

Ecosystem Services in the Baltic Sea

Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea





Ecosystem Services in the Baltic Sea

Valuation of Marine and Coastal Ecosystem
Services in the Baltic Sea

Heini Ahtiainen and Marcus C. Öhman

Ecosystem Services in the Baltic Sea
Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea
Heini Ahtiainen and Marcus C. Öhman

ISBN 978-92-893-3861-5 (PRINT)
ISBN 978-92-893-3863-9 (PDF)
ISBN 978-92-893-3862-2 (EPUB)
<http://dx.doi.org/10.6027/TN2014-563>

TemaNord 2014:563
ISSN 0908-6692

© Nordic Council of Ministers 2014
Layout: Hanne Lebech
Cover photo: Heini Ahtiainen

Print: Rosendahls-Schultz Grafisk

Printed in Denmark



Stockholm Resilience Centre
Research for Governance of Social-Ecological Systems



This publication has been published with financial support by the Nordic Council of Ministers. However, the contents of this publication do not necessarily reflect the views, policies or recommendations of the Nordic Council of Ministers.

www.norden.org/en/publications

Nordic co-operation

Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland, and Åland.

Nordic co-operation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic co-operation seeks to safeguard Nordic and regional interests and principles in the global community. Common Nordic values help the region solidify its position as one of the world's most innovative and competitive.

Nordic Council of Ministers

Ved Stranden 18
DK-1061 Copenhagen K
Phone (+45) 3396 0200

www.norden.org

Content

Preface.....	7
Summary	9
1. Introduction.....	13
1.1 Regional workshop on the valuation of marine and coastal ecosystem services.....	14
2. Ecosystem services – defining the concept	15
3. Valuing ecosystem services.....	19
3.1 Valuation methods.....	21
4. Ecosystem services as a global priority	25
5. The Baltic Sea environment and human impact.....	27
6. Ecosystem services provided by the Baltic Sea	31
6.1 Provisioning ecosystem services.....	31
6.2 Cultural ecosystem services	32
6.3 Supporting ecosystem services.....	33
6.4 Regulating ecosystem services	33
6.5 Economic valuation studies of ecosystem services in the Baltic Sea.....	34
7. Baltic Sea governance and ecosystem services.....	37
8. Future perspectives	41
References	45
Sammanfattning på svenska.....	53
Appendix 1. Background on valuation methods.....	55
Appendix 2. Background information on Baltic environment and human impacts	59
Appendix 3. Valuation studies of ecosystem services in the Baltic Sea area	63
Appendix 4. Discussions in the regional workshop on the valuation of marine and coastal ecosystem services in the Baltic Sea	67
Opening discussion	68
Group discussions.....	69
Panel discussion	73

Preface

Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea
Heini Ahtiainen^{1,2} and Marcus C. Öhman^{3,4}

Acknowledgements: We gratefully acknowledge the contribution of the following persons to this report: Mikhail Durkin, Jorid Hammersland, Minna Pyhälä, Monika Stankiewicz, Kerstin Blyh, Siv Ericsson, Anna-Stiina Heiskanen, Kari Hyytiäinen, Holger Janßen, Soile Kulmala and Christian Neumann. The participants of the Regional Workshop on the Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea in Stockholm, Sweden, in 7–8 November 2013 are also acknowledged for their inputs.

This report was prepared as an outcome of the Regional Workshop on the Economic Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea (Regional workshop om värdering av kustnära och marina ekosystemtjänster), been held on 7–8 November 2013, in Stockholm, Sweden. This work on the project was coordinated by the Stockholm Resilience Centre (SRC), Stockholm University, in a partnership with the UNEP Regional Seas Programme, Baltic Marine Environment Protection Commission – Helsinki Commission (HELCOM) and the Ministry of the Environment of Sweden with financial support provided from the Nordic Council of Ministers and the Swedish Presidency of the Nordic Council of Ministers within 2013.

¹ HELCOM, Baltic Marine Environment Protection Commission, Katajanokanlaituri 6 B, FI-00160 Helsinki, Finland.

² Present affiliation: MTT Agrifood Research Finland, Latokartanonkaari 9, FI-00790 Helsinki, Finland. Email: heini.ahtiainen@mtt.fi

³ Stockholm Resilience Centre, Stockholm University, SE-10691, Stockholm, Sweden.

⁴ Present affiliation: Ministry for Rural Affairs, Swedish Government Offices, SE-10333 Stockholm, Sweden.

Summary

The Baltic Sea provides many ecosystem services that directly or indirectly contribute to human well-being. They can be divided into four different categories according to the Millennium Ecosystem Assessment. These include provisioning ecosystem services such as fishery, aquaculture, energy and waterways; cultural ecosystem services such as recreation and education; regulating ecosystem services including climate regulation, sediment retention and mitigation of eutrophication; and finally supporting ecosystem services that are not directly used but underlie all other services, including such aspects as the cycling of materials and primary production. Ecosystem services may also be divided into intermediate services (e.g. habitat maintenance), final services (e.g. fish) and goods/benefits (e.g. food).

Even though ecosystem services play such an important role for millions of people in the Baltic Sea region, knowledge on the functioning of the Baltic Sea ecosystems and their connection to ecosystem services is still limited. An understanding of Baltic Sea ecosystem services and the benefits they provide is essential to sustainable resource management and can aid in achieving good environmental status. Information on the benefits provided by marine and coastal ecosystems is needed in marine decision-making both at a national and regional level. The latter includes, for example, the objectives of the Baltic Sea Action Plan of the Baltic Marine Environment Protection Commission (HELCOM) and the European Union Marine Strategy Framework Directive as well as the EU Biodiversity Strategy 2020.

This report presents an overview of the ecosystem services and associated benefits provided by the Baltic Sea, including information on the approaches of assessing and valuing ecosystem services being applied in the Baltic Sea region. It also identifies the main challenges in ecosystem service assessments in the Baltic Sea and outlines the way forward in applying assessment tools in regional and national policies. The report has been prepared as an outcome of the Regional Workshop on the Economic Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea that was held on 7-8 November, 2013, in Stockholm, Sweden. The project was coordinated by Stockholm Resilience Centre (SRC) at Stockholm University in a partnership with HELCOM, the Ministry of the Envi-

ronment of Sweden and the UNEP Regional Seas Programme with financial support provided from the Nordic Council of Ministers and its Swedish Presidency in 2013.

Main challenges in assessing the ecosystem services in the Baltic Sea

- Accurately describing ecosystem services and how they are linked with the ecosystem structures.
- Trade-offs and interactions of ecosystem services.
- Finding relevant indicators for the assessment of ecosystem services and ecosystem improvement.
- Evaluating how measures to improve the marine environment impact the provision and trade-offs of ecosystem services and further their value.
- Assessing the effects of changes in ecosystem services to human well-being, taking into account possible future developments.
- Taking ecological thresholds and non-linearities into account in valuation.
- Providing internationally comparable information on the value of ecosystem services.
- Incorporating uncertainty about ecosystem services into value estimates.
- Translating ecosystem services information so it becomes relevant to policy and decision-making.

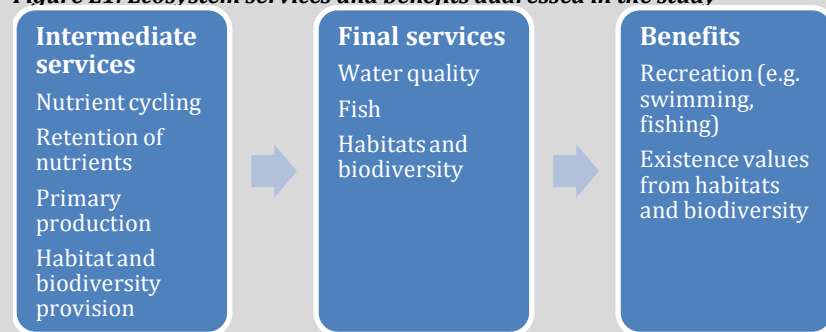
Case study: Benefits from reduced eutrophication in the Baltic Sea (Ahtiainen *et al.* 2012, 2014)

The purpose of the study was to estimate the benefits of reducing eutrophication in the Baltic Sea to the general public. The change in eutrophication was based on the existing policy targets set by the HELCOM Baltic Sea Action Plan. Contingent valuation was chosen as the valuation method, as it is able to capture values related both to the recreational use of the sea and the existence of a healthy marine environment. Contingent valuation is a survey-based method that elicits individuals' willingness to pay for a well-defined environmental change, with willingness to pay representing the benefits of the change in monetary terms.

The valuation survey was designed in international cooperation and implemented in 2011 in all nine coastal countries of the Baltic Sea. Altogether, 10,500 responses were collected. In addition to the valuation questions, the survey collected information on respondents' attitudes, experiences of eutrophication, level of knowledge, and background (e.g. income and age).

In the survey, the state of the Baltic Sea was described with five ecosystem characteristics: water clarity, blue-green algal blooms, underwater meadows, fish species and state of deep sea bottoms. Thus, the study examined mainly recreation and existence benefits from water quality and marine habitats (see Figure E1). Change in eutrophication was presented to respondents with colour maps illustrating the improvement in the condition of the Baltic Sea.

Figure E1: Ecosystem services and benefits addressed in the study



The results showed that people attach a great value to improving the state of the Baltic Sea. The majority of the citizens in the Baltic Sea countries were willing to pay for reduced eutrophication, and the total willingness to pay was around 3,600 million euros per year. The findings also indicated that people value having the entire Baltic Sea in a healthier state, that recreation on Baltic Sea shores and waters is popular in all coastal countries, and that many are worried about the marine environment.

The estimates are useful in assessing the benefits of reducing eutrophication according to the HELCOM Baltic Sea Action Plan targets and achieving the Good Environmental Status in the Marine Strategy Framework Directive with regard to eutrophication. In addition, benefits can be compared with the costs of nutrient abatement to assess the economic efficiency and social desirability of nutrient abatement programs.

1. Introduction

The Baltic Sea provides many goods and services that contribute to human well-being. These include, for example, fish stocks, biodiversity, water quality and climate regulation, which in turn create human welfare in terms of food, tourism, recreation opportunities and inspiration. Ecosystem services are ecosystem functions and processes that are beneficial to humans, either directly or indirectly. The concept of ecosystem services can be used to analyze the interaction between nature and humans, and assess the significance of ecosystems and biodiversity.

Many benefits provided by nature are not recognized by markets and market prices, thus being ignored in decision-making. This leads to undervaluation of nature and ecosystem services, and loss of biodiversity (TEEB 2008). The purpose of valuation is to capture the numerous values people derive from nature, which can be integrated into decision-making.

Better understanding of the value of ecosystem services increases the awareness of the benefits provided by nature, and makes the trade-offs between the protection of the marine environment and other economic actions visible. Ecosystem valuation can thus assist in designing more efficient policies. Benefit estimates can be compared with the costs of environmental protection measures in cost-benefit analyses to assess the economic efficiency of nature conservation projects or programs. Such analyses can also be useful in setting environmental targets and in deciding how to allocate public spending. In addition, valuation is one of the ways to take into account public values and encourage public participation.

Despite recent initiatives and efforts to study ecosystem services, the understanding of the function of the Baltic Sea ecosystems that provide the services and the resulting benefits to human societies is still limited. There is a need to improve the knowledge of ecosystem services to produce comparable information for the Baltic Sea region. The knowledge of ecosystem services and their value to society can aid in achieving the regional and national environmental objectives set for the Baltic Sea. Information on the benefits provided by marine and coastal ecosystems can support reaching the objectives of the HELCOM Baltic Sea Action Plan. Such information is also needed for the implementation of the EU Marine Strategy Framework Directive (Directive 2008/56/EC).

With this report an overview of the ecosystem services and associated benefits provided by the Baltic Sea is presented including information on the approaches of assessing and valuing ecosystem services being applied in the Baltic Sea region. The main challenges in ecosystem service assessments in the Baltic Sea and the way forward in applying assessment tools in regional and national policies are outlined.

1.1 Regional workshop on the valuation of marine and coastal ecosystem services

The Regional Workshop on the Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea was organized in Stockholm, Sweden, 7–8 November 2013 with the purpose of exchanging information, discussing how economic valuation of the Baltic Sea can be used for ecosystem-based marine management, and allowing experts and policymakers to meet. Participants of the workshop included representatives of the scientific community and academia, administration, non-governmental organizations (NGOs) and the private sector. This report follows the topic-wise arrangement of the workshop with chapters (presentations) addressing ecosystem services with relation to defining the concept, global and regional perspectives, and marine management, complemented by discussions on state-of-play and future of ecosystem valuation in the region. This report presents some of the discussed issues and outcomes of the workshop at the end of each relevant section. Some of the questions posed in the discussion boxes were used as the basis for the group discussions. Additional information on the workshop and its outputs can be found in Appendix 4.

2. Ecosystem services – defining the concept

Working with ecosystem services requires a clear and consistent understanding of their definition and typology. Several different definitions and classification schemes of ecosystem services have been suggested (Daily 1997, Costanza *et al.* 1997, MA 2005, Fisher *et al.* 2009). One of the most widely used definitions is the one developed by the Millennium Ecosystem Assessment (MA 2005) which has been applied in analyzing the situation in the Baltic Sea (Garpe 2008, Söderqvist *et al.* 2012).

