Environmental Research Plan

of the Federal Ministry for the Environment,

Nature Conservation and Nuclear Safety

UFOPLAN Reference Number: 3710 25 202

Published as Chapter II of UBA-Texte 01/2013 - UBA-FB-Nr: 001695

http://www.umweltbundesamt.de/uba-info-medien/4398.html

Methodologies regarding Economic and Social Analyses and Impact Assessments of Measures including Cost-Benefit-Analyses in the context of the Marine Strategy Framework Directive

- Summary -

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ON BEHALF OF THE GERMAN FEDERAL ENVIRONMENT AGENCY

January 2013

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Abbreviations

HELCOM	Convention on the Protection of the Marine Environment of the Baltic Sea Area.
CBA	Cost-benefit analysis.
MEA	Millenium Ecosystem Assessment.
MSFD	Marine Strategy Framework Directive.
EGS	Ecosystem Goods and Services.
OSPAR	Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic.
TEV	Total Economic Value.
WG ESA	EU Working Group "Economic and Social Analysis".
WFD	EU-Water Framework Directive (2000/60/EG).

Abstract

The present report is a summary of the research project "Methodologies regarding Economic and Social Analyses and Impact Assessments of Measures including Cost-Benefit-Analyses in the context of the Marine Strategy Framework Directive", funded by the German Federal Environment Agency.

The project´s work included the development of a methodological framework (Chapter 2), and, based upon this framework, the design of a quantity structure for the monetarisation of economic benefits associated with marine protection measures (Chapters 3 and 4). This methodology to evaluate benefits in the context of MSFD implementation was then tested in two case studies (Chapters 5 and 6).

The results of this testing exercise have been used to develop a practically oriented "Practitioner´s Guidebook", which serves decision makers as a guidance through the difficult field of benefit evaluation in the context of MSFD implementation. The Practitioner´s Guidebook is not summarized in this document, but exists as a separate document (in German).

Additionally, in the context of this project, a contingent valuation study was performed to elicit the willingness-to-pay (WTP) of people for reducing eutrophication in the Baltic Sea. The results of the survey were utilized in the present project, and are also incorporated into the ongoing work of the international research network BalticStern (Chapter 7).

1 Introduction and project overview

In June 2008, the Marine Strategy Framework Directive (2008/56/EC - MSFD) of the European Parliament and of the Council was published. This Directive obliges the EU Member States to achieve or maintain "Good Environmental Status" (GES) in their marine environments by 2020 at the latest. It establishes a framework for community action in the field of marine environmental policy, expanding the EU Water Policy to encompass all European waters. At the same time, the MSFD represents the environmental pillar of the integrated EU maritime policy ("Blue book").

For the purpose of achieving or maintaining GES, marine strategies containing programs of measures shall be developed and implemented in order to protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected. Prior to implementing such measures, however, the MSFD requires the Member States to conduct Impact Assessments, including Cost-Benefit-Analyses (CBA). In this context, the economic estimation of (environmental) benefits is highly important - and challenging. Theoretical concepts for conducting such economic estimations exist in abundance. The lack of quantifiable data, however, results in the necessity of combining quantitative and qualitative information (e.g. through multi-criteria analysis). To give more political weight to economic estimations of environmental benefits, further development of methodologies and a reliable data base are necessary.

In this context, the German Federal Environment Agency´s contract "*Methodologies regarding Economic and Social Analyses and Impact Assessments of Measures including Cost-Benefit-Analyses in the context of the Marine strategy framework Directive*" has a double objective: first, to generate information about the economic benefits associated with marine protection measures. And secondly, to develop a methodology to quantify the benefits of such measures in order to include these into a CBA, in a practical and understandable way.

The project adhered to the following work process:

In the first two steps, a methodological framework was developed (Project Modules 1 and 2), based on interviews with MSFD experts and policy makers from selected EU Member States and an analysis of the relevant processes on EU level (i.e. the Common Implementation Strategy/CIS process), as well as international research projects focusing on a practical application of the results. The framework provided operational and sound methodological guidance for proceeding with the next project steps, customized to German marine waters.

Based upon the methodological framework and guidance, the following third step incorporated the design of a concept for systematically analyzing and categorizing the benefits of marine protection measures into a CBA. This concept consists of a quantity structure to describe the relation between ecological improvements and resulting economic benefits (Project Module 3a). In addition, the concept consists of information about monetizing these benefits, and about alternative procedures, if no quantitative information is available (Project Module 3b).

At a stakeholder-workshop with international attendance, these preliminary results were presented to and discussed with experts and stakeholders from the fields of science and policy. The chosen methodology and planned next steps were generally regarded positively. Furthermore, policy makers made clear that accessibility of the methodology and transparency with regard to uncertainties will be highly important for a later application of the project´s results, in the context of choosing measures and analyzing these via cost-benefit analysis.

Following the stakeholder-workshop, the developed methodology was tested in two separate case studies (Project Modules 4a and 4b), treating selected pressures according to Annex III, Table 2 MSFD. The objective of the testing was twofold: first, the case studies were to quantify the economic benefits of reduced pressures on the environment as far as possible, using available data and testing the limits of quantification with present data availability. Second, the developed methodology had to be applied and tested in the case studies, in order to gain insight into difficulties and elaborate proposals for improving the concept. Additionally, data gaps and research needs were identified. For the cases studies, the pressures "Marine Litter" (in the North Sea) and "Eutrophication" (in the Baltic Sea) were selected.

Thus, the case studies supported the final and fifth step of the project, which is the preparation of a "Practitioner´s Guidebook" for quantifying economic benefits of marine protection measures in the context of MSFD implementation.

The following flow chart visualizes the project´s key steps.

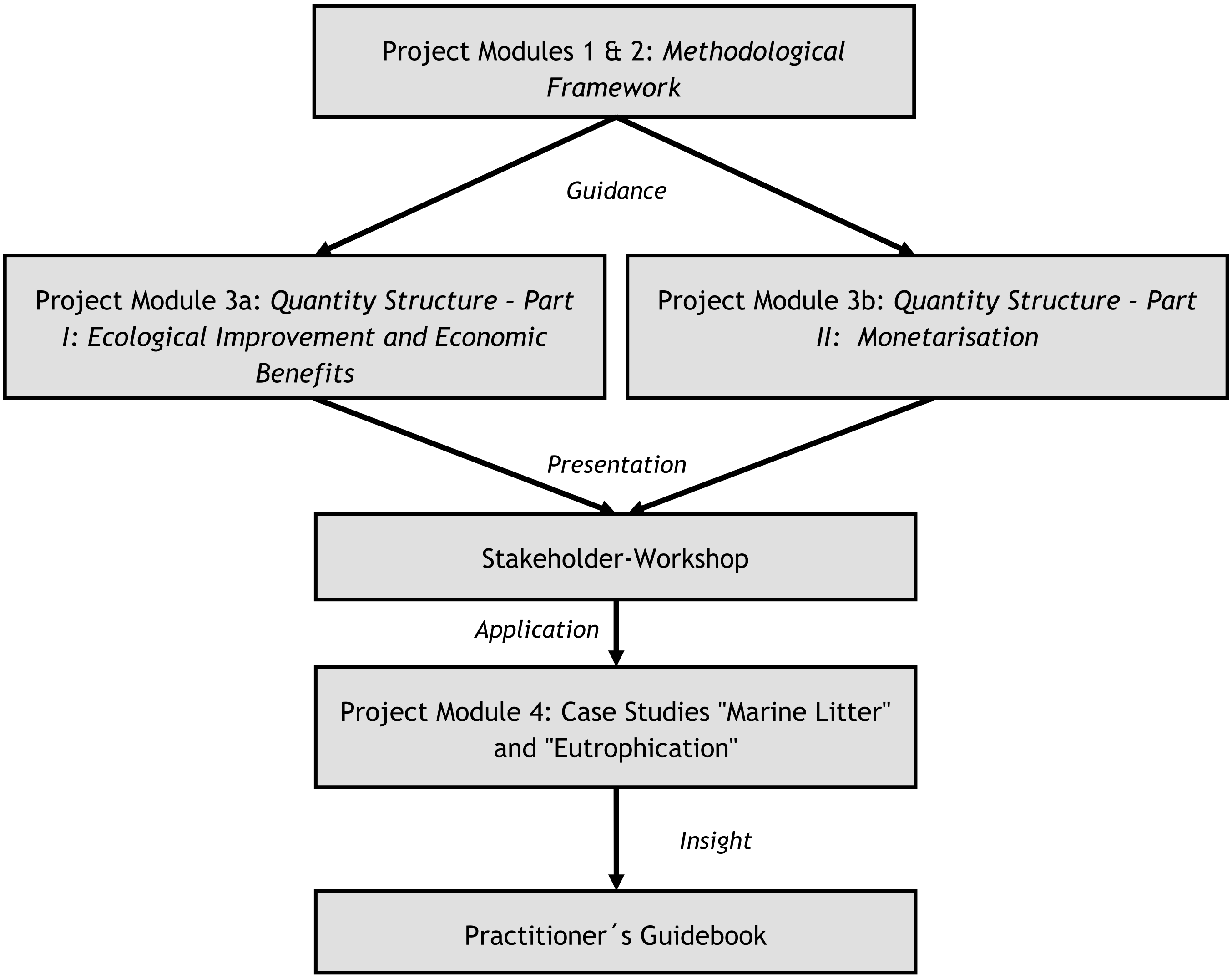

Figure 1: Flow Chart

Additionally, in the context of the project, a contingent valuation study was performed, eliciting people's willingness-to-pay for a reduction of the Baltic Sea's eutrophication. The results of the survey were used in one of the case studies, and contributed to the ongoing work of the research network BalticSTERN (Meyerhoff/Angeli 2012).

The present project summary contains short overviews of the various project steps, concentrating on processes and results.

2 Project Modules 1 and 2: Methodological Framework

2.1 Objective

Project Modules 1 and 2 aimed at analyzing the regulatory and practical information available, regarding CBA and the quantification of benefits in the context of MSFD implementation, and also, based upon the acquired information, at developing guidance and a methodological framework for the further steps of the project.

2.2 Background

Due to the lack of experience with the application of CBA in policy making in Germany, and because of the obligation of the MSFD to regionally coordinate the steps towards full implementation and GES, an analysis of experience existing in other Member States was considered crucial for the first steps of the project. Especially important was the examination of the different approaches to quantify benefits , as the methodology employed greatly impacts the results of such assessments (and, therefore, could potentially lead to very divergent results in the process of selecting measures).

