

The economic value of ecosystem services provided by the Baltic Sea and Skagerrak

Existing information and gaps of knowledge

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Existing information and gaps of knowledge

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Preface

The Swedish Environmental Protection Agency, by assignment of the Swedish Government, has carried out a project, led by Katrin Zimmer to gather information about the economic impacts of the human influence on the Baltic Sea and the Skagerrak¹ environment. The project, based on already existing material, attempts to compare the situation if no further measures are implemented compared to if further measures are implemented. The countries around the Baltic Sea have been invited to participate in the project and the search for economic marine information has been carried out in every state that borders the Sea.

The goal of the project is to provide decision makers with the information available regarding the economic benefits of ecosystem services, the cost of measures required to protect these services, as well as the estimated costs of non-action.

The assignment was divided into different subprojects which resulted in different reports.

1. Ecosystem services provided by the Baltic sea and Skagerrak
2. The economic value of ecosystem services provided by the Baltic Sea and Skagerrak - Existing information and gaps of knowledge
3. Trends and scenarios exemplifying the future of the Baltic Sea and Skagerrak – Ecological impacts of not taking action
4. The costs of environmental improvements in the Baltic Sea and Skagerrak – A review of the literature
5. Costs and benefits from nutrient reductions to the Baltic Sea
6. Tourism and recreation industries in the Baltic Sea area – How are they affected by the state of the marine environment? – An interview study
7. Economic information regarding fisheries - Swedish Board of Fisheries

Each of the reports 1-5 contains information on knowledge gaps and suggestions of new research or how existing information could be compiled.

All subprojects have been compiled into one synthesis report with the title What's in the Sea for me – Ecosystem Services of the Baltic Sea and Skagerrak.

The authors of the main text of this report are Linus Hasselström and Tore Söderqvist, Enveco Environmental Economics Consultancy Ltd., Stockholm. The annexes consist of country reports prepared by Berit Hasler, Louise Martinsen, Anders Branth Pedersen, Anders Fonnesbech-Wulff and Sune T. Neye, National Environmental Research Institute, University of Aarhus (Denmark), Heidi Tuhkanen under the supervision of Tea Nömmann, Stockholm Environment

¹ The project defines the Baltic Sea and the Skagerrak as the waters of the Bothnian Bay, the Bothnian sea, the Gulf of Finland, the Gulf of Riga, the Baltic Proper, the Danish Straits, the Kattegat and the Swedish coast of the Skagerrak.

Institute Tallinn Centre / Estonian Institute for Sustainable Development (Estonia), Heini Ahtiainen, MTT Agrifood Research Finland (Finland), Astrid Kowatsch and Ralf Döring, DUENE e.V. (Germany), Alf Vanags and Rita Kasa, Baltic International Centre for Economic Policy Studies – BICEPS (Latvia), Daiva Semėnienė, Center for Environmental Policy – AAPC (Lithuania), Tomasz Żylicz, Agnieszka Markowska and Mikołaj Czajkowski, Warsaw University, Warsaw Ecological Economics Center (Poland), Natalia Volchkova and Olga Lazareva, Center for Economic and Financial Research at New Economic School, Moscow (Russia) and Linus Hasselström, Enveco Environmental Economics Consultancy Ltd. (Sweden).

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Stockholm, August 2008

Swedish Environmental Protection Agency

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Summary

This report presents the results from a subproject in *Economic Marine Information*, a Swedish government assignment for the Swedish Environmental Protection Agency. There are three main purposes with the project:

1. To collect and bring forward information being available on the economic effects of a changed marine environment of the Baltic Sea². Such effects could be the benefits of an improved marine environment or the damage of a deteriorated marine environment.
2. Based on (1), to identify knowledge gaps in terms of economic effects related to different ecosystem services and marine environmental problems.
3. Based on (1) and (2) and the judgements of the experienced environmental economists involved in the project, to suggest new, highly prioritized research and studies.

The project has been carried out in collaboration with representatives for each of the nine Baltic Sea countries, and each representative has written a country report regarding (1), (2) and (3) above. The most important results in these country reports have been collected into a short synthesis text. This report contains this text, followed by the country reports as annexes.

In total, about 40 studies relating to values of the Baltic Sea environment have been found. These have mainly been related to topics of eutrophication, fisheries (recreational and professional), oil and marine debris and locations for windmill farms. A few studies have approached more than one area of environmental problems simultaneously.

The studies are in most cases related to specific scenarios and local regions, a fact which makes it hard to draw general quantitative conclusions regarding benefits of an improved Baltic Sea environment. However, some quantitative results are possible to generalize from large scale studies performed in the 1990s on the values of reduced nutrient loads to the Baltic Sea. The original results from these studies are, however, heavily outdated. In this report an attempt is made to update them.

The table below presents results on what economic effects have been subject to study so far. It also provides suggestions on areas for further research. The results and suggestions are made for the types of ecosystem services used in another *Marine Economic Information* report (Garpe, 2008).

² "The Baltic Sea" refers in this project to the Bothnian Bay, the Bothnian Sea, the Gulf of Finland, the Gulf of Riga, the Baltic Proper, the Danish Straits, the Kattegat and the Swedish part of the Skagerrak.

Ecosystem services coverage: what has been done and within which areas are further studies suggested in the country reports?

Category		Service	Degree of coverage in economic research, relative to other ecosystem services (aggregate based on number of related studies and the degree to which the specific services have been studied).	Degree of priority, regarding the need for future studies
Supportive services	S1	Biochemical cycling	Low	?
	S2	Primary production	Low	?
	S3	Food web dynamics	Low	?
	S4	Diversity	Medium	!
	S5	Habitat	High	!!
	S6	Resilience	Low	?
Regulating services	R1	Atmospheric regulation	Low	?
	R2	Regulation of local climate	Low	?
	R3	Sediment retention	Low	?
	R4	Biological regulation	Low	?
	R5	Pollution control	Low	?
	R6	Eutrophication mitigation	Low	?
Provisioning services	P1	Food	High	!!!
	P2	Inedible resources	Low	?
	P3	Genetic resources	Low	?
	P4	Chemical resources	Low	?
	P5	Ornamental resources	Low	?
	P6	Energy	Low	?
	P7	Space & waterways	Low	?
Cultural services	C1	Recreation	High	!!!
	C2	Aesthetic value	High	!!!
	C3	Science & education	Low	?
	C4	Cultural heritage	Medium	!
	C5	Inspiration	Low	?
	C6	The legacy of nature	Medium	!

Legend:

? = The country reports do not specifically mention this service as an important priority for future research

! = Important area for further studies

!! = Very important area for further studies

!!! = Crucial area for further studies

The following suggestions are made for issues of prioritizing future research and studies, based on the country reports.

- First of all, there seems to be a consensus about the need for a new, large scale study, valuing the benefits of decreased nutrient loads to the Baltic Sea. The studies made in the nineties are outdated in two aspects: (1) Most countries have changed dramatically in terms of economic development in the last decade, and (2) valuation methods have been subject to important methodological developments during the last decade, allowing more precision in the valuation results. Also, voices are raised in the country reports for (a) valuing different attributes of reduced nutrient reductions, such as use/non-use values, effects on fisheries, tourism, bathing water quality, visual quality of beaches etc., and (b) constructing scenarios for valuation which are based on a feasible and possible action programme which might actually accomplish what is valued.
- Also relating to nutrients, there is a need for valuing *marginal* benefits of reduction. This is very important since the socially efficient nutrient reduction level can be identified only if there is knowledge of both marginal costs and marginal benefits of reduction. At present, a lot is known about marginal costs, but practically nothing about marginal benefits. Using a choice experiment methodology is one possible way to estimate marginal benefits.
- Related to fisheries, there are suggestions to study the potential gain to the fishery industry of a programme for cod-stock recovery. There are also suggestions to conduct further studies, linking nutrient load changes to habitat quality and “end results” for the fishery industry. Thirdly, effects in the fishery industry should be linked to potentially large cultural values from preserving traditional fishing communities. Finally, more research should be done on economic values of recreational fisheries directly relating to the Baltic Sea, since most studies are very broad from a geographical point of view, or focus on fisheries in lakes and rivers.
- Related to oil spill, there are two important tasks for future studies. The first is to quantify economic consequences of the ecological impacts from oil spill accidents. The second is to value reductions of *risks* for oil spill accidents, since this is very important for conclusions on which political and technical measures should be taken.
- Methodologically, voices are raised about the importance of connecting the economic measures to specific and scientifically measurable ecological conditions, in order to know more precisely what

is valued. Valuation should be used as a tool for making priorities between different political targets, and this connection is crucial for having the results usable.

- Finally, the costs of non-action in specific political and geographical areas should be estimated.

Sammanfattning

Den här rapporten presenterar resultaten från ett delprojekt inom *Economic Marine Information*, genomfört av Naturvårdsverket på uppdrag av Sveriges regering. Projektet har tre huvudsyften:

1. Att samla in och lyfta fram befintlig information om de ekonomiska effekterna av förändringar i Östersjöns havsmiljö. Sådana effekter kan vara fördelarna med en förbättrad havsmiljö eller skadorna från en försämrad havsmiljö.
2. Att baserat på (1) identifiera kunskapsluckor när det gäller de ekonomiska effekterna satt i relation till de olika ekosystemtjänsterna och havsmiljöproblemen.
3. Att baserat på (1) och (2) samt på bedömningar gjorda av de erfarna miljöekonomerna som deltar i projektet föreslå nya högprioriterade studier och forskningsinsatser.

Projektet har genomförts i samarbete med representanter för var och en av de nio östersjöstaterna och varje representant har författat en egen landrapport gällande punkterna (1), (2) och (3) här ovan. De viktigaste resultaten i dessa landrapporter har samlats till en kortare sammanställning. Den här rapporten innehåller denna sammanställning, följd av landrapporterna i form av bilagor.

Totalt har cirka 40 studier kring Östersjömiljöns ekonomiska värden hittats. Studierna har främst handlat om övergödning, fiske (både yrkesfiske och fritidsfiske), oljeutsläpp och nedskräpning, samt lokalisering av vindkraftverk. Några få studier har behandlat mer än ett miljöområde parallellt.

Studierna är i de flesta fall relaterade till specifika scenarier och områden, vilket gör det svårt att dra allmänna kvantitativa slutsatser kring vinsterna med en förbättrad Östersjömiljö. Sådana slutsatser kan dock dras ur de storskaliga studier som genomfördes under 1990-talet kring värdet av minskade utsläpp av näringsämnen i Östersjön. De ursprungliga resultaten från de här studierna är dock kraftigt föråldrade. I rapporten görs ett försök att uppdatera dessa.

Tabellen nedan presenterar resultatet över vilka ekonomiska effekter som hittills har studerats. Den ger även förslag på vilka områden som bör studeras ytterligare. Resultat och förslag görs i enlighet med den klassificering av ekosystemtjänster som använts i en annan *Economic Marine Information*-rapport (Garpe, 2008).

Ekosystemtjänster: vad har gjorts och inom vilka områden föreslås vidare studier enligt de olika landrapporterna?

Kategori		Tjänst	Grad av täckning i ekonomisk forskning jämfört med andra ekosystemtjänster (summan är baserad på antalet relaterade studier och graden i vilken den specifika tjänsten har studerats)	Prioriteringsgrad när det gäller behovet av framtida studier
Stödjande tjänster	S1	Biogeokemiska kretslopp	Låg	?
	S2	Primärproduktion	Låg	?
	S3	Näringsväv	Låg	?
	S4	Biologisk mångfald	Medel	!
	S5	Livsmiljö	Hög	!!
	S6	Resiliens	Låg	?
Reglerande tjänster	R1	Luftreglering	Låg	?
	R2	Klimatreglering	Låg	?
	R3	Sedimentbevarande	Låg	?
	R4	Biologisk reglering	Låg	?
	R5	Reglering av föroreningar	Låg	?
	R6	Minskad övergödning	Låg	?
Producerande tjänster	P1	Livsmedel	Hög	!!!
	P2	Råvaror	Låg	?
	P3	Genetiska resurser	Låg	?
	P4	Kemikalier	Låg	?
	P5	Utsmyckningar	Låg	?
	P6	Energi	Låg	?
	P7	Utrymme & vattenvägar	Låg	?
Kulturella tjänster	C1	Rekreation	Hög	!!!
	C2	Estetiska värden	Hög	!!!
	C3	Vetenskap & utbildning	Låg	?
	C4	Kulturarv	Medel	!
	C5	Inspiration	Låg	?
	C6	Naturarv	Medel	!

Teckenförklaring:

? = Landrapporterna nämner inte specifikt den här tjänsten som en viktig prioritering för framtida studier

! = Viktigt område för framtida studier

!! = Mycket viktigt område för framtida studier

!!! = Mest viktigt område för framtida studier

Baserat på landrapporterna lades följande förslag på vilken framtida forskning som bör genomföras.

- För det första tycks det finnas en samstämmighet över behovet av en ny storskalig studie, där man utvärderar nyttan med minskade näringsutsläpp i Östersjön. De studier som genomfördes under 1990-talet är föråldrade av två skäl: (1) De flesta av länderna har förändrats dramatiskt när det gäller den ekonomiska utvecklingen under det senaste årtiondet, och (2) ekonomiska värderingsmetoder har genomgått en viktig metodologisk utveckling under det senaste årtiondet, vilket har lett till större precision i värderingsresultaten. Röster höjs även i landrapporterna för (a) en värdering av olika attribut för en reduktion av näringsutsläppen, som till exempel användar-/icke-användarvärden, effekter på fisket, turismen, badvattenkvaliteten, den estetiska strandkvaliteten, etc, och (b) konstruerandet av värderingsscenarier som är baserade på genomförbara och möjliga åtgärdsprogram, som faktiskt skulle kunna åstadkomma det som värderas.
- När det gäller näringsämnen finns det även ett behov av att utvärdera reduktionens *marginalnytta*. Detta är mycket viktigt eftersom den för samhället effektiva reduktionsnivån bara kan identifieras om det finns kunskap både om reduktionens marginalkostnad och dess marginalnytta. För närvarande vet man mycket om marginalkostnaden för reduktioner, men praktiskt taget ingenting om marginalnyttan. En möjlig väg för att uppskatta marginalnyttan är att använda choice-experiment-metoder.
- När det gäller fisket anses det viktigt att studera fiskeindustrins potentiella nyttor av en återhämtning av torskbeståndet. Det föreslås även vidare studier som kopplar samman förändringar i näringsutsläppen med kvaliteten på habitat och hur fisket till sist påverkas ekonomiskt. Effekterna för fiskeindustrin bör även sammanlänkas med de potentiellt stora kulturvärden som ligger i att bevara de traditionella fiske-lägena. Slutligen bör mer forskning genomföras kring fritidsfisket i Östersjön, eftersom de flesta av studierna är mycket breda i det geografiska perspektivet eller fokuserar på fisket i sjöar och floder.
- När det gäller oljeutsläppen finns det två viktiga uppgifter för de framtida studierna. Den första handlar om att beräkna oljeutsläppens ekonomiska konsekvenser. Den andra är att beräkna värdet av *riskreduktioner* kopplade till oljeutsläpp, eftersom detta är mycket viktigt för de slutsatser som ligger till grund för politiska och tekniska åtgärder.
- Röster höjs angående vikten av att metodologiskt koppla samman de ekonomiska åtgärderna med specifika och vetenskapligt mätbara ekologiska förutsättningar för att kunna förstå mer exakt vad som beräknas. Utvärderingen bör användas som verktyg när man prioriterar mellan olika politiska mål. Denna koppling är av mycket stor vikt för att resultaten ska bli användbara.

1. Introduction

This report presents the results from subproject 3 in *Economic Marine Information*, a Swedish government assignment for the Swedish Environmental Protection Agency. There are three main purposes with the project:

- (1) To collect and bring forward information being available on the economic effects of a changed marine environment of the Baltic Sea³. Such effects could be the benefits of an improved marine environment or the damage of a deteriorated marine environment.
- (2) Based on (1), to identify knowledge gaps in terms of economic effects related to different ecosystem services and marine environmental problems.
- (3) Based on (1) and (2) and the judgements of the experienced environmental economists involved in the project, to suggest new, highly prioritized research and studies.

The project has been carried out by the following consortium with representatives from each Baltic Sea country:

- Denmark: National Environmental Research Institute, University of Aarhus
- Estonia: Stockholm Environment Institute Tallinn Centre / Estonian Institute for Sustainable Development
- Finland: MTT Agrifood Research
- Germany: DUENE, Institute for Sustainable Development of Landscapes of the Earth e.V.
- Latvia: Baltic International Centre for Economic Policy Studies
- Lithuania: Center for Environmental Policy
- Poland: Warsaw University, Warsaw Ecological Economics Center
- Russia: Centre for Financial and Economic Research at New Economic School
- Sweden: Enveco Environmental Economics Consultancy Ltd.

Country reports regarding (1), (2) and (3) above are found in the annexes to this report. The main text of this report summarizes the country reports and provides general conclusions.

The country reports have been produced in the period of January to March 2008. The aim in terms of which studies to include has been broad, and information from the scientific as well as the “grey” literature (e.g. reports from government agencies and consultancies) is reported. The aim has also been broad in terms of which types

³ “The Baltic Sea” refers in this project to the Bothnian Bay, the Bothnian Sea, the Gulf of Finland, the Gulf of Riga, the Baltic Proper, the Danish Straits, the Kattegat and the Swedish part of the Skagerrak.

of economic effects to include. The monetary measures of interest to this project are not only those which are correct from a strict welfare economics point of view (i.e. changes in consumer surplus and changes in producer surplus/profits), but also other measures which are not necessarily correct from this point of view, such as changes in revenues, expenditures, costs, etc.

Throughout the report, the ecosystem goods and services classification used in Garpe (2008) is used. Garpe reviews how these goods and services support people and societies in the Baltic Sea countries. From now on in this report, “ecosystem services” will be used as an abbreviation of “ecosystem goods and ecosystem services”. See table 1 for a listing of these services.

Table 1. Ecosystem services classification used throughout the report.

Supportive services	S1	Biochemical cycling
	S2	Primary production
	S3	Food web dynamics
	S4	Diversity
	S5	Habitat
	S6	Resilience
Regulating services	R1	Atmospheric regulation
	R2	Regulation of local climate
	R3	Sediment retention
	R4	Biological regulation
	R5	Pollution control
	R6	Eutrophication mitigation
Provisioning services	P1	Food
	P2	Inedible resources
	P3	Genetic resources
	P4	Chemical resources
	P5	Ornamental resources
	P6	Energy
	P7	Space & waterways
Cultural services	C1	Recreation
	C2	Aesthetic value
	C3	Science & education
	C4	Cultural heritage
	C5	Inspiration
	C6	The legacy of nature

This report is organized as follows: In chapter 2, a brief introduction to the theory of economic valuation of the environment and some keywords and concepts are presented. In chapter 3, we first summarize the results from the country reports in terms of which studies have been made in the Baltic Sea area (section 3.1). In section 3.2, some general and able-to-aggregate results from these studies are presented and discussed. Section 3.3 concludes the report in terms of which are the knowledge gaps and which are the most important tasks for researchers and others in the near future within this area. Annexes I-IX contain the nine country reports.

2. Methods for estimating benefits of environmental change

People are affected by the environmental status of the Baltic Sea in the sense that its marine ecosystems provide goods and services from which people enjoy wellbeing when consuming them and firms enjoy profits when using them as inputs in their production. A change of the environmental status of the sea resulting in a changed provision of ecosystem services will therefore affect wellbeing and profits. This influence on wellbeing and profits might be direct because of people's and firms' use of ecosystem services, but there might also be an indirect influence through a changed economic activity in society, causing such things as increased production, employment and income, which in the end are likely to result in increased wellbeing and profits.

If there is an *improved* environmental status resulting in an increased provision of ecosystem services, this will cause an increase in wellbeing and profits, which in such a case constitute the *benefits* of the improvement. Analogously, a *deterioration* of the environmental status would result in a decrease in wellbeing and profits, which in such a case constitute the *costs* of the deterioration. These costs are sometimes called *damage costs* in order to clarify that they are about the costs caused by an environmental deterioration.

An important task for environmental economists is to assess the size of benefits and costs due to environmental change and express them in monetary terms as far as possible. This is done by using various *valuation methods*. This report is about the results of such work in the countries around the Baltic Sea, and the annexes show that several different methods have been used for this monetization. The purpose of this chapter is to briefly explain the main valuation methods available for monetization and their theoretical basis. A reader who wishes to have a more thorough exposition about this is referred to, for example, Brännlund and Kriström (1988), Freeman (2003), Johansson (1991, 1993), Pearce et al. (2006), Söderqvist et al. (2004), and – for overviews with a Baltic Sea perspective – e.g. Gren et al. (2000), Rönnbäck et al. (2007) and Söderqvist et al. (2005).

This chapter also introduces some abbreviations which will be used throughout the report, including the annexes. The abbreviations are listed in table 2.

Table 2. Abbreviations used in the report.

CE	Choice experiments
CS	Compensating surplus
CV	Compensating variation
CVM	Contingent valuation method
DE	Defensive expenditure method
DEM	German mark
DKK	Danish krone
EEK	Estonian kroon
ES	Equivalent surplus
EUR	Euro
EV	Equivalent variation
FIM	Finnish markka
GBP	British pound
HCM	Human capital method
HPM	Hedonic price method
k	kilo = 1 000
LTL	Lithuanian litas
LVL	Latvian lats
M	Mega = 1 000 000
MCS	Marshallian consumer surplus
PFM	Production function method
PLN	Polish zloty
RCM	Replacement cost method
RP	Revealed preferences
RUB	Russian rouble
SEK	Swedish krona
SP	Stated preferences
TCM	Travel cost method
USD	US dollar
WTA	Willingness to accept compensation
WTP	Willingness to pay

2.1. Valuation methods

Valuing environmental changes economically is about analyzing the trade-offs individuals are prepared to make between the environment and other resources. Economic theory suggests that such trade-offs reveal the influence that environmental changes have on human wellbeing. In other words, economists measure the influence of an environmental change on wellbeing as the resources individuals would be willing to give up in order to have the change (or prevent the change). Another word for this willingness to give up resources is *willingness to pay* (WTP). In some situations it is more relevant to study another kind of trade-off, namely what people require as compensation if the environmental change takes place (or is prevented), i.e. their *willingness to accept compensation* (WTA).

WTP and WTA are closely linked to the concept of consumer surplus. Consumer surplus is the difference between the maximum amount an individual is willing to pay for consuming a good and the amount that she actually has to pay for the good. Economic theory suggests that changes in wellbeing can be measured as changes in consumer surplus. These changes can be defined in somewhat different ways, which explains the fact that there are several measures of changes in consumer surplus available: e.g., changes in the *marshallian consumer surplus* (MCS), compensating variation (CV), equivalent variation (EV), compensating surplus (CS) and equivalent surplus (ES). The reader is referred to, for example, Freeman (2003) and Johansson (1991, 1993) for details on the definitions of these measures. The change in *profits* (or, which is almost the same thing, *producer surplus*) is the corresponding measure for changes in firms' "wellbeing".

Since economic values are about trade-offs that individuals are willing to make, economic values depend on the individuals' preferences, i.e. their more or less fixed opinions about how important (or unimportant) different goods and services are for their wellbeing. The focus on individuals' preferences in economics reflects an anthropocentric ethical point of departure, and also the importance of the principle of consumer sovereignty, i.e. that every individual is the sole person who can judge what is good or bad for her. A discussion of such points of departure is beyond the scope of this report, but it should be noted that the view that economic values are determined by individuals' preferences implies that the results from valuation studies are not more informed than the individuals themselves are (Daily et al., 2000). This fact has probably played an important role in the discussion among, for example, ecologists and economists about the reasonableness of economic valuation of environmental change.

Sometimes ecosystem goods and services are subject to free trade and pricing on markets, i.e. they are *market goods/services*. It is in this case straightforward to use data on people's and firms' market behaviour for estimating demand and supply, and these relationships can in turn be used for estimating changes in consumer surplus and profits. However, a considerably more typical case for ecosystem services is that they are not traded and priced on any market. For being able to compute the economic value of environmental changes influencing also such *non-market goods/services*, special valuation methods have been developed within environmental economics. These valuation methods can be divided into three main groups:

- Revealed preferences (RP) methods
- Stated preferences (SP) methods
- Other valuation methods, less firmly rooted in economic theory

Each of these groups of methods is briefly described below.

2.1.1. Revealed preferences methods

RP methods make use of linkages between ecosystem services and one or more market goods. This means that they are all based on data on people's or firms' actual market behaviour, which is usually viewed as an important advantage. The four most important valuation methods within this group are:

- The production function method (PFM)
- The travel cost method (TCM)
- The hedonic price method (often also called the property value method) (HPM)
- The defensive expenditure method (DE)

The production function method is possible to apply when it is known how ecosystem services contribute to the production of some market good. Ecosystem services are often such an input to production. For example, some fish species are very dependent on the availability of suitable coastal habitats as nursery areas. If there is a change in the quality or quantity of these habitats, this might influence the stock of these fish species, which in turn might reduce the catch (or "production") in commercial fisheries and thus the supply of these fish species on the market for fish. If there is information on these relationships, it is also possible to use the PFM for putting an economic value of the habitat change. PFM is therefore an important method for valuing ecosystem services economically, but its application is often limited because of insufficient knowledge of how nature works as a production factor.

The travel cost method provides an opportunity to value the recreational opportunities provided by nature. The willingness to pay for visiting a recreational area may be estimated if there are enough data on how much money and time people spend for travelling to the area. Early TCM applications were studies of the recreational access value of areas such as nature reserves in the United States. A more modern version of the method is to analyze how different characteristics of a recreational area affect the demand for recreation. For example, the number of people visiting a beach might partly depend on its water quality. If knowledge is available of how water quality is manifested, and if the effect of water quality on recreational demand can be isolated from that of all other factors influencing demand (travel cost, income, services on site, etc.), there exist possibilities to estimate the WTP for improved water quality.

The hedonic price method is based on the idea that the supply of ecosystem services might play a role for property values. A summer house situated by a beach characterized by poor water quality might have a lower market price than a summer house situated by a beach with clean water, even if the houses and the surroundings are identical in all other respects. If data exist on property values and characteristics influencing property values (including water quality), an indirect

market price on water quality might be estimated and in some cases even the WTP for an improved water quality.

The defensive expenditure method uses data on people's market behaviour when they try to compensate themselves for a reduced supply of some ecosystem service. One example is when people install some equipment to protect themselves from an environmental deterioration, for example, a coal filter cleaning the drinking water coming from contaminated groundwater. From a drinking water perspective, such a filter works as a substitute for clean groundwater if the filter preserves the quality of the drinking water. For a small change in the supply of an ecosystem service, such defensive expenditures may give information on the WTP for the change.

2.1.2. Stated preferences methods

Sometimes there is no linkage between the ecosystem service one wishes to value economically and some market good, or the linkage might be weak or poorly explored. With the help of SP methods, this problem can be solved by estimating the WTP for the ecosystem service directly by creating a hypothetical market situation. This way of gaining information about the economic value of ecosystem services has been increasingly applied during the last decades. Two main SP methods are the following:

- The contingent valuation method (CVM)
- Choice experiments (CE)

The contingent valuation method uses interviews or mail surveys that describe a scenario in which a change in the supply of an ecosystem service is explained and illustrated for a (usually) random sample of individuals. The scenario is followed by questions about the respondents' WTP for a realization of the change. This is a debated method, see e.g. Smith (2004). The requirements are substantial regarding the design of text, pictures and other things which are used in the questionnaire for communicating information about the considered change in the supply of the ecosystem service. Moreover, CVM and other SP methods do not use data on individuals' actual market behaviour. As a consequence, a main question is whether individuals would actually pay the WTP inferred from their responses if the scenario becomes a reality. This and other questions related to SP methods have been subject to extensive testing and therefore much is known today about how a SP method should be applied for maximizing reliability and validity, see, e.g., the discussion in SEPA (2006). The hypothetical setting used by SP methods makes it possible to also approach people who at least at present do not use the ecosystem service but might still be willing to pay something for an increased provision of the service. RP methods cannot provide information on such a *non-use value* of ecosystem services. For example, only values held by visitors are taken into account if an improved environmental quality in a recreational area is valued using TCM. However, it is not unlikely that also non-visitors care for the environmental quality

in the area. A CVM study can be used for capturing also the WTP of these non-visitors.

Choice experiments are quite similar to CVM, but are based on how respondents make repeated choices among at least two alternatives. The alternatives differ with respect to levels of attributes characterizing the ecosystem service and the payment requirements for the respondent. The WTP for the environmental attributes can be derived from the choices made by the respondents.

2.1.3. Other valuation methods

All methods mentioned so far are characterized by the fact that they can all be justified by economic theory. However, also other valuation methods are used for valuing environmental changes but these are less firmly rooted in economic theory. This fact might make it difficult to interpret the results produced by these methods, of which three are briefly described below:

- The replacement cost method (RCM)
- The human capital method (HCM)
- The costs of realizing political decisions (“political WTP”)

The replacement cost method resembles DE in the sense that it is applied to cases where a market good might replace an ecosystem service. However, RCM is typically based on data about the costs for socially co-ordinated actual or hypothetical projects rather than data on people’s actual trade-offs at a market. One example might be a study of the costs for stocking fish in order to at least partly compensate for the loss of natural coastal habitats which are needed for the fish species subject to stocking. Another example is the construction of sewage treatment plants to compensate for the lost water cleaning capacity when wetlands are ditched. Replacement costs thus refer to the costs of replacing the loss of an ecosystem service. These costs can be interpreted as the economic value of the ecosystem service, given that the following conditions hold: (i) the man-made replacement system provides services of equally high quantity and quality as the ecosystem service, (ii) the man-made replacement system is the cost-effective way of replacing the ecosystem service, and (iii) people would in fact be willing to pay the costs for the replacement system if the ecosystem service is no longer available (Freeman, 2003).

The human capital method is based on, inter alia, the idea that a person’s value is what she produces and that wages give information about productivity. HCM provides a basis for using data on production losses in order to value illness. Costs of medical treatment are usually added to the production losses. Such data are interesting and might in some cases be motivated by the fact that they provide information on the lower boundary of economic damage. However, the method has to be

used cautiously because it might give results that are not defensible, for example, that retired people have no value.

The cost of realizing political decisions provides some valuation possibilities by using cost data. It is doubtful whether such decisions reveal “society’s WTP” for a changed supply of ecosystem services because the decisions do not necessarily reflect people’s WTP. However, this does not imply that there are not cases where people’s preferences are relatively strongly reflected. The decision was perhaps preceded by an intensive discussion in which the opinions of many groups were expressed and also converged. A valuation through the cost of realizing political decisions has some similarities with RCM, which suggests that the three conditions mentioned above for RCM are again applicable.

2.2. Databases

The listing of methods in the previous section suggests that there are many options available for valuing ecosystem services economically, and the country reports in the annexes show how most of these methods have been applied in the case of the Baltic Sea. In a world-wide perspective, there have been thousands of applications of valuation methods in the last decades. Overviews of these applications are facilitated by the existence of databases for valuation studies such as the Environmental Valuation Reference Inventory (EVRI)⁴, the Nordic Environmental Valuation Database (NEVD)⁵ and the Valuation Study Database for Environmental Change in Sweden (ValueBase^{SWE})⁶; see also McComb et al. (2006) for a review of such databases. The existence of these databases means that it is relatively easy to find studies representing the state-of-the-art for different valuation methods.

Valuation study databases are also of help for identifying studies which might be used as a basis for generalizing valuation results to new policy settings. Possibilities to make such generalizations are important because it might sometimes be expensive and time-consuming to carry out new valuation studies. Such a generalization of valuation results are referred to as *benefit transfer*. In the case of the Baltic Sea, such transfers were made in the Baltic Drainage Basin Project in the 1990s for generalizing Lithuanian and Polish valuation results to Estonia, Latvia and Russia and for generalizing Swedish valuation results to Denmark, Finland and Germany. See the annexes and also chapter 3.

⁴ <http://www.evri.ca>

⁵ <http://www.norden.org/pub/sk/showpub.asp?pubnr=2007:518>

⁶ <http://www.beijer.kva.se/valuebase.htm>

3. Results

In this chapter, the results from the country reports are presented, in terms of which studies have been made across the Baltic Sea region, what general conclusions can be drawn from these studies, and which are the most important knowledge gaps and areas for prioritized research and studies in the near future. Section 3.1 summarizes and lists the studies found. Section 3.2 updates the results from the Baltic Drainage Basin Project reported in the annexes. Section 3.3 concludes the report in terms of knowledge gaps and suggestions for further studies.

3.1. What has been done so far?

In total, the country reports present about 40 studies on the benefits of an improved marine environment (or the costs of a deteriorated environment) in the Baltic Sea area. A few of these are international studies, relevant for all or several Baltic Sea countries. Most of the international studies are related to the Baltic Drainage Basin Project, a research project carried out in the mid-1990s (see details in, e.g., section 3.2). The “local” studies are mainly case studies, focusing on a specific local action, proposition or (more or less) likely-to-be-an-event related to the environment.

Most of the studies have been made in Denmark, Finland, Germany and Sweden, and few or no primary studies have been found in Estonia, Latvia, Lithuania and Russia. In the country reports in the annexes for these countries, however, unique insights are given related to which are the most important knowledge gaps to be covered.

One result from this literature review is that there is an overweight on stated preferences methods compared to revealed preferences methods. Within the group of SP methods, CVM is more frequent than CE. These outcomes correspond well with the types of studies that are found in general valuation study databases such as NEVD and ValueBase^{SWE} (cf. section 2.2).

Summaries of the studies are found in the annexes. In table 3 below, a topic-by-topic overview is presented of some of the important studies found in the country reports, based on specific focus areas of the environmental issues to which the studies are related (eutrophication, fisheries, oil and marine debris, windmill parks and other/several areas). The references to these studies are found in the respective annexes.

Table 3. Overview of important studies found in the country reports, topic-by-topic (full references are found in the annexes for each country respectively).

Focus of the study	Country	Reference
Eutrophication	All BS countries	The Baltic Drainage Basin Project (see e.g. Markowska & Zyllicz (1999) and Turner et al. (1999))
	Denmark	Atkins & Burdon (2006)
		Atkins et al. (2007)
	Estonia	Gren (1996)
	Finland	Siitonen et al. (1992)
		Kiiriki et al. (2003)
		Kosenius (2004)
		Laukkanen & Huhtala (2008)
	Germany	Hirschfeld (2007)
		Mewes (2006)
	Sweden	Frykblom (1998)
		Hasselström et al. (2006)
		Sandström (1996)
		Soutukorva (2001)
		Söderqvist and Scharin (2000)
Fisheries	Denmark, Finland, Iceland, Norway, Sweden	Toivonen et al. (2000)
	Denmark	Roth & Jensen (2003)
	Estonia	Vetmaa et al. (2003)
	Finland	NAO (2007)
		Olkio (2005)
		Parkkila (2005)
		Valkeajärvi & Salo (2000)
	Germany	Bundesforschungsanstalt für Fischerei (2007)
		Döring et al. (2005)
	Sweden	Fiskeriverket (2008)
		Olsson (2004)
		Paulrud (2004)
		Soutukorva and Söderqvist (2005)
Oil and marine debris	Denmark, Germany, Sweden	Hall (2000)
	Denmark	Storstroms amt (2002)
	Estonia, Sweden	Sanctuary and Fejes (2006)
	Estonia	Etkin (2000)
	Finland	Ahtiainen (2007)
	Sweden	Forsman (2003, 2006, 2007)
Windmill parks	Denmark	Ladenburg (2007)
		Ladenburg & Dubgaard (2007)
		Ladenburg (2008)
	Germany	Benkenstein et al. (2003)
		Scharlau et al. (2004)
	Sweden	Ek (2002)
		Liljestam and Söderqvist (2004)
Other/several areas	Denmark	COWI (2007)
		Visitdenmark (2007)

	Estonia	Vetemaa et al. (2003)
	Finland	HELCOM and NEFCO (2007)
		Siitonen et al. (1992)
	Lithuania	Lithuania Environmental Financing Strategy (2001)
		Povilanskas et al. (1998)
		Sceponaviciute et al. (2007)
	Russia	Bodrov (2005)
		EBRD (2003)
		Kaliningrad Regional Public Fund (2002)
		Nordstream (2007)
	Sweden	Eggert & Olsson (2003)
		Franzén et al. (2006)
		Paulsen (2007)

Regarding eutrophication, the results of the Baltic Drainage Basin Project have been used frequently. These results are presented and discussed in all the country reports. For example, see the summaries of Markowska & Zylicz (1999) and Turner et al. (1999) in annex IX. In these reports, results from large scale Polish and Swedish CVM studies on reduced nutrient loads are discussed and aggregated to all the Baltic Sea countries. One result from the project is an estimate of aggregate WTP across the Baltic Sea area for a reduction of the nutrient loads by 50 %.

Regarding fisheries, a large scale international study is found in Toivonen et al. (2000), who report on several CVM studies for recreational fisheries in the Nordic countries. The report presents the WTP for three different scenarios related to improved or preserved possibilities for recreational fisheries.

Regarding oil spill and marine debris, Hall (2000) presents an overview of economic and social costs to coastal communities in Great Britain, Norway, Denmark, Germany and Sweden from historic oil spill accidents and marine debris. The results from this report concerning Denmark, Germany and Sweden are found in the respective annexes. One major, general conclusion worth mentioning is that direct cleaning costs only constitute a share of the total costs to society from oil spill, since there are also negative effects in not least fisheries and the tourism industry when an oil spill accident occurs. This is also evident in Swedish case studies by Forsman (2003, 2006 and 2007).

Regarding windmill parks, one general conclusion from, e.g., Ladenburg & Dubgaard (2007) and Liljestam & Söderqvist (2004), is that the public seems to have a positive WTP for locating windmill parks offshore rather than on land or very near

the coast. Another general conclusion from the empirical research seems to be that the marginal WTP for increasing the parks' distance from the shore is decreasing.⁷

Reports from the above studies/projects can be used for drawing general conclusions on the values of an improved marine environment across the Baltic Sea area, and hand-picked conclusions from these reports are found in the annexes. In section 3.2, below, we develop the results from the Baltic Drainage Basin Project, taking into account new information on income elasticities of WTP and the fact that many countries have changed since the mid-1990s in terms of economic strength.

Regarding the other studies in the annexes, quantitative conclusions which are valid for the whole Baltic Sea area are more inaccessible. This is because there have been very few coordinated valuation efforts, and the studies have in most cases focused on specific scenarios or occurrences in specific geographical areas of the Baltic Sea. Neither the scenarios or occurrences, nor the geographical areas are instantly comparable.

As an example of the difficulties in aggregating occasional results to the Baltic Sea area, Atkins and Burdon (2006) will be used. In this study, the authors estimate the value of a specific nutrient load reduction programme in the Randers Fjord by exemplifying to the respondents with expected changes in water transparency by 2.5 – 3 meters. Aggregating this to the Baltic Sea level, one would have to assume (1) that a given nutrient reduction increases the water transparency by 2.5 – 3 meters also in other areas, (2) that the inhabitants near the Randers Fjord are representative in general, with respect to the values attached to increased water transparency, and (3) that the distribution of usages of the specific area (how large proportion of the “users” of the area go swimming, boating, recreational fishing etc.) is representative. This is at least true if one wants to argue that the value an individual attaches to an increased water transparency is dependent on whether he/she is bathing, fishing, boating or doing other activities in the area.

In theory, one could utilize some results from the Randers Fjord estimations and other studies together with benefit transfer methods, in order to calculate the potential benefits of the scenario in different similar areas. Conducting such studies in practice, however, is a research project of its own, and it would require efforts way beyond the scope of the framework for this project in order to achieve reliable results.

⁷ An example might explain this to a non-economist reader: People tend to be willing to give up an amount of money - say amount A - for placing the park 10 miles offshore rather than on the beaches. However, the amount they are willing to pay for placing the windmill park *additionally* 10 miles offshore, is less than this amount A.

Unfortunately for aggregation purposes, most studies found in the country reports are in fact local and specific, since there have not been many coordinated research projects in the area to this date.

3.2. Updating results from the 1990s

The review of studies of economic effects shows that very few studies can be used for obtaining a general picture of the benefits of an improved Baltic Sea environment. However, as mentioned in section 3.1, and as is evident from the country reports in the annexes, one coordinated effort was made in the mid-1990s in the already mentioned Baltic Drainage Basin Project. This project entailed benefit studies in Lithuania, Poland and Sweden and the results will be discussed and updated below.

The results of the studies in the Baltic Drainage Basin Project have been reported and used in a large number of studies, see e.g. Turner et al. (1995), Söderqvist (1996), Gren et al. (1997), Gren (1999), Markowska and Zylicz (1999), Turner et al. (1999) and Söderqvist (2000). Several different CVM surveys were carried out, and the results vary somewhat depending on what results are used and what assumptions are made regarding the WTP of non-respondents. In an attempt to update these results to present-day conditions, we have chosen to focus on the results of the mail CVM surveys in Poland and Sweden because they were based on identical survey instruments.

In these CVM surveys, a questionnaire containing information on the effects of the eutrophication of the Baltic Sea was sent by mail to random samples of Poles and Swedes. Besides giving a background to what is meant by eutrophication, the information focused on describing oxygen shortage episodes, changed composition of animals and plants in the sea, and algal blooms including potential health risks. The questionnaire also included questions from which it was possible to infer the respondents' WTP for an action plan that would reduce the eutrophication to a level that the Baltic Sea sustains. The Polish results were generalized to those Baltic Sea countries which in the 1990s were called "transition economies" (Estonia, Latvia, Lithuania and Russia), and the Swedish results were transferred to the established market economies of Denmark, Finland and Germany.

On the whole, the results suggested that large-scale actions against the excessive loads of nutrients should be taken, at least if actions are designed in a cost-effective way and not according to a principle that all nutrient sources in all countries should reduce their loads by the same percentage (Gren et al., 1997; 2000). The studies also indicated that concern for future generations was the most important motive among both Poles and Swedes for accepting to fund actions against eutrophication (Söderqvist and Markowska, 1997; Söderqvist, 1998).

The annexes include information about the original WTP estimates and also express the estimates in EUR²⁰⁰⁷. However, since the WTP estimates are based on surveys carried out more than 10 years ago, it is uncertain if they correspond at all to today's WTP among people living in the Baltic Sea countries. As is emphasized in some of the annexes, one reason for the WTP estimates to be obsolete is the substantial changes in terms of, for example, economic growth that has taken place in the former "transition economies" since the mid-1990s. It is likely that the general positive economic development in the Baltic Sea countries during the last decade has influenced people's concern for the environmental status of the Baltic Sea positively. This suggests a need for new internationally coordinated studies on people's WTP for an improved marine environment.

It is still possible to make a rough update of the WTP results from the 1990s by adjusting them for the positive economic development. More precisely, studies have shown that a 1% increase in people's income results in about 1% increase in people's demand for reduced eutrophication effects (Hökby and Söderqvist, 2003). As to the sensitivity of WTP for increases in income, a 1% increase in income has been found to result in about 0.3% increase in WTP (Hökby and Söderqvist, 2003). This implies an income elasticity of WTP equal to 0.3, and results by Ready et al. (2002) suggest that this is probably a conservative estimate.⁸

Using (a) the estimate of an income elasticity of WTP of 0.3, (b) the growth in GDP per capita as a proxy for income growth, and (c) data in IMF (2007) on GDP per capita, population and consumer price index for the nine Baltic Sea countries, the old WTP estimates from the 1990s were updated to the figures reported in table 4. As a total for the adult population in all Baltic Sea countries, these benefits amount to slightly less than 5 000 MEUR²⁰⁰⁵ per year. The variation in WTP among different countries mainly reflects different population sizes and the fact that, on average, the original WTP estimate per Swede was about 10 times higher than the original WTP estimate per Pole.

Much research efforts are definitely still needed for obtaining a detailed, comprehensive and up-to-date picture of the benefits of a reduced marine eutrophication. We will return to this issue in section 3.3. However, the figures in table 4 are still likely to roughly indicate the substantial benefits that society would receive from achieving an undisturbed Baltic Sea. It should be emphasized that these benefits should not be interpreted as the benefits of taking actions *per se*, but the benefits of taking the particular actions that in fact would succeed in achieving an undisturbed Baltic Sea.

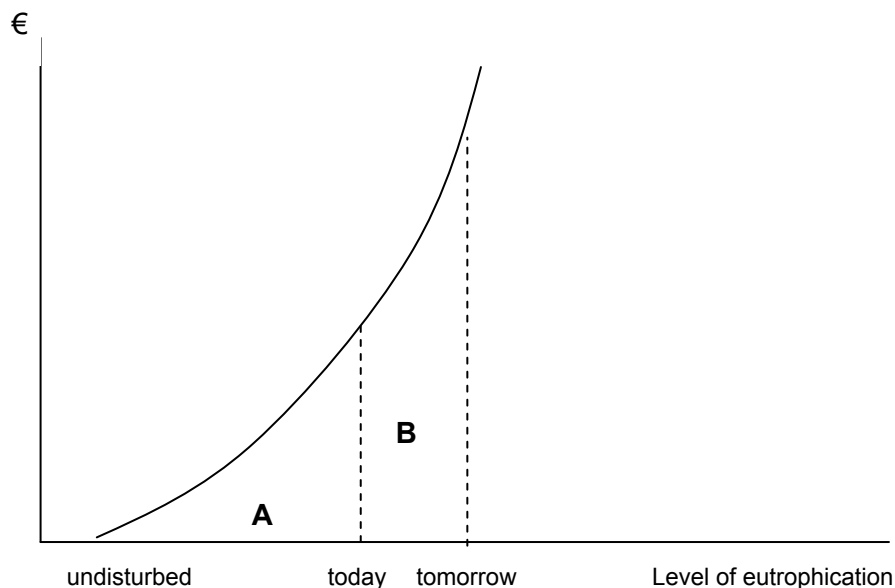
⁸ Note that the income elasticity of demand and the income elasticity of WTP are two different entities, which explains why the estimates differ. As is explained in Hökby and Söderqvist (2003), the former is based on the demand function and the latter is based on a function which relates WTP to a number of explanatory variables including income.

Table 4. Benefits of accomplishing a Baltic Sea undisturbed by excessive inputs of nutrients as measured by the annual total willingness-to-pay during 20 years among adult people living in the Baltic Sea drainage basin.

Country	MEUR ²⁰⁰⁵ per year
Denmark	920
Estonia	60
Finland	610
Germany	530
Latvia	60
Lithuania	80
Poland	930
Russia	180
Sweden	1 460
<i>Total</i>	<i>4 830</i>

Furthermore, 5 000 MEUR²⁰⁰⁵ per year might be interpreted as the costs of taking no action instead of taking actions that would result in this undisturbed situation. These costs of no action are likely to increase over time if no action implies a further deterioration of the environmental status of the sea, introducing an additionally decreased wellbeing among those affected by the environmental status. This is illustrated schematically by figure 1. The figure shows a curve for the marginal costs of eutrophication, which are defined as the change in the total costs of eutrophication resulting from a marginal (say a one-unit) change in the level of eutrophication. These marginal costs are the same thing as the marginal decrease in people's wellbeing due to eutrophication. It is assumed that these costs are increasing with the level of eutrophication, which explains the gradually increasing slope of the curve. Given today's level of eutrophication, the benefits of accomplishing an undisturbed Baltic Sea are equal to area A under the curve. According to the estimates in table 4, this area amounts to about 5 000 MEUR²⁰⁰⁵ per year. If no action today results in an increased level of eutrophication tomorrow, the figure indicates that this implies additional costs of eutrophication amounting to area B under the curve. This also means that given tomorrow's level of eutrophication, the benefits of accomplishing an undisturbed Baltic Sea are equal to area A plus area B.

Figure 1. A marginal cost of eutrophication curve.



3.3. Knowledge gaps and suggestions for further studies

This section concludes the report in terms of knowledge gaps and important areas for further studies. In section 3.3.1, brief summaries of the most important conclusions from each country report are presented. In section 3.3.2, we summarize the results in terms of which ecosystem services have been covered by economic analyses, and which are the most important ecosystem services to pinpoint for further research, according to the country reports. In section 3.3.3, we present a shortlist of suggestions for studies to be prioritized, based on the conclusions from the country reports.

3.3.1. Conclusions from the country reports, regarding knowledge gaps and suggestions for further studies

Denmark: Hasler et al. conclude that there are only a few Danish studies that assess the value of water quality changes and eutrophication issues. More empirical research is suggested, both for specific cases and more generally, maybe as case studies in each country or/and a new large scale CVM or CE study. The authors argue that the use of CE, compared to CVM, enables gathering of more detailed information on values of different attributes of the environment, such as bathing

water quality, fishery possibilities, quality of the beaches, etc. Many of the ecosystem services are not assessed in terms of their value, and for many of these, “*the available scientific knowledge and data available are likely to present a sufficient basis for economic assessments and valuation studies*” (annex I, p. 72). Hasler et al. emphasize the importance of more research on use values from recreation and fishery possibilities, linked to data on water quality and eutrophication, and effects in the tourism industry from eutrophication and pollution with hazardous substances.

Estonia: Tuhkanen concludes that “*all of the reviewed studies, except for one, uses data from the 1990s, which makes the results somewhat dated, as Estonia has undergone rapid changes in the recent decade – most likely affecting values*” (annex II, p. 88). Further, a conclusion from the Estonian country report is that there is a large number of knowledge gaps related to values of an improved environmental state in the Baltic Sea, and that “*one way to prioritize future study areas is to relate them to pressing topics like eutrophication*” (p. 89). Regarding oil spill, the conclusion from the literature review is that both the studies with results for Estonia value costs “directly”, and neither of them includes a valuation of ecosystem effects from oil spill. Tuhkanen also concludes that there is a need for economic investigations of non-use values related to the Baltic Sea environment, since these might account for a significant share of the total economic value of the sea.

Finland: Ahtiainen concludes that only a few of the ecosystem services listed in Garpe (2008) have been covered. However, she argues that there is a need to consider “*which ecosystem services or environmental impacts are of most relevance from the Finnish viewpoint*” (annex III, p. 110). She continues by stating that more information on already studied areas, such as eutrophication, fisheries and oil spills is still needed. Regarding eutrophication, Ahtiainen, though, mentions an ongoing large-scale study among Finns on the value of reducing eutrophication in the Gulf of Finland.

Related to fisheries, the Finnish conclusion is that more studies are needed which focus on the value of fisheries in the Baltic Sea more directly, since most studies have included other water systems or have focused on rivers. Regarding oil spill, Ahtiainen concludes that there are no studies on the value of reducing the risk of future oil spill, since the (one) study being found estimates the benefits of reducing the harm from possible future oil spills. Ahtiainen also concludes that “*typically, the economic measure has not been directly linked to any ecological variable, and it is also common that the environmental change has not been described quantitatively. Thus it may be difficult for example to attach the values for reducing eutrophication to a specific nutrient reduction*” (p. 111). She also emphasizes the need for more comprehensive valuation studies, and that there is a need to study marginal benefits or damages of changes in the marine environment, since little has been done in this area.