Millennium Ecosystem Assessment (MA) classification of ecosystem services

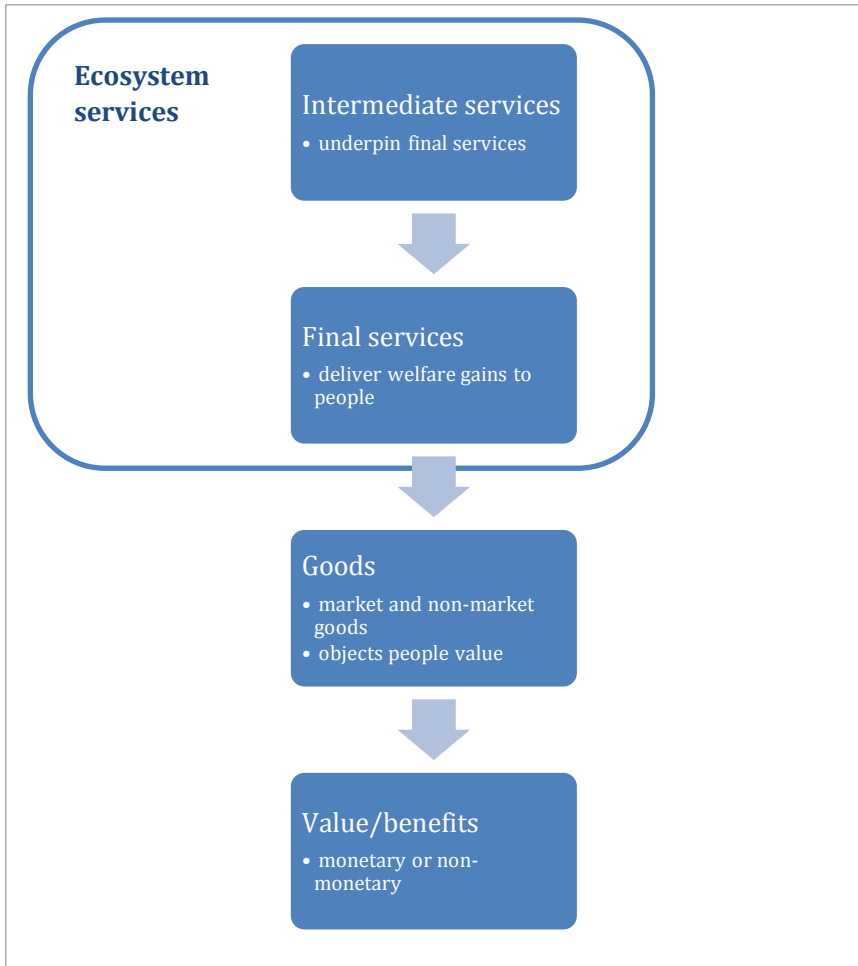
- *Regulating*, e.g., pollination and the regulation of climate and erosion.
- *Provisioning*, products from the ecosystems, e.g. food, genetic resources and energy sources.
- *Cultural*, e.g. recreation, inspiration, aesthetic and educational values.
- *Supporting*, maintain other services, e.g. primary production and nutrient cycling.

Since the MA, the classification of ecosystem services has been developed to be applicable to different decision contexts (e.g. Boyd & Banzhaf 2007, Wallace 2007, Fisher *et al.* 2009, UK NEA 2011). It has been noted that some ecosystem services contribute to the provision of others, and that double-counting needs to be avoided in the valuation of ecosystem services. Therefore, ecosystem services are often divided into intermediate and final services, and also separated from the goods or benefits they provide (Fisher *et al.* 2009, Turner *et al.* 2010, UK NEA 2011).

Figure 2 presents a classification for the valuation of ecosystem services. It is based on the key idea that ecosystem services provide goods and benefits to humans that can be valued (Fisher & Turner 2008, Fisher *et al.* 2009). In the definition, ecosystem services are considered to be ecological in nature, and they do not have to be utilized directly. Intermediate services support final services but are not directly linked to human welfare, and final services directly deliver welfare gains to people. UK NEA (2011) also separates between goods that include all out-

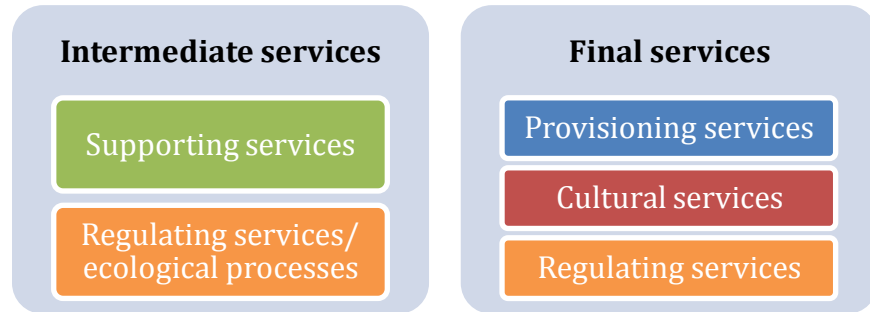
puts from ecosystems that are valued by people, and benefits that represent the value of welfare improvements.

Figure 1: Classification of ecosystem services for valuation



This division of ecosystem services aids in considering all significant services to human well-being (European Commission 2010), and it also helps avoiding the problem of double-counting (Fisher *et al.* 2009, UK NEA 2011). The MA classification and the division of ecosystem services into intermediate and final services and benefits can be used together (see Figure 3). In that case, provisioning and cultural services are always final ecosystem services, regulating services may be either final or intermediate services and supporting services are always intermediate services (UK NEA 2011). Also, some ecosystem services can be either intermediate or final depending on the context.

Figure 2: Classification of ecosystem services



Adapted from UK NEA 2011, p. 17.

As the existence of multiple classification schemes of ecosystem services complicates comparisons between studies, a standard classification that is consistent with other classification schemes has been proposed (Haines-Young & Potschin 2011, 2013). The Common International Classification of Ecosystem Services (CICES) has been developed to facilitate comparisons between different definitions. The starting point of the CICES classification is the MA (2005) typology of ecosystem services, but it has been developed further to make a distinction between final ecosystem services, goods and benefits, with similarity to the UK NEA (2011) definition.

The classification of ecosystem services is a challenge concerning the Baltic Sea. The existing classification schemes for ecosystem services do not necessarily take into account the special characteristics of the Baltic Sea, and therefore it is important to adapt these to the conditions of the area.

3. Valuing ecosystem services

Ecosystem services are valued to assess the socio-economic benefits (or losses) resulting from changes in the market and non-market goods provided by ecosystem services. This view is essentially anthropocentric and focuses on human well-being. In addition to human benefits, nature is often considered to have intrinsic value, i.e. value in itself (e.g. Ehrenfeld 1972).

Valuation of ecosystem services is inherently interdisciplinary, and it entails combining the approaches of natural and social sciences to characterize the relationships between ecosystems, the provision of ecosystem services and human well-being. Steps in the valuation of ecosystem services include assessing how the policy change affects the ecosystem and the provision ecosystem services, how the changes in ecosystem services impact human welfare, and what is the value of these changes (Defra 2007).

The effects of biodiversity conservation on ecosystem services and further on human well-being can also be assessed in relation to human well-being targets (Conservation Measures Partnership 2012). According to MA (2005), these targets include necessary material for good life (such as income, food and shelter), health, good social relations, security, and freedom and choice. Conservation projects can provide direct benefits to humans while achieving conservations goals, or provide ecosystem services that contribute to human well-being (Conservation Measures Partnership 2012). It is also possible to set goals for human well-being targets in conservation projects.

According to White *et al.* (2011), valuation of ecosystem services can be done at three levels: qualitative, quantitative and monetary. Qualitative valuation means identifying the effects of changes in the provision of ecosystem services on human well-being, e.g. qualitatively describing the changes in the recreational use of a certain nature area after a policy change. Quantitative valuation involves estimating the changes in ecosystem benefits in numbers, e.g. determining the increase in the yearly number of visitors to the area. Monetary valuation entails expressing the values in monetary terms, e.g. estimating the change in the annual value of the recreational visits to the area.

According to literature, economic valuation of ecosystem services should consider double counting, marginal valuations, spatial explicit-

ness and threshold effects (Turner *et al.* 2010). Double-counting occurs when underlying ecosystem services that contribute to final service benefits are valued separately and the values are aggregated to obtain estimates of ecosystem value (Turner *et al.* 2010). For example, valuing nutrient cycling and recreation in marine areas separately and summing the values up leads to double-counting, as nutrient cycling contributes to having usable water for the purposes of recreation. Thus, the value of nutrient cycling is already embodied in the recreation benefits. The double-counting problem can be avoided by having a clear understanding of the interactions of ecosystem services and valuing only goods provided by final ecosystem services.

Marginal valuation entails that marginal changes in value are estimated instead of total values. Estimating the total economic value of ecosystem services is considered neither useful nor advisable for several reasons (Brouwer *et al.* 2013). First, marginal value reflects the value of an additional unit of ecosystem services, and it changes with the level of provision of ecosystem services. Therefore, multiplying marginal values with quantities may lead to biased estimates of total value. Second, for ecosystem services that are fundamental to human well-being, total value is argued to be infinite. Third, policy decisions rarely consider total losses of ecosystem services, and therefore valuing marginal changes is more useful.

Spatial explicitness implies that it is important to take into account the spatial heterogeneity of ecosystem services provision and benefits (Turner *et al.* 2010). Provision of ecosystem services is affected, for example, by the ecosystem area, quality and the scale of delivery (Brouwer *et al.* 2013). Benefits depend on the number of affected people, distance to the ecosystem and availability of substitutes, among others (Brouwer *et al.* 2013). Interdisciplinary work is needed to account for spatial variability.

Nonlinearities are often present in ecosystem services, meaning that there are certain thresholds after which the system changes dramatically into another steady state. Possible thresholds should also be considered in valuation to produce appropriate benefit estimates. In situations with high ecological uncertainty or irreversible changes in ecosystems, other policy guiding principles, such as the precautionary principle, can be more useful (TEEB 2010).

3.1 Valuation methods

Environmental valuation methods are currently most commonly used to assess the economic value of ecosystem services (Kettunen *et al.* 2012). These include stated preference and revealed preference methods. Also direct market valuation is commonly used. Stated preference methods (SP) are based on carefully constructed surveys that ask people's willingness to pay for a well-defined change in the provision of ecosystem services. They are widely applicable to different kinds of ecosystem services, and are the only methods that are able to capture values that are not related to the use of ecosystem services. However, they have been criticized on the grounds of relying on survey responses and not on actual behavior. Revealed preference methods (RP) are based on observing people's behavior in markets. They rely on the assumption that people's expenditure on travelling or housing reflects also environmental values. They can be used for estimating recreation and aesthetic values, based on statistics or survey data. When time and resource constraints preclude conducting new studies, e.g. collecting survey data, methods using existing valuation studies (benefit transfer and meta-analysis) can be considered.

Besides monetary value estimates, valuation studies typically collect information on public knowledge, attitudes and opinions on ecosystem services and the environment. This information can be used to complement the benefit estimates in ecosystem service assessments.

In addition to the above-mentioned methods, economic values are sometimes based directly on market prices or costs, which is less resource-intensive. Market prices are only applicable when such data are available, and even then prices need to be adjusted for distortions such as taxes and subsidies (UK NEA 2011). It is also possible that the market price does not capture wholly the social costs and benefits, giving an underestimation of the value of the good. Cost-based methods rely on the availability of cost data, and they typically tend to either overestimate (replacement cost) or underestimate (avoidance costs) the value of ecosystem services (Turner *et al.* 2010).

Qualitative and quantitative approaches can be used to complement monetary valuations and when monetary valuation of ecosystem goods is difficult or impossible, e.g., in the case of some cultural ecosystem services (inspiration, spiritual values).

Methods to value ecosystems services are listed in Table 1 with examples of applications in the Baltic Sea area, and more detailed information of each method can be found in Appendix 1.

The choice of valuation approach depends on the context and the ecosystem benefits in question and on the level of ambition of the examination. Ecosystem service assessments can begin with qualitative and quantitative descriptions followed by monetary valuation in later phases. Monetary valuation makes sense especially for major issues or large-scale projects, when large benefits or costs are at stake. More information on the suitability of valuation methods to different ecosystem services can be found in Table 3 in Brouwer *et al.* (2013).

Table 1: Methods to value ecosystem services

Method	Data source	Applicability and examples
<i>Stated preference methods</i> Contingent valuation, choice experiment	surveys	recreation, aesthetic benefits, non-use/existence values, e.g. recreation and existence benefits from reduced eutrophication ¹
<i>Revealed preference methods</i> Travel cost method, hedonic pricing	surveys, statistics	recreation, aesthetic benefits, e.g. recreation benefits from increased fish catch ² , benefits of residential properties from improved water quality ³
<i>Methods using existing studies</i> Benefit transfer, meta-analysis	existing valuation studies	based on primary studies, recreation, aesthetic benefits, non-use/existence values, e.g. the benefits from reduced eutrophication ⁴
<i>Cost-based methods</i>	cost data	data on replacement or avoidance costs available, e.g. value of coastal zones as nutrient filters ⁵
<i>Market prices</i>	market data	goods traded in markets, e.g. the value of fish landings ⁶
<i>Non-monetary methods</i> Qualitative, quantitative	statistics, focus groups, interviews, workshops	when obtaining monetary estimates not appropriate/ possible, e.g. describing the recreational use of marine areas ⁷ , shared values for reducing eutrophication ⁸

¹ Ahtiainen *et al.* (2014), ² Håkansson (2008), ³ Artell (2013), ⁴ Turner *et al.* (1999), ⁵ Gren (2013).

⁶ Kulmala *et al.* (2012), ⁷ Ahtiainen *et al.* (2013), ⁸ BalticSTERN (2013).

Box 1: Input from the workshop on valuing ecosystem services

- The concept of ecosystem services is sometimes difficult to understand, and therefore improving the knowledge and understandability of ecosystem services and the associated values is considered important. This can be achieved by making ecosystem services as concrete, personal and relevant as possible.
- Human wellbeing depends on ecosystem services. Ecosystem services that are linked to familiar issues, such as recreation, health, livelihoods and value of coastal homes, help understand and relate to them.
- It is worth explaining how policies on ecosystem services affect people's life and work.
- Case studies and local examples are useful in bringing ecosystem services closer to people. Visualizing the state of ecosystem services, what affects them and how they affect human well-being, for example, by showing them on maps can be used as a tool.
- Both monetary and non-monetary values can help people understand ecosystem services, but they need to be explained using good examples.
- For businesses, the use of valuation of ecosystem services can be an incentive for the development of new business chances and opportunities, such as innovations, are important. Likewise economic gains or long term costs, reflected through ecosystem valuation may help bringing the concept into daily business activities/routines.
- Raising the level of awareness amongst the public and politicians makes it easier to show that marine and coastal ecosystem services are valuable and that they are societal goods benefitting all.
- As ecosystem valuation mainly is calculated on the basis of present values there is a need to develop forecasting models to secure that the valuation can consider upcoming future needs for goods and services.
- Calculating the monetary value of ecosystem services facilitate the visibility, but the monetary valuation is not always possible and even less appropriate if relevant knowledge is lacking. A lot of the economic valuations tend to be on the provisioning ecosystem services – fish, fuel and wood have a market value. The cultural values are difficult to evaluate.
- Using economic valuation of ecosystem services is very important for decision makers to get the message across.
- Interdisciplinary studies are needed for valuation. There is an urging need to bring together biologist, economist and social sciences both on the research level as well as on the management level. Also, the existing data and results should be made more readily available.

