental entities belong to a moral category beyond monetary relations: to offer a price is an act of bribery, to accept a price is an act of betrayal.
- Markets are not sources of human freedom and prosperity, but rather of alienation, exploitation, and impoverishment.

The key difference from group 3b is that group 4 takes a rosier view of markets. They tend to disagree with the idea that "commoditization of nature reinforces existing extractive, exploitative and unjust neoliberal capitalist relations" and – like group 2 – strongly disagrees with the statement "markets are not sources of human freedom and prosperity, but rather of alienation, exploitation, and impoverishment" and reject the idea that pricing environmental features is akin to bribery/betrayal. This is the only group to consider strongly that beneficiaries should pay for ecosystem services, and the only group to show only weak support for protecting biodiversity for intrinsic reasons.

However, this group considers that the complexity of environmental choices cannot be reduced to any simple figure, and while information about values is important to evaluate policies, in practice decision makers do not make much use of monetary values. At the same time, the group tends to agree that "most decision-makers give little or no attention to arguments based on emotional, cultural or spiritual values of nature" and is strongly of the view that "economic arguments lead decision makers to give less attention to impacts not expressed in monetary terms". Overall this group is happy with the idea of using markets and pricing in environmental management, and indeed considers this essential if decision-makers are to consider the environment fully, but remains ambivalent regarding how effective it might be.

4.2 Areas of consensus

One of the clearest and most interesting findings relates to the areas of broad consensus that cut across all the perspectives identified. The strongest consensus statement was disagreement that "Damaging the marine environment is acceptable so long as it is compensated for, with no overall loss of biodiversity" (Figure 3), closely followed by agreement that "Biodiversity should be protected for its intrinsic worth, irrespective of any value for humans" (Figure 4). These two statements represent a strong shared perspective that places avoiding damage to marine biodiversity and ecosystems as a fundamental obligation. However these are not consensus views in the Q-sort sense, because it is possible to detect a statistically significant difference in the strength of feeling: group 1 showed higher

agreement for conserving biodiversity than the other groups, while group 2 was less rejecting of the idea that damage could sometimes be acceptable via compensation.

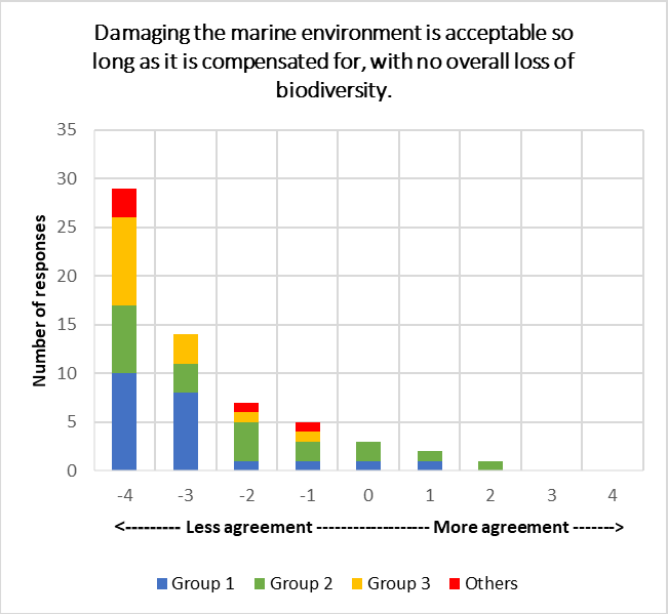

Figure 3: Consensus that compensation does not make damage acceptable.

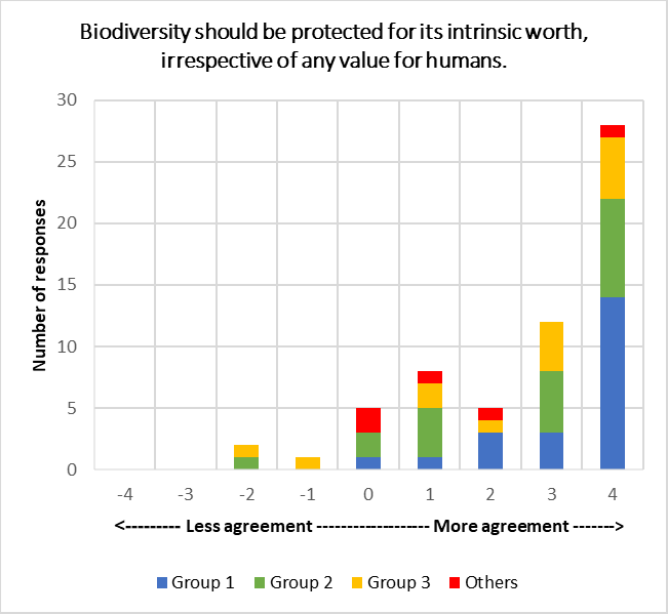

Figure 4: Consensus that biodiversity should be protected for its intrinsic worth.

The second strongest nexus relates to the role of laypersons with respect to their views and preferences regarding marine management (Figure 5, Figure 6). There is broad agreement that decisions should not be "left to experts" and that individual preferences are relevant in the context of

determining social norms and values. However the "anti-valuation" perspective identified as group 1 is more ambivalent about this second aspect.