Germany: Kowatsch and Döring conclude that *“on land and in the case of coastal zone management we have now some studies on cost effectiveness of measures to reduce nutrient loads etc. However, from a benefit perspective, we have nearly nothing. Therefore, it is necessary to conduct studies to evaluate the benefits from an improving environmental status of the Baltic Sea in the future.”* (annex IV, p. 134). They further emphasize knowledge gaps in terms of the benefits of nutrient and contaminant reductions in the Baltic Sea and the economic effects in the fishing industry of a stock recovery and improvements of conditions in the spawning grounds of cod and salmon. They suggest research within these areas, and also research on the possible losses from potential non-actions in the coming years.

Latvia: Vanags and Kasa conclude that there are no direct studies in Latvia which offer estimates of the benefits of a cleaner Baltic Sea environment. Vanags and Kasa express this as a *“total gap in knowledge”* (annex V, p. 149). The inference made from the Baltic Drainage Basin Project to today’s benefits from reduced effluents of nutrients in Latvia is uncertain not least since the studies within this project are becoming outdated. Regarding future possible studies, they conclude: *“Finally, there is only one reliable solution for filling these gaps – or perhaps this one large gap. This is simply to conduct a specific Latvian contingent valuation study today.”* (p. 150). They also bring forward the aspect that the techniques for contingent valuation have improved during the last decades, which increases the possibilities for reliable estimates.

Lithuania: Semenienė concludes that only a few economic valuation studies have been found in Lithuania. One important result from these studies is, however, that *“tested economic valuation methods generated meaningful and commensurable quantitative results, which could be interpreted reasonably and rationally from the socio-economic and geographical point of view”*. (annex VI, p. 164) She also argues that the Eastern Baltic Sea countries have specific features in comparison to Western Baltic Sea countries. For example, methods which require historic information have to be used cautiously, since the economies of countries like Lithuania have changed a lot recently. Another main conclusion is that *“economic valuation methods can and should enjoy wide acceptance and application in identifying the coastal policy priorities and approaches in the Baltic States.”* (p. 164)

Poland: Zyllicz et al. conclude that there have only been a limited number of relevant studies in Poland. The available information from the studies in the 1990s is old since there have been methodological developments regarding contingent valuation, and since Poland has gone through major economic changes recently. They also conclude that the valuation studies made this far have not been related directly to any specific programme of reduction of nutrient loads. They continue: *“Finally, there have been no attempts to disaggregate the values to numerous services the Baltic Sea can provide.”* (annex VII, p. 187). Based on these shortcomings, they argue that there is a need for a new, large scale valuation study, connected to expected environmental changes due to a feasible and probably international pro-

gramme. Also, they argue that the possibilities of valuing services separately should be considered.

Russia: Volchkova and Lazareva conclude that the shortage of studies found in Russia, aimed at economic assessment of natural resources and environmental policy implementation, can be explained partly by a non-existence of market economic traditions. They note that projects being more in line with such traditions, especially those funded by international organizations, often provide assessments of their economic and ecological impacts if such projects present an environmental threat. They continue by defining three crucial circumstances which define the knowledge gap: Shortages of data, shortages of trained environmental economists and a lack of coordination among research bodies. They also mention a lack of sufficient international cooperation.

Sweden: Hasselström concludes that “*most of the valuation studies focus on topics connected to eutrophication and the value of cultural services such as recreation and aesthetic values.*” (annex IX, p. 226). He continues by stating that there are few studies related to marginal benefits of nutrient reductions, and that such studies might be important for political decision making. Regarding oil spill, Hasselström concludes that some short-run socioeconomic consequences have been studied, but that nothing has this far been done relating to consequences of oil spill to the values of ecosystem services. Another important research area in the future is related to further studies on the link between eutrophication and the provision of food in the ecosystems, since existing results on the benefits of reducing nutrient loads might give an incomplete picture of the true values, not taking this link into consideration.

3.3.2. Which ecosystem services are covered by economic research so far, and which are the most important knowledge gaps?

In this section, we summarize the findings of the country reports in terms of the ecosystem services coverage and the suggested areas for future research, related to specific ecosystem services. In order to make the results accessible, we have chosen to present the highly schematic table 5 below. Note that the results in this table are taken from (our perception of) what has been stated in the country reports, and that these results might have been different if other groups of scientists or people had been asked. Nevertheless, the results in table 5 below might serve as a unique indication of the aggregate opinions of leading environmental economists around the Baltic Sea about which research and studies should be prioritized in the near future.

The results are presented in two dimensions: (1) Degree of coverage in economic research this far; and (2) Degree of priority, regarding the need for future studies.

Table 5. Ecosystem services coverage: what has been done and within which areas are further studies suggested in the country reports?

Category		Service	Degree of coverage in economic research, relative to other ecosystem services (aggregate based on number of related studies and the degree to which the specific services have been studied).	Degree of priority, regarding the need for future studies
Supportive services	S1	Biochemical cycling	Low	?
	S2	Primary production	Low	?
	S3	Food web dynamics	Low	?
	S4	Diversity	Medium	!
	S5	Habitat	High	!!
	S6	Resilience	Low	?
Regulating services	R1	Atmospheric regulation	Low	?
	R2	Regulation of local climate	Low	?
	R3	Sediment retention	Low	?
	R4	Biological regulation	Low	?
	R5	Pollution control	Low	?
	R6	Eutrophication mitigation	Low	?
Provisioning services	P1	Food	High	!!!
	P2	Inedible resources	Low	?
	P3	Genetic resources	Low	?
	P4	Chemical resources	Low	?
	P5	Ornamental resources	Low	?
	P6	Energy	Low	?
	P7	Space & waterways	Low	?
Cultural services	C1	Recreation	High	!!!
	C2	Aesthetic value	High	!!!
	C3	Science & education	Low	?
	C4	Cultural heritage	Medium	!
	C5	Inspiration	Low	?
	C6	The legacy of nature	Medium	!

Legend:

? = The country reports do not specifically mention this service as an important priority for future research

! = Important area for further studies

!! = Very important area for further studies

!!! = Crucial area for further studies

Related to (1), we have chosen the attributes of *low*, *medium* and *high* as an indication of how well the area has been studied in the Baltic Sea countries. The classification is based on (a) the number of studies found which are related to the specific service (relatively to other services); and (b) the degree to which the studies found are related to the specific service. Some studies are only weakly linked to the specific service, and just stating the number of studies related to each service would thus be misleading. For example, some studies are related very indirectly to eutrophication mitigation services, since they value a reduced eutrophication, but do not really measure the values and effects of changes in the Baltic Sea's own eutrophication mitigation capacity.

Related to (2), we have divided the results into four classes, based on the conclusion sections in the country reports. The classification (with legends) is:

? = The country reports do not specifically mention this service as an important priority for future research

! = Important area for further studies

!! = Very important area for further studies

!!! = Crucial area for further studies

One interesting observation is that all the areas in which further studies in the near future have been judged to be important, very important or crucial, have in several cases been subject to research before. Two entirely different potential conclusions might be drawn because of this (here presented very “edgy”).

- (1) That these areas are the most important ones, which has already resulted in many studies.
- (2) That it exists some kind of bias towards wanting to focus more on already studied areas, and that other areas are not viewed as important due to lack of knowledge about these areas.

Also, one possible explanation to why there have not been much done so far related to valuations of, for example, regulating services could be that this is a very difficult area, demanding ecological knowledge. There might be a bias among economists to value easy-to-value-topics and scenarios, rather than trying to perform valuations in yet very uncertain areas.

Nevertheless, important areas for further research and studies seem to be related to values of the supportive services of diversity and habitat, the provisioning of food, and the cultural services of recreation, aesthetics, cultural heritage and the legacy of nature. In order to get a more complete picture of which are the most important knowledge gaps to fill in the near future, we suggest an evaluation based on these results in combination with the results on the status of the ecosystem services in Garpe (2008).

3.3.3. Suggestions related to further studies

Below, we are now able to present some main suggestions for future research, based on the conclusions from the country reports.

- First of all, there seems to be a consensus about the need for a new, large scale study, valuing the benefits of decreased nutrient loads to the Baltic Sea. The studies made in the nineties are outdated in two aspects: (1) Most countries have changed dramatically in terms of economic development in the last decade, and (2) valuation methods have been subject to important methodological developments during the last decade, allowing more precision in the valuation results. Also, voices are raised in the country reports for (a) valuing different attributes of reduced nutrient reductions, such as use/non-use values, effects on fisheries, tourism, bathing water quality, visual quality of beaches etc., and (b) constructing scenarios for valuation which are based on a feasible and possible action programme which might actually accomplish what is valued.
- Also relating to nutrients, there is a need for valuing *marginal* benefits of reduction. This is very important since the socially efficient nutrient reduction level can be identified only if there is knowledge of both marginal costs and marginal benefits of reduction. At present, a lot is known about marginal costs, but practically nothing about marginal benefits. Using a choice experiment methodology is one possible way to estimate marginal benefits.
- Related to fisheries, there are suggestions to study the potential gain to the fishery industry of a programme for cod-stock recovery. There are also suggestions to conduct further studies, linking nutrient load changes to habitat quality and “end results” for the fishery industry. Thirdly, effects in the fishery industry should be linked to potentially large cultural values from preserving traditional fishing communities. Finally, more research should be done on economic values of recreational fisheries directly relating to the Baltic Sea, since most studies are very broad from a geographical point of view, or focus on fisheries in lakes and rivers.
- Related to oil spill, there are two important tasks for future studies. The first is to quantify economic consequences of the ecological impacts from oil spill accidents. The second is to value reductions of *risks* for oil spill accidents, since this is very important for conclusions on which political and technical measures should be taken.

- Methodologically, voices are raised about the importance of connecting the economic measures to specific to specific and scientifically measurable ecological conditions, in order to know more precisely what is valued. Valuation should be used as a tool for making priorities between different political targets, and this connection is crucial for having the results usable.
- Finally, the costs of non-action in specific political and geographical areas should be estimated.

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Annex I. Denmark

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Introduction

This country report describes Danish studies and data on economic effects and ecosystem services of an improved marine environment or damage of a deteriorated marine environment, as well as studies on the current situation in the Baltic and valuation studies of related Danish water bodies. The literature and data revealed comprise studies that have used any kind of valuation method with relevance to the Baltic Sea, that can be used to assess relevant welfare economic effects (i.e. changes in consumer surplus and changes in producer surplus/profits), but also other monetary measures such as revenues, expenditures, costs, gross domestic product, gross regional product, etc.

On a broad basis we have sought for studies and analyses of economic effects of

- (i) *eutrophication*
- (ii) *people's willingness to pay for an improved marine water quality*
- (iii) *fish (e.g. cod) stock changes on commercial fisheries, and*
- (iv) *tourism and recreational fisheries*

Each of the studies is summarized with respect to the following information:

- a. *Study reference*: Full bibliographic information, including web address if the study is downloadable from the Internet.
- b. *Environmental focus of the study and to what ecosystem service(s) this focus is related*: A description of what aspect of marine environmental change was subject to study, according to the definitions and services described in Garpe (2008).
- c. *Extent of environmental change*: A description (in quantitative terms whenever possible) of the environmental change that caused the economic effect.
- d. *Study area and study population/industry*: A description of what area and population/industry were subject to study.
- e. *Valuation method*: A description of method and how the economic effect was estimated.
- f. *Economic measure(s)*: The measure(s) used for expressing the economic effect, e.g. consumer surplus, willingness to pay, willingness to accept compensation, producer surplus, profits, revenues, expenditures, costs, gross domestic product, gross regional product, as well as the unit (per person/household/visitor etc.) and period of time the measures are valid.
- g. *Estimated values of the economic measure*: The monetary values in DKK and to Euros in 2007 prices. If applicable both aggregate values for the whole study population and values per object in the population are included.

h. *Any other especially interesting piece of information*, such as that the study was a part of a cost-benefit analysis, that it covered economic effects also in other countries, or that the study also estimated changes in the number of jobs, changes in the number of visitors, etc.

After the summaries of the studies the general findings are summarised, including a description of the extent to which the ecosystem services listed in Garpe (2008) have been subject to study.

Subsequently we discuss crucial gaps of knowledge and suggest what research could be carried out for filling these gaps.

Search method

In 2002, the Economic Council of Denmark concluded that:

“While there are information about economic costs of a couple of measures regarding the [Danish] water environment, we don’t know anything about the economic value of the benefits” (our translation from Danish)
(The Economic Council, 2002, p. 219)

However, a year later, a literature survey (Pedersen, 2003) regarding economic valuation of wastewater emissions of nitrogen, phosphorus, and organic matter identified one single study specifically analysing Danish costs and benefits of an improved water environment – Turner et al.’s 1999 study (see below).

Remembering these studies, it was not expected to find other Danish valuation studies from before 2002-2003, but a cross check was performed. Additionally, new valuation studies have been published during the last five years. A few directly address the Baltic, and others have relevance for the Baltic as similar or related changes in water bodies are analysed.

The studies cover both published and scientific articles and reports, as well as “grey” literature. The databases the Environmental Valuation Reference Inventory (EVRI. Weblink: <http://www.evri.ca>) the Nordic Environmental Valuation Database (NEVD. Weblink: <http://www.norden.org/pub/sk/showpub.asp?pubnr=2007:518>) and the Valuation Study Database for Environmental Change in Sweden (ValueBase^{SWE}. Weblink: <http://www.beijer.kva.se/valuebase.htm>) have been used together with Google search and search on relevant internet pages, including the homepages of Ministries, organisations, research institutes and universities.

As a starting point, a draw from the EVRI database of potential interesting studies, relevant analyses, studies, evaluations etc. was made. This was double checked with the Nordic Environmental Valuation Database (NEVD) and the studies covered in Navrud (2007).

Furthermore, this information was supplemented with knowledge from the following information sources:

ISI Web of Knowledge - Web of Science (database on the internet containing information about international journal articles)

Searches have been performed in the database on relevant combinations of terms.

For instance:

“valuation and baltic and denmark”

“costs and eutrophication and baltic”

“benefits and eutrophication and baltic”

“eutrophication and denmark”

“tourism and baltic”

“fishery and denmark and baltic”

“angling and denmark”

etc. etc.

<http://www.google.com>

Google is an excellent tool to hit the more ‘grey literature’ – e.g. unpublished documents and articles written in Danish. Google searches on relevant combinations of terms have been performed. For instance: “valuation baltic denmark .pdf” – searching on these terms results in a list of pdf-documents where the terms “Baltic”, “valuation” and “Denmark” are mentioned. Searches on Danish search terms have been performed too, covering the same terms as above.

<http://www.bibliotek.dk>

In this database all Danish library resources can be identified. Searches on relevant terms (both English and Danish) have been performed.

Furthermore, relevant analyses have been identified through the authors’ personal knowledge about these, and through literature lists in already identified studies.

Exchange rates and consumer price indices

The exchange rates that have been used to convert value estimates from DKK to/from EUR (or other currencies) have been found on the following homepage:

<http://nationalbanken.statistikbank.dk/statbank5a/default.asp?w=1024> .

The exchange rates refer to average annual spot rates and are presented as DKK per 100 units of foreign currency.

The Danish consumer price index have been used to correct for inflation. The index can be found on the following homepage:

http://www.dst.dk/Statistik/seneste/Indkomst/Priser/FPI_inflation.aspx

Findings

In this first section presenting the relevant studies (see table DK.1 for an overview) we are describing studies with direct relevance for evaluation of changes in the environmental conditions and environmental services and goods in the Baltic. We first present studies on eutrophication, then studies on recreational fisheries and then studies assessing the visual amenities of offshore windmills.

Table DK.1. Overview

No.	Ecosystem service, good - environmental focus	Reference	Method	Economic measure	Study Area
Studies with direct relevance for economic evaluation of changes in the Baltic Sea					
1	Eutrophication	Turner et al. (1999)	CVM	CS	The Baltic
2	Eutrophication	Atkins and Burdon (2006)	CVM	CS	Randers Fjord
3	Eutrophication	Atkins et al. (2007)	CVM	CS	Randers Fjord
4	Recreational fisheries	Toivonen et al. (2000)	CVM	CS	The Nordic countries
5	Recreational Fisheries	Roth and Jensen (2003)			
6	Recreational Fisheries	Toivonen et al. (2004)	CVM	CS	The Nordic countries
7.	View, wind-mills offshore	Ladenburg and Dubgaard (2007)	CE	CS	Denmark, eastern coast
8.	View, offshore windmills	Ladenburg (2007)	CE	CS	Denmark, eastern coast
9	View, offshore windmills	Ladenburg (2008)	CE		Denmark, eastern coast
Studies with relevance for the current situation in the Baltic Sea					
10	Tourism	VisitDenmark (2007), COWI (2007)	Turnover, market prices		The eastern part of Denmark, the Baltic Sea
11	Sailing	VisitDenmark (2007), COWI (2007)	Expenditures		The eastern part of Denmark, the Baltic Sea
12	Oil spill	Hall (2007)	Expenditure		Denmark
13	Oils spill	Anonymous (2007)	Expenditure, lost profits		Grønsund (Lolland, Falster)
Studies with indirect relevance, economic assessment of other water bodies (e.g. inland waters)					
14	Lake view	Hasler et al. (2002)	HP		Lakes in Denmark
15	Water quality, lake	Fardan et al. (2005)	CE	CS	Furesøen, lake at Zealand
16	Fisheries	Jensen et al. (2000)	Revenues		Ringkøbing Fjord
17	Groundwater, surface water	Hasler et al. (2005)	CE	CS	Denmark
18	River basins/valleys	Hansen and Thorsen (2006)	CE	CV	Denmark

Eutrophication

1. TURNER ET AL. (1999)

Study reference(s)

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

See also

Söderqvist, Tore, 1996. Contingent Valuation of a Less Eutrophicated Baltic Sea. Beijer Discussion Paper Series No.88, Beijer International Institute of Ecological Economics, Stockholm.

Pedersen, Anders Branth, 2003. Økonomisk værdisætning af spildevandsemissioner af nitrogen, fosfor og organisk stof [Economic Valuation of emissions of nitrogen, phosphorous and organic matter from waste water]. Miljøprojekt nr. 821 (2003), The Environmental Protection Agency, Copenhagen.

Study area and study population

The Baltic Sea. All countries. A mail questionnaire was sent to randomly selected respondents in Sweden and Poland. A Danish benefit estimate was extrapolated by correcting the Swedish WTP with the difference in Denmark's and Sweden's GDP per capita. Needless to say, this correction is based on strong assumptions and according to the authors the estimated benefits 'should thus not be taken too literally'.

Environmental focus and extent of environmental effect

A 50 per cent reduction of nitrogen and phosphorus. Nutrient reduction simulations were carried out on an empirical budget model of the Baltic Proper.

Valuation method

Benefits were assessed through the contingent valuation method (willingness-to-pay, dichotomous choice).

Economic benefit measure

Compensating variation – willingness to pay

Estimated benefit values⁹

⁹ In converting the value estimates from SEK¹⁹⁹⁵ to EUR²⁰⁰⁷ the following exchange rates: SEK¹⁹⁹⁵ – DKK¹⁹⁹⁵: 78,6531 DKK per 100 SEK in 1995
DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745,0551 DKK per 100 EUR in 2007

The Swedish 1995 questionnaire was mailed to 600 randomly selected adult Swedes. The response rate was 60 per cent. Respondents were informed about the effects of eutrophication and were in the valuation scenario asked to assume that an action plan against eutrophication had been suggested. An action plan that over 20 years would decrease eutrophication to a level, that the Baltic can sustain. A level which is assumed to be attainable with a 50 per cent reduction in the nutrients. The respondents were presented for the following question:

"If there would be a referendum in Sweden about whether to launch the action plan or not, would you vote FOR or AGAINST the action plan if your environmental tax would amount to SEK A per year during 20 years?" (Söderqvist 1996: 6) (Söderqvists underlining)

Instead of the 'A', different amounts between 1 000 and 25 000 SEK¹⁹⁹⁵ (135-3 379 EUR²⁰⁰⁷) were added. Mean annual WTP was 5 900 SEK¹⁹⁹⁵ (798 EUR²⁰⁰⁷), and 3 300 SEK¹⁹⁹⁵ (446 EUR²⁰⁰⁷) if non-respondents were assumed to have a zero WTP.

Corrected with the GDP difference, the Danish WTP is estimated to be 6 770 SEK¹⁹⁹⁵/year (915 EUR²⁰⁰⁷); and 3 790 SEK¹⁹⁹⁵/year (512 EUR²⁰⁰⁷) if non-respondents have zero WTP.

From this a national WTP for the Danish adult population is estimated to be 12 376 MSEK¹⁹⁹⁵ (1.673 MEUR²⁰⁰⁷), 6929 MSEK¹⁹⁹⁵ (937 MEUR²⁰⁰⁷) if non-respondents have zero WTP.

Any other especially interesting piece of information

The abatement costs are also estimated as part of the study. Abatement measures are divided into three classes in the study:

- Reductions in the deposition of nutrients on Baltic Sea and on land within the drainage basin.
- Changed land uses reducing leaching of nutrients.
- Creation of nutrient sinks which reduce the transports of Nutrients to the Baltic Sea.

Estimated costs¹⁰

Marginal costs of different measures reducing N and P at the source are summarized in the two tables below. It is not specifically specified which year the costs refer to, but for details regarding the cost estimation work reference is made to Gren et al. (1995); hence it is assumed that the cost estimates refer to 1995.

and price index:
DKK¹⁹⁹⁵ – DKK²⁰⁰⁷: 1,2806
have been used.

¹⁰ Regarding the conversion of values from SEK¹⁹⁹⁵ to EUR²⁰⁰⁷, see the previous footnote. For the conversion from DKK²⁰⁰³ to DKK²⁰⁰⁷, the price index: DKK²⁰⁰³ – DKK²⁰⁰⁷: 1.1160 has been used.

Table DK.2 Marginal costs of different measures reducing the nitrogen load to the coast (SEK¹⁹⁹⁵ per kg N)

Region	Agriculture	Sewage treatment plants	Atmospheric deposits	Wetlands
Sweden	20-242	24-72	135-9500	23
Finland	57-220	24-60	874-6187	66
Germany	20-122	24-60	210-3576	27
Denmark	23-200	24-60	544-3576	12
Poland	12-101	7-35	523-3412	10
Latvia	59-196	7-35	183-1195	20
Lithuania	72-208	7-35	254-1723	15
Estonia	55-192	7-35	153-1999	36
St Petersburg	43-236	7-35	353-1884	51
Kaliningrad	28-210	7-35	273-1593	43
Belgium			742-4184	
France			1507-9045	
Netherlands			562-7184	
Norway			475-3460	
UK			785-4855	

Source: Turner et al. (1999, p. 345)

Table DK.3. Marginal costs of phosphorous reductions (SEK¹⁹⁹⁵ per kg P)

Region	Agriculture	Sewage treatment plants	Wetlands
Sweden	155-6604	41-52	18232
Finland	225-6080	41-52	1748
Denmark	144-2610	41-68	1202
Germany	188-2964	41-68	899
Poland	114-2033	20-100	611
Estonia	282-5622	20-100	6090
Latvia	234-5662	20-100	1234
Lithuania	186-6696	20-100	964
St Petersburg	230-4314	20-100	823
Kaliningrad	338-4290	20-100	545

Source: Turner et al. (1999, p. 345)

It is apparent, that constructing wetlands is considered the most cost effective Danish N abatement measure. Other Danish (potential) low cost options are agricultural reduction in use of nitrogen fertilisers and cultivation of cash crops, and increased cleaning capacity at sewage treatment plants. Regarding P reductions, improvement in sewage treatment plants is the most cost effective measure.

A 51 per cent reduction of the Danish nutrient load to the Baltic has an estimated cost of 2962 MSEK¹⁹⁹⁵/year (400 MEUR²⁰⁰⁷).

Net benefit

In conclusion, the 50 per cent reduction scenario has an estimated net benefit within the range of 3 967 to 9 414 MSEK¹⁹⁹⁵/year (536-1 272 MEUR²⁰⁰⁷).

The benefit transfer from Sweden to Denmark

As pointed out by Turner et al. (1999), the results should not be taken too literally. E.g. Pedersen (2003) is questioning whether Swedes and Danes can be assumed to have the same preferences for the Baltic. The Baltic constitutes only a part of the Danish waters, while it constitutes a very large part of Swedish waters. Therefore, the estimated Danish WTP based on Swedish responses might (conservatively) be considered a WTP for a 50 per cent nutrients reduction in all Danish waters (Pedersen 2003)

Based on this assumption, and a calculation of total 1995 nutrient emissions to all Danish waters (68 666 tonnes N, 2 593 tonnes P), Pedersen (2003, p. 32, see note 17 and 18) estimates a Danish WTP for a halving of Danish nutrient levels (in all Danish waters) within the range of 141-251 DKK²⁰⁰¹ (21-38 EUR²⁰⁰⁷) per kilo nutrient.

On the other hand, the extrapolated values from Turner et al (1999) are quite similar to those of the CVM and CE on groundwater protection by Hasler et al (2005). Considering that the Turner study is focusing on the whole Baltic we assess that the benefit transfer is reliable, but also that the results should be confirmed and further explored by a new stated preference study.

2. ATKINS AND BURDON (2006)

Full reference

Atkins, J. P. and Burdon, D. 2006. An initial economic evaluation of water quality improvements in the Randers Fjord, Denmark. Marine Pollution Bulletin, 53:195-204.

Study area and study population

Randers Fjord (Århus County, east coast of Jutland). The fjord goes into Kattegat. The fjord is a shallow estuary and a popular location for angling, boating, water-sports, camping, and bathing. There is little evidence of commercial fisheries or industries within the fjord. Population: Individuals in Århus County.

Environmental focus and extent of environmental change

Reduced eutrophication. At the time for the study, there was evidence of a 10-fold increase in nitrogen and phosphorus transport compared to natural levels, making the fjord susceptible to eutrophication.

Valuation method

Benefits are assessed using the contingent valuation method. Costs are assessed though assessment of the costs associated with reducing eutrophication.

Economic measure

The provided benefit measures are compensating surplus measures – i.e. willingness to pay. Costs are assessed in the form of mitigation costs.

Benefit estimates¹¹

The article is presenting some initial findings. Data are analysed in more detail in Atkins et al (2007, see below). Postal survey (2003). 1510 questionnaires to individuals in Århus County (649 177 inhabitants). Response rate was 15 per cent. The contingency and questions were very strongly influenced by Söderqvist (1996). The authors describe a subtract of the scenario presented to the respondents:

“Suppose that an Action Plan was being proposed for the Randers Fjord, in order to reduce the nutrient inputs from both sewage plants and agricultural sources, resulting in improved water quality within the Fjord. . . . It has been calculated that full implementation of an Action Plan could result in an increased transparency of 2.5–3 m throughout the Fjord over the next 10 years. . . therefore with this improved water transparency the bottom of the Fjord will be visible whilst boating, swimming and fishing in most locations. . . . Suppose an Action Plan could only be implemented if funding for it could be received through an increase in local taxes. Without this funding there is little likelihood that the water quality will improve beyond its present level, so that the improved benefits discussed earlier will not come about.”
(Atkins and Burdon, 2006, p. 201)

Respondents were asked how much they maximum were willing to pay per month for a 10 year period to implement the action plan. 70 per cent indicated a willingness-to-pay for the plan. Bids ranged between 0 and 134 EUR²⁰⁰³ per month (0 and 143 EUR²⁰⁰⁷). Average bid was 12.02 EUR²⁰⁰³ per month (12.85 EUR²⁰⁰⁷). Based on the total population of Århus County, a total benefit of 5.5 MEUR²⁰⁰³ per month (5.88 MEUR²⁰⁰⁷) in the 10 year period for the population in the county can be calculated.

Cost estimates

Costs associated with reducing nutrient loading to the Randers Fjord are also assessed in the study. Different measures (in Danish aquatic plans) to improve water quality, and their estimated emission reduction are summed up. Different (farm and area) measures and their cost effectiveness are shown in the table below.

¹¹ The amounts presented in the article has been converted to EUR using the following exchange rate: EUR²⁰⁰³ – DKK²⁰⁰³: 13,4 EUR per 100 DKK in 2003. This rate is used to convert the estimates back into DKK²⁰⁰³.
In converting the value estimates from DKK²⁰⁰³ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745,0551 DKK per 100 EUR in 2007
and price index:
DKK²⁰⁰³ – DKK²⁰⁰⁷: 1,0674
have been used.

Table DK.4: Measures and cost-effectiveness (in EUR²⁰⁰⁰)¹²

	Area (ha)	Reduced N-leaching (tons N)	Gov costs (MEUR/year)	Farm costs (MEUR/year)	Cost-effect (MEUR/year)
Area measures					
Wetlands	6 000	2 100	1.4		0.7
Forest	17 340	900	2.7		3.1
ESA-area	29 195	900	9.3		10.4
Organic farming	155 700	1 600	31.7		19.9
Farm measures					
Less N in foodstuffs		3 100		0	0
Lower stocking density		100		1.5	15.0
Cover crops (6%)	120 000	3 000		8.4	2.9
Lower N-norms (10%)		5 100		17.0	3.4
Higher utilisation of N in animal manure		7 600		5.4	0.7
Total	328 235	24 400	45.1	32.3	3.1

Source: Atkins and Burdon (2006, p. 200)

*Costs converted by the authors from DKK into € at DKK 1 = EUR 0.134

The costs of building and upgrading waste water treatment plants are also assessed. These numbers are based on case studies in Germany (see the table below).

Table DK.5: Costs, waste water treatment (in EUR^{1990s})¹³

Size (p.e.)	New plant (EUR/p.e.)	Reconstruction and extension (EUR/p.e.)	Modernisation (EUR/p.e.)
<1 000	766.50	383.25-459.9	229.95
1 000-5 000	613.20	306.60-383.05	178.85
5 000-20 000	459.90	229.95-281.05	153.30
20 000-100 000	357.70	178.85-229.95	153.30
>100 000	255.50	127.75-178.85	153.30

Source: Atkins and Burdon (2006, p. 200)

* Costs converted by the authors from DM into EUR at DM 1 = EUR 0.511

¹² Note that it is not specifically stated which year the estimates refer to. In connection to the table it is noted that the estimates are obtained from Jacobsen (2002); as the estimates presented in Jacobsen (2002) originates from Jacobsen (2000), it is nevertheless assumed that the values refer to the year 2000. Note also that Atkins and Burdon (2006) have converted the estimates to EUR using an exchange rate of 13.4 EUR per 100 DKK.

¹³ In Atkins and Burdon (2006) it is specified that the estimates – according to a personal comment from Kampet (who is the original author of the table) – refer to average 1990s values.

Based on Gren's (2000) calculations of the marginal costs of reducing coastal discharges of nitrogen and phosphorus from Danish waste water treatment plants - 2.83–7.10 EUR²⁰⁰⁰ (3.23–8.11 EUR²⁰⁰⁷) per kg for nitrogen and 4.84–8.04 EUR²⁰⁰⁰ (5.53–9.19 EUR²⁰⁰⁷) per kg for phosphorus - a cost of nearly 300 MEUR²⁰⁰⁰ (343 MEUR²⁰⁰⁷) over the period 1993–2005 to implement the EU Urban Waste Water Treatment Directive for the Randers Fjord area is calculated.¹⁴

3. ATKINS ET AL. (2007)

Full reference

Atkins, J. P., Burdon, D. and Allen, J. H., 2007. An application of contingent valuation and decision tree analysis to water quality improvements. *Marine Pollution Bulletin*, 55:591-602.

This study is, empirically, reporting the same contingent valuation study as Atkins and Burdon (2006, see above), but the study is updating and extending these preliminary results, and e.g. the WTP estimates are quite different from those reported in Atkins & Burdon (2006).

Study area

The Randers Fjord was one of four study sites for the EU funded project EUROTROPH, which investigated nutrient cycling and the trophic status of European coastal ecosystems.

Valuation method

The method used is different than Atkins & Burdon (2006). In this 2007 version, a decision tree analysis is applied (Classification and Regression Trees (C&RT) methodology). A model 'ideal for determining patterns and deriving models from large noisy datasets typically obtained from contingent valuation surveys'. The decision tree model shows that income level, age, living distance to Randers Fjord, and prior knowledge regarding eutrophication of the fjord, are important factors influencing the WTP - findings which might be missed or found to be insignificant using more standard modelling procedures.

Economic measure

Compensating surplus

¹⁴ It is not specified which year the estimates refer to. Since they build on Gren (2000) it is however assumed that they refer to 2000.

In converting the value estimates from EUR²⁰⁰⁰ to EUR²⁰⁰⁷ the following exchange rates:

EUR²⁰⁰⁰ – DKK²⁰⁰⁰: 745.3665 DKK per 100 EUR in 2000

DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007

and price index:

DKK²⁰⁰⁰ – DKK²⁰⁰⁷: 1.1424

have been used.

Estimated values¹⁵

A mean WTP of 57 DKK²⁰⁰³ (8.2 EUR²⁰⁰⁷) per person per month in 10 years is reported. This can be summed up to a total of 22.8 MDKK²⁰⁰³ (3.3 MEUR²⁰⁰⁷) for Aarhus County per month in 10 years. The WTP is considerably lower than what was reported in Atkins et al. (2006, see above). However, the difference in findings is not explicitly discussed in the paper, although it was stated in the 2006 article, that the results were preliminary.

The estimated WTP for eutrophication reduction in Randers Fjord corresponds approximately one quarter of the WTP findings for all Danes for reducing eutrophication in the Baltic Sea by 50 per cent (see Turner et al., 1999; Gren, 2000).

Recreational fishing/angling in the Baltic and related Danish water bodies

4. TOIVONEN ET AL. (2000)

Full reference

Toivonen, A.L, Appelblad, H, Bengtsson, B., Geertz-Hansen, P., Gudbergsson, G., Kristofersson, D., Kyrkjebø, H., Navrud, S., Roth, E., Tuunainen, P. and Weissglas, G., 2000. The Economic Value of Recreational Fisheries in the Nordic Countries. TEMA Nord Report 2000.

Environmental focus of the study and to what ecosystem service(s) this focus is related

Recreational fisheries, angling

Extent of environmental change

Improvement of recreational fishing possibilities by opening up a new river to fishing.

Study area and study population/industry

Denmark and the other Scandinavian countries, representative sample, randomly chosen. Response rate 45.8 % in DK

Valuation method

Contingent valuation, dichotomous choice and open ended

¹⁵ In converting the value estimates from DKK²⁰⁰³ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰³ – DKK²⁰⁰⁷: 1.0674 have been used.

Economic measure

Compensating surplus per year, increase in income tax

*Estimated values of the economic measure*¹⁶

- Use values:
 - Recreational fishing salmon and sea trout in river: 901 DKK²⁰⁰⁰ (138 EUR²⁰⁰⁷)
 - Recreational fishing perch, pike-perch in lake: 722 DKK²⁰⁰⁰ (111 EUR²⁰⁰⁷)
 - Recreational fishing grayling, brown trout, arctic char in lake: 899 DKK²⁰⁰⁰ (138 EUR²⁰⁰⁷)
- Non-use and use values:
 - Preservation of Nordic freshwater fish stocks: 2 150 DKK²⁰⁰⁰ (300 EUR²⁰⁰⁷)

Any other especially interesting piece of information

Navrud (2007) describes that this CVM study was constructed for value transfer, and to test the validity of value transfer between the Nordic countries. However, this study, as most multicountry CVM studies, is based on CVM scenarios that are trade-offs between what is optimal design in each country and the need to use the same CVM scenario and questionnaire in all countries to avoid that differences in valuation are due to methodological differences (but only reflect differences in individual preferences of people in different countries). Thus, some of the scenarios might be hypothetical in some countries even if they are very relevant in others. To conclude, the scientific soundness of the study is sufficient to serve as a basis for transfers.

5. ROTH AND JENSEN (2003)

Full reference

Roth, E. and Jensen, S. 2003. Impact of recreational fishery on the formal Danish economy. IME working paper 48/03, University of Southern Denmark.
<http://www.sam.sdu.dk/ime/PDF/roth48.pdf>

Study area

Denmark.

Environmental focus and environmental impact

¹⁶ In converting the value estimates from DKK²⁰⁰⁰ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰⁰ – DKK²⁰⁰⁷: 1.1424 have been used.

Economic impact of recreational fishery (variable costs) on the formal economy. Recreational fishery is defined as: Angling (rod and line), leisure fishing (nets and fish traps in marine waters), and ‘put and take’-fishing. The study is only focusing on Danish residents.

Valuation method

Assessment of expenditures for recreational fishing revealed by interview

Economic measure

Consumer surplus

*Value estimates*¹⁷

The estimation of the economic impact is performed from the demand side using Danish input-output tables (containing 72 commodity groups). Variable costs of recreational fishermen are taken into account (primary data are based on Toivonen et al.’s (2000) findings (see above)), but not fixed costs (like for instance fishing equipment). In the study, there is a focus on both direct and indirect impacts. E.g. transportation costs, lodging, licenses, extra food, fishing journals etc.). Toivonen et al.’s (2000) mail survey was originally sent to 5 192 Danes in 1999. 2 376 responded (46 per cent).

Of these, 546 responses came from recreational fishermen. These 546 respondents were asked the following question:

“Approximately how much did you spend during the last 12 months on recreational fishing? Please fill in the form below. If you had no expense on an item, please write “0” Kr. DO NOT count the cost of items that last for many years, e.g. gear (rods, nets), fishing clothes and boats”.

The direct impacts are the result of firms selling directly to recreational fishermen while the indirect impacts result from firms selling directly to recreational fishermen which are getting supplies from other firms. Induced impacts are not a part of the model.

The study estimates, that the direct effects of recreational fishery in Denmark generates 500 jobs. Additionally, indirect effects generate 258 jobs. In total, these 758 jobs constitute a total of 0.03 per cent of the total jobs in Denmark. Needless to say, recreational fishermen’s fixed costs, which are not assessed in the study, are adding a number of further jobs. The variable costs impact on import is 68

¹⁷ It is assumed that the presented value estimates all refer to 1999, which was the year the mail survey was conducted. In converting the value estimates from DKK¹⁹⁹⁹ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK¹⁹⁹⁹ – DKK²⁰⁰⁷: 1.1757 have been used.

MDKK¹⁹⁹⁹ (10.7 MEUR²⁰⁰⁷), on indirect taxes 127 MDKK¹⁹⁹⁹ (20.0 MEUR²⁰⁰⁷), and on income 303 MDKK¹⁹⁹⁹ (47,8 MEUR²⁰⁰⁷).¹⁸

6. TOIVONEN ET AL. (2004)

Full reference

Toivonen, A.L., Roth, E., Navrud, S., Gudbergsson, G., Appelblad, H., Bengtsson, B. and Tuunainen, P., 2004. The Economic Value of Recreational Fisheries in Nordic Countries. [Fisheries Management and Ecology](#), 11(2):1-14.

Environmental focus of the study and to what ecosystem service(s) this focus is related

Recreational fisheries

Extent of environmental change

Maintenance of the current state of fish stocks and quality of recreational fisheries.

Study area and study population/industry

Anglers in the Nordic countries - Denmark, Finland, Iceland, Norway, Sweden. An identical contingent valuation mail survey was carried out between October 1999 and January 2000 in all five Nordic countries. An updated application of the Dillman method was used. 25 000 Nordic citizens were selected from the respective national population registers to receive the survey, and the response rate was 45.8%. Respondents were asked for their annual fishing expenditure; how much more, over and above actual expenditure, they would be willing to pay before it became too expensive to fish; and how much they would be willing to pay for preserving the current fish stocks and current quality of recreational fishing. Socio-demographic characteristics were also collected. The project was supported by the Nordic Council of Ministers, the Ministry of Agriculture and Forestry (Finland), The Agricultural Productivity Fund (Iceland), and 8 participating institutions.

Valuation method

Contingent valuation

Economic measure

Compensating surplus; willingness to pay for the preservation of the existence of current fish stocks and current quality of recreational fishing to persons participating in fishing or enjoying the benefits derived from it.

Fishing expenditures, extra willingness to pay (WTP) for the same fishing experience and WTP were modelled as a function of a range of fishing behaviours and socio-demographic characteristics. General linear multiple regression models were

¹⁸ We assume that all figures are 1999 data.

used, and non-linear relationships were fitted to the models using logarithmic transformations.

Estimated values¹⁹

Estimated aggregate values for annual fishing expenses and the components of total economic value for Denmark is shown in the table below. In the study, OECD purchasing power parities of 1999 were used to convert DKK¹⁹⁹⁹ to USD¹⁹⁹⁹.

Table DK.6. Expenditure and willingness to pay in MUSD¹⁹⁹⁹ (EUR²⁰⁰⁷ in parentheses).

	Fishermen's Annual Fish- ing Ex- penses	Use Value	Non-Use Value	Use Value+Non- Use Value	Total Economic Value~
Denmark	60 (80)	29 (39)	254 (339)	283 (378)	322 (430)

Any other especially interesting piece of information

Overall, consumer surplus goes to the young, urban, educated, and well-off fishermen, and the people who value recreational fisheries the highest also derive the highest benefit from the resource.

Regression models were used to identify demographic characteristics, types of fishing patterns and differences in the countries' management regimes that can explain both actual fishing expenditure and willingness to pay for the non-market benefits by persons participating in fishing or enjoying the benefits derived by it. Net benefit, i.e. willingness to pay over and above actual expenditure was highest amongst those fishing. In Denmark, the small number of generalist fishermen gets the highest benefit.

The non-use value of recreational fisheries was elicited through posing questions on willingness to pay for the preservation of the existence of current fish stocks and current quality of recreational fishing to persons participating in fishing or enjoying the benefits derived from it. For those not fishing or people in general, the power of the models to explain willingness to pay for the existence of recreational fisheries was very weak. The benefit, i.e. willingness to pay, is higher if somebody in the household fishes. Educated, young, urban, well-off citizens also put value on the non-use of the resource.

¹⁹ The amounts presented in the article has been converted from DKK to USD using the following exchange rate (OECD 1999 PPP):

USD¹⁹⁹⁹ – DKK¹⁹⁹⁹: 847 DKK per 100 USD in 1999. This rate is used to convert the estimates back into DKK¹⁹⁹⁹.

In converting the value estimates from DKK¹⁹⁹⁹ to EUR²⁰⁰⁷ the following exchange rate:

DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007

and price index:

DKK¹⁹⁹⁹ – DKK²⁰⁰⁷: 1.1757

have been used.

Windmills offshore

7. LADENBURG AND DUBGAARD (2007)

Full reference

Ladenburg, J. and Dubgaard, A., 2007. Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark. *Energy Policy*, 35:4059-4071.

See also

Ldenburg, J., Dubgaard, A., Martinsen, L. and Tranberg, J., 2005. Economic valuation of the visual externalities of off-shore wind farms. Report. No. 179, Food and Resource Economic Institute, University of Copenhagen. Weblink: <http://www.foi.life.ku.dk/Publikationer/Rapporter/~media/migration%20folder/upload/foi/docs/publikationer/rapporter/nummererede%20rapporter/2005/179.pdf.ashx>

Focus

Offshore wind farms create visual disamenities, and the study assesses the value of placing wind farms at larger distances from shore.

Area

The windmill farms in question are specifically located in The Sound. The study has been carried out by means of a questionnaire which is formatted according to the discrete choice method and has been mailed to 700 individuals. The survey sample consists of respondents randomly drawn from the Danish population.

Valuation method

Choice experiment

Economic measure

Compensating surplus. The value of placing wind farms at larger distances from the shore is evaluated in terms of the respondents' willingness to pay to increase the distance.

Estimated values

The figure below depicts the estimated willingness to pay as function of the distance from shore. The willingness to pay is expressed in EUR per household per year. It is found that the willingness to pay increases at a decreasing rate with respect to the distance. See the figure below.

Figure DK.1: Willingness to pay as function of distance (EUR/household/year; the particular year to which the estimates refer is not specified).

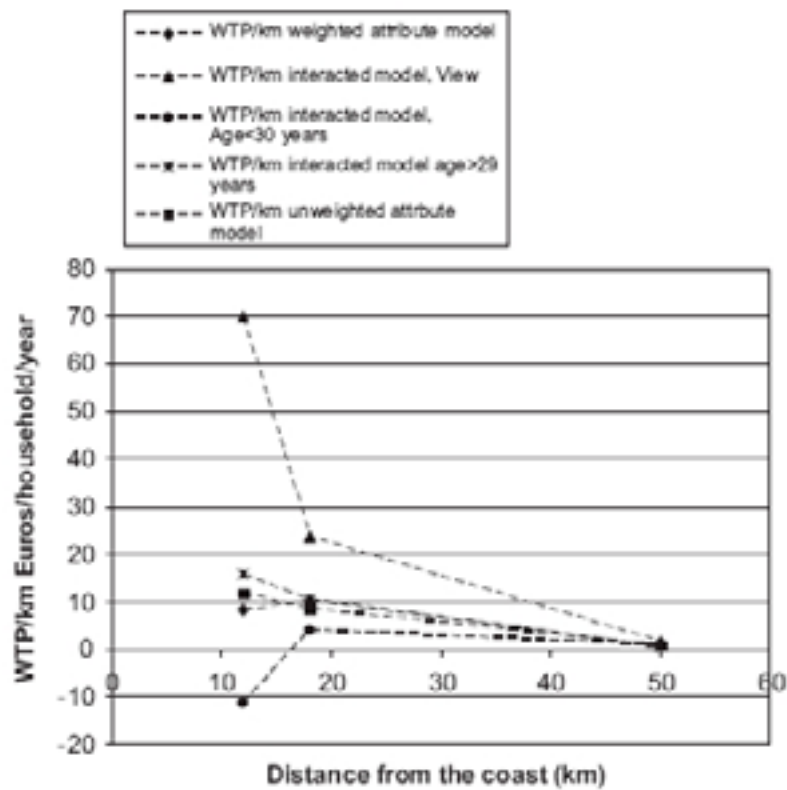


Fig. 3. Marginal WTP for reducing the visual disamenities of offshore wind farms.

8. LADENBURG (2007)

Full reference

Ladenburg, J., 2007. Visual Disamenity Costs of Off-shore Wind Farms in the Coastal Zone and Prior Information. Part of Ph. D. thesis. Institute of Food and Resource Economics, University of Copenhagen.

See also

Ladenburg, J., Dubgaard, A., Martinsen, L. and Tranberg, J., 2005. Economic valuation of the visual externalities of off-shore wind farms. Report. No. 179, Food and Resource Economic Institute, University of Copenhagen. Weblink:
<http://www.foi.life.ku.dk/Publikationer/Rapporter/~media/migration%20folder/upload/foi/docs/publikationer/rapporter/nummererede%20rapporter/2005/179.pdf.ashx>

Focus

The paper is extending the results of Ladenburg and Dubgaard (2007) by including prior information on respondents living in the vicinity of two existing wind mill farms.

Area

The existing wind mill farms are located in Nysted and Horns Rev. Data from communities in the coastal zone is accounted for by including respondent information from these areas in the survey sample from Ladenburg and Dubgaard (2007).

Valuation method

Choice experiment.

Economic measure

Compensating surplus. The value of placing wind farms at larger distances from the shore is evaluated in terms of the respondents' willingness to pay to increase the distance.

*Estimated values*²⁰

In the table below, the values estimated in the study are shown.

²⁰ It is assumed that the presented value estimates all refer to 2004, which was the year the survey was conducted. In converting the value estimates from EUR²⁰⁰⁴ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and DKK²⁰⁰⁴ – EUR²⁰⁰⁴: 743.9938 and price index: DKK²⁰⁰⁴ – DKK²⁰⁰⁷: 1.0552 have been used.

Table DK.7: Willingness to pay estimates (EUR/household/year; the particular year to which the estimates refer is not specified).

Variable	Na-sample WTP	Hr-sample WTP	Ny-sample WTP
dist12	46.4	31.6	79.0
dist18	103.3	85.4	94.8
dist50	128.6	79.0	154.9
sizeL	-17.9	9.5	15.8
sizeM	-2.1	11.6	13.7

The figure shows that there is a larger WTP in Nysted (Ny) compared to the nation sample (Na) and the Horns Rev sample (Hr) in all distances. However Ladenburg (2007) also investigates different interaction models and he finds that users of the coastal zone, such as anglers, hobby sailors and visitors express a stronger preference for reducing the visual disamenities.

9. LADENBURG (2008)

Full reference

Ladenburg, J., 2008. Attitudes towards on-land and offshore wind power development in Denmark; choice of development strategy. *Renewable Energy*, 33(1):111-118.

Study area

The attitude towards more wind power is analyzed by a representative sample of the Danish population.

Environmental focus

The focus is Danish preferences between on-land and off-shore wind turbines

Valuation method

Choice experiment

Estimation results

The study provides no welfare measures as such. Instead a probit model is developed to show the common attitude towards on-land and off-shore wind farms respectively. The model is a latent utility model describing changes in utility caused by changes in the present state.

Table DK.8. Probit model for attitude towards more on-land turbines

Variables	Model 1		Model 2	
	Parameter	Significance	Parameter	Significance
Age 50+	-0.6507	(0.001)	-0.6205	(0.010)
Gender_age50+	0.4175	(0.085)	0.3613	(0.210)
Age_missing	-0.7155	(0.048)	-0.7684	(0.111)
Large_cities_west	0.7789	(0.035)	0.8349	(0.074)
Large_cities_east	0.5909	(0.003)	0.4383	(0.067)
View_turbines_land	0.0459	(0.810)	-0.1408	(0.553)
View_turbines_land_sea	-0.8608	(0.079)	-0.5986	(0.286)
Constant	0.8900	(<0.0001)	5.1793	(<0.0001)
Pimp_land ^a	-	-	-1.1879	(<0.0001)
	$P^2 = 0.0930$, N=354		$P^2 = 0.4167$, N=354	

a) The variable is a discrete variable taking distinct levels 1-5, where 1 represents very positive and 5 very negative, the β represents the change in the latent variable moving one level in the discrete variable. The 'semi continuous' approach gives the best fit compared to a log and similar transformations.

Table DK.9. Probit models for attitude towards more offshore turbines

Variables	Model 1		Model 2	
	Parameter	Significance	Parameter	Significance
Age55+	-0.4574	(0.037)	-0.9747	(0.013)
Age_missing	-0.8472	(0.121)	-1.3279	(0.052)
View_turbines_sea	0.1430	(0.780)	0.7664	(0.401)
View_turbines_sea-miss	-1.3390	(0.023)	-1.3599	(0.124)
View_turbines_land	-0.2605	(0.307)	-0.1096	(0.780)
Beach_user	-0.5484	(0.020)	-0.4202	(0.223)
Constant	2.1379	(0.001)	7.7647	(<0.001)
Visual_imp_offshore ^a	-	-	-1.1050	(<0.001)
Birds_sealife_imp_offshore ^b	-	-	-0.1158	(<0.001)
Impacts_bird-miss	-	-	1.8430	(0.068)
Impacts_sealife-miss	-	-	1.1743	(0.211)
	N = 369, $p^2 = 0.1182$		N = 369, $p^2 = 0.5565$	

a) The variable is a discrete variable taking distinct levels 1-5, where 1 represents very positive and 5 very negative, the β represents the change in the latent variable moving one level in the discrete variable. The 'semi continuous' approach gives the best fit compared to a log and similar transformations.

b) The variable is combined measurement of the joint discrete perception of the impacts on birds and life in the sea. The variable is log transformed.