2.3 Practical Approach

As described above, the following approach was developed based upon an analysis of relevant documents and literature, and several interviews with experts and policy makers from selected Member States.

The most important documents analyzed are:

- WG ESA (2010): Economic and social analysis for the initial assessment for the MSFD: A Guidance Document - a legally non-binding Document – Draft December. 2010[1].
- German Initial Assessment: Marggraf et al. (2011)[2] (first project report of the research project "Initial Assessment"; February 2011).
- EFTEC/ENVECO (2010): OSPAR Regional Economic and Social Assessment for the Marine Strategy Framework Directive – draft works specification[3].
- SEPA (2008): The economic value of ecosystem services provided by the Baltic Sea and Skagerrak. Existing information and gaps of knowledge. Report 5874[4].

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[1] Final Version (Dec. 2010) to be found at: http://circa.europa.eu/Members/irc/env/marine/library?l=/implementation_coordinat/economic_analysis/3-legal_documents/assessment_documentpdf/_EN_1.0_&a=d.

[2] Final Version (in German) to be found at: http://www.umweltbundesamt.de/wasser/themen/downloads/meere/gutachten_zur_erstellung_der_oekonomischen_anfangsbewertung.pdf

Final Versions separately for the North and Baltic Seas (in German) to be found at: http://www.meeresschutz.info/index.php/berichte.html.

[3] Final Version to be found at: http://sciencesearch.defra.gov.uk/Document.aspx?Document=me5103_9927_FRP.pdf.

- United Kingdom: DEFRA (2009): Scoping Study for Elements of the Marine Strategy Framework Directive -Impact Assessment Evidence Base[5].
- France: Agence des aires marines protégées/Ifremer (2010): Évaluation Initiale Volet Analyse économique et sociale Guide technique en vue de la réalisation des projets d'analyse[6].
- Netherlands: Rob van der Veeren (2009): Economische analyse van het gebruik van de Noordzee[7].
- European Commission, DG Environment (2010): Scoping study on the requirements for economic assessment in the Marine Strategy Framework Directive - Final report[8].

Expert interviews were conducted with policy makers from France (*Ministère de l'Écologie, du Développement durable, des Transports et du Logement und French Marine Protected Areas Agency*), United Kingdom (*DEFRA, ABPMER*), Finland (*MTT Economic Research, Agrifood Research Finland*), Netherlands (*Rijkswaterstaat*) and Sweden Schweden (*Swedish Environmental Protection Agency*).

The topics in question were approached according to semi-structured interviews, with the following project-relevant results:

- For the drafting of the quantity structure to categorize economic benefits, the recommendations of the EU CIS Working Group "Economic and Social Analysis" (WG ESA) were in many cases adopted, thus utilizing the concept of Total Economic Value (TEV). This concept is also widely recognized by the questioned policy makers and is included in the German Initial Assessment. Therefore, the work of the present project is based on the ecosystem services approach and uses the TEV framework to categorize economic benefits of measures, including non-use values.
- The quantity structure (chapter 3) presents an overview of pressures and impacts, and elaborates on the interconnectivity between ecological improvements and the resulting benefits.
- Because of the generally insufficient data availability, and the difficulty in acquiring and/or using data from other countries or regions, the quantity structure focuses solely on German marine waters.
- Inspite of the coverage of coastal waters by the WFD, such waters are to be included into the present methodology, as many benefits of marine protection measures are achieved

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4 To be found at: http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5874-6.pdf.

5 To be found at: http://randd.defra.gov.uk/Document.aspx?Document=ME5101_9114_FRP.pdf.

6 To be found at: http://wwz.ifremer.fr/dcsmm/content/download/38683/528616/file/Guide%20technique%20PI.pdf.

7 To be found at:
http://www.noordzeeloket.nl/krm/stand_van_zaken/nationaal_traject/Economische_analyses_2010.

8 To be found at: http://ec.europa.eu/environment/enveco/studies.htm.

in such waters. Additionally, benefits realized in other marine regions or other Member States´ waters are excluded from the analysis.

- The same is true for (additional) benefits that are created by land-based measures in addition to the improvement of the marine environment. Nevertheless, if such benefits evolve, they will be marked as additional benefits and described qualitatively.
- Because of limited data availability and high uncertainties surrounding the complex processes of marine ecosystems, interactions between various pressures and impacts are not considered in the development of the quantity structure. Such interactions are, nevertheless, described qualitatively, if information is available.
- The benefitting sectors of the economy are categorized according to the sectors listed in the German Initial Assessment (see above). To be able to also depict benefits created in non-economic sectors (i.e. the society) - non-use values such as altruistic and aesthetic values - the additional sector "society" has been added.
- The changes in economic benefits through measures that evolve in the different sectors are classified into primary and secondary benefits. Primary benefits describe benefits that are realized directly in one of the economic or societal sectors of the German Initial Assessment. These will be depicted quantitatively, as far as possible. Secondary benefits (Co-Benefits) are created in functionally connected sectors or companies, e.g. in suppliers, and will be excluded from the quantity structure for the reason of greater accessibility and simplicity. Such co-benefits will be described qualitatively, as far as possible.
- In the project, the discount rates of the German Environment Agency´s guidance for the evaluation of environmental impacts ("Methodenkonvention"[9]) will be used exclusively.
- As a time-frame for the assessment of economic benefits of measures, the "technical[10]" life cycle of the measure will be used, as is generally done in cost-benefit assessments. In the case of measures where this approach is not feasible (e.g. legislative changes without a time frame associated to them), time scale and discount rates will be chosen on an individual basis.
- The use of cost- and price-based approaches to monetize benefits (such as the replacement cost method) will be scrutinized in the course of the project, as general methodological difficulties exist in using results of such studies based on these approaches in a CBA. When possible or necessary, such methods will be used as proxy (auxiliary quantity), or as alternative data if no other information is available (data category c: see chapters 4 and 5).

Beside the documents and literature sources listed above, existing studies aimed at the evaluation of benefits were collected and analyzed. The relevant studies were categorized and

[9] Final Version (in German) to be found at: http://www.umweltdaten.de/publikationen/fpdf-l/3193.pdf.

[10] "Technical" in the case of regulatory legislation means the legislative life time of such regulatory instruments (e.g. the time scale of a legislative regulation, or the legislative guaranteed financing period for supporting measures etc.).

summarized, and transferred to a data base that was created according to the recommendations of the "Methodenkonvention" (see above). This work took place throughout the project.

The methodological framework described in this chapter formed the basis for the upcoming project steps, namely the development of the quantity structure (chapter 3) and the case studies (chapters 4 and 5).

3 Project Module 3a – Quantity Structure Part I: Ecological Improvement and Economic Benefits

3.1 Objective

The pressures and impacts according to Annex III, Table 2 MSFD formed the basis from which the quantity structure was developed. These pressures and impacts are to be reduced by marine protection measures in order to achieve GES. These marine protection measures, in turn, shall be assessed by cost-benefit analyses prior to their implementation. While the determination of the cost-side of measures is comparably straightforward - which does not mean that such an undertaking is easy - information regarding the effects of measures on environmental benefits is usually lacking. Such effects can be manifold, and the identification of all possible benefit categories affected is therefore a crucial first step.

The objective of the *Project Module 3a - Quantity Structure* was, accordingly, to devise a structure that can be used to identify and classify all benefits of reduced pressures into a comprehensive and practical structure. This serves to visualize the "overall benefits" of a reduction of a certain pressure on the one hand, and on the other hand, helps to evaluate the individual benefits. The quantity structure therefore represents the basis for the following project steps, i.e. the monetarisation of benefits and the case studies.

3.2 Conceptual Background

The design of the quantity structure is principally based on the concept of "Total Economic Value" (TEV), as this framework easily allows for a practical categorization of all possible benefits. The TEV sums up all components of the economic benefits of the reduction of a given pressure/impact, and is widely recognized as a good approach for the purpose of economic evaluation of ecosystem goods and services (EGS). The framework is intrinsically anthropocentric, putting an emphasis on the value of EGS for human consumption and usage - meaning also that the value of such EGS increases with the increasing benefits derived for humans[11]. The classification of the benefits into different benefit categories under the TEV framework allows for an easy completeness check.

The TEV framework classifies the total economic value into use and non-use values (Pearce/Turner 1990; UBA 2007). The use values of ecosystem goods and services are further divided into direct consumptive values (e.g. the consumption of fish and other marine "products") and direct non-consumptive values (e.g. "use" of a landscape for recreation or the use of waterways for transportation), as well as indirect use values (e.g. the natural purification of drinking water or the biological decomposition of waste) and option values (i.e. the potential use of EGS in the future).

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[11] In this context, the expression "benefit" encompasses also human well-being and satisfaction; in this sense, a reduction in environmental pressures (i.e. an increase in environmental quality) results in higher benefits through increased well-being and contentment.

The non-use values are classified into existence values, altruistic and heritage values (see figure 2, depicting the various benefit categories of the TEV).

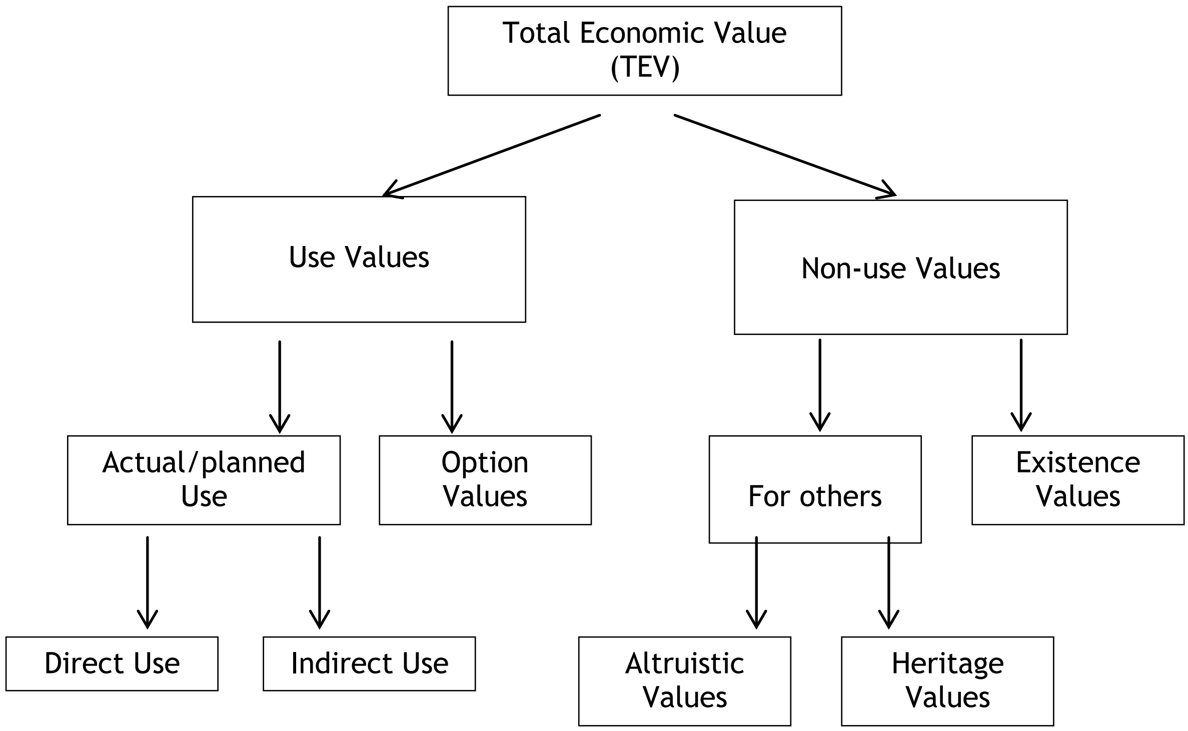

Figure 2: Concept of the Total Economic Value (TEV)