4. Ecosystem services as a global priority

A major initiative taken by the United Nations (UN) to highlight the important role ecosystems play for the well-being of humanity was the Millennium Ecosystem Assessment (MA 2005). It compiled information on what the consequences may be when ecosystems change, and provided recommendations for the future on how to deal with these changes. It was concluded that over the past 50 years, humanity have changed ecosystem services more than ever before. These changes correlate with the economic development of the world, but they come with a cost most notable in environmental degradation and biodiversity loss and with that the impoverishment of ecosystem services. The MA noted that ecosystem services will most likely continue to degrade, making it difficult to achieve the Millennium Development Goals, which also concerns the Sustainable Development Goals of the future (Griggs *et al.* 2013, Rockström *et al.* 2013, Schultz *et al.* 2013, Elmqvist *et al.* 2014).

The Economics of Ecosystems and Biodiversity (TEEB) initiative took a global perspective on the valuation of ecosystem services by studying the economics of biodiversity loss. The aim was to incorporate the value of ecosystems services into decision-making. TEEB is organized in three phases, of which the third one is ongoing. The findings of the first phase were summarized in an interim report in 2008, highlighting the continuing decline in biodiversity and related losses of ecosystem services, discussing the economic valuation of biodiversity and ecosystem services, and describing how policies could be improved to better conserve biodiversity (TEEB 2008). The second phase of TEEB produced several reports directed to policy-makers (e.g. TEEB 2009), and the ongoing third phase focuses on communication, maintaining the TEEB network and supporting national TEEB studies (TEEB 2013). Several countries in Europe, such as Germany, the Netherlands and Poland have initiated national TEEB studies, and Nordic countries (Finland, Sweden, Norway, Denmark and Iceland) have published a synthesis on the socio-economic role and significance of biodiversity and ecosystem services (TEEB Nordic, Kettunen *et al.* 2012). TEEB Nordic compiled information on ecosystem services in the Nordic countries, including marine areas, and assessed the status and

socio-economic value of marine fisheries. According to TEEB Nordic, there are considerable knowledge gaps related to marine ecosystem services, with the exception of fisheries. Another initiative related to the marine environment is TEEB for Oceans and Coasts, which draws attention to the economic benefits of ocean and coastal ecosystems and aims to provide examples and guidance on incorporating ecosystem values into policy decisions (TEEB for Oceans and Coasts 2013).

United Nations Environment Programme (UNEP) has developed several global background studies and reports for economic valuation of ecosystem services, including Guidance Manual for the Valuation of Regulating Services (2010). Importantly, UNEP's activities *inter alia* covered coastal and marine ecosystems (e.g. wetlands in Sri Lanka, reefs in St. Lucia, Tobago, Belize, Jamaica, and the Dominican Republic). Ecosystem valuation is a priority for UNEP. With their Ecosystem Services Economics (ESE) program they aim at building stakeholder capacity to make scientifically based information to integrate an ecosystem-service based approach into national administration. According to UNEP there is a need to develop the understanding of how ecosystem services influence and relate to the well-being of humanity. They have three focus areas including (1) Economic Valuation and Natural Wealth, (2) Equity in Ecosystem Management and (3) Disaster Risk Management. The ESE program also relates to Millennium Ecosystem Assessment (MA 2005). There is great interest to apply the concept of ecosystem services into UNEP's Regional Seas Programme. This programme that was launched in 1974 aims at improving the environmental status of the world's seas and coastal areas by facilitating collaboration among neighboring coastal countries.

Box 2: Input from the workshop on ecosystem services as a global priority

- International experience and collaboration is important and the research community is at frontline utilizing it.
- It would be useful to develop a common understanding and methodology of ecosystem services with neighboring countries in the Baltic Sea area.
- International experiences should be utilized by finding good examples and policy instruments of ecosystem services based management. Also bad examples are useful to learn important lessons.

5. The Baltic Sea environment and human impact

The marine environment is under pressure by anthropogenic inputs of nitrogen, phosphorus, organic matter and hazardous substances originating from land-based sources and activities at sea. Commercial fishing is also a strong and widespread pressure affecting the marine ecosystem. The sea bed is further under pressure by constructions, dredging and disposal of dredged materials which can have large impacts locally. Releases of oil not only cause pollution effects but may also directly threaten biodiversity such as marine birds and mammals.

The Baltic marine environment represents a unique brackish water ecosystem which is highly fragile and sensitive to anthropogenic impacts. More specific background information about it is presented in Appendix 2.

According to a HELCOM assessment of ecosystem health of the Baltic Sea marine environment, the entire sea area is generally impaired (HELCOM 2010). None of the open basins of the Baltic Sea has an acceptable environmental status and only very few coastal areas along the Gulf of Bothnia can be considered healthy.

Eutrophication, caused by nutrient pollution, is a major concern in most areas of the Baltic Sea. According to a recent HELCOM assessment (HELCOM 2013a), it was noted that almost the entire open Baltic Sea was eutrophied with the exception of the open sea areas of the Bothnian Bay. Coastal areas in Orther Bucht (Germany) and the outer coastal Quark (Finland) were the only coastal areas assessed by national authorities as being in good ecological status in terms of eutrophication.

Currently, the level of nutrient inputs equals the levels of loads in the early 1960s (Gustafsson *et al.* 2012). Inputs of nutrients to the Baltic Sea have decreased since the late 1980s. Especially inputs from direct point source such as municipalities, industries and fish farms have decreased markedly from 1994 to 2010; by 43% for nitrogen and 63% for phosphorus. For the whole Baltic Sea, flow-normalized inputs of total nitrogen and phosphorus to the Baltic Sea have decreased by 16% and 18%, respectively, from 1994 to 2010 (HELCOM in prep).

Although some improvements can be noted in some specific areas the concentrations of nutrients at sea have in general not declined accordingly. The long residence time of water in the open Baltic Sea, as well as feedback mechanisms such as internal loading of phosphorus from sediments and the prevalence of blooms of nitrogen-fixing cyanobacteria in the main sub-basins of the Baltic Sea, are processes that slow down the recovery from an eutrophied state (HELCOM 2013b).

Living organisms and bottom sediments are affected by hazardous substances in all parts of the Baltic Sea (HELCOM 2010). Despite significant reductions of inputs of hazardous substances, only few coastal sites are undisturbed by them. However, several management actions have proved to be successful such as the reduction of atmospheric inputs of mercury, lead, and cadmium, and inputs of persistent organic pollutants including DDT, PCBs and TBT. Concentrations of radioactive substances originating from the Chernobyl fallout are still high in the northern, eastern, and central parts of the Baltic Sea, but the concentrations of the radionuclide cesium-137 are decreasing in all areas of the Baltic Sea.

The status of biodiversity appears to be unsatisfactory in most parts of the Baltic Sea. Alarming changes in many habitats and at all levels of the food chain have been reported (HELCOM 2010). Promising signs of successful remediation include an improvement in the status of top predators such as grey seals and white-tailed eagles in recent decades.

In the past ten years good progress has been made in enlarging the network of protected areas: between 2004 and 2013 the protected marine area has increased from 3.9 to 11.7% (HELCOM 2013c). The number of Baltic Sea Protected Areas (BSPAs) is also increasing with 163 sites listed at present.

In addition to anthropogenic pressures such as over-fishing and eutrophication, climate-related changes in precipitation, run-off patterns and biogeochemical cycles of the Baltic Sea may erode the resilience of the ecosystem. At present, it is not clear how climate change will influence eutrophication conditions and productivity in the Baltic Sea (HELCOM 2013d).

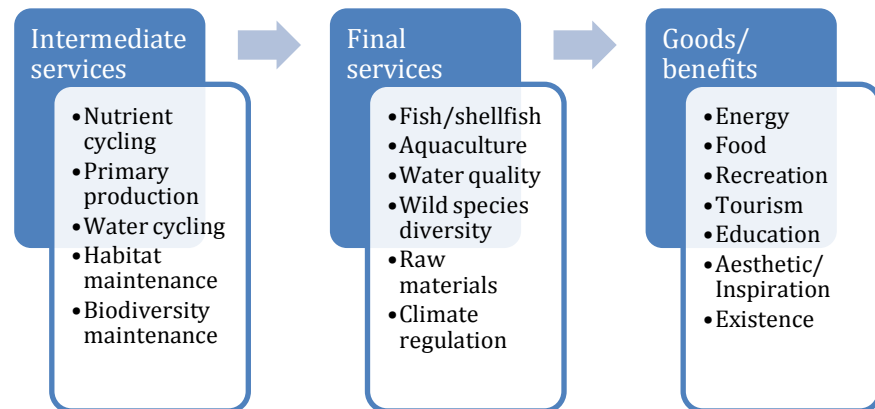
Box 3: Input from the workshop on Baltic Sea environment and human impact

- Despite numerous data on environmental impacts of human activities, there is insufficient information on their impacts on ecosystem services, as well as how ecosystem services affect human behavior and welfare.
- There still is a lack of mapping of different ecosystem services.
- Ecosystem services can be seen as a means of describing the full picture more appropriately, including social, economic and environmental aspects.
- It is important to consider the land and the sea as an integrated whole.
- Spatially-specific ecosystem services valuation was called for. For example, basin-specific analysis is needed in the Baltic Sea area.
- Both studies that improve understanding at the local level and international studies are important.
- More comparisons among countries would be useful but there is a need to develop common indicators.

6. Ecosystem services provided by the Baltic Sea

Figure 3 lists some examples of intermediate and final ecosystems services provided by the Baltic Sea environment and the resulting goods or benefits. It is useful to note that some of the ecosystem services can be intermediate or final depending on the context.

Figure 3: Examples of coastal and marine ecosystem services in the Baltic Sea



6.1 Provisioning ecosystem services

Fish is a major provisioning ecosystem service of the Baltic Sea used for consumption (Garpe 2008). It provides people not only with food but also with employment opportunities. Fish is also used as fish meal for fodder for farmed fish, pigs and poultry. The main species caught on a commercial basis are cod, sprat, herring and salmon. Although it is an important resource that raises a lot of political attention, it is a fairly small activity in comparison to other industries. As an example, in Sweden there were around 1,600 professional fishermen in 2012, and the catch was approximately 160,000 tons with the value of 110 million euros (Kettunen *et al.* 2012, p. 142). However, the net benefits from the fishery have been questioned (Waldo *et al.* 2010).

Another provisioning ecosystem service used for human consumption, as well as for resource enhancement, is aquaculture. Fish farming is carried out in the Baltic Sea and has the potential to increase (Aquabest 2012). A common species used is rainbow trout.

Genes and genetic resources are important aspects of ecosystem services (Bailey 2011). The Baltic Sea is estimated to host more than six thousand species (Ojaveer *et al.* 2010). As stated above, loss of biodiversity and genetic resources is a problem also in the Baltic Sea. For example, a majority of the original wild Baltic salmon populations have become extinct, and much of the original genetic variation in Baltic salmon has already been lost due to extinction of individual populations and reduction in population sizes (Palmé *et al.* 2012).

Further provisioning ecosystem services of the Baltic Sea are energy, as well as space and waterways. Here especially space for various anthropogenic activities on and in the Baltic Sea has become more important over the last years. For example, the Baltic Sea is becoming increasingly interesting for offshore wind power (Lumbreras and Ramos 2013), which may support other ecosystem services such as providing habitats for fish and mussels (Andersson and Öhman 2010). Notably, competition for marine space in parts of the Baltic (Janßen *et al.* 2013) is one of the drivers for the implementation of Marine Spatial Planning.

6.2 Cultural ecosystem services

The Baltic Sea is an important recreation area for the people living in the surrounding countries. According to a survey conducted in the coastal states in 2010, over 80% of people have spent leisure time at the sea in all countries except Russia (Swedish EPA 2010). In Denmark, Estonia, Finland, Latvia and Sweden, the majority of people have visited the Baltic Sea during the last 12 months. The most common activities at the Baltic Sea in all countries are swimming and spending time at the beach. Sport fishing is also common in Baltic Sea countries. In Sweden, the number of recreational fishermen is estimated to be one million (Swedish EPA 2009).

In terms of revenue, tourism is of vast importance in the Baltic Sea region. The tourism industry is estimated to have an annual turnover of 90 billion euros, and it provides employment for some 2 million people (Swedish EPA 2009). In Germany, there were more than 33 million overnight stays along the Baltic coast in 2009, with the majority having the beach as the main reason for choosing the destination (Haller *et al.* 2011).

The value of the Baltic Sea for education and research is difficult to estimate, but given the large number of educational institutions in the region, it clearly plays an important role. Indeed, as there are almost 5,000 scientific publications listed in the “ISI Web of Science” database, with the word “Baltic Sea” in the title, it is very important for research.

6.3 Supporting ecosystem services

The various ecosystem services in themselves depend on supporting ecosystem services. As they are not used by humans in a direct manner they are usually not given sufficient attention. The living nature depends on the flow of materials including nitrogen, phosphorus, carbon, water and oxygen. The cycling of these materials is necessary for marine life. If they are disturbed it may come with a cost such as eutrophication (enhanced levels of N and P), climate change (raised levels of carbon dioxide), changes in salinity (freshwater inflow) and anoxic conditions in the depths of the sea (oxygen depletion due to decomposition of high levels of organic matter).

Primary production, i.e. the production of plant material through photosynthesis, is a basic ecosystem function in the Baltic Sea. It is the basis for the food chain. Primary production also regulates oxygen levels in the sea and in the atmosphere.

Habitat maintenance is a supporting ecosystem service. It is defined as the place where living organisms occur and the Baltic Sea provides a great variety of habitats. Important habitats are for example the beds of mussels, areas of macro-algae such as *Fucus*, and sea-grass beds.

Another supporting ecosystem service of profound importance is biodiversity maintenance. Higher levels of biodiversity usually support a larger variety of ecosystem services. It not only opens up a larger choice of interactions within an ecosystem it may also have a buffering function protecting against disturbance.

6.4 Regulating ecosystem services

The Baltic Sea is also a provider of a range of regulating ecosystem services. One is the sink function for carbon dioxide (CO₂). Indeed, the oceans of the world store approximately half of the carbon dioxide humans have produced (Sabine *et al.* 2004). However, it should be noted that CO₂ sequestration also increases ocean acidity which can have a

negative impact on marine life (Hoegh-Goldberg *et al.* 2007). Another ecosystem service of significance is sediment retention. This is clearly illustrated in the presence of beaches (well-known cultural ecosystem service used by many people (Klein *et al.* 2004)). However, beach erosion is a problem (European Commission 2004).

As stated above, eutrophication is one of the most critical threats to the Baltic Sea. In that context an ecosystem service of vast importance is the mitigation of eutrophication. Organism and sediment may store nutrients. For example, sea grass beds have multiple functions: they provide important nursery habitats for commercial species, may serve as a sediment trap stabilizing coastal erosion and are important in the sequestration of carbon (Duarte *et al.* 2005). The effects of hazardous substance may also be buffered.