Simple descriptive statistics from the sample survey show that 25% of the respondents have a negative attitude towards on-land wind farms but only 5% have a negative attitude towards off-shore wind farms. Generally the survey shows that off-shore wind farms are preferred to on-land. The tables show the propensities of the respondents to hold a positive attitude towards more wind farms. A negative sign tells that respondents who value that specific factor have a higher propensity to hold a negative attitude. Worth noting is the Age55+ variable indicating that

respondents older than 55 generally hold a negative attitude towards an increase in both on-land and off-shore wind farms.

Studies and data describing the current situation in the Baltic Sea

This section deal with studies and data that can be used to describe the current situation/status for the ecosystem services and the value they deliver in the current situation and quality. No studies are found estimating the economic impacts of eutrophication on tourism or fisheries.

10. TOURISM

Full reference

VisitDenmark, 2007. Tre forretningsområder i dansk turisme 2006 – Kystferie, Storbyferie og Mødeturisme [Three business areas in Danish tourism 2006 – coastal tourism, city tourism and business tourism]. Tabelrapport.

COWI, 2007. Economic analysis of the BSAP with focus on eutrophication.

*Summary*²¹

According to COWI (2007) tourism and travel in the Baltic Sea region accounted for about 2.9% of the regional GDP in 2004. Furthermore, the tourism and travel sector is estimated to provide jobs for nearly 2 million people in the region. Marine environment is an important asset in this context as the attractiveness of the Baltic Sea and its environmental quality is closely interlinked through the nature and ecosystems on which many tourist-based activities depend. In this context it is noted that the World Tourism Organization's forecasts indicate that the Baltic Sea will experience higher growth rates in tourism compared to other regions.

Tourism in Denmark amounted to about 2.2% of the country's GDP in 2006, which emphasizes the importance of the tourism sector for the Danish economy. According to VisitDenmark (2007) coastal tourism accounted for 58% of the turnover of tourism in Denmark in 2006, which clearly makes this type of tourism the dominating in the Danish tourism sector. To assess the importance of coastal tourism in the areas of the country that are relevant to the Baltic Sea, overnights statistics are obtained from VisitDenmark/Statistics Denmark. By excluding the regions of the country that are not in direct contact with the Baltic Sea (the west coast) and the area of Copenhagen which is more dominated by city tourism, an estimate of the tourist overnight stays in the coastal regions of the Baltic Sea is obtained. Multiplying by the average daily tourist consumption in the affected regions gives an esti-

²¹ In converting the value estimates from DKK²⁰⁰⁶ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰⁶ – DKK²⁰⁰⁷: 1.0171 have been used.

mate of the turnover of coastal tourism in the Baltic Sea area of the country. This amounts to 12.8 billion DKK²⁰⁰⁶ (1.75 billion EUR²⁰⁰⁷) in 2006 excluding cruise tourism, which gave a total contribution of 318 MDKK²⁰⁰⁶ (43.4 MEUR²⁰⁰⁷). Cruise tourism is also one of the fastest growing types of tourism growing 28% from 2004 to 2006 for cities in the Baltic Sea region as a whole. The grand total of tourism consumption related to the Baltic Sea regions of Denmark is thus roughly 13.2 billion DKK²⁰⁰⁶ (1.8 billion EUR²⁰⁰⁷).

11. RECREATIONAL SAILING - VISITDENMARK 2007

Full reference

VisitDenmark, 2006. Lystsejlerturismen i Danmark 2006 [Sailing tourism in Denmark 2006]. VisitDenmark. Weblink: <http://www.visitdenmark.dk>.

Study area

Danish harbours, 2006. Sample represents total number of overnights 2006. 624 interviews were conducted in Limfjorden, Kattegat, Eastern Jutland, North and east of Funen, "Smålandsfarvandet" – the marine area south of Zealand, Western Zealand. The Sound. Bornholm and Christiansø and others. All of these areas are relevant as they are part of or interlinked with the Baltic Sea by a fjord.

Findings²²

The sailors spend in average 265-276 DKK²⁰⁰⁶ per person per day (36-38 EUR²⁰⁰⁷). The turnover from sailing tourists in Denmark is in all 240 MDKK²⁰⁰⁶ (33 MEUR²⁰⁰⁷). The motives for sailing to the specific harbours are manifold, but beyond 70% of the tourists stated that nature is a motivation for visiting the harbour. At the same time the possibilities for doing activities such as swimming/bathing are not regarded very important; below 5%, relaxing (almost 90%) and sunbathing (almost 50%) were actually much more popular. Only 1-3% chose the harbour because of good water quality indicated by the blue flag.

Oil spills

12. HALL (2000)

Full reference

Hall, K., 2000. Impacts of Marine Debris and Oil. Economic and Social Costs to Coastal Communities. KIMO, Shetland Islands Council, Environment & Transport

²² In converting the value estimates from DKK²⁰⁰⁶ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰⁶ – DKK²⁰⁰⁷: 1.0171 have been used.

tation Department, Grantfield, Lerwick. Weblink:
<http://library.coastweb.info/810/1/Karensreport.pdf>

Study area

A number of countries are included in the study. In Denmark, five municipalities situated at the North Sea coastline (Western Jutland) are included in the study. The beaches cleaned up are sandy and of medium to high quality.

Environmental focus

The cost of marine debris and oil to coastal communities and organisations.

Benefits

The study contains an interesting discussion regarding the consequences of marine debris, but there is no specific information regarding Denmark.

Method

Costs are assessed through assessment of costs associated with cleaning up beaches.

Value estimate

Cost estimates are presented in the form of restoration costs.

Cost estimates²³

There is a huge variation in beach cleaning costs in the analysed municipalities (see the two tables below).

Table DK.10. Expenditure per km beach cleaned

Municipality	Expenditure per km beach cleaned in GBP ¹⁹⁹⁷ (EUR ²⁰⁰⁷ in parentheses)
Sydthy	4 375 (7 799)
Holmsland	3 300 (5 883)
Thyborøn-Harboøre	1 632 (2 909)
Blåvandshuk	1 625 (2 897)
Hanstholm	500 (891)

Source: Hall (2000, p. 28)

²³ In converting the value estimates from GBP¹⁹⁹⁷ to EUR²⁰⁰⁷ the following exchange rates: GBP¹⁹⁹⁷ - DKK¹⁹⁹⁷: 1.082,3220 DKK per 100 GBP in 1997
DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745,0551 DKK per 100 EUR in 2007
and price index:
DKK¹⁹⁹⁷ – DKK²⁰⁰⁷: 1,2272
have been used.

Table DK.11. Expenditure, beach cleaning, per capita

Municipality	Expenditure, beach cleaning, per capita in GBP¹⁹⁹⁷ (EUR²⁰⁰⁷ in parentheses)
Holmsland	6.16 (11)
Thyborøn-Harboøre	5.96 (10.6)
Sydthy	0.90 (1.6)
Hanstholm	0.81 (1.4)

Source: Hall (2000, p. 28)

Furthermore, it is apparent from the study, that costs for beach cleaning have increased steeply in the five municipalities from 1987 to 1997 (see the table below). However, it is not analysed, why the costs have increased. E.g. are the municipalities cleaning the beaches better, or are the beaches dirtier.

Table DK.12. Comparison of beach cleaning costs in some different Danish municipalities (1987 and 1997, DKK)

Municipality	Length (km)		Cost (DKK)	
	1987	1997	1987	1997
Skagen	62		498 000	
Hirtshals	40		232 000	
Hjørring	9		147 000	
Lokken-Vra	12		147 000	
Pandrup	23		361 489	
Hanstholm	43	10	37 825	50 000
Thisted	15		200 229	
Sydthy	24	24	54 685	105 000
Thyborøn-Harboøre	20	19	26 950	310 000
Lemvig	19	19	158 000	
Ulfborg-Vemb	13		25 000	
Holmsland	40	40	178 475	330 000
Blabjerg	12		200 000	
Blavandshuk	40	40	300 000	650 000
Fano	11		46 000	
Skaerbaek	10		65 000	
<i>Total</i>	<i>393 km</i>	<i>152 km</i>	<i>2 677 653</i>	<i>1 445 000</i>

Source: Hall (2000, p. 32)

*It is not stated in the report whether this is 1987- or 1997-prices or both.

13. STUDY OF COSTS OF AN OIL SPILL IN GRØNSUND

Full reference

Storstrøms amt (2002) "Baltic Carrier" olieforureningen - undersøgelse og vurdering af miljøeffekter". <http://www.stam.dk/download/TMF/VM/BalticCarrier/DK-Rapporttrykklar.pdf>

Study area

Grønsund between Falster and Farø, Bogø, Møn in the South Eastern part of Denmark.

Focus

Assessments of the hazards from an oil spill accident in the fjord from the ship "Baltic Carrier". The accident happened in 2001.

Economic measures

Ecosystem costs are approximated through assessment of lost revenues from tourism, fisheries and aquaculture.

Findings²⁴

The area is attractive for tourists because of the good conditions for bathing, sailing and angling. Except for the oil spill accident several factors influenced tourism negatively on a general scale in 2001; the BSE, algal blooms in the Baltic Sea as well as the terrorist attack in USA on 11 September 2001. All in all it seems like the number of tourists from Germany declined to the area after 2001, but an increase in tourists from other countries to this specific area has outweighed the decline in German tourists. Therefore the tourist industry in the Southern Danish area, with an annual turnover on 1.5 billion DKK²⁰⁰¹ (225 MEUR²⁰⁰⁷), has not really been affected economically by the oil spill.

Commercial fisheries have a turnover at approx. 150 MDKK²⁰⁰¹ (22.5 MEUR²⁰⁰⁷), and the oil spill is estimated to cost about 1.5 MDKK²⁰⁰¹ (0.225 MEUR²⁰⁰⁷); i.e. 1% of the total turnover.

The aquaculture in the area comprises 7 marine farms, and the annual turnover is 71 MDKK²⁰⁰¹ (10.6 MEUR²⁰⁰⁷). The farms in the area had to close down during the whole year of 2001, and the lost revenue was about 20 MDKK²⁰⁰¹ (2.9 MEUR²⁰⁰⁷).

²⁴ In converting the value estimates from DKK²⁰⁰¹ to EUR²⁰⁰⁷ the following exchange rates: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰¹ – DKK²⁰⁰⁷: 1.1160 have been used.

Studies of changes in other water bodies, where results can be of relevance to the Baltic Sea (knowledge of preferences etc.)

In this last presenting section we present valuation studies dealing with water bodies being of relevance to the evaluation of WTP for improvements of the Baltic Sea. Improvements of the Baltic Sea can take place by wetland restoration, lake restoration and other measures on agricultural land. We have therefore judged that it is relevant to include some studies where the values of wetland restoration, lakes and lake quality are assessed as these are indirectly linked to the value of improvements of the Baltic Sea (reduced nutrient loads and reduced eutrophication).

These studies comprise valuation of the aesthetical value of a view from residents to lakes in Denmark, ground- and surface water improvements.

14. HASLER ET AL. (2002)

Full reference

Hasler, B., Damgaard, C.K., Erichsen, E.H., Jørgensen, J. J. and Kristoffersen, H. E., 2002. De rekreative værdier af skov, sø og naturgenopretning. - værdisætning af naturgoder med husprismetoden [The Recreational Values of Forest, Lake and Nature Restoration, valuation of nature goods using the hedonic price method]. AKF (Danish Institute of Governmental Research), Copenhagen. Weblink: http://www.akf.dk/udgivelser/container/2002/udgivelse_1427/ .

Study area and population

Residential areas close to 6 Danish lakes in the western and eastern part of Denmark.

Ecosystem service

The view of the water from the house.

Valuation method

Hedonic pricing

Benefit measure

Consumer surplus.

*Value estimates*²⁵

The value of a view to lakes/the waterfront from a house is between 13 and 24% of the house price. Hence, the value of a view in the eastern part of Denmark, close to

²⁵ In converting the value estimates from DKK²⁰⁰² to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰² – DKK²⁰⁰⁷: 1.0897 have been used.

the Copenhagen area, was 330 000 DKK²⁰⁰² (48 265 EUR²⁰⁰⁷) per house, while it was 165 000 DKK²⁰⁰² (24 133 EUR²⁰⁰⁷) in a residential area close to a lake in the western part of the country. These values do not represent the value of view to the marine areas, e.g. the Sound and the Belts (that are coastal parts of the Baltic sea), but the results indicate that the value of such views are significantly positive. Furthermore the results do not tell anything about whether and how the value is dependent on the quality of the lake/the water body.

15. FARDAN ET AL. (2005)

Full reference

Fardan, J., Mørkbak, M., and Nissen, C.J., 2005. Cost-Benefit Analysis of restoring Lake Fure – a Discrete Choice Experiment. Master Thesis at the Royal Veterinary- and Agricultural University, Denmark.

Study area

Lake Fure in North Zealand. The lake is 941 hectares, and is used for bathing, sailing and fishing. The lake is affected by a heavy load of nutrient, low water transparency and decreasing biodiversity, both with respect to fish, migratory bird and plants.

Environmental focus

Restoration of Lake Fure, and peoples' willingness to pay (WTP) for it. Separate estimates are provided for peoples WTP for improved biodiversity (defined in terms of the size and species composition of the bird population in the area), improved water transparency (and the no. of bathing days cancelled) and improved composition of fish species. For biodiversity, water transparency as well as the composition of fish species the study operates with two potential levels of improvement; medium and large.

Additional comments to environmental focus

Although the study is not concerned with the marine environment as such it has nevertheless been decided to include it in the report. The character of the goods subjected to valuation – i.e. benefits from bathing, sailing and fishing – are in many respects quite similar for marine and freshwater environments. For want of anything better, the estimated WTP's for improvements in lake water quality (and the goods associated with this improvement) may therefore serve to give an indication of different user groups WTP's for improvements in the marine environment and/or the possibilities for using the marine environment for bathing, sailing and fishing.

Valuation method

The Choice experiment (CE) method is used to assess the benefits associated with the restoration of Lake Fure for three different user groups; bathers, sailors, an-

glers. A separate CE is conducted for each user group. The focus is on assessment of use related values.

Value measures²⁶

The benefit measures resulting from the application of the CE method are compensating surplus measures, and are assessed in terms of individual annual WTP. Costs are estimated via assessment of project restoration costs.

Benefit estimates

For all three user groups data were gathered through questionnaires. For the bathers, the questionnaire was distributed to bathers actually visiting Lake Fure, for the other two user groups questionnaires were mailed to members of local anglers and sailors associations. The effective sample sizes were 91, 210 and 514 for bathers, anglers and sailors respectively. The individual WTP estimates for the different user groups resulting from the study are shown in the table below.

Table DK.13. Annual WTP per person in DKK²⁰⁰⁵ (EUR²⁰⁰⁷ in parentheses).

	Bathers		Anglers		Sailors	
	Medium improve- ment	Large improve- ment	Medium improve- ment	Large im- proveme- nt	Medium im- proveme- nt	Large im- prove- ment
Biodiver- sity	85.52 (12)	171.04 (24)			137.0 (19)	274.0 (38)
Cancelled bathing days	299.81 (42)	599.62 (83)				
Clearness of water			432.99 (60)	938.1 (130)	801.09 (111)	1.735.7 (241)
Composi- tion of fish species			430.8 (60)	861.6 (120)		
Total WTP per person – medium improve- ment	385.33 (54)		863.79 (120)		938.09 (130)	
Total WTP per person – large improve- ment		760.66 (106)		1 799.75 (250)		2 009.7 (280)

The aggregate WTP estimates for the restoration project for different discount rates and a time horizon of 80 years is shown in the table below. The sizes of the popula-

²⁶ In converting the value estimates from DKK²⁰⁰⁵ to EUR²⁰⁰⁷ the following exchange rate:
DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index:
DKK²⁰⁰⁵ – DKK²⁰⁰⁷: 1.0364
have been used.

tions over which benefits for the different user groups are gathered are 5 373, 669 and 2 146 for bathers, anglers and sailors respectively.

Table DK.14: Aggregate benefits in DKK²⁰⁰⁵ for the Lake Fure restoration project (80 year time horizon) (EUR²⁰⁰⁷ in parentheses)

	Discount rate		
	2%	5%	6%
Benefits – Medium improvement	155 021 352 (21 564 060)	58 882 986 (8 190 847)	45 549 886 (6 336 162)
Benefits – Large improvement	321 177 011 (44 676 945)	121 995 204 (16 969 997)	94 371 364 (13 127 416)

Cost estimates

Welfare economic restoration costs are assessed using a combination of factual costs and budgeted costs. Applying a discount rate of 5%, total costs for the restoration project are estimated to 18 782 212 DKK²⁰⁰⁵ (2 612 677 EUR²⁰⁰⁷). Lowering the discount rate to 2% or raising it to 6% has little effect on the cost estimate.

16. JENSEN ET AL. (2002)

Full reference

Jensen F., Munk-Madsen, E., Roth, E. and Vestergaard, N., 2002. Socioøkonomisk undersøgelse af den samfundsmæssige og økonomiske betydning af fiskeriet på Ringkøbing Fjord og dens opland. Ringkøbing Amtskommune (Ringkøbing County), Ringkøbing.

Study area and population

Ringkøbing Fjord at the west coast of Jutland. Denmark's largest river by volume, the popular Skjern River, is having its mouth and delta in the fjord. The value of recreational fishery is estimated by using Toivonen's WTP questionnaire findings (see Toivonen description above), and by using data for the number of fishing licenses in the area.

Environmental focus

The economic importance of fishery and angling at the fjord.

Valuation method

The economic value of commercial fishery is calculated by using statistical data for catches at the fjord.

Value measure

Consumer surplus.

Value estimates²⁷

The average ‘occasional angler’ is having operating costs of 732 DKK²⁰⁰¹/year (110 EUR²⁰⁰⁷), while an average ‘passionate angler’ is having costs of 2.650 DKK²⁰⁰¹/year (397 EUR²⁰⁰⁷). The additional WTP is 459 DKK²⁰⁰¹/year (69 EUR²⁰⁰⁷) for occasional anglers and 1 320 DKK²⁰⁰¹/year (198 EUR²⁰⁰⁷) for passionate anglers. It is estimated, that there are approximately 2 000 of each type of anglers in the area. The total net benefit of angling for these 4 000 anglers (representing 50 600 ‘angling days’ a year) has a value of 3 558 000 DKK²⁰⁰¹/year (532 944 EUR²⁰⁰⁷) (Jensen et al., 2002, p. 47). The uncertainties in the calculation are large.

It is informed, that 50 per cent of Danish anglers primarily are fishing in the sea or along the coast line (Jensen et al. 2002, p. 47).

The side effects of angling are calculated through an estimation of tourist bed-nights based on an analysis of this in Sønderjylland County (Southern Jutland). For the Ringkøbing Fjord area the ‘angling tourism’ is estimated to have a side effect of 80 462 bed nights. If all these bed nights are spent in holiday cottages, the economic value is 27.5 MDKK²⁰⁰¹ (4.1 MEUR²⁰⁰⁷). If they are spent on camping grounds, the value is 23.7 MDKK²⁰⁰¹ (3.5 MEUR²⁰⁰⁷). These values can be converted to between 36 and 47 direct and indirect jobs. It is underlined, that the data foundation for this conclusion is weak (Jensen et al. 2002, pp. 58-67).

In commercial fishing there is approximately generated 5.5 full time jobs. Furthermore, side effects are generating approximately 15 jobs (Jensen et al. 2002, p. 60).

Benefit transfer?

The method might be copied to a Baltic Sea context.

17. HASLER ET AL. (2005)

Full reference

Hasler, B., Lundhede, T., Martinsen, L., Neye, S., and Schou, J. S., 2005. Valuation of groundwater protection versus water treatment in Denmark by Choice Experiments and Contingent Valuation. NERI Technical Report No. 543, National Environmental Research Institute. Weblink:
www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR543.PDF

²⁷ It is not specifically stated which year the estimates refer to – the study builds partly on Toivonen (2000), partly on 2001 prices of fishing licenses. In lack of specific information it is assumed that the values refer to 2001 – i.e. the reference year of the most recent data source.
In converting the value estimates from DKK²⁰⁰¹ to EUR²⁰⁰⁷ the following exchange rate:
DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007
and price index:
DKK²⁰⁰¹ – DKK²⁰⁰⁷: 1.1160
have been used.

Study area

Denmark.

Environmental focus

Groundwater pollution and people's willingness to pay (WTP) to mitigate/avoid the consequences of groundwater pollution. Focus is on assessment of:

- 1) People's WTP for drinking water quality – where the possible quality levels are naturally clean, treated or uncertain, and
- 2) People's WTP for surface water quality – where the possible quality levels are very good, less good and poor.

The levels for surface water quality, which were defined in terms of the conditions for animal and plant life in watercourses and lakes, were described as follows:

- Very good: Animal and plant life is natural, varied and in balance. Slight to medium impact from human activity.
- Animal and plant life is markedly different than would be the case under natural conditions and is, to a degree, in a state of imbalance. Representative of the current situation.
- Animal and plant life is significantly different than would be the case under natural conditions and is in a state of serious imbalance. Often completely changed due to human activity.

Additional comments to environmental focus

The focus of the study is not related to the marine environment as such. As Danish studies specifically related to the marine environment are scarce, it has nevertheless been decided to include the study in the report, as it could be argued that the magnitude of the results regarding people's willingness to pay for improved surface water quality – i.e. their WTP for improved conditions for plant and animals in the freshwater aquatic environment, may give an indication of people's WTP for improved conditions for plants and animals in the marine environment.

Valuation method

Two valuation methods are applied in the study; the Contingent Valuation (CVM) method and the Choice Experiment (CE) method. One of the foci of the study is to compare the results obtained by the two methods. In both methods the payment vehicle used is a fixed annual sum to be paid by the household via the water bill. The CVM and the CE studies were conducted as two parallel but independent questionnaire surveys in the fall of 2004.

Value measure

The benefit estimates are compensating surplus measures of the welfare changes in focus.

*Value estimates*²⁸

²⁸ In converting the value estimates from DKK²⁰⁰⁴ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007

The CE questionnaire was sent to 900 respondents of whom 584 responded. Each respondent was presented with 6 choice sets. The estimated WTP's are based on 3.074 choice observations, and should all be interpreted relative to the status quo situation, which is characterised by uncertain drinking water quality and a less good surface water quality. More specifically, the estimated WTP's (in DKK²⁰⁰⁴/household/year) were 1 899 (269 EUR²⁰⁰⁷) for naturally clean drinking water, 912 (129 EUR²⁰⁰⁷) for treated drinking water, 1 204 (171 EUR²⁰⁰⁷) for very good surface water quality and -1 759 (-249 EUR²⁰⁰⁷) for poor surface water quality.

The CVM survey was conducted using the payment card approach, and the questionnaire was sent to 900 respondent. Each respondent was presented with two different valuation scenarios, where the reference in both cases is the status quo situation (as described above). In scenario 1, respondents are asked for their WTP for obtaining naturally clean drinking water quality and very good surface water quality, in scenario 2, respondents are asked for their WTP for obtaining treated drinking water, while keeping the surface water quality at the less good level. The estimated WTP's (in DKK²⁰⁰⁴/household/year) are 711 (101 EUR²⁰⁰⁷) (558 respondents) and 529 (75 EUR²⁰⁰⁷) (485 respondents) for scenario 1 and 2 respectively. As the WTP estimates apply to scenarios as such, separate estimate for WTP for improved surface water quality cannot be obtained from the CVM survey.

Upon comparison, the WTP measures obtained by the two methods are quite different (3 104 DKK²⁰⁰⁴/household/year (440 EUR²⁰⁰⁷) from the CE versus 711 DKK²⁰⁰⁴/household/year (101 EUR²⁰⁰⁷) from the CVM for scenario 1). In this connection the author recommend that the CE results are used, while the CVM results may serve to set a lower bound for the value of the benefits considered.

Cost estimates

The study reports no cost estimates.

18. THORSEN AND HANSEN (2007)

Full reference

Thorsen, B. J., and Hansen, M., 2007. Værdien af naturgenopretning af danske ådale [The value of restoring Danish river basins]. Vidensblad, Skovbrugsserien, Rapport nr. 9.6-6. Skov og Landskab (Forest and Landscape), LIFE, Københavns Universitet (University of Copenhagen).

Study area

and price index:
DKK²⁰⁰⁴ – DKK²⁰⁰⁷: 1.0552
have been used.

Fictive river basins in Denmark, where wetlands and rivers will be restored and re-established to fulfill the requirements of the EU Water Framework Directive and the Habitats Directive.

Study population

The Danish population

Valuation method

Choice experiment, conducted in 2004, reported in 2005.

Welfare measure

Compensating variation.

*Benefit estimates*²⁹

The households annual WTP for a change from agricultural land to meadow is 136 DKK²⁰⁰⁴/household/year (19 EUR²⁰⁰⁷), while the WTP for wetlands is 164 DKK²⁰⁰⁴/household/ year (23 EUR²⁰⁰⁷). The WTP for wooded wetlands is 252 DKK²⁰⁰⁴/household/ year (36 EUR²⁰⁰⁷). The WTP for a meandered river as compared to a channel is 410 DKK²⁰⁰⁴/household/ year (58 EUR²⁰⁰⁷), and WTP for protecting plants and animals so that the living conditions improve from low to medium and high, respectively, is 257 DKK²⁰⁰⁴/household/ year (36 EUR²⁰⁰⁷) and 400 DKK²⁰⁰⁴/household/year (57 EUR²⁰⁰⁷). The WTP for free access to the areas is 320 DKK²⁰⁰⁴/household/year (45 EUR²⁰⁰⁷).

Conclusions

In general, the summaries above indicate that there exist only a few Danish studies using economic methods, including valuation methods, to assess the value of water quality changes and changes in eutrophication. The overall conclusion is that there are considerable potentials for improving the knowledge about the value of ecosystem services in the Danish part of the Baltic.

For summarizing the conclusions in relation to what extent different ecosystem goods and services have been subject to valuation, the table below (table DK.15) summarises to what extent the different ecosystem service has been subject to valuation and to what extent we have identified a significant gap of knowledge for this service. It is apparent from the table that for a large number of ecosystem services and goods connected to the Baltic and the marine environment in general no

²⁹ In converting the value estimates from DKK²⁰⁰⁴ to EUR²⁰⁰⁷ the following exchange rate: DKK²⁰⁰⁷ – EUR²⁰⁰⁷: 745.0551 DKK per 100 EUR in 2007 and price index: DKK²⁰⁰⁴ – DKK²⁰⁰⁷: 1.0552 have been used.

economic studies are found. As a consequence of the very limited amount of studies related directly to the marine environment we have included studies of similar ecosystem goods and services related to inland water bodies etc., but even when we do so there are very few Danish valuation studies related to water.

It should be noted however that for most of the ecosystem services and goods described in table DK.15 there are a large number of studies within natural science analysing e.g. biochemical cycling in marine environments (including the Baltic), primary production related to marine water quality, marine food web dynamics etc. As this research is very broad and comprehensive we have not described these studies here. However, we judge that for many of the ecosystem services and goods, the available scientific knowledge and data available are likely to present a sufficient basis for economic assessments and valuation studies.

Table DK.15. Summary of conclusions in relation to ecosystem services (note that not all studies included in the table refer to the marine environment).

Supportive services	S1	Biochemical cycling	No economic studies
	S2	Primary production	No economic studies
	S3	Food web dynamics	No economic studies
	S4	Diversity	Two studies, 1) focusing on groundwater and surface water protection and the benefits of good conditions for animal and plant life in surface water and 2) on diversity in river basins and valleys. We suggest further research within the area of valuing marine diversity.
	S5	Habitat	Two studies, 1) focusing on surface water protection and the benefits of good conditions for animal and plant life in surface water and 2) on diversity in river basins and valleys. The studies are not addressing habitat quality directly and none of them are conducted in the Baltic. We suggest further research within the area of valuing marine habitat quality.
	S6	Resilience	The studies found on eutrophication can be connected to resilience, but resilience is not directly addressed in any study.
Regulating services	R1	Atmospheric regulation	No economic studies
	R2	Regulation of local climate	No economic studies
	R3	Sediment retention	No economic studies
	R4	Biological regulation	One study regarding groundwater and surface water protection, but biological regulation is not addressed directly in this study.
	R5	Pollution control	Three studies are dealing with pollution control regarding groundwater and surface water pollution, oil spill and lake quality. No Danish original studies addresses pollution control in the Baltic directly, and we suggest further research within the area of valuing the effects of pollution control in the Danish marine areas and the Baltic.
	R6	Eutrophication mitigation	Four studies regarding surface water protection, lake protection, eutrophication of a fjord and of the Baltic by

			benefit transfer from a Swedish study. No Danish original studies addresses eutrophication in the Baltic directly, and we suggest further research within the area of valuing reductions in eutrophication of the Danish marine areas and the Baltic.
Provisioning services	P1	Food	Three studies are found regarding fisheries, including recreational fisheries. No Danish original studies addresses changes in food provision from water quality changes directly, and we suggest further research within the area of valuing changes in provisioning of food in the Baltic.
	P2	Inedible resources	No economic studies
	P3	Genetic resources	No economic studies
	P4	Chemical resources	No economic studies
	P5	Ornamental resources	No economic studies
	P6	Energy	Three studies are found regarding offshore windmill farms; however – all three are based on the same survey material. Other energy types related to the marine environment are not investigated by economic assessments.
	P7	Space & waterways	No economic studies
Cultural services	C1	Recreation	Five studies on recreational fisheries (3), tourism, sailing and river basins/valleys. The studies on tourism and sailing are not linked to water quality, and we suggest that further research are conducted valuing changes in use values such as bathing water quality, tourists demand for water quality, sailors demand for water quality etc.
	C2	Aesthetic value	One study found regarding the value of lake view.
	C3	Science & education	No economic studies
	C4	Cultural heritage	No studies regarding the marine; one valuation study done regarding wetland restoration and protection of cultural heritage. This study is not included in the survey however, as we have judged that the valuation issue was too far from the Baltic perspective.
	C5	Inspiration	No economic studies
	C6	The legacy of nature	No economic studies

Regarding eutrophication, three studies are of particular interest: Turner et al (1999), Atkins and Burdon (2006) and Atkins et al. (2007), which are all CVM studies. The Turner study is focusing on the Baltic, but the Danish WTP in the study is extrapolated from Swedish respondents stated WTP, and it is indeed questionable whether the average Dane has the same preferences and WTP for better conditions in the Baltic as the average Swede. In contrast, the Atkins and Burdon (2006) and Atkins et al. (2006) studies are based on a survey among Danish respondents, but here the study-site is Randers Fjord, which is not part of the Baltic – even though the fjord is adjacent to Kattegat, and the water quality of the fjord influences the quality of Kattegat to some degree.

Although these studies assess some aspects of eutrophication mitigation, the knowledge of the benefits from improving the water quality in marine areas remains very limited and general. We therefore find it relevant to conduct more empirical research, including specific studies as well as more general ones, within this area.

Two other interesting CVM studies (Toivonen et al., 2000; 2004) have been identified as well. These studies focus on the value of recreational fisheries in Denmark in general. Furthermore, Danish studies focusing on the value of offshore windmills are described – these studies are valuing the benefits of placing the windmills offshore in Kattegat and the Danish Straits; focus in the studies are on placing offshore windmills at different distances from the coast, and on operating with different farm sizes (in terms of the number of windmills per wind farm). These studies provide knowledge of how people perceive physical constructions offshore when they can see the constructions from land. It is not investigated how sailors and other users of the sea perceive these constructions. Biological assessments indicate that the windmills do not have negative influence on fish and mussels – in fact the studies show that the opposite is more likely to happen.

Finally, a number of other studies regarding the current situation in the Baltic, and regarding related water bodies are described.

Even though a number of studies have been performed we are (still) quite uninformed regarding the economic value of the benefits connected to an improvement in the Danish water environment – especially when it comes to the marine environment, as most of the existing studies focus on lakes, rivers/river basins and groundwater.

The conclusion is that from a Danish perspective we lack knowledge of the benefits of most marine ecosystem services and goods. In terms of where future research efforts should be directed, we find it very important to learn more about the benefits from improved use values such as bathing water quality, quality of the beaches, visual quality and smell, fishery possibilities linked to data on water quality and eutrophication, changes in tourism from eutrophication and pollution with hazardous substances. Use values are often more certain and easy to assess than non use values. However, non use values are very important as well, and as we also lack information on most non use values connected to the marine environment, we also find it relevant to focus on ways to – if not directly assess these values then at least – include them in analyses.

By looking at the statistics for valuation studies in the Nordic Countries it is revealed, that Denmark is lagging far behind Sweden and Norway when it comes to the number of implemented valuation studies. In conclusion, there is a clear evidence that new Danish valuation studies connected to the environmental degradation as well as scenarios for improvements in the Baltic are necessary to enlighten the value of a clean Baltic Sea.

In general, such projects can be carried out as individual case studies within each country, or/and by a new large scale valuation study, preferable by stated preference methods like CVM or CE. Travel cost methods, hedonic pricing methods and market price approaches can successfully be used in addition to stated preference

methods, but stated preference methods are more comprehensive and flexible as they allow researchers the possibility to assess hypothetical scenarios for improvements, e.g. in the Baltic Sea.

A large scale study in the Baltic, involving many countries, has the advantage that benefit transfers can be tested between the countries, and tests for preference heterogeneity between respondents in the different countries around the Baltic can be performed. Such tests can improve the use of benefit transfers and therefore induce benefit transfers to be used more frequently.

By using CE more detailed information can be gathered, compared to the use of CVM, travel costs or hedonic pricing. By performing CE's, preferences for ecosystem services and goods that are not treated in the former studies, such as bathing water quality and quality of the beaches, visual quality and smell, fishery possibilities, changes in tourism and non-use values, e.g. from clean water, can be assessed.

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

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Annex II. Estonia

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Introduction

The Estonian country report's aim is to identify and review the studies available on the economic effects of a changed marine environment of the Baltic Sea in terms of Estonia. The scope is aligned with the other country reports. Between mid-January and the end of February, potential valuation methods and broader Baltic Sea studies were reviewed for background information. To identify studies relevant to Estonia, international research databases and personal contact with researchers at the main research institutes in Estonia were used to identify relevant work in the field. Also contacted were relevant governmental, non-governmental, and also international organizations including project related organizations. After a review of the literature, the relevant studies were limited to eight studies and valuations were converted into EUR²⁰⁰⁷. In the summaries, general descriptions for research covering other relevant countries are referred to when relevant. In the conclusion, the results are further discussed, identifying gaps of knowledge and suggestions for further research.

Findings

International studies

ETKIN, D.S., 2000. WORLDWIDE ANALYSIS OF OIL SPILL CLEANUP COST FACTORS. IN: PROCEEDINGS, TWENTY-THIRD ARCTIC AND MARINE OILSPILL PROGRAM (AMOP) TECHNICAL SEMINAR. ENVIRONMENT CANADA, OTTAWA, ONTARIO. 161-174. WEBLINK: [HTTP://WWW.ENVIRONMENTAL-RESEARCH.COM/ERC_PAPERS/ERC_PAPER_2.PDF](http://www.environmental-research.com/ERC_PAPERS/ERC_PAPER_2.PDF)

The paper analyses global oil spill clean up cost factors and does not describe any particular ecosystem service. The environmental change causing the economic effect is assumed to be an oil spill. The study covered 40 countries around the world, including Estonia, using case studies from over 300 spills. The used cost estimation modelling technique that can be applied to various kinds of marine spills and takes into account the following cost factors: oil type, shoreline oiling, cleanup methodology, spill size, location, and specified spill amount.

The model uses updated cost data collected from the oil spill cases to construct an Average Per-Unit Marine Oil Spill Cleanup Costs By Nation/Region. The spill

costs are based on a relatively small number of spills in some nations due to the lack of data. Thus, the cost is only indicative of general trends for historical spills, which can be used to indicatively predict costs. The cost does not reflect third-party damage claims or natural resource damage costs additional to clean up costs. The costs are overall costs and no period of time is mentioned.

In the study, the costs of the spills were normalized to USD¹⁹⁹⁹ by applying US Consumer Price Index change percentages to correct for any differences in monetary values due to inflation. Currency conversions were done for the costs at the time of the incident. The Average Per-Unit Marine Oil Spill Cleanup Costs for Estonia are below and less than the European average, but higher than Lithuania and Finland.

Table EE.1. Costs of oil spills for Estonia.

	USD ¹⁹⁹⁹	EUR ²⁰⁰⁷
Average per-unit Marine oil spill clean up costs	6.13/liter or 6820.62/tonne	5.8/liter 6398.7/tonne

GREN, I.M., 1999. VALUE OF LAND AS A POLLUTANT SINK FOR INTERNATIONAL WATERS. ECOLOGICAL ECONOMICS, 30:419–431.

See annex IX for general description. In terms of Estonia –

The marginal benefit calculations were based on figures from Gren et al. (1997) which had calculated the Estonian nitrogen load to be 18 000 tonnes N/year and calculated the marginal costs for land as sinks and other uses. See table below. Sweitzer et al. (1995) had estimated the Estonian drainage basin for Estonia as 461 000 sq. km. The calculated marginal benefit shown below is based on the exchange rate 1 USD = SEK 7.99 (17 Dec. 1998).

Table EE.2. Estonian Marginal Costs and Benefits of Nitrogen reduction

	SEK ¹⁹⁹⁸	EUR ²⁰⁰⁷
Estonian marginal costs per kg N (land as sink) *	41-303	6.2-45.8
Estonian marginal costs per kg N (land as other uses) *	0.1-357	0-53.9
Estonian marginal benefits per kg N	18.6	2.8

*Gren et al. (1997)

Furthermore, the study calculated and compared the values for the Estonian drainage basin land as a nitrogen sink using various decision rules. The rules included maximisation of international benefits, maximisation of national net benefits,

minimisation of international costs for 50% total N-reduction, and minimisation of costs for a 50% reduction in national N-loads for Ley, Energy Forests, Wetlands, and Catch crops. This was compared to the also calculated values for the Estonian drainage basin land as a nitrogen sink using various decision rules under the scenario of a doubling of the wetlands areas. The optimal nitrogen reductions for Estonia were calculated given the same decision rules. In the re-calculations of the values for the Estonian drainage basin land as a nitrogen sink using various decision rules when the area of wetlands was doubled, where there was a significant decrease in Estonian wetlands value under the scenarios of minimization of international costs for 50% total N-reduction, as well as for the minimization of Estonian costs for a 50% reduction in national N-loads.

MARKOWSKA, A., AND ZYLICZ, T., 1999. COSTING AN INTERNATIONAL PUBLIC GOOD: THE CASE OF THE BALTIC SEA. ECOLOGICAL ECONOMICS, 30:301–316.

See annex IX for general description. In terms of Estonia -

Based on the Lithuanian contingent valuation study results extrapolated to Estonia, the Lithuanian mean WTP was multiplied by the ratio between Estonia's GDP per capita at PPP and Lithuania's GDP per capita at PPP. The following calculations were made:

Table EE.3. Estonian WTP and aggregate benefits.

	USD ¹⁹⁹⁵	EUR ²⁰⁰⁷
Estimated mean WTP per capita	29	41.6
Aggregate benefit for Estonia	33 million	47.4 million

POVILANSKAS, R., VADALA, F.T., ARMAITIENE, A., EHRLICH, Ü., AND KUNDROTAS, A., 1998. BALTIC COAST ECONOMIC VALUATION AS A TOOL IN COASTAL CONSERVATION POLICY IN THE BALTIC STATES. FINAL PHARE ACE RESEARCH PROJECT REPORT TO THE EUROPEAN COMMISSION. KLAIPEDA – ROME – TALLINN – VILNIUS.

The following research objectives were formulated for the project:

- To investigate and practically apply different methods of economic valuation of (semi) natural coastal biotopes around the Curonian Lagoon (Lithuania) and the Matsalu Bay (Estonia).
- To develop recommendations for including economic valuation into standard appraisal and decision taking procedures related to coastal conservation, planning and management in Lithuania and Estonia.

Two main questions were addressed during the project:

- How much the population of Lithuania and Estonia is willing to pay for the conservation and maintenance of natural and semi-natural coastal biotopes and their biological and aesthetic values?
- What is the rating of the environmental protection and nature conservation in the coastal areas of the Baltic States in comparison with other social issues?

Potential loss of biotopes in coastal areas was examined/valuated during the project. Three geographical coastal regions – Curonian Spit and Nemunas delta in Lithuania and environs of the Matsalu Bay in Estonia were analysed in the Baltic Coast study. Total study area covered over 1000 km².

In order to obtain statistically significant results from all applied WTP formats, the total national respondent's samples in both Estonia and Lithuania were divided into random samples. Respondents in every subsample were asked different forms of the WTP question for valuation of different biotopes or in general for the valuation of the "nature" in each of the three surveyed coastal regions. The respondent group for the CVM pilot test survey consisted of 550 respondents in Estonia and 1683 respondents in Lithuania.

In terms of Estonia -

The valuations relevant to Estonia are a contingent valuation method (CVM) and travel cost method (TCM). In terms of CVM, the aggregate annual willingness to pay (WTP) was calculated by multiplying the expected mean by the total voter number in the country and using a 10% annual discount rate. Alternative scenarios were described and illustrated to portray the development sequence of direct human impact or natural succession to the landscape.

TCM estimated the WTP for the recreation sites natural features and/or for its recreational amenities via the good "recreational visits." Although travel, lodging and recreational services were accounted for, travel costs make up the main share of visit costs to the Estonian area - Matsalu Bay - due to a short visiting time. A one-step TCM approach is applied where the consumer surplus is calculated from the demand function derived directly from empirical data. The total annual consumer surplus is derived from integrating the visitation rate equation for each visit cost interval and summing the results.

The total annual WTP for 1997, estimated from the mean and median with an annual 10% discount rate and the WTP for various coastal biotopes compared with an

estimated conservation costs (according to study assessments) are found in table EE.4 and EE.5 below.

Table EE.4. Annual WTP for Matsalu Bay.

CVM format	Referendum		Discrete Choice		Payment card		Open end	
Biotope/Landscape	Mean	Median	Mean	Median	Mean	Median	Mean	Median
	1000 USD¹⁹⁹⁷							
General nature	818	1636	908	68-227	2819	908	1182	727
Coastal meadows			636	68-227			727	727
Floodplains			454	68-227			636	364
Forested meadows			364	68-227			454	364
	1000 EUR²⁰⁰⁷							
General nature	857.7	1715.5	952.1	71.3-238	2955.9	952.1	1239.4	762.3
Coastal meadows			666.9	71.3-238			762.3	762.3
Floodplains			476.1	71.3-238			666.9	381.7
Forested meadows			381.7	71.3-238			476.1	381.7

Table EE.5. WTP compared to estimated conservation costs for Matsalu Bay.

Biotope	WTP (CVM open ended format)	Estimated conservation cost
	1000 USD¹⁹⁹⁷	
Coastal meadows	636	140
Floodplains	454	250
Forested meadows	364	250
<i>Total</i>	1454	640
	1000 EUR²⁰⁰⁷	
Coastal meadows	666.9	146.8
Floodplains	476.1	262.1
Forested meadows	381.7	262.1
<i>Total</i>	1524.6	671.1

The difference between the WTP as social benefits from coastal nature and the maintenance costs or the social costs of these biotopes is the total CS or net economic value of the nature. Since maintenance costs in Matsalu reserve are higher than actual producer surplus due to low use values, it is important to support these figures with external economic figures like WTP of non-use values.

For Matsalu Bay, the total estimated consumer surplus is the following:

Table EE.6. Total estimated Consumer Surplus for Matsalu Bay.

Area	CS for total marginal visit costs	CS for travel costs	Separational CS
	1000 USD¹⁹⁹⁷		
Matsalu Bay	91	80	Not estimated
	1000 Eur²⁰⁰⁷		
Matsalu Bay	95.4	83.9	Not estimated

The consumer surplus value is lower than the WTP elicited from the contingent valuation. The difference is based on the function of this area as a wetlands with high non-use or indirect use value.

Other relevant information:

- Several valuations were used and compared. Hedonic Price Method (HPM) and Travel Cost Method (TCM) based on revealed preference are more applicable to valuation of coastal areas with very high nature use values and important social connotations attributed to the specific landscapes of these areas. Also, HPM calculation was used for the Lithuanian sites, but was not appropriate for Matsalu Bay because it is a sparsely populated wetland area.
- There are several future recommendations for further valuation studies, like the inclusion of non-participation and visitor distribution assessment, analysis of criteria for segregation of areas, analysis of alternative and multiple destinations, possible use of secondary data, consequences of introduction of entrance fees.
- The results should be seen as a pilot test of different subjective economic valuation approaches rather than an indepth study.
- In the study, monetary values are attributed to natural and semi-natural dynamic biotopes, as well as a transitioning economy from centrally planned to market economy. Attitudinal and demographic questions were also included in the CVM surveys. At the time of the study, the social welfare context of Estonia was not considered favorable for high social WTP for nature in terms of non-consumptive use values or non-use values.
- The study also looks at the Lithuanian coastline and compared several valuation methods. The authors conclude HPM and TCM based on revealed preference to be more applicable to valuation of coastal areas with high nature-use values and important social connotations attributed to the specific landscapes. Also, HPM which was used for the Lithuanian sites was not seen as appropriate for Matsalu Bay because it is a sparsely populated wetland area.

SANCTUARY, M., AND FEJES, J., 2006. WHAT'S MISSING FROM MEASURES OF OIL SPILL DAMAGES? A CLOSER LOOK AT ECOSYSTEM VALUATION AND POLICY RESPONSES. ARCHIVE NUMBER: U2032. IVL, SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE, STOCKHOLM.

Weblink:

<http://www.srv.se/upload/R%C3%A4ddningstj%C3%A4nst/olja/How%20clean%20is%20clean/Delrapport%203.a%20Whats%20missing%20from%20measures%20of%20Oil%20Spill%20Damages.pdf>

See annex IX for overall study details. In terms of Estonia -

The environmental change was triggered by the leaking of an estimated 300 tonnes of heavy fuel oil cargo from the Maltese tanker Alambra (75 366 GT) during its loading a cargo in the Port of Muuga, Tallinn (Estonia) in 2000.

The valuation of the spill is based on the summing of the various direct costs incurred detailed below, including lost income from port operators, a charter boat operator, and oil loading contractor while the Alambra vessel was at berth.

Table EE.7. Compensation claims for the Alambra incident, Tallinn, Estonia 2000.

Claim	USD ²⁰⁰⁰	EUR ²⁰⁰⁷
Clean up – Estonia	620 000	581 652
Clean up – Sweden (Swedish Rescue Service Agency and Local authorities)	647 500	607 451
Estonian State – Pollution Fine	655 000	614 487
Swedish Coast Guard – Water Pollution Fine	56 000	52 536
Ship charter operator - Estonia	100 000	93 815
Estonian Port operator (lost berth time)*	2 240 000	2 101 451
Estonian Oil loading contractor (lost work time) *	733 000	687 662
<i>Total</i>	<i>4 995 500</i>	<i>4 686 517</i>

Other relevant information:

The value of damages by oil spills does not include direct, indirect, and passive use of ecosystem services. The study focuses on Sweden.

TURNER, R. K., GEORGIU, S., GREN, I-M., WULFF, F., BARRETT, S., SÖDERQVIST, T., BATEMAN, I.J., FOLKE, C., LANGAAS, S., ZYLICZ, T., MÄLER, K-G., AND MARKOWSKA, A., 1999. MANAGING NUTRIENT FLUXES AND POLLUTION IN THE BALTIC: AN INTERDISCIPLINARY SIMULATION STUDY. ECOLOGICAL ECONOMICS, 30:333–352.

See annex IX for general description. In terms of Estonia -

Based on the Polish contingent valuation study results extrapolated to Estonia, the Polish mean WTP estimate was multiplied by the ratio between Estonia's GDP per capita at PPP and Poland's GDP per capita at PPP. The following calculations were made:

Table EE.8

	SEK¹⁹⁹⁵	EUR²⁰⁰⁷
Annual WTP per person	700 (355)*	156.6 (79.4)
National WTP, year 1 – annual mean WTP estimates per person multiplied by the (adult) population in the Baltic drainage basin part of Estonia	MSEK 790 (401)	MEUR 176.7 (89.7)
National WTP present value - The time horizon: 20 years (specified in the CVM studies). Discount rate: 7% (this rate was used also in the estimation of nutrient reduction costs).	MSEK 8 369 (4248)	MEUR 1 871.9 (950.2)
National WTP present value per year	MSEK 418 (212)	MEUR 93.5 (47.4)

* Brackets are for benefit figures which assume zero WTP of non-respondents.

In calculating the costs and benefits (see table below) from reducing the overall nutrient load to the Baltic Sea by 50%, which for Estonia would mean a 55% reduction of its nutrient load, Estonia would be one of the few countries that would not gain economically.

Table EE.9

	MSEK¹⁹⁹⁵	MEUR²⁰⁰⁷
Benefits for Estonia	418 (212)	93.5 (47.4)
Annual costs for Estonia	1529	342
Net benefits for Estonia	-1 111 (-1 317)	-248.5 (-294.6)

* Brackets are for benefit figures which assume zero WTP of non-respondents.

Estonian studies

GREN, I.M., EHRLICH, Ü., AND BRINCH PEDERSEN, M., 1996. ECONOMIC VALUATION OF FLOOD PLAINS AND COASTAL WETLANDS IN ESTONIA. WWF, 1-35.

The purpose of the study is to estimate the benefits from wetland conservation in Estonia for two types of wetlands: coastal wetlands and floodplains (the former of which is most relevant to the marine environment value). The study mentions the ecosystem services relevant to the coastal wetlands to include cultural, provision-

ing, regulating and supporting, limits itself to the use-values of the three services provided by the coastal wetlands which can be estimated in monetary terms: Grasslands, Reeds, and Nitrogen Sink. Grasslands and reeds are seen as provisioning services, while nitrogen sink is seen as a regulating service in terms of biological regulation and eutrophication mitigation.

The environmental change causing the environmental effect is possible conservation of the wetlands, which are under threat due to the privatization of land leading to expected unsustainable wetland management. Drainage and conversion of wetlands to agricultural land has decreased the wetlands' natural nutrient retention and reduction capacities and is seen as a source of substantial leakage of nutrients from agriculture to the Baltic Sea.

In terms of the valuation method, the harvest value of reed and grasslands/hay are estimated for selected sites using market prices and transferred to other wetland sites. The harvest values are calculated as the associated changes in producer surplus using market prices of the good minus the cost of obtaining the good. The harvest value is assumed to be constant per hectare, i.e. the entire wetland production divided by the area.

For nitrogen sinks, the value is calculated as a replacement cost using a model for the cost of reducing the nitrogen loads to the Baltic Sea at various levels. The value is calculated as the difference in costs between using wetlands as a nitrogen sink and alternative nitrogen abatement measures. The replacement value is then the cost avoided by not having to implement higher-cost measures. Wetland value increases with the cost of alternative measures, as well as the increase in nitrogen reduction targets. In a Baltic Sea context, the value of Estonian wetlands depends on the availability of low cost alternative measures in the Baltic Sea region.