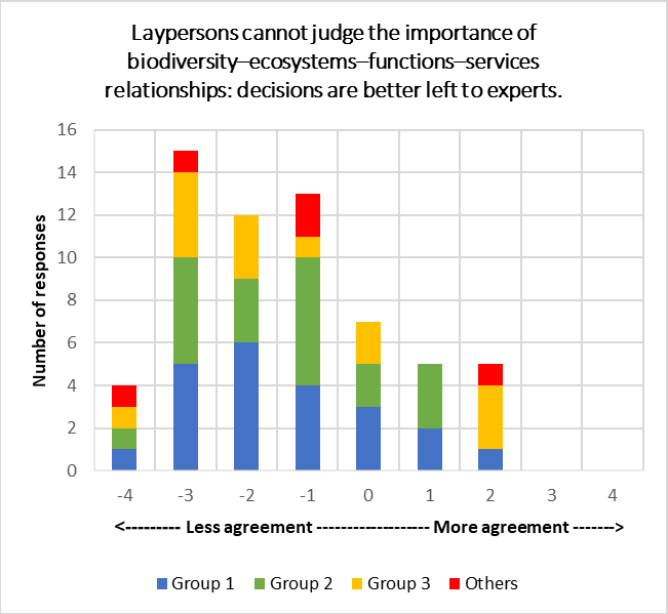

Figure 5: Broad consensus that laypersons have a role to play in environmental management.

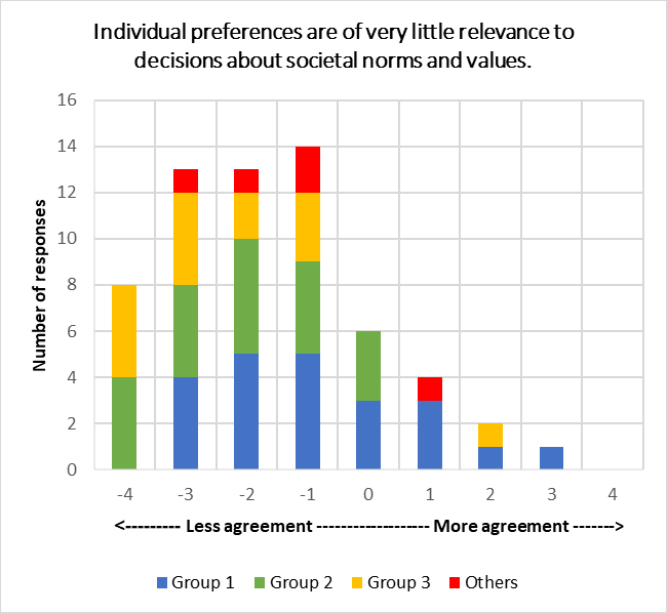

Figure 6: Broad consensus that individual preferences are relevant to societal decisions.

There are other consensus statements in the Q-sort sense of not displaying significantly different attitudes across the groups identified, but through broad-based disagreement or uncertainty rather than agreement. In particular, there is no identifiable pattern in responses to the statement "Most decision-makers give little or no attention to arguments based on emotional, cultural or spiritual values of nature" (Figure 7). Of course this is more a matter of interpretations of what happens in

actual decision processes rather than any fundamental feature of a respondent's world-view, and likely depends on the decisions in question, the institutional contexts, and the individual decision makers, so views on this statement could clearly vary depending on individual experience. There is also wide spread of views regarding whether or not decision makers have actually made use of existing monetary valuation evidence (Figure 8).

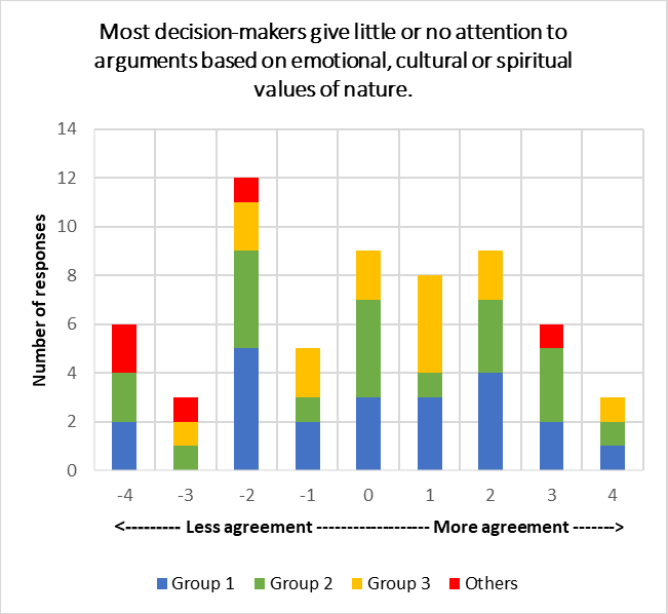

Figure 7: Widely varying views on extent to which decision-makers take account of emotional, cultural or spiritual values.

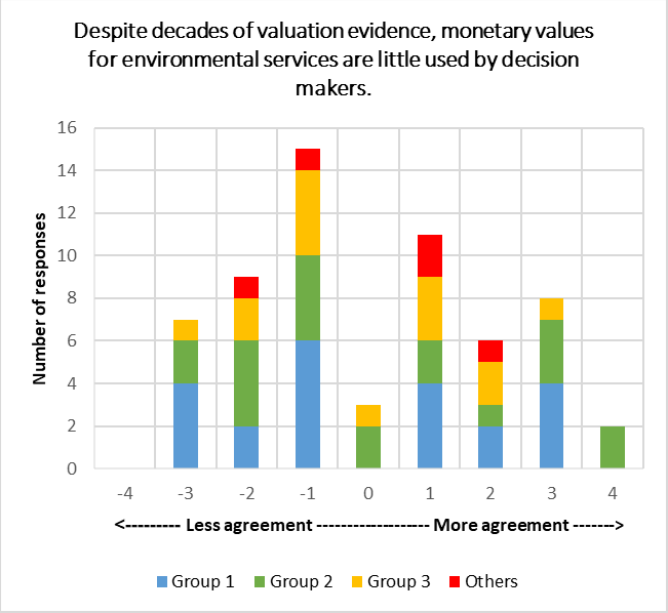

Figure 8: Uncertainty regarding whether or not monetary values are actually used by decision makers.