6.5 Economic valuation studies of ecosystem services in the Baltic Sea

At present, there are a few dozen studies that have been conducted on the benefits of ecosystems services and improvement of the environment in the Baltic Sea. These studies have mainly focused on recreation, aesthetic values, existence values and food (fisheries). The report by Söderqvist and Hasselström (2008) presents a comprehensive review of the available literature on the economic value of ecosystem services provided by the Baltic Sea. In addition, they discuss the knowledge gaps related to different ecosystem services and environmental problems and made suggestions for future research.

The review by Söderqvist and Hasselström (2008) included some 40 studies on the value of the Baltic Sea environment (see Appendix 3). Most of the studies were local or regional, with only few international studies. Of environmental issues, eutrophication and fisheries were studied the most. Detailed information of each study can be found in Söderqvist & Hasselström (2008). Based on existing knowledge, the review assessed ecosystem services coverage in the Baltic Sea area and the need for future studies (see Table 5 in Söderqvist and Hasselström 2008). Previous research had focused on habitats, diversity, food, recreation and aesthetic value, and these were seen as most important for future studies as well. In addition, the report suggested studying the benefits of decreased nutrient loads to the Baltic Sea, assessing the gains of a cod-stock recovery program, valuing recreational fishing and valuing the risk of oil spills.

Since the review in 2008, further research on the value of the marine environment has been conducted in the Baltic Sea area, in part addressing the gaps identified in the report by Söderqvist & Hasselström (2008).

Focus of these recent studies has mainly been on eutrophication (Kosenius 2010, Ahtiainen *et al.* 2014) and oil spills (Tegeback & Hasselström 2012, Depellegrin & Blažauskas 2013). In the ecosystem services framework, Kulmala *et al.* (2012) have studied the economic value of provisioning and recreational services of Baltic salmon, and Kosenius & Ollikainen (2012) the benefits from habitats and species, recreation, and food and raw materials. The importance of cultural ecosystem services, mainly recreation, has been studied by Ahtiainen *et al.* (2013) and Lewis *et al.* (2013). Some of these studies have been conducted in all Baltic Sea coastal countries (Ahtiainen *et al.* 2013, 2014), providing comparable information for the whole region. More information on these studies can be found in Appendix 3.

The benefit estimates from Ahtiainen *et al.* (2014) have been utilized further in a cost-benefit analysis studying the economic efficiency of reducing eutrophication in the Baltic Sea according to the HELCOM Baltic Sea Action Plan (2007) targets (BalticSTERN 2013, Hyytiäinen *et al.* 2013). The findings indicated that the benefits of reducing eutrophication exceed the costs by 1–1.5 billion euros annually. The study is an example of how the value of ecosystem services can be compared to the costs of taking actions to improve the environment and how valuation can support marine decision-making.

In a report by Söderqvist *et al.* (2012), ecosystem services were linked to global environmental status descriptors which gives indications of the costs of degradation.

Box 4: Input from the workshop on economic valuation studies of ecosystem services in the Baltic Sea

- There is a need to increase our understanding of the interactions between ecological and socio-economic aspects.
- More information is needed on the linkages between ecosystem services, their natural fluctuations and how they are affected as well as how they influence human behavior and well-being.
- Forecasts that extend over a long time including scenarios to assess future development are needed.
- Studies could be particularly useful where the links between pressures and ecosystem services are quite complex or unclear. One consideration is to focus on those ecosystem services that are easy to communicate.
- Concrete regional case studies and studying those ecosystem services that are closely linked to human welfare would be beneficial.
- Topics that should be addressed in this context include EU policies, such as the Common Agricultural Policy and Common Fisheries Policy, and also Marine Spatial Planning, eutrophication, oil spills, dioxin issues, transport, tourism, recreation, fishing, energy production, agriculture and new uses of the sea.
- Ecosystem services assessment that relate to spatial planning, both on the local, national and regional scale, are needed. These could, for example, identify hotspot areas for different ecosystem services.
- Also benefits from the ecosystem services to the private sector and businesses should be evaluated more.

7. Baltic Sea governance and ecosystem services

The following issues identified as being relevant for further discussion in relation to the use of ecosystem services valuation in the Baltic Sea context:

- Ecosystem services measurements and indicators and systems for ecosystem accounting.
- Internalization of environmental costs and examples how it could be applied in solving regional environmental problems in the Baltic Sea Area.
- Identifying important and crucial knowledge gaps to enable to sufficient economic valuation of marine and coastal ecosystem services in the Baltic and other regional seas.
- Economic valuation of marine and coastal ecosystem services in the implementation of the HELCOM BSAP, in particular in the policy making processes.
- Valuation of ecosystem services in the context of reaching Good Environmental Status in the MSFD.
- Application of ecosystem valuation in Marine Spatial Planning.
- Global, regional and national experiences from UNEP and TEEB that can be applied in the Baltic Sea.

These issues are addressed partly through the existing governance structures/frameworks, as described below.

The Baltic Sea and its ecosystem services are administrated by national governments, governmental agencies, the European Union. In addition, a range of international agreements influence Baltic Sea management.

The Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention) is governed by the Helsinki Commission (HELCOM), consisting of all Baltic Sea littoral countries and the EU. Within its almost 40 years, HELCOM developed into a regional environmental policy maker and focal point for the Baltic Sea covering various issues relating to the protection of marine environment and its natural resources. The HELCOM Baltic Sea Action Plan (BSAP) adopted in

2007 is implementing an ecosystem approach in managing the Baltic Sea environment based on ecological objectives and guided by relevant indicators and targets (Backer *et al.* 2010). With its ecosystem approach, the BSAP directly links to issues related to ecosystem services. Valuation of ecosystem services could involve assessing the changes in the provision of ecosystem services and the associated benefits of reaching the BSAP targets to demonstrate the welfare effects of the Action Plan. It should also be noted that the BSAP has a close link to the EU Marine Strategy Framework Directive (MSFD, 2008/56/EC), as both frameworks are striving to reach the Baltic Sea in good environmental status by 2021/2020 respectively.

Another organization of importance in this context is the Council for Baltic Sea States (CBSS). Following the geopolitical changes in the Baltic Sea regions after the cold war the CBSS was established in 1992. It is an organization that facilitates regional intergovernmental cooperation. There are 12 members including the Baltic Sea states and the European Commission. It has different expert groups with some relating to marine issues such as the expert group on maritime policy and Baltic 21 considering sustainable development.

Nordic Council of Ministers (NCM) also plays an important role in the management of the Baltic Sea. The committee of senior officials for fisheries and aquaculture shows an interest in a major provisioning ecosystem service. NCM also have a program to fund NGOs in the area which is instrumental in the cooperation with Baltic Sea states and with North-western Russia.

There are also various EU directives and policies that influence Baltic Sea management, the most important being the Marine Strategy Framework Directive (MSFD), adopted in 2008 (European Parliament 2008, EC 2012). The aim of the MSFD is reaching a Good Environmental Status (GES) by 2021, which is interpreted in terms of ecosystem functioning and services provision. The MSFD lists several descriptors that should be considered when establishing the environmental targets for the GES, including biological diversity, alien species, fisheries, food webs, eutrophication, contaminants and litter. The MSFD requires an ecosystem-based approach to the management of marine waters (Art. 1.3), although it does not specify how the analyses should be undertaken in practice (WG ESA 2010). Therefore, also other approaches are possible, e.g. in the Initial Assessment. For example, the ecosystem approach in the analysis of marine uses entails identifying ecosystem services of marine areas, identifying and possibly valuing the welfare derived from these services and also identifying the drivers and pressures affecting ecosystem ser-

vices (WG ESA 2010). In the analysis of cost of degradation, the ecosystem approach involves identifying the ecosystem services and associated benefits of achieving GES, where the benefits can be interpreted as the losses if GES is not reached (WG ESA 2010). The estimated benefits can later be compared to the costs of reaching GES and by that support the prioritizations needed in the Programme of Measures to be developed by the end of 2015.

Also the EU Water Framework Directive (Directive 2000/60/EC) (WFD) is of great importance as the majority of nutrients and hazardous substances to the marine environment comes via the river mouths. The aim of the Directive was that all surface water should reach good ecological and chemical status. The implementation of WFD is in its second cycle and updated programs of measures should be adopted by 2015. For the management of the Baltic it is important with an integrated approach between the implementation of the MSFD and the WFD. The identification and valuation of ecosystem services should be an effective support tool for this integration in the planning and prioritization in the program of measures as i.a. measures for eutrophication.

The Common Fisheries Policy (CFP) is a clear example of how the EU regulates one of the most important ecosystem services: fish. As all countries surrounding the Baltic Sea, except Russia, are part of the European Union fishery management, commercial fish species are mainly regulated through the Common Fisheries Policy. Decisions on how fishery resources are allocated are taken by the EU Council of Ministers every year. Before the decision is taken the scientific community through ICES, and the fishery industry and NGOs through the Baltic Sea Regional Advisory Council (BSRAC), give their recommendations (Stohr and Chabay 2010). The CFP is decisive as it, in a direct manner, influence national law. What is agreed within the CFP has to be followed by all member states. The revised CFP that entered into force 2014 is aiming to end overfishing and make fishing environmentally, economically and socially sustainable. Some of the most important changes in the CFP is the discard ban and that quotas shall be defined according to Maximum Sustainable Yield. Implementation of ecosystem-based management in fisheries, e.g. long-term multi-species management plan for major Baltic stocks is one of the examples of related challenges. The new CFP will bring decisions on technical and conservation measures closer to the fishing grounds, in particular to national administrations, fishermen and other interest groups, called the regionalization. In this term the use of valuation of ecosystem services on a regional scale within the Baltic can develop as an important tool for the communication between the fisheries sector and i.a. the implementation of the MSFD.

There are also other EU initiatives that influence Baltic Sea management. The most overarching initiative is the EU Strategy for the Baltic Sea Region (EUSBSR). It is the first strategy within EU in which a macro-region with several countries is defined with the specific objective to enhance collaboration within that certain region (Metzger and Schmitt 2012). With the strategy initiatives from different sectors are brought together and cooperation is promoted. Sectors that relates to ecosystem services include both increased prosperity and improved environmental management.

Box 5: Input from the workshop on Baltic Sea governance and ecosystem services

- Ecosystem services approach is useful in fulfilling the requirements of the current policy targets, such as the Marine Strategy Framework Directive (MSFD), the Water Framework Directive and the HELCOM Baltic Sea Action Plan (BSAP) as well as within Marine Spatial Planning.
- Ecosystem services valuation is a tool for the implementation and assessment of existing policies, for example, in cost-benefit analyses and analyzing the costs of inaction.
- For policy support, evaluation of policy scenarios is important.
- Ecosystem services valuation can provide better incentives and justification for the implementation of new measures, targets and policies, such as the MSFD or the BSAP.
- Ecosystem services assessments and valuation is a tool of convincing the public about the need for the EU directives. Showing the socio-economic value and the implications to the people of reaching the good environmental status might increase the support for the policy.
- Valuation for policy purposes should be as transparent and clear as possible. The cross-sectorial approach involving all stakeholders is necessary.

8. Future perspectives

We are far from having the complete picture on the value of ecosystem services in the Baltic Sea. However, several studies have addressed the value of environmental improvements in marine and coastal areas, so there is some knowledge on the potential value of ecosystem services in the Baltic Sea, especially related to recreation, fisheries and non-use or existence values of the marine environment. To date, most studies have not utilized the ecosystem services framework, and therefore it is not necessarily straightforward to link these studies to specific ecosystem services. Despite this, the existing results are useful in ecosystem service assessments and valuations.

For the purposes of valuation, further work is needed on identifying and describing the Baltic Sea ecosystem services and their interactions, evaluating how policy changes affect these ecosystem services and assessing the effect of changes in ecosystem services to human welfare. This is required in order to conduct high-quality cost-benefit analysis of programs of measures for the EU Marine Strategy Framework Directive. It is important to relate the economic values to specific ecological indicators and descriptors that can be measured. Linking values to ecological indicators allows for estimating marginal benefits, e.g. in the context of eutrophication, benefits per reduced kilogram of nitrogen or phosphorus.

Valuation of ecosystem services can support the achievement of current policy targets in the Baltic Sea area, such as those set by the EU Marine Strategy Framework Directive, the Water Framework Directive and the HELCOM Baltic Sea Action Plan. Usefulness for policy support requires that the value estimates can be connected to the policy objectives, i.e. valuation studies are designed in accordance with current targets. In addition, close cooperation between researchers and policy makers can increase the relevance of value estimates to marine policies.

International cooperation is important also in the valuation of marine ecosystem services, as the Baltic Sea is shared by nine countries, and most of the environmental issues in the sea are transboundary. The current knowledge mainly originates from studies that are restricted to certain areas of the Baltic Sea and focus on a specific ecosystem service. More attention should be drawn to international studies, especially as international cooperation is required by the EU Marine Strategy Frame-

work Directive. Cooperation could be in the form of exchanging ideas and experiences and implementing joint studies. As in other geographical areas, the ecosystem services provision and the benefits to humans in the Baltic Sea are spatially heterogeneous. There is, however, little knowledge of the spatial variation in ecosystem services and benefits in the area, requiring further work. More detailed and site-specific mapping, e.g. of underwater habitats, as well as other local amenities would be needed, to complement existing knowledge.

An important question is to identify which ecosystem services should be a priority for future research. In the review by Söderqvist and Hasselström (2008), habitats, biodiversity, food, recreation and aesthetic values were considered to be the most important, and more studies on eutrophication, cod-stocks and impacts of recreational fishing in general as well as oil spills on shoreline were needed. Policy-relevance of the values for ecosystem services should be one of the crucial factors in choosing the focus of future research, and descriptors and issues brought forward within coherent implementation of the HELCOM BSAP and EU MSFD should receive the most emphasis; priority should be given to the largest environmental threats of the Baltic Sea.

Main challenges in assessing the ecosystem services in the Baltic Sea area and integrating them into policy and decision-making include:

- Accurately describing ecosystem services and how they are linked with the ecosystem structures.
- Trade-offs and interactions of ecosystem services.
- Finding relevant indicators for the assessment of ecosystem services and ecosystem improvement.
- Evaluating how measures to improve the marine environment impact the provision and trade-offs of ecosystem services and further their value.
- Assessing the effects of changes in ecosystem services to human well-being, taking into account possible future developments.
- Taking ecological thresholds and non-linearities into account in valuation.
- Providing internationally comparable information on the value of ecosystem services.
- Incorporating uncertainty about ecosystem services into value estimates.
- Translating ecosystem services information so it becomes relevant to policy and decision-making.