In terms of estimated values (prices presented in EEK¹⁹⁹⁴), the value of the coastal wetlands based on its different uses:

Table EE.10

	EEK ¹⁹⁹⁴	EUR ²⁰⁰⁷
Grasslands/hay	469-871 EEK/ha	81.5-151.4 EUR/ha
Reeds	835-5 434 EEK/ha	145.1-944.5 EUR/ha
Nitrogen sink	8 000 EEK/ha/year	1 390.5 EUR/ha/year
Total annual value	4.7 MEEK (0.9-27 MEEK range)	0.8 MEUR (0.2-4.7 MEUR range)
Total value, including the current and future values	5 840-186 060 EEK/ha	1 015.1 – 32 340.5 EUR/ha

In terms of estimated values, (prices presented in EEK¹⁹⁹⁴), the productivity of coastal wetlands used for grazing cattle lies between 0.7-1.3 tonnes/ha and the

price farmers would pay to purchase hay on the market as a substitute is 670 EEK/tonne. Costs are assumed to be negligible. The value of coastal wetlands as a food for livestock is between 469-871 EEK/ha.

In terms of reeds, the harvested area is about 570 ha with a yield ranging from 500-700 truss/ha with a market price between 9-13 EEK/truss. The cost of harvesting is subtracted from the income/ha, which is 4 500-9 100 EEK. Harvesting costs include capital costs for two harvest machines and the payment of wages. The value of reed harvested from coastal wetlands lies between 835-5 435 EEK/ha.

As a Nitrogen Sink, the value is calculated as the cost avoided by not implementing higher cost alternative measures. To calculate the wetland values as a nitrogen sink, a model is used to correspond to the different reduction targets in the total nitrogen load to the Baltic Sea. At 50% reduction required by the ministerial agreements, the nitrogen sink value for Estonian coastal wetlands is 8 000 EEK/ha/year. The value as nitrogen sink accounts for about 4/5 of the total value.

In this study, the estimated total annual value is an aggregate of the respective services as the sum of the service values, which is 4.7 MEEK, with a range of 0.9 to 27 MEEK. The wide variation is mainly due to the nitrogen sink value and the various Baltic wide targets for nitrogen reduction. The total value, including the current and future values, of the services is calculated to be 5 840 – 186 060 EEK/ha.

Other relevant information:

- The study also looked at the services and values of floodplains in Estonia.
- The first valuation study applied to Estonian wetlands.
- According to discussions with one of the co-authors, the general scientific quality of this paper is questionable due to the monetary information being based on extrapolations of analogues rather than empirical studies. Also, the ranges of monetary estimations of different services are very large and hard to convert into current prices. This topic still needs further study.

VETEMAA, M., ESCHBAUM, R., EERO, M., AND SAAT, T., 2003. THE IMPACT OF FISHERIES ON WATER BIRDS IN ESTONIA: NATURE PROTECTION AND SOCIO-ECONOMIC PERSPECTIVES. IN: I. COWX (EDITOR) PROCEEDINGS OF THE SYMPOSIUM: INTERACTIONS BETWEEN FISH AND BIRDS: IMPLICATIONS FOR MANAGEMENT. FISHING NEWS BOOKS, BLACKWELL SCIENCE, 72-83.

The environmental focus of this study is the evaluation of the proportion and value of the catch obtained in Estonia in 1998-99 through fishing activities with high by-catch risk of rare and endangered birds. The more relevant focus is the value of the safe fishing catch. The ecosystem service covered is a provisioning service of food:

fish and supporting service of habitat. Although it does not relate directly to marine water quality, it does relate to the overall marine ecosystem.

In terms of the conflict between the rare and endangered birds and the fishing industry, the hypothetical environmental changes causing the economic effect would be protection of birds at the loss of the economic value within the fishing industry. Protection could take place via establishing new protected areas and/or the setting of more stringent regulations regarding nature conservation in existing areas. Protection should help to avoid both the drowning of water-birds as by-catch in nets and also fishing activities disturbing nesting sites.

The study broke down the value of the catch according to the water bodies, including the Baltic Sea. Fishing activities were classified as “dangerous” according to the risk of specific bird by-catch. The study utilized data on the total catches, by-catch, average first-buyer prices and the number of fishing licenses issued by the counties in 1998-99.

The value of catch of fishing not endangering birds of special concern in Estonian fishing (Atlantic fishing excluded) for open sea fishing in the Baltic Sea was calculated in 1998 and 1999 for both open sea and coastal fishing.

Table EE.11. Annual value of safe catch of fishing.

Safe catch fishing	10³ EUR²⁰⁰³	10³ EUR²⁰⁰⁷
open sea fishing - 1998	9 044	12 873.44
open sea fishing - 1999	6 738	9 284.64
coastal fishing – 1998	2 430	3 458.92
coastal fishing – 1999	1 631	2 247.44
Revenue received from high risk fishing activities	100–150	137.80-206.69

Other relevant information:

The value of safe fishing was 100% for open sea fishing and > 95 % for coastal fishing in the Baltic Sea between the years 1998-99. The number of fishermen in West-Estonia (Baltic sea and inland water bodies) is still around 700 and the annual revenue received from high risk fishing activities was estimated to be 100-150 000 EUR (10-15 working places annually or less than 1% of those involved in small scale fishery).

Conclusions

In terms of economic valuation of the Baltic Sea, relatively few studies have been performed for Estonia. All of the reviewed studies, except for one, uses data from the 1990s, which makes the results somewhat dated, as Estonia has undergone

rapid changes in the recent decade – most likely affecting values. The studies identified focus on some aspects of Supporting, Regulating, Provisioning, and Cultural services, but most do *not* specify eco-system services in more detail.

However, three of the studies relevant to Estonia cover the entire Baltic Sea Region. They focus on the Regulating service of Eutrophication mitigation (R6). In these studies, information from either Poland or Lithuania was extrapolated to Estonia based on GDP. Several further studies not included in the literature review used these studies to draw policy conclusions and calculated the net benefits for the countries around the Baltic Sea region based on various scenarios of nutrient reductions, as well as various methods of bargaining as well as distributing the costs of nutrient reduction measures.

One group of studies deals with coastal wetlands gathering its data directly from Estonia and more than one study valued provisioning services of fish (P1). Costs of oil spills were also calculated in two studies where ecosystem services were not specified, but referring to specific ecosystem services through space and waterways can be inferred.

In the studies, cultural and supporting services were mentioned only generally and not specifically broken down into their ecosystem services (except for Recreational services). It follows then that the specific ecosystem categories of these services (S1-S6 and C1-C6) are opportunities for future studies. Also, most of the specific ecosystem services of Provisioning services other than Food (P2-P7) and Regulating services (R1-R5) have not been studied specifically. Due to the large number of knowledge gaps, one way to prioritise future study areas is to relate them to pressing topics like eutrophication. According to the recently released Eurobarometer study on Attitudes of European Citizens towards the Environment by the European Commission (2008), the highest concern in the Baltics (Estonia, Latvia, and Lithuania) was water pollution, which they at some level attributed to the condition of the Baltic Sea and eutrophication.

According to Garpe (2008), ecosystem services negatively and directly impacted by eutrophication include, i.e. Habitat, Food, Recreation, Aesthetic Value, Resilience and the Legacy of Nature. Out of these, the more comprehensive use-values of food and recreation could be evaluated at the minimum using economic market data. Ideally, the study would use comparable methodologies in several Baltic Sea Region countries.

Included in the literature review is Gren et al. (1996), which had a weaker scientific base due to the methodology. However, it relates directly to the economic valuation of the coastal wetlands in terms of provisioning services and regulating services. Despite the uncertainty behind the values, this study gives a good base for further studies in this field, especially due to the strong link between the nitrogen sink ecosystem service and eutrophication. The results of a more scientifically strong

study could then provide a comparison to the results of Gren (1999), which valued the marginal benefits of wetlands for their pollutant sink ecosystem services based on marginal costs.

As mentioned in the literature review, the Gren (1999) study also re-calculated the values for the Estonian drainage basin land as a nitrogen sink using various decision rules when the area of wetlands was doubled. According to the study, there was a significant decrease in Estonian wetlands value under the scenarios of minimization of international costs for 50% total N-reduction, as well as for the minimization of Estonian costs for a 50% reduction in national N-loads. In determining both the need for potential wetlands re-cultivation for Nitrogen sink services around the Baltic Sea, as well as the most location for re-cultivated wetlands, further studies could be made to support these conclusions.

In terms of valuating semi-natural areas along the Estonian coast, Povilanskas et al. (1998) use visitors' WTP to capture both use and non-use values, including recreation limited to one specific bay in Estonia. As the area of the Estonian coastline used for recreation extends farther than this limited case study and the tourism services industry is growing in Estonia, this also represents an opportunity for further study. Studies should account for Estonian and international visitors. This is particularly significant because tourism along the coastline is potentially affected by the marine environment quality.

Etkin (2000) and Sanctuary et al. (2006) both value the costs of oil spills for Estonia, but both limited only to the direct costs. Neither study includes the value of the damage to natural resources or the impact on the value of the direct, indirect and passive use of ecosystem services.

In addition the listed literature, there were several studies that were not included due to aggregated information that placed the resulting values partially outside of the scope of the Baltic Sea. First of all, COWI (2007) contained quantified values for provisioning services in terms of landings, etc. for the Baltic Sea Region countries and Martínez (2007) quantified values for the overall ecosystem services for Baltic Sea area countries, but did not limit the services to those directly resulting from the Baltic Sea. The methodologies, however, could be used to calculate provisioning services directly coming from the Baltic Sea. Also, Ehrlich et al. (2001) calculates aggregate non-use values using WTP of Estonian working age population for the preservation of Estonian Semi Natural Communities. These communities included, but were not limited to coastal habitats such as coastal meadows, of which there are 5 250 ha and alvars, of which there are 9 300 ha. The WTP was analyzed according to sociometric features, income and education, which seem to influence WTP. The study also calculated the annual costs of maintenance of these areas, as well as the annual economic value for Riparian Grasslands (floodplains) in Estonia for Fish and as a Nitrogen sink based on Emajõgi River information. This could provide direction for studies of non-use values for specific coastal areas.

In Estonia, provisional services such as food/fish are closely linked with cultural heritage services like the existence of the declining traditional fishing community. The value of this has not been calculated in Estonia, but predicted by Vetemaa et al. (2003) to be larger than the official economic value of a collapse in the Estonian fishing industry. This prediction is supported by COWI (2007).

Although two studies mentioned above did look at the cost of oil spills, future studies could also cover the broader impacts of the ferry/shipping industry and the ports to the marine environment – not just from oil spills. Another industry, which uses marine space is the wind energy industry. Wind energy is a growing industry in Estonia and according to Environmental Impact Assessments windmills do not impact the environment negatively. However, the use of marine space and therefore their value, i.e. as an energy source, could be added to the overall value of the Baltic Sea for Estonia. In Estonia, there is also now discussion about the use of ports as sites for windmills.

Furthermore, a The Baltic Sea Regional Project, BSRP - project to support management of the Baltic Sea ecosystem led by International Council for the Exploration of the Sea (ICES) which ran from 2003 – 2007 was supposed to do socio-economic analysis with regard of the BS ecological quality, its goods and services. However, according to coordinators, this aspect was postponed to the project's second phase due to complexity of the issue. Furthermore, it is unlikely to take place in this context due to changes in the GEF eligibility of the eastern Baltic states. Studies by Vetemaa at the Estonian Marine Institute, Tartu University for the BSRP project were limited to the fisheries economy.

Although there are quite many natural science research papers available about the Estonian coastal waters, the socio-economic aspects have been most insufficiently investigated. The few papers available are mostly outdated. There are almost no economic investigations of the non-market values of the Estonian coastal waters, which is particularly regrettable because these values account for a significant part of the total economic value of the sea. In general, it can be said that the degree the Estonian waters have been investigated so far is in no way in correlation with its actual significance for the Estonian economy. Furthermore, the economic investigations of the Estonian sea and their resources available at present do not provide information on its actual social and economic value.

Table EE.12. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	No studies found.
	S2	Primary production	
	S3	Food web dynamics	
	S4	Diversity	
	S5	Habitat	One study, which looked at the conflict between the fishing industry and rare and endangered bird habitats.
	S6	Resilience	No studies found.
Regulating services	R1	Atmospheric regulation	Not specifically discussed, but could be included in the non-use values studied in several of the reports.
	R2	Regulation of local climate	
	R3	Sediment retention	
	R4	Biological regulation	
	R5	Pollution control	
	R6	Eutrophication mitigation	Two studies which focused on the coastal wetlands in terms of their value as a nitrogen sink based on replacement cost of using alternative abatement measures and marginal benefit calculations. One of the studies was not scientifically strong. We suggest further studies as this directly links to the high priority topic of eutrophication.
Provisioning services –	P1	Food	Two studies. Potentially one study which focused on the market value of Hay harvested within the coastal wetlands based on market value. This did not define the ecosystem service. Another study focused on the value of fishing catch considered safe in terms of its effect on rare and endangered birds. Other studies valuing the fishing landings did not limit their catch source to the Baltic Sea Region.
	P2	Inedible resources	Potentially one study (undefined ecosystem service) which focused on the market value of Hay and Reeds harvested within the coastal wetlands based on market value.
	P3	Genetic resources	No studies found.
	P4	Chemical resources	No studies found.
	P5	Ornamental resources	Potentially one study (undefined ecosystem service) which focused on the market value of Hay and Reeds harvested within the coastal wetlands based on market value.
	P6	Energy	No studies found, but there are recent developments in the development of wind energy sites along the coast.
	P7	Space & waterways	Potentially two studies focused on the direct costs incurred from oil spills from shipping vessels. The specific ecosystem services were not identified. Crucial knowledge gap regarding the value of direct, indirect, and passive use of ecosystem services damaged by the oil spills.
Cultural services –	C1	Recreation	One study which assessed the WTP, conservation costs and consumer surplus of one specific Bay. Due to the use of Estonian coasts for recreation, we suggest further studies in regards to the WTP for coastal tourist leisure and recreation use.

	C2	Aesthetic value	Potentially 1 study, which discussed "the non-use value" of semi-natural areas along the Estonian coast. Suggested further study due to rapid development of tourist industry since 1998.
	C3	Science & education	No studies found.
	C4	Cultural heritage	No studies found. Due to the predicted cultural importance of the fishing industry, we suggest further studies to add to the value of the fishing industry as a food provider.
	C5	Inspiration	No studies found.
	C6	The legacy of nature	Potentially 1 study, which discussed "the non-use value" of semi-natural areas including, but not separating the Estonian coast. It was not included in the literature review due to aggregation. Suggested further study due to the perceived importance of nature to Estonians and existence of methodology.

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Annex III. Finland

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Introduction

This report reviews Finnish studies that have focused on valuing water systems. The emphasis is on the Baltic Sea, but as there are rather few studies relating directly to it, studies concerning inland waters are also included in the review.

Relevant studies have been found by contacting several research institutes, universities and individuals. Several studies have also been identified based on an earlier review of Finnish valuation studies.

In total 12 studies which relate to the Baltic Sea have been identified. In addition, there are several valuation studies focusing on inland waters. Also studies that are currently in the process are listed to provide information on the forthcoming results.

Most information exists on the effects of eutrophication to the marine environment and to inland waters. Fisheries have also been discussed in several studies, although none of them is directly related to the Baltic Sea but instead to the rivers that empty to the sea. Both use and non-use values have been estimated, although some studies have focused only on use values. Cultural ecosystem services have been studied the most, and among these recreation has been of main interest. There are relatively few estimates on provisioning services, and more studies might be needed on these. Non-use values relate to supporting services, such as habitat and diversity, and there are some estimates of their value.

Findings

Valuation of the Baltic Sea

There is only a limited number of studies discussing the economic value of water systems in Finland. The studies relating directly to the Baltic Sea are quite rare as only 12 of them have been found. The basic information on the studies is collected to table FI.1 in order to give a general view of the studies and to facilitate making comparisons between the studies. The studies are discussed more thoroughly below. In addition to the ten valuation studies presented in table FI.1, there are a couple of studies (HELCOM and NEFCO 2007, Laukkanen and Huhtala 2008) that are only described below as they do not readily fit the categories of the table.

The studies concerning the economic effects related to the state of the Baltic Sea include journal articles, reports and dissertations or theses. Most are published in the 2000s, some in the 1990s. This might indicate an increasing interest in and demand for economic valuation studies in Finland. The Gulf of Finland has been the target area in most Finnish studies. The scope has varied from local to international.

Most studies have employed stated preference methods, and revealed preference studies have thus far been uncommon in Finland. Only one revealed preference study has been found, and it uses the travel cost method. The most common method among the listed studies is contingent valuation. This may be partly because these studies are typically easier to find than studies using other, not so well-established methods. Some studies have also used benefits transfers which have mainly been based on the results of a Swedish contingent valuation study (Söderqvist, 1995).

The environmental issues covered in the studies include eutrophication, fisheries and oil spills. Eutrophication has been of primary interest in Finland and there are several studies that focus on its impacts. There are also three studies on fisheries and one on oil spills. These probably represent the most important environmental issues related to the Baltic Sea in Finland.

The discussed ecosystem services have been mostly cultural (recreation and aesthetic value) and supporting services (biodiversity and habitat). The ecosystem services have not generally been explicitly mentioned in the study reports, so they have been identified based on the focus of the study and the specified environmental change.

Most studies have estimated both use and non-use value. There are, however, some studies that have focused exclusively on use value and recreation. The economic measure has typically been willingness to pay. In most cases the reports include estimates of both the mean/median values and the aggregate value of the study population.

Studies on Baltic Sea

The studies addressing economic effects related to the Baltic Sea are described in this section. The basic information on the studies is also presented in table FI.1. All value estimates have been converted to 2007 Euros with the cost-of-living index³⁰, which is calculated based on the consumer price index and therefore develops similarly.

³⁰ This index is available at http://www.stat.fi/til/khi/tau_en.html.

SIITONEN, H., WARTIOVAARA, J., KASANEN, P. AND KOMMONEN, F., 1992.
SELLU- JA PAPERITEHDASINTEGRAATIN YMPÄRISTÖNSUOJELUTOIMIEN
HYÖTYJEN JA HAITTOJEN ARVIOINTI - CASE-TUTKIMUS. RESEARCH REPORT
122, PUBLICATIONS OF THE WATER AND THE ENVIRONMENT
ADMINISTRATION, SERIES A. 262 PP.

Siitonen et al. (1992) focus on the cultural ecosystem services and the recreational value of reducing the amount of nutrients entering into the sea. The article provides an estimate of the value of the environmental protection measures taken by a pulp and paper factory in Pietarsaari on the coast of the Gulf of Bothnia. The factory reduced the amount of phosphorus and nitrogen in its waste water during the 1980s which lead to improved water quality in the sea area near Pietarsaari.

The value of the improved water quality is estimated based on benefit transfer from international studies and also on the present damage compensations to fishermen. The benefit transfer values are multiplied by the number of residences in Pietarsaari which is considered an approximation of the amount of households. The benefits to fishing are approximated by the paid compensations to fishermen, which are thought to represent the current damages to the fishing industry. The aggregate value of the improved water quality for the residents of Pietarsaari is estimated to range from 269 000 EUR²⁰⁰⁷ (1.2 MFIM¹⁹⁸⁹) to 515 000 EUR²⁰⁰⁷ (2.3 MFIM¹⁹⁸⁹) per year during the ten year period of 1980-1989.

The report estimates also the costs for the environmental protection measures and compares these to the benefits in a cost-benefit study.

KIIRIKKI, M., RANTANEN, P., VARJOPURO, R., LEPPÄNEN, A., HILTUNEN, M.,
PITKÄNEN, H., EKHOLM, P., MOUKHAMETSHINA, E., INKALA, A., KUOSA, H.
AND SARKKULA, J., 2003. COST EFFECTIVE WATER PROTECTION IN THE GULF
OF FINLAND. THE FINNISH ENVIRONMENT 632, FINNISH ENVIRONMENT
INSTITUTE.

Weblink: <http://www.ymparisto.fi/download.asp?contentid=10366&lan=en>

Kiirikki et al. (2003) estimate the reduction costs of nutrient load entering the Gulf of Finland. The costs are estimated for one ton of nitrogen equivalent, which corresponds to one ton of biologically available nitrogen or 0.14 tons of phosphorus. The cost estimates include only the waste water treatment sector. The costs are estimated to vary between 894 EUR²⁰⁰⁷ - 29 000 EUR²⁰⁰⁷ (850 EUR²⁰⁰³ – 28 000 EUR²⁰⁰³) per ton depending on the specific measure.

KOSENIOUS, A.-K., 2004. ESTIMATING THE BENEFIT FROM ALGAL BLOOM REDUCTION - AN APPLICATION OF CONTINGENT VALUATION METHOD. MASTER'S THESIS, DEPARTMENT OF ECONOMICS AND MANAGEMENT, UNIVERSITY OF HELSINKI.

Kosenius (2004) studies the benefits of reduced eutrophication in the Gulf of Finland. The ecosystem services concerned are cultural (recreation and aesthetic value) and provisioning (food). The extent of the change is a 25 % reduction in algae blooms by the beginning of the next summer season and a 50 % immediate reduction in the risk of getting a shellfish poisoning.

The study population includes the tourists of the town of Hanko on the coast of the Gulf of Finland, and their willingness to pay is elicited using contingent valuation method. The interviews have been conducted in Hanko in July 2003, and there are 212 respondents. Both the mean and the median willingness to pay are 26 EUR²⁰⁰⁷ (24.9 EUR²⁰⁰³) per person per year. The tourists' aggregate willingness to pay is estimated based on the amount of tourists staying in Hanko during the three summer months, and it is 308 000 EUR²⁰⁰⁷ (293 000 EUR²⁰⁰³) per year.

According to the author the aggregate benefit estimate is likely to be an underestimation, as there are probably more tourists visiting and staying in Hanko during the summer months than what is assumed in calculating the aggregate value. In addition to tourists, also others will benefit from reduced eutrophication.

TOIVONEN, A.-L., ROTH, E., NAVRUD, S., GUDBERGSSON, G., APPELBLAD, H., BENGTTSSON, B. AND TUUNAINEN, P., 2004. THE ECONOMIC VALUE OF RECREATIONAL FISHERIES IN NORDIC COUNTRIES. FISHERIES MANAGEMENT AND ECOLOGY 11: 1-14.

Toivonen et al. (2004) estimate the value of recreational fishing in all Nordic countries. Their focus is on cultural ecosystem services (recreation) and supporting services (diversity and habitat). The valuation method used is contingent valuation, and the questionnaire is sent by mail to 5 000 Finns in the autumn 1999. The response rate is 51 %.

The study provides separate estimates of the fishermen's current fishing expenses, the value of the fishing experience in addition to the true expenses and the value of preserving current fish stocks and the quality of recreational fisheries in the Nordic countries. Fishing in all waters (lakes, rivers and sea) is included in the valuations, and the value estimates are for fishing as a whole and not separately for different types of water bodies. Thus it is not possible to separate the value of sea fishing from the value of fishing in inland waters.

According to the results of the Finnish survey, the mean fishing expenses are 173 EUR²⁰⁰⁷ (930 FIM¹⁹⁹⁹) per fisherman per year, making the aggregate expenses 227

MEUR²⁰⁰⁷ (1220 MFIM¹⁹⁹⁹) per year. The mean extra willingness to pay for the fishing experience is 83 EUR²⁰⁰⁷ (446 FIM¹⁹⁹⁹) per fisherman per year, and the aggregate 93 MEUR²⁰⁰⁷ (501 MFIM¹⁹⁹⁹) per year. The aggregate value for preserving the current fisheries for both fishermen and non-fishermen is estimated to be 180 MEUR²⁰⁰⁷ (967 MFIM¹⁹⁹⁹).

Identical surveys have been conducted simultaneously in all five Nordic countries. The survey includes also questions about the value of three hypothetical scenarios of fishing that specify the fishing site, species and tackle that can be used. The fishing sites are streams and lakes, so the results do not directly apply to sea fishing. The willingness to pay estimates are calculated based on the estimates presented in Toivonen et al. (2000).

PARKKILA, K., 2005. SIMOJOEN LOHEN SAALISMÄÄRÄN LISÄÄNTYMISEN TALOUDELLINEN ARVIOINTI CONTINGENT VALUATION –MENETELMÄLLÄ. MASTER'S THESIS, DEPARTMENT OF ECONOMICS AND MANAGEMENT, UNIVERSITY OF HELSINKI. 86 PP. + 17 APPENDICES.

Weblink: <http://ethesis.helsinki.fi/julkaisut/maa/talou/pg/parkkila/simojoen.pdf>

Parkkila (2005) discusses the economic value of increasing the salmon catch in the river Simojoki which empties into the Gulf of Bothnia. The relevant ecosystem services are cultural (recreation) and supporting (diversity). The method employed in the study is contingent valuation. The study population includes fishermen who have purchased a fishing licence for Simojoki in 2003. The questionnaire is sent by mail during the summer 2004 to 1013 fishermen all over Finland. The response rate is 28 %.

The fishermen's willingness to pay is estimated for an increase in the amount of salmon and doubling of the salmon catch in the river Simojoki. The mean willingness to pay per fisherman per fishing season is estimated to be 50 EUR²⁰⁰⁷ - 56 EUR²⁰⁰⁷ (47.8 EUR²⁰⁰⁴ - 53.8 EUR²⁰⁰⁴). The aggregate value of increasing the salmon catch in river Simojoki is 31 000 EUR²⁰⁰⁷ (30 000 EUR²⁰⁰⁴) per year.

The survey includes also questions about the amount of money the respondents use for fishing. The average expenses per fishing trip to river Simojoki are asked, as well as the value of fishing-related possessions, such as the boat and other fishing equipment.

AHTIAINEN, H., 2007. WILLINGNESS TO PAY FOR IMPROVEMENTS IN THE OIL SPILL RESPONSE CAPACITY IN THE GULF OF FINLAND – AN APPLICATION OF THE CONTINGENT VALUATION METHOD. MASTER'S THESIS, DEPARTMENT OF ECONOMICS AND MANAGEMENT, UNIVERSITY OF HELSINKI.

Weblink: http://www.mm.helsinki.fi/mmtal/ye/tutkimus/Ahtiainen_gradu.pdf

Ahtiainen (2007) uses the contingent valuation method to estimate the benefits from reducing the harm from possible future oil spills in the Gulf of Finland. The focus is on cultural and supporting ecosystem services, namely recreation, aesthetic value, diversity and habitat. The harm to recreation and to nature by possible oil spills is reduced by making the Finnish oil spill response capacity more efficient.

The study population includes all Finns, and the questionnaire is sent by mail to 1000 people. The sample has two strata, those who live on the coast of the Gulf of Finland and those who live elsewhere. The response rate is 37 %. The mean willingness to pay for reducing the harm from future oil spills is estimated to be 28 EUR²⁰⁰⁷ (27.5 EUR²⁰⁰⁶) per person as a one-time payment and thus Finns' aggregate willingness to pay is 112 MEUR²⁰⁰⁷ (109 MEUR²⁰⁰⁶).

NATIONAL AUDIT OFFICE OF FINLAND (NAO), 2007. KALATALOUDEN KEHITTÄMINEN. PERFORMANCE AUDIT REPORTS 155/2007: 50.

Weblink:

http://www.vtv.fi/chapter_images/8152_1552007_Kalatalouden_kehittaminen_netiti.pdf

National Audit Office of Finland (NAO) (2007) estimates the benefits from recreational fishing in the river Tornionjoki (Torne River) using travel cost method. The related ecosystem service is cultural (recreation). The travel costs are determined with a mail survey that is sent to 1 500 fishermen, who have purchased a fishing licence to the river Tornionjoki. The response rate is 67 %, but the travel cost analysis includes only those respondents who are not local residents of the Torne River Valley and those whose trip's primary purpose is fishing.

The travel costs in this study are calculated based on the respondent's announcement, and they include the costs of travelling, accommodation, eating, boat renting and the price of the fishing licence. The mean travel costs per day are 106 EUR²⁰⁰⁷ (103 EUR²⁰⁰⁶). The estimate of the consumer surplus per a fishing day is 183 EUR²⁰⁰⁷ (179 EUR²⁰⁰⁶) and the aggregate consumer surplus or the net benefit for the recreational fishermen in the river Tornionjoki is estimated to be 6.8 MEUR²⁰⁰⁷ (6.6 MEUR²⁰⁰⁶) per year.

HELCOM AND NEFCO, 2007. ECONOMIC ANALYSIS OF THE BSAP WITH FOCUS ON EUTROPHICATION. HELCOM BSAP TASK FORCE 6/2007. DRAFT OF THE FINAL REPORT.

Weblink:

<http://sea.helcom.fi/dps/docs/documents/Ad%20hoc%20Task%20Force%20for%20HELCOM%20BSAP/HELCOM%20BSAP%20TASK%20FORCE%206%202007/3-4%20Draft%20final%20report%20on%20economic%20analysis.pdf>

HELCOM and NEFCO (2007) present the economic analysis of the Baltic Sea Action Plan (BSAP) in their report. The report discusses mainly the costs of the

possible actions in the BSAP but also provides some benefit estimates of improving the ecological status of the Baltic Sea. The report includes estimates of the volume and/or value of different industries in the Baltic Sea countries, such as commercial fishery, aquaculture and the tourism sector.

HELCOM and NEFCO (2007) estimate that the annual value of fish catches in the Western Baltic Sea is 1 520 MEUR in 2001. The value is based on the total catches in 2001 and the average price for fisheries products in the European Union which is about 1.37 EUR per kg (European Commission, 2006). The report also discusses the value of landings, which represent the value and weight of fisheries products landed in EU ports by all vessels. The value of landings in Finland is estimated to be 16 MEUR in 2004, making the value per kg 0.18 EUR.

The value of aquaculture (farming of aquatic organisms such as fish) in Finland in 2003 is estimated to be 41 MEUR, and the value per kg is 3.06 EUR. The output value of fishery and aquaculture products produced by the processing industry is estimated to be 105 MEUR in Finland in 2003.

The report estimates that the tourism and travel industries in the Baltic Sea region account for about 2.9 % of regional GDP in 2004. The sector is estimated to provide jobs for nearly 2 million people. (Roest, 2004). The report also uses the results from Turner et al. (1999) to estimate the benefits from reduced eutrophication.

The report includes value and volume estimates for all nine Baltic Sea countries. Most estimates are taken from the report of the European Commission (2006). It should be noted that the report is a draft version of the final report.

LAUKKANEN, M. AND HUHTALA, A., 2008. OPTIMAL MANAGEMENT OF A EUTROPHIED COASTAL ECOSYSTEM: BALANCING AGRICULTURAL AND MUNICIPAL ABATEMENT MEASURES. ENVIRONMENTAL AND RESOURCE ECONOMICS, 39: 139-159.

Laukkanen and Huhtala (2008) formulate a model for determining the optimal nutrient abatement allocation for agriculture and waste water treatment sector and present an empirical application to the Finnish coastal waters of the Gulf of Finland. In addition to the costs of the abatement measures the model includes an estimate of the avoided damage from reduced eutrophication. The damage function is constructed using the willingness to pay estimates from Turner et al. (1999).

In the article, the used indicator of eutrophication is the weighted sum of nitrogen and phosphorus, where phosphorus receives a higher weight (weights: 7.2 for phosphorus, 1 for nitrogen). Thus the damage from eutrophication is a function of a weighted sum of the two nutrients. The total willingness to pay for a 20-year period that is calculated based on the estimates in Turner et al. (1999) is expressed as the

willingness to pay for the avoided damage from eutrophication when nutrient load is reduced.

The article includes also sensitivity analyses on the effect of changing the relative weights of the nutrients in the damage function and the effect of lowering the estimated total willingness to pay on the damage estimates.

This review includes also three international studies, which present information on the economic effects for all nine Baltic Sea countries (Turner et al., 1999; Gren, 1999; Markowska and Zylicz, 1999). The aspects of these studies are discussed more thoroughly in the general summaries in the final report, and only the results relevant to Finland are reported here.

TURNER, R.K., GEORGIOU, S., GREN, I-M., WULFF, F., BARRETT, S., SODERQVIST, T., BATEMAN, I.J., FOLKE, C., LANGAAS, S., ZYLICZ, T., MALER, K-G. AND MARKOWSKA, A., 1999. MANAGING NUTRIENT FLUXES AND POLLUTION IN THE BALTIC: AN INTERDISCIPLINARY SIMULATION STUDY. ECOLOGICAL ECONOMICS 30: 333-352.

Turner et al. (1999) estimate the value of reducing eutrophication in the Baltic Sea to a sustainable level in 20 years. The Finnish estimate is based on a benefit transfer from a Swedish contingent valuation study. The mean willingness to pay per person per year is 369 EUR²⁰⁰⁷ (3040 SEK¹⁹⁹⁸) (assuming a zero WTP for non-respondents) and thus the aggregate willingness to pay is 1 386 MEUR²⁰⁰⁷ (11 414 MSEK¹⁹⁹⁸) per year.

GREN, I-M., 1999. VALUE OF LAND AS A POLLUTANT SINK FOR INTERNATIONAL WATERS. ECOLOGICAL ECONOMICS, 30: 419-431.

Gren (1999) discusses the value of land as a pollutant sink and provides estimates for the marginal benefits of reducing the nitrogen load to the Baltic Sea by one kilogramme. The marginal benefit for Finland is estimated using a benefit transfer, and it is 4.4 EUR²⁰⁰⁷ (37.2 SEK¹⁹⁹⁹) / kg of reduced nitrogen.

MARKOWSKA, A. AND ZYLICZ, T., 1999. COSTING AN INTERNATIONAL PUBLIC GOOD: THE CASE OF THE BALTIC SEA. ECOLOGICAL ECONOMICS, 30: 301-316.

Markowska and Zylicz (1999) present the estimates of abatement costs for nitrogen reductions to the Baltic Sea and also the benefits from reduced eutrophication. The benefits for Finland are estimated again using a benefit transfer from the Swedish study, although the benefit estimates are modified to correspond to the results of the Polish valuation study. The mean willingness to pay is 175 EUR²⁰⁰⁷ (232 USD¹⁹⁹⁹) per person and thus the aggregate benefits are 656 MEUR²⁰⁰⁷ (872 MUSD¹⁹⁹⁹)

Ongoing studies related to the Baltic Sea

A couple of valuation studies relating to the Baltic Sea are currently being conducted in Finland. The information presented here is tentative, as the results of the studies have not yet been published. Some studies are yet to be implemented.

One of the ongoing studies estimates the benefits from reduced amount of nutrients and eutrophication in the Gulf of Finland with the choice experiment (Kosenius, 2008). The attributes used to describe the environmental change are water clarity, abundance of coarse fish, the state of the bladder wrack population and the mass occurrences of the blue green algae blooms. The results of the study will include the marginal prices for the attributes as well as the welfare estimates for different policies to reduce the amount of nutrients in the Gulf of Finland. The study population includes all Finns with the focus on those who live in the coastal municipalities. The study will add to the existing data on the economic effects of eutrophication in Finland and provide original and extensive information on the value of reducing the amount of nutrients in the Gulf of Finland. According to the tentative results the mean willingness to pay for reducing eutrophication in the Gulf of Finland ranges from 363 EUR²⁰⁰⁷ to 473 EUR²⁰⁰⁷ per household per year depending on the extent of the change. Thus the aggregate willingness to pay ranges from 9.9 MEUR²⁰⁰⁷ to 12.9 MEUR²⁰⁰⁷ per year.

The second study estimates the value of securing the grey seal population in the Baltic Sea at a sustainable level. It employs the contingent valuation method and people are asked their support for or opposition to securing the growth of the grey seal population. The study is a part of a larger project which examines the conflict of protecting the grey seal population and fishing salmon in the Baltic Sea. The aim is to construct a model that determines the optimal size of the grey seal population and the amount of salmon catch. The purpose is to make the benefits from professional and recreational fishing commensurable to the benefits from hunting and preserving the grey seal. The study has been started in 2007, and the design of the questionnaire is underway.

Third study, which estimates the value of recreational fishing of salmon and protecting the salmon population in the river Tornionjoki is also being planned. Tornionjoki empties into the Gulf of Bothnia. According to the current plans the pilot survey will be conducted already during the year 2008.

Fourth valuation study employs the travel cost method to estimate the value of water recreation and to study the effects of water quality changes to water recreation benefits in Finland (Vesterinen, unpublished). The relevant ecosystem service is cultural, namely recreation. The specific change in the water quality is described with a stepwise change in water clarity from status quo by +/-1.5 meters in the respondent's home municipality. The waterbodies include all lakes and coastal areas in Finland and the study population consists of Finns. The travel cost study is

conducted through telephone and mail, and there are 5 535 respondents. The travel costs are estimated based on the costs from car travel, reported costs by the respondent and the opportunity cost of time. The study estimates the value of one-day water recreation trip, which is 7.3 – 22.2 EUR²⁰⁰⁷. The annual consumer surpluses from decreasing/increasing the water clarity by 1.5 meters are 50-153 MEUR²⁰⁰⁷/56-167 MEUR²⁰⁰⁷ for swimmers and 64-193 MEUR²⁰⁰⁷/76-234 MEUR²⁰⁰⁷ for fishermen.

Valuation of inland waters

In addition to the reasonably small amount of studies concerning the economic effects and the Baltic Sea, there are several studies that focus on inland waters. These have no direct relation to the Baltic Sea but they still give insights on the economic value of water quality and water-related impacts in Finland. The basic information on Finnish inland waters valuation studies is presented in table FI.2.

All inland water studies are reports or dissertations/theses. Most of them have been conducted in the 1990s. The studied environmental issues include eutrophication, biodiversity and fisheries. The covered ecosystem services include cultural services (recreation and aesthetic value), provisioning services (food and genetic resources) and supporting services (biodiversity and habitat). Most studies have focused on lakes and there is only one study discussing the value of rivers.

Most studies have employed contingent valuation method. Some studies have used the same basic setting as contingent valuation and asked respondents' willingness to pay for a change in the environmental good, but in other respects they do not necessarily meet the requirements of a carefully conducted stated preference study. In these studies the valuation scenarios are generally vaguely described and the studies do not mention the contingent valuation method in the report.

Most inland water studies have estimated both use and non-use value, but some have focused solely on use value. Willingness to pay is the most common economic measure.

Studies on inland waters

The studies related to the economic value of Finnish inland waters are collected into table FI.2 and also briefly described here.

KYBER, M., 1981. VESISTÖN LIKAANTUMISEN VIRKISTYSKÄYTÖLLE AIHEUTTAMAT HAITAT JA NIIDEN ARVIOINTI KATSELMUSTOIMITUKSESSA. RESEARCH NOTES 23/1981, TECHNICAL RESEARCH CENTRE OF FINLAND (VTT).

Kyber (1981) estimates the proportion of the price of a waterfront property that results from its location near a waterbody. This is also called the recreation value per cent of the waterfront. The recreation value per cent can be determined by comparing the prices of sites that are onshore to the prices of sites located inland. The recreation value per cent ranges on average from 70 % to 80 % in Finland. Thus a significant part of the price of the waterfront is caused by its proximity to a water system.

The report also presents the proportional damage per cent, which is the damage to recreation from water pollution or eutrophication. The damage per cent depends on the extent of the pollution, and it ranges from 0 % when there is no damage to 95 % when the waterbody is practically unusable. The proportional damage per cent is estimated using a survey that asks property owners their opinions on the damages.

Also the effect of water quality on the onshore properties is examined. This is based on the comparison of property prices near waterbodies that have a different water quality. The water quality is classified using the general usability classification of the Finnish water administration. Based on several studies the market value of the shorefront property falls at most 60 % when the water system becomes polluted.

MÄNTYMAA E., 1993. YMPÄRISTÖHYÖTYJEN ARVIOINTI CONTINGENT VALUATION –MENETELMÄLLÄ. RESEARCH REPORTS 109, RESEARCH INSTITUTE OF NORTHERN FINLAND, UNIVERSITY OF OULU, 140 PP.

Mäntymaa (1993) conducts a contingent valuation study to estimate the value of improving the water quality in lake Oulujärvi and also the value of preventing the water quality from deteriorating. The study focuses on cultural ecosystem services (recreation) but also non-use values are estimated. The water quality is described with a water quality ladder, where the water quality is classified mainly based on the suitability of the lake for different recreational activities. The respondent determines first the reference (current) water quality, and is then asked the willingness to pay for improving the water quality by one class followed by the willingness to pay for preventing the quality from deteriorating by one class from the reference level.

The study is implemented with interviews in 1999, and there are 282 respondents. The mean willingness to pay for improving the water quality in the lake by one class is 114 EUR²⁰⁰⁷ (546 FIM¹⁹⁹¹) per household per year, which makes the aggregate willingness to pay 2.0 MEUR²⁰⁰⁷ (9.7 MFIM¹⁹⁹¹) per year in the area surrounding lake Oulujärvi. The mean willingness to pay for preventing the deterioration of the water quality by one class is 166 EUR²⁰⁰⁷ (791 FIM¹⁹⁹¹) per household per year, and thus the aggregate willingness to pay 2.9 MEUR²⁰⁰⁷ (14.0 MFIM¹⁹⁹¹) per year in the area.

MATTILA, T., 1995. RANTAKIINTEISTÖN VIRKISTYSARVO JA VESISTÖN LIKAANTUMISEN VAIKUTUS SIIHEN. MIMEOGRAPH SERIES 6, FINNISH ENVIRONMENT INSTITUTE. 101 PP.

Mattila (1995) uses the same approach as Kyber (1981) and studies the recreation value per cent of a shorefront property. The recreation value is determined using the purchase prices of properties and it is on the average 80 %. The report also examines the factors that affect the price of a shorefront property and their magnitude. The most important factors that have an effect on the price are location, the size of the lake, water quality and beach quality.

The report also presents the results of a survey that examines the effects of deteriorating water quality to the use of a shorefront property. The proportional values of different water recreation activities are determined based on respondents' answers. The recreation value per cent (80 %) is divided to the share that is due to the direct recreational use of the waterbody and to the share that is due to the water environment. Both shares range from 0 % to 40 % of the recreation value per cent depending on the water quality of the waterbody.

MOISSEINEN, E., 1997. CONTINGENT VALUATION - THE CASE OF THE SAIMAA SEAL. PUBLICATIONS IN SOCIAL SCIENCES 28, UNIVERSITY OF JOENSUU, 208 PP.

Moisseinen (1997) studies the value of protecting the endangered Saima ringed seal, which lives only in the lake Saimaa in Finland. The contingent valuation mail survey proposes a conservation program for the seal and asks the respondent's willingness to pay for it. The relevant ecosystem services in the study are supporting (diversity) and provisioning (genetic resources).

There are two different surveys: a national one with the sample drawn from the Finnish population, and a local one with the sample drawn from the Pihlajavesi area near lake Saimaa. The national sample has three strata: residents of big cities, residents of smaller cities and the countryside and recreational fishermen. The national survey is sent by mail in November 1992 to 1 700 Finns, and the response rate is 60 %. The local survey is mailed in September 1993 to 400, and the response rate is 56 %.

The valuation scenarios are fairly similar in both surveys, but the local survey includes more attitudinal questions to provide complementary information to the valuation question results. The mean (and median) willingness to pay estimates based on the national survey are 42 EUR²⁰⁰⁷ (205 FIM¹⁹⁹²) for the residents of big cities, 36 EUR²⁰⁰⁷ (173 FIM¹⁹⁹²) for the residents of smaller cities and countryside and 60 EUR²⁰⁰⁷ (294 FIM¹⁹⁹²) for recreational fishermen. According to the results of the local survey the mean willingness to pay is 14 EUR²⁰⁰⁷ (71 FIM¹⁹⁹³) and the

median 10 EUR²⁰⁰⁷ (50 FIM¹⁹⁹³) per household. The aggregate values are not reported.

The report includes also an analysis of the behavioural intentions of the respondents to the local survey.

LUOTO, I., 1998. ÖJANJÄRVEN VIRKISTYSKÄYTTÖ JA SEN TALOUDELLINEN ARVOTTAMINEN. RESEARCH REPORT 8/1998, CHYDENIUS INSTITUTE, UNIVERSITY OF JYVÄSKYLÄ.

Luoto (1998) estimates the recreational value of lake Öjanjärvi near the town of Kokkola which is situated on the coast of the Gulf of Bothnia. Although the study focuses on valuing the recreational use, it also includes the estimation of non-use value. The ecosystem services include mainly cultural services (recreation and aesthetic value) but also supporting services (diversity). The aim is to value the environmental and recreational benefits of the lake. The study population includes the people who have a summer cottage in the vicinity of the lake and those who visit the Laajalahti beach on the lake. The study is implemented with personal interviews, and there are 102 cottagers and 40 beach visitors who have responded to the survey.

The questionnaire has several different valuation questions. The first asks the value of one recreation day or visit to the beach depending on if the person is a cottager or a beach visitor. The cottagers' mean willingness to pay per one recreation day is 34 EUR²⁰⁰⁷ (175 FIM¹⁹⁹⁷) making the aggregate willingness to pay 3.1 million EUR²⁰⁰⁷ (15.9 FIM¹⁹⁹⁷). The beach visitors' mean willingness to pay per visit to the beach is 3.3 EUR²⁰⁰⁷ (17 FIM¹⁹⁹⁷) and thus the aggregate willingness to pay is 79 000 EUR²⁰⁰⁷ (408 000 FIM¹⁹⁹⁷).

The second valuation question depicts a scenario where the shore in the respondent's property or the Laajalahti beach becomes unsuitable for recreational and other uses, and asks the respondent's willingness to pay to prevent this. The cottagers' mean willingness to pay is 4200 EUR²⁰⁰⁷ (21370 FIM¹⁹⁹⁷) per household making the aggregate willingness to pay 1.2 MEUR²⁰⁰⁷ (5.9 MFIM¹⁹⁹⁷). The visitors' mean willingness to pay is 79 EUR²⁰⁰⁷ (406 FIM¹⁹⁹⁷) and thus the aggregate willingness to pay 98 000 EUR²⁰⁰⁷ (505 000 FIM¹⁹⁹⁷).

The third valuation question enquires for the joint value of the cottagers' property and the recreational equipment there. The mean property value is 57 000 EUR²⁰⁰⁷ (285 000 FIM¹⁹⁹⁷) making the aggregate value of the properties near the lake 20.3 MEUR²⁰⁰⁷ (104 MFIM¹⁹⁹⁷). The respondents also evaluate the proportion of the value of their property that stems from the location near the lake, and the average reported proportion is 60 %.

MATERO, J. AND SAASTAMOINEN, O., 1998. MONETARY ASSESSMENT OF THE IMPACTS OF FORESTRY ON WATER-BASED BENEFITS IN FINLAND. *BOREAL ENVIRONMENT RESEARCH*, 3: 87-96.

Matero and Saastamoinen (1998) estimate the monetary value of the damages that forestry practices cause to water-based values in Finland. Several different water-related impacts are included in the analysis: hydroelectric power, flood protection, water supply, professional fishing, fish farming, crayfish fishery, recreational activities and biodiversity. The covered ecosystem services are supporting (diversity), provisioning (food, energy) and cultural (recreation).

The article does not present any original research or estimates, but instead the monetary values of the impacts are estimated based on existing work. All impacts are valued separately. Market impacts are mainly valued based on their market value or costs. Non-market impacts are valued using benefit transfer from contingent valuation or hedonic pricing studies. Some value estimates are called “guess estimates”, which means that the authors have guessed the value based on some existing information.

The impacts are valued separately and then summed up to comprise the total value estimate. The total damages that forestry causes to water-based values ranges from 3.5 MEUR²⁰⁰⁷ (17 MFIM¹⁹⁹²) to 19 MEUR²⁰⁰⁷ (93 MFIM¹⁹⁹²) per year. The authors themselves note that summing up the value of independent impacts may produce a misleading estimate of the total value.

VALKEAJÄRVI, P. AND SALO, H., 2000. KALASTUS JA KALASTUKSEN ARVOTTAMINEN PÄIJÄNTEELLÄ VUONNA 1996. FISH AND GAME REPORTS 196, FINNISH GAME AND FISHERIES RESEARCH INSTITUTE.

Valkeajärvi and Salo (2000) estimate the value of fishing in Päijänne, which is the second largest lake in Finland. The study aims at estimating the value of the recreational fishing experience, and the related ecosystem services are cultural (recreation), provisioning (food) and supporting (diversity). There is no change in the environmental good, but instead the respondents are asked the value of their fishing experience if they catch a trout that weighs 1 kilogram.

The survey is sent to residents and property owners in the municipalities surrounding lake Päijänne in late winter 1997. The sample size is 6405 and the response rate 57 %, but only 436 respondents have answered the question about the value of recreational fishing. The median value in rod fishing is 16 EUR²⁰⁰⁷ (80 FIM¹⁹⁹⁷) per trout, and in net fishing it is 8 EUR²⁰⁰⁷ (40 FIM¹⁹⁹⁷) per trout. The aggregate values are not reported.

The study also tries to estimate the intangible value of fishing by asking the respondent how much s/he would need as compensation to give up fishing altogether for half a year, one year or five years.

OLKIO, K., 2005. VIRTAVESIKUNNOSTUSTEN SOSIOEKONOMISISTA
VAIKUTUKSISTA KESKI-SUOMESSA. CENTRAL FINLAND REGIONAL
ENVIRONMENT CENTRE, JYVÄSKYLÄ. 113 PP.

Olkio (2005) estimates the socio-economic effects of restoring rapids in the Central Finland. The main purpose of the study is to find out the experiences and opinions of restoration projects, but the questionnaire includes also a question about the respondent's willingness to pay for fishing in a restored rapid. The relevant ecosystem service is cultural (recreation). The restored rapid is described as follows: all fish species would reproduce naturally, catch and release fishing would be applied and there would be a small amount of fishers.

The survey is sent by mail to fishermen who have bought a fishing licence for one of the two studied rapids in 2002. There are altogether 199 respondents. The results of the willingness to pay question are not analysed in the report, and only the distribution of the responses is presented. The author states that over half of the respondents would be willing to pay 21 EUR²⁰⁰⁷ (20 EUR²⁰⁰²) for a one-day fishing licence in a restored rapid, which is double the reference price of 10 EUR²⁰⁰⁷.

Ongoing studies related to inland waters

Also the benefits of inland waters are being addressed in a couple of ongoing studies. Lehtoranta (unpublished) conducts a contingent valuation study to estimate the value of restoring lake Vesijärvi in Lahti. The survey is sent by mail in the autumn 2001 to 2550 residents of the municipalities Lahti and Hollola near lake Vesijärvi. The response rate is 56 %. The purpose of the study is to value the reduced eutrophication in lake Vesijärvi. The ecosystem services concerned are cultural (recreation) and supporting (diversity, habitat). The extent of change in the state of the lake is from satisfactory to good, which means that the lake would be well suited to all recreational uses, it would be close to its natural state and the blue green algae blooms would become less frequent. The results are not yet fully analysed, so there are no available benefit estimates.