Perhaps associated with this, there is there was fairly general ambivalence on the statement "Too little is known about the ecosystems of the deep sea to determine what is sustainable and resource-efficient, and what is not." Here, most participants tended to classify this statement around the mid-range in their Q-sorts, i.e. expressing neither agreement nor disagreement. Similarly, there is ambivalence regarding "There is reasonable scientific understanding of the supporting and regulatory services provided by marine ecosystems" (Figure 10), although this case moves away from consensus since group 1 are more likely to reject the proposition. Group 1 is also much more likely to agree that "Economic arguments lead decision makers to give less attention to impacts not expressed in monetary terms".

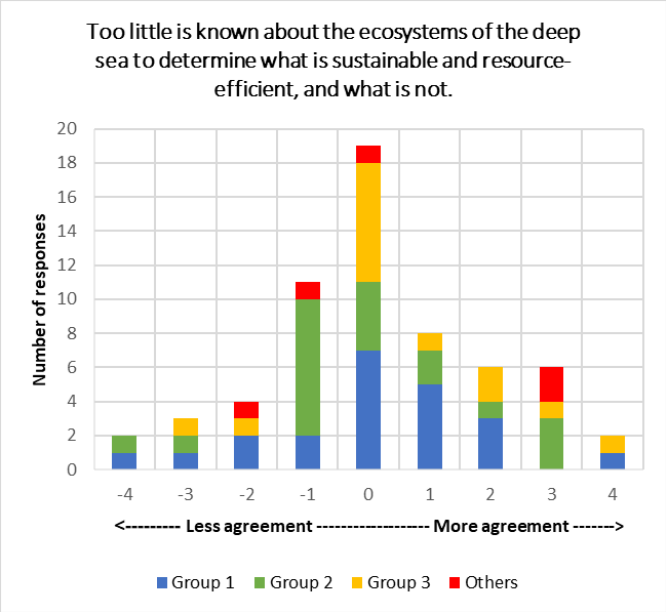

Figure 9: General uncertainty regarding whether or not we know enough about deep seas to manage them sustainably.

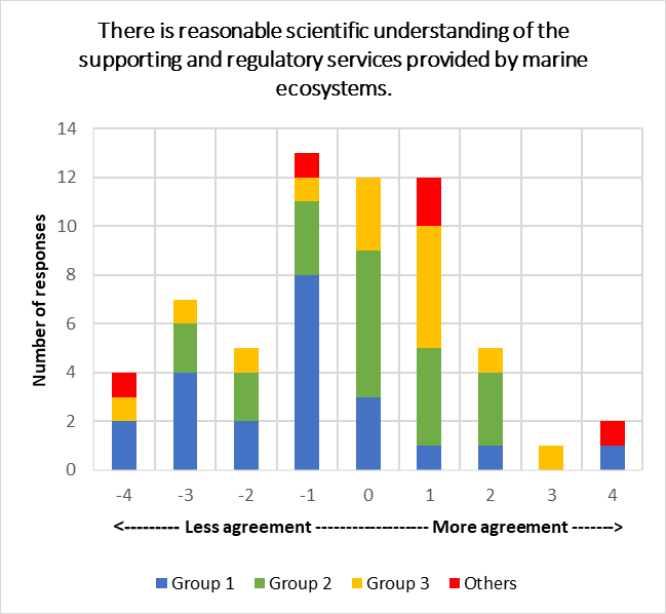

Figure 10: Views on adequacy of scientific understanding of supporting and regulatory services of marine ecosystems.

In the following section, we turn to assessing the areas of disagreement in more detail. To recap the main areas of consensus:

- Damage to marine environment is not acceptable, even if compensated for.
- Biodiversity should be protected for its intrinsic value.
- Individual preferences are relevant to social decisions, and decisions should not be left to experts.

And the areas of generalised uncertainty across the groups identified:

- regarding the information decision-makers use: whether or not they consider emotional, cultural and spiritual values, and whether or not they have actually used valuation evidence.
- regarding the state of scientific knowledge: whether or not we know enough about deep-sea ecosystems, and their supporting and regulatory services, to make sound judgements about their sustainable management.

4.3 Areas of disagreement

The ways in which the typical perspectives identified differ offer interesting insights into the ways in which valuation and appraisal are perceived, and what that might mean for how valuation could contribute to marine management.

4.3.1 Divergence on fundamental principles

The roots of the principal themes identified in section 4.1 can be traced back to some divergent views on fundamental principles regarding how human relationships with ecosystems should be considered. We have covered above the broad areas of agreement on this theme – conservation for intrinsic reasons, avoiding damage even if compensated for – but beyond that there are some striking differences. Views on whether or not beneficiaries should pay for ecosystem services, and on whether or not some environmental entities should be "beyond monetary relations" (Figure 11) show a fairly stark split. Those in groups 2 and 3 tend to reject quite strongly the idea of environmental entities being off limits to monetary valuation and trade-off, whereas group 1 tends to accept this proposition. Coherent with that, group 1 also tends to reject the idea of payment for services, whereas groups 2 and 3 are more divided on this issue, though broadly more favourable towards it, especially in group 3. Of course the statement is somewhat vague as it begs the question of which beneficiaries and which services (for example, many people would make a distinction between a multinational industrial fishing company and a subsistence fisher) but the response pattern can be seen to reflect a general difference in how commercialisation of human-environment interactions is perceived.