Box 6: Input from the workshop on future perspectives

- A challenge in ecosystem services valuation is the link from study results to policy-making. For example, values of ecosystem services and how it affects funding of environmental projects is not clear.
- Economic values of ecosystem services should be used to highlight their importance to policy-makers and the general public.
- Important aspect of using the concept of ecosystem services is increasing awareness and understanding, and communicating the linkages between ecosystems and human welfare. The concept can be seen as a marketing tool that can help people realize how dependent we are on ecosystem services.
- Valuation of ecosystem services is useful in prioritizing between measures, fulfilling the requirements of EU directives, setting targets, cost-benefit analyses, developing more sustainable economies and balancing between the short-term and long-term targets.
- It is important to describe the connection between sea and land.
- It should be clear what taxes are contributing to in terms of ecosystem services.
- The ecosystem services concept can be used to balance the cost of implementing action against inaction (i.e. the loss of benefits of not improving the state of the marine environment).
- Ecosystem service assessments and valuation should be developed further among policy-makers, ecologists, social scientists and economists.

References

- Ahtiainen H, Artell J, Czajkowski M, Hasler B, Hasselström L *et al.* (2013). Public preferences regarding use and condition of the Baltic Sea – An international comparison informing marine policy. *Marine Policy* 42: 20–30. <http://dx.doi.org/10.1016/j.marpol.2013.01.011>
- Ahtiainen H, Artell J, Czajkowski M *et al.* (2014). Benefits of meeting nutrient reduction targets for the Baltic Sea—a contingent valuation study in the nine coastal states. *Journal of Environmental Economics and Policy* 3(3): 278–305. <http://dx.doi.org/10.1080/21606544.2014.901923>
- Ahtiainen H, Hasselström L, Artell J, Angeli D, Czajkowski M *et al.* (2012). Benefits of meeting nutrient reduction targets for the Baltic Sea – Combining ecological modeling and contingent valuation in the nine littoral states. MTT Discussion Papers 1/2012. Available at: http://www.mtt.fi/dp/DP2012_1.pdf
- Andersson MH, Öhman MC (2010). Fish and sessile assemblages associated with wind turbine constructions in the Baltic Sea. *Marine and Freshwater Research* 61: 642–650. <http://dx.doi.org/10.1071/MF09117>
- Andersson MH, Dock-Åkerman E, Ubral-Hedenberg R, Öhman MC, Sigraý P (2007). Swimming behaviour of roach and stickleback in response to wind power noise and single-tone frequencies. *Ambio* 36: 636–638. [http://dx.doi.org/10.1579/0044-7447\(2007\)36\[636:SBORRR\]2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36[636:SBORRR]2.0.CO;2)
- Andersson MH, Lagenfelt I, Sigraý P (2012). Do ocean-based wind farms alter the migration pattern in the endangered European Silver Eel (*Anguilla anguilla*) due to noise disturbance? *Effects of Noise on Aquatic Life* 393–396.
- Archambault S (2004). Ecological modernization of the agriculture industry in southern Sweden: reducing emissions to the Baltic Sea. *Journal of Cleaner Production* 12: 491–503. [http://dx.doi.org/10.1016/S0959-6526\(03\)00109-4](http://dx.doi.org/10.1016/S0959-6526(03)00109-4)
- Artell J (2013). Lots of value? A spatial hedonic approach to water quality valuation. *Journal of Environmental Planning and Management*, forthcoming DOI: 10.1080/09640568.2013.772504
- Backer H, Leppanen JM, Brusendorff AC, Forsius K, Stankiewicz M, Mehtonen J, Pyhala M, Laamanen M, Paulomaki H, Vlasov N, Haaranen T (2010). HELCOM Baltic Sea Action Plan - A regional programme of measures for the marine environment based on the ecosystem approach. *Marine Pollution Bulletin* 60: 642–649. <http://dx.doi.org/10.1016/j.marpolbul.2009.11.016>
- BalticSTERN (2012). Last edited: 19.7.2013. Accessed: 18.9.2013. Available at: <http://www.stockholmresilience.org/21/research/research-programmes/balticstern.html>
- BalticSTERN (2013). The Baltic Sea – Our Common Treasure. Economics of Saving the Sea. Report 2013: 4, The Swedish Agency for Marine and Water Management.
- Bailey JK (2011). From genes to ecosystems: a genetic basis to ecosystem services. *Population Ecology* 53: 47–52. <http://dx.doi.org/10.1007/s10144-010-0251-4>
- Bockstael NE, McConnell KE (2007). Environmental and Resource Valuation with Revealed Preferences; A Theoretical Guide to Empirical Models. *The Economics of Non-market Goods and Resources vol. 7*. Springer.

- Boyd J, Banzhaf S (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* 63: 616–626. <http://dx.doi.org/10.1016/j.ecolecon.2007.01.002>
- Brouwer R, Brander L, Kuik O, Papyrakis E, Bateman I (2013). *A synthesis of approaches to assess and value ecosystem services in the EU in the context of TEEB*. Final Report. 15 May 2013. VU University Amsterdam, Institute for Environmental Studies. Available at: <http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/EU%20Valuation.pdf>
- Carson RT, Hanemann WM (2005). Contingent valuation. In Mäler, K-G. and Vincent, J. R. 2005. *Handbook of Environmental Economics, vol. 2*. Elsevier B.V. pp. 821–936.
- Champ PA, Boyle KJ, Brown TC (Eds.) (2003). *A Primer on Nonmarket Valuation*. Kluwer Academic Publishers. <http://dx.doi.org/10.1007/978-94-007-0826-6>
- CIGES (2013). *The Common International Classification of Ecosystem Services Version 4.3*. January 2013.
- Conservation Measures Partnership (2012). *Addressing Social Results and Human Wellbeing Targets in Conservation Projects*. Draft Guidance. June 27 2012.
- Costanza R *et al.* (1997). The value of the world's ecosystem services and natural capital. *Nature* 387: 253–260. <http://dx.doi.org/10.1038/387253a0>
- Daily GC (1997). *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press. Washington, DC, USA.
- Defra (2007). *An introductory guide to valuing ecosystem services*. Department for Environment, Food and Rural Affairs. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69192/pb12852-eco-valuing-071205.pdf
- Dellegrin D, Blažauskas N (2013). Integrating Ecosystem Service Values into Oil Spill Impact Assessment. *Journal of Coastal Research* 29: 836–846. <http://dx.doi.org/10.2112/JCOASTRES-D-11-00191.1>
- Duarte CM, Middelburg JJ, Caraco N (2005). Major role of marine vegetation on the oceanic carbon cycle. *Biogeosciences* 2, 1–8.
- EC (2012). *Report from the commission to the council and the European Parliament. Contribution of the Marine Strategy Framework Directive (2008/56/EC) to the implementation of existing obligations, commitments and initiatives of the Member States or the EU at EU or international level in the sphere of environmental protection in marine waters*. Brussels, 16.11.2012. COM (2012) 662 final.
- Eggert H, Tveteras R (2007). Potential rent and overcapacity in the Swedish Baltic Sea trawl fishery for cod (*Gadus morhua*). *ICES Journal of Marine Science* 64: 439–445. <http://dx.doi.org/10.1093/icesjms/fsm019>
- Ehrenfeldt, D. (1972). *Conserving Life on Earth*. Oxford University Press: New York.
- Elmqvist T, Cornell S, Öhman MC, Daw T, Moberg F, Norström A, Persson Å, Peterson G, Rockström J, Schultz M, Hermansson-Török E (2014). *Global sustainability and Human prosperity – contribution to the Post-2015 agenda and the development of Sustainable Development Goals* (TemaNord 2014:527).Nordic Council of Ministers: Copenhagen. pp 50. <http://dx.doi.org/10.6027/TN2014-527>
- European Commission (2004). *Living with coastal erosion in Europe – Results from the Erosion study. Luxembourg*. Available at: http://www.euroSION.org/project/euroSION_en.pdf
- European Commission (2010). *Economic and social analysis for the initial assessment for the Marine Strategy Framework Directive: A guidance document*. Working Group on Economic and Social Assessment, 21 December 2010.

- European Parliament (2008). *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)*. Official Journal of the European Union 25.6.2008.
- Finnish Game and Fisheries Research Institute (2009). *The Report of Data Analysis to support the development of a Baltic Sea salmon action plan*. Brussels: European Commission. 19 p. Available at: http://ec.europa.eu/fisheries/documentation/studies/baltic_sea_salmon_en.pdf
- Fisher B, Turner RK (2008). Ecosystem services: Classification for valuation. *Biological Conservation* 141: 1167–1169. <http://dx.doi.org/10.1016/j.biocon.2008.02.019>
- Fisher B, Turner RK, Morling P (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics* 68(3): 643–653. <http://dx.doi.org/10.1016/j.ecolecon.2008.09.014>
- Garpe K (2008). Ecosystem services provided by the Baltic Sea and Skagerrak. In Swedish. *Environmental Protection Agency Report 5873*.
- Gren I-M (2013). The economic value of coastal waters as nutrient filters for the Baltic Sea. *Regional Environmental Change* 13: 695–703. <http://dx.doi.org/10.1007/s10113-012-0370-x>
- Griggs D, Stafford-Smith M, Gaffney O, Rockström J, Öhman MC, Shyamsundar P, Steffen W, Glaser G, Kanie N, Noble I (2013). Sustainable development for people and planet. *Nature* 495: 305–307. <http://dx.doi.org/10.1038/495305a>
- Gustafsson BG, Schenk F, Blenckner T, Eilola K, Meier HEM *et al.* (2012). Reconstructing the Development of Baltic Sea Eutrophication 1850–2006. *Ambio* 41: 534–548. <http://dx.doi.org/10.1007/s13280-012-0318-x>
- Haines-Young R, Potschin M 2011. Common International Classification of Ecosystem Services (CICES): 2011 Update. Paper prepared for discussion at the expert meeting on ecosystem accounts organised by the UNSD, the EEA and the World Bank, London, December 2011. Contract No EEA/BSS/07/007.
- Haines-Young R, Potschin M (2013). *Common International Classification of Ecosystem Services (CICES): Consultation on Version 4: August-December 2012*. Report to the European Environment Agency. EEA Framework Contract No EEA/IEA/09/003.
- Haller I, Stybel N, Schumacher S, Mossbauer, M (2011). Will beaches be enough? Future changes for coastal tourism at the German Baltic Sea. *Journal of Coastal Research* 61: 70–80. <http://dx.doi.org/10.2112/SI61-001.68>
- Hassler B (2011). Accidental versus operational oil spills from shipping in the Baltic Sea: risk governance and management strategies. *Ambio* 40: 170–178. <http://dx.doi.org/10.1007/s13280-010-0128-y>
- Havenhand JN (2012). How will ocean acidification affect Baltic Sea ecosystems? An assessment of plausible impacts on key functional groups. *Ambio* 41: 637–644. <http://dx.doi.org/10.1007/s13280-012-0326-x>
- HELCOM (2007). *Baltic Sea Action Plan*. HELCOM Ministerial Meeting, Krakow, Poland, 15 November 2007. Available at: http://www.helcom.fi/Documents/Baltic%20sea%20action%20plan/BSAP_Final.pdf
- HELCOM (2009). Eutrophication in the Baltic Sea – An integrated thematic assessment of the effects of nutrient enrichment and eutrophication in the Baltic Sea region. *Baltic Sea Environment Proceedings No. 115B*. Available at: <http://helcom.fi/Lists/Publications/BSEP115B.pdf>
- HELCOM (2010). Ecosystem Health of the Baltic Sea 2003–2007: HELCOM Initial Holistic Assessment. *Baltic Sea Environment Proceedings No. 122*. Available at: <http://www.helcom.fi/Lists/Publications/BSEP122.pdf>

- HELCOM (2013a). *Eutrophication status in the Baltic Sea 2007–2011 – a concise Thematic assessment*. Available at: <http://www.helcom.fi/Documents/Ministerial2013/Associated%20documents/Supporting/Eutrophication%20assessment%202007-2011.pdf>
- HELCOM (2013b). Approaches and methods for eutrophication target setting in the Baltic Sea region. *Baltic Sea Environment Proceedings No. 133*. Available at: <http://www.helcom.fi/Lists/Publications/BSEP133.pdf>
- HELCOM (2013c). *HELCOM PROTECT- Overview of the status of the network of Baltic Sea marine protected areas*. Available at: <http://www.helcom.fi/Documents/Ministerial2013/Associated%20documents/Supporting/HELCOM%20BSPAs%20report%202013.pdf>
- HELCOM (2013d). Climate change in the Baltic Sea Area, HELCOM thematic assessment in 2013. *Baltic Sea Environment Proceedings No. 137*. Available at: <http://www.helcom.fi/Lists/Publications/BSEP137.pdf>
- HELCOM (in prep). Updated Fifth Baltic Sea Pollution Load Compilation (PLC-5.5) – An Extended Summary. *Balt. Sea Environ. Proc. No. XXX*. Available at: <http://www.helcom.fi/Documents/Ministerial2013/Associated%20documents/Supporting/PLC-5.5%20Extended%20Summary%20for%20MM2013.pdf>
- Hendozko E, Szefer P, Warzocha J (2010). Heavy metals in *Macoma balthica* and extractable metals in sediments from the southern Baltic Sea. *Ecotoxicology and Environmental Safety* 73: 152–163. <http://dx.doi.org/10.1016/j.ecoenv.2009.09.006>
- Hensher D, Rose J, Greene W (2005). *Applied Choice Analysis: A Primer*. Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511610356>
- Håkansson C (2008). A new valuation question: analysis of and insights from interval open-ended data in contingent valuation. *Environmental and Resource Economics* 39: 175–188. <http://dx.doi.org/10.1007/s10640-007-9102-y>
- Hoegh-Guldberg O *et al.* (2007). *Coral reefs under rapid climate change and ocean acidification*. *Science* 318: 1737–1742. <http://dx.doi.org/10.1126/science.1152509>
- ICES (2003). *Environmental status of the European seas*. ICES, Copenhagen, Denmark.
- Hyytiäinen K, Ahlvik L, Ahtianen H, Artell J, Dahlbo K, Huhtala A (2013). *Spatially explicit bio-economic modelling for the Baltic Sea: Do the benefits of nutrient abatement outweigh the costs?* Submitted manuscript.
- Janßen HS, Kidd T, Kvinge (2013). A spatial typology for the sea: a contribution from the Baltic. *Marine Policy* 42: 190–197. <http://dx.doi.org/10.1016/j.marpol.2013.03.001>
- Kettunen M, Vihervaara P, Kinnunen S, D'amato D, Badura T, Argimon M, Ten Brink P (2012). *Socio-economic importance of ecosystem services in the Nordic Countries. Synthesis in the context of The Economics of Ecosystems and Biodiversity (TEEB)*. TemaNord 2012: 559, Nordic Council of Ministers. <http://dx.doi.org/10.6027/TN2012-559>
- KleinYL, Osleeb JP, Viola MR (2004). Tourism-generated earnings in the coastal zone: a regional analysis. *Journal of Coastal Research* 20: 1080–1088. <http://dx.doi.org/10.2112/003-0018.1>
- Kondratyev S, Trumbull N (2012). Nutrient loading on the Eastern Gulf of Finland (Baltic Sea) from the Russian catchment area. *Journal of Hydrology and Hydromechanics* 60: 145–151.
- Kosenius A-K (2010). Heterogeneous preferences for water quality attributes: The case of eutrophication in the Gulf of Finland, the Baltic Sea. *Ecological Economics* 69: 528–538. <http://dx.doi.org/10.1016/j.ecolecon.2009.08.030>