Besides the TEV framework, the understanding and categorization of EGS of the Millennium Ecosystem Assessment (MEA) was also used in developing the quantity structure. The MEA classifies EGS into four main categories: provisioning services, regulating and supporting services, and cultural services (MEA 2005).

Contrary to the TEV framework, the MEA specifically aims at depicting the complex interactions between ecosystems and human activities. The two concepts, however, complement one another and can be utilized together. The regulating services according to the MEA, for example, can be classified as indirect use values and option values of the TEV. The provisioning and cultural services (MEA classification) mainly fall under the TEV category "direct use values", or non-use values in the case of some cultural services. Supporting services, however, are included in the TEV only because of their importance in providing other ecosystem services (Defra 2007). The following table 1 provided an overview of the ecosystem goods and services provided by marine ecosystems.

Table 1: Ecosystem Goods and Services provided by marine ecosystems

Provisioning Services	**Regulating Services**
Provision of food	Gas- and climate regulation
Provision of genetic resources and medicine	Protection against floods and storms
Provision of energy (wind, tidal energy, waves)	Protection against erosion
Provision of other renewable resources for other purposes (jewelry, souvenirs etc.)	Decomposition of waste and contamination
Provision of non-renewable resources	
Provision of transport routes	
Cultural Services	**Supporting Services**
Recreation and tourism	Primary production
Aesthetics and amenities	Nutrient cycle
Cultural heritage and identity	Ecosystem stability and resilience
Spiritual and religious values	Habitats
Research and teaching	Food webs
	Biodiversity

Source: Bertram/Rehdanz (2012). The classification of EGS follows the classifications developed by Turner et al. (2010) and Arcadis Belgium (2010).

It is necessary to clarify that ecosystem goods and services are not equal to the benefits derived from them. Benefits, in this sense, are created through human use , generally by combining several EGS (e.g. several supporting services to use fertile soil for agriculture). On the basis of Boyd/Banzhaf (2007), Fisher et al. (2009) propose to understand ecosystem goods and services as aspects of an ecosystem, that are used actively or passively to generate human well-being. EGS are, therefore, ecological phenomena incorporating ecological structures and processes, at the point where these are actually used by humans. Therefore, according to this understanding, EGS establish the connection between physical systems (i.e. ecosystems) and human well-being (Boyd/Banzhaf 2007; Fisher et al. 2009).

Such theoretical considerations are useful in the context of developing the quantity structure, as they help to avoid double counting of benefits. For example, it is possible that the same EGS or a combination thereof contribute to several different benefit categories: the reduction of nutrient input and eutrophication reduces the risk of toxic algal bloom, with positive effects on both recreation and tourism, as well as human health. These two different increases in benefits can be added without methodological difficulties. Double counting, however, can occur when the ecosystem goods and services of several ecosystems are quantified separately and aggregated without considering whether or how the EGS influence each other. If increases in benefits are exclusive to one another, they cannot be summed up and aggregated into a single value (Turner et al. 2008).

3.3 Practical Approach

Step 1: Definition and summary of pressure reductions

The pressures and impacts according to Annex III, table 2 MSFD formed the basis from which the pressure reductions were assessed. During the analysis of the interconnections between pressures reduction on the one hand, and resulting ecological improvements and benefits on the other, however, it turned out that several pressures have very similar impacts on the marine environment (at least according to the reduced complexity level of this current analysis). To avoid unnecessary repetitions and to increase overall readability, these have been treated together[12].

Step 2: Analysis of the bio-physical impacts of measures to reduce pressures

The next step involved the analysis of the actual biophysical effects of a reduction of pressures in the environment. To this end, the individual pressures (or a package of pressures - see above) were defined and the most important contributors to the pressures identified. For example, marine litter is defined, according to the European Commission (2011) as "... *any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It consists of items that have been made or used by people and deliberately discarded or unintentionally lost into the sea and on beaches, including such materials transported into the marine environment from land by rivers, draining or sewage systems or winds. For example, marine litter consists of plastics, wood, metals, glass, rubber, clothing or paper*".

The main contributors to his pressure are the economic sectors shipping, fisheries, the tourism industry and industrial activities along the cost and on the open sea (offshore platforms). Additionally, litter reaches marine waters from land-based activities (via rivers) (Fleet et al. 2009; Marggraf et al. 2011).

Subsequently, the changes in biological, physical and chemical structures, processes and functions due to pressure reductions were described in general, both through a qualitative textual description, as well as visually through a flow chart (for selected pressures). Afterwards, the changes in EGS provision resulting from such ecological improvements were analyzed and classified (according to the TEV framework). Additionally, the different pressures were assessed separately for the North and Baltic Seas with regard to their relevance, life time and domain, and with regard to the uncertainties involved. Also, interdependencies between various pressures were described and attached as an annex in tabular form to the Project Module 3-Report.

Step 3: Identification of societal benefits of pressure reductions

The illustration of the effects of pressure reductions in the environment on environmental quality and ecosystem services provision forms the base for identifying and analyzing the benefit

[12] Table 3.1.1 in the report to Project Module 3a lists these pressures and states where the respective pressures are covered in the report.

categories affected by these environmental changes. All TEV-categories were assessed, including direct and indirect use values, as well as option and non-use values. For each pressure, the benefits of a reduction were examined individually and described verbally as well as in the form of a more illustrative table. This quantity structure served as the basis for the evaluation of changes to the TEV categories through pressure reductions.

The resulting benefits were then attributed to different economic sectors and societal groups (the "profiting sectors"). These sectors were defined according to classification systems used in available marine-focused evaluation studies (e.g. Loureiro et al. 2006), in assessments of economic losses through marine pressures and impacts (e.g. Mouat et al. 2010), and in accordance with the reports of the MSFD-CIS Working Group ESA and the German working group responsible for the MSFD-Initial Assessment.

Direct and indirect use values are usually easily attributed to a specific sector. Non-use values, however, whose benefits are not necessarily realized in an economic sector but benefit society as a whole, are more difficult to attribute. To accommodate for this, an additional "sector" was introduced: "society". In the following table 2, the affected economic sectors and the "sector" society are shortly defined and described, and brought together with the respective TEV categories. Sectors which are affected negatively by measures, e.g. some forms of marine technologies affected through regulations or legal obligations, are not included in the table, as the focus of the project lies exclusively on the benefit side of measures. For a more detailed assessment and description of these sectors, see Marggraf et al. (2011).

Table 2: Definition of profiting economic and societal sectors

Sector/Area	Description	TEV categories
Fisheries	Commercial fisheries, including coastal and small-scale fisheries.	Direct use values (consumptive) and option values
Angling	Fishery for recreational or sport purposes.	
Aquaculture	Captive breeding of marine animals in or close to their natural habitats, usually with a commercial purpose.	
Tourism	Visitors staying at least one night at the destination:	Direct use values (non-consumptive) and option values
Recreation	Visitors (both locals and from other regions) staying for one single day maximum (without an overnight stay).	
Shipping	Ships and other marine vessels utilizing marine sea lanes and the open sea, especially professional shipping and harbors and marinas.	
Industry	Industrial facilities and power plants along the coast, as well as offshore wind power and tidal power plants.	
Health	Acute and chronic diseases and health risks associated with contaminated sea food or water.	Indirect use values and option values
Agriculture	Agricultural activities including animal husbandry near the coast.	
Society	All benefits not realized in a specific economic sector are attributed to the society as a whole (no direct or future direct use).	Non-use values and options values

The definition of sectors is in accordance with EC (2010), BSH (2010), Arcadis Belgium (2010), Loureiro et al. (2006), Zylicz et al. (1995), Turner et al. (1999) and Mouat et al. (2010).

Step 4: Identification of sectors for which negative impacts can be expected

Pressure reductions can usually be achieved only through measures that in some way regulate or inhibit the activities responsible for the pressure at hand. Hence, "negative benefits" - i.e. "costs" - can arise in certain affected economic sectors. The project´s focus was on the (positive) benefit side of measures, and not on the cost side. Nevertheless, a short description of the negative effects of measures, and the affected sectors, was included in the project module 3a report. Again, more details and background to the economic sectors and the affiliated activities can be found in Marggraf et al. (2011).

Step 5: Description of possible secondary effects

Beside the directly affected economic and societal sectors (section 2.3.1of the project module 3a report), other sectors which are functionally connected to these primarily affected sectors might be impacted through the effects of measures as well. These impacts are described in the project as "secondary effects", and are included for the sake of completeness (see project module 3a report, section 6).

The description of the secondary effects, however, is just a partial analysis. This means that although negative effects can be created in individual sectors (e.g. through the closing of facilities and loss of jobs), these negative effects do not necessarily translate to macro-economic losses. For example, it is possible that jobs lost are just transferred to another region or sector - if this region or sector is not covered by this analysis, the benefit connected to the new jobs is also not covered. Summarizing this: the analysis of the secondary effects of pressure reductions on economic sectors is a regional or sector-specific analysis and does not necessarily cover the macro-economic impacts.

Step 6: Description and visualization of the benefits of measures through a common quantity structure

The principal result of the project module 3a is the description and visualization of the economic and societal sectors positively affected by reductions of certain pressures, as well as the assignment of TEV value categories to the individual sectors. After identifying and describing these for each pressures separately in step 3 (see above), the project finally involved a visualization of the benefits, profiting sectors and pressures in a single, common quantity structure.