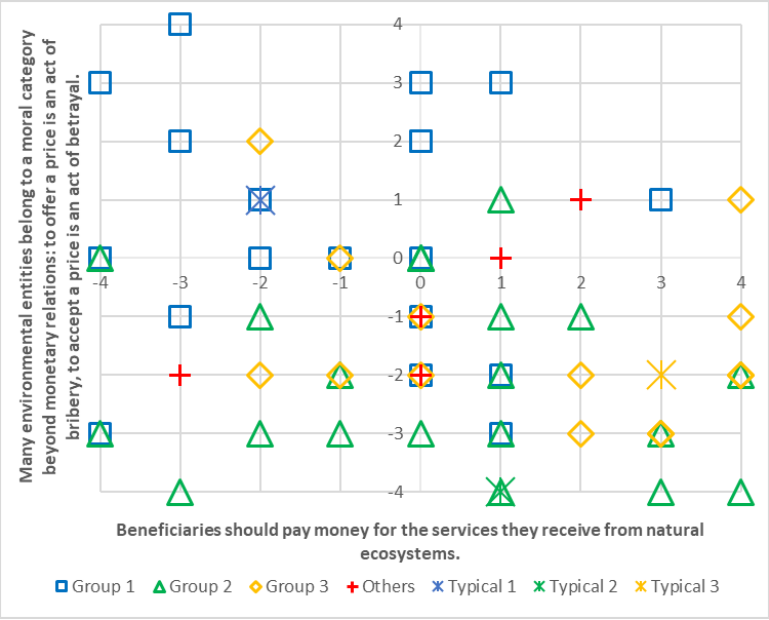

Figure 11: Views on paying for ecosystem services and on commodification of nature.

The groups split along similar lines regarding the validity of expressing the complexity of the values underlying human-nature relationships in terms of simple monetary or quantitative indicators (Figure 12). A typical group 1 perspective holds strongly that such indicators are inadequate across the board, whereas group 2 is much more ambivalent about this issue. Group 3 extends the trend displayed by group 2: while these perspectives tend to agree that "The values that inform environmental choices

are plural and incommensurable and cannot be captured by any single monetary or non-monetary measure", they do not agree that "Monetary values are inadequate proxies for the many values underlying the services produced by healthy ecosystems." These positions are not necessarily contradictory: it is quite possible to contend that there are certain aspects of our ethical obligations to nature (for example, to conserve for intrinsic reasons and to seek to avoid damage wherever possible) that cannot be reduced to monetary or quantitative figures, while still maintaining that monetisation is valid for certain values related to the services and benefits humans derive from nature. Indeed, this distinction is crucial in seeking a potential convergence between the perspective in terms of whether or not valuation could have a role to play in improved environmental management, as we discuss below.

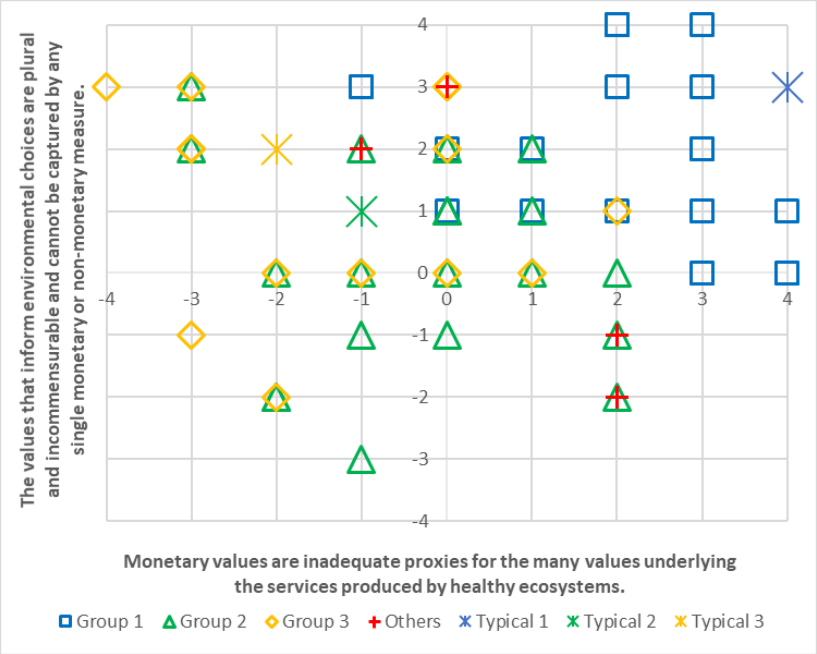

Figure 12: Views on reducing complex values to monetary measures.

4.3.2 Divergence on practical impacts

Leading on from the moral and ethical debates, there are widely divergent views on the practical impacts of using monetary valuation. These start with different perspectives on how market mechanisms impact on society (Figure 13). The group 2 perspective strongly rejects the condemnation of markets mechanisms in the statement "Markets are not sources of human freedom and prosperity, but rather of alienation, exploitation, and impoverishment" and also rejects the idea that "Monetary valuation will encourage policies that place the impacts of environmental damage disproportionately on the poor." Group 1, by contrast, is quite ambivalent regarding the role of markets and has some sympathy with the view that regressive outcomes may arise from policies encouraged by valuation.

Group 3 is intermediate on these issues. In practice, while it is widely recognised that market institutions have aided great progress in human society historically, it has become increasingly clear in recent years that the current western-dominated capitalist system may still be achieving further advances on average, but at a considerable cost in terms of increasing inequality within and between nations. Economists also recognise that many market-based instruments (including environmental taxes and payments for ecosystem services) would often have regressive impacts (i.e. represent larger proportions of income for poorer groups) – and while it would be possible to use the revenues to compensate for this redistributive effect, there is no guarantee that that would actually occur. The divergence on these issues might be considered in terms of the current broader societal debate regarding the appropriate level of government intervention in "free" market systems.