An ongoing study discusses the value of reducing the eutrophication in lake Hiidenvesi (Ahtiainen, unpublished). The valuation method is contingent valuation, and the survey is sent by mail to 2000 respondents who live in the surrounding municipalities of the lake. The study will be implemented during the first half of the year 2008, and the results will be ready in the summer of 2008.

Conclusions

The existing body of studies that focus on the economic effects relating to the Baltic Sea or other water systems in Finland is limited. However, it seems that the interest in valuing water environment is growing as several studies have been conducted in the 2000s and also a considerable number of studies are currently in process. The ongoing studies will provide useful information on the value of waterbodies and their improved state in the near future.

There are still significant gaps in the available information on the economic effects of the changed environment of the Baltic Sea in Finland. Only few of the ecosystem services and their value have been studied. However, it is reasonable to consider which ecosystem services or environmental impacts are of most relevance from the Finnish viewpoint. The topics already studied include eutrophication, fisheries and oil spills, and it might be justifiable to assume that these have been recognized as the most important issues for Finns. Although information exists on these issues, more is still needed to get a comprehensive understanding on the economic effects.

The studies have usually focused on cultural ecosystem services, mainly on recreation and sometimes also on aesthetic value. There are only few estimates on the provisioning services. Non-use values have been included in several studies, in which case the relevant ecosystem services are supporting, such as diversity and habitat. The ecosystem services considered in the Baltic Sea valuation studies have been collected into table FI.3.

In Finland eutrophication is often considered the most serious problem in the state of the Baltic Sea. This concern can be seen in the number of studies discussing eutrophication and its effects. There are still some information gaps, but on the other hand a large-scale study on the value of reducing eutrophication in the Gulf of Finland is in process.

There are some studies on the fisheries and their value, but these have not concentrated in the Baltic Sea as such, but have included other water systems or focused on the rivers that empty into the sea. There is a need for studies that address the value of recreational and professional fishing in the Baltic Sea more directly.

There has been a growing concern on the threat of a large oil spill in the Gulf of Finland. One study has been conducted to estimate the benefits of reducing the harm from possible future oil spills, but there are no studies on the value of reducing the risk of future oil spills.

There are many industries that have not been studied enough. For example it seems that the tourism sector has been for the most part ignored. Only one of the Baltic Sea studies has estimated the value of reduced eutrophication for the tourists of one

town on the coast of the Gulf of Finland. However, there are no comprehensive studies on the impact of the environmental status of the Baltic Sea on the tourism in Finland.

The most common method in valuation has been contingent valuation. So far only few choice experiments or revealed preference studies have been conducted related to the Baltic Sea in Finland. Some are however in process.

Typically the economic measure has not been directly linked to any ecological variable, and it is also common that the environmental change has not been described quantitatively. Thus it may be difficult for example to attach the values for reducing eutrophication to a specific nutrient reduction. The marginal damage estimates or formulation of a damage function are generally not possible based on the available values. Only Gren (1999) presents the marginal benefits from nitrogen reductions. Laukkanen and Huhtala (2008) derive a damage function for “nitrogen equivalents” based on willingness-to-pay estimates provided in Turner et al. (1999). The use of a wider range of valuation methods could provide additional information on the marginal values of changes in water ecosystems. For example choice experiments would provide marginal benefit estimates for the attributes used to describe the environmental good.

There is a need for more comprehensive valuation studies that focus directly on the economic effects of the Baltic Sea. The existing studies provide information on the value of an improved water environment, but their focus has generally been narrow with regard to the study area or the environmental impact. Also estimates of the marginal benefits or damages of changes in the marine environment are needed, as there are few of them.

Table FI.1. Baltic Sea valuation studies

Study reference	Focus of the study	Ecosystem services	Study population/ industry	Valuation method	Estimated values (in EUR ²⁰⁰⁷)
Siitonen, H. et al. 1992	to value the reduction in the amount of phosphorus and nitrogen in the waste water of a pulp and paper factory	recreation	residents of the town of Pietarsaari	benefit transfer and the value of compensations paid to fishers	aggregate value for the citizens of Pietarsaari 269 000 – 515 000 EUR per year for the time period of 10 years (1980-1989)

Turner, R. K. et al. 1999	to value reducing the eutrophication of the Baltic Sea to a sustainable level in 20 years	use and non-use services	Finns	benefit transfer from a Swedish contingent valuation study	mean WTP: 369 EUR (zero WTP of non-respondents) or 659 EUR per person per year for 20 years, aggregate WTP: 1386 MEUR (zero WTP of non-respondents) or 2476 MEUR per year
Gren, I-M. 1999	to value Baltic Sea coastal wetlands as nitrogen sinks and estimate the marginal value of nitrogen reductions to the Baltic Sea coastal waters	use and non-use services	agriculture, forestry	benefit transfer from Swedish and Polish contingent valuation studies	marginal benefits 4.4 EUR per kilogram of reduced nitrogen
Markowska, A. and T. Zylicz 1999	to estimate the benefits from reduced eutrophication of the Baltic Sea	use and non-use value	Finns	benefit transfer from a Swedish contingent valuation study (results were translated using a Polish study by multiplying the original WTP by 0.55)	mean WTP: 175 EUR per person, aggregate 656 MEUR
Kiirikki, M. et al. 2003	to estimate the reduction costs of nutrient load entering the Gulf of Finland	not available	waste water treatment sector	estimation of investment and operation costs	costs vary between 894 – 29 000 EUR per ton of nitrogen equivalent
Kosenius, A.-K. 2003	to value the reduced eutrophication of the sea in terms of algae blooms and shellfish poisoning	recreation, aesthetic value, food	tourists of Hanko	contingent valuation	mean/median WTP: 26 EUR per person per year, aggregate 308 000 EUR per year (unspecified number of years)
Toivonen, A.-L. et al. 2004	to estimate fishermen's current recreational fishing expenses	recreation	fishermen	survey, reported expenses for the last 12 months	mean expenses 173 EUR per fisherman per year, aggregate 227 MEUR per year
	to value recreational fishing experience	recreation	fishermen	contingent valuation	mean WTP: 83 EUR per fisherman per year, aggregate 93 MEUR per year
	to value the conservation of the current state of fish stocks and quality of recreational fisheries in Nordic countries	recreation, diversity, habitat	fishermen and non-fishermen	contingent valuation	aggregate willingness to pay 180 MEUR per year

Parkkila, K. 2005	to value the increase in the amount of salmon and doubling of the salmon catch in river Simojoki	recreation, diversity	fishermen who had a fishing licence for the river Simojoki in 2003	contingent valuation	mean WTP: 50 - 56 EUR per fisher per fishing season, aggregate value 31 000 EUR per year
Ahtiainen, H. 2007	to value the reductions in the harm from future oil spills in the Gulf of Finland	recreation, aesthetic value, diversity, habitat	Finns	contingent valuation	mean WTP: 28 EUR per person, aggregate 112 MEUR, one-time payment
National Audit Office of Finland (NAO) 2007	to value the welfare from recreational fishing in the river Tornionjoki (Torne River)	recreation	fishermen who had a fishing licence for the river Tornionjoki	travel cost method	consumer surplus 183 EUR per fishing day, aggregate consumer surplus 6.8 MEUR per year, mean travel costs 106 EUR per day

Table FI.2: Inland waters valuation studies

Author(s)	Focus of the study	Eco-system services	Study population/ industry	Valuation method	Estimated values (in EUR ²⁰⁰⁷)
Kyber, M. 1981	to estimate the recreational value of a waterfront based on purchase prices and the damages to recreation or to property value from water pollution	recreation	property owners near the water-body	hedonic pricing ^A (value estimated based on purchase prices), survey	the recreation value per cent of the waterfront is 70 % - 80 % and the market value of a on-shore property decreases by 0 % - 60 % depending on the pollution
Mäntymaa E. 1993	to value the improvement in the water quality of the lake by one class in terms of algae blooms, smell, sliming and recreational activities	recreation, non-use services	residents and cottage owners	contingent valuation	mean WTP: 114 EUR per household per year, aggregate 2.0 MEUR per year (unspecified number of years)
	to value the avoidance of deterioration in the water quality of the lake by one class in terms of algae blooms, smell, sliming and recreational activities	recreation, non-use services	residents and cottage owners	contingent valuation	mean WTP: 166 EUR per household per year, aggregate 2.9 MEUR per year, unspecified number of years
Mattila, T. 1995	to determine which elements comprise the recreational value of the shorefront property and how the deterioration of water quality affects it	recreation	property owners	hedonic pricing ^A (value estimated based on purchase prices), survey	the recreation value per cent of a shore-front property is 80 %

Moisseinen, E. 1997	to value the protection of Saima ringed seal conservation program to protect the species	genetic resources, diversity	Finns, three subsamples	contingent valuation	mean/median WTP: per household: 42 EUR (big cities), 36 EUR (smaller cities and countryside) and 60 EUR (fishermen), one-time payment
	to value the protection of Saima ringed seal conservation program to protect the species	genetic resources, diversity	residents of the nearby area	contingent valuation	mean WTP 14 EUR per household, median 10 EUR per household, one-time payment
Luoto, I. 1998	to value one recreation day/visit to the beach in lake Öjanjärvi	recreation, diversity	cottagers and the users of the Laajalahti beach	contingent valuation	cottagers: mean WTP: 34 EUR per person per day, aggregate 3.1 MEUR, beach visitors: mean WTP: 3.3 EUR per person per visit, aggregate 79 000 EUR
	to value preventing the shore situated in the respondent's property or the beach becoming unsuitable for recreation and other uses in lake Öjanjärvi	recreation, diversity	cottagers and the users of the Laajalahti beach	contingent valuation	cottagers: mean WTP: 4 200 EUR per household, aggregate 1.2 MEUR, beach visitors: mean WTP: 79 EUR per household, aggregate 98 000 EUR, one-time payment
	to estimate the use value of Lake Öjanjärvi in terms of the value of the summer cottage property and recreational equipment	recreation, aesthetic value	cottagers	survey, contingent valuation*	mean value 57 000 EUR per property, aggregate 20.3 MEUR
Matero, J. and O. Saastamoinen 1998	to value the impacts of forestry practices on water-based benefits	recreation, diversity, food, energy	forestry	benefit transfer, estimation of costs, hedonic pricing, guess estimates	total damages from forestry: 3.5 - 19 MEUR per year (based on costs, WTP, market value)
Valkeajärvi, P. and H. Salo 2000	to value fishing in lake Päijänne using the value of fishing a trout that is 1kg in weight	recreation, food, diversity	residents and property owners of the area	survey, contingent valuation*	rod fishing: median value 16 EUR per person per 1 kg trout, net fishing: median value 8 EUR per person per 1 kg trout
Olkio, K. 2005	to value the restoration of rapids, all fish species would reproduce naturally, catch and release fishing and small amount of fishers	recreation	fishermen who had fishing licenses in the area in 2001	survey, contingent valuation*	over 50 % of the respondents were willing to pay 21 EUR for the one-day fishing license
* Same basic setting as in contingent valuation, but in other respects does not necessarily meet the requirements of a carefully conducted contingent valuation study.					
^ Similar to the hedonic pricing method, but the approach is simpler.					

Table FI.3. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	No studies found.
	S2	Primary production	No studies found.
	S3	Food web dynamics	No studies found.
	S4	Diversity	Three studies found, mainly valuing the preservation or improvement in the current state of fisheries. In addition there are several inland water studies on diversity.
	S5	Habitat	Two studies, one focusing on the value of habitats in all water bodies and one on the value of habitats in the Gulf of Finland.
	S6	Resilience	No studies found.
Regulating services	R1	Atmospheric regulation	No studies found.
	R2	Regulation of local climate	No studies found.
	R3	Sediment retention	No studies found.
	R4	Biological regulation	No studies found.
	R5	Pollution control	No studies found.
	R6	Eutrophication mitigation	No studies found.
Provisioning services	P1	Food	One study considering shellfish. Also studies on fisheries, but they do not discuss food directly. In addition two inland water studies considering food.
	P2	Inedible resources	No studies found.
	P3	Genetic resources	No Baltic Sea studies found. One inland water study on Saima ringed seal.
	P4	Chemical resources	No studies found.
	P5	Ornamental resources	No studies found.
	P6	Energy	No Baltic Sea studies found. One inland water study on energy.
	P7	Space & waterways	No studies found.
Cultural services	C1	Recreation	Several studies found, focusing on the effects of reduced eutrophication, recreational fishing and tourism. Most Finnish studies include the estimation of the effects on recreation. In addition several inland water studies on recreation, mainly on fishing.
	C2	Aesthetic value	Two studies found, which discuss the value of properties, tourism and health. Also one inland water study on aesthetic value.
	C3	Science & education	No studies found.
	C4	Cultural heritage	No studies found.
	C5	Inspiration	No studies found.
	C6	The legacy of nature	No studies found.

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Annex IV. Germany

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Introduction

A few research institutes which are engaged in resource economics, especially in economic valuation of public goods, exist in Germany. Furthermore, some institutes focus on aquatic ecosystems, particularly the Baltic Sea. These institutes have been contacted to gather information about scientific investigations concerning economic valuation of goods and services provided by the Baltic Sea.

In addition, we have enquired different other institutions as government and administration facilities, associations of environmental protection, environmental policy or tourism in order to find some grey literature in the form of studies, expertises etc.

In each case we have asked for both existing or planned studies and knowledge about further studies or contemplable institutions.

As another source we have used the existing databases of literature which can be found on the internet. Special valuation study databases (EVRI, ENVALUE, ESD, RED) emerged not to be very helpful in finding studies about the German Baltic Sea.

In table DE.1 you find the German institutions and associations of capital importance relating to our request.

Table DE.1. Important institutions

Chairs at universities
Environmental and Resource Economics, Göttingen (Prof. Marggraf) http://www.uni-goettingen.de/de/19014.html
Landscape Economics, Berlin (Prof. Hartje) http://www.landschaftsoekonomie.tu-berlin.de
Landscape Economics, Greifswald (Prof. Hampicke) http://www.uni-greifswald.de/~laoekon/laoekon.htm
Resource and Environmental Economics, Bonn (Prof. Holm-Müller) http://www.ilr1.uni-bonn.de/abtru/abtru_d.htm
Theory of Production and Resource Economics, Hohenheim (Prof. Dabbert) http://www.uni-hohenheim.de/1597.html?typo3state=institutions&lsfid=57
Research institutes
Helmholtz Centre for Environmental Research (UFZ), Leipzig/Halle http://www.ufz.de
Institute for Ecological Economy Research (IÖW), Berlin http://www.ioew.de
Institute for International and European Environmental Policy (Ecologic), Berlin

http://www.ecologic.de
Institute for Baltic Sea Research (IOW), Warnemünde http://www.io-warnemuende.de
Institute for Coastal Research (GKSS), Geesthacht http://www.gkss.de
Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin http://www.igb-berlin.de
Institute of Marine Sciences (IFM-Geomar), Kiel http://www.ifm-geomar.de
Baltic Institute of Marketing, Transport and Tourism, Rostock http://www.ostseeinstitut.uni-rostock.de
Federal Research Centre for Fisheries , now: Johann Heinrich von Thünen Institute http://www.bfa.fish.de http://www.vti.bund.de/de
Federal Agricultural Research Centre, now: Johann Heinrich von Thünen Institute http://www.fal.de http://www.vti.bund.de/de
Leibniz-Centre for Agricultural Landscape Research e.V. (ZALF) http://www.zalf.de/home_zalf/gb_index.html
Administration/Associations
Federal Environmental Agency, Dessau http://www.umweltbundesamt.de
Federal Agency of Sea Traffic and Hydrography, Hamburg/Rostock http://www.bsh.de
WWF, project-office Baltic Sea, Stralsund http://www.wwf.de/regionen/ostsee

Findings

Existing studies concerning the Baltic Sea

During the investigation we could approve our assumption: The economic effects of an improved marine environment or damage of a deteriorated marine environment of the German part of the Baltic Sea have not really been studied, neither in Germany nor in other areas. Only few papers/studies have been found comprising economic estimations concerning the Baltic Sea in Germany. But most of these studies neither contain any original data raised in Germany nor had been finished in Germany.

INTERNATIONAL STUDIES

1) Gren, I-M., 1999. *Value of land as a pollutant sink for international waters. Ecol. Econ.*, 30: 419-431.

Summary: See annex IX (Sweden).

The paper presents calculated nitrogen loads and marginal costs and benefits from nitrogen reduction to the Baltic Sea for each region in the drainage basin.

Findings for Germany:

Marginal costs per kg N: 10-61 SEK¹⁹⁹⁷ (1-7 EUR²⁰⁰⁷), land as sinks
0.1-937 SEK¹⁹⁹⁷ (0.01-100 EUR²⁰⁰⁷), others
Marginal benefits per kg N: 18.6 SEK¹⁹⁹⁷ (2 EUR²⁰⁰⁷)

Values of marginal increases in the nitrogen sink area are calculated for different types of pollutant sinks (wetlands, catch crops, energy forests, ley) and under alternative decision rules. The results for Germany are given in table DE.2.

Table DE.2. Marginal values of increased area of land types in Germany

Decision rule	Optimal N reduction	Net benefits [MSEK ¹⁹⁹⁷] (MEUR ²⁰⁰⁷)	Costs [MSEK ¹⁹⁹⁷] (MEUR ²⁰⁰⁷)	Wetlands [SEK ¹⁹⁹⁷ /ha] (EUR ²⁰⁰⁷ /ha)	Wetlands* [SEK ¹⁹⁹⁷ /ha] (EUR ²⁰⁰⁷ /ha)
IB1)	14 %	1 074 (114)		1 100 (116)	1 260 (133)
NB2)	9 %	271 (29)		470 (50)	470 (50)
IC3)	31 %		8 028 (850)	14 400 (1 524)	4 390 (465)
NC4)	50 %		3 074 (325)	35 100 (3 715)	31 700 (3 355)

^{*)} if the current area of land type is doubled

¹⁾ IB, maximisation of international net benefits

²⁾ NB, maximisation of national net benefits

³⁾ IC, minimisation of international costs for a 50% total N-reduction

⁴⁾ NC, minimisation of costs for a 50% reduction in national N-loads

The values of catch crop, energy forest and ley grass are zero.

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

Summary: See annex IX (Sweden)

The results for Germany are given in table DE.3 and in the following.

Table DE.3. Marginal costs of different measures of N and P reduction [SEK¹⁹⁹⁵ (EUR²⁰⁰⁷) per kg reduction]

	Agriculture	Sewage treatment plants	Atmospheric deposits	Wetlands
N	20-122 (2-13)	24-60 (2.5-6)	210-3 576 (22-377)	12 (1.3)
P	188-2 964 (20-312)	41-68 (4-7)	--	899 (95)

Estimates of benefits in Germany:

Average WTP per person*year: 6 500 SEK¹⁹⁹⁵ (685 EUR²⁰⁰⁷)

If non respondents are considered to have zero WTP: 3 640 SEK¹⁹⁹⁵ (384 EUR²⁰⁰⁷)

National WTP in the first year: 15 800 MSEK¹⁹⁹⁵ (1 665 MEUR²⁰⁰⁷)

Non respondents=zero WTP: 8 848 MSEK¹⁹⁹⁵ (933 MEUR²⁰⁰⁷)

Present value (time horizon: 20 years): 167 385 MSEK¹⁹⁹⁵ (17 642 MEUR²⁰⁰⁷)

Non respondents=zero WTP: 93 736 MSEK¹⁹⁹⁵ (9 879 MEUR²⁰⁰⁷)

3) *Markowska A., Zylicz T., 1999. Costing an international public good: the case of the Baltic Sea. Ecol. Econ., 30: 301-16.*

Summary: See annex IX (Sweden)

The findings for Germany are:

Mean annual WTP per capita: 278 US \$¹⁹⁹⁵ (179 EUR²⁰⁰⁷)

Aggregate benefits: 676 MUSD¹⁹⁹⁵ (435 MEUR²⁰⁰⁷)

The German benefits are probably underestimated because only the population living in the Baltic drainage basin is considered in the benefits study.

4) *Söderqvist, T., 2000. The Benefits of a Less Eutrophicated Baltic Sea: In: Gren, I-M., Turner, K. and Wulff, F. (Editors): Managing a Sea. The Ecological Economics of the Baltic. Earthscan Publications Ltd, London, pp. 66-77.*

The study of Söderqvist refers to the same surveys of Sweden, Poland and Lithuania as mentioned in 3) and uses the same method of extrapolation to other countries: For Germany the Swedish mean WTP estimate per person is multiplied by the ratio between Germany's GDP per capita and Sweden's GDP per capita. National benefits are calculated multiplying the mean annual WTP estimates per person by the (adult) population in the Baltic Sea drainage basin part of Germany. As also noted in 3) the case of Germany is likely to cause a considerable underestimation, as the German users of the Baltic Sea also live in other parts of Germany.

Findings for Germany:

Mean annual WTP per capita: 3334 SEK¹⁹⁹⁵ (354 EUR²⁰⁰⁷)

National benefits per year: 8 104 MSEK¹⁹⁹⁵ (861 MEUR²⁰⁰⁷)

National benefits, present value: 85 852 MSEK¹⁹⁹⁵ (9 118 MEUR²⁰⁰⁷)

5) Hall, K., 2000. *Impacts of Marine Debris and Oil. Economic and Social Costs to Coastal Communities. Kommunenes Internasjonale Miljøorganisasjon (KIMO), Lerwick, Shetland, 97 pp. Weblink:*
<http://www.kimointernational.org/Portals/0/Karensreport.pdf>

Summary: See annex IX, Sweden

Findings for Germany (**North Sea**): Municipalities which were contacted through Schutzgemeinschaft Deutsche Nordseeküste (SDN, Association for the protection of the German North Sea coast), spend approximately 17 500 GBP²⁰⁰⁰ (23 749 EUR²⁰⁰⁷) per year cleaning 255 km of dyked area using both manual and mechanical means. They remove 450 tonnes of debris from medium to low use areas which are cleaned seasonally as necessary.

Expenditures per km of beach cleaned:	69 GBP ²⁰⁰⁰ (94 EUR ²⁰⁰⁷)
Expenditures per t of debris removed from beaches:	39 GBP ²⁰⁰⁰ (53 EUR ²⁰⁰⁷)

STUDIES FOCUSING ON GERMANY

1) Döring, R., Bender, S., Brosda, K., Kraus, G., Kube, J., Laforet, I., Schaber, M., Schulz, N. and Sordyl, H., 2005. *Wege zu einer natur- und ökosystemverträglichen Fischerei am Beispiel ausgewählter Gebiete der Ostsee (Ways towards environmentally sound fisheries in selected areas of the Baltic Sea). BfN-Skript Nr. 170, Bonn. Weblink:*
<http://www.habitatmarenatura2000.de>

Mainly a study on the influence of fishing practices on species and ecosystems in the Southern Baltic Sea, the study also includes calculations of changes in revenues and profits of German fishing vessels after a recovery of the Baltic Sea Cod stocks. The Cod stocks, western and eastern, are overfished and well below long term reference points. The reproduction success is additionally reduced because of the low oxygen and salinity contents in the spawning areas (especially Bornholm and Gotland deep) due to the eutrophication of the Baltic Sea. With an investment in the stocks, reducing of fishing for several years, in the long run, a company operating a 24 meter trawling vessel may be able to increase its profits by 100% (from around 28 000 EUR to 58 000 EUR) after a recovery. It was not possible to calculate increases in revenues for the whole fleet because of the unclear fishing capacity after a recovery of the stocks. However, in addition to higher revenues, it seems possible to switch fishing methods from bottom trawls to longlines. In this case, negative impacts of fishing on the marine ecosystems and the bycatch of unwanted species will be reduced to a very low level.

2) Mewes, M., 2006. *Die volkswirtschaftlichen Kosten einer Stoffausträge in die Ostsee minimierenden Landnutzung (Costs of land use measures mitigating the discharge of nutrients into the Baltic Sea), Shaker Verlag, Aachen.*

The study focuses on different measures of land use to mitigate the nonpoint discharges of nutrients (N, P) into the Baltic Sea. Area of investigation is the German basin of the Baltic Sea. Based on data of emission and immission estimated by the model MONERIS (Modelling Nutrient Emissions in River Systems) (for the model see Behrendt et al. 1999, 2002), targets of mitigation and appropriated measures are formulated. Costs and effectiveness of these measures are calculated in order to compile ranking lists. Consulting of land users in areas of loamy soil, riparian marginal strips on grassland as well as long-lasting land set-aside on sandy soil are considered to be the most important measures. The target of reducing the immission of N and P by 25 % generates costs of 34 MEUR per year or 20 EUR/ha*year assuming that the consulting is implemented in 50 % of cases.

3) Hirschfeld, J., 2007. *Methoden der sozioökonomischen Analyse zur Bewertung von Handlungsoptionen des Integrierten Küstenzonenmanagements (Methods of socio-economic analyses to valuate courses of action in the integrated coastal zone management)*. In: Schernewski, G., Glaeser, B., Sekscinska, A. and Thamm, R. (Editors): *Coastal development: The Oder estuary and beyond*. Coastline Report No. 8: 191-201. Weblink: http://www.eucc-d.de/plugins/coastline_reports/files/Coastline%20Reports8%20-%20Oder%20Estuary.pdf

The marginal abatement costs for nitrogen reduction are calculated considering municipal waste water of the Oder River. The determined marginal abatement costs range between one and sixteen Euro per kg N within the dimension of 2,500 t N per year and show a sharp increase within the intervall of 2,500 to 3,300 t N per year. The author highlights the preliminary character of these calculations because planning data has to be updated.

4) Bundesforschungsanstalt für Fischerei (Federal Research Centre for Fisheries), 2007. *Dorsch/Kabeljaufänge durch die deutsche Freizeitfischerei der Nord- und Ostsee, 2004-2006 (The German recreational fisheries' cod catch in the Baltic and North Sea, 2004-2006)*, Hamburg. Weblink: http://www.bfa-fish.de/cln_044/nn_819438/DE/aktuelles/aktuelles/2007/2007_09_12Angelfischerei.html

Over three years, scientists of the German Federal Research Centre for Fisheries in Rostock collected data on effort and catches in the German recreational fisheries mainly in the Baltic Sea. Their findings give an idea of how much fish anglers catch additionally in comparison to the fishing sector. This shows a direct value of resources and an improvement of the stock would allow higher catches in the future. The German data suggests that there are great variations over the years. In 2004, they estimated between 1 900 and 3 600 t, in 2005 2 750 and 5 100 t and in 2006 1 900 and 3 100 t. With a very conservative assumption of 1.5 EUR/kg (paid

to the fishermen on the 'normal' market) this would result in benefits for the anglers between 2.85 and 7.65 MEUR. It is clear that recreational fishing is taking place around the whole Baltic Sea with approximately comparable results.

In order to get some information about costs which are caused by the cleaning of oil spills and other contaminations of the Baltic, the Central Command for Marine Emergencies in Germany had been contacted. Unfortunately, nobody there was willing to deliver these data. Because the Central Command acts by order of the waste producer, it is not authorised to transmit data.

Besides the studies mentioned above, there are a lot of other projects and reports dealing with similar questions but neither in direct reference to the Baltic nor directly evaluating the costs or benefits of a changed marine environment. Nevertheless, they are all interesting because the findings are possibly transferable to the Baltic. Other studies may be important for further steps of the SEPA project, particularly the research into costs of certain measures to mitigate the nutrient contaminations. In a following chapter ("further studies of importance") we will dwell on these studies.

STUDIES IN WORK/PLANNED STUDIES

In addition to the few existing studies of economic research concerning the Baltic, we found some projects that aim at examining this matter in the next years. Obviously, the lack of economic investigation has been noticed.

- One broadly based research group around the **Integrated Coastal Zone Management (ICZM)** is now – during the second phase of investigation – involving economists to consider some economic questions. Supported by the Federal Ministry of Education and Research (BMBF), the ICZM-project started in 2004 for the first 3 years period. In 2002, the federal state Mecklenburg-Western Pomerania, Germany, and the Vojevodship Western Pommerania, Poland, signed the Regional Agenda 21 "Oder Lagoon". This Regional Agenda 21 mentions coastal zone management explicitly as one major topic of co-operation and forms the conceptual and spatial basis for this project. The systematic integration of the inshore and coastal waters into the planning process plays a vital role, as they are central elements of the landscape. Within the second phase, the following aspects will be examined by economists:
 - Which realistic water quality objectives can be derived for the present and the future, taking into account the variety of use claims?
 - Which steering options for water quality are there, and how efficient and cost effective are they?

The Institute for Ecological Economy Research (IÖW) attends to these questions. A case study is planned aiming at eliciting the **preferences for an improved water quality of recreationists** along the Polish-German Baltic Sea coast.

- The Institute for Ecological Economy Research is also involved in another European project named SPICOSA (Science and Policy Integration for COastal Systems Assessment) which has a duration of four years from February 2007. The SPICOSA working hypothesis is that the present approach to managing the coastal zone resource needs a much improved, interactive link between the best interests of the natural-resource system and the society that benefits from it. The project tries to assist the European Union in its goal of achieving sustainable development by developing and testing a conceptual methodological framework for this transition in coastal zones. The Oder estuary has been chosen as the German study site. Economic analyses of scenarios will be one of the deliverables. A concrete objective is to **value the water quality with the hedonic pricing method**.
- Another intended investigation with economic background is also located in the Oder estuary region. This project is arranged on findings of the Institute for Baltic Sea Research (IOW), revealing that reduced charges of nutrients can result in both an enhanced and a declined water quality at regional scale. Therefore the project aims at **valuing the measures to mitigate the nutrient contamination of the Oder estuary** considering ecological and economic aspects. Regarding the economic valuation, the **changing monetary added value** will be elicited. Different measures will be examined to find a combination with optimal cost-benefit ratio. The investigations are planned as a thesis starting in 2008.
- Within a German research programme for adaptation strategies to the climate change (KLIMZUG), a group of research institutes (amongst others: ecologic, IÖW, IOW) submitted a project proposal concerning the impacts of climate change on the Baltic Sea coast. One topic is the **water quality and its perception valued by tourists**. The project is planned with both face to face and written interviews in the form of choice experiments.
- According to information obtained by the German Baltic Sea project office of the WWF, a second part of the project BALANCE will be applied including economic considerations. BALANCE is an INTERREG III B co-funded project aimed towards development of informed marine management tools for the Baltic Sea based on spatial planning and cross-sectoral and transnational co-operation. The project ended in December 2007 and further application will be worked out until the beginning of 2009. Special economic topics have not been formulated yet but the arising interests aim at **valuing the benefits of coastal services**.
- DUENE e.V. (institute for sustainable development of landscapes of the earth) is involved in a project proposal to investigate the importance of **Zebra Mussels** in the Szczecin Lagoon (INTERREG IV A co-funded). From an economic standpoint a re-introduction of the mussels may help to improve the water quality and to be a **cost-effective measure to reduce the nutrient load** of the Lagoon. At the end, it may be beneficial for the Baltic Sea because of the reduction of loads of the river Oder entering the Baltic Sea.

Further studies

In recent years, since the implementation of the European Water Framework Directive, a number of research projects have been arranged supplying interdisciplinary analyses of hydrological, ecological and economic consequences of different management strategies to reach a good ecological status in the river basins. Papers concerning socioeconomic analysis focus on potential measures and their costs to reach this good ecological status but also include valuations of benefits resulting from a changed management.

Further valuation studies have been conducted in the direct area of the Baltic Sea coast to get information about the willingness to pay for special biotopes or landscapes. The Baltic Sea does not take centre stage of these investigations but due to the study area we assumed the findings to be of importance.

As a general view we composed table DE.4 comprising these valuation studies with short information about the main contents. Afterwards, some details are mentioned in the text.

Table DE.4. Valuation studies with reference to water systems or coastal regions

Economic valuation concerning water systems					
Author (year)	object of investigation	study area	method	economic measure	estimated values [EUR]
Meyerhoff (2002)	biodiversity of floodplains	Elbe River, Rhine River, Weser River (catchment areas)	contingent valuation	willingness to pay	11.95/household*year total: 153 MEUR (first year) 108 MEUR (following years)
Dehnhardt (2002)	nutrient retention	floodplain of the Elbe River	replacement cost	substitutes of nutrient reduction (wastewater treatment plant, agricultural land use)	585/ha*year total: 8.8 MEUR/year
Arlinghaus (2004)	recreational fisheries	Germany	a) contingent valuation b) input-output-analysis	a) willingness to pay b) induced business volume	a) 134/fisher*year; 4.2/fishing day non-use value: 21/person*year b) 5250 MEUR/year
Meyerhoff (2004)	wadden sea (North Sea coast)	Germany	contingent valuation	willingness to pay	3.99/household*year total: 383.5 MEUR/year
Muthke & Holm-Mueller (2004)	water quality (one/two classes)	a) Ville Lakes b) Güstrower Lakes	contingent valuation	willingness to pay (dichotomous choice)	a) 42.36/52.44/household*year b) 30.09/33.56/household*year
Wronka (2004)	quality of drinking water	two communities in Hesse	contingent valuation	willingness to pay	13-18.50/household*year
Hirschfeld, Dehnhardt & Dietrich (2005)	a) biodiversity b) recreation	Werra River (catchment area)	benefit transfer	willingness to pay	a) 11-15.6 MEUR/year b) 4.2-4.7 MEUR/year
Becker et al. (2005)	water quality (one/two classes)	Ems River (whole basin) Rhine River (part of the basin)	contingent valuation	willingness to pay	18.95/28.26/year ¹⁾
Meyerhoff et al. (2008)	water quality, beach amenities	freshwater lakes/ rivers in the metropolitan area of Berlin	contingent valuation	willingness to pay	0.15/day without a swim advisory "not recommended/forbidden"
Economic valuation in coastal regions of the Baltic Sea					
Degenhardt & Gronemann (1998)	cultural landscape preservation	Rügen Island	contingent valuation	willingness to pay	0.45/overnight stay
Karkow (2003)	cropping conducive to conservation (specific biodiversity)	Rügen Island	contingent valuation	willingness to pay	71/household*year
Beil, Hampicke & Kowatsch (prep.)	salt grassland (specific biodiversity)	Zingst Peninsula	contingent valuation	willingness to pay	0.21/overnight stay

¹⁾ In fact, the average willingness to pay is not significant because only 20 % of the respondents were willing to answer. The majority of the respondents refused any financial contribution to improve the water quality. The average WTP was calculated to investigate the influences on the amount.

In the following the studies of table DE.4 are shortly presented:

Meyerhoff (2002): In order to investigate the benefits of improving the preservation of endangered species and habitats along the Elbe River, 1300 households within the catchment area of three German Rivers (Elbe, Weser, Rhine) are asked for their WTP. The results show that a considerable demand for protecting the biodiversity of riparian wetlands of Elbe River exists.

Dehnhardt (2002): Also within the study area of the Elbe River, a replacement cost approach is used to assess indirect use values, such as the benefits derived from the nutrient retention in flood plains. Therefore, the nitrogen reduction effect is quantified for some defined relocation sites. In a second step, two substitutes providing an equivalent service are considered: the building of sewage treatment plants and measures to reduce nitrogen emissions from agriculture. After determining the marginal costs, the monetary value of restored flood plains is estimated by assessing the replacement costs to provide the same service in kg N retention. The results of Meyerhoff (2002) and Dehnhardt (2002) are also published in English (Meyerhoff & Dehnhardt 2007).

Arlinghaus (2004): The study is a social and economic analysis of recreational fisheries in Germany. Based on a telephone survey of active anglers (474) and persons of the general public (323), use and non use values as well as economic effects are revealed in order to estimate the economic benefits associated with angling. Although the study includes both the inland and the inshore fishery, it provides much information for the Baltic Sea. The data possibly could be used to recompute the benefits on the Baltic Sea level.

Meyerhoff (2004): The German Wadden Sea is a very special ecosystem and more or less unique in the world. Climate change threatens this ecosystem because of increasing storms and a change in the species composition in case of higher temperatures. In this study, the authors analyse the WTP of the German population for climate change mitigation measures to preserve this ecosystem. As the Wadden Sea is a special ecosystem in the North Sea the results are not applicable for the Baltic Sea.

Muthke & Holm-Müller (2004): Main objective is the benefit transfer. Beside the analysis of national benefit transfer based on two German contingent valuation studies, additional efforts are made to investigate into the validity and accuracy of international benefit transfer by considering two Norwegian studies (Bergland et al. 1995) which employed a similar survey design. On the assumption that the results can be generalised, the authors advise to forego the international benefit transfer. However, they consider the national benefit transfer to be possible if the level of tolerance is chosen high enough (margins of error around 50%). In the German survey, the respondents are asked for their WTP (higher sewage fee) to prevent a degradation from „swimmable“ to „fishable“ (one class) respectively from „swim-

mable“ to „boatable“ (two classes), which means that the equivalent surplus is measured. Even though the questionnaires refer to water quality of surface water bodies, the results could serve as indication for a WTP for water quality of the Baltic Sea.

Wronka (2004): The aim of this study is to investigate the WTP for preventing a deterioration of the environment (equivalent surplus) or for improvement (compensating surplus) in the Lahn-Dill-Hillside of Germany. As scenarios, the author chooses biodiversity and the quality of drinking water. The study is designed to analyse a possible benefit transfer via a fund.

Hirschfeld et al. (2005): The results of this study are based on a benefit transfer. The investigations are part of a cost-benefit analysis for potential measures to reach a good ecological status at the Werra River. The possible benefits associated with gains in biodiversity and recreational uses are up to five times higher than the calculated costs. The socio-economic analysis is integrated into a spatial decision support system. Because the benefit assessment is not a primary valuation, the results are not of particular importance.

Becker et al. (2005): Within a project concerning the management of river basins in Germany the WTP for a better water quality (25 % increase of salmons) is investigated. The calculated benefits shall be compared with calculated costs of the measures. During the survey, a high number of chosen persons (80 %) are not willing to participate. Additionally, only a minority of the respondents (44 %) has a WTP for improving the water quality. Therefore, an intended benefit function transfer can not be realised.

Meyerhoff et al. (2008): The preferences of bathers in the metropolitan region of Berlin for increasing the quality of bathing sites is analysed with an online survey. Only to respondents (420) who state a $WTP > 0$ a choice experiment is presented. An additional test for monotonicity reveals that the number of people who show inconsistent preferences is rather low. Among the factors affecting the bathing experience, the cleanliness of the beach and lawn as well as bathing water quality rank highest.

Degenhardt & Gronemann (1998): As one of two main issues, the authors investigate the WTP for Nature Conservation measures in pastures and the preservation of biodiversity in general. A second issue is to analyse the embedding effect with an investigation of WTP for a single species and the reason for a lower or missing WTP for other species.

Karkow (2003): Visitors of Rügen Island are asked for their WTP for a scenario that comprises 10% cropping conducive to conservation. The interviews take place near a field that shows the effect of the relating form of use (floral richness). 63 % of the 150 respondents are willing to contribute to a conversion of land use. How-

ever, the results of a similar survey in Berlin differ from those on Rügen: in Berlin, only 32% of the respondents are willing to pay an average amount of 61 EUR in comparison to 71 EUR on Rügen. The calculations show that the costs of the scenario considered in the survey would be more than compensated by the WTP of the population. Since the study focuses on arable land, it is of little avail for the Baltic Sea.

Beil et al. (prep.): Salt meadows of the Baltic coast play a major role in nature protection. In the research area „Sundische Wiese“ (Zingst peninsula) a restoration of former salt meadows is planned by removing a dyke. The costs and benefits of this measure are calculated. In order to determine the benefits, a contingent valuation among tourists is conducted to elicit the WTP for existence of characteristic salt grassland species. The results show the economic importance of nature protection areas influenced by the Baltic Sea.

Furthermore there exists a comprehensive investigation concerning cost-effectiveness-analyses, which is of particular interest within the European Water Framework Directive:

Osterburg et al (2007): Kosteneffiziente Maßnahmenkombinationen nach Wasserrahmenrichtlinie zur Nitratreduktion in der Landwirtschaft (cost efficient combination of measures diminishing nitrate in agriculture in the water framework directive)

The Institute of Rural Studies of the Federal Agricultural Research Centre (FAL, now vTI) finished the project „Water Resources Management in Cooperation with Agriculture“ (WAgriCo, EU-LIFE). The objectives were analysis, modelling and economic (accompanying) research of implementation of the EU water framework directive. Therefore, water protection measures with/in agriculture had been compiled and evaluated. Farm and general economic valuation of measures and modelling on supra-regional level (model: RAUMIS) had been carried out in order to develop a result-oriented agri-environmental measure for improvement of N efficiency.

STUDIES FOCUSING ON TOURISM

We found some studies on the Baltic Sea and its environment especially with regard to tourism. These studies are not economic investigations but respond to some questions of economic matter:

1) Bütow, M., Poske, B. and Steingrube, W., 2000. *Gutachten zu den tourismuswirtschaftlich relevanten Wirkungen des Energievorhabens Heringsdorf der EEG-Erdgas Erdöl GmbH (Expertise on the impacts of an energy project on the touristic economy in Heringsdorf/Usedom Island).*

The expertise analyses the impacts of an energy project (power generation) which is planned at a centre of Baltic tourism on Usedom island. In addition to other questions, economic effects due to declining tourism are evaluated. By dint of average expenditures per diem and number of accommodations in the region a total revenue of 44.5 MEUR is calculated not taking into account revenues from day visitors and tourism oriented employees. Each percent of declining tourism implies approx. 0.5 MEUR declining revenue. A survey of tourists (487) highlighted that 4 % of the respondents would not come back in case the power plant was realised.

2) Dolch, T. and Schernewski, G., 2003. *Hat Wasserqualität eine Bedeutung für Touristen? Eine Studie am Beispiel des Oderästuars (Does water quality have an impact on tourism? A study in the Oder estuary).*

In a survey, 449 tourists were interviewed in order to elicit whether water quality effects their choice of holiday destination. The results show that water quality is not of decisive importance. Tourists are not really aware of water quality problems and choose their holiday destination on the basis of accommodation prices, touristic infrastructure, and ambience.

3) Benkenstein, M., Zielke, K. and Bastian, J., 2003. *Wirkungseffekte von Offshore-Windkraftanlagen in Mecklenburg-Vorpommern auf touristische Nachfrage- und Angebotsstrukturen (Impacts of offshore wind energy plants in Mecklenburg-Western Pomerania on structures of touristic supplies and demands).*

The study analyses different investigations on impacts of offshore wind energy plants conducted, amongst others, in Mecklenburg-Western Pomerania and Schleswig-Holstein. The authors summarise that there is not any significant negative correlation between the number of plants and the number of accommodations. A negative impact on tourism and on the local economy is ruled out.

4) Scharlau, A., Laube, M., Zdechlikewitz, M., Grammig, S., Hansch, A., Volkmar, J., Schelzel, R. and Beck, Ch., 2004. *Durchführung und statistische Aufbereitung einer Befragung zu Einflüssen und Auswirkungen der geplanten Errichtung eines Offshore-Windparks vor der Halbinsel Fischland-Darss-Zingst (Survey on the impacts of the offshore windpark planned in front of the peninsula Fischland-Darss-Zingst)*

In contrast to the findings of Benkenstein et al. (2003), this study accentuates that 63% of the tourists being on the peninsula would be averse to come back due to the

windpark planned. This fact would have considerable economic consequences which are unfortunately not considered in this study.

Wüstenberg, B., 2007. Befragung von Wassersporttouristen am Greifswalder Bodden – ein Beitrag zur Tourismusforschung (Survey of tourists going in for aquatic sports in the Greifswalder Bodden – a contribution to the touristic research)

In this paper, an annual added value of the tourism of aquatic sports in the area of the Greifswalder Bodden is calculated. The survey shows that each aquatic athlete expends an average amount of 15 EUR per diem for convenience products and for the gastronomy. The findings are extrapolated on the tourists (aquatic athletes) in the Greifswalder Bodden as a whole and give an annual added value of 1.76 MEUR.

Conclusions

Compared to English-speaking countries, the economic valuation of environmental goods and services does not have a long tradition in Germany. Consequently, studies that have assessed the economic value of water and especially of the Baltic Sea are few and far between. Additionally, it is understandable that the marine environment and the Baltic Sea especially are not in the focus of Germany's environmental policy and of studies on improvements in environmental quality. The drainage basin for the Baltic Sea is very small, only around 10% of Northern Germany and the small area around the Oder River in the East. Until 1989/90 (reunification) it was of even smaller importance relating to the whole area of West Germany. Therefore, the North Sea has always been more in the focus of Germany's policy on discharge of nutrients and contaminants in rivers than the Baltic Sea.

In recent years, the number of studies conducted has increased somewhat: socio-economic aspects are now addressed in most water-related research projects. But the work is mainly focused on the evaluation of cost-effective measures to reduce nutrient and contaminants loads instead of asking for a valuation of the benefits of an improved environmental status.

Until today, and as far as we can assess, research in the Baltic Sea has focused on marine pollution research (Institute for Baltic Sea Research, Rostock-Warnemünde) and the analysis of macro-, micro- and zooplankton, benthos ecosystems and fish stock assessment (University of Kiel, Leibniz Institute for Marine Sciences, and the Johan Heinrich v. Thünen Institute, Institute for Baltic Sea fisheries, of the Federal Research Institute for Rural Areas, Forestry and Fisheries in Rostock).

In recent years, the Federal Agency for Nature Conservation, Department of Marine and Coastal Nature Conservation on Vilm Island, has been financing a number of studies on the situation of species and marine ecosystems in the German coastal

waters and the Economic Exclusive Zone (EEZ). The Federal Agency is responsible for the Natura 2000-sites in the EEZ and for the development of management plans for the next years. Only in one project (Döring et al. 2005), an economic question was part of the investigation. In all other studies, there is only very few economic analysis, at the moment especially in a study on alternative fishing methods in the Natura 2000-sites. With this research, at least, there is now considerable knowledge on status of the ecosystems and many species in the Southern Baltic Sea.

From this description of ongoing research without taking into account economics it is clear where the knowledge gaps are. On land and in the case of coastal zone management we have now some studies on cost effectiveness of measures to reduce nutrient loads etc. However, from a benefit perspective, we have nearly nothing. Therefore, it is necessary to conduct studies to evaluate the benefits from an improving environmental status of the Baltic Sea in the future. It is important to calculate cost-effective measures to reach a certain goal; however, it is also important to get an idea of the benefits of measures in order to be able to get more public support for them. So **gaps** are especially:

- Benefit studies on a reduction of nutrient and contaminants inflow in the Baltic Sea from Germany
- Change in revenues and profits for the fishing sector in case of a stock recovery (especially cod, salmon and some freshwater species) and improvement of conditions in the spawning grounds of cod and salmon

To fill these gaps we suggest the following research:

- Calculation of recovery programmes for overused fish stocks and comparison with fleet data from the countries surrounding the Baltic Sea
- Analysis of WTP for an improvement of the status of the Baltic Sea in Germany
- Possible losses in case of non-actions in the coming years

We can summarise our findings by following the overview of ecosystem services in table DE.5:

- Eutrophication: In Germany, the studies on reduction of nutrient inflow either focus on rivers or use the cost-effectiveness-method. Some research projects attend to benefits of reduced runoffs in rivers. Two studies aim at eliciting the benefits of fishing (professional and recreational) with an idea on additional revenues, profits or benefits (in case of recreational fishing) of an improved stock situation of the cod stocks. Cod stocks are lower because of bad spawning conditions in the deeper layers.
- Fishery: For fisheries, there is only one study directly aimed at the fishing sector and one study on the recreational site. In the study on the fishing sector, the influence of fishing on ecosystems in the Southern Baltic Sea is

investigated without an analysis of the economic impacts. But it is clear that some fishing practices have direct negative influence on species (by-catch, habitat destruction) and ecosystems (habitat destruction). This may reduce benefits from fishing in the future. For recreational fishing it is evident that reduced cod stocks influence the catchability for the anglers. To our knowledge there are no studies on the economic effects of aquaculture in German waters. Aquaculture at the coast is rejected by the tourist sector and therefore we have no cages at the coast.

- Hazardous substances: To our knowledge there are no studies on hazardous substances in Germany. Analyses of contaminants in fish caught in the Baltic Sea were all below critical levels.
- Shipping: As far as we know there are no relevant studies on the influence of the introduction of alien species (especially from an economic perspective) and the consequences of oil spills in our coastal waters. The study of Reinhardt et al. (2003) concerning the economic impact of the spread of alien species in Germany deals mainly with terrestrial species or species which are not relevant for the Baltic Sea (e.g. muskrat (*Ondatra zibethicus*), American Crayfish (*Orconectes limosu*)).
- Construction and development: No studies were found.
- Climate change: There are some studies on the influence of climate change on coastal ecosystems and plans to investigate the necessities to improve the protection of coastal areas. But to our knowledge there are no economic analyses besides the costs for measures (dyke building etc.). Within a German research programme for adaptation strategies to the climate change (KLIMZUG), one project is planned focussing on economic impacts on the Baltic coast.

Table DE.5. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	Two studies with a focus on the cod stocks depending on the water quality in the spawning grounds. No direct studies on biochemical cycling in the Baltic Sea.
	S2	Primary production	No studies were found.
	S3	Food web dynamics	No studies were found.
	S4	Diversity	No studies were found.
	S5	Habitat	One study on the ecological status of habitats in the Southern Baltic Sea. But no economic calculations.
	S6	Resilience	No studies were found.
Regulating services	R1	Atmospheric regulation	There is one project on coastal zone management (ICZM) with aspects of changes because of climate change. But no direct studies were found.
	R2	Regulation of local climate	No studies were found.
	R3	Sediment retention	No studies were found.
	R4	Biological regulation	No studies were found.
	R5	Pollution control	No studies were found.
	R6	Eutrophication mitigation	One study on costs of reducing nutrient inflow in the Baltic Sea. Additionally three ongoing studies (ICZM-projects) analysing inflows by rivers.
Provisioning services	P1	Food	Two projects analysing fish catch (especially cod) from the Baltic Sea.
	P2	Inedible resources	No studies were found.
	P3	Genetic resources	No studies were found.
	P4	Chemical resources	No studies were found.
	P5	Ornamental resources	No studies were found.
	P6	Energy	No studies were found.
	P7	Space & waterways	No studies were found.
Cultural services	C1	Recreation	Five studies on the influence of environmental quality or projects (like wind power plants) on tourism. No real economic investigations
	C2	Aesthetic value	Three projects on the wind power plants at the coast and acceptance by tourists. No real economic investigations
	C3	Science & education	No studies were found.
	C4	Cultural heritage	One goal of the fisheries project on the Southern Baltic Sea was the development of strategies to preserve the small scale fishing sector.
	C5	Inspiration	No studies were found.
	C6	The legacy of nature	No studies were found.