A checkmark in the respective cell of the table indicates that benefits in this economic or societal sector should be expected. through the reduction of the respective pressure. A checkmark in (brackets) illustrates that, while the respective reduction of the pressure has potentially positive effects, these are, at the same time, dependent on either the importance of the pressure, or whether a reduction of the pressure is actually perceptible to humans or not (e.g. in the case of reduced "physical loss - sealing" and its effects on tourism).

This first overview of possible benefits and profiting sectors clearly shows that both recreational (and commercial fishing activities are positively affected by reductions of almost all pressures. The same is true - but to a slightly lesser degree - for tourism and recreation. All pressure reductions positively affect non-use and option values.

Table 3: Benefits of pressure reductions (common quantity structure)

Pressure		Use Values										Non-use values
		Direct use values (consumptive)			Direct use values (non-consumptive)				Indirect use values		Option values	Altruistic/existence/heritage values
		Fisheries	Angling	Aquaculture	Tourism	Recreation	Shipping	Industry	Health	Agriculture	All affected sectors	Society
Physical Loss	Smothering Sealing	✓	✓		(✓)	(✓)					✓	✓
Physical Damage	Siltation	(✓)	(✓)				✓				✓	✓
	Abrasion	✓	✓								✓	✓
	Selective Extraction	✓	✓		(✓)	(✓)					✓	✓
Other physical disturbance	Underwater noise	✓	✓		✓	✓					✓	✓
	Marine litter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Interference with hydrological processes	Thermal regime	(✓)	(✓)	(✓)							(✓)	✓
	Salinity regime											✓
Contamination through hazardous substances	Synthetic compounds Non-synthetic substances (Oil) Radio-nuclides	✓	✓	✓	✓	✓			✓		✓	✓
Systematic and/or intentional release of substances	Introduction of other substances (solid, liquid, gaseous)	✓	✓	✓	✓	✓			✓		✓	✓

Nutrient and organic matter enrichment	Fertilizers	✓	✓	✓	✓	✓			✓		✓	✓
	Organic matter											
Biological disturbances	Microbial pathogens	✓	✓	✓	✓	✓			✓		✓	✓
	Invasive species	✓	✓				✓		✓		✓	✓
	Fisheries	✓	✓		✓	✓					✓	✓

Source: own illustration.

4 Project Module 3b – Quantity Structure Part II: Monetarisation

4.1 Objective

The objective of project module 3b was to identify and further develop methodologies and evaluation studies to facilitate the quantification of the benefits analyzed in project module 3a. The work done in module 3b was therefore based on the quantity structure (see chapter 3) that brought together pressure reductions, expected benefits and the profiting sectors. Additionally, this module was based on and further elaborated the database of available evaluation studies created in project modules 1 and 2.

4.2 Practical Approach

The practical approach followed in this project module is illustrated in figure 3, and described in more detail throughout the chapter.

The first step (Step A) consists of the identification and analysis of evaluation studies suitable for application in the project´s context, and sums up the relevant contents and parameters of the studies, so that a possible user of the methodology can easily reconstruct the background and original values used and generated in the respective study.

These evaluation studies and the values determined therein were then classified into four categories, which reflect the reliability of the values generated (based on the recommended priotization of their utilization):

- Category a: values based on market prices OR avoided damages OR contingent valuation studies conducted in the German North or Baltic Sea;
- Category b: values based on evaluation studies from other regions, that were transferred to the conditions in Germany via a "Benefit Transfer";
- Category c: Values generated by applying avoidance costs OR costs of recovery; and
- Category d: no quantitative values available; instead, qualitative descriptions of the benefits is preferable.

If the studies available were suitable for application in the context of this project, the monetary values were attributed to the respective benefit categories and economic sectors identified in the quantity structure (Step B).

> Example Step B:
>
> In a given contingent valuation study, residents are asked about their willingness-to-pay for improving the bathing water quality of local water bodies. The values generated are attributed to the benefit category "recreation", as only residents were asked.

The following steps B1-B2 served to adapt the values to a reference value and their conversion to a per-unit value (Step B1), as well as to adjust them to the present-day German income and price levels (Step B2). The adjustment of income and price levels was computed by calculating the differences of the gross domestic product per capita (adjusted by the income elasticity of the generated values, i.e. the willingness-to-pay) and of the purchasing power in the respective countries.

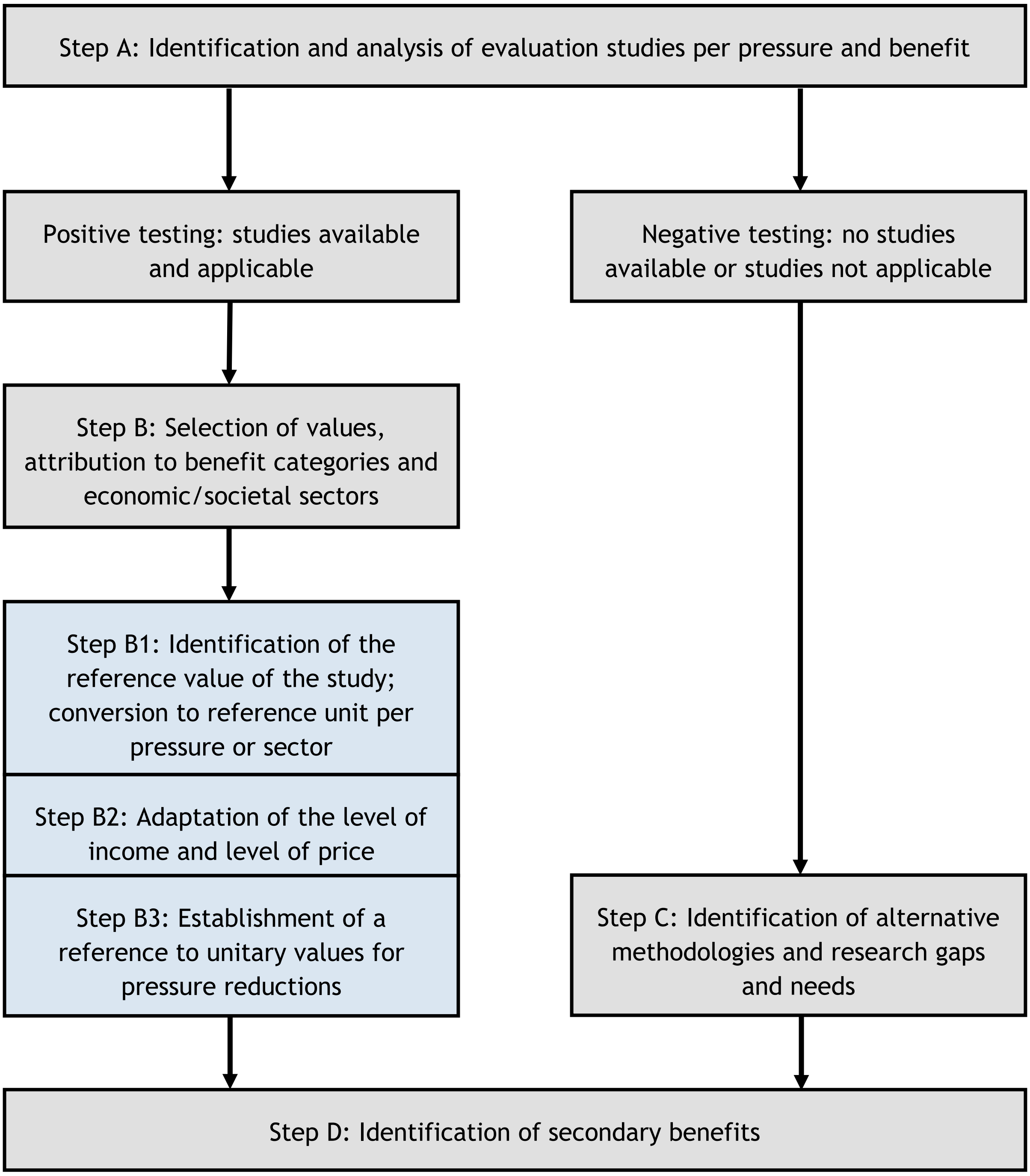

Figure 3: Practical approach of project module 3b

Example Step B1:

Tourists' willingness-to-pay for a clean beach in France was ascertained to be 4 EUR_{2000} per visit. It is assumed that a tourist visits the area once a year, to stay for an average of seven days. Additionally, it is assumed that of these seven days, five are spent on the beach (one visit per day on the beach). Therefore, a willingness-to-pay of 20 EUR_{2000} per visitor per year is calculated.

Example Step B2:

The same willingness-to-pay - 20 EUR_{2000} per visitor per year - is adjusted to German price and income levels, resulting in a final WTP of 26,11 EUR_{2010} per visitor per year.

In the next step (Step B3), the values generated in this way were referred to the respective pressure, to generate values per unit of pressure. This step was the most complex step of project module 3b, and the one with the highest inherent uncertainties.

Example Step B3:

The pressure "Biological disturbances - introduction of microbial pathogens" impacts - among others - human health, through possible contamination of bathing waters or seafood. Mourato et al. (2003) ascertained the willingness-to-pay of British households to reduce the risk of infections with gastroenteritis (stomach upset) through bathing in contaminated water to range from 2.7% to 1%. The discovered WTP was 1.1 - 2 British $Pounds_{2002}$/household per year. At the same time, the World Health Organization (WHO 2003) estimated that around 200 "Colony Forming Units" (CFU) of intestinal enterococcus (IE) per 100 ml of water result in a 5% risk of catching gastroenteritis (referenced to average or good water quality: EC 2006), while around 40 FCU/100 ml water reduce the risk to 1% (referenced to excellent water quality; EC 2006).

After applying Steps B1 and B2, and assuming a) an average of five visits to marine bathing water a year, b) two persons per household (Destatis 2012) and c) a 5% risk of catching gastroenteritis, the resulting WTP amounts to 3,8 - 7 3,8-7 EUR_{2010} per person per avoided illness. Reducing the risk of catching gastroenteritis from 5% (or 200 FCU IE/100 ml) to 1% (or 40 FCU IE/100 ml), and referring the value to the reduction in FCU, the willingness-to-pay that results from this calculation is 0,02-0,04 EUR_{2010}/person per avoided FCU IE/100 ml water (equals the avoided illnesses).