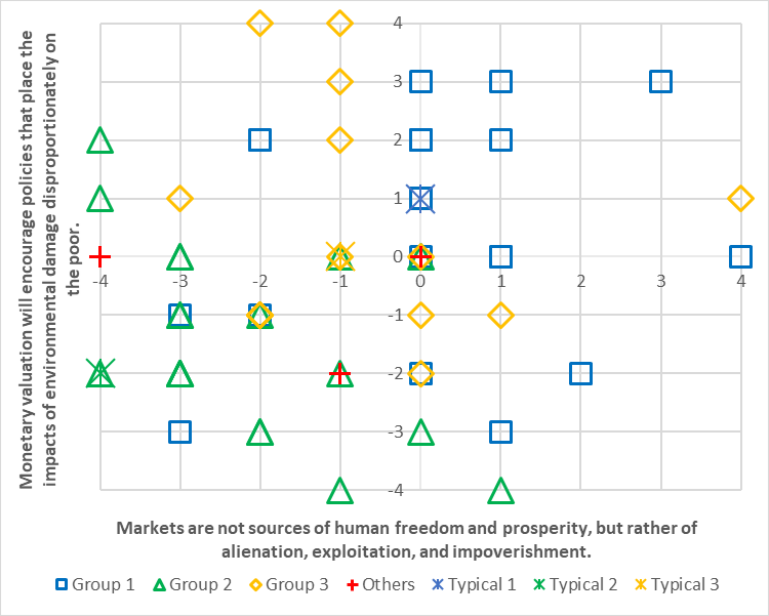

Figure 13: Views on market, values, social equity and poverty.

This extends to divergent views regarding how valuation might influence understanding of and thinking about human-ecosystem relationships (Figure 14). Group 2 sees strong potential to improve understanding, awareness, and learning about human-environment relationships through the use of valuation within an ecosystem services framework; group 3 somewhat less so; but both agree that this frame of thinking need not weaken wider and intrinsic motives for protection. Group 1 is uncertain and overall ambivalent on both of these issues.

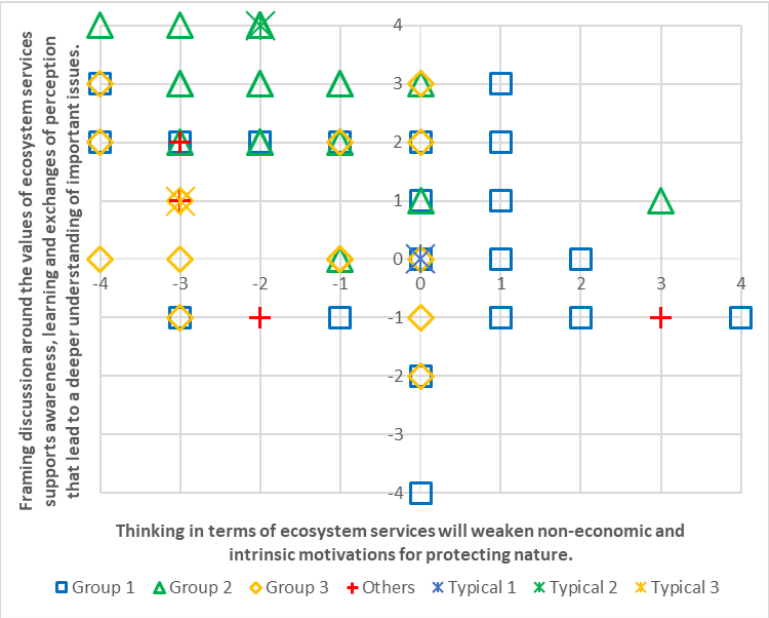

Figure 14: Views on how valuation could impact on understanding of human-environment relations and on wider motivations for conservation.

Views on the ways valuation influences decision makers also vary in similar ways (Figure 15). Groups 2 and especially 3 consider that decision makers need valuation information in order to evaluate the consequences of policy actions; group 1 is not convinced. Group 1 also fears that the use of economic arguments reduces the emphasis placed on arguments expressed in other terms. While group 2 is ambivalent about this idea, group 3 also agrees. To understand this, it should be kept in mind that the argument cuts two ways: on the one hand, the idea that monetary arguments detract attention from other factors can be seen as a rationale for staying away from valuation methods. But on the other hand, if we recognise that decision processes almost inevitably involve some form of monetary argument, even if only an estimate of the financial costs of an action, the argument can be interpreted as a driver for valuation precisely in order to increase the attention on non-marketed services, by ascribing monetary value to them.

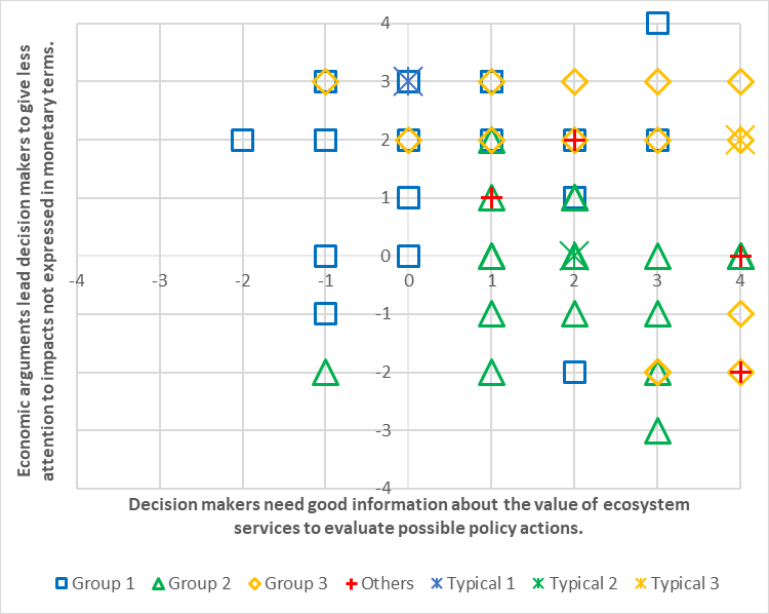

Figure 15: Views of influence of monetary valuation on decision makers.