- Kosenius A-K, Ollikainen M (2012). *Ecosystem benefits from coastal habitats in Finland, Sweden, and Lithuania*. European Association of Environmental and Resource Economists 19th Annual Conference. June 2012. Prague, Czech Republic. Available at: http://www.webmeets.com/files/papers/EAERE/2012/150/benefit_coastal_habitats_EAERE2012.pdf
- Kulmala S, Haapasaari P, Karjalainen TP, Kuikka S, Pakarinen T, Parkkila K, Ropmakaniemi A, Vuorinen PJ (2012). Ecosystem services provided by Baltic salmon – a regional perspective to the socio-economic benefits associated with a keystone migratory species. In Kettunen *et al.* 2012. Socio-economic importance of ecosystem services in the Nordic Countries. *Synthesis in the context of The Economics of Ecosystems and Biodiversity (TEEB)*. TemaNord 2012: 559, Nordic Council of Ministers. <http://dx.doi.org/10.6027/TN2012-559>
- Larsson U, Elmgren R, Wolff F (1985). Eutrophication of the Baltic Sea: causes and consequences. *Ambio* 14: 9–14.
- Lewis AR, Baulcomb C, Fletcher R, Margońsk P, Glenk K, Nadolma KA, Luzeńczyk AM, Hussain S (2013). *Identifying and Valuing Marine Cultural Ecosystem Services: Poland and the Baltic Sea*. Rural Policy Centre Research Briefing, July 2013. Available at: http://www.sruc.ac.uk/downloads/file/1509/2013_identifying_and_valuing_marine_cultural_ecosystem_services_poland_and_the_baltic_sea, <http://dx.doi.org/10.1002/we.1498>
- Lumbreras S, Ramos A (2013). Offshore wind farm electrical design: a review. *Wind Energy* 16: 459–473.
- Madsen N (2007). Selectivity of fishing gears used in the Baltic Sea cod fishery. *Reviews in Fish Biology and Fisheries* 17: 517–544. <http://dx.doi.org/10.1007/s11160-007-9053-y>
- Metzger J, Schmitt P (2012). When soft spaces harden: the EU strategy for the Baltic Sea Region. *Environmental and Planning A* 44: 263–280. <http://dx.doi.org/10.1068/a44188>
- Millennium Ecosystem Assessment (MA) (2005). *Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington, DC.
- Navrud S, Ready R (Eds.) (2007). Environmental Value Transfer: Issues and Methods. *The Economics of Non-market Goods and Resources* vol. 9. Springer. <http://dx.doi.org/10.1007/1-4020-5405-X>
- Nelson JP, Kennedy PE (2009). The Use (and Abuse) of Meta-analysis in Environmental and Natural Resource Economics: An Assessment. *Environmental and Resource Economics* 42: 345–377. <http://dx.doi.org/10.1007/s10640-008-9253-5>
- Öhman MC, Sigraý P, Westerberg H (2007). Offshore windmills and the effects of electromagnetic fields on fish. *Ambio* 36: 630–633. [http://dx.doi.org/10.1579/0044-7447\(2007\)36\[630:OWATEO\]2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36[630:OWATEO]2.0.CO;2)
- Österblom H, Hansson S, Larsson U, Hjerne O, Wulff F, Elmgren R, Folke C (2007). Human-induced trophic cascades and ecological regime shifts in the Baltic sea. *Ecosystems* 10: 877–889. <http://dx.doi.org/10.1007/s10021-007-9069-0>
- Ojaveer H, Jaanus A, MacKenzie BR, Martin G, Olenin S, *et al.* (2010). Status of Biodiversity in the Baltic Sea. *PLoS ONE* 5: e12467. <http://dx.doi.org/10.1371/journal.pone.0012467>
- Parkkila K, Haltia E, Karjalainen TP (2011). *Benefits of the salmon stock restoration for recreational anglers of the river Iijoki – pilot study with contingent valuation method*. Riista- ja kalatalous – Tutkimuksia ja selvityksiä 4/2011.

- Rockström J, Sachs JD, Öhman MC, Schmidt-Traub G (2013). *Sustainable Development and Planetary Boundaries*. Sustainable Development Solutions Network Report for the UN High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, pp 45.
- Roots O, Suursaar U (2010). Hazardous substances in the water, biota and sediments of the North Estonian coastal sea. *Environmental Toxicology III*, Book Series: *WIT Transactions on Ecology and the Environment*. 132: 79–90.
- Sabine CL, Feely RA, Gruber N, Key RM, Lee K, Bullister JL, Wannikhof R, Wong CS, Wallace DWR, Tilbrook B, Millero FJ, Peng T-H, Kozyr A, Ono T, Rios AF (2004). The Oceanic Sink for Anthropogenic CO₂. *Science* 305: 367–37. <http://dx.doi.org/10.1126/science.1097403>
- Schultz M, Rockström J, Öhman MC, Cornell S, Persson Å, Norström A (2013). *Human prosperity requires global sustainability - a contribution to the Post-2015 agenda and the development of sustainable development goals*. A Stockholm Resilience Centre Report. pp 21.
- Saikku L, Asmala E (2010). Eutrophication in the Baltic Sea; The role of salmonid aquaculture, consumption, and international trade. *Journal of Industrial Ecology* 14: 482–495. <http://dx.doi.org/10.1111/j.1530-9290.2010.00221.x>
- Stohr C, Chabay I (2010). Science and Participation in Governance of the Baltic Sea Fisheries. *Environmental Policy and Governance* 20: 350–363. <http://dx.doi.org/10.1002/eet.552>
- Swedish EPA (2008). Trends and scenarios exemplifying the future of Baltic Sea and Skagerrack – ecological impacts of not taking action. Swedish Environmental Protection Agency, *Economic Marine Information*. Report 5875.
- Swedish EPA (2009). *What's in the sea for me? Ecosystem Services Provided by the Baltic Sea and Skagerrak*. Report 5872, Swedish Environmental Protection Agency.
- Swedish EPA (2010). *BalticSurvey – a study in the Baltic Sea countries of public attitudes and use of the sea*. Report 6348, Swedish Environmental Protection Agency.
- Söderqvist T, Hasselström L (2008). *The economic value of ecosystem services provided by the Baltic Sea and Skagerrak*. The Swedish Environmental Protection Agency Report 5874.
- Söderqvist T, Hasselström L, Soutukorva Å, Cole S, Malmaeus M (2012). *An ecosystem service approach for analyzing marine human activities in Sweden*. Swedish Agency for Marine and Water Management, report 2012: 8.
- TEEB (2008). *The economics of ecosystems and biodiversity: An interim report. European Commission 2008*. Available at: http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf
- TEEB (2009). *The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary*: Responding to the Value of Nature.
- TEEB (2010). *The Economics of Ecosystems and Biodiversity (TEEB)*. Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.
- TEEB (2013). *The Economics of Ecosystems and Biodiversity. Guidance manual for TEEB Country Studies*. Version 1.0. Available at: http://www.teebweb.org/wp-content/uploads/2013/06/TEEB_GuidanceManual_2013_1.0.pdf
- TEEB for Oceans and Coasts* (2013). Project Flyer, March 2013. Available at: <http://www.teebweb.org/wp-content/uploads/2013/04/2013-Oceans-and-Coasts-Flyer.pdf>
- Tegeback A, Hasselström L (2012). *Costs associated with a major oil spill in the Baltic Sea. BalticMaster project report*. Available at: http://www.balticmaster.org/media/files/general_files_1200.pdf

- Turner RK, Morse-Jones S, Fisher B (2010). Ecosystem valuation – A sequential decision support system and quality assessment issue. *Annals of the New York Academy of Sciences*. Issue: Ecological Economics Reviews 1185: 79–101.
[http://dx.doi.org/10.1016/S0921-8009\(99\)00046-4](http://dx.doi.org/10.1016/S0921-8009(99)00046-4)
- Turner RK, Georgiou S, Gren I.-M, Wulff F, Barrett S, Söderqvist T, Bateman IJ, Folke C, Langaas S, Zylicz T, Mäler K.-G, Markowska A (1999). Managing nutrient fluxes and pollution in the Baltic: an interdisciplinary simulation study. *Ecological Economics* 30: 333–352.
- UK National Economic Assessment (UK NEA) (2011). The UK National Ecosystem Assessment. Technical Report. UNEP-WCMC, Cambridge.
- Voigt HR 2007. Heavy metal (Hg, Cd, Zn) concentrations and condition of eelpout (*Zoarces viviparus* L.), around Baltic Sea. *Polish Journal of Environmental Studies* 16: 909–917.
- Waldo S, Paulrud A, Jonsson A (2009). A note on the economics of Swedish Baltic Sea fisheries. *Marine Policy* 34: 716–719. <http://dx.doi.org/10.1016/j.marpol.2009.11.007>
- Wallace KJ (2007). Classification of ecosystem services: Problems and solutions. *Biological Conservation* 139: 235–246. <http://dx.doi.org/10.1016/j.biocon.2007.07.015>
- White S, ten Brink P, Simmons B (2011). Recognising the Value of Biodiversity: New Approaches to Policy Assessment. In ten Brink (ed) (2011). *The Economics of Ecosystems and Biodiversity (TEEB) in National and International Policy Making*, p.131–173. Earthscan, London and Washington.
- WG ESA (2010). *Economic and social analysis for the initial assessment for the Marine Strategy Framework Directive: A guidance document*. Working Group on Economic and Social Assessment.
- Zeller D, Rossing P, Harper S, Persson L, Booth S, Pauly D (2011). The Baltic Sea: Estimates of total fisheries removals 1950–2007. *Fisheries Research* 108: 356–363. <http://dx.doi.org/10.1016/j.fishres.2010.10.024>
- Zettler ML, Schiedek D, Bobertz R (2007). Benthic biodiversity indices versus salinity gradient in the Southern Baltic Sea. *Marine Pollution Bulletin* 55: 258–270. <http://dx.doi.org/10.1016/j.marpolbul.2006.08.024>
- Ö see under “O” above.

Sammanfattning på svenska

Östersjön erbjuder många olika ekosystemtjänster som på ett direkt eller indirekt sätt bidrar till människans välbefinnande. De kan delas in i fyra olika kategorier (utifrån "Millennium Ecosystem Assessment"): försörjande tjänster är t.ex. fiske, vattenbruk, energi och sjöfart; kulturella tjänster är bl.a. rekreation och utbildning; stödande tjänster, som inte i direkt bemärkelse används av människor, där t.ex. naturens cykler och primärproduktion ingår samt; reglerande tjänster däribland klimatreglering, sedimentering, och begränsande av övergödning. Ekosystemtjänster kan också delas in i intermediära tjänster (t.ex. livsmiljöer), slutliga tjänster (t.ex. fisk) och varor/tjänster (t.ex. mat). Trots att Östersjöns ekosystemtjänster spelar en så viktig roll för miljontals människor i Östersjöregionen är förståelsen för hur Östersjöns ekosystem fungerar och vilka ekosystemtjänster de erbjuder begränsad. Att förstå värdet av Östersjöns ekosystemtjänster är centralt för att uppnå god miljöstatus och en hållbar resursförvaltning. Detta gäller på nationell nivå men också för det regionala arbete inom t.ex. Helsingforskommissionen (HELCOM) och målen i aktionsplanen för Östersjön, EU:s havsmiljödirektiv och EU:s strategi för biologisk mångfald. Denna rapport ger en överblick av Östersjöns ekosystemtjänster utifrån olika perspektiv och värderingsmetoder. Framtida utmaningar belyses vad gäller hur ekosystemtjänster ska värderas och hur de kan användas för nationell och regional förvaltningen av Östersjöns resurser. Denna rapport har tagits fram som resultat av en regional workshop om ekonomisk värdering av marina och kustnära ekosystemtjänster i Östersjön som hölls 7-8 november 2013 i Stockholm, Sverige. Projektledare har varit Stockholm Resilience Centre, Stockholms universitet i samarbete med HELCOM, Sveriges Miljödepartementet och UNEP:s regionala havsprogram med stöd från Nordiska ministerrådet och Sveriges ordförandeprogram i ministerrådet för 2013.

Appendix 1. Background on valuation methods

Many environmental or ecosystem goods do not have a market price or the price does not represent the total value, and therefore specific valuation methods have been developed to estimate their monetary value. Two concepts that are used are willingness to pay (WTP) and willingness to accept compensation (WTA), with the former being more commonly used. WTP measures the amount of money a person is willing to pay to obtain the ecosystem good. Hence, it is a measure of the economic benefits from the good. WTA is the amount of money a person is willing to accept to give up ecosystem goods, i.e. it measures the economic losses of forgoing the good.

Values are typically categorized into use values and non-use (or passive use) values. Use values refer to the direct and indirect benefits from the actual use of the ecosystem service, whereas non-use values are not related to the use of the service. For example, people may value the existence of a healthy marine ecosystem although they do not visit the sea. The following present the basics of the most widely used economic valuation methods. Good reviews can be found e.g. in Turner *et al.* (2010) and Champ *et al.* (2003).

Stated preference methods

In stated preference methods, people are asked to express their willingness to pay for a change in the state of the environment. This is done using surveys that can be implemented via mail, interviews or the internet. The advantage of these methods is that they are able to capture also values that are not related to the use of the good (so called non-use or passive use values). However, there is controversy on the reliability of the benefit estimates as they are not based on actual behavior. These methods are also resource-intensive.