For some option and non-use values, such as "improved biodiversity" as a result of increased ecosystem quality, new methods and indicators have been developed which allow for a utilization of either replacement or recovery cost approaches (values of the above mentioned category c). A significant part of the evaluation studies identified in Step A were not suitable for utilization in the context of this project. Examples include studies that evaluate not a single benefit, but a bundle of benefits created through a measure - e.g. the establishment of a marine protected area - or studies that do not contain enough information for attributing the benefit to a quantified reduction of a pressure. For some benefit categories or pressures, no evaluation studies exist at all (underwater noise is a good example for this). Nevertheless, in these cases, the benefit was described in a qualitative way (Step C).

Example Step C:

A reduction of the pressures "Physical loss - smothering/sealing" results in direct use values in the economic sectors commercial and private fishing,, tourism and recreation, and in non-use values for the general society (through option and non-use values representing a conservation and improvement of the ecosystem "sea floor").

At the time of the project work on module 3b, methodologies for either an ecological assessment of biodiversity losses on the sea floor, or the monetary evaluation of such biodiversity losses (e.g. no evaluation studies were available) did not exist. As an ecological indicator for these losses, therefore, a proxy had been used: the PDF ("potentially disappeared fraction" [of species]; Köllne 2001) approach, which is normally utilized for measuring land-based biodiversity losses. For the monetary evaluation of these losses, an average value provided in replacement cost assessments from Germany was used (Ott et al. 2006; Reumann-Schwichtenberg et al. 2011): 0.55 EUR_{2010}/m^2. This value states the cost of restoring one square meter of damaged land (or, in this case, sea floor) to its original, undisturbed state, and is set to be equal to the benefit resulting from reduced sealing/smothering. This value, however, needs to be used with care, as equalizing restoration cost with benefit creates methodological difficulties in cost-benefit analyses.

A qualitative description of secondary effects (co-benefits), which can result in functionally connected economic sectors, was completed at the end of module 3b´s practical approach, in Step D (see section 3 of the module´s report).

The presented approach is a pragmatic reaction to the significant gaps in base data (i.e. basic natural science information regarding marine ecosystems and pressures) and benefit information (i.e. missing or inadequate evaluation studies), that incorporates many uncertainties. These uncertainties are mainly due to methodological issues (i.e. benefit transfers, inherent uncertainties of evaluation studies etc.) or the previously mentioned data gaps. Some of these uncertainties are explained in more detail in sections 5 and 6 (case studies).

Regarding "lessons learned" from project module 3b, it has become clear that the data and information gaps are significant regarding the quantification of economic benefits resulting from reduced pressures. Beside the natural science data, there is a great lack of good and suitable evaluation studies for the marine environment. For some pressures - e.g. nutrients and organic matter enrichment, marine litter, contamination through hazardous substances (oil), or the introduction of microbial pathogens - a relatively wide range of studies is available, but of varying quality. Most of these, however, are not utilizable, as important information is lacking: for example, the results of a study need to be transferable, i.e. a kind of reference point is necessary to transfer the information or other regions or pressure situation. Other pressures - e.g. physical loss (an exception is the visual disturbance through wind farms), physical damage, underwater noise, interference with hydrological processes or alien species - are not covered at all by evaluation studies. For a part of the latter pressures, alternative methodologies and approaches were developed in the project in order to be able to provide monetary values (see example Step C above).

Overall, there are more studies available that evaluate direct and indirect use values, as there are for non-use and option values. These latter values, however, are the ones mostly affected by pressure reductions, and they are therefore - relatively seen - underrepresented. Because of this underrepresentation, a qualitative description of non-use value benefits is strongly recommended.

5 Case Study 1: Marine Litter

5.1 Objective

As mentioned in the introduction, the objective of the case studies was twofold: first, they were to quantify the economic benefits of reduced pressures on the environment as far as possible, using available data and testing the limits of quantification with present data availability. Secondly, the developed methodology had to be applied and tested in the case studies, in order to gain insight into the difficulties and elaborate proposals for improving the concept. Additionally, data gaps and research needs were identified. "Marine Litter in the North Sea" was selected as one of the two topics to be investigated due to its high relevance.

5.2 Background

The case study follows the EU commission´s definition of marine litter (European Commission 2011):

> "... *any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It consists of items that have been made or used by people and deliberately discarded or unintentionally lost into the sea and on beaches, including such materials transported into the marine environment from land by rivers, draining or sewage systems or winds. For example, marine litter consists of plastics, wood, metals, glass, rubber, clothing or paper*".

Due to the longevity of some of the materials - complex plastic compounds mostly - and their decomposition into so-called "microplastics[13]", marine litter is a serious threat to both the marine environments and the maritime economic activities (mainly tourism, recreation shipping and fisheries).

The most significant share of marine litter in the North Sea stems most likely from the activities of the shipping and fisheries sectors (Fleet 2003, cited in UBA 2010; Herr 2009). Additional immission pathways include offshore activities like oil rigs (Fleet et al. 2009), tourism and recreational activities on the coast, and coastal industries. Also, immissions via rivers and wind are considered to be significant, although relevant data is not available (Werner 2012; Liebezeit/Dubaish 2012).

The data and information base is also insufficient regarding the amount of marine litter in the North Sea environment, and the potential measures and their effectiveness. To be able to test the developed methodology, it was therefore necessary to fill these data gap by making assumptions.

5.3 Practical Approach

Based on OSPAR (1995) and several assumptions, it was calculated that around 12.000 t marine litter is constantly present in the water column and on the sea floor, and that 1.058 t are washed up on the coast. Furthermore, a hypothetical bundle of measures was devised, whose

[13] More information and definitions of microplastics: see Gorycka 2009.

quantitative reductions of marine litter were estimated to reach 20% (reduction of litter in the water column and on the sea floor), respectively 40% (reduction of washed up litter). The uncertainties of these assumptions are explicitly mentioned.

In order to be able to quantify the economic benefits resulting from reductions of marine litter in the North Sea, it was necessary to include evaluation studies with sufficient information to calculate the benefits per unit of pressures reduction (i.e. t of marine litter) Such studies and data were identified and analyzed in project module 3b, and divided into four categories, which reflect the reliability of the values generated (on the recommended priotization of their utilization):

- Category a: values based on market prices OR avoided damages OR contingent valuation studies conducted in the German North or Baltic Sea;
- Category b: values based on evaluation studies from other regions, that were transferred to the conditions in Germany via a "Benefit Transfer";
- Category c: Values generated by applying avoidance costs OR costs of recovery; and
- Category d: no quantitative values available; instead, qualitative descriptions of the benefits is preferable.

In the course of the case study work, the values per unit of pressure reduction calculated in module 3b were then adapted and transferred to the specific situation of the German North Sea (open water and coastal areas). To this end, it was necessary to attribute the resulting benefits to the respective "target group" (i.e. the profiting sectors: e.g. number of fishing vessels, information regarding tourism and recreation on the coast etc.). Additionally, for some pressures it was also necessary to make assumptions regarding basic "links" between a reduction of litter and resulting environmental changes (e.g. the impacts of reduced marine litter on fish stocks).

The results - i.e. the benefits resulting in each sector - deviate accordingly, relative to the quality and category of the data and studies upon which they are based. For example, the hypothetical bundle of measures results in benefits for the tourism/recreation sector (through clean beaches) amounting to 338.776.000 – 1.195.680.000 EUR_{2010} (category b data), whereas in the shipping sector, the benefits merely exceed the one million Euro mark (through less damages to propellers and equipment; data of the category a).

The following table 4 provides an overview of the results of the case study, and also lists the assumptions made in each category.

Table 4: Table of results of the case study "Marine Litter"

Benefit category	Sector	Benefit (qualitative description)	Benefit (quantitative)	Database (categories)	Assumptions
Direct use values (consumptive)	Private Fishing/ Recreational Fishing	Potentially higher fish stocks	20.400 □ 51.200 EUR$_{2010}$/a	Category b (WTP and benefit transfer)	Link pressure - resulting benefit Number of marine anglers Quantity of litter in North Sea Link reduction - amount of benefits
	Fisheries	Pot. higher fish and mussel stocks Less contamination of catches	See shipping and fisheries below	See shipping and fisheries below	Quantity of litter in North Sea Link reduction - amount of benefits
Direct use values (non-consumptive)	Tourism and recreation	Less litter on beaches	338.776.000 □ 1.195.680.000 EUR$_{2010}$/a	Category b (WTP and benefit transfer)	Duration and number of visits Quantity of litter in North Sea Link reduction - amount of benefits
	Aquaculture	Less damages to vessels and facilities	52.000 EUR$_{2010}$/a	Category a-b (damage avoided, partly adapted)	Contamination of mussel culture Quantity of litter in North Sea Link reduction - amount of benefits
	Harbors	Less damages facilities and equipment	160.000 EUR$_{2010}$/a	Category a-b (damage avoided, partly adapted)	Quantity of litter in North Sea Lineari Link reduction - amount of benefits
	Shipping/ Fisheries	Less damages to facilities and equipment Fewer rescue operations	1.420.000 EUR$_{2010}$/a	Category a-b (damage avoided, partly adapted)	Number of operations Quantity of litter in North Sea Link reduction - amount of benefits
Indirect use values	Agriculture	Less cleaning costs Less damages to facilities and equipment	68.000 □ 95.000 EUR$_{2010}$/a	Category a (damage avoided, not adapted)	Price level Shetland Islands Comparability of pressure situations Quantity of litter in North Sea Link reduction - amount of benefits
Non-use values	Society	Existence of marine ecosystems Higher ecosystem quality and biodiversity	606.320.000 EUR$_{2010}$/a	Category b (WTP and benefit transfer)	Relevance of study results Target group (profiting group) Quantity of litter in North Sea Link reduction - amount of benefits
Option values	Society	Future use of marine ecosystems	992.160.000 EUR$_{2010}$/a	Category b (WTP and benefit transfer)	Target group (profiting group) Quantity of litter in North Sea Link reduction - amount of benefits
TOTAL TOTAL (excluding WTP)			Ca. 2-3 Bn. EUR$_{2010}$/a 1,7 M. EUR$_{2010}$/a	See above	See above

Source: Own illustration.

Because of the high variabilities in the case study´s results, the uncertainties of the procedure were discussed in detail in the final section of the case study report. These were especially relevant during the following steps of the procedure:

- The selection of the measures and the effectiveness of the measures.
- The use of data of the category b, namely the use of WTP-studies covering other regions than the (German) North Sea.
- The determination of necessary information through assumptions (namely the amount of litter present in the North Sea, and the links between pressure reduction - ecosystem improvement - resulting benefits).