Following on from the above observations, there is a clear split regarding views on whether valuation would help conservation and the avoidance of biodiversity loss (Figure 16). Group 1 broadly rejects the idea that "Estimating the total economic value of the goods and services provided by oceans would support their conservation" while groups 2 and especially 3 accept it. Clearly, any hope for convergence in perspectives regarding the practical role of valuation would need to address this dichotomy. In this context it is interesting to note the even stronger divergence in views on the statement "Failure to use valuation is a key cause of the observed degradation of ecosystems and the loss of biodiversity" – rejected outright by group 1, but considered more neutrally or positively by groups 2 and 3 respectively. The argument in favour revolves around the ideas of externalities and free-riding, noting that the absence of markets and prices mean individual actors have not had (economic) incentives to consider the impacts of their production/consumption activities on sources of benefits and sinks for waste products that have been provided "free" by ecosystems, and that failure to recognise non-use values may hinder conservation. The argument against holds that common property resources can be well-managed by community institutions without the need for market prices, and that introducing valuation methods and prices risks destroying these non-market motives for conservation. In principle these issues regarding the actual impacts of different approaches could be resolved empirically, though there is something of a gap here in the economics literature. This can be explained by the fact that it is hard to demonstrate a counterfactual or to carry out proper controlled experiments, but nevertheless the evidence base is slowly increasing and offers hope of better assessing in future the conditions under which valuation and appraisal methods, and/or market instruments, have beneficial or detrimental impacts.

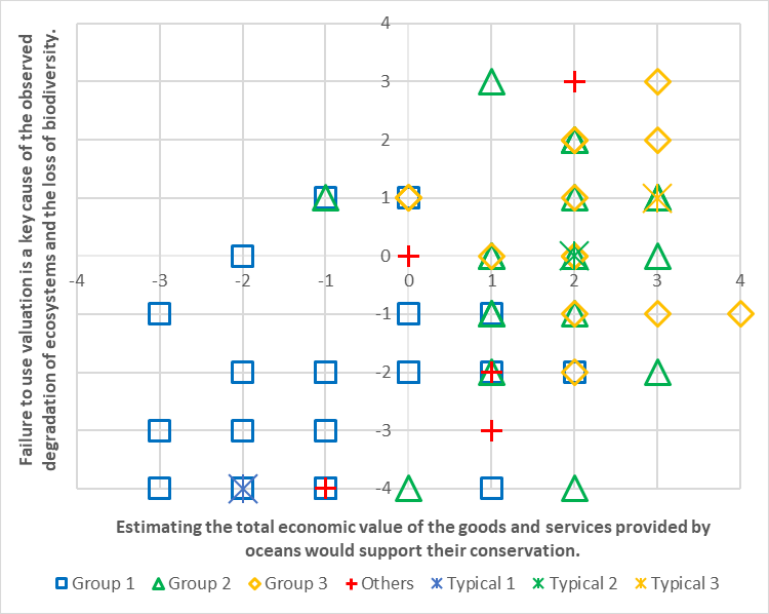

Figure 16: Views on the role of valuation as a tool to combat biodiversity loss.

4.3.3 Divergent views on role of valuation

Combining the divergent views on the underlying ethical framework with those on the practical consequences of using valuation helps to explain the different overall perspectives on the appropriate role for valuation in marine environmental management.

One clear distinction concerns views on whether or not CBA is a useful tool for organising complex information in a coherent pattern, and views on whether valuation should contribute only to informing, not determining decisions (Figure 17). Group 1 tends to be unconvinced that CBA can help organise information, and thinks it should not determine decisions. Group 3 tends to the opposite view, with CBA seen as useful, and decision-making driven by CBA results acceptable. Group 2 is intermediate, seeing CBA as useful, but recognising that other factors need to be taken into account in reaching management and policy decisions. This can be related to views on whether or not monetary figures can be adequate proxies for the various values of ecosystem services, and on whether valuation could help conservation in practice (see Figure 12, Figure 16): group 1 holds strongly that monetary values are not adequate and combines that with the view the valuation will not aid conservation; group 3 holds more or less the opposite view; while group 2 is similar to 3, agreeing that valuation is likely to help conservation, but nevertheless more ambivalent regarding the adequacy of valuation to represent the full range of values.

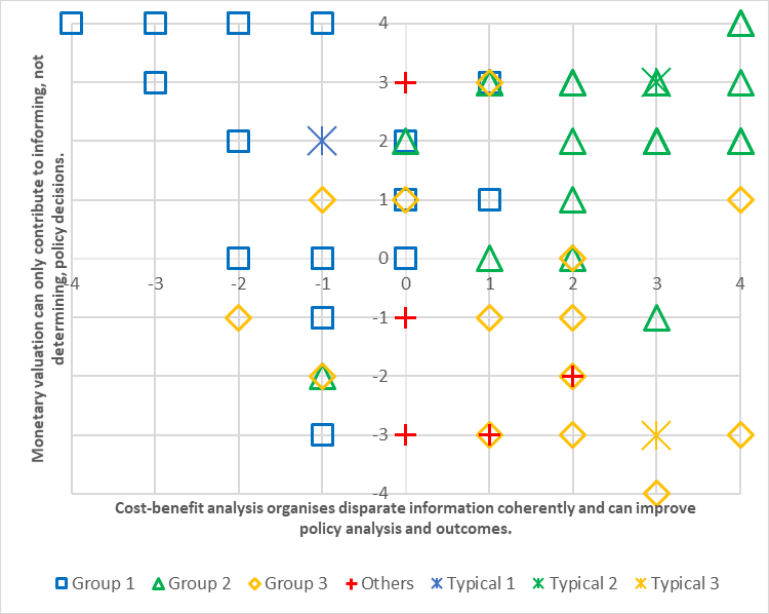

Figure 17: Perspectives on role of valuation and appraisal in decision-making.