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Annex V. Latvia

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Introduction

We have been unable to identify any studies that offer estimates of the benefits of a cleaner Baltic Sea environment calculated specifically for Latvia, i.e. directly using Latvian data. While a number of studies report costs and examine the cost effectiveness of different ways of improving water quality in the Baltic Sea, we have identified four that report monetary values of benefits. Moreover, all of the studies that include estimates of benefits of a cleaner Baltic Sea for Latvia have been developed from the evidence on benefits gathered within the framework of the Baltic Drainage Basin Project (Turner et al, 1995). These studies are: Gren, Soderqvist, & Wulff (1997); Markowska & Zylicz. (1999) and Turner et al (1999) as well as the Baltic Drainage Basin Project itself and summaries of the salient points of these papers are provided below. All of these papers focus on the both the costs and the benefits of reducing the influx of nutrients such as nitrogen and phosphorous to the Baltic Sea and the mitigation of eutrophication. The estimation of benefits by country uses the 'benefit transfer' method to arrive at estimates of benefits for each country, including Latvia, based on detailed surveys undertaken in Sweden, Poland and Lithuania. Where Sweden is taken as 'representative' of Western countries bordering the Baltic Sea and Poland and Lithuania are assumed to be 'representative' of transition countries.

An important general point in these studies is that the specification of the way in which the mix of nutrients is regulated can affect outcomes. Thus, as reported in the Baltic Drainage Basin Project Report (1995) as well as in publications by Gren et al (1997), Turner et al (1999), and Wulff (2000), a policy of regulating just one nutrient in one area may well make eutrophication problems worse in the Baltic Proper. Using analysis in the Gulf of Riga as an example, these publications show that a 30% phosphorous (P) inputs reduction (if a modern sewage treatment plant was built for the city of Riga) will result in reduced exports of P. However, more nitrogen (N) then will be exported to the (nitrogen-limited) Baltic Proper. These N exports may then generate increased eutrophication damage in the Baltic Proper. In other words, by reducing P loads to the Gulf of Riga the eutrophication damage would be exported to the Baltic Proper, while the condition of the Gulf would improve. The Baltic Drainage Basin Project Report (1995) points out that "the simultaneous regulation of both N and P inputs is both more environmentally effective and more cost-effective than single input regulatory measures". Other publications referring to this issue come to similar conclusions.

We have also been unable to identify any sector specific studies on the impact of the Baltic Sea environment, e.g. tourism, fishing or any that deal with specific ecosystem services. However, there are two studies that have directly estimated willingness to pay (WTP) for inland water quality in Latvia using contingent valuation methods. We provide summaries of these papers because they provide a potential benchmark against which valuations based on the benefit transfer method may be compared. Moreover, in the case of one study, water quality in the Gauja also affects the Baltic Sea.

Findings

This section is divided into two parts. The first part offers summaries of the papers that report WTP by 'Latvia' for a cleaner Baltic Sea. The second part reports on the WTP studies of inland water quality in Latvia.

The Latvian 'evaluation' of a cleaner Baltic Sea

As already noted in the introduction a key study for the measurement of WTP for water quality improvement in the Baltic Sea region is the Baltic Sea Drainage Basin Project and the papers that it has generated. None of these papers directly estimated WTP for Latvia but used the benefit transfer method to transpose survey results from either Poland or Lithuania or some combination of both to Latvia. Since these studies were carried out in 1995 there are clearly problems in using them as indicators of contemporary WTP in Latvia. Here we first summarise four papers that report some kind of WTP for Latvia.

1. TURNER ET AL. (1995)

a) Turner, K., Gren I.-M., Wulff F. (Eds.), (1995). *The Baltic Drainage Basin Report*. Brussels: European Commission, EV5V-CT-92-0183 (Summary report)

b) Specific ecosystem services were not explicitly valued in this study

c) The environmental change valued is described as "The clean up target illustrated in the survey was equivalent to the 50% N and P reduction target which was used to determine the cost-effective pollution abatement package of measures". In other words implicitly the environmental change is a 50% reduction in N and P in the Baltic Sea

d) The study covered 14 countries of the Baltic Sea Drainage Basin, including Latvia. However, surveys were carried out only in Sweden, Poland and Lithuania

e) The reported results are based on contingent valuation surveys in three countries and then for the other countries the benefit transfer method was applied. For Lat-

via, Poland was used as the reference country and the Latvian WTP per capita was calculated as equal to the Polish WTP multiplied by the ratio of Latvian GNP per capita (nominal) to Polish GNP per capita (nominal).

f) The economic measures reported for Latvia are: annual WTP per capita, national WTP per year, the present value of national WTP discounted at 7% over a 20 year period, and the annual value of the NPV of WTP. Also reported are the costs to Latvia of achieving its share of the target reduction of 50% of nutrient loads.

g) For Latvia the most interesting reported values were:

Annual WTP per capita	778 SEK
Annual value of NPV of WTP	796 MSEK
Latvian annual abatement costs	1 799 MSEK

Clearly for Latvia at that time the costs far outweighed the benefits.

Assuming that the benefits refer to 1995, Latvian per capita benefits calculated in EUR²⁰⁰⁷ are:

Annual WTP per capita (2007)	180 EUR ²⁰⁰⁷
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h) This is a very well known study that generated many other articles.

2. TURNER ET AL. (1999)

a) Turner, R. K., Georgiou S., Gren I-M., Wulff F., Barrett S., Söderqvist T., Bateman I.J., 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.

b) This article is based on study 1 and hence also does not consider specific ecosystem services.

c) The environmental change here is described in two ways: firstly it is said that respondents were asked to assume that eutrophication would be brought down to a sustainable level over 20 years and secondly the environmental change is described as a “reduction of the nutrient load to the Baltic Sea by 50%”.

d) Baltic Sea countries. So as compared with Study 1 Belarus, the Czech republic, Norway, Slovakia, and Ukraine are excluded.

e) As with study 1 contingent valuation methods were used. Indeed the same surveys formed the basis for the numbers reported. However, the benefit transfer me-

thod was applied in a different way. In contrast to study 1 the Polish WTP was transformed to a Latvian one by applying the ratio of Latvian GDP at PPP (purchasing power parity) to Polish GDP at PPP. It is also the case that the Polish WTP to which the transformation is applied to get a Latvian WTP was different – in study 1 it was 870 SEK and in this study it is 840 SEK. These two factors lead to radically different measures for Latvia, though it is clear that the major source of divergence is the different choice of conversion factor.

f) The WTP measures reported for Latvia are: annual WTP per capita; national WTP per year; the present value of national WTP discounted at 7% over a 20 year period, and the annual value of the NPV of WTP. Also reported are the costs to Latvia of achieving its share of the target reduction of 50% of nutrient loads. One difference is that for each of these WTP measures two figures are reported – one in which non-respondents are simply left out of the figures and another in which they are included but assigned a zero value.

g) For Latvia the most interesting reported values were:

Annual WTP per capita	569 (284) SEK
Annual value of NPV of WTP	583 (291) MSEK
Latvian annual abatement costs	1 799 MSEK

The figures in brackets represent WTP when non respondents are included with a zero valuation

Again it is clear that for Latvia at that time the costs far outweighed the benefits.

Again assuming that 1995 is the year of the survey converting to EUR²⁰⁰⁷ gives the following figure

Annual WTP per capita (2007)	131 EUR ²⁰⁰⁷
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h) Comparison of study 2 with study 1 illustrates one possible hazard associated with the benefit transfer method, i.e. the same data generate radically different valuations!

3. MARKOWSKA & ZYLICZ (1999)

a) Markowska, A., & Zylisz, T. (1999). Costing an international public good: The case of the Baltic Sea. *Ecological Economics* 30, 301-316.

b) No specific ecosystem services are addressed. The main focus of the study is to identify an efficient transfer system that will support the improvement of eutrophication in the Baltic Sea.

c) 50% reduction of nutrient loads to the Baltic Sea.

d) The 9 Baltic Sea countries.

e) Contingent valuation surveys.

f) The study reports WTP per person and a measure of aggregate benefit by country, including for Latvia. It also reports abatement costs by country. In contrast to Study 1 and Study 2 the Lithuanian survey carried out in lat 1994 was the basis for applying benefit transfer, though not in a straightforward way. In particular the Lithuanian survey was open-ended (OE) and face-to-face and using the results obtained from other surveys conducted under the auspices of the Baltic Drainage Basin Project the results of this survey were converted into those from a hypothetical dichotomous choice (DC) survey. The Lithuanian WTP figure was adjusted by the ratio of Latvian GDP at PPP to Lithuanian GDP at PPP (reported as 0.84) to generate Latvian WTP.

g) Estimated values for Latvia:

Annual average per capita WTP	24 USD
Aggregate WTP	46 MUSD

Assuming these figures are for 1995 we can translate the WTP per capita into EUR²⁰⁰⁷ to get:

Annual Latvian WTP per capita (2007)	128 EUR ²⁰⁰⁷
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Here it is interesting to note that we get a figure very similar to study 2, which is not surprising since the benefit transfer method used is very similar.

h) As with the study 1 and study 2 Latvian benefits from the posited clean up are very small representing only 0.08% of the total benefits. This means that in order to persuade Latvia to participate in a clean up Latvia would have needed massive transfers from the richer/larger Baltic Sea countries.

This study also reports nominal per capita incomes in the year of the calculations so it is of interest to see what WTP is a share of incomes for different countries. Some selected examples are the following:

Sweden	0.14%
Finland	0.17%
Poland	0.29%
Latvia	0.3%

What is interesting here, indeed rather surprising, is that the much poorer Poland and Latvia are willing to devote a higher share of their income to a cleaner Baltic than are the richer Sweden and Finland. This result should perhaps alert us to the possibility that all might not be well with the methods of calculating WTP in the transition countries.

4. GREN ET AL. (1997)

a) Gren, I-M., Soderqvist, T. & Wulff, F. (1997). Nutrient reductions to the Baltic Sea: Ecology, Costs and Benefits. *Journal of Environmental Management* 51, 123-143.

b) No specific ecosystem services.

c) Implicitly, a 50% reduction in nutrient loads in the Baltic.

d) Baltic Sea countries.

e) Contingent valuation survey plus benefit transfer.

f) Annual WTP per capita, national WTP for one year, present value of WTP and annualised PV of willingness to pay.

g) The figures here report WTP after non-respondents have been included and assigned a WTP of zero:

Annual per capita WTP for Latvia	257 SEK
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Note this is slightly different from a similar figure reported in study 2 (284 SEK)

Conversion to EUR²⁰⁰⁷:

Annual WTP per capita for Latvia = 59 EUR²⁰⁰⁷

Latvian evaluation of cleaner inland waters

While these studies do not address Baltic Sea clean up they do represent use of contingent valuation methods applied to very similar water quality issues for inland water. The studies were done in 1996 and 2006/2007 so they also represent a benchmark over time.

1. READY ET AL. (2002)

Ready, R., Malzubris, J., & Senkane, S. (2002). The relationship between environmental values and income in a transition economy: surface water quality in Latvia. *Environment and Development Economics*, 7, 147-156.

This study applied contingent valuation methods to measuring citizen willingness to pay (WTP) in the town of Sigulda for an improvement in surface water quality in the river Gauja, a river that runs into the Baltic Sea. Only one environmental good, i.e., surface water quality, was included in the study. There was no detailed data about the benefits of improving inland water quality to the Baltic Sea except for mentioning that “the benefits that would accrue to local residents from such a project would include both those associated with improvements in the Baltic Sea due to reduced nutrient loads, and those associated with improved water quality in the rivers flowing into the sea” (Ready, Malzubris, & Senkane, 2002, p. 149). People were asked to value an improvement that would make the water in the Gauja ‘suitable for swimming and fishing but not for direct consumption’. The survey administered in the second half of 1996 showed that the mean WTP was 0.27 LVL per month per person or 0.7% of a person’s income. This incidentally, was below the cost per person needed to improve water quality to the stated level (0.9% of income).

The study was carried out in 1996, not too different from the time of the Baltic Drainage Basin project surveys, and if the sums reported here are converted to EUR²⁰⁰⁷ we see that the annual per capita WTP for cleaner inland water is **just 7.9 EUR²⁰⁰⁷**. This is a fraction of what is reported in the Baltic Drainage Project benefit transfer estimates.

2. PAKALNIETE ET AL. (2007)

Pakalnite, K., Lezdina, A., & Veidemane, K. (2007). *Assessing environmental costs by applying Contingent Valuation method in the sub-basin of the river Ludza: Latvian case study report*. Riga: ACTeon and BEF Latvia.

This is another study applying contingent valuation methods and was carried out in the sub-basin of the river Ludza which is about 200 kilometres inland from the Baltic Sea coast. This study focused on a range of ecosystem services such as the use of surface waters (the rivers and lakes) for socio-economic activities such as fishing, recreation, and tourism; current water quality and objectives for its improvement concerning nutrients; and biodiversity of other species. This study found that the upper river Ludza and the lake Ludza is at risk “due to elevated nutrient concentrations reasons being diffuse pollutions from agriculture and forests and point source pollution (from public and, particularly, individual sewage facilities)” (p. 19). When valuing benefits for water quality improvements in the areas at

risk, this study stated that the improvements would improve the water ecosystem (e.g. visual quality of water, biodiversity of water animals and plants) and its use by people (e.g. recreational activities, fishing). For tourism no benefits were identified as “it can’t be stated that tourism activities in the WBs [water basins] are limited due to poor water quality” (pp. 20-21). In terms of WTP for improving the water quality in the basin, this study finds an average **WTP of 13.75 EUR per year per household or 3.3% of household income for those who were willing to pay something**. If zero bidders are included the average WTP was 6.5 EUR per year per household. The average household size in the sample was 2.73 so a household WTP of 6.5 EUR corresponds to a WTP per capita of 2.38 EUR (and probably more than this per adult). This again is much less than the WTP figures offered in the studies based on the Baltic Drainage Project surveys.

This study was undertaken in 2006/2007 so as compared with the 1996 figures for the Gauja people were prepared to pay almost twice as much as a proportion of income ten years later. This study also reports differences among users and non-users of services where the mean WTP value of those who never visit the lake is 13.5 EUR while for those who visit the lake often or very often 15 and 14.8 EUR respectively. The study also states that the maximum WTP value among those who never visit the lake or river is much lower than among those who visit – 56.9 EUR and 142.3 EUR respectively (pp. 47-48). Unlike in the previous study, no references to the Baltic Sea water quality were made in this paper.

Conclusions

Studies on the costs and benefits from reduced pollution to the Baltic Sea for Latvia are thin on the ground – indeed we have found none that addresses this directly for Latvia. Studies that have addressed this issue in a general way have focused on reducing nitrogen and phosphorus with a purpose to mitigate eutrophication and all are linked to the Baltic Drainage Basin Project conducted by an international and interdisciplinary group of researchers in the early 1990s. Studies that have been conducted on the costs and benefits of preserving the water ecosystem specifically in Latvia concern only inland waters. See also table LV.1

So the first conclusion is that when it comes to a valuation by Latvians of the ecosystem services provided by the Baltic Sea there is a **total gap in knowledge**.

The second conclusion is that the use of benefit transfer methods may be extremely unreliable for this particular case. It is certainly extremely surprising that willingness to pay for better local water quality is so much less than WTP for Baltic Sea water quality as estimated from the data of the Baltic Drainage Basin Project, i.e. 8 EUR per year as against about 130 EUR per year. Also, the method of converting 1995 figures to 2007 figures is also unreliable. The correct of inferring today’s valuation from historical data would involve knowledge of the income elasticities

of demand for ecosystem services and for Latvia we have no knowledge of these either.

Finally, there is only one reliable solution for filling these gaps – or perhaps this one large gap. This is simply to conduct a specific Latvian contingent valuation study today. A positive aspect is that techniques of contingent valuation have moved on since the early 1990s so there is some prospect of achieving reliable estimates.

Table LV.1. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	
	S2	Primary production	
	S3	Food web dynamics	
	S4	Diversity	The Ludza inland water study considered biodiversity
	S5	Habitat	
	S6	Resilience	
Regulating services	R1	Atmospheric regulation	
	R2	Regulation of local climate	
	R3	Sediment retention	
	R4	Biological regulation	
	R5	Pollution control	
	R6	Eutrophication mitigation	All three studies reported here focused on this
Provisioning services	P1	Food	
	P2	Inedible resources	
	P3	Genetic resources	
	P4	Chemical resources	
	P5	Ornamental resources	
	P6	Energy	
	P7	Space & waterways	
Cultural services	C1	Recreation	One inland water study found that was WTP for recreational uses such as swimming and fishing
	C2	Aesthetic value	
	C3	Science & education	
	C4	Cultural heritage	
	C5	Inspiration	
	C6	The legacy of nature	

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Annex VI. Lithuania

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Introduction

With the purpose to find as much as possible studies, related to possible economic changes due to changes in the Baltic Sea water quality, a number of governmental, research institutions and non-governmental organisations were contacted in Lithuania. In addition, some local and foreign experts, who have worked and / or managed international projects, related to the Baltic Sea, were approached for results of the projects. Moreover, available international literature and Internet sources, as well as related databases were searched for interested materials.

There are basically four economic valuation studies, which can more or less directly meet objective of this sub-project in Lithuania. The studies are described in detail in this report.

In addition to economic valuation studies, described here, there are, of course, a huge number of research projects, which investigate ecosystems in the Baltic Sea and their changes; however, these studies do not provide any monetised values of changes of the investigated ecosystems.

Findings

Five studies and information on oil spills are presented below.

Nevėžis willingness to pay study (Ščeponavičiūtė et al., 2007)

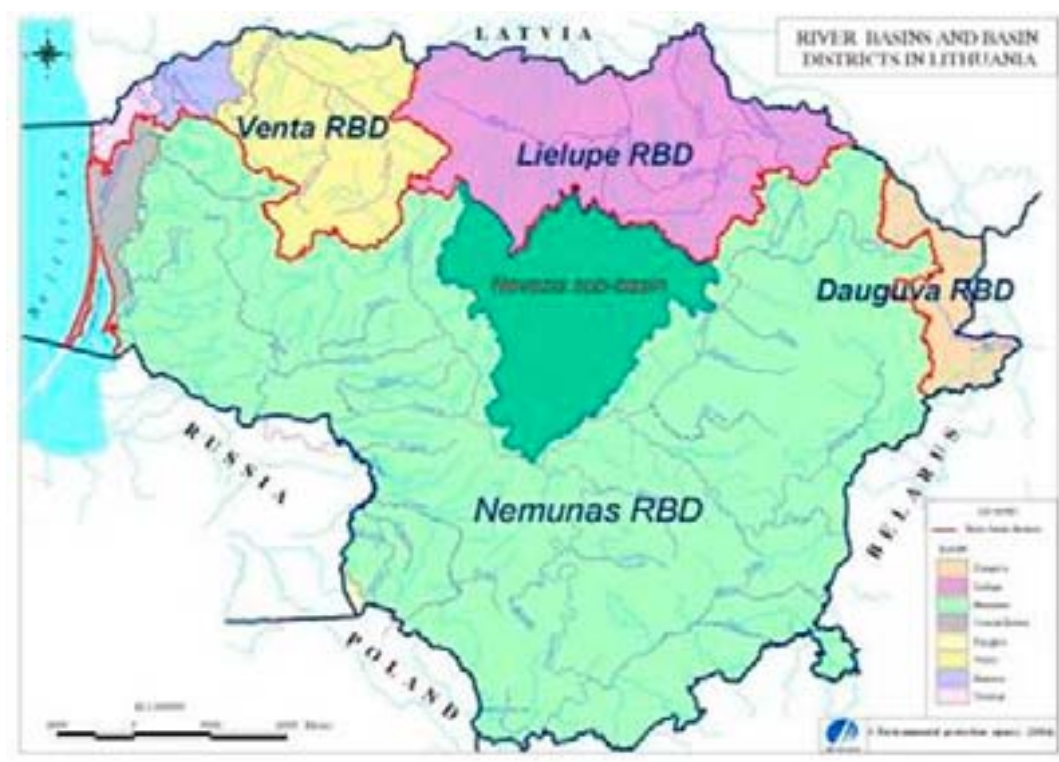
ENVIRONMENTAL FOCUS OF THE STUDY, EXTENT OF ENVIRONMENTAL CHANGE AND STUDY AREA

The goal of the study was to assess the willingness of inhabitants to pay for the water quality improvement. The good – water quality improvement – was chosen because water quality problems are characteristic to many Lithuanian rivers, and theoretically these results might be indicative of WTP values for other rivers in Lithuania. Nevėžis river basin was selected for the study due to the fact that a large number of water bodies at risk of not reaching good status by 2015 exist in the basin, and therefore it was important to assess the benefits that can be brought by the costly programme of measures.

The environmental change described in the scenario of the survey was related to the increase of surface water quality in all water bodies of Nevezis river basin from the current status up to the good ecological status required by the Water Framework Directive.

Figure LT.1. Nevezis river basin is marked in green in the central part of the territory of Lithuania.

RBD – river basin district (according to Water Framework Directive)



In total 48 respondents were interviewed during the pre-test exercise and 512 respondents interviewed during the actual interview. The survey revealed that the majority of respondents think that water quality is moderate or poor. Only about 7 % of respondents thought that water quality in the basin was good or very good. It was clarified that ‘water use’ purposes prevail in the basin, as majority of people like to go to water sites for resting (~60%) near the water and for swimming (~59%).

VALUATION METHOD

A contingent valuation method for Nevėžis basin study was selected as a method, suitable for assessing both use and non-use values provided by water ecosystem. The majority of the rivers in Nevėžis basin can be classified as poor and very poor. Due to the poor water quality, both the natural ecosystem and water uses deteriorate.

rate and important benefits to humans are lost. With the improvement of water quality a number of benefits can be achieved in terms of the improvement of natural ecosystem and increase in water use options for water users. The water quality improvement as a good to value was chosen for the study.

ECONOMIC MEASURES AND ESTIMATED VALUES

48 per cent of the survey population answered that in principle they would agree to contribute financially to water quality restoration in the rivers of Nevėžis basin and 52% of respondents said that they disagree to pay for water quality improvement.

Out of 260 arguments against the contribution to water quality improvement 130 were protests. 10.4% of the 'Protest bidders' stated that they were not willing to pay in principle because thought that money would not be used for water quality improvement, the major part (35%) declared that State has to take care of water quality issues. In the group of 'zero bidders' people having insufficient income prevail, they make about 42.6%. The high number of protest bidders implies that the results of this study should only be used with careful consideration.

Majority of people who were not against the financial contribution for achieving better water quality (28.7%) stated that they would be ready to pay for water quality change because they would like children and grandchildren to have better quality water. Approximately the same amount of respondents (26.6%) was willing to pay because they expected to do recreational activities at the water bodies.

Respondents' willingness to pay ranged from 0.5 LTL²⁰⁰⁷ or 0.14 EUR²⁰⁰⁷ to 60 LTL²⁰⁰⁷ or 17.4 EUR²⁰⁰⁷ per household per month, mean willingness to pay for the improvement of water quality up to good status was 5.91 LTL²⁰⁰⁷ or 1.7 EUR²⁰⁰⁷ per month. If 'zero bidders' were included, the mean value decreased to 3.82 LTL²⁰⁰⁷ or 1.1 EUR²⁰⁰⁷ per household per month.

The average size of a household in Lithuania is 2.4 persons. Converting the above numbers into numbers per person per month results in 0.7 EUR²⁰⁰⁷ (without zero bidders) and 0.5 EUR²⁰⁰⁷ (with zero bidders).

The variables explaining the stated WTP amount were: average income of the respondent, presence of children in the family and purpose of the visits to water bodies. Bearing in mind the results of both analyses it can be summarised, that higher value for the water quality is given when it is expected to receive such benefits like direct uses of water.

CONCLUSIONS AND REMARKS FOR THE FUTURE

Several methodological lessons were obtained from this study which can be useful for further work in the field of valuing benefits of a better water quality:

1. The good selected for the valuation has to be easy to describe and present for the public. If the good is marginal, people experience difficulties in understanding of what they are asked to give value for. For instance, in Nevėžis case it was extremely difficult to explain the good (water quality improvement) because actual change in the river (removal of nutrients) is hardly visible from the perspective of an inhabitant.
2. A high level of co-operation with ecologists is needed in order to assess the hypothetical situation after the implementation of the measures. It is especially important when applying economic models for WFD purposes. The good to value is good water quality and it is also a task of ecologists to explain what a good quality is in terms of human use and non-use values.
3. A preliminary analysis of the study area is needed in order to better prepare the survey material (e.g. questionnaire). Screening of the current water uses in the selected study area can be helpful in revealing the use values people receive from the ecosystem currently and consequently this may help identifying possible future benefits that may be most interesting for inhabitants.
4. Contingent valuation method appears to be more relevant to environmental changes that are significant and which impacts can be easily explained and can be clear in people's mind. In the Nevėžis case study dealing with relatively limited changes in water quality and eutrophication that do not drastically change the aquatic ecosystem, only a few respondents mentioned that the value they had proposed was the value given to the proposed scenario as opposed to the value they might allocate taking into account all other expenses they might have – a situation that might be exacerbated by the comparatively low average income in the region investigated.
5. It is important as well to agree commonly how to treat protest bidders, as those in Eastern Baltic countries will perhaps make much greater portion as in Western Baltic countries.

Ukmergė willingness to pay study (Milieu Ltd. with AAPC, 2001)

To illustrate some of the challenges municipalities faced in developing and implementing environmental investments prior accession to the EU, in the frame of the development of the Lithuanian Environmental Financing Strategy, a case study was prepared for the municipality of Ukmergė in 1999.

The Ukmergė WTP survey was administered by the Sociological Information Centre in Vilnius in September 1999. A full description of survey results is provided in Annex 6.2 and the willingness-to-pay results are discussed in Chapter 7 of the Environmental Financing Strategy of Lithuania.

ENVIRONMENTAL FOCUS OF THE STUDY

The project team designed a survey to gauge perceptions of Ukmerge residents about the quality of their municipal services and willingness-to-pay for system improvements focused principally on meeting EU requirements.

The survey implemented in Ukmerge had three goals:

1. Examine satisfaction with key municipal environmental services related to the directives;
2. Estimate the demand (i.e. the willingness to pay) function associated with the improvements from the directives;
3. Use the demand estimates to calculate the national willingness to pay.

EXTENT OF ENVIRONMENTAL CHANGE

The survey focused mainly on extension of sewerage lines, improved drinking water quality, and solid waste.

Ukmerge had a relatively new wastewater treatment facility that already met the requirements under the UWWT directive. Only sewerage was therefore considered in the survey, and only respondents who indicated that they did not have sewerage services were surveyed. 42.6% of respondents said that they did not have these services.

The service/environmental change was described in a following way: "if you were connected, you would not need to service your private septic system or pit toilet. This would create a more sanitary environment in your yard. If you currently use a pit toilet, connection would allow you the opportunity to have indoor plumbing. Furthermore, there is little or no smell associated with centralized sewage systems".

Respondents were also asked about the quality of their drinking water. Over 41% of respondents stated that their water was probably or definitely healthy to drink while 31% of respondents replied probably yes or definitely yes.

Excessive iron and minerals in drinking water are the main areas where drinking water system upgrades are needed nationally. Ukmerge, on the other hand, had a rather advanced water supply system, which included an iron removal facility. The only equipment that required upgrading under the directive was approximately 23 kilometers of water supply piping. Thus, the service /environmental change in Ukmerge case study was described in the following way: "Suppose there were a program to complete all upgrades necessary to ensure that the water supply system would be completely safe in the future and no colors or odors would be present. First, some groundwater wells that supply Ukmerge with drinking water would need to be re-drilled and repaired. Approximately 23 kilometers of water supply

pipes must be reconstructed or cleaned to reduce leakage of drinking water from the system, and to be sure that the water delivered to your home would be clean and tasty. These measures together would assure that you, your neighbors, and businesses in Ukmerge would have access to drinking water that had no color (e.g. no red or orange), no odor, tasted good and was completely safe to drink."

In the waste sector, the survey asked a variety of questions about landfills, recycling of organic wastes, and packaging. Respondents were asked whether they would favor construction of an environmentally secure landfill and proper closure of old landfills to minimize threats to groundwater; packaging waste recycling services and separate collection of organic waste.

STUDY AREA AND STUDY POPULATION/INDUSTRY

The municipality of Ukmerge is comprised of the city of Ukmerge, six small townships, and small rural settlements. The total population of the municipality was 51,000, thirty-one thousand of which resided in the city of Ukmerge in 1999. Given that households probably value the environmental benefits approximation would generate, they were supposed be willing to pay for them. The purpose of this study was to estimate the magnitudes of the willingness to pay for the environmental benefits associated with the following directives in the town of Ukmerge:

- 80/778/EEC (Drinking Water) – upgrading of pipes only
- 91/271/EEC (Urban Wastewater Treatment) – extension of sewerage only
- 99/31/EC (Landfills)
- Landfill upgrading
- Organic waste recovery and reuse components.
- 94/62/EEC (Packaging Waste)

These directives posed a potentially serious financing problem for municipalities and for the Government of Lithuania. To the extent that these costs could not be covered by budgetary or other support, it meant that tariffs had to be increased.

"How much can tariffs increase without generating a subscriber rebellion?" – was the first question the survey implementers asked. The broad answer to this question was "by as much as people actually value the benefits resulting from implementation of the directives." "But is it likely that the major directives affecting municipalities will have no value to service subscribers?" – that was another question raised by those responsible for the Survey. It was supposed that directive 91/271/EEC should improve the quality of surface waters, increasing recreation opportunities, and offer sewerage services to those who needed it. 80/778/EEC would improve the quality of drinking water consumed by residents. It was assumed that these benefits were very real and personal, meaning that willingness to pay had in general to be positive.

One of the major assumptions was that financing of these service upgrades had to use increased tariffs. The feasibility of this strategy was thus evaluated by estimating household willingness to pay for upgraded landfill, sewerage, and recycling programs. Then estimated benefits were compared with approximation costs.

VALUATION METHOD

The method used for estimating the willingness to pay was contingent valuation and relied on the use of a highly structured survey to infer willingness to pay.

ECONOMIC MEASURES AND ESTIMATED VALUES OF THE ECONOMIC MEASURE

A description of the change in services was prepared which detailed the benefits respondents would enjoy if the measures stipulated in the respective directives were implemented. The original resulting willingness to pay in LTL¹⁹⁹⁹, also adjusted for CPI sums in EUR²⁰⁰⁷ are presented in table LT.1 below.

Table LT.1. The willingness to pay for water and sewerage services, adjusted for CPI, LTL and EUR per person per month.

Willingness to pay in LTL ¹⁹⁹⁹	Willingness to pay in EUR ²⁰⁰⁷	Estimated percentage of population that would support the drinking water / sewerage extension programme
Drinking water		
0.24	0.08	20%
0.12	0.04	50%
0.06	0.02	80%
Sewerage extension		
1.75	0.57	20%
0.64	0.21	50%
0.24	0.08	80%

Note: Numbers in the second column are calculated by the author of this summary, using CPI change in Lithuania and exchanging LTL to EUR

If, as estimated in 1999, 42.6% of the Lithuanian people did not have sewerage services, this meant that the national WTP for sewerage upgrading was approximately 12.1 million LTL. In EUR²⁰⁰⁷, this would mean 3.93 million.

Similarly, the estimated cost of upgrading the 23 kilometers of water supply pipe in Ukmerge municipality was approximately 10 million LTL and the estimated WTP of the 52,000 residents of Ukmerge municipality was approximately 74,880 LTL per year. On a national level, a similar pipe upgrading program was evaluated at approximately 5.3 million LTL. In EUR²⁰⁰⁷, this sum equals 1.72 million.

CONCLUSIONS AND REMARKS FOR THE FUTURE

It was found that household willingness to pay was substantial for upgraded landfill management and expanded sewerage service, but virtually zero for the two recycling programs considered. Relative to costs, households were willing to pay approximately 80–90 per cent of costs for landfill improvement, but less than 10 per cent for upgraded sewerage service and recycling programs.

In conclusion, it was emphasised by the authors of the survey that the analysis pertained only to the three services, for which demand was estimated and costs cited, and more wide study would need to be undertaken in order to compare willingness to pay for broader environmental sector and costs required to implement the environmental acquis. However, it was stressed that households undoubtedly perceived benefits and costs from entering the EU that extended beyond these services.

This study is quite old and its results are only indirectly interesting to the purpose of the evaluating economic benefits because of environmental changes of the Baltic Sea. Nevertheless, it shows that wastewater collection problems are being evaluated at quite a high level in comparison to other environmental programmes.

Baltic coast study (Povilanskas et al., 1998)

The environmental focus of the study is the valuation of “nature” in the surveyed coastal regions in Curonian Spit in Lithuania and Matsalu Bay in Estonia in order to test whether economic valuation methods can assist in optimising coastal conservation policy decisions in the Eastern Baltic Countries.

ENVIRONMENTAL FOCUS OF THE STUDY, EXTENT OF ENVIRONMENTAL CHANGE AND STUDY AREA

The following research objectives were formulated for the project:

- To investigate and practically apply different methods of economic valuation of (semi) natural coastal biotopes around the Curonian Lagoon (Lithuania) and the Matsalu Bay (Estonia).
- To develop recommendations for including economic valuation into standard appraisal and decision taking procedures related to coastal conservation, planning and management in Lithuania and Estonia.

Two main questions were addressed during the project:

- How much the population of Lithuania and Estonia is willing to pay for the conservation and maintenance of natural and semi-natural coastal biotopes and their biological and aesthetic values?
- What is the rating of the environmental protection and nature conservation in the coastal areas of the Baltic States in comparison with other social issues?

Potential loss of biotopes in coastal areas was examined/valuated during the project. Apart from sparsely scattered rural settlements, the surveyed regions in Lithuania were comprised by the following biotopes:

- Bare sand dunes of the Curonian Spit,
- Dry pine forests of the Curonian Spit,
- Mugo (mountain) pine plantations of the Curonian Spit,
- Dry meadows of the Curonian Spit,
- Sandy beaches of the Curonian Spit,
- Wetlands of the Nemunas delta,
- Floodplains of the Nemunas delta,
- Wet alder forests of the Nemunas delta.

Three geographical coastal regions – Curonian Spit and Nemunas delta in Lithuania and environs of the Matsalu Bay in Estonia were analysed in the Baltic Coast study. Total study area covered over 1000 km².

In order to obtain statistically significant results from all applied WTP formats, the total national respondent's samples in both Estonia and Lithuania were divided into random samples. Respondents in every subsample were asked different forms of the WTP question for valuation of different biotopes or in general for the valuation of the "nature" in each of the three surveyed coastal regions.

The respondent group for the CVM pilot test survey consisted of 550 respondents in Estonia and 1683 respondents in Lithuania.

VALUATION METHOD

In order to elicit and compare use and non-use values of the Eastern Baltic coastal biotopes, three different economic valuation methods were applied in Lithuania:

- contingent valuation,
- hedonic price analysis and
- travel cost analysis

As mentioned in the study, there were two specific circumstances which had to be addressed with special attention: First of all, monetary values were attributed to natural and semi-natural very dynamic and ever changing coastal biotopes; and second, this was done in the situation from centrally planned to a market economy.

In CVM survey respondents were asked different forms of the willingness to pay questions for valuation of different biotopes. The aggregate annual willingness to pay was derived by multiplying the expected mean by a total voter's numbers in the country and using 10% annual discount rate.

During the application of the individual travel cost model the dependence of the visitation rates on the total marginal visit costs for using nature-related amenities at the site was analysed. The total annual consumer surplus was derived by integrating the visitation rate equation for each visit cost interval and summing the results.

The value of the marginal implicit price of the Curonian Spit nature, depending on the property area, was derived from a difference between prices for property with identical area on the Curonian Spit and Palanga. Then the expected cumulative marginal implicit price of the nature, i.e. total willingness to pay for natural peculiarities, of the Curonian Spit was estimated for the annual value of 1997, using 11.8% interest rate.

ECONOMIC MEASURES AND ESTIMATED VALUES

According to the attributed mean willingness to pay values, all surveyed biotopes can be grouped into:

- relatively highly valued – pine and alder forests, 13 – 30 EUR²⁰⁰⁷ (originally 9-21 USD¹⁹⁹⁷)
- moderately valued – drifting sand dunes, wetlands and coastal meadows, 10 – 11.5 EUR²⁰⁰⁷ (originally 7-8 USD¹⁹⁹⁷)
- low valued – dry meadows, forested meadows, coastal meadows, floodplains and sandy beaches, 6 – 10 EUR²⁰⁰⁷ (originally 4-7 USD¹⁹⁹⁷)

Results of all three valuation methods in Lithuania are presented in tables LT.2, LT.3 and LT.4 below. All values are calculated by the author of this summary using exchange rate between USD and LTL in 1997, CPI change and exchange rate between EUR and LTL in 2007.

Table LT.2. Contingent valuation results (in EUR²⁰⁰⁷ per person).

CVM format	Referendum		Discrete choice		Payment card		Open ended	
Biotope/Landscape	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Curonian Spit								
General nature	10	19	10	1.1-3.6	26	13	16.9	4.3
Dry meadows			4.3	1.1-3.6			7.2	2.9
Wandering dunes			10	1.1-3.6			10	8.7
Sandy beaches			5.8	0-1.1			5.8	1.4
Pine forests			14.4	1.1-3.6			30.3	8.7
Mountain pine plantations			8.7	1.1-3.6			7.2	2.9
Nemunas delta								
General nature	5.8	17.3	7.2	1.1-3.6	42	14.4	17.3	5.8
Wetlands			10	1.1-3.6			11.6	4.3
Floodplains			10	1.1-3.6			7.2	1.4
Wet alder forests			13				17.3	5.8

Table LT.3. Travel cost results

Total estimated consumer surplus for the Curonian Spit and Nemunas delta, kEUR²⁰⁰⁷		
Area	CS for total marginal visit costs	Separational CS
Curonian Spit	13 640	1 360
Nemunas delta	277	Not estimated

The hedonic price method was used only to value the “nature” of the Curonian Spit. Systematic differences in the property value between the Curonian Spit and another resort town Palanga were analysed.

The result showed that the value of the “nature” of the Curonian Spit equalled 3 300 kEUR²⁰⁰⁷ (originally 2 290 kUSD¹⁹⁹⁷).

Table LT.4 presents the comparison of results of all economic valuation methods used in Lithuania.

Table LT.4. Comparison of results of all valuation methods.

Method	Value of nature in kEUR ²⁰⁰⁷	
	Curonian Spit	Nemunas Delta
WTP, contingent valuation, referendum format	2 800	1 600
Consumer surplus, travel cost analysis	1 400	280
Marginal implicit price, hedonic price analysis	3 300	Not estimated

CONCLUSIONS AND REMARKS FOR THE FUTURE

A few quite specific and also general conclusions were drawn by the authors of the study for different valuation techniques and interpretations of results. A few of them, which may indirectly be relevant for further analyses, are presented below:

- Results showed that the only significant differences between the elicited mean WTP values are in fact between the nature of the Curonian Spit and the nature of the Nemunas Delta while the nature of the Matsalu Bay invariably enjoys the highest mean WTP values.
- Consumer surplus values derived for the Nemunas delta and the environs of the Matsalu Bay were by an order lower than those elicited from the contingent valuation. The difference is based on the function of both areas as wetlands with high non-use or indirect use values. Much more striking results of the comparison between the valuation results obtained by different methods were that the consumer surplus value of the Curonian Spit elicited by the travel cost method was by far much higher than the total WTP values elicited by any of the contingent valuation techniques.
- The concept of a willingness to pay a onetime donation for biotope conservation was easier understood by the respondents than a concept of a willingness to accept (realistic) amount of money as a one-time compensation of the loss of specific biotope features.
- Extending the interpretation of the WTP from the referendum format as a minimal legal WTP (here reference is made to Harrison & Kristrom, 1995) to the revealed consumer surplus, authors of the study under description argue that for such areas like Curonian Spit, with complex non-consumptive uses and site-specific social connotations of the nature, the total consumer surplus is the maximum legal WTP. That is, in contrast to wetlands and other less-frequented areas without recreational amenities, the consumer surplus of the areas with effective “trade” of natural or cultural peculiarities can indicate the current ceiling of the attributable economic values.
- This study was the pioneering economic valuation study and it is suggested by the authors to treat it as a pilot test of different subjective economic valuation approaches rather than an in-depth study of a single chosen issue.

- The CVM was acknowledged as the most applicable method, while hedonic price and travel cost methods were thought to be less applicable for practical purposes in the Baltic States.
- Nevertheless, the most important result of the Baltic Coast study was that tested economic valuation methods generated meaningful and commensurable quantitative results, which could be interpreted reasonably and rationally from the socio-economic and geographical point of view.
- So, the major conclusion of the Baltic Coast study was that subjective economic valuation methods can and should enjoy wide acceptance and application in identifying the coastal conservation policy priorities and approaches in the Baltic States.

The Baltic Drainage Basin Project (Turner et al., 1995)

As written by the authors of the Baltic Drainage Basin Project summary, the overall objective of “this interdisciplinary project was to identify the significant environmental pressures that have been changing the state of the Baltic Sea and to analyse appropriate (efficient and environmentally effective) response options.”

Further the overall objective was divided into the following six interrelated intermediate goals:

- “a) A quantification of the regional (i.e. Baltic Sea and linked coastal regions and drainage basins) resource system and carrying capacity. The aim was to provide as comprehensive and rigorous a profile of the Baltic ecological resource base as was feasible, and to further relate this resource inventory to socio-economic activities, pressures and trends.
- b) A quantification of the nutrient loading trends for the Baltic region (subdivided into individual drainage basin areas) which have led to changes in the trophic state of the Baltic Sea and its sub-systems.
- c) To develop a model for predicting the concentration of nutrients in the different drainage basin areas.
- d) To estimate the costs of various strategies designed to reduce the nutrient loading of the Baltic Sea; and in particular to try to identify cost-effective nutrient abatement options.
- e) To explore the feasibility of estimating in monetary terms the social benefits of nutrient reduction strategies. In particular, to deploy household production func-

tion, travel cost, hedonic pricing and contingent valuation methods in a small number of case-study contexts. In addition, the problem of benefit estimates transfer and aggregation was explored.

f) To simulate basin-wide net benefit outcomes and investigate their institutional implications.”

One of monetary valuation studies to estimate the economic benefits of environmental improvements in the Baltic Sea was conducted in Lithuania. This study represented the first deployment of environmental benefits valuation methods in the context of transition economies.

Both use and non-use economic (willingness-to-pay) value estimates were derived for marine and coastal resources.

A “good” used in the survey, was equivalent to the 50% N and P reduction target which was used to determine the cost-effective pollution abatement package of measures.

A total of 44.2% of the Lithuanian pilot sample positively answered the question about support for the Baltic tax, while 41.6% of respondents said that they would not support the proposed action.

The mean and median WTP for Lithuania in LTL¹⁹⁹⁴ and EUR²⁰⁰⁷, received from the pilot survey, are presented in table LT.5 below. This table also contains a result for an assumption of a hypothetical DC face to face survey in Lithuania, used further in acquiring basin wide benefit estimates.

Table LT.5. WTP estimates for Lithuania.

Mean WTP per person per year		Median WTP per person per year	
LTL ¹⁹⁹⁴	EUR ²⁰⁰⁷	LTL ¹⁹⁹⁴	EUR ²⁰⁰⁷
27.92	22.44	10	8.04
Hypothetical WTP per person per year			
USD ¹⁹⁹⁵		EUR ²⁰⁰⁷	
28		62	

Regression models revealed no significant factors except for household income. It should be stressed that so far (as also other studies showed) the income is the most significant factor impacting the WTP value in the Baltic countries. Table LT.6 presents the amounts for Lithuania used for basin-wide benefit estimates.

Table LT.6. Amounts for Lithuania used for basin wide benefit estimates.

Annual willingness to pay per person		National willingness to pay per year		National willingness to pay, present value		National willingness to pay, present value per year	
SEK ¹⁹⁹⁴	EUR ²⁰⁰⁷	MSEK ¹⁹⁹⁴	MEUR ²⁰⁰⁷	MSEK ¹⁹⁹⁴	MEUR ²⁰⁰⁷	MSEK ¹⁹⁹⁴	MEUR ²⁰⁰⁷
502	506	1 314	1 323	13 922	14 022	696	700

Valuation of land as a pollutant sink study (Gren, 1999)

As explained in the paper, two earlier studies of Soderqvist (1996) and Markowska and Zylicz (1996) are used to transfer estimates of benefits from nitrogen reductions to the Baltic Sea to other countries around the Baltic Sea. The results from the Polish study were transferred to Lithuanian conditions. Table LT.7 presents marginal costs and benefits from nitrogen reductions to the Baltic Sea in Lithuania.

Table LT.7. Marginal costs and benefits from nitrogen reductions to the Baltic Sea in Lithuania.

Drainage basin area, thousand km ²	Nitrogen load, thousand tonnes N/year	Marginal costs, SEK, kg N		Marginal benefits, SEK, kg N	Marginal benefits, EUR ²⁰⁰⁷ , kg N
		Land as sinks	Others		
66	45	36 - 283	0.1 - 500	12.4	2.07

Note: The last column is added and numbers calculated by the author of this summary.

The paper analyzes values of marginal change in the area of particular types of land as a pollutant sink under different decision-making policies (see table LT.8):

- maximization of international net benefits (IB),
- maximization of national net benefits (NB),
- minimization of international costs for a 50% total N reduction (IC),
- minimization of costs for a 50% national N reduction (NCs)

Table LT.8. Estimated marginal values of increased area of land types in Lithuania.

Policy context	Optimal N reduction	Net benefit		Wetlands		Catch crops		Wetlands, if current area is doubled	
		MSEK	MEUR ²⁰⁰⁷	SEK/ha	EUR ²⁰⁰⁷ /ha	SEK/ha	EUR ²⁰⁰⁷ /ha	SEK/ha	EUR ²⁰⁰⁷ /ha
IB	37%	897	150	590	92	0	0	640	107
NB	38%	142	24	130	22	0	0	140	23
IC	56 %	1 781	297	692	115	30	5	2 230	372
NICs	50 %	761	127	1 120	187	20	3	270	45

Note: The marginal value of energy forest and ley grass were 0 SEK / ha.

Note: The values in EUR are calculated by the author of this annex. They are based on the exchange rate 1 USD = SEK 7.99 of 17.12.1998, as indicated in the paper, exchange rate between USD and LTL at that time, Lithuanian CPI change and current exchange rate between EUR and LTL.

Oil spills on the Lithuanian coast and Klaipeda port area

In Lithuania, the Methodology for Calculating Damage done for Environmental Noncompliance is in effect and used in cases of breaches of environmental regulations. Oil spills are cases which directly impact the quality of sea water in a “visible” way. Information on oil spills cannot directly help in economic valuation of environmental change; however, the economic valuation exercise is a very important reciprocal tool to assist, e.g. Lithuanian authorities in setting damage calculation related rates, which would attempt to reflect external environmental costs.

The Methodology defines methods for calculation of compensation for the damage done for environment. Compensation for the damage has to be calculated in cases when environment is contaminated by the pollutants which are not allowed to be released and/or pollution done by a forbidden way or in a forbidden place.

The compensation (Z_n) of the damage done to water resources and soil has to be calculated using the following formula (when released amount of pollutants makes less than one tonne):

$$Z_n = T_n * I_n * Q_n * K_{kat},$$

where:

T_n – tariff for a pollutant, which for oil products made 146 500 LTL/t in 2002, when the Methodology was adopted. In 2007 it equalled approximately 159 000 LTL²⁰⁰⁷ or 45 900 EUR²⁰⁰⁷.

I_n – coefficient for adjusting for inflation, defined according to the CPI, announced by the Department of Statistics;

Q_n – amount of pollutants, calculated as a difference between pollutants released to the environment and pollutants collected by means, officially recognised by environmental authorities, t;

K_{kat} – coefficient for the category of a water body, soil surface or its deeper layers:

1. Sea – 0.8
2. Surface water bodies except of those listed in 3 and 4 positions – 1
3. Artificial water bodies, less than 0.5 ha – 0.6
4. Surface water bodies in protected areas, except of those listed in 3. – 1.5
5. Soil surface and/or deeper layers, except of those listed in 6. – 0.8
6. Soil surface and/or deeper layers in protected areas – 1.5
7. Groundwater bodies – 1.5

n – type of a pollutant.

If released amount of pollutants makes more than one tonne, in above formula Q_n becomes $Q_n^{0.8}$.

It can be seen from the coefficients above that pollution to the sea is treated not so strictly as to most of other water bodies.

Information on oil spills in the Lithuanian Baltic Sea coast was obtained from Lithuanian responsible authority – Marine Environmental Protection Agency under the Klaipeda Environmental Regional Department.

Table LT.9 below describes the extent of oil spills and similar activities which have happened since 1999 in the Lithuanian territory of the Baltic Sea and the coast.

Table LT.9. Damage evaluation of oil spills in the Lithuanian territory of the Baltic Sea and the coast.

Year	Amount spilled or contaminated territory	Damage evaluation according to the Methodology in effect in Lithuania, LTL	Damage evaluation according to the Methodology in effect in Lithuania, EUR ²⁰⁰⁷
1999	100 litres of heavy fuel oil 15 kg of oil products 100 m ² polluted by oil products 260 kg of diesel fuel 4 m ³ of oil <i>Total 1999</i>	65 565	21 320
2000	200 m ² polluted by oil products 20 kg of oil products on the beach 20 kg of heavy fuel oil spill on the beach Sea containers in the sea 200 kg of oil products on the beach 400 m ² polluted by oil products 100 kg of oil products on the beach 500 m ² polluted by oil products 8 kg of oil products on the beach <i>Total 2000</i>	455 726	147 730
2001	Spill in Butinge terminal 150 litres of heavy fuel oil 59 tonnes spill in Butinge oil terminal <i>Total 2001</i>	2 782 625	889 620
2002	15 m ³ of diesel fuel 5 litres of hydraulic oil <i>Total 2002</i>	138 121	43 290
2003	2 m ³ of sludge 0.97 m ³ of diesel fuel <i>Total 2003</i>	209 797	66 420
2005	Spill in Butinge terminal and other	172 780	53 860
2006	Not specified	8 150	2 470
2007	Not specified	122 374	35 440
<i>Total</i>			1 260 150

Note: Summarised by the author of this annex from the data received from the Sea Environmental Protection Agency under the Klaipeda Regional Environmental Protection Department.

Conclusions

The major conclusion which can be drawn from the specific studies, conducted in Lithuania, is that the economic valuation and in these cases – contingent valuation – can be applied in Lithuania, as it provides not only special scientific information and gives understanding on people's opinion on water resources management and on their priorities, guiding decision making processes, but it also contains a very important "public awareness raising" component, which helps informing people about water management issues and thus increase their overall awareness and understanding.

It should be born in mind that Eastern Baltic countries have some specific features in comparison to Western Baltic countries, which need to be taken into account while selecting the method of economic evaluation and making comparisons. Those methods, which require any historic information, need to be viewed very cautiously, as earlier transition period and later speedy economic growth obviously impacts values of economic indicators which in other conditions may be used for reflection of environmental changes.