Most common stated preference methods are contingent valuation (CV) and choice experiment (CE). Contingent valuation can be used to measure the benefits of a change in the provision of ecosystem services

(see e.g. Hanemann & Carson 2007). It entails describing the current status and the after-change status of the ecosystem. Contingent valuation is widely used, and it is applicable to many ecosystem goods.

Choice experiment, in turn, asks respondents to make choices between goods that are described in terms of their attributes (see e.g. Hensher *et al.* 2005). Choice experiment provides more information than contingent valuation, as it captures the value of the good as well as its attributes. However, designing the survey and analyzing the data can be more complicated.

Revealed preference methods

Revealed preference methods are well-established, and their greatest advantage is that they are based on observing people's actual behavior in the markets. However, these methods can only be used to estimate use values, and they are less flexible as they have to be based on actual environmental conditions and behavior.

Most widely used revealed preference methods are the travel cost method (TC) and hedonic pricing (HP) (see e.g. Bockstael & McConnell 2007). The travel cost method is used to estimate the value of recreation based on the costs incurred from traveling to recreation sites. The travel costs are considered to represent the recreational value of visiting a particular site. The limitation of the travel cost method is that it is resource-intensive and only applicable to specific sites.

Hedonic pricing is typically applied to housing markets. It can be used to analyze how e.g. air quality, noise, landscape or water quality affect property prices and thus estimate the price people are willing to pay for these environmental characteristics. The method is only applicable to those environmental attributes that affect housing prices and it may be difficult to obtain the appropriate data.

Methods based on existing studies

Benefit transfer (BT) uses an existing valuation study or studies to estimate the value of ecosystem goods in a previously unstudied site (see e.g. Navrud & Ready 2007). The prerequisite is that the sites and the ecosystems goods are similar enough. Recently, the use of benefit transfer has increased due to increasing demand for benefit estimates and limited possibilities to conduct resource-intensive primary studies. Ben-

efit transfer is quick and inexpensive to implement, but empirical studies have found substantial transfer errors in the benefit estimates.

Meta-analysis (MA) takes stock of and summarizes existing studies on a specific ecosystem good, for example, air quality or forest recreation (see e.g. Nelson & Kennedy 2009). Dozens or even hundreds primary valuation studies are analyzed to find which factors affect observed value estimates. Meta-analysis can also be used for benefit transfer. The limitations include the availability of primary studies and the complexities in the statistical modeling.

Methods based on costs and prices

Values are sometimes inferred based on costs or market prices. These methods are typically less resource-intensive to use and data is sometimes more readily available.

Cost-based methods include damage costs avoided and replacements cost methods. They estimate values based on the cost of avoiding damages due to lost ecosystem services, or the cost of replacing services or providing substitute services. These costs are considered to provide useful estimates of the value of ecosystem goods, as the value of the services must be at least the incurred costs. However, they are not considered to produce strict measures of economic values as they are not based on willingness to pay.

Some ecosystem values can be based on data on market prices. These include values for e.g. fish, shellfish and timber. Goods with market prices are relatively simple to value, but the prices may represent only a partial value of the good or the prices may be distorted by subsidies or taxes.

Non-monetary methods

Non-monetary valuation can be used when monetary valuation is not considered appropriate or possible. This entails different kinds of qualitative and quantitative approaches, including the examination of statistics or using techniques such as focus groups, citizen's juries, participatory modeling and multi-criteria analysis. The aim can be on identifying relevant ecosystem services and possible values attached to them, the prioritization of ecosystem services, or assessing the importance of ecosystem benefits by examining their magnitude. It is also possible to study the existence of shared values, focusing on what individuals or groups think the society should pay for ecosystem services.

Appendix 2. Background information on Baltic environment and human impacts

The Baltic Sea is a unique sea with little comparison to any other sea in the world. Its uniqueness is mainly the result of a salt concentration that is neither marine nor freshwater; it is an intermediate between the both and hence defined as a brackish sea. However, the salinity follows a gradient with almost freshwater in the northernmost part of the sea close to the Torne river, at the border between Sweden and Finland. In the south-western area, in the coastal waters of Denmark, it is approaching marine conditions. The average salt concentration is approximately 7 per mille which is one-fifth of what is typical for oceans. The lower salinity is the result of 200 rivers flowing into to the Baltic Sea in combination with a low salt water intrusion from the Atlantic (ICES 2003). The Baltic Sea is divided into seven sub-areas. The Belt Sea is situated in the south-western area, the Baltic Proper is the largest area found in the south, Gulf of Riga to the east is encased by Estonia and Latvia and the Gulf of Finland further to the east is surrounded by Estonia, Russia and Finland. The Archipelago Sea, Bothnian Sea and Bothnian Bay stretch out between Sweden and Finland.

As a result of the intermediate salt concentrations the Baltic Sea sustain both marine and freshwater species. As the Baltic Sea in geological terms is a young sea, the time span for more profound evolutionary adaptations is too short. Hence the organisms in the sea proliferate under a certain level of physiological stress that may affect growth and reproduction (Zettler *et al.* 2007). This is also one of the main reasons the Baltic Sea is seen as a vulnerable ecosystem in which human stressors can cause large scale changes. Another reason for making it sensible to stress is that it is a fairly shallow sea with an average depth of 55 m. Given the large catchment area compared to the sea surface there is a limited volume of water that receives an inflow of water from a huge area influenced by human activities.

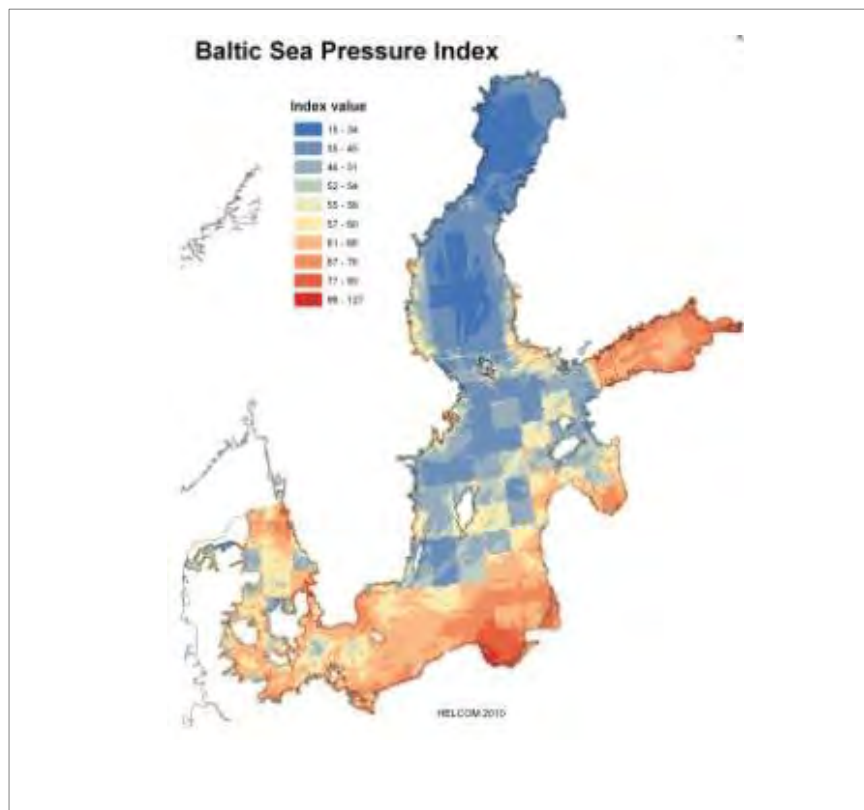
The catchment area of the Baltic Sea covers 1.7 million km² (compared to for example the area of Denmark which is approximately

43,000 km²). There are almost 90 million people living in this area with around 50 million having a distance of 150 km or less to the sea. The Baltic Sea coast line stretches along nine countries including Russia, Estonia, Latvia, Lithuania, Poland, Germany, Denmark, Sweden and Finland with eight of them being part of the European Union. In addition to the nine littoral countries Ukraine, Belarus, Czech Republic, Slovakia and Norway are also part of the catchment area. The geography of the land area of the Baltic Sea region varies greatly. The northern part is sparsely populated dominated by coniferous forests. In the south human presence is much more pronounced with a dominance of farmland and urban developments. Hence, the largest inputs in terms of nutrients are found in the south.

Eutrophication is a major problem in the Baltic Sea (HELCOM 2009). It is caused by increased levels of nutrients and affects a broad range of ecosystem services. With large nutrient inputs enhanced growth of algae and cyanobacteria may follow. Before the Second World War, the Baltic Sea water was nutrient poor and much clearer. After the war the nutrient inputs to the Baltic Sea increased due to the increase of agricultural and industrial developments and overall population growth. Today large-scale algal blooms are common. The main substances causing the eutrophication of the Baltic Sea are nitrogen and phosphorus (Larsson 1985). Important sources are agriculture and urban dwellings as well as air emissions (Archambault 2004). For example, in the eastern Gulf of Finland poultry plants and animal husbandry are major contributors to eutrophication (Kondratyev and Trumbull 2012). Untreated sewage is still a problem in some areas while some countries have a well-developed sewage treatment.

Hazardous substances are anthropogenic substances that are harmful to the environment and/or to humans. Effluents from rivers and seashores as well as from shipping and air emissions may contain such contaminants. In addition, there are also diffuse sources such as long range transport originating from outside the region. Substances include different metals such as cadmium, mercury, lead and zinc as well as persistent organic pollutants (POP) including PCB and DDT. There are large proportions that have been assimilated in organisms such as invertebrates (Hendozko 2010) and fish (Voigt 2007) as well as sediments (Roots *et al.* 2010); they will persist in the system in decades to come. The input from some substances has decreased but the problem remains. Some substances are still found in high levels and there are new contaminants.

Figure 4: Baltic Sea Pressure Index (BSPI) showing the sum of anthropogenic pressures present in areas of 5 km × 5 km (52 pressure data layers included)



Source: HELCOM, 2010.

A human activity that has a profound effect is fishing given the large number of key species that are removed from the Baltic Sea ecosystem (Österblom *et al.* 2007, Zeller *et al.* 2010). All countries around the Baltic Sea are actively harvesting fishery resources. The complexity that characterizes fishery management is in general poorly understood. The biggest problem to achieve a long-term sustainable fishery in the Baltic Sea is over capacity with an oversized fishing fleet (Eggert and Tveteras 2007). Another problem is the illegal, unregulated and unreported fishing (IUU). Even though fishery is an activity that has such a major effect on the Baltic Sea ecosystem it is also an activity that can be regulated and adequate management schemes can have a fairly quick effect.

Aquaculture is also a provider of fish. It is an activity that has potential for future developments in the Baltic Sea. However, there are also environmental effects to consider such as increased nutrient loads (Saikku and Asmala 2010).

In terms of maritime activities such as shipping the Baltic Sea has a comparable high occupancy of ships; 15% of the world's cargo ships are found in the area (Swedish EPA 2008). Oil spills, emissions of nitrogen oxides and the introduction of alien species from ballast waters are some environmental issues of concern related to shipping. Oil pollution is largely caused by intentional discharges (Hassler 2011). Notably, chronic oil pollution from intended spills can be a bigger problem than smaller single accidents. However, a larger spill could lead to a major catastrophe given the sensitive ecosystem that characterizes the Baltic Sea.

The Baltic Sea is also a provider of energy. The number of offshore windmills is increasing (Lumbreras and Ramos 2013). This may have environmental effects where wind parks are constructed including reef effects (Andersson and Öhman 2010), sound effects (Andersson *et al.* 2007, 2012) and impacts from magnetic fields (Öhman *et al.* 2007).

Climate change is expected to have a major impact on the Baltic Sea. The temperature has increased by 0.7 °C during the past century and with the foreseen climate alteration it will continue to increase. In addition precipitation is predicted to intensify. A higher nutrient load is further expected. This will all affect various components of the ecosystem including algal blooms (e.g. Hense *et al.* 2013). Another issue that relates to climate change is ocean acidification. Increased levels of carbon dioxide can change the level of acidity in seas around the world including the Baltic Sea. How it may affect the Baltic Sea is difficult to predict (Havenhand 2012).

Appendix 3. Valuation studies of ecosystem services in the Baltic Sea area

This Appendix lists the valuation studies mentioned in the summary report by Söderqvist & Hasselström (2008) and describes the recent valuation studies in the Baltic Sea region (see below the table).

Table A1: Valuation studies in Söderqvist & Hasselström (2008)

Issue	Country	Studies
Eutrophication	international	Markowska & Zyllicz 1999, Turner <i>et al.</i> 1999
	Denmark	Atkins & Burdon 2006, Atkins <i>et al.</i> 2007
	Estonia	Gren 1996
	Finland	Siitonen <i>et al.</i> 1992, Kiirikki <i>et al.</i> 2003, Kosenius 2004
	Sweden	Frykblom 1998, Hasselström <i>et al.</i> 2006, Soutukorva 2001, Sandström 1996, Söderqvist & Scharin 2000
Fisheries	international	Toivonen <i>et al.</i> 2000
	Denmark	Roth & Jensen 2003
	Estonia	Vetmaa <i>et al.</i> 2003
	Finland	NAO 2007, Olkio 2005, Parkkila 2005, Valkeajärvi & Salo 2000
	Germany	Bundesforschungsanstalt für Fischerei 2007, Döring <i>et al.</i> 2005
	Sweden	Fiskeriverket 2008, Olsson 2004, Paulrud 2004, Soutukorva & Söderqvist 2005
Oil and marine debris	international	Hall 2000, Sanctuary and Fejes 2006
	Denmark	Storstroms amt 2002
	Estonia	Etkin 2000
	Finland	Ahtiainen 2007
	Sweden	Forsman 2003, 2006, 2007
Windmill parks	Denmark	Ladenburg 2007, Ladenburg & Dubgaard 2007, Ladenburg 2008
	Germany	Benkenstein <i>et al.</i> 2003, Scharlau <i>et al.</i> 2004
	Sweden	Ek 2002, Liljestam & Söderqvist 2004
Other/several topics	Denmark	COWI 2007, Visitdenmark 2007
	Estonia	Vetmaa <i>et al.</i> 2003
	Finland	HELCOM and NEFCO 2007, Siitonen <i>et al.</i> 1992
	Lithuania	Lithuania Environmental Financing Strategy 2001. Povilankas <i>et al.</i> 1998. Sceponaviciute <i>et al.</i> 2007
	Russia	Bodrov 2005, EBRD 2003, Kaliningrad Regional Public Fund 2002, Nordstream 2007
	Sweden	Eggert & Olsson 2003, Franzen <i>et al.</i> 2006, Paulsen 2007

Several studies have been carried out under the international research network BalticSTERN (BalticSTERN 2012). The network includes partners from all nine coastal countries, making international studies covering the whole Baltic Sea region possible. BalticSurvey examined the recreational use of and public perceptions towards the Baltic Sea marine environment with a coordinated survey across all coastal countries, collecting 9000 responses (Ahtiainen *et al.* 2013, Swedish EPA 2010). The findings revealed that the Baltic Sea is an important recreation site in all surrounding countries. Most respondents had visited the sea at some point and the average number of recreation days spent at the sea ranged from 3 (coastal Russia) to 35 days (Sweden) per year. The survey also brought forward the concern people have about the state of the sea, especially regarding marine litter, damage to flora and fauna, hazardous substances and oil spills. Surveys such as this are useful in investigating the general public's views and also recreation behavior when statistics are not available. Also, international coordination ensures that results are comparable across countries.