Based upon the discussion of data and information gaps, and the uncertainties resulting from the necessary assumptions to close the gaps, the following recommendations were issued to be included in the Practitioner´s Guidebook:

- Not to use WTP-studies (or other CVM studies), or at least in a very limited way. If such studies are to be used, than it is recommended to only use surveys from Germany, customized for an utilization in the context of MSFD benefit evaluation.
- Instead, to use more studies based on assessments of avoided damages or market prices.
- To reduce the amount of research necessary to obtain specialized data (e.g. on profiting sectors), the creation of a database customized for the purpose of MSFD benefit evaluation.

6 Case Study 2: Eutrophication

6.1 Objective

As mentioned in the introduction, the objective of the case studies was twofold: first, they quantify the economic benefits of reduced pressures on the environment as far as possible, using available data and testing the limits of quantification with present data availability. Secondly, the developed methodology had to be applied and tested in the case studies, in order to gain insight into difficulties and elaborate proposals for improving the concept. Additionally, data gaps and research needs were identified. "Eutrophication in the Baltic Sea" was selected as a topic for its high urgency and relatively good data availability.

6.2 Background

The case study follows the EU commission´s definition of eutrophication (European Commission 1991):

> *"…the enrichment of waters by nutrients, especially compounds of nitrogen and/or phosphorous, causing an accelerated growth of algae and higher forms of plant life to produce and undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned."*

In most parts of the Baltic Sea, significant reduction in nitrogen and/or phosphorous immissions are necessary to reduce eutrophication to the level necessary to achieve good environmental status. In the frame of the Baltic Sea Action Plan, maximum immissions were determined for the whole Baltic Sea, amounting to yearly reductions of 21 kt phosphorous and 600 kt nitrogen[14]. Based upon these overall reductions, the targets for the German emission reductions were calculated (yearly reductions of 5.620 t nitrogen and 240 t phosphorous) (Helcom 2007).

Eutrophication is mainly caused by diffuse immissions from inland-based agricultural activities, but urban and rural wastewater and treatment plants, as well as atmospheric deposition and erosion, represent significant sources as well (UBA 2010). Average yearly immissions from German sources in the years 1997-2008 amounted to 20 kt nitrogen and 500 t phosphorous (Helcom 2007; Helcom 2011).

A reduction of eutrophication levels results in less algae growth (algal blooms), and consequently in a higher available oxygen and increased degree of transparency of the water. The consequences for fish and other marine animals, however, vary: on the one hand, higher levels of available oxygen can positively affect populations of fish inhabiting the sea floor (e.g. cod). On the other hand, the reduced production of microalgae can negatively impact smaller fish species feeding on these microalgae (e.g. herring and sprat populations). Hence, a reduction in eutrophication can negatively affect associated fisheries as well. All in all, however, it can be assumed that a lesser influx of nitrogen and phosphorous generally has positive effects on fish populations and on the whole ecosystem (Bertram et al. 2012 - project module 3a/3b).

[14] An actualization of these targets is planned for autumn 2013.

Contrary to marine litter, causes for eutrophication can also be natural (although to a much lesser degree than human activities). Here, and in other procedural steps and analyses, lie some of the uncertainties involved in calculating the economic benefits of a reduction of nitrogen and phosphorous immissions, summarized by the following questions:

- Which immissions are natural, and which anthropogenic?
- How can the whole complex nutrient cycle be considered?
- How to estimate the effectiveness and life-time of measures?
- How to cope with non-linearity (i.e. the thresholds, which when exceeded, result in ecosystem collapses, or the non-linearity of reductions and resulting benefits)?

To be able to test the developed methodology, it was therefore necessary to fill these data gaps by assumptions. Also, because of missing evaluation data regarding phosphorous, the case study only estimates the benefits of nitrogen reductions.

6.3 Practical Approach

In this case study, three scenarios were developed:

- "Basic scenario": no reductions; the calculations are based on the yearly average immissions from Germany (20 kt nitrogen).
- "Policy scenario": reductions based on the Baltic Sea Action Plan are achieved in 2021(yearly immissions of 15 kt nitrogen).
- "Delayed reduction scenario": targets are achieved at a later stage, and the scenario illustrates the "benefits lost" through such a delay. The parameters are: 50% achievement of the reduction targets until 2015, and full achievement by 2027.

Based on the WFD Programs of Measures (PoM), a hypothetical bundle of measures was developed, to achieve the targets according to the respective scenario.

To be able to quantify the economic benefits resulting from reductions of eutrophication levels in the Baltic Sea, evaluation studies with sufficient information to calculate the benefits per unit of pressures reduction (i.e. t of nitrogen) were necessary. Such studies and data was identified and analyzed in project module 3b, and classified into four categories (described above in chapters 4 and 5).

Reducing eutrophication in the Baltic Sea potentially affects commercial fisheries and recreational fishermen (direct, consumptive use values), the tourism and recreation sector (direct, non-consumptive use-values), human health (indirect use values) and the society as a whole (option and non-use values).

Based upon the above described scenarios, benefits could be quantified for the sector "recreation" (direct, non-consumptive use values) and the society (option values and non-use values). The benefits resulting in the other sectors could only be described in a qualitative way, as the evaluation studies assessing these were inadequate for this purpose. The direct, non-consumptive use values (recreation) amount to 39.948 - 419.281 EUR_{2010} per t nitrogen reduction (based on data of the categories a and b), resulting in a yearly benefit from 217.420.574 to

2.281.968.218 EUR_{2010} (as depicted in figure 4, which illustrates the increasing value over the years for the policy and delayed reduction scenarios).

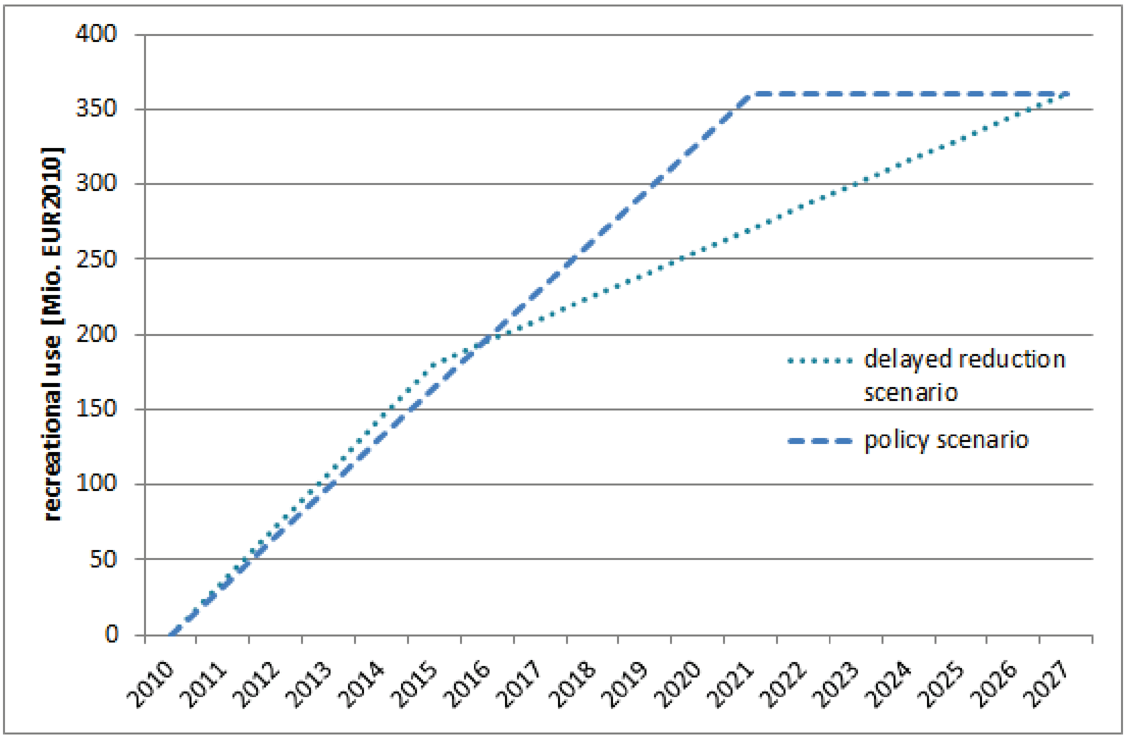

Figure 4: Benefits in recreation based upon WTP-values from Meyerhoff/Angeli (2012).

In the benefit category "option values", economic benefits ranging from 13.375 to 21.294 EUR_{2010} per t nitrogen immissions reduction were identified (based on data of the category a). From these values, a yearly benefit in option values amounting to 72.792.829 - 115.891.950 EUR_{2010} was calculated for Germany. The benefits in the category non-use values ranged from 287 to 457 EUR_{2010} per t reduction (also using data of the category a), resulting in yearly benefits of 1.561.440 - 2.485.936 EUR_{2010} in Germany.

Summing up, the individual economic benefits (i.e. from the benefit categories direct, non consumptive use values, option values and non-use values) range from 53.610 to 441.032 EUR_{2010} per t nitrogen immission reduction, or on a yearly basis from 291.774.842 - 2.356.322.487 EUR_{2010} in Germany. Not included in these figures are benefits accrued in the fisheries, recreational fishing and human health "sectors". These benefits were therefore described qualitatively.

Some studies analyzed the aggregated values of a reduced eutrophication, i.e. the various benefit categories affected are not quantified individually. A splitting of these results into values for TEV benefit categories is normally not possible. Nevertheless, such studies can serve as a tool to compare and verify the results. In the analyzed "aggregated values studies", the overall benefits of a reduced eutrophication amount to 14.027 - 58.430 EUR_{2010} per t nitrogen immission reduction or 76.344.277 - 318.006.969 EUR_{2010} per year (in Germany), results which are significantly lower than the results of the case study, again demonstrating the great variabilities of such benefit estimations.

In addition to the uncertainties described above - regarding the nutrient cycle, basic knowledge of ecosystem functions and the effectiveness of measures - an additional layer of uncertainties was created through the inherent methodological difficulties of evaluation studies, especially if these originate from other marine areas. These uncertainties are reflected in the broad rangeh of the calculated results.

In this case study it was also demonstrated how difficult the evaluation of economic benefits in the context of MSFD implementation actually is, especially considering the insufficient availability of data. Additionally, the developed methodology is only applicable if the user is already familiar with evaluation exercises.