Leading on from this, we reach the divergent overall assessment of valuation in terms of its practical role in achieving sustainable marine environmental management (Figure 18). From the group 1 perspective, valuation is not essential, is not an effective way to save biodiversity, and better valuation evidence would not in itself lead to improved environmental outcomes. Group 2 and especially group 3 disagree, seeing valuation as a potentially useful tool that, in the practical context of the modern world, may well have an important role to play if we are to achieve sustainability.

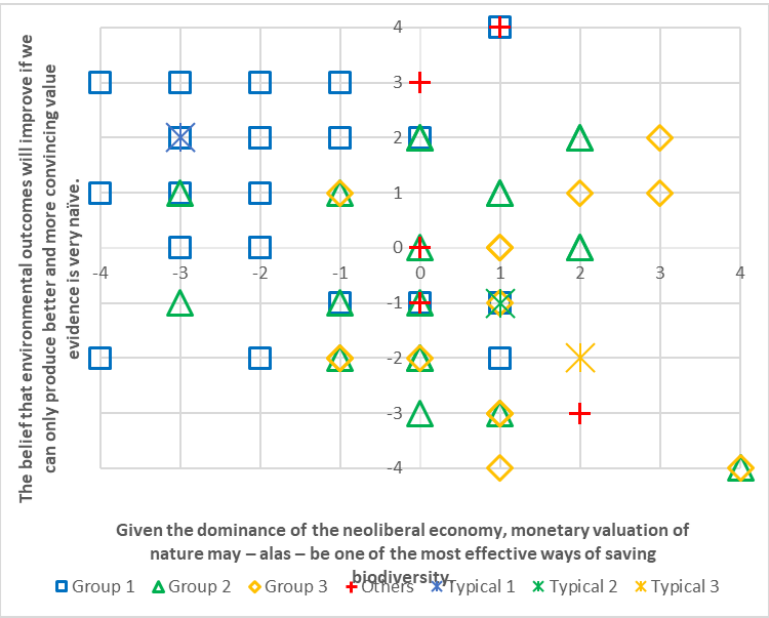

Figure 18: Summary of views on the role of valuation in environmental management.

5 Discussion

Although the above presentation of the divergent perspectives identified in the survey may seem to reveal a huge gulf, there are some areas that could be explored for constructive dialogue and possible convergence in viewpoints.

Firstly, although there are disagreements at quite a fundamental level, there are nevertheless points of general agreement that could be used as a basis for building trust – notably associated with strongly supporting conservation for intrinsic reasons and rejection of the idea that compensation makes damage acceptable. These points represent, on the one hand, a strong set of boundaries that could put limits on the scope of applicability for valuation and appraisal methods, and on the other, a shared view or common purpose regarding a non-negotiable commitment to achieving effective marine conservation. In other words, the disagreements are about the effectiveness of different tools for achieving the goal, but pretty much everyone is broadly agreed on what the goal should be, and that at least is a good place from which to start.

In fact some important limits are already well recognised in the economics literature/profession, in particular with respect to the over-riding need to protect "critical natural capital", and more generally recognition that values change with quantities. This means that any particular point estimate is only going to apply at the margin, and any value for a non-marginal change in quantities is usually going to be an integral of a non-constant function. This in turn implies that the severity of error associated with imprecise valuation depends on the rate at which that function changes (in technical terms, the elasticity of demand): risks are low where elasticity is low; where elasticity is high, rapidly changing values make the consequences of small quantity changes significant, so valuation and market-based instruments are riskier; for 'critical natural capital', elasticity is effectively infinite, marginal valuation is inappropriate, and the Precautionary Principle must apply (Farley, 2008).

Furthermore, it is clear that, although broadly supportive of valuation methods and their potential for aiding decision making, the perspectives assembled as group 2 and even group 3 do not view valuation as a panacea (Figure 19). At the same time, even within group 1 there is some acceptance that ecosystems can in some respects be seen as assets providing a flow of services to humans (Figure 20). It is also worth recalling that not all the respondents with advanced economics study in the survey were associated with groups 2 or 3. For example, one researcher with a resource economics background and associated with group 1 said "I support valuation and BCA[10] but I also think the entire

[10] Benefit cost analysis, more commonly known as cost benefit analysis (CBA).

exercise in valuation is insufficient due to the inherently anthropocentric nature of utility and despite the best efforts at further elaboration of the TEV framework". This position recognises the usefulness of valuation and appraisal as tools, despite also acknowledging that they are imperfect for both fundamental and practical reasons. It is a pragmatic stance: as noted above, all tools and models are imperfect in some ways, the relevant issue is determining under what conditions they can be useful.

Thus, another participant (group 2 – economist, civil servant) described economic appraisal as "a framework to express a mixture of positives and negatives, both in monetary and non-monetary terms. It is best used when there is a mixture, never purely monetary." This is stressing the use of appraisal methods for their information-structuring role, coupled with recognition that it is not possible to express all costs and benefits in monetary terms. It is familiar ground for experts, but might surprise others who may tend to think of economic appraisal as a "black box" approach leading to a single "bottom line" figure and a binary decision, and distrust it on those grounds.

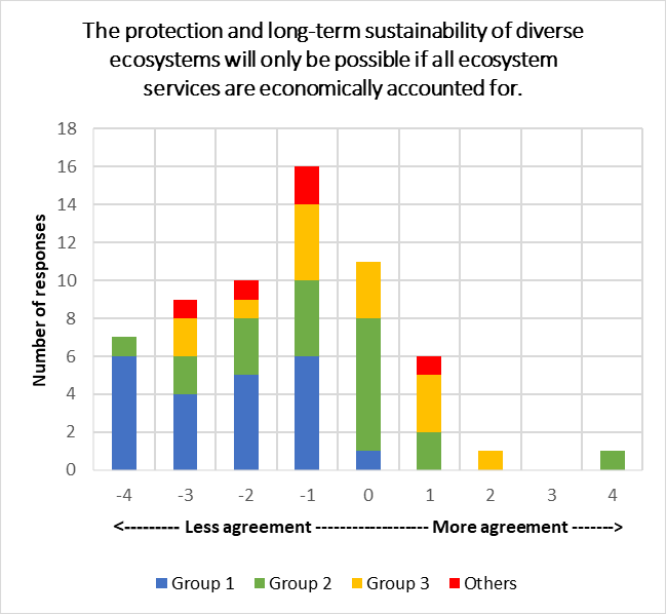

Figure 19: Economic valuation of all services not seen as essential to conservation.