More specific conclusions drawn after conduction of each study and remarks for the future of such type of a valuation were provided at the end of the description of each valuation study. Here we summarise the most important ones:

1. The good selected for the valuation has to be easy to describe and present for the public. If the good is marginal, people experience difficulties in understanding of what they are asked to give value for.
2. A high level of co-operation with ecologists and other scientists is needed in order to assess the hypothetical situation after the implementation of the water quality improvement measures.
3. Contingent valuation method appears to be more relevant to environmental changes that are significant and which impacts can be easily explained and can be clear in people's mind.
4. It is important to agree commonly how to treat protest bidders, as those in Eastern Baltic countries will perhaps make much greater portion as in Western Baltic countries.
5. Some studies show that quite often drinking water and wastewater collection and treatment problems are being evaluated at quite a high level in comparison to other environmental programmes.
6. Striking results from one study, made approximately 10 years ago, of the comparison between the valuation results obtained by different methods were that the consumer surplus value of the Curonian Spit elicited by the travel cost method was by far much higher than the total WTP values elicited by any of the contingent valuation techniques.

7. One study showed that the concept of a willingness to pay was easier understood by the respondents than a concept of a willingness to accept.

As shown, only a few economic evaluation studies have been performed in Lithuania, therefore all conclusions are, of course, only preliminary. Nevertheless, the most important result was that tested economic valuation methods generated meaningful and commensurable quantitative results, which could be interpreted reasonably and rationally from the socio-economic and geographical point of view.

The major conclusion of a few studies carried out in Lithuania is that economic valuation methods can and should enjoy wide acceptance and application in identifying the environmental policy priorities and approaches in the Baltic States. This is especially relevant having in mind a great need to improve the water quality in the Baltic Sea and implement the Water Framework Directive as well as the EU Marine Strategy.

As mentioned before, the experience on economic valuation is too short in Lithuania, therefore knowledge gaps exist in all related sectors and ecosystem services. The most important driver currently, which is understood by civil servants, is related to the implementation of the Water Framework Directive and thus a need to value environmental costs and benefits of selected measures improving ecological status of water resources.

Table LT.10. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	No studies found
	S2	Primary production	No studies found
	S3	Food web dynamics	No studies found
	S4	Diversity	Three studies found, all focusing on general biodiversity issues in water bodies valued. A strong cooperation with ecologists is needed to better describe environmental changes understandable to a broad public.
	S5	Habitat	Three studies found, all focusing on general habitat (as well as biodiversity) issues in water bodies valued. A strong cooperation with ecologists is needed to better describe environmental changes understandable to a broad public.
	S6	Resilience	No studies found
Regulating services	R1	Atmospheric regulation	No studies found
	R2	Regulation of local climate	No studies found
	R3	Sediment retention	No studies found
	R4	Biological regulation	No studies found
	R5	Pollution control	Two studies found, one focusing on environmental service change and another focusing on water resource quality change due to implementation of EU directives
	R6	Eutrophication mitigation	Two studies found, one focusing on the change in the Baltic Sea and another – on the change in water bodies of one river basin district.
Provisioning services	P1	Food	No studies found
	P2	Inedible resources	All studies found are related to provision of some kind of inedible resources' services.
	P3	Genetic resources	No studies found
	P4	Chemical resources	No studies found
	P5	Ornamental resources	No studies found
	P6	Energy	No studies found
	P7	Space & waterways	No studies found
Cultural services	C1	Recreation	Three studies found all, among other issues, focusing on valuation of better recreational opportunities due to water quality change
	C2	Aesthetic value	Two studies found, which, among other issues, focus on valuation of an aesthetic features of water bodies before and after implementation of certain pollution control measures
	C3	Science & education	No studies found
	C4	Cultural heritage	One study found, focusing on natural resources, including cultural heritage, of the Curonian Spit
	C5	Inspiration	No studies found
	C6	The legacy of nature	No studies found

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Annex VII. Poland

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Introduction

The aim of the report is to review the studies focusing on valuation of benefits from improved water quality of the Baltic Sea in Poland. The scope of the benefits involves all possible changes in quantifiable ecosystem goods and services and approaches to monetize them. Where possible, the costs of measures aiming at improving water quality were also reported.

In January and February 2008, all the major research institutions, non-government organizations and administrative bodies were contacted in search for the relevant studies. In addition, international literature and valuation studies databases were searched for primary data and possible applications. Two Polish empirical studies were identified, resulting in five different estimates. In addition, one international study was identified, where total ‘ecosystem service product’ of coastal ecosystems in Poland was estimated following Costanza et al. (1997).

In addition to empirical studies, eight applications of the results were identified, which refer to the empirical data and – in some cases – to its utilization in policy-making framework. One additional paper presents a review of data on goods and services provided by the Polish Baltic Sea Coast, with special focus on biological value. Finally, numerous national primary studies and research projects were identified, focusing on changes in the Baltic Sea environment, its impacts, damages and measures to prevent it. Since the impacts or damages in those studies were not monetized, these quantitative studies are only listed for potential future uses.

Findings

Primary studies

There have been two major primary studies aiming at estimating the value of benefits of improved Baltic Sea conditions. The most relevant study comes from an international project called *The Baltic Drainage Basin Project* (Markowska et al., 1996; 1999; Żylicz et al., 1995). The second, more recent study focuses mainly on the quality of surface waters in Poland thus it is only indirectly related to the Baltic Sea (Markowska, 2004). One additional study reported here estimates total ‘eco-

system service product' of coastal ecosystems in Poland. The sections below give short description of the studies.

BALTIC SEA STUDY OF 1994

The *Baltic Drainage Basin Project* consisted of a few empirical components which were conducted in Poland.

Face-to-face interviews

a. Study reference:

Markowska and Żylicz (1996; 1999)

b. Environmental focus of the study and to what ecosystem service(s) this focus is related:

Recreational and non-use services. In particular recreation and aesthetic values. Analysis of responses to the question about reasons of support for potential improvement of water quality allows concluding that the values of cultural heritage and legacy of nature have also been captured.

c. Extent of environmental change:

Reduction of the Baltic Sea eutrophication back to the level from the 1950s; all the beaches available for swimming as opposed to a limited number of open beaches (presented on the maps); 10-year international action.

d. Study area and study population/industry:

Random sample of adults in Poland.

e. Valuation method:

CVM, DC.

f. Economic measure(s):

Compensating variation, per person per year.

g. Estimated values of the economic measure:

129 PLN¹⁹⁹⁴ / adult person per year = 98.44 EUR²⁰⁰⁷

h. Any other especially interesting piece of information:

The study was carried out in November 1994 on a representative nation-wide sample of 1161 adults by a professional polling agency using face-to-face interviews. Valuation scenario of the study included a description of eutrophication effects observed in the Baltic Sea (algae blooms) that led to closing-up of several beaches during the summer of 1994 on the Polish Baltic Sea coast. The respondents were shown the maps with the range of pollution and beaches that had to be closed because of eutrophication effects. The scenario mentioned a possibility of carrying out an international clean-up action over the next 10 years. Such an action would call for collecting financial resources in each Baltic country in the form of an earmarked tax. The respondents were then asked if they would support such an action.

The majority of respondents, i.e. 62.5% answered "yes" to the question about support for the tax, and 29.8% answered "no"; 6.7% said they did not know. A dichotomous choice question on acceptance/rejection of an initial bid followed. Ini-

tial bids in the amounts of 5, 10, 20, 50, 100, 200, 500 and 1 000 PLN¹⁹⁹⁴ were randomly distributed across the sample. For estimation of mean and median values of WTP, a linear logit model was used. Based on the model coefficients, the average value of 169 PLN¹⁹⁹⁴ was calculated for "positive" bidders³¹.

The respondents who rejected the idea of payment were divided into two groups: "legitimate zero bidders", who did not think the resource in question was a priority or could not afford to pay, and "protest bidders", who viewed the idea of payment as not being their responsibility or who apparently protested against some aspects of the questionnaire. The reasons for refusing to pay the "Baltic Sea tax" was analysed using an attitudinal questions included in the questionnaire.

Mean value for the sub-sample consisting of positive and legitimate zero bidders, excluding protest bidders has been calculated (it was assumed that in case of protest bidders, zero-statement might not reflect real value they might attach to the resource). Such a modified mean WTP equalled 129 PLN¹⁹⁹⁴. After recalculating using OECD CPI indices³² and exchange rate of the National Bank of Poland from the 2nd of January 2008³³ this results in 98.44 EUR²⁰⁰⁷. Aggregating the result over the entire adult population of Poland in 2007³⁴ resulted in the value of 3 018 MEUR²⁰⁰⁷ per year.

Pilot study

- a. Study reference:
Markowska and Żylicz (1996; 1999)
- b. Environmental focus of the study and to what ecosystem service(s) this focus is related:
Recreational and non-use services. In particular recreation and aesthetic values.
- c. Extent of environmental change:
Reduction of the Baltic Sea eutrophication back to the level from the 1950s; all the beaches available for swimming as opposed to a limited number of open beaches (presented on the maps); 10-year international action.
- d. Study area and study population/industry:
Random sample of adults in Poland.
- e. Valuation method:
CVM, OE.
- f. Economic measure(s):
Compensating variation, per person per year.
- g. Estimated values of the economic measure:
32 PLN¹⁹⁹⁴ / adult person per year = 4.42 EUR²⁰⁰⁷
- h. Any other especially interesting piece of information:

³¹ Only those, who answered positively the first question on support for the Baltic tax.

³² <http://www.oecd.org>

³³ <http://www.nbp.pl>

³⁴ Based on a forecast of the Polish Central Statistical Office (GUS): <http://www.stat.gov.pl>.

The main study described above was preceded by a pilot study of representative sample of 1166 adults in Poland, using open-ended WTP question. The scenario, maps used to illustrate the problem and the payment vehicle were the same as in the face-to-face study described above. It's worth noting that the pilot study with an open-ended WTP question was compatible with a study carried out a few months later in Lithuania. These two studies used almost identical scenarios and questions.

In the Baltic *pilot study*, the mean value of Willingness to Pay for reduction of eutrophication effects so that all Polish beaches could be open with possibility of swimming equalled 32 PLN¹⁹⁹⁴ (24.42 EUR²⁰⁰⁷ after conversion with CPI and exchange rate). This value is calculated for the sample excluding protest bidders. Aggregation of the result to the entire adult population of Poland resulted in 749 MEUR²⁰⁰⁷ per year.

Mail study

- a. Study reference:
Markowska and Żylicz (1996; 1999)
- b. Environmental focus of the study and to what ecosystem service(s) this focus is related:
Recreational and non-use services. In particular recreation and aesthetic values. Analysis of responses to the question about reasons of support for potential improvement of water quality allows concluding that the values of cultural heritage and legacy of nature have also been captured.
- c. Extent of environmental change:
Reduction of the Baltic Sea eutrophication back to the level from the 1950s; all the beaches available for swimming as opposed to a limited number of open beaches (presented on the maps); 10-year international action.
- d. Study area and study population/industry:
Random sample of adults in Poland.
- e. Valuation method:
CVM, PC.
- f. Economic measure(s):
Compensating variation, per person per year.
- g. Estimated values of the economic measure:
236 PLN¹⁹⁹⁵ / adult person per year = 140.69 EUR²⁰⁰⁷
- h. Any other especially interesting piece of information:
The *mail study* was carried out in April/May 1995. The questionnaire was similar to the Swedish one, where the main results were collected by mail as well. Out of 600 questionnaires sent, 304 were filled out and returned resulting in the response rate a little over 50%, what may be considered reasonably good. Mean WTP for the sample excluding protest bidders equalled 236 PLN¹⁹⁹⁵ (140.69 EUR²⁰⁰⁷). The authors suspect that low response rate might result in overestimation of the WTP value (those who filled out the questionnaires might have been more interested in

the problem than an average citizen). Therefore, we do not recommend this result for aggregating for the entire population of Poland.

Beach study

- a. Study reference:
Żylicz *et al.* (1995)
- b. Environmental focus of the study and to what ecosystem service(s) this focus is related:
Recreational and non-use services. In particular recreation and aesthetic values. Analysis of responses to the question about reasons of support for potential improvement of water quality allows concluding that the values of cultural heritage and legacy of nature have also been captured.
- c. Extent of environmental change:
Reduction of the Baltic Sea eutrophication back to the level from the 1950s; all the beaches available for swimming as opposed to a limited number of open beaches (presented on the maps); 10-year international action.
- d. Study area and study population/industry:
Convenience sample on Polish beaches.
- e. Valuation method:
CVM, DC.
- f. Economic measure(s):
Compensating variation, per person per year.
- g. Estimated values of the economic measure:
 $180 \text{ PLN}^{1994} / \text{adult person per year} = 137.36 \text{ EUR}^{2007}$
- h. Any other especially interesting piece of information:
The beach study was carried out in August 1994 at several recreational sites along the Polish coast of the Baltic Sea where 441 respondents were interviewed ("positive" bidders). The main purpose of this study was to obtain rough bid estimates for further use in the main study and to cross-check observations made in focus groups which had been organised before. The survey was administered by students from the Warsaw University. The mean value of WTP calculated using the best-fitting log-logistic model equalled 180 PLN^{1994} ($137.36 \text{ EUR}^{2007}$). This value is calculated only for "positive" bidders (no distinction of legitimate zero bidders and protest bidders was made). The beach study seems to be the least valuable study for this project (Economic Marine Information) because of non-representativeness of the sample and possible overestimation of values (survey carried out on beaches). Therefore, we do not recommend this result for aggregating for the entire population of Poland.

SURFACE WATER QUALITY STUDY

- a. Study reference:
Markowska (2004)

- b. Environmental focus of the study and to what ecosystem service(s) this focus is related:

Use and non-use values of fresh waters in Poland. In particular, recreation, aesthetic values and food. Analysis of responses to the question about reasons of support for potential improvement of water quality allows concluding that the values of cultural heritage and legacy of nature have also been captured.

- c. Extent of environmental change:

Gradual improvement of quality of surface waters in Poland; by 2015 all water bodies would have been suitable for swimming and fish breeding.

- d. Study area and study population/industry:

Random sample of adults in Poland.

- e. Valuation method:

CVM, OE.

- f. Economic measure(s):

Compensating variation, per household per month.

- g. Estimated values of the economic measure:

PLN²⁰⁰³ / household per month = 1.98 EUR²⁰⁰⁷

- h. Any other especially interesting piece of information:

The study on the valuation of potential surface water quality improvement in Poland was devised as a part of cost-benefit analysis of implementing in Poland the directive 91/271/EEC concerning urban wastewater treatment. The empirical study was conducted by a professional polling agency in July 2003 on a representative sample of 952 Poles, using face-to-face interviews.

Valuation scenario focused on two separate aspects of water quality: quality of surface waters and quality of drinking water in household taps (the latter is not relevant to this report and is therefore not reported here). The respondents were informed that a programme of investments in water sector was planned, which would result in gradual improvement of quality of surface waters in Poland so that in 2015 all waters would be at least suitable for swimming and fish breeding. The costs of this programme would have to be covered at least partly from increased user fees for water and sewer services.

Respondents whose households were connected to water and sewer services were asked how much more they would be willing to pay monthly in the form of user fees for implementing the programme which would result in the described water quality improvement. Of the interviewed households 61.7% were connected to water and sewer systems, 26.1% had only water connection, 10% had no public connection and 2.3% had other types of connection.

The average WTP for improved quality of surface water obtained in this survey was equal to 6.51 PLN²⁰⁰³ (1.98 EUR²⁰⁰⁷) per household per month for the sample excluding protesters; the sample consisted only of the inhabitants of households connected to sewer services.

The general conclusion of this study was that the implementation of the urban wastewater treatment directive in Poland is not economically efficient. In the basic scenario, the benefits of improved quality of surface water according to the empirical study results and discounted for 30-year period using 5% discount rate were estimated to be 12.8 billion PLN²⁰⁰³, while the discounted costs of implementation of the directive were equal to 24.5 billion PLN²⁰⁰³.

Assuming that the average WTP for improvement of the quality of surface water with respect to the households not connected to sewage system is the same as WTP of the households connected to sewage system, it is possible to aggregate the WTP value by multiplying the annual average WTP per household ($1.98 \text{ EUR}^{2007} \cdot 12$) by the number of households in Poland. The aggregated annual value is 337 MEUR²⁰⁰⁷ per year.

ECOSYSTEM SERVICE PRODUCT APPROACH

- a. Study reference:
Martínez et al., 2007
- b. Environmental focus of the study and to what ecosystem service(s) this focus is related:
Total Polish coastal ecosystem services value. This includes categories such as habitat, resilience, recreation, aesthetics, cultural heritage, the legacy of nature, food, inedible resources.
- c. Extent of environmental change:
No change – total value estimated
- d. Study area and study population/industry:
Coastal ecosystems in Poland (intertidal and subtidal areas on and above the continental shelf to a depth of 200m; areas routinely inundated by saltwater; adjacent land, within 100 km from the shoreline).
- e. Valuation method:
'Ecosystem Service Product'.
- f. Economic measure(s):
Compensating variation transferred from Costanza *et al.* (1997) study.
- g. Estimated values of the economic measure:
See details below.
- h. Any other especially interesting piece of information:
The paper integrates information on ecological, economic and social importance of the coasts at a global scale. The calculated economic value of goods and services provided by coastal ecosystems are 77% of global ecosystem services calculated by Costanza *et al.* (1997).
The 'Ecosystem Service Product' calculated for Poland is given in table PL.1.

Table PL.1. 'Ecosystem Service Product' calculated for Poland [MUSD]

	Natural			Modified	
	Terrestrial	Aquatic	Total	Semi-altered	Altered
Poland	71.93	4.83	76.76	274.96	431.31

Applications and extensions of the results of primary studies

The primary results of the above studies were applied in several papers. This chapter briefly summarizes the applications and the results relevant for Poland. Where possible cost estimates are also given.

GREN *ET AL.* (1997B)

Authors discuss the possibilities of international CBA study on reduction of Baltic pollution and summarize existing knowledge. The preliminary results show almost all transition countries would lose from implementing a program of 50% reduction of nutrient emissions, while virtually all 'market economies' would be better off. Valuation of impacts is not directly related to the reduction in nutrient loads or concentrations but reduction in 'eutrophication'. The results of the *Baltic Drainage Basin Project* are reported.

With regard to Poland the results of the mail CVM survey (2.1.2) are reported for its similarity to Swedish scenario. Estimated mean WTP is 600 SEK¹⁹⁹⁶ / person / year. Conservative approach assumes WTP of non-respondents to be 0, resulting with an average WTP of 300 SEK¹⁹⁹⁶ per adult person per year.

Estimated national WTP equals 7 842 MSEK¹⁹⁹⁶ first year of the 20-year time horizon. At 7% discount rate this amounts to 83 077 MSEK¹⁹⁹⁶.

KÖHN (1998)

The paper discusses feasibility of environmental sustainability of the Baltic Sea, ways environmental economics can support decision making and possibilities of designing a program with environmental and social targets in mind.

No specific benefit estimates are given although approaches to identify them are sketched.

GREN (1999)

The paper analyzes values of marginal change in the area of particular types of land as a pollutant sink under different decision-making contexts – international coordi-

nation vs. national policies. The results reveal high differences in the values depending on the context. The following policies were considered:

- maximization of international net benefits (IB)
- maximization of national net benefits (NB)
- minimization of international costs for a 50% total N reduction (IC)
- minimization of costs for a 50% national N reduction (NCs)

Production function approach is applied for wetlands capacity to reduce leaching of pollutants. The estimated 'benefits from nitrogen reductions' are cited after (Söderqvist, 1996) and (Markowska et al., 1996). The annual WTP values of the entire region for improvement of environmental conditions prior to the 1950s are reported to be 31 billion SEK.

The study assumed linear relation of benefits for all regions and nitrogen reductions (500 000 Mg of N, what corresponds to 50% reduction of total N load). Polish nitrogen load is estimated at 245 000 Mg N/year (of the total anthropogenic N load of 706 000 Mg / year). As a result marginal benefits of N load reduction for Poland are estimated to be 6.2 SEK / kg N, while marginal costs of reductions to be 15-101 SEK / kg N (for land used as sink; increased area of wetlands) and 0.1-937 SEK / kg N (for others – lowest: decrease in nitrogen fertilizers use and cleaning capacity at sewage treatment plants, highest: reduction in air emissions). The estimated marginal values of increased area of land types in Poland, under different policy contexts, are given in table PL.2.

Table PL.2. Marginal values of increased area of land types in Poland

Policy context:	Optimal N reduction:	Net benefit: [MSEK]	Wetlands [SEK/ha]	Catch crops [SEK/ha]	Wetlands* [SEK/ha]	Catch crops* [SEK/ha]
IB	42 %	-545	300	0	330	0
NB	15 %	-75	0	0	0	0
IC	55 %	1020	4070	30	1230	0
NICs	50 %	4562	830	30	220	0

* if the current area of the land type is doubled

The marginal value of energy forest and ley grass were 0 SEK / ha, thus confirming higher relative value of creating nutrient sinks (wetlands) than measures decreasing leaching (catch crops, energy forests, ley grass).

TURNER *ET AL.* (1999)

The study of costs of a range of abatement options and benefits of 50% N and P load reduction policies in the Baltic Sea area.

The marginal costs of different measures to reduce N and P loads in Poland are given in table PL.3 below.

Table PL.3. Marginal costs of N and P reductions by different measures (SEK/kg of pollutant)

	Agriculture	Sewage treatment plants	Air deposition	Wetlands
N	12-101	7-35	523-3 412	10
P	114-2 033	20-100		611

The cost effective mix of measures of all Baltic countries for 50% N loading reduction was estimated to consist of 35% reduction due to agriculture, 28% due to wetlands, 31% due to sewage treatment plants and 6% due to air emissions. Of this Poland is claimed to be the most cost effective, constituting 40% of total reduction (2/3 of the current national load).

In the corresponding mix for P reduction the sewage treatment plants were a major element (66%). Again, Poland was estimated to contribute 66% of the total reduction.

The estimates of benefits are reported after Georgiou *et al.* (1995). The mail survey in Poland is referred to. The valuation scenario – a reduction of the eutrophication to a level the Baltic Sea can sustain – was not corresponding to any specific nutrient reduction target, although authors refer to 50% reduction (after Helsinki Commission) and the 20-year time horizon. The average WTP reported is 840 SEK and 426 is a conservative estimate (non-respondents are considered to have WTP=0). The total benefits in Poland are estimated to be 21 958 MSEK in the first year (11 136 MSEK conservatively) and the present value for the 20 year period to be 232 623 MSEK SEK (117 974 MSEK conservatively).

The estimated cost effective program of 50% total load reduction assumed the reduction of Polish loads by 63%, what generated costs of 9 600 MSEK / year, and benefits of 11 631 MSEK / year (5 899 MSEK / year conservatively). This results in net the benefit of 1 761 MSEK / year (-3 701 MSEK / year conservatively).

TURNER (2000)

The paper discusses the general potential of interdisciplinary modelling of environmental and socio-economic processes as a tool in policy making. An overview of the *Baltic Drainage Basin Project* research project results is given.

Full range of environmental damage costs associated with eutrophication in the Baltic Sea is approximated by beach recreation and amenity services. The costs are estimated based on simultaneous cost effective total N and P load reduction meas-

ures undertaken in all Baltic Sea countries. The results of the above are taken from (Turner et al., 1999) and summarized in table PL.4 below.

Table PL.4. Costs and benefits of reducing nutrient load to the Baltic Sea by 50% [MSEK / year]

	Reduction (%)	Costs	Benefits	Benefits*	Net benefits	Net benefits *
Poland	63	9 600	11 631	5 899	1 761	-3 701

* conservative estimates assuming WTP of non-respondents was equal to 0.

LEDOUX AND TURNER (2002)

Authors discuss the importance of valuing environmental resources and give practical policy-relevant examples.

Referring to Gren *et al.* (2000), Georgiou *et al.* (2001), Georgiou *et al.* (1995), and Söderqvist (2000), the paper presents the results of cost effective reductions of nutrient loads in Baltic Sea countries. This is followed by benefit valuation results (from the *Baltic Drainage Basin Project*) – same as in Gren *et al.* (1997b) above.

NEUMANN AND SCHERNEWSKI (2005)

The paper employs a 3D ecosystem model of the Baltic Sea to analyze effects of 50% N and P load reductions by proportional 50% load reductions in all countries and cost effective approach suggested by Gren (2000). The results show that in the medium-term mostly coastal waters benefit from reductions and thus Poland gains more from the cost-effective approach, since reductions in Wisła and Odra are higher, which leads to better quality of coastal waters, while the central Baltic Sea may still suffer from summer blooms of nitrogen-fixing cyanobacteria. The study refers to costs of the two scenarios by Gren (2000). No estimates of monetary benefits are given.

GREN AND FOLMER (???)

The paper develops a model accounting for uncertainty regarding degradation of water quality from coastal countries, to show cooperative and non-cooperative (Nash) solutions including risk aversion. The results show that the abatement scale increases with risk aversion in both cooperative and non-cooperative solutions, while net benefits decrease.

The benefit valuation data used is based on Gren's (2001) benefit transfer of the results given in Söderqvist (1996; 1998) and Markowska and Żylicz (1996). The total benefits for the Baltic Sea drainage basin are estimated to be 31 000 MSEK

(2001). This is linearly transformed to damage function of 50% nitrogen loads reduction (550 000 Mg N) following Gren et al. (1997a). The estimated costs are given in table PL.5.

Table PL.5. Marginal costs of nitrogen loads reduction.

Region	Nitrogen emissions [Tg N]	National own impact	Deposition on coast	Marginal cost of reduction [SEK/kg N]
Wisia	145	0.15	54	0-2233
Odra	84	0.15	48	0-2232
Polish coast	28	0.15	43	0-1116

The maximum benefits from nitrogen reductions under cooperative solutions for different risk aversion magnitude (b coefficient) are given in table PL.6 below.

Table PL.6. Maximum net benefits of Poland under cooperative and non-cooperative (Nash) solutions

	b=0		b=0.0001		b=0.001	
	Reduction [%]	Net benefit [MSEK / year]	Reduction [%]	Net benefit [MSEK / year]	Reduction [%]	Net benefit [MSEK / year]
Cooperative solution	48	1 264	46	1 435	47	289
Nash solution	5	48	4	39	4	-38

Review of existing data on goods and services

a. Study reference:

Węśławski et al. (2006)

b. Environmental focus of the study and to what ecosystem service(s) this focus is related:

Mineral resources, biological resources and other resources such as space for wind farms, recreation, defence. Estimates are related to food, inedible resources and recreation.

c. Extent of environmental change:

No environmental change valued.

d. Study area and study population/industry:

Polish Exclusive Economic Zone.

e. Valuation method:

Biological valuation methods based on recommendations from a workshop at Gent University held in December 2004, mostly productivity valuation method (PM).

f. Economic measure(s):

No explicit economic measures; some values seem to be based on revenues related to exploiting specific resources (PM).

g. Estimated values of the economic measure:

See below.

h. Any other especially interesting piece of information:

The paper provides a compilation of data and information coming from different sources, sometimes “grey literature” or discussions during workshops, related to goods and services provided by so-called Polish Exclusive Economic Zone (EEZ), i.e. the shallow part of the Southern Baltic equivalent to approximately 10% of the terrestrial area of Poland. The paper focuses on biological assessment – uniqueness and richness of biodiversity – rather than on a market value. Several estimates of value of goods and services are provided – see table PL.7.

Table PL.7. Estimates of the value of goods and services provided by the Polish EEZ according to Węśławski et al. (2006)*

Goods/services	Valuation method	Estimated value
Gravel and sand	PM	1 MEUR/year
Crude oil	PM	75 MEUR/year
Amber	PM	20 MEUR/year
Commercial fishery	PM	60 MEUR/year
Inshore fishery	PM	10 MEUR/year
Space for wind farms	HPM (??)**	500 MEUR/year

*EUR²⁰⁰⁶ estimates

** in the text, the estimated value of 500 MEUR/year is linked to the earmarked investments, while HPM is abbreviated earlier as Hedonic Price Method

The paper lists numerous other goods and services related to the Polish Baltic Sea coast together with potential methods of valuation, however without estimates. Also, assessment of the labour market related to the Sea is provided, i.e. the number of workers employed in different sectors.

A general impression about the estimates provided in this paper is such that they do not seem to be very robust. No empirical studies with appropriate references are mentioned. For some estimates, such as “space for wind farms”, it is not clear what method has been used. The values for fishery are linked to “landings”, which probably means that the authors meant revenues. The value for amber, on the contrary, is linked to the number of jobs created in this sector, thus the estimate was probably based on multiplying the estimated number of jobs in the sector by an average salary. These observations lead to a conclusion that the paper, although very broad and interesting in its description of different value categories and their possible valuation, should not be treated as a reliable source of estimates.

Other quantitative studies

Several other quantitative studies and research projects conducted in Poland were identified, however since they did not monetize benefits or costs of changes in the Baltic Sea environment they are only listed below for their future more detailed review and potential use in other subprojects.

The two major research institutions focusing on chemical, biological and ecological analysis of the Baltic Sea are:

- Uniwersytet Gdański – Wydział Biologii, Geografii i Oceanologii
- [Gdansk University – Department of Biology, Geography and Oceanology]
- <http://www.bgo.ug.gda.pl/>
- Instytut Oceanologii PAN
- [Institute of Oceanology of the Polish Academy of Sciences]
- <http://www.iopan.gda.pl/>

The examples of relevant research projects, studies and papers are given below:

- Atmosferyczny dopływ związków azotu, fosforu i żelaza w świetle eutrofizacji Basenu Gdańskiego [Atmospheric Deposition of Nitrogen, Phosphorus and Ferric Compounds in the Light of the Gdansk Bay Eutrophication]
- Śmiertelność ptaków wodnych na polskim wybrzeżu Bałtyku na skutek zanieczyszczeń ropopochodnych [Mortality of Birds on Polish Coast as a Result of Oil Pollution]
- Badania toksyczności zakwitów sinic w środowisku bałtyckim i rejonach przymorskich [Study of Toxicology of Cyanoses Blooms in the Baltic Sea Environment and Coastal Regions]
- Substancje biogeniczne w osadach Zatoki Pomorskiej i Gdańskiej [Biogenic Substances in the Gdansk Bay Sediments]
- Model rozwoju bioróżnorodności planktonu bałtyckiego w warunkach przewidywanych zmian globalnych klimatu na przykładzie wód przybrzeżnych Zatoki Gdańskiej [Model of the Development of Biodiversity of the Baltic Sea Plankton due to Expected Global Climate Changes, Example of Gdansk Bay]
- Przenoszenie zanieczyszczeń organicznych do Bałtyku w obszarze ujścia Odry [Transport of Organic Pollutants to the Baltic Sea in the Region of Odra Estuary]
- Model bilansu wodnego Morza Bałtyckiego [Water Balance model of the Baltic Sea]
- Dynamika wód wlewowych w Bałtyku Południowym [Dynamics of Inlet Waters of the Southern Baltic Sea]
- Badania wpływu warunków hydrometeorologicznych na stan zanieczyszczenia chemicznego i biologicznego strefy brzegowej Południowego Bałtyku [Effects of Hydro-meteorological Conditions to

the Chemical and Biological Pollution of Coastal Waters of the Southern Baltic Sea]

- Model dynamiki wód polskiego wybrzeża Bałtyku. Rola prądów wstępujących w wymianie wód [The Model of Dynamics of Polish Baltic Coastal Waters. The Importance of Ascending Currents in Water Exchange]
- Meissner, W. (2005). "Ptaki jako ofiary zanieczyszczeń mórz ropą i jej pochodnymi" [Birds as Victims of Oil Pollution of the Baltic Sea], *Wiadomości Ekologiczne* [Ecological News] 51: 17-34, Poland
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Conclusions

There have been only a limited number of studies aiming at valuing changes in the Baltic Sea environmental conditions, see also table PL.8. All of the studies estimated the value of improvement of the Baltic Sea to some more favourable condition. The use of stated preference methods allows to interpret the results as valuing recreational (use) as well as non-use services.

The available empirical results are quite old however. The methodological development of SP methods as well as transitions in Polish society and economy require that the results are considered heavily outdated. What is more, the scope of environmental change, described in the scenarios of the valuation exercises, does not transfer directly to any particular programme of reduction of nutrient loads. Finally, there have been no attempts to disaggregate the values to numerous services the Baltic Sea can provide. Despite these obvious shortcomings the results seem to be extensively used in numerous applications and policy analyses.

There seems to exist a necessity for a new, large-scale valuation study. The valuation exercise should be based on the description of expected changes due to a feasible, probably international programme. If possible the uncertainty about the re-

sults should be incorporated into the exercise (e.g. presented to the respondents of stated preference studies in an understandable way). Possibilities of estimating the value of services separately should be considered, avoiding double-counting however. Selected approaches are given below:

- Non-use values of improved Baltic Sea conditions (environment, well being of species, biodiversity, oil pollution risk reduction and other difficult to otherwise value services) could be estimated by choice experiments. The relative advantage of CE over CVM is its ability to value each of the attributes separately and non-linearly. Conducting a large-scale CE exercise addressing most of non-use services at once would reveal their relative importance to the respondents avoiding double counting, which might occur if separate CVM studies of each service were employed.
- Recreational services of improved Baltic Sea conditions could be estimated employing travel cost method and hypothetical questions (choice experiments?), to estimate changes in compensating variation of the Poles over the decades.
- Impacts on fish stock and catch could be estimated using market price approach.
- Biodiversity changes could be alternatively valued using 'Potentially Disappeared Fraction'.

Finally synergies with the ExternE project series (EU framework programs, <http://www.externe.info>) should be investigated for valuation of eutrophication and acidification of marine ecosystems due to air depositions.

As evident from our survey, Polish valuation studies were carried out – mainly in the 1990s – in compliance with the relevant recommendations on stated preference surveys. Thus they can be regarded as state-of-the-art analyses (of their time). In fact, they were used in a number of international reviews thus confirming their adequacy. The recent progress in valuation methodologies is, however, quite remarkable which limits the validity of previous findings. In particular, the following extensions and revisions can be of interest for any future Baltic-wide evaluation studies.

1. Separating benefits from reduced Baltic Sea eutrophication into components related to specific services provided by the sea ecosystems (that depend, *inter alia*, on the level of eutrophication). Applying traditional contingent valuation questionnaires did not allow for such a separation. Modern surveying techniques – including choice experiments – do allow for breaking the total WTP into "prices" that people separately attach to specific attributes. These estimates may prove useful for choosing best abatement policy scenarios.

2. The most recent valuation studies carried out in Poland (cf. Czajkowski, 2008) show the way how to tackle "scope", "embedding" and "warm glow" effects that proved so cumbersome in earlier stated preference surveys. Our studies seem to demonstrate that people tend to evaluate not only the physical attributes of a surveyed good, but also certain ideas attached to it. Thus not only abatement policy scenarios, but perhaps even abatement policy mixes can be of interest. It would be useful to design future studies to explicitly account for not only the final outcome, but also for what sea protection measures (e.g. wetland restoration, improved fertilizers, tertiary treatment etc.) are envisaged.

Table PL.8. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	
	S2	Primary production	
	S3	Food web dynamics	
	S4	Diversity	
	S5	Habitat	
	S6	Resilience	
Regulating services	R1	Atmospheric regulation	
	R2	Regulation of local climate	
	R3	Sediment retention	
	R4	Biological regulation	
	R5	Pollution control	All four empirical studies within the Baltic Drainage Basin Project and one surface water quality study.
	R6	Eutrophication mitigation	All four empirical studies within the Baltic Drainage Basin Project and one surface water quality study.
Provisioning services	P1	Food	One study (on surface water quality).
	P2	Inedible resources	
	P3	Genetic resources	
	P4	Chemical resources	
	P5	Ornamental resources	
	P6	Energy	
	P7	Space & waterways	
Cultural services	C1	Recreation	All four empirical studies within the Baltic Drainage Basin Project and one surface water quality study.
	C2	Aesthetic value	All four empirical studies within the Baltic Drainage Basin Project and one surface water quality study.
	C3	Science & education	
	C4	Cultural heritage	All four empirical studies within the Baltic Drainage Basin Project and one surface water quality study.
	C5	Inspiration	
	C6	The legacy of nature	All four empirical studies within the Baltic Drainage Basin Project and one surface water quality study.

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Annex VIII. Russia

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Introduction

Two Russian regions have access to Baltic Sea – Leningradskaya oblast (or St.-Petersburg, Gulf of Finland) and Kaliningradskaya oblast. While there are several research centers in Russia that study, monitor and model the ecological and biological situations both in the sea and in the coastal areas we failed to find any reports that provide the economic valuation of the benefits due to policy measures that related to the cleaning of Baltic sea. We found only one report that estimate the economic value of biological assets in this region (on Kurshskaya spit). This reflects the overall situation in Russia with economic assessments of natural resources and policy impact evaluations.

Findings

Inferences for Russia from international studies on Baltic Sea

INFERENCE FOR RUSSIA FROM *THE BALTIC DRAINAGE BASIN PROJECT*

Reference: Markowska, A. and T. Zylicz, 1999. Costing an international public good: the case of the Baltic Sea. *Ecological Economics*, 30, 301-316

Environmental focus: Recreational and non-use services (C1).

Extent of environmental change: Reduction of the Baltic Sea eutrophication back to the level from the 1950s, 10-year international actions.

Valuation method: CVM (open-ended format question) survey, face-to-face interviews of 1002 randomly selected Lithuanians. The Lithuanian WTP was extrapolated to Russia using ratios of the Lithuanian GDP to Russian GDP

Economic measure: Compensating variation, per person per year.

Estimated values of the economic measure: 38 USD¹⁹⁹⁴ / adult person per year = 31 EUR²⁰⁰⁷ and aggregate value is 276 MUSD¹⁹⁹⁴ = 262 MEUR²⁰⁰⁷

Any other especially interesting piece of information: Extrapolation was obtained by assuming that within each of the groups of countries (sub-regions) WTP (willingness to pay) is proportional to GDP per capita at Purchasing Power Parity (PPP). However the authors indicate that “Russian WTP estimated in our study

could have been overestimated” because of large difference between nominal GDP and GDP in PPP.

INFERENCE FOR RUSSIA FROM INTERDISCIPLINARY STUDY WHICH FOCUSED ON N AND P FLUXES ON A DRAINAGE BASINS-WIDE SCALE IN THE BALTIC REGION

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

Environmental focus: Recreational and non-use services (C1).

The study of costs of a range of abatement options and benefits of 50% N and P load reduction policies in the Baltic Sea area.

The marginal costs of different measures to reduce N and P loads in two Russian regions with Baltic Sea access are given in table RU.1 below.

Table RU.1. Marginal costs of N and P reductions by different measures (SEK/kg of N and P reduction, respectively).

Pollutant	Region	Agriculture	Sewage treatment plants	Air deposition	Wetlands
N	St-Petersburg	43-236	7-35	353-1 884	51
N	Kaliningrad	28-210	7-35	273-1 593	43
P	St-Petersburg	230-4 314	20-100		823
P	Kaliningrad	338-4 290	20-100		545

The cost effective mix of measures of all Baltic countries for 50% N loading reduction was estimated to consist of 35% reduction due to agriculture, 28% due to wetlands, 31% due to sewage treatment plants and 6% due to air emissions. Of this Poland, Russia and the Baltic states account for 72% of the total N reduction.

In the corresponding mix for P reduction the sewage treatment plants were a major element (66%). The Baltic States, Poland and Russia together account for approximately 90% of the total P reduction.

The estimates of benefits are from Georgiou et al. (1995). Results with respect to willingness to pay for Russia are extrapolated from the Polish mail survey. The valuation scenario – a reduction of the eutrophication to a level the Baltic Sea can sustain – was not corresponding to any specific nutrient reduction target, although authors refer to 50% reduction (after Helsinki Commission) and the 20 year time horizon.

Estimated values of the economic measures for Russia: Average WTP per person from 461 SEK¹⁹⁹⁵ = 59 EUR²⁰⁰⁷ (if non-respondents are considered to have WTP=0) to 909 SEK¹⁹⁹⁵ = 116 EUR²⁰⁰⁷, total benefits 3 340-6 585 MSEK¹⁹⁹⁵ = 426-841 MEUR²⁰⁰⁷ in the first year and the present value for the 20-year period to be 55 384 – 69 761 MSEK¹⁹⁹⁵ = 7 080- 8 915 MEUR²⁰⁰⁷.

The estimated cost effective program of 50% overall Baltic Sea N load reduction (which imply the reduction of Russian N loads by 44%) involved the following estimates:

Costs: 586 MSEK¹⁹⁹⁵ = 75 MEUR²⁰⁰⁷ / year,

Benefits: 1 769 – 3 488 MSEK¹⁹⁹⁵ = 226- 445 MEUR²⁰⁰⁷ / year

Net benefit: 1 183-2 902 MSEK¹⁹⁹⁵ = 151- 370 MEUR²⁰⁰⁷ / year

This study, combined with other findings relating to the importance of the spatial location of nutrient loading, indicates that N reduction measures in the Polish and Russian coastal zone areas would be disproportionately effective.

VALUE OF LAND AS A POLLUTANT SINK FOR INTERNATIONAL WATERS

Reference: Gren, I.-M., 1999. Value of land as a pollutant sink for international waters. *Ecological Economics*, 30, 419-431.

Environmental focus: Eutrophication mitigation (R6) and fish resources (P1).

Russian drainage basin area is estimated to be 328.4 thousand sq. km (from Sweitzer et al. (1995)), Russian N load 35 thousand tons of N per year, marginal costs of land as sink 14-113 SEK per kg of N and other marginal costs 0.1-1500 SEK per kg of N (from Gren et al. (1997), lowest-decrease in nitrogen fertilizers use and cleaning capacity at sewage treatment plants, highest - reduction in air emissions), marginal benefits 12.4 SEK per kg of N (from Markowska and Zylicz, 1996, extrapolation to Russia from Poland survey).

The study analyzes values of marginal change in the area of particular types of land as a pollutant sink under four frameworks, both international coordination and national policies. The following policies are considered:

- maximization of international net benefits (IB)
- maximization of national net benefits (NB)
- minimization of international costs for a 50% total N reduction (IC)
- minimization of costs for a 50% national N reduction (NCs)

The estimated marginal values of increased area of land types in Russia, under different policy contexts, are given in table RU.2 below.

Table RU.2. Marginal values of increased area of land types in Russia

Policy framework:	Optimal N reduction	Net benefits MSEK ¹⁹⁹⁵	Net benefits MEUR ²⁰⁰⁷	Wetlands SEK ¹⁹⁹⁵ /ha	Wetlands EUR ²⁰⁰⁷ /ha	Catch crops SEK ¹⁹⁹⁵ /ha	Catch crops EUR ²⁰⁰⁷ /ha
IB	46 %	842	108	90	11	0	0
NB	11 %	31	4	0	0	0	0
	Optimal N reduction	Net costs MSEK ¹⁹⁹⁵	Net costs MEUR ²⁰⁰⁷	Wetlands SEK ¹⁹⁹⁵ /ha	Wetlands EUR ²⁰⁰⁷ /ha	Catch crops SEK ¹⁹⁹⁵ /ha	Catch crops EUR ²⁰⁰⁷ /ha
IC	52 %	1 373	175	1 970	252	10	1.3
NCs	50 %	493	63	140	18	0	0

National studies

STUDY ON KURSHSKAYA SPIT

Reference: Economic evaluation of biodiversity of National park “Kurshskaya spit”, Kaliningrad regional public Fund “21st century”
(http://www.biodat.ru/index_e.htm)

The Kurshskaya spit is a 98-kilometer peninsula (out of which 48 kilometers is the Russian part and the rest is the Lithuanian one) which width ranges from 400 to 4 000 meters. The spit separates the shallow-water lagoon Kurshskiy bay from the Baltic Sea. The Kurshskiy bay is very rich in fish resources.

The Kurshskaya spit National Park is one of the most unique national parks in Russia. The park square is 6 621 ha, the square of water area in the protected zone is 9 800 ha. Its west boundary lies along the coast of the Baltic Sea and the east one lies along the Kurshskiy bay. 72 percent of its territory is covered by forests with very diverse flora (around 600 species) and fauna (around 300 species). Kurshskaya spit serves as an important bird migration post with around 150 bird species crossing it on their way from South Europe to North Africa.

The project aimed at the estimation of economic values of various services provided by the spit and the bay was carried out by Kaliningrad regional public fund “21st century” and financed by Global Environment Facility grant in 2002.

Below is the short summary of the approaches and the results.

Environmental focus: fish resources of Kurshskiy bay (P1)

Valuation method: Direct market value (income and costs difference) of commercial and recreational fishery in the Russian part of the bay over a 100 years time period, discount rate 3%. The catch volume was forecasted based on the past data

(see table RU.3 below) and taking into account the economic and legal improvements in fishery infrastructure.

Estimated value of fish resources (P1) in the bay over 100 years: 970 MRUB¹⁹⁹⁹ = 75 MEUR²⁰⁰⁷

Table RU.3. Catch dynamic in Russian part of Kurshskii bay

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Catch volume, tonnes	3785.7	3923.3	2944.8	2269.4	2459.9	2971.9	3691.4	4658.8	3994.8	2218.5

Environmental focus: recreational resources (C1)

Valuation method: Consumer surplus, park visitors' survey in February 2000. Willingness to pay was approximated by the actual costs of visit. Two methods of consumer surplus evaluation were exploited.

In the first approach the visitors were grouped according to the distance they need to travel to get to the park: visitors from Zelenograd (city right near the spit) region, from the rest of Kaliningrad oblast, from Moscow and other Russian cities and foreigners. The actual average costs of the visit of the representatives of the group were used as proxies for the marginal costs of the visit of the average representative of the next group. Table RU.4 shows the frequency of visits, costs and consumer surplus of the representatives of various groups.

Table RU.4. Visits, costs and consumer surplus of different groups of visitors.

Zone	Number of visits per person per year	Average costs of visit, RUB ¹⁹⁹⁹ per person	Consumer surplus, RUB ¹⁹⁹⁹ per person	Number of visitors per year (from park's authority)
Zelenograd region	26	240	67	1 769
Kaliningrad oblast	7	307	118	33 609
Moscow and the rest of Russia	4	425	2 775	7368
Germany and other foreign countries	1	3 200		13 755

The second approach to estimate the consumer surplus was based on the desegregation of visitors by three income groups. The average costs of visit are estimated for each income group. Then the difference between the average costs within the group and the average cost of the highest income group is used as a measure of consumer surplus for each person within the income group.

The structure of the surveyed sample and the corresponding parameters is presented in table RU.5 below.

Estimated value of recreational resources (C1) of the park: 22 – 38 MRUB¹⁹⁹⁹ per year = 1.7-2.9 MEUR²⁰⁰⁷ per year.

Table RU.5. Characteristics of different income groups.

Average per capita income, RUB ¹⁹⁹⁹ per month	Share of the surveyed sample	Average period of stay, days per year	Average costs of visit, RUB ¹⁹⁹⁹ per person	Consumer surplus, RUB ¹⁹⁹⁹ per day per person
less than 500	12.3	7	76	232
500-1000	33.3	11	186	122
above 1000	54.4	23	308	0

Environmental focus: forest resources (R1, P1, P2, P6)

Valuation method: Direct consumption of timber (for energy (P6) and industrial use (P2), direct consumption of berries, mushrooms etc (P1) and indirect value of CO₂ absorption (R1)

Both legal and illegal use of timber was evaluated based on the survey of local households.

Indirect evaluation of forests as a source of CO₂ absorption is based on the average parameters of biological absorption ability of coniferous and deciduous forests: 20-25 tones of CO₂ per hectare or 5-5.5 tones of carbon per hectare. The price of 1 ton of carbon was estimated at 10 USD¹⁹⁹⁹. The overall forest area at the spit is equal to 4 409 hectares.

Estimated value of forest resources in the region: 208 MRUB¹⁹⁹⁹ per year = 16 MEUR²⁰⁰⁷ per year out of which:

- Forest as source of fuel (P6): 316 kRUB¹⁹⁹⁹ per year= 24 kEUR²⁰⁰⁷ per year
- Forest as source of industrial timber (P2): 1.04 MRUB¹⁹⁹⁹ per year = 80 kEUR²⁰⁰⁷ per year
- Forest as a source of food (P1): 1.3 kRUB¹⁹⁹⁹ per year = 100 EUR²⁰⁰⁷
- Forest as source of CO₂ absorption (R1): 205.7 MRUB¹⁹⁹⁹ per year= 15.8 MEUR²⁰⁰⁷ per year

*Environmental focus: overall evaluation of ecosystem services
(C2+C3+C4+C5+C6)*

Valuation method: Willingness to pay to preserve the clean Kurshskaya spit as a unique natural park. 405 people were surveyed in February 2000, out of which 204 local people, 97 people from Kaliningrad and 104 other visitors.

More than 60% of surveyed local people and 97% of visitors believe that there is an immediate threat to the existence of the spit and urgency actions need to be undertaken. The willingness to pay (WTP) in monetary and non-monetary (to spend some leisure time) terms was revealed in iterative auctions. Table RU.6 below reports the results.

Estimated value (C2+C3+C4+C5+C6): 9.6 MRUB¹⁹⁹⁹ per year = 0.7 MEUR²⁰⁰⁸ per year.

Table RU.6. Estimates of the WTP for preserving the clean Kurshskaya spit as a unique national park.

Group of population	WTP in monetary terms, thous. RUB ¹⁹⁹⁹ per year	WTP in non-monetary terms		WTP total, kRUB ¹⁹⁹⁹ per year
		person-days per year	kRUB ¹⁹⁹⁹ per year	
Local population	9.4	3 306	38.4	47.8
Population of Kaliningrad	5 214.2	---	---	5 214.2
Other visitors	3 182.9	68 350	1 237.1	4 420.0

STUDY ON KOPORSKAYA BAY OF A GULF OF FINLAND

This study and the studies summarized below have evaluated the losses due to man's impact on the natural resources of Russian part of Baltic Sea.

Reference: Bodrov O. (2005) "Main sources and factors of man's impact on the natural resources of Gulf of Finland south coast",
<http://baltfriends.ru/rus/ourvalue/ohv06.htm>

Environmental focus: Fish resources (P1).

Valuation method: Direct market value of killed traumatized fish in the diversion facilities of Leningradskaya nuclear plant.

The fish losses are estimated to be from 300 tonnes to 1000 tonnes per year. Estimated value of lost fish resources (P1): 1.9 MEUR²⁰⁰⁷ per year.

STATE APPROVED METHODOLOGY FOR ESTIMATION OF AVERTED ECOLOGICAL HARM DUE TO STATE ECOLOGICAL CONTROL

Reference: Instruction of State committee on wild life conservation, March 9, 1999.

Environmental focus: Water pollution damage (R4??, P1??).

Water pollution damage is defined as material and financial losses (direct and indirect) as a result of decrease in biological productivity of water ecosystems, deterioration of consumption characteristics of water as natural resource, additional expenses to eliminate the pollution effects and to restore the water quality, and the monetary estimates of public health harm as well.

Valuation method: Expert and analytical evaluation (details are not revealed).

Estimated values of specific ecological harm due to water pollution are presented in table RU.7.

Table RU.7. Estimated values of ecological harm due to water pollution.

Region	Reduced value of pollution mass, thousand of conventional tonnes	Losses due to water pollution, MRUB ¹⁹⁹⁸	Losses due to water pollution, MEUR ²⁰⁰⁷
Gulf of Finland	281.90	2 169.68	228
Russian territorial waters of Baltic sea in Kaliningradskaya oblast	71.73	479.02	50

The derived specific loss due to water pollution was as follows:

- Gulf of Finland: $7\,510.1 \text{ RUB}^{1998} = 788 \text{ EUR}^{2007}$ per conventional ton of pollutant
- Russian territorial waters of Baltic Sea in Kaliningradskaya oblast: $6\,680.9 \text{ RUB}^{1998} = 701 \text{ EUR}^{2007}$ per conventional ton of pollutant.