For the development of the Practitioner´s Guidebook, the results are translated into the following recommendations:

- If it is necessary to use WTP-studies (or other CVM studies) to quantify the benefits of reduced eutrophication, to use only the recent WTP study of Meyerhoff/Angeli (2012), which was conducted in the context of this project, and which is customized for utilization in the context of MSFD benefit evaluation in Germany[15].
- Instead of using WTP studies (or other CVM studies), to use more studies based on assessments of avoided damages or market prices.

[15] The study calculates a maximum benefit by achieving the targets of the Baltic Sea Action Plan of 439 to 692 m. EUR_{2010}. These figures represent the lower boundary, according to the authors. The study´s results are also used in the context of the international network BalticSTERN, where the results of the study are applied to a different target group, resulting in total benefits of 1.87 bn. EUR_{2010}.

7 Willingness-to-pay study "Eutrophication of the Baltic Sea"

In the context of the network BalticSTERN (http://www.stockholmresilience.org/balticstern), a "BalticSurvey" was conducted in 2010 in all countries neighboring the Baltic Sea. The objective of this survey was to examine the general knowledge about, and moral attitude towards, the Baltic Sea, as well as to gain insight into the Baltic Seas importance as a tourism and recreation destination. The survey was performed by a network of research institutions under the lead of enveco (Environmental Economics Consultancy, Stockholm), and it included a common questionnaire, which was developed and applied in all countries during the same period of time. Between April and June 2010, a total of 9.000 people were selected by chance and interviewed. A summary of the overall results of the BalticSurvey can be found in Söderqvist et al. (2010a) and Söderqvist et al. (2010b).

As a follow-up to the BalticSurvey, the international working group developed a second transnational survey - BalticSUN (Baltic Sea survey on use and non-use values). As eutrophication is regarded as the most important threat to the ecosystems of the Baltic Sea (HELCOM 2009, also UBA 2011), this pressures was chosen as the subject of BalticSUN. The objective was to analyze the willingness-to-pay of the populations of the countries neighboring the Baltic Sea for a lesser degree of eutrophication than would be achieved with existing policies and implemented measures.

The second goal of BalticSUN was to be able to use the results of the study as a basis to support decision making with regards to measures to reduce eutrophication in the Baltic Sea. Again, a common questionnaire was developed, that allows for both a national and an international usage of the generated results.

Specifically, the interviewees were asked about their willingness-to-pay for an improvement in water quality until 2050, resulting from reduced nutrient immissions. The appraised environmental targets were deducted from the targets stated in the Baltic Sea Action Plan. Additionally, general data and preferences were being examined, in order to gain insight into factors influencing the stated WTP. For example, these data and preferences included whether people actually use the Baltic Sea for recreation, how much the interviewees knew about the ecosystems and the environmental problems, and general socio-demographic data.

The German part of the BalticSUN study was conducted in the frame of this project.

7.1 Results

In the German WTP study, 1.463 people belonging to an online panel were questioned. The biggest share of these people (82,9%) did visit the Baltic Sea for recreational purposes at least once before the study started. The majority of the interviewees stated that walking or hiking on the beach/the coast, sunbathing and swimming were their main reasons for visiting the Baltic Sea. Around 5% stated that the recreational activities available in visits to the Baltic Sea are unique to the region.

The socio-demographic characteristics of the interviewees conform to the German average with regard to the variables "age" and "sex". Significant differences between the German average and the sample, however, exist in the variable "education" (70% of the interviewees had a higher education entrance qualification, whereas the German average amounts to 25,4%). This distortion can probably be attributed to the selection of an online panel as the way to contact and select interviewees.

The interviewees mostly also expressed concern about the environmental condition of the Baltic Sea, and agreed to the notion that an international contract for the protection of the Baltic Sea would be necessary. 70% of the people were familiar with the problem of nutrient enrichment and eutrophication, whereas the concrete phenomena connected to it were not generally known. For example, around half of the interviewees (57.6%) knew about algal blooms in the Baltic Sea, whereas only one third had heard about any change in fish populations because of high eutrophication levels. Even less interviewees (22.2%) knew about the impacts on marine plant life, such as the suppression of sea grass through increased algal growth. Less than a quarter stated to have personally experienced the effects of eutrophication when visiting the Baltic Sea.

With regard to the willingness-to-pay, 56% of the interviewees stated to be generally willing to pay for achieving the targets of the Baltic Sea Action Plan. For this part of the sample, the average willingness-to-pay is 48 Euro per year for achieving the targets, with a median value of 30 Euro per year. Applied to the target group - German households - and choosing the most conservative assumptions (i.e. the median value as base value, a corrected number of households willing to pay), the total willingness-to-pay for a reduction of the eutrophication of the Baltic Sea according to the Baltic Sea Action Plan amounts to 440 m. Euro per year[16]. Choosing less conservative assumptions and figures, the overall willingness-to-pay reaches one bn. Euro per year, a figure that is probably overestimated because of the positive assumptions made.

[16] See footnote 15 for information of the results published in the context of BalticSTERN.

8 Summary

Within the frame of the German Federal Environment Agency´s contract "*Methodologies regarding Economic and Social Analyses and Impact Assessments of Measures including Cost-Benefit-Analyses in the context of the Marine strategy framework Directive*", a methodology for the assessment of economic benefits of marine protection measures that are implemented in the context of the Marine Strategy Framework Directive was developed - and tested. It was obvious from the beginning of the project that such an undertaking would face significant restrictions with regard to data availability - both basic natural science data, as well as utilizable evaluation studies. However, it was part of the project´s aim **to illustrate the limitations** of benefit evaluation today.

In the course of the project, and especially during the work on the case studies, it was revealed that the most significant gaps in **data and information availability** can be found in the following areas:

- Basic knowledge about most of the pressures: significance and pathways of the pressures, life time and associated environmental damages.
- Basic knowledge about the links between ecosystems and socio-economics: functional connections between "environmental improvements", the associated changes in "ecosystem services provision" and the resulting changes to the "economic benefits".
- Evaluation studies: missing references to the analyzed pressure, determination of the TEV category/categories under scrutiny not always possible, low transferability.
- Measures: potential measures, including information on effectiveness and costs.

Because of the significant data gaps, it was necessary to make **several assumptions** in order to be able to test the developed methodology in the case studies. These assumptions partly result in **significant uncertainties**, which severely restricted the validity of the case studies´ results regarding the monetary value of the pressure reductions. The assumptions concern all above listed data and information gaps.

A further factor contributing to the uncertainties of the case studies´ results is the utilization of contingent valuation studies, especially **willingness-to-pay studies**. These are - through several inherent methodological weaknesses - responsible for the great variabilities in the case studies´ results. This is especially true for the case study "Marine Litter". If the results of such studies are furthermore transferred from other marine areas to the German conditions, via a Benefit Transfer, the inherent uncertainties add to the ones connected to the Benefit Transfer to very high levels of uncertainty.

Beside the high uncertainty of the results, however, **the large amount of work** necessary to identify and analyze the specialized information needed for a benefit evaluation is also of concern regarding the practicability of the methodology. Such information - e.g. regarding the determination of the "target group", i.e. the profiting sectors, and obtaining information about its statistics - is not easily available and necessitates time-consuming research (in the case study "Marine Litter", the research into target groups amounted to a workload of approximately 30 man-hours; this figure, however, can be higher depending on the level experience of the person conducting the research, and the respective pressure or benefit).

Because of these two major topics - the high uncertainties on the one hand, and the high amount of work on the other - the developed methodology in the form tested in the case studies was deemed to be **usable only in a limited way**, as the main criteria **practicability**, **simplicity of application** and **acceptability** through decision makers were not fulfilled.

The situation regarding data and information gaps could be improved through **research projects** customized for this purpose. To this end, it would be desirable to include scientists with experience in economic evaluation exercises into such predominantly natural science research, to enhance the chances that the results generated in such projects are in the end actually utilizable for economic evaluations of benefits.

Based on the previously described insights gained through testing the methodology in the case studies, the following recommendation have been issued for inclusion into the **Practitioner´s Guidebook**, to enhance its practicability, simplicity of application and acceptability:

- To **reduce uncertainties**: it is recommended not to use willingness-to-pay studies (or other contingent valuation studies) in benefit evaluation. Exceptions to this recommendation are studies that are conducted in Germany, and customized to the respective purpose[17] (like Meyerhoff/Angeli 2012[18]).
- Instead, it is recommended to rely more on avoided damages or market prices for evaluating benefits of marine protection measures.
- To **reduce the amount of work**: it is recommended to create a specialized database for the evaluation of benefits of marine protection measures, especially containing information on target groups/profiting sectors.

Through translating these recommendations into **changes to the methodological approach**, it is expected that the acceptance of the Practitioner´s Guidebook by decision makers it significantly increased by reducing uncertainties and the necessary amount of work.

In conclusion, it has become clear that an approach to economic evaluation of benefits of marine protection measures and to cost-benefit analyses that focuses strongly on "monetizing everything" does not seem feasible. The necessary amount of work, and the uncertainties of such an approach, resulting in figures that are not usable by authorities to justify decisions, is too significant. Here, it is therefore additionally recommended to clearly differentiate between sound and transparent base data, and base data that comes with great uncertainties. Only benefits whose evaluation can be grounded on good and reliable data should be assessed quantitatively., In the cases where good data is lacking, all other benefits should not be monetized; instead, these benefits should be described qualitatively, and considered in decision making via an alternative matrix (such as a Multi-Criteria Analysis).

[17] For conducting a customized willingness-to-pay study, minimum costs of 20.000 Euro and six months of time need to be scheduled.

[18] Chapter 7.

9 Sources

Agence des aires marines protégées/Ifremer (2010): Évaluation Initiale Volet Analyse économique et sociale Guide technique en vue de la réalisation des projets d'analyse.

Arcadis Belgium (2010): Inventory of the socio-economic activities affecting the Belgian marine waters and the related developments within the European Marine Strategy Framework Directive 2008/56/EC. Final Report. Berchem, Belgium.

Bertram, C., Kugler, U., Rehdanz, K., Hiebenthal, C., Interwies, E., Dworak, T., Friedrich, R., Görlitz, S., Fantke, P., Kuhn, A., Preiss, P., Reumann-Schwichtenberg, J., Rumohr, H. (2012): Module 3a und 3b: Aufbau eines Mengengerüstes – Teil 1: Zusammenstellung relevanter Komponenten, Teil 2: Vorschläge zur Monetarisierung.

Bertram, C. und Rehdanz, K. (2012): On the environmental effectiveness of the EU Marine Strategy Framework Directive. Marine Policy, forthcoming.