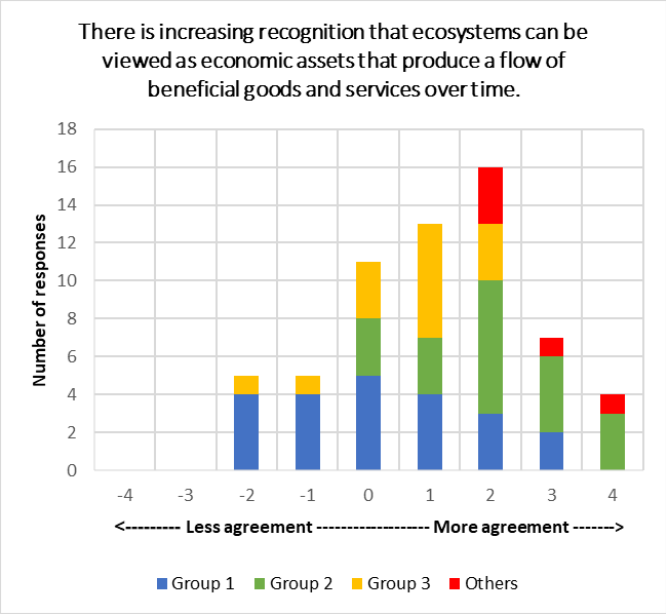

Figure 20: Views on seeing ecosystems as economic assets.

In terms of seeking convergence, therefore, valuation and appraisal approaches that focus on learning opportunities and open exchange of information, and that stress the existence of wider motivations and values that are not fully represented in monetary figures, may be treated with less hostility than approaches that take a top-down approach and/or that fail to make the appropriate caveats regarding what is and is not claimed regarding the figures estimated, what they represent, and how they may, and may not, be interpreted.

Better communicating the ways in which economists recognise the limits of the tools they use might also go some way towards assuaging fears regarding the uses of valuation methods. This could be helped by more research/evidence regarding the actual impacts of using valuation and appraisal methods. As noted above, this is challenging, as it is generally difficult to demonstrate the counterfactual (i.e. how would the decision process or behaviour have been different if it had/had not used valuation evidence?) and some fears relate to highly subjective matters that are difficult to observe (e.g. the concern that value evidence leads decision makers to focus less on the non-monetised impacts). Nevertheless the evidence that is available on these matters can be helpful in allowing people from both perspectives to develop a more nuanced appreciation of when valuation evidence may, and may not, be useful.

There is also support for a plurality of approaches. For example, a participant (group 1 – research ecologist) stated "I tend to think that intrinsic and utilitarian views on biodiversity conservation speak to different groups of people and that different decision makers will prioritize some views over others.

I think it is important to present the full array of values, recognizing that they are measured on different scales, to highlight important issues to consider in the decision-making process"

This is important because it offers another route forwards: although group 1 presents views that are generally sceptical regarding valuation and appraisal methods, even this group has positive (just) scores for the statements "Decision makers need good information about the value of ecosystem services to evaluate possible policy actions" and "Framing discussion around the values of ecosystem services supports awareness, learning and exchanges of perception that lead to a deeper understanding of important issues." Of course this does not necessarily signal agreement or even neutrality regarding the statements (since the scores are relative) but does give some indication of recognition, or at least non-rejection, of some potential usefulness in these methods. At the same time, all groups have negative scores for "Thinking in terms of ecosystem services will weaken non-economic and intrinsic motivations for protecting nature", and all groups have positive scores for "The values that inform environmental choices are plural and incommensurable and cannot be captured by any single monetary or non-monetary measure." Thus, again, even the pro-valuation perspective recognised the limits on these methods.

This is not to understate the disagreements between the perspectives identified, which are significant. But the main disagreements are connected rather to concerns about misuse of methods: considering monetary estimates to cover all sources of value, rather than being partial estimates of certain types of value, or treating appraisal as necessary and sufficient to determine decisions, rather than one option for structuring certain forms of information as one input to decision processes.

In other words, in terms of the perspectives identified in the study, the rather stark "valuation can cover all values and appraisal can replace deliberation" view that is most rejected by group 1 is not in fact a representation of how groups 2 or 3 think. And group 1 is not rejecting ideas of ecosystem service thinking or valuation out of hand, but rather expressing understandable concerns about applicability and appropriate uses that are to some extent recognised by groups 2 and 3 as well. There is room, then, for dialogue and learning on both sides that may well lead to some softening of views or compromises. Large transdisciplinary and collaborative research projects such as ATLAS are excellent vehicles for this kind of progress.

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Document Information

EU Project N°	678760	**Acronym**	ATLAS
Full Title	A trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe		
Project website	www.eu-atlas.org		

Deliverable	**N°**	5.3	**Title**	Validity, legitimacy and acceptability of ecosystem valuations
Work Package	**N°**	5	**Title**	Valuing Ecosystem Services

Date of delivery	**Contractual**	31/05/2019	**Actual**	08/01/2020
Dissemination level	x	PU Public, fully open, e.g. web		
		CO Confidential restricted under conditions set out in Model Grant Agreement		
		CI Classified, information as referred to in Commission Decision 2001/844/EC		

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Version log			
Issue Date	**Revision N°**	**Author**	**Change**