Following the survey on recreation and public perceptions in the Baltic Sea countries, a coordinated study was implemented on the monetary benefits of reducing marine eutrophication (Ahtiainen *et al.* 2012, 2014). Contingent valuation studies were carried out with identical questionnaires in all nine Baltic Sea countries in 2011. With over 10000 respondents, the study examined public willingness to pay for reduced eutrophication according to the Baltic Sea Action Plan (BSAP) targets from 2007 (HELCOM 2007). The results reveal the monetary benefits of reaching the BSAP targets for eutrophication. The benefit estimates were also compared to the costs of reducing nutrient loads in a subsequent cost-benefit analysis (see e.g. BalticSTERN 2013), making it possible to analyze the economic efficiency of reducing eutrophication. The results also allow for estimating the marginal benefits of reducing nutrient loads, i.e. the benefits per kilogram of reduced nitrogen/phosphorus.

In addition to the above-mentioned Baltic-wide efforts, there are some recent regional studies. Kosenius (2010) estimated the Finns' willingness to pay for improving water quality in the Gulf of Finland using the choice experiment method. The results can be used flexibly to estimate the benefits of different water quality improvements in the Gulf of Finland and perhaps also other parts of the Baltic Sea. The study provided value estimates separately for changes in water clarity, abundance of coarse fish, status of bladder wrack and occurrence of blue-green algal blooms, and estimated the value of various water quality improvement scenarios.

Kulmala *et al.* (2012) examined the ecosystem services provided by Baltic salmon and also presented estimates of the economic value of provisioning and recreational services of salmon. Based on data from the Finnish Game and Fisheries Research Institute (2009), the economic value of commercial salmon landings in Denmark, Finland, Poland and Sweden was estimated at 0.9–3.6 million euros per year. The value of recreational fishing was based on several studies on anglers' willingness to pay for improved quality of recreational fishing and for preserving wild salmon stock (e.g. Håkansson 2008, Parkkila *et al.* 2011), ranging from 8 to 19 euros per fishing day. The study utilized the ecosystem service framework, so the results are directly applicable to estimating the value of ecosystem benefits provided by Baltic salmon.

Another study using the ecosystem services framework in the Baltic Sea analyzed the ecosystem benefits from coastal habitats in two areas: the Finnish-Swedish archipelago and Lithuanian coast (Kosenius & Ollikainen 2012). The choice experiment valuation study was implemented in Finland, Sweden and Lithuania in 2011. The state of coastal habitats was described in term of the amount of healthy vegetation, the preservation of currently pristine environments and the size of fish stocks. The results are useful in assessing the value of marine ecosystem benefits provided by habitats and species, recreation, and food and raw materials.

Tegeback & Hasselström (2012) estimated the costs associated with a major oil spill in the Baltic Sea, including the direct (cleaning beaches), market (tourism, fisheries) and nonmarket costs (environmental costs). They conducted three different case studies of potential spills: two close to the Swedish coast and one in the Polish coast. Depending on the location, the costs ranged from approximately 100 to 400 million euros. These cost estimates can help decide the level of preparedness for future oil spills, assess the effects from oil spills on fishing and tourism industries and also to the general public in the Baltic Sea.

Lewis *et al.* (2013) studied the monetary value of cultural ecosystem services related to Baltic Sea food webs. With a choice experiment conducted in Poland in 2012, they elicited willingness to pay for four ecological features: algal bloom intensity and timing, local species visibility, regional species population and local fisheries catch consistency and profitability. The findings increase the information on the value of cultural ecosystem services provided by the Baltic Sea in Poland. According to Lewis *et al.* (2013), a similar case study was also conducted in Finland, but the results have not been published yet.

Depellegrin & Blažauskas (2013) used existing studies and value estimates to assess the losses from oil spills in the Lithuanian coast. The

total losses were based on the value of recreational services, marine ecosystem services, commercial fisheries and seabirds, amounting to 524 million EUR/year. The aggregate estimates included the value of both intermediate and final ecosystem services and goods, and therefore double-counting is possible. Also, the study estimated the total economic value of the Lithuanian coastal zone and not marginal values. Therefore, the applicability of the value estimates is questionable. However, the analysis was spatially explicit, which enables evaluating the spatial distribution of values.

Appendix 4. Discussions in the regional workshop on the valuation of marine and coastal ecosystem services in the Baltic Sea

The Regional Workshop on the Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea was organized in Stockholm, Sweden, in 7–8 November 2013. Participants of the workshop included representatives of the scientific community, administration, non-governmental organizations (NGOs) and the private sector.

Group discussions took place on both days of the workshop. Each group was given a role from which the members should view the questions to get a wide perspective on the issues. The roles were: researchers, managers, non-governmental organizations (NGOs), finance/business, politicians and the public. Altogether, about 70 people participated in the discussions in seven groups. The following summary is based on the discussions in the workshop and opinions of individual participants (this does not necessary represent the views of the organizers).



Photo: Heini Ahtiainen

Opening discussion

Only eight of the twenty-four ecosystem services in the Baltic Sea are functioning properly with seven under severe threat. The four main challenges for the Baltic Sea are: eutrophication, fisheries, hazardous substances and maritime activities. These challenges call for substantial management efforts with a cross-sectorial approach. Politicians, businesses, scientists and society must all take part. There is a great need for a common language and understanding of ecosystem services and their value. Already, there is support for an integrated, holistic and ecosystem services based management strategy for the Baltic Sea, and many measures to improve its state has been identified.

The ecosystem services concept is difficult for many to understand. Using economic valuation of ecosystem services is important for the decision makers to get the message across. Designing sectorial policies and management strategies that are compatible with environmental goals and human activities is important. It is necessary to link what is happening on land with what is happening in the sea and to see them as an integrated whole

The HELCOM Baltic Sea Action Plan was the first attempt, at a regional level, to manage the Baltic Sea. HELCOM has recognized the importance of valuing ecosystem services and also agreed to intensify the valuation of marine and coastal ecosystem services in planning and accounting policies. The major task for HELCOM is to promote a healthy marine environment and to bridge the science-political-public interaction.

There are limitations to what governments can do so linking businesses to government is called for, as is international collaboration. Also educating government and businesses is important; media can play an important role here. Supplying politicians with numbers without them knowing the context or the background will not help the Baltic Sea. The planetary boundaries concept can be used as a communication tool together with the ecosystem services concept to describe how the Baltic Sea system functions.

Human wellbeing depends on ecosystem services. Identifying ecosystem services and its users, makes it easier to understand how they are affected and how human beings depend upon them. Valuing ecosystem services has an effect on human wellbeing and is important for improving the policymaking processes. The value of ecosystem services becomes clearer once they have been identified. Calculating the monetary value of ecosystem services can also facilitate visibility, but the monetary valuation is not always possible and may not be appropriate if relevant knowledge is lacking. A lot of the economic valuations tend to be on

the provisioning ecosystem services – fish has a market value. The cultural values are difficult to evaluate.

When it comes to the Baltic Sea, further work is needed to identify and describe the ecosystem services found there, including their interactions. It is also important to evaluate how policy changes affect ecosystem services and assess how changes in ecosystem services relate to human wellbeing.

Group discussions



Q1: Which are the most important topics/fields where ecosystem services valuation could be applied in the Baltic Sea region?

- Work several disciplines, chain from ecosystem services to human well-being.
- Define links between ecosystem services.
- To make the links between ecosystem services, impacts and human behavior easier to understand.
- Have common indicators for the purpose of assessments and valuation.

- Forecasting, scenarios and “taking high” form future needs for goods and services.
- Land-sea connection.
- Concrete regional case studies.
- Fisheries, recreation, beauty, water quality, value of summer houses, transport, tourism, agriculture, food.
- Implementation of EU directives (MSFD, WFD, CFP, CAP).
- Marine spatial planning (including MPA’s).
- Permitting (conservation vs. exploitation).
- Conflict areas given priority.
- Raising awareness and communicating.

Q2: What kind of ecosystem valuation is most useful to decision-makers and policy-support? What kind of policies would benefit from ecosystem services information?

- International studies that help integration of policies.
- Related to the requirements of directives, e.g. assessing the cost of inaction.
- Prioritization of measures.
- Studies that help setting targets for ecosystem services.
- Valuation of conservation vs. exploitation.
- Concrete and clear messages, raising awareness.
- More sustainable policies.
- Private/industry focused valuation (businesses, jobs).
- Spatial planning (hotspots for ecosystem services).
- Introducing new sea activities, e.g. wind power.
- Integrated policies linking different sectors.
- Transparent and clear valuation studies.
- Studies with clear purposes.
- Practical studies (what is the eelgrass worth, what is the nutrient reduction vs fish farming in open cages worth etc.).

Q3: How can the value of ecosystem services become visible and easy to understand?

- Personal and concrete examples.
- Case studies.
- Local examples (e.g. algal blooms).
- Using human welfare targets/indicators to improve the understanding of the links from ecosystem services to human welfare (e.g. health, jobs, pollution and dioxin in fish).
- Bringing forward the idea of several ecosystem services and their interactions.
- Visualizations and graphical tools, e.g. maps.
- Target-group specific information (e.g. the public, businesses, politics).
- Showing new business chances and opportunities.

Q4: How can international experiences and approaches be utilized in the Baltic Sea region?

- International experiences and collaboration important.
- Identifying knowledge gaps.
- Synthesis what's missing between disciplines.
- Good (and bad) examples that can be learnt from.
- Co-operation at different levels.
- HELCOM can facilitate collaboration.
- optimizing financing ex. BONUS.

Q5: What are the most crucial challenges in the ecosystem services valuation in the Baltic Sea Region?

- How to turn valuation results into real policies and actions.
- Call for high-quality valuation studies while also using value transfers/results from other studies.
- Are the results reliable if value/benefit transfer used.
- Important to show uncertainties and confidence intervals.
- Bringing different stakeholders together and using a common language.
- Developing models for forecasting.
- Can be more relevant to look at marginal changes than total value.

Q6: How can economic valuation of marine and coastal ecosystem services support the further implementation of the current policy targets (e.g. HELCOM Baltic Sea Action Plan and the EU Marine Strategy Framework Directive)?

- Better and more correctly describe the full picture of cost and benefits – social, economic and environmental.
- Tool for cost-benefit analyses.
- Justifying new measures and implementing certain targets.
- Assessing the cost of inaction.
- Designing better and more coherent policies and incentives.
- Showing the benefits of obtaining good environmental status.
- Describing the connection between sea and land.
- Increasing public awareness and understanding of the directives and their targets.
- Tool for integrating sectors at the local level.
- Consulting the public.
- Transparency important.
- Basin-specific analysis needed.
- Developing a common understanding and methodology with neighboring countries.

Q7: How could ecosystem services valuation be utilized for implementing the programs of measures in the EU MSFD?

- Help to proactively ensure GES with regards to balancing short term gains with long term prosperity.
- Interdisciplinary studies with social and natural sciences.
- Spatial prioritization.
- Evaluation tool (ex post/ex ante).
- Work needs to be planned from the ecosystem services perspective from the beginning.
- International studies and comparisons between countries.
- A challenge is to make it practical.

Q8: What is needed to apply such valuation methods for ecosystem services in the management of the Baltic Sea?

- Integrating and connecting sciences (e.g. fish and eutrophication).
- Sharing the available data.
- Common terminology and broader communication.
- Defining the carrying capacity of the ecosystem.
- Mapping of ecosystem services.

Q9: How can ecosystem services be addressed and studied in a useful way for the future governance of the Baltic Sea?

- Spatial planning as a concrete framework.
- Supporting strategies bottom-up.
- Spatially and temporally specific information.
- Scenario analysis.
- International studies for some issues.

Panel discussion

The valuation of ecosystem services can serve as a communication tool to help the Baltic Sea countries consider the environment and conservation. The management of the oceans needs to be improved and a cross-sectorial approach involving all stakeholders is necessary.

Integration is necessary and all involved need to speak a common language – understanding the terminology and the very basic functioning of nature. The role of the valuation at the moment is to use it for communication and to create a political will.

Keeping valuation of ecosystem services on the agenda is important. This entails raising awareness of ecosystem services among the public and policy-makers.



The issue of governance must be addressed at both local and global level. Being able to compare results, taking a multidisciplinary approach and using other perspectives than purely the environmental one is important too. Using marketing tools to promote the valuation of ecosystem services is needed, for instance connecting ecosystem services to health and food.

A lot of society's values are measured in monetary terms, but it is not possible to put a monetary value on the intrinsic value of nature. We must deal with both of those values. Because of that there is a need for a common language. Also the participation, understanding and cooperation between different stakeholders - natural scientists, governments and municipalities - is important. That gets into the aspect of communication. Media has a central part but also governments have a large role communicating the ecosystem services. When it comes to valuation, it is also an issue to raise awareness: this is actually worth keeping or restoring for future generations. A lot is being done in different areas and a lot of research is going on. A scientific basis for understanding ecosystem services is necessary.



Ecosystem Services in the Baltic Sea

This report presents an overview of the ecosystem services and associated benefits provided by the Baltic Sea, including information on the approaches of assessing and valuing ecosystem services being applied in the Baltic Sea region. It also identifies the main challenges in ecosystem service assessments in the Baltic Sea, and outlines the way forward in applying assessment tools in regional and national policies.

Valuation of the benefits provided by ecosystem services can aid in designing more efficient policies for the protection of the Baltic Sea. The existing studies on the value of improved marine environment are useful in assessing the importance and value of some marine ecosystem services, but further work is still needed on describing ecosystem services and their interactions, and evaluating how policy changes affect these services and human well-being.