Boyd, J. und Banzhaf, S. (2007): What are ecosystem services? The need for standardized environmental accounting units. Ecological Economics 63: 616-626.

Brouwer, R. (1998): Future Research Priorities for Valid and Reliable Environmental Value Transfer. CSERGE Working Paper GEC 98-28, London.

BSH (Bundesamt für Seeschifffahrt und Hydrographie) (2010): Hintergrundpapier: Entwurf Übersicht zu Nutzungen/Schutz der Meeresumwelt in der deutschen ausschließlichen Wirtschaftszone in Nord- und Ostsee. Date: 18.01.2010. Hamburg.

Defra (Department for Environment, Food and rural Affairs) (2007): An Introductory Guide to Valuing Ecosystem Services. Department for Environment, Food and Rural Affairs, London. Online: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/eco-valuing.pdf.

DEFRA (2009): Scoping Study for Elements of the Marine Strategy Framework Directive - Impact Assessment Evidence Base.

Destatis (2012): Gebiet und Bevölkerung – Haushalte 2010. http://www.statistik-portal.de/Statistik-Portal/de_jb01_jahrtab4.asp.

Dworak, T., Görlitz, S., Interwies, E. et al. (2011): Methodische Grundlagen für sozio-ökonomische Analysen sowie Folgenabschätzungen von Maßnahmen einschließlich Kosten-Nutzen Analysen nach EG-Meeresstrategie-Rahmenrichtlinie (MSRL).

EC (European Commission) (2010): Working Group on Economic and Social Assessment. Economic and Social Analysis for the Initial Assessment for the Marine Strategy Framework Directive: A Guidance Document. A legally non-binding document. 21st December 2010.

EC (European Commission) (2010): Scoping study on the requirements for economic assessment in the Marine Strategy Framework Directive - Final report.

EC (European Commission) (2011): Draft: Relationship between the initial assessment of marine waters and the criteria for good environmental status. Marine Environment and Water Industry Unit, DG Environment, European Commission: 77 S.

EFTEC/ENVECO (2010): OSPAR Regional Economic and Social Assessment for the Marine Strategy Framework Directive – draft works specification.

EG (1991): Richtlinie 91/271/EWG des Rates vom 21. Mai 1991 über die Behandlung von kommunalem Abwasser, Der Rat der Europäischen Gemeinschaften. Amtsblatt der Europäischen Gemeinschaften.

EG (2006): Richtlinie 2006/7/EG des Europäischen Parlaments und des Rates vom 15. Februar 2006 über die Qualität der Badegewässer und deren Bewirtschaftung und zur Aufhebung der Richtlinie 76/160/EWG. Amtsblatt der Europäischen Union 64, S. 37-51.

Fanshawe, T. und M. Everard (2002): The Impacts of Marine Litter. Report of the Marine Litter Task Team, Marine Pollution Monitoring Management Group.

Fisher, B., Turner, R.K. und Morling, P. (2009): Defining and classifying ecosystem services for decision-making. In: Ecological Economics 68, S. 643-653.

Fleet, D. M. (2003): Untersuchung der Verschmutzung der Spülsäume durch Schiffsmüll an der deutschen Nordseeküste - Untersuchung der Müllbelastung an den Spülsäumen der deutschen Nordseeküste – Umweltbundesamt - FKZ 202 96 183.

Fleet, D. M. (2012): Email dated 28.03.2012.

Fleet, D., van Franeker, J., Dagevos, J. und M. Hougee (2009): Marine Litter. Thematic Report No. 3.8. In: Marencic, H. und J. de Vlas (Eds.). Quality Status Report 2009. Wadden Sea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Galgani, F., Fleet, D., van Franeker, J., Katsanevakis, S., Maes, T., Mouat, L., Oosterbaan, L., Poitou, I., Hanke, R., Thompson, R., Amato, E., Birkun, A., Janssen, C. (2010): Marine Strategy Framework Directive, Task Group10 Report, Marine Litter.

Gorycka, M. (2009): Environmental Risks of Microplastics. Faculteit der Aard- en Levenswetenschappen, Vrije Universiteit, Amsterdam.

Guse, N. (2012): OSPAR Fulmar Litter EcoQO – Masse von Plastikmüllteilen in Eissturmvogelmägen. Final Report for the BfN, Bonn.

Hall, K., (2000): Impacts of Marine Debris and Oil. Economic and Social Costs to Coastal Communities. KIMO.

Hanley, N. und B. Kristrom (2002): What's it worth? Exploring uncertainty over values using contingent valuation. Economics Department, University of Glasgow.

HELCOM (2007): HELCOM Baltic Sea Action Plan. Adopted on 15 November 2007 in Krakow, Poland by the HELCOM Extraordinary Ministerial Meeting. HELCOM, Helsinki.

HELCOM (2011): The Fifth Baltic Sea Pollution Load Compilation (PLC-5). Baltic Sea Environ. Proc. No. 128.

Herr, H. (2009): Vorkommen von Schweinswalen (Phocoena phocoena) in Nord- und Ostsee – im Konflikt mit Schifffahrt und Fischerei?

Köllner, T. (2001): Land Use in Product Life Cycles and its Consequences for Ecosystem Quality, University of St. Gallen, ETH Zürich.

Loureiro, M. L., Ribas, A., López, E., Ojea, E. (2006): Estimated Costs and Admissible Claims linked to the Prestige Oil Spill. In: Ecological Economics 59 (2006), S. 48-63.

Marggraf, R., Brandt, A., Dickow, M.C., Lauterbach, F.R., Sauer, U., Voßen, D. und B. Weppe (2011): Gutachten zur Erstellung der ökonomischen Anfangsbewer¬tung im Rahmen der Umsetzung der Meeresstrategie-Rahmenrichtlinie (MSRL) im Auftrag des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit.

MEA (Millenium Ecosystem Assessment) (2005): Ecosystems and Human Well-Being: Wetlands and Water – Synthesis. World Resources Institute, Washington, DC, USA. Online: http://www.maweb.org/documents/document.358.aspx.pdf

Meyerhoff, J. und D. Angeli (2011): Ermittlung der Zahlungsbereitschaft in Deutschland für Maßnahmen zur Reduzierung der Eutrophierung in der Ostsee (BalticSTERN/Sun). Ergebnisbericht November 2011 im Auftrag des Umweltbundesamtes, FKZ 3710 25 202.

Mouat, J., Lopez Lorano, R. and Bateson, H. (2010): Economic Impacts of Marine Litter. KIMO International.

Mourato, S., S. Georgiou, E. Ozdemiroglu, J. Newcombe, und A. Howarth (2003): Bathing Water Directive Revisions: What are the Benefits to England and Wales? A Stated Preference Study. CSERGE Working Paper ECM 03-12, Center for Social and Economic Research on the Global Environment, University of East Anglia.

NABU (2010): Müllkippe Meer - Plastik und seine tödlichen Folgen (www.nabu.de/meeresschutz/NABU-Broschuere_Muellkippe_Meer.pdf).

OSPAR (1995): Summary record of the meeting in Stockholm of the 3rd Working Group on Impacts of the Marine Environment.

OSPAR (2010): Quality Status Report 2010 (http://qsr2010.ospar.org/en/downloads.html).

Ott, W., Baur, M., Kaufmann, Y. (2006): Deliverable D.4.2.-RS 1b/WP4 – July 06. „Assessment of Biodiversity Losses“; NEEDS project, FP6, Project no: 502687.

Pearce, D.W. und Turner, R.K. (1990): Economics of natural resources and the environment. Harvester Wheatsheaf, London.

Reumann-Schwichtenberg, J., Bachmann, T. und P. Preiss (2011): Sachstandspapier zu Arbeitspaket Natur und Landschaft, Ökosystem und Biodiversität - Schätzung externer Umweltkosten und Vorschläge zur Kosteninternalisierung in ausgewählten Politikfeldern (UBA Methodenkonvention) Forschungsprojekt im Auftrag des Umweltbundesamtes, FKZ 3708 14 101.

Rosenberger, R.S. und Loomis, J.B. (2001): Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan (2000 revision). U.S. Department of Agriculture, Forest Service.

SEPA (2008): The economic value of ecosystem services provided by the Baltic Sea and Skagerrak. Existing information and gaps of knowledge. Report 5874.

Turner, R.K., Hadley, D., Luisetti, T., Lam, V.W.Y. and Cheung, W.W.L. (2010): An Introduction to Socio-Economic Assessment within a Marine Strategy Framework, CSERGE, UEA. Department for Environment, Food and rural Affairs, UK.

Turner, R.K., Georgiou, S., Gren, I.-M., Wulff, F., Barrett, S., Söderqvist, T., Bateman, I., Folke, C., Langaas, S., Zylicz, T., Mäler, K.-G. and A. Markowska (1999): Managing nutrient fluxes and pollution in the Baltic: an interdisciplinary simulation study. Ecological Economics, 30: 333-352.

Turner, R.K., Paavola, J., Cooper, P., Farber, S., Jessamy, V. und S. Georgiou (2003): Valuing nature: lessons learned and future research directions. Ecological Economics, 46: 493-510.

UBA (2007): Ökonomische Bewertung von Umweltschäden. Methodenkonvention zur Schätzung externer Umweltkosten, Dessau. Online: http://opus.kobv.de/zlb/volltexte/2008/6413/pdf/3193.pdf.

UBA (2010): Einträge von Nähr- und Schadstoffen. Daten zur Umwelt: http://www.umweltbundesamt-daten-zur-umwelt.de/umweltdaten/public/theme.do?nodeIdent=2395

Umweltbundesamt (UBA) (2010): Abfälle im Meer - ein gravierendes ökologisches, ökonomisches und ästhetisches Problem. (http://www.umweltdaten.de/publikationen/fpdf-l/3900.pdf).

UNEP (2005): Marine Litter: An Analytical Overview.

UNEP (2009): Marine Litter: A Global Challenge.

Van der Veeren, R. (2009): Economische analyse van het gebruik van de Noordzee.

WG ESA (2010): Economic and social analysis for the initial assessment for the MSFD: A Guidance Document - a legally non binding Document – Draft Dec. 2010.

WHO (2003): Guidelines for safe recreational water environments. Volume 1: Coastal and fresh waters. World Health Organization.

Zylicz, T., Bateman, I., Georgiou, S., Markowska, A., Dziegielewska, D., Turner, R.K., Graham, A. and Langford, I. (1995): Contingent Valuation of Eutrophication Damage in the Baltic Sea Region. CSERGE Working Paper GEC 95-0.