Those measures of derived specific losses are recommended for further estimation of averted ecological harm due to state ecological control. For this the changes in reduced value of pollution mass due to state ecological control should be estimated in the following way:

Change (Δ) in reduced value of pollution mass = $\sum_{\text{over all pollutants } i} (\Delta \text{ in pollutant mass}_i \text{ due to state control/maximum concentration limit of pollutant}_i)$

LOSSES DUE TO NORD STREAM PIPELINE CONSTRUCTION

Reference: Short summary of the draft estimations of the environmental impact of Russian part of sea gas pipeline NORD STREAM. Prepared by Nord Stream AG in 2007 (in Russian). Weblink: http://www.nord-stream.com/fileadmin/Dokumente/ru/Rus_Preliminary_EIA/Preliminary_EIA-071017.pdf

Environmental focus: P1, P2, P7 ??

Nord Stream is a gas pipeline to link Russia and the European Union via the Baltic Sea. Nord Stream will transport up to 55 billion cubic metres of gas each year.

The paper points out various negative effects due to Nord Stream pipeline construction and exploitation. The paper stresses that the potential ecological losses will be incurred only during construction period and most of them will be reversible. The exploitation of the pipeline assumed to be very safe. The only economic evaluation of the ecological losses due to pipeline construction the paper provides are the official environmental payments the project will pay to Russian authorities. Those payments will include:

- payments for nature management (exploitation of water resources)
- payments for environmental pollution
- payments to compensate unavoidable fauna losses

Estimated payments of the project in its current state for Russian part of the pipeline construction is $71.5 \text{ MRUB}^{2007} = 2.2 \text{ MEUR}^{2007}$.

ECOLOGICAL LOSSES DUE TO CONSTRUCTION OF FERRY TERMINAL IN BALTIISK

Reference: Environmental impact evaluations of Baltic sea ports' development, Kaliningrad. EBRD December 2003. Weblink: http://www.mintrans.ru/pressa/EIA_Baltiysk_FinalReport_AI-V.pdf (in Russian).

Environmental focus: Not specified.

The ferry terminal in Baltiisk is a part of the ferry complex Ustj-Luga – Baltiisk – Germany is implemented by Ministry of Transportation of Russia Federation and financed by the European Bank for Reconstruction and Development (EBRD).

The paper describes the characteristics of the terminal and discusses the potential environmental losses. Methodology is not described and we failed to find more comprehensive references for the estimated losses.

Evaluation method: Averted ecological harm due to construction of water treatment plant at ferry terminal

Estimated benefits: $392.35 \text{ kRUB}^{1999} = 30 \text{ kEUR}^{2007}$ per year (at the same time the ecological losses due to ferry construction is estimated $15.639 \text{ MRUB}^{2002} = 700 \text{ kEUR}^{2007}$).

EVALUATION OF AVERTED ECOLOGICAL LOSSES DUE TO SUBMERGED SHIPS' SALVAGING

Reference: Report "International audit of wild-life conservation in Baltic region" by Audit Chamber of Russian Federation. Weblink: <http://www.ach.gov.ru/>

Environmental focus: Not specified.

This is an official report by Audit Chamber of Russian Federation and it does not discuss research details and methodology. The report addresses the averted ecological harm due to more than 60 submerged ships' salvaging over 1997-1999.

Estimated benefits: $170 \text{ MRUB}^{1999} = 13 \text{ MEUR}^{2007}$

Conclusions

Because of the non-existence of market economic tradition in Russia it is not surprising that we failed to find any national studies aimed at economic assessments of natural resources and environmental policy impact evaluations. There are some partial improvements over last ten years. Most of the commercial projects that present an environmental threat tend to provide the economical and ecological assessment of their implementation. This is especially the case when the projects are financed by international organizations. Still there is a tendency to equate the environmental losses caused by the project with the value of environmental taxes the project should pay in the budget.

While there are a number of sociological, ecological and economic think tanks nowadays in Russia there were no coordinated cost-benefit analyses of environmental policies. In our view there are three crucial moments that define the substantial knowledge gap in Russia in this respect:

- Shortages of data, both for benefit and cost analyses. Besides the one research project on Kurshskaia spit we did not find any studies in Russia that aimed at the evaluation of consumer surplus due to consumption of ecosystem services. As far as the cost side is concerned most of analysis refers to state-approved methodologies which rationality is not clear.
- Shortage of trained environmental economists.
- Lack of coordination among existing ecological, sociological and economic research centres. Insufficient international cooperation.

Table RU.8 below summarizes our findings with respect to the present state of economic assessment of environmental policies aimed at the improvement of Baltic Sea ecosystem's provision of goods and services in Russia.

Table RU.8. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	No studies found.
	S2	Primary production	No studies found.
	S3	Food web dynamics	No studies found.
	S4	Diversity	No studies found.
	S5	Habitat	No studies found.
	S6	Resilience	No studies found.
Regulating services	R1	Atmospheric regulation	One study found which refer not to the Baltic Sea itself but rather to the forest resources in coastal area of Baltic Sea
	R2	Regulation of local climate	No studies found.
	R3	Sediment retention	No studies found.
	R4	Biological regulation	Some data were found in the state approved methodology
	R5	Pollution control	No studies found.
	R6	Eutrophication mitigation	One international study provides extrapolation for Russia
Provisioning services	P1	Food	One international study provides extrapolation for Russia. One national study evaluates fish resources in small part of Russian coastal area of Baltic Sea. Partial evaluation of fish resources is done in two more national studies. State-approved methodology claims to incorporate the fishery resources.
	P2	Inedible resources	One study found which refers not to the Baltic Sea itself but rather to the forest resources in coastal area of Baltic sea
	P3	Genetic resources	No studies found.
	P4	Chemical resources	No studies found.
	P5	Ornamental resources	No studies found.
	P6	Energy	One study found which refers not to the Baltic Sea itself but rather to the forest resources in coastal area of Baltic sea
	P7	Space & waterways	Two national papers present some figures evaluating the environmental losses due to changes in the waterways service provision.
Cultural services	C1	Recreation	Two studies found: one study is extrapolation from the international studies and the second is the authentic Russian study which refers however to a very small part of Baltic coast in Russia
	C2	Aesthetic value	One study estimates WTP for use of all this services in small part of Russia coast of Baltic Sea
	C3	Science & education	
	C4	Cultural heritage	
	C5	Inspiration	
	C6	The legacy of nature	

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Environmental impact evaluations of Baltic sea ports' development, Kaliningrad. EBRD December 2003. [Оценка воздействия на окружающую среду. Проект развития балтийских портов (Калининградский компонент). Итоговый отчет (Приложения I-V) Декабрь 2003] Weblink http://www.mintrans.ru/pressa/EIA_Baltiysk_FinalReport_AI-V.pdf

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International audit of wild-life conservation in Baltic region by Audit Chamber of Russian Federation [Отчет о результатах проверки "Международный параллельный аудит охраны окружающей среды района Балтийского моря (на основе Хельсинкской Конвенции) в части участия Счетной палаты Российской Федерации"] Weblink: <http://www.ach.gov.ru/>

Short summary of the draft estimations of the environmental impact of Russian part of sea gas pipeline NORD STREAM. Nord Stream AG, 2007 [Краткое изложение предварительного варианта материалов по ОВОС (оценке воздействия на окружающую среду) российской секции морского газопровода Nord Stream] Weblink: http://www.nord-stream.com/fileadmin/Dokumente/ru/Rus_Preliminary_EIA/Preliminary_EIA-071017.pdf

Annex IX. Sweden

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Introduction

This paper attempts to summarize the studies made this far on valuation of ecosystem services in the Swedish parts of the Baltic Sea. The report covers studies from the databases EVRI (Environmental Valuation Reference Inventory³⁵), NEVD (Nordic Environmental Valuation Database³⁶), and ValueBase^{SWE37}. It also covers later studies, found through contacts with research organizations, universities and governmental agencies. Hopefully, this report is thus complete in terms of what has been done on valuing environmental change in the Swedish parts of the Baltic Sea. As mentioned in chapter 1 of this report, the scope of valuation methods subject for being included is broad.

Monetary amounts are recalculated to EUR²⁰⁰⁷, using Mean Year Consumer Price Indexes from Statistics Sweden and the exchange rate valid 1 Jan 2008.

This country report is disposed as follows: In the next section, entirely Swedish studies are first presented, related to *invasive species* (one study), *eutrophication* (five studies), *fisheries* (five studies), *oil and marine debris* (five studies), *windmill parks* (two studies) and *other/several areas* (three studies). Subsequently, three studies with results for all Baltic Sea countries are summarized. The country report is concluded by a discussion on what has been done, and which are the most important knowledge gaps.

³⁵ www.evri.ca

³⁶ <http://www.norden.org/pub/miljo/miljo/sk/TN2007518.pdf>

³⁷ <http://www.beijer.kva.se/valuebase.htm>

Findings

Swedish studies

INVASIVE SPECIES

Gren I-M., Isacs L., Carlsson M., 2007. Calculation of costs of alien invasive species in Sweden – technical report. Working Paper Series 2007:7. Swedish University of Agricultural Sciences (SLU), Department of Economics, Uppsala ISSN: 1401-4068.

The study focuses on yearly costs of the presence of 13 different alien invasive species in Sweden, both aquatic and non-aquatic. The marine species included in the study are the bay barnacle (*Balanus improvisus*) and the bacteria causing the fish disease Furunculosis (*Aeromonas salmonicidae*).

The bay barnacle is a crustacean with a grey and white lime shell, which fouls on stationary constructions in power plants and ports, and not the least on boats and vessels. The costs of controlling are estimated to 18 MEUR²⁰⁰⁷ – 45 MEUR²⁰⁰⁷ (166 MSEK²⁰⁰⁶ – 419 MSEK²⁰⁰⁶) yearly. The bacteria causing Furunculosis to salmon is suspected to come from the introduction of the rainbow trout to the Baltic. Today, it is controlled through effective use of vaccine and antibiotics. The costs for these measures are estimated to about 0.2 MEUR²⁰⁰⁷ (2 MSEK²⁰⁰⁶) yearly

The ecosystem services valued are thus related to the provision of inedible resources (Bay barnacle fouling on boats and stationary equipment in powerplants) and food (Furunculosis).

EUTROPHICATION

Frykblom, Peter (1998), “Halved Emissions of Nutrients, What are the Benefits? - A Contingent Valuation Survey Applied to Laholm Bay”, in Questions in the Contingent Valuation Method - Five Essays, doctoral thesis, Agraria 100, Department of Economics, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden.

The article presents an estimation of WTP to reduce the nutrient emissions by 50 percent in the Laholm Bay along the Swedish west coast. The estimation was performed as a CVM-study, conducted through a mail survey sent out to 500 randomly selected residents in the communities of Båstad, Halmstad and Laholm, and the concerned ecosystem services values are likely to be focused on aesthetics, recreational values and perhaps the legacy of nature, depending on what is included in the respondents answers. The payment vehicle chosen for the survey was a monthly tax on top of the community income tax. Dichotomous questions were

posed with five different bids; 20, 40, 100, 200 and 250 SEK¹⁹⁹⁸ (2.4, 4.8, 12.0, 24.0 and 30.0 EUR²⁰⁰⁷). The payments in the action plan scenario proposed were to occur each month over a period of twenty years, (and a discount rate of 6 percent was used).

The response rate was 67.4 percent, or 327 individuals. The mean annual WTP was estimated to 90 EUR²⁰⁰⁷ (747 SEK¹⁹⁹⁸), which gives a total annual WTP of 10.8 MEUR²⁰⁰⁷ (90 MSEK¹⁹⁹⁸).

Hasselström, L. Söderqvist T and Malm T. Welfare consequences of a resilient ecological state: the case of filamentous red algae on beaches in Öland, Sweden. in manus 2006.

In the article, an estimation is made of losses in producer surplus in the camping market on the island of Öland along the Swedish east coast, stemming from beaches and shallow sand seabottoms being covered by filamentous red and brown algae. This study relates mainly to topics of (unwanted) resilience, and the cultural services providing aesthetic and recreational values. The algae are removed by camping owners in order to increase the attractiveness of nearby beaches to tourists, which imposes a cost. Telephone interviews on efforts for beach cleaning in the year 2004 were conducted in the summer of 2005 with 24 of 29 active camping companies near beaches on Öland, which gives a response rate of 83 percent. In order to control for strategic behaviour, a specially designed version of the interval method (Bohm 1979, 1984, 1995) was used.

The yearly costs for beach cleaning efforts on Öland are estimated to 10 – 38 kEUR²⁰⁰⁷ (92 000-344 000 SEK²⁰⁰⁵). These costs represent a direct profit-loss to camping producers. The authors argue, however, that these costs only constitute a subset of true losses in producer surplus, since the beaches are still not clean due to (1) producers choose not to clean beaches perfectly as this is too costly and/or (2) it is not practically possible to clean beaches perfectly. A model is developed to take this into consideration. The model uses hedonic pricing, where price is a function of e.g. a beach “cleanliness” variable. A rational camping producer chooses beach cleanliness (and thus the optimal cleaning effort) as to maximize profits, weighing the impact of cleaner beach on price versus cleaning costs. With an assumption of increasing marginal cost of cleaning, no producer will clean the beach to 100 %.

The price on camping is thus, all else equal, still lower in a situation with filamentous algae on beaches than in a situation with no algae. Using the model, this results in a total profit-loss to producers ranging from 10 kEUR²⁰⁰⁷ – 0.7 MEUR²⁰⁰⁷ (0.1 - 6.5 MSEK²⁰⁰⁵), depending on beach cleaning costs and level of beach cleanliness.

Sandstrom, M., 1996. Recreational benefits from improved water quality: A random utility model of Swedish seaside recreation. Working paper series in economics and finance, working Paper No. 121, August 1996, Stockholm School of Economics, Stockholm, Sweden.

Weblink: <http://swopec.hhs.se/hastef/papers/hastef0121.pdf>

The article focuses on cultural ecosystem services of the Baltic Sea, namely the Swedes' recreational benefits of reduced nutrient loads. Two cases are simulated: (1) a 50 % reduction in the nutrient load along the entire Swedish coastline, and (2) a 50 % reduction in the nutrient load in the Laholm Bay in south-west Sweden. Both simulations use the travel-cost method, with travel cost data from the Swedish Tourism and Travel Database, the household production function method, and a random utility maximization (RUM) model. The operative variable used is sight depth. A regression is run of sight depth on the concentrations of phosphorus and nitrogen.

The results are expressed as yearly increases in consumer surplus for the Swedish population due to the better sight depth. In case (1), the increase in consumer surplus per year is estimated to 29 MEUR²⁰⁰⁸ or 65 MEUR²⁰⁰⁸ (240 MSEK¹⁹⁹⁶ resp. 540 MSEK¹⁹⁹⁶), depending on model specifications. In case (2), the corresponding estimations are 1.4 MEUR²⁰⁰⁸ or 3.9 MEUR²⁰⁰⁸ (12 MSEK¹⁹⁹⁶ resp. 32 MSEK¹⁹⁹⁶). The author argues that these results are likely to be biased downwards.

Soutukorva, Å., 2001. A Random Utility Model of Recreation in the Stockholm Archipelago.

Beijer International Institute of Ecological Economics, Discussion paper 135. The Royal Swedish Academy of Sciences, Stockholm.

The paper examines how an improved water quality, defined as increased sight-depth, affects the demand for recreation in the Stockholm archipelago. The valuation is thus related to recreational services. Sight depth is scientifically linked to nutrient concentration, which makes it a usable indicator. In the paper, an empirical link is provided between a hypothetical one-meter-increase in sight depth and resulting changes in consumer surplus for archipelago recreationists.

The author bases the results on two questionnaire surveys carried out in the autumns of 1998 and 1999 on randomly selected respondents in the counties of Stockholm and Uppsala in Sweden. There were 1 840 respondents in the 1998 study, and 1 500 respondents in the 1999 study, which gives response rates of 47.2% and 60 % respectively. In the questionnaires, questions were posed on recreation behavior in the area (number of visits, methods for travelling, type of recreation etc.), and a Random Utility Model (the conditional logit model) was used for regressing visits in the archipelago on mean sight depth, travel cost and communication possibilities by ferry.

The result of the study shows that the recreational benefits from improving the average sight depth in the area are 10 – 307 EUR²⁰⁰⁷ (85 – 273 MSEK¹⁹⁹⁹), depending on model specifications and the value attached to travel time.

The author argues that this might be an understatement, since non-use values are not accounted for.

Söderqvist, T. and Scharin, H, (2000), "The regional willingness to pay for a reduced eutrophication in the Stockholm archipelago", Discussion Paper, no. 128, Beijer International Institute of Ecological Economics, The Royal Swedish Academy of Sciences.

The authors estimate the recreational benefits of reduced eutrophication in the Stockholm archipelago, using an application of the contingent valuation method. Eutrophication is operationalized through sight-depth, which is scientifically linked to the water concentrations of nitrogen and phosphorus. A survey was performed in September 1998 with a sample of 4 000 randomly selected inhabitants in the counties of Stockholm and Uppsala. The response rate was 47.2 %. The survey consisted of background questions, such as number of visits to the archipelago during the summer of 1998, travel methods, age, etc., and it also included one closed-ended and one open-ended question about the willingness to pay for a hypothetical nutrient-abatement programme which would increase the average sight depth in the archipelago with one meter. As a payment vehicle, an increase in expenses due to higher prices of tap water and agricultural products were chosen (in the pilot-study, a tax-increase was chosen, which generated a lot of protest-responses, among other reasons since people believed that it would be difficult to ear-mark the tax money).

The closed-ended question was of "willingness-to-pay-larger-than-zero-or-not"-type. 39 % responded "yes definitely", 44 % responded "yes probably", and 17 % responded "no". In the open-ended question, the results were a mean of 8.5 EUR²⁰⁰⁷ (71 SEK¹⁹⁹⁸) and a median of 6.0 EUR²⁰⁰⁷ (50 SEK¹⁹⁹⁸) per person per month for the abatement programme, when 118 "protesters" had been excluded. Using a conservative assumption, where the respondents who stated "yes probably", are assigned a willingness to pay of zero, the mean is 5.2 EUR²⁰⁰⁷ (43 SEK¹⁹⁹⁸) per person per month.

Aggregating to the population in the counties of Stockholm and Uppsala, these results give the yearly willingness to pay 61 - 101 MEUR²⁰⁰⁷ (506 – 842 MSEK¹⁹⁹⁸).

FISHERIES

Fiskeriverket, 2008. Fritidsfiske och fritidsfiskebaserad verksamhet (Recreational Fishing and Recreational Fishing Dependant Business). Fiskeriverket, Gothenburg, Sweden. Weblink:
http://www.fiskeriverket.se/download/18.323810fc116f29ea95a80001699/Fritidsfiske_web.pdf

In this report from the Swedish Board of Fisheries, one purpose is to evaluate the socioeconomic values of recreational fishing and its dependant businesses. The Board of Fisheries used two large scale surveys; one directed to the public (including recreational fishermen) and one directed to different businesses dependant on recreational fishing. The aim of the surveys was not the least to gather general information, such as how many people go fishing regularly, where do they go, how frequently do they go fishing etc, and what are the characteristics of firms in fishing dependant businesses.

The result from this study is that during 2006, 1 million Swedes between 16 and 74 years old went fishing at least once. The number of fishing days summed to 13.8 million. The largest proportions of recreational fishermen, out of the population, are found in northern Sweden. In total, approximately 18 000 tonnes of fish were caught by recreational fishermen, of which 9 000 tonnes were caught in the Baltic Sea, the Kattegatt and the Skagerrak. The approximately 1 300 firms that are dependent on recreational fishing are mainly small and situated in sparsely populated areas. The total yearly turnover for these firms is estimated to approximately 53 MEUR²⁰⁰⁷ (500 MSEK²⁰⁰⁷).

The study relates to recreational values and the provisioning of food. Regarding the economic effects of recreational fishing in Sweden, questions were posed in the survey relating to the actual costs (for equipment, trips etc.) and the hypothetical WTP for recreational fishing of today's characteristics. Using this information, the authors estimate the consumer surplus to 80 MEUR²⁰⁰⁷ (750 MSEK²⁰⁰⁷) per year. This corresponds to a consumer surplus per kilo fish of approximately 4.2 EUR²⁰⁰⁷ (40 SEK²⁰⁰⁷) per kilo fish. The respondents also answered questions on the WTP for a scenario in which the catch possibilities would double. The WTP for such a scenario was estimated to 60 MEUR²⁰⁰⁷ (570 MSEK²⁰⁰⁷) per year. The scenario would also lead to 3.1 million more fishing days per year. This would result in 400 000 extra days of fishing tourism, which would have large positive effects for fishing dependant businesses.

Olsson, B., 2004. Stated preferences for improved cod stock in Sweden. In: Two Essays on Valuation of Marine Resources: Applications to Sweden. Licentiate of Philosophy Thesis, Department of Economics, Göteborg University.

In the article, the value of an improved cod stock in Skagerrak and Kattegatt off the Swedish west coast is estimated. The cod stock is mainly related to provisioning ecosystem services, such as food and genetic resources, and also to recreational values through the possibilities of recreational fishing for cod. Secondly, the legacy of nature and the possibilities for science and education might be affected.

An increase of the coastal cod stock in the area from the 2001 level to the 1974 level is valued. This change is defined as an increase in the catch per trawling hour from two kilograms to 100 kilograms of cod. The WTP-estimation is made through contingent valuation on a population of 600 respondents randomly sampled from the counties of Västra Götaland and Halland in southwestern Sweden. The author uses two different formats for the valuation: dichotomous choice and open-ended questions. The mean values of an improved cod stock are estimated to 25 – 99 EUR²⁰⁰⁷ (230 – 900 SEK²⁰⁰⁴), depending on the estimation method, and a modest aggregation procedure gives the aggregate willingness to pay 77 MEUR²⁰⁰⁷ (704 MSEK²⁰⁰⁴).

Paulrud A., 2004. Economic valuation of sport-fishing in Sweden – empirical findings and methodological developments. Doctoral thesis. Swedish University of Agricultural Sciences (SLU). Umeå, Sweden.

The doctoral thesis is based on five different papers: I. Paulrud (2004a) “Recreational values of different types of sport-fishing in western Sweden”, II. Paulrud (2004b) “Marginal valuation of improving the catch for sport-fishers”, III. Laitala & Paulrud (2004) “A multi-attribute extension of discrete-choice contingent valuation for valuation of angling site characteristics”, IV. Paulrud & Laitila (2004) “Valuation of management policies for sport-fishing on Sweden’s Kaitum River” and V. Krström et al. (2004) “RUM based models for binary response contingent valuation”.

The first two papers use an empirical study in the county of Bohus in southwestern Sweden, and they serve as an important contribution to this summary of environmental values in the Baltic Sea, by increasing the knowledge on recreational values. The other papers use studies on river- and lake fisheries in the county of Jämtland in northern Sweden, and in the Kaitum River close to the town Kiruna in northern Sweden.

The Bohus-studies were performed through a mail survey with 1 220 responding anglers in the area in 1998. The values for five types of angling were examined; “ordinary” (in lakes), “put and take” (in lakes), “river”, “Coast” and “Guide-boat”. The latter two types are related to the marine environment, and are thus relevant for this summary. The author used two different methods, the Zonal Travel Cost Method (ZTCM) and Contingent valuation (CVM). The results are reported as average Consumer Surplus (CS) in the former case, and Compensating Variation (CV) in

the latter. In both papers, the marginal values of catch (kilos and per number of catches) are calculated. The results are reported in table SE.1 below.

Table SE.1. Results from Paulrud articles I and II.

Method	Type	Average value per fishing day EUR ²⁰⁰⁷ (SEK ¹⁹⁹⁸)	Marginal value per number of catches EUR ²⁰⁰⁷ (SEK ¹⁹⁹⁸)	Marginal value per kilo EUR ²⁰⁰⁷ (SEK ¹⁹⁹⁸)
ZTCM	Coast	7.0 (56)	0.8 (7)	1.1 (9)
	Guide-boat	13.8 (115)	1.2 (10)	1.9 (16)
CVM	Coast	N.A.	0.6 (5)	1.3 (11)
	Guide-boat		1.0 (8)	1.8 (15)

One important conclusion from the paper, also taking into account papers III, IV and V above, is that the marginal value of catch varies substantially between the type of fishing and the location for fishing. The author also suggests more research on benefit transfer, in order to be able to extrapolate the results from these and similar studies in the future.

Soutukorva Å., Söderqvist T., 2005. Gone fishing to the Stockholm-Roslagen archipelago – results from surveys on anglers' travels, catches and habits. Beijer Occasional Paper Series, Beijer International Institute of Ecological Economics, The Royal Swedish Academy of Sciences, Stockholm.

In the article, the economic value of improved recreational fishing conditions in the Stockholm archipelago is estimated. The ecosystem service valued is thus cultural/recreational services. The article also contributes substantially to the literature on methods for valuing recreational fisheries.

Improved recreational fishing conditions are here operationalized as an increase in the catch-rate of perch. Data is collected in two different mail surveys conducted in 2002, which provide information on e.g. travel costs, fishing behavior (e.g. target species) and the respondents' relationship to the archipelago, for a population of sport-anglers (N=500, response rate = 58%) and randomly selected inhabitants (N=2000, response rate =52 %) of the counties of Stockholm and Uppsala. The authors develop a random utility model, regressing the probability that a certain fishing site is visited on catch rate, travel cost and communications.

For a doubled catch, i.e. an increase in the average perch catch per fishing- hour corresponding to 0,8 kilos, the total willingness to pay is estimated to 0.42 MEUR²⁰⁰⁷ (3.7 MSEK²⁰⁰²).

Toivonen, A-L., Appelblad H., Bengtson B., et al., 2000. Economic Value of Recreational Fisheries in the Nordic Countries, TemaNord 2000-604, Nordic Council of Ministers, Copenhagen. ISBN 92- 893-0551-7.

The study reports on willingness-to-pay-studies related to recreational fisheries in Denmark, Finland, Iceland, Norway and Sweden. The study thus focuses on recreational ecosystem services in the Baltic Sea (and rivers and lakes in the Baltic Sea countries).

The results were obtained through a contingent valuation mail survey in all the Nordic countries in 1999, with a sample size of totally 25 000 randomly sampled inhabitants in the countries. The response rate was 45.8 %, varying from 34.2 % in Iceland to 51.3 % in Finland. In the survey, questions were posed on actual recreational-fishing expenses, willingness to pay (as a fee to a local fund) for three scenarios of new recreational fisheries in lakes and streams, and the willingness to pay (through a hypothetical increase in income taxes) for preserving the current fish stocks and the current quality of recreational fisheries in the Nordic countries. The article also provides substantial knowledge about the structure of the recreational fisheries industry in the Nordic countries, regarding who fishes where and when etc.

As an example of the results; the Swedes' annual expenses related to recreational fisheries is 326 MEUR²⁰⁰⁷ (2 730 MSEK¹⁹⁹⁹). Another result is the population's annual willingness to pay for preserving the current state as above. It is estimated in Sweden to 298 MEUR²⁰⁰⁷ (2 500 MSEK¹⁹⁹⁹). However, the shares of these total expenses related to activities the Baltic Sea are not specified, which makes conclusions on the Toivonen et al. study regarding this area difficult.

An important qualitative result: Using only actual expenses is an incorrect measure of WTP for recreational fisheries. A better estimation requires an estimation of the WTP above the actual expenses for active fishermen, and an estimation of WTP for non-active fishermen (which targets non-use values). Results on expenses can, though, be used in calculations of the economic impacts on different industries relating to recreational fisheries.

OIL AND MARINE DEBRIS

I. Forsman B., 2003. Socioekonomiska effekter av större oljepåslag. Förstudie med scenario. [Socioeconomic consequences of major oil spill accidents – Preliminary study including scenario]. SSPA Rapport nr 2003: 3294-1. Räddningsverket, Karlstad.

II. Forsman B., 2006. Socioekonomiska effekter av större oljepåslag – scenariorstudier för Halland, Skåne, Blekinge och Kalmar Län [Socioeconomic consequences of major oil spill accidents – scenario studies for the provinces of Halland, Skåne, Blekinge and the county of Kalmar]. SSPA Rapport nr 2006: 4238-1. Räddningsverket, Karlstad, Sweden.

III. Forsman B., 2007. Socioekonomiska effekter av större oljepåslag – scenariorstudie för Stockholmsregionen [Socioeconomic consequences of major oil spill accidents – scenario study for the Stockholm region]. SSPA Rapport nr 2007: 4478. Räddningsverket, Karlstad, Sweden.

Oil spill relates to supporting services such as e.g. habitats, biodiversity, biochemical cycling and resilience. It also relates to the provisioning of food, genetic and chemical resources and potentially the provisioning of space and waterways. Last but not least, oil spill causes deteriorations in cultural values, such as recreation and aesthetic values.

The following three reports present scenarios in which there is a major oil leakage accident along the Swedish coastlines. The author aims to investigate the different socioeconomic consequences for e.g. the tourist industry and the costs for cleaning. The report series does not investigate potential ecological effects.

Report I above presents a scenario in which 25 000 tonnes of oil leaks into the Baltic along the coast of Bohuslän in Southwestern Sweden, after a collision. 100 000 cubic meters of oil, contaminated water and oil emulsion is taken care of offshore, and massive beach cleaning efforts are carried out.

The economic consequences are the following: The costs for direct cleaning efforts are estimated to approximately 33 – 44 MEUR²⁰⁰⁷ (300 – 400 MSEK²⁰⁰³). The turnover in the tourist industry in the area is reduced by 170 MEUR²⁰⁰⁷ (1 600 MSEK²⁰⁰³) the first year. 4000 people in the industry are likely to become unemployed. The fishing industry suffers from a 5 % reduction in profits, corresponding to approximately 5.5 MEUR²⁰⁰⁷ (50 MSEK²⁰⁰³), fish farms suffer from having to discard 10 % of the Swedish year production, corresponding to a reduced turnover by 1.6 MEUR²⁰⁰⁷ (15 MSEK²⁰⁰³). Recreational fishing in the area is reduced by 50 %. Costs for increased medical/health-care are estimated to 1.6 MEUR²⁰⁰⁷ (15 MSEK²⁰⁰³).

Report II above presents four different scenarios for oil spill accidents in the provinces of Halland, Skåne, Blekinge and the county of Kalmar. In total, these scenarios represent a total of 30 000 tonnes of oil leak, of which 20 000 tonnes reaches the coastlines. 100 000 cubic meters oil, oil emulsion and contaminated water is taken care of along the beaches and offshore. The direct costs for cleaning are estimated to between 22 – 38 MEUR²⁰⁰⁷ (200 and 350 MSEK²⁰⁰⁶), of which the county of Kalmar is hardest struck.

The indirect effects for the tourism industry are estimated to 19 – 100 MEUR²⁰⁰⁷ (175 – 930 MSEK²⁰⁰⁶), stated as decreased turnover. The effects are expected to be worst in the province of Halland. There are also effects in the real-estate market, where prices are expected to decrease. Costs for increased health care are estimated to 1.6 MEUR²⁰⁰⁷ (15 MSEK²⁰⁰⁶). Regarding fisheries, both recreational and industrial fisheries are expected to be affected, giving a cost to society corresponding to 1 and 2 MEUR²⁰⁰⁷ (9 and 18 MSEK²⁰⁰⁶) respectively.

Finally, report III above presents a scenario in which 30 000 tonnes of oil leaks into the sea in the Stockholm region, and 20 000 tonnes reach the beaches of the Stockholm archipelago. In total, as in the other scenarios, 100 000 cubic meters of oil, contaminated water and oil emulsion is taken care of on- and offshore. The costs for cleaning are estimated to 53 MEUR²⁰⁰⁷ (500 MSEK²⁰⁰⁷).

The resulting turnover reduction in the tourism industry is estimated to approximately 37 MEUR²⁰⁰⁷ (350 MSEK²⁰⁰⁷), where the communities of Värmdö and Haninge are most severely affected. The negative effects for recreational fisheries and industrial fisheries are estimated to 0.7 and 0.2 MEUR²⁰⁰⁷ (7 and 2 MSEK²⁰⁰⁷), respectively. Costs for increased health care are estimated to 1.6 MEUR²⁰⁰⁷ (15 MSEK²⁰⁰⁷).

Hall K., 2000. Impacts of marine debris and oil. Economic and social costs to coastal communities. Technical report. Kommunenes Internasjonale Miljøorganisasjon (KIMO), Shetland, Scotland.

This report is also included in the Danish and the German country-reports, since there are results valid for these countries as well.

The report investigates the cost of marine debris and oil to coastal communities and organizations. Oil spill relates to supporting services such as e.g. habitats, biodiversity, biochemical cycling and resilience. It also relates to the provisioning of food, genetic and chemical resources and potentially the provisioning of space and waterways. Oil spill also causes deteriorations in cultural values, such as recreation and aesthetic values.

The report is based on surveys on socio-economic consequences as a result of oil spill and marine debris in the UK, Ireland, Denmark, Sweden, Norway, the Netherlands and Germany, from which the authors have received data on direct clean-up costs for actual cases with marine debris and oil, as well as indirect effects on e.g. tourism.

Results specific for Sweden: Every summer since 1992, the Swedish west coast has been cleaned up from marine debris and oil. The coastline in this area is jagged, which makes cleaning more expensive than in other areas. In the province of Bohuslän, the beach cleaning costs were estimated to be at least 1.2 MEUR²⁰⁰⁷ (10 MSEK¹⁹⁹⁷) in the year 1997. In 1993, it was calculated that an oil spill event caused a 20 % reduction of the tourist income in the municipality of Sotenäs, corresponding to 7.8 MEUR²⁰⁰⁷ (total income 24 MGBP¹⁹⁹³). Regarding marine debris and fisheries, the total cost for fouled propellers, blocked intake pipes, damaged nets and destroyed catch is estimated to 0.74 MEUR²⁰⁰⁷ (6.2 MSEK¹⁹⁹⁸) per year along the Swedish west coast.

Sanctuary M., Fejes J., 2006. What's missing from measures of oil spill damages? A closer look at ecosystem valuation and policy responses. Archive number: U2032. IVL, Swedish Environmental Research Institute, Stockholm.

Oil spill relates to supporting services such as e.g. habitats, biodiversity, biochemical cycling and resilience. It also relates to the provisioning of food, genetic and chemical resources and potentially the provisioning of space and waterways. Last but not least, oil spill causes deteriorations in cultural values, such as recreation and aesthetic values. The study has three objectives. (1) To provide more knowledge on the potential damages from oil spill, (2) to establish a basis for a better oil spill compensation regime, and (3) to suggest areas for improvement of the existing practice in Sweden, based on local Swedish experience.

The study has a broad perspective, providing summaries of cost estimations for a range of oil-spill accident cases. The cost measures include, in some cases, diminished recreational values, replacement costs for certain animal-species and property damage costs, whereas in some cases, the cost measures are narrower. The report includes cost estimations for the case of the Maltesian Alambra 2000 accident in the Port of Muuga in Tallin, Estonia, where 300 tonnes of heavy fuel oil leaked out, affecting also the Swedish islands of Fårö and Gotland and parts of the Stockholm archipelago.

Cost estimations for Sweden: Clean-up costs (a restoration cost measure) in Sweden were estimated to 491 000 EUR²⁰⁰⁸ (originally 647 500 USD²⁰⁰⁰). See also the Estonian country report for cost estimations related to Estonia.

WINDMILL PARKS

Ek., K. (2002). Valuing the environmental impacts of wind power: a choice experiment approach. Licentiate Thesis, Lulea University of Technology, Sweden. Weblink: publ.ltu.se/1402-1757/2002/40/LTU-LIC-0240-SE.pdf

The article estimates willingness to pay for trade-offs between different attributes of windmills in Sweden, such as location, height, amount of noise etc. The valuation method used is choice experiment, and the “changes” in the environment are thus hypothetical rather than factual. A postal survey was sent out in March 2002 to 1000 randomly selected Swedish house owners. The response rate was 56 %.

An interesting result: The average willingness to pay for electricity generated in windmills offshore rather than windmills onshore is estimated to 0.39 cent²⁰⁰⁸ per kWh (3.47 Swedish öre²⁰⁰² 1 öre = 0.01 SEK). This might be interpreted as the opportunity cost of building windmills along the coast rather than offshore (author’s own interpretation). The cost is in this case related to cultural ecosystem services, with reduced recreational and aesthetic values along the coastline, since the authors conclude that noise and visual impact are important determinants of the respondents’ utility. Another conclusion is that there is a positive willingness to pay for having small rather than large windmill parks onshore, but offshore this relation does not exist.

The article also tests for general attitudes towards wind power and different explanatory variables.

Liljestam, A., Söderqvist, T., 2004. Ekonomisk värdering av miljöförändringar. En undersökning om vindkraftutbyggnad med scenariovärderingsmetoden (CVM) [Economic Valuation of Environmental Change: A Contingent Valuation Study of Windpower Development]. Report 5403, Swedish Environmental Protection Agency, Stockholm.

In the report, the authors investigate the value of alternative locations for windmill parks. The starting point is a contingent valuation mail-survey conducted with one representative per household (N=421) in the area of Björkö, south of Sundsvall on the Swedish east coast. The ecosystem services “reached” with this paper are related to cultural ecosystem services, with reduced recreational and aesthetic values along the coastline as a consequence of windmill parks.

Three scenarios are used in the survey. In scenario A, the starting point is a windmill park on land, with an alternative location 5 km offshore. In scenario B, the same starting point is used, but with an alternative location 25 km offshore. In scenario C, the starting point is a windmill park 5 km offshore, with an alternative

location 25 km offshore, as in scenario B. For each scenario, the respondents are asked to state their willingness to pay for the alternative location.

The mean WTP is estimated to, respectively: 36 EUR²⁰⁰⁷ (323 SEK²⁰⁰⁴) (scenario A), 83 EUR²⁰⁰⁷ (750 SEK²⁰⁰⁴) (scenario B) and 75 EUR²⁰⁰⁷ (679 SEK²⁰⁰⁴) (scenario C). Aggregating to the whole sample (including the non-respondents) gives, under certain assumptions, a total WTP of 6 050 – 9 570 EUR²⁰⁰⁷ (55 000 – 87 000 SEK²⁰⁰⁴) (scenario A), 18 480 – 26 070 EUR²⁰⁰⁷ (168 000 – 237 000 SEK²⁰⁰⁴) (scenario B), and 12 870 – 21 560 EUR²⁰⁰⁷ (117 000 – 196 000 SEK²⁰⁰⁴) (scenario C).

The reasons for the respondents' WTP are stated to be the negative effects from wind power on the view and the level of noise, a belief that the alternative sites would give rise to a higher power production, a desire to protect the nature of Björkö, and solidarity with neighbours living close to the windmill parks in the starting point.

OTHER/SEVERAL AREAS

Eggert H., and Olsson B., 2003. Heterogeneous Preferences for Marine Amenities: a Choice Experiment Applied to Water Quality. Working Paper, Department of Economics, Göteborg University, Sweden.

In the report, the benefits of improving coastal water quality in terms of bathing water quality, fishing possibilities and biodiversity levels are estimated, using a survey on inhabitants in the southwestern parts of Sweden. The ecosystem services valued are thus cultural/recreation and aesthetic values (and perhaps the legacy of nature), the provisioning of food, and the supporting service of diversity.

The survey was designed as a choice experiment study, concerning the coastal waters of the Swedish west coast, Skagerrak and Kattegatt. The sample (N=800, response rate 43 %) was randomly selected from the permanent population in the counties of Västra Götaland and Halland, and the survey was conducted in May 2002. Apart from debriefing questions and background questions on socioeconomic factors and habits of using the coastal area, the questionnaire consisted of choice experiments, in which the respondents could choose between different alternatives for water quality improvements, relating to bathing water, fishing possibilities and biodiversity, and a status quo alternative.

A multinomial logit model was then used to analyze the data. The marginal yearly WTP for avoidance of a reduction in biodiversity level is estimated to, in average, 158 EUR²⁰⁰⁷ (1400 SEK²⁰⁰²), whereas the corresponding result for an improvement from the current level is estimated to 68 EUR²⁰⁰⁷ (600 SEK²⁰⁰²). Regarding bathing water quality, the average marginal yearly WTP for improvement is (also) estimated to 68 EUR²⁰⁰⁷ (600 SEK²⁰⁰²). The average marginal yearly WTP for an im-

provement of the cod stock is estimated 147 EUR²⁰⁰⁷ (1300 SEK²⁰⁰²). Aggregating to the population in the area (roughly one million inhabitants), and assuming zero WTP for non-respondents, the result is a marginal yearly WTP for either improving the cod stock or avoiding deterioration of marine biodiversity corresponding to 45 – 70 MEUR²⁰⁰⁷ (400-700 MSEK²⁰⁰²). No aggregation is made for bathing water quality.

Franzén F., Soutukorva Å., Söderqvist T., 2006. Skagerraks miljö i samhällsekonomisk belysning [The Skagerrak environment from a socioeconomic perspective], Enveco Miljöekonomi, Forum Skagerrak II. Stockholm.
Weblink: www.forumskagerrak.com.

The report focuses on the socioeconomical perspective of the environmental situation in Skagerrak. More narrowly, the report aims to describe the socioeconomic effects in the area, related to decreases in coastal fishery, eutrophication, oil spill, marine debris and contaminants. The related ecosystem services are mainly recreation and aesthetic values and the provision of food. In many cases, the authors use benefit transfers for the estimations. Below, the methods and the results for each of the problem areas are summarized.

Coastal fisheries

In the area, the cod population shows dramatically decreasing trends. Two case studies are made; one which examines the possible benefits and costs of measures to increase the cod population in the area, and one which investigates what the economic consequences would be, if the cod population along the Norwegian Skagerrak coast would decrease in the same drastic way as the population in Sweden. Only the first case study will be subject for this summary.

In the former case, two scenarios for cod moratoriums are specified: one in which no cod-fisheries are permitted in the Kattegatt-Skagerrak area, and one in which there is a unilateral Swedish cod-moratorium. In order to calculate the benefits of a cod moratorium, the authors use benefit transfers from studies such as e.g. Olsson (2004) and Eggert & Olsson (2004), which present the WTP for an increased cod-stock. The benefit transfer, made through population size in the area, results in a willingness to pay for a moratorium, which leads to an increase in the cod stock to the 1974 level, corresponding to 27 – 152 MEUR²⁰⁰⁷ (254 – 1430 MSEK²⁰⁰⁷). For a unilateral Swedish cod moratorium, the cost is estimated to 0.25 – 0.81 MEUR²⁰⁰⁷ (2.4 – 7.6 MSEK²⁰⁰⁷) per year, using information about total profits in the Swedish cod-fishery industry (24 – 76 MSEK²⁰⁰⁷), and the information that approximately 10 % of the cod catches in Sweden are made in the Kattegatt-Skagerrak area. The costs of the bilateral scenario are estimated to 2.5 – 6.0 MEUR²⁰⁰⁷ (23.3 – 56.4 MSEK²⁰⁰⁷) per year, using the same method for cost calculation in Denmark as for Sweden, and adding the results.

With these costs and benefits, the authors conclude that such a bilateral moratorium would be economically feasible if the 1974 cod population could be reached in the area within 4.5 to 61 years through the moratorium. The authors also argue that profit-loss is a more relevant measure of costs than income-loss, since income-loss as a measure does not consider the fact that, when not fishing; a lot of operating costs don't exist anymore.

Eutrophication

Some of the eutrophication effects in Skagerrak are toxic algal blooms, water turbidity, more widespread distribution of filamentous algae, decrease in eelgrass meadows (see e.g. Paulsen 2007 in this report for the economic effects of such a decrease) and an increased tendency to oxygen shortage episodes. In the report, the authors point at different example studies valuing the benefits of "getting rid of" these problems. They also make a benefit transfer, through population size in the area, estimating the total willingness to pay for a decrease in nitrogen loads, based on a meta-study by Hökby and Söderqvist (2003). Below (table SE.2) are the results for the county of Västra Götaland.

Table SE.2. Total yearly WTP (MEUR²⁰⁰⁷ [MSEK²⁰⁰⁷]) for all adults (N=1 140 million) in Västra Götaland for different reductions of nitrogen load to Skagerrak.

Reduction in nitrogen load (tonnes per year)	Yearly WTP
10 000	77 (725)
25 000	117 (1 108)
50 000	162 (1 532)
100 000	223 (2 106)
110 000	234 (2 202)

Using data on costs for nitrogen reduction, obtained from the decision support system Nest (www.mare.su.se), the authors conclude that a 10 % reduction of nitrogen loads accomplished locally is likely to be economically motivated. A 50 % reduction is probably only motivated if it is accomplished through measures in several Baltic Sea and North Sea countries, which would lower the costs for the reduction (and also give benefits in other countries). However, the authors argue that the local perspective should not be forgotten in similar discussions.

Oil spills

The area is likely to be sensitive to oil spill, since there are many sensitive ecosystems in the area, and the distance to the shore is obviously short, which constitutes a great risk of costly damage to the coast. In the report, the authors present three

scenarios on oil spill. Using a cost-model for oil cleanup by Etkin (2000), the (cleanup) costs for each scenario is calculated. Note that these costs include Sweden, Denmark as well as Norway. Table SE.3 summarizes the scenarios and the costs. Note that the costs below only include direct cleanup costs, and that, hence, no secondary effects on fisheries, tourism industry etc. are considered. (In the articles by Forsman (2003, 2006 and 2007), referred to in this report, these secondary effects are expected to be substantive.)

Table SE.3. Oil spill scenarios and the related costs (MEUR²⁰⁰⁷ [MSEK²⁰⁰⁷])

Scenario	Cleanup costs
135 minor spills (1 tonne each) per year	0.14 – 0.48 (1.3 – 4.5) per year
One oil spill of 50 000 tonnes heavy fuel oil	39 (367)
Medium size oil spill, 400 tonnes heavy fuel oil	4.9 (46)

Marine debris

The report refers to Väst kuststiftelsen (2005), who estimated the costs for cleaning beaches in Bohuslän from debris in 2004 to 1.2 MEUR²⁰⁰⁷ (10.7 MSEK²⁰⁰⁴). Adding costs to the fishing-industry, as reported in Hall (2000), caused by fouled propellers, blocked intake pipes, damaged nets and destroyed catch (0.74 MEUR²⁰⁰⁷ [6.2 MSEK¹⁹⁹⁸]), the cost for marine debris in Bohuslän can be estimated to 1.94 MEUR²⁰⁰⁷. This is likely to be an underestimation, since it doesn't include indirect economic effects of debris, such as effects in the tourism industry.

Contaminants

The report refers to studies made on costs and benefits of remediating contaminated sediments at three Norwegian Skagerrak ports. No estimations are made for the Swedish parts of the Skagerrak. The authors argue that more studies on the costs and benefits of specific toxic-pollutant-reducing programmes are desirable, since benefit transfers regarding this area are uncertain by nature.

Paulsen S., 2007. Topics on the ecological economics of coastal zones; linking land uses, marine eutrophication, and fisheries. Doctoral thesis, Swedish University of Agricultural Sciences (SLU), Uppsala. ISSN 1652-6880. ISBN 978-91-576-7372-5.

The thesis consists of four different papers: I. Paulsen S.S., "Valuation of coastal habitats sustaining plaice fisheries". II. Paulsen S.S. "Economic impacts of coastal habitat change on eel fisheries: A fishermen's knowledge based survey", III. Paulsen S.S. "Investment in wetlands for pollution abatement under uncertainty", and IV. Stål J., Paulsen S., Pihl L., Rönnbäck P., Söderqvist T., Wennhage H. "Coastal habitat support to fish and fisheries on the Swedish west coast".

Papers I and II present direct valuations of the marine ecosystem services in the Baltic Sea, and will be subjects for this summary. The related ecosystem service for these papers is provision of food.

In paper I, ecological changes in shallow soft bottoms along the Swedish west coast are valued, in terms of their impact on plaice fisheries in Kattegatt and Skagerrak. These bottoms are important nursery grounds for many species, including plaice. Due to marine eutrophication, these areas are getting covered by filamentous algae, which reduce the habitat quality, having a negative effect on plaice recruitment.

The author bases paper I on two models; one ecological, linking the quality of the habitat to changes in the plaice population, and one economic dynamic optimization model linking fish recruitment with fisheries profits over time.

The result is that the presence of algal mats on the Swedish west coast could reduce profits in the plaice-fishing industry in the area with 30 – 40 %, corresponding to 1 002 – 1 677 MEUR²⁰⁰⁷ (7.6 – 12.5 billion DKK²⁰⁰⁷) over the time period (55 years) chosen, depending on the plaice recruitment level and the discount rate used in the simulation.

In paper II, the author links a (probably anthropogenic) decrease of eelgrass meadows (60 % decrease since the 1980s) on shallow bottoms along the Swedish west coast to profit-loss in the eel-fisheries industry, concluding that habitat loss has a significantly negative effect on eel catches and profits. A total mail/telephone survey was applied to the active eel-fishermen in the counties of Bohuslän and Halland along the coast, which corresponds to a sample of 106 eel fishermen. The response rate was 61.5 %. In the survey, questions were among other things posed on general information about fishing activity and on the respondents' own ecological experience regarding seagrass meadows and how this affects eel-catches and the efforts needed to catch eel.

The conclusion is that eel fishery is negatively affected in three ways because of the eelgrass meadow decreases: the catches are reduced, more working time is needed to catch eel, and the costs for operating are higher. In total, these three effects cause profit reductions in the industry corresponding to 0.70 MEUR²⁰⁰⁷ (6.4 MSEK²⁰⁰⁵). These costs are comparable in importance with the effects of e.g. seal damage and cormorant predation, and larger than the damage costs caused by crabs or fouling of gears.

International studies

The following articles/reports have results valid for all Baltic Sea countries. Here you will find the summaries. In each of the country-reports, these studies will be referred to, regarding the results in the specific country.

Gren I-M., 1999. Value of Land as a Pollutant Sink for International Waters. Ecological Economics 30:419-431.

The paper analyzes the values of a marginal change in the area of land as a pollutant sink under different contexts and objects regarding decision-making: (internationally) coordinated versus non-coordinated choices of pollutant abatement choices, and maximization of net benefits versus minimization of costs for pollutant abatement. The author concludes that the value of a marginal change in the area of pollutant sinks, using coordinated policies, is always higher or equal to the corresponding value using uncoordinated (national) policies. When costs are minimized, the value of a marginal change in the area of pollutant sinks depends on whether the country has relatively high or low nutrient-abatement cost options available. Assuming a linear relation between nitrogen reductions and benefits, the marginal benefit in each Baltic Sea country is calculated, using data from Söderqvist (1996) and Markowska & Zylicz (1999³⁸) [two articles which were also used for the results in Turner et al. 1999, above].

Relevant results for Sweden: For Sweden, this calculation gives a marginal benefit of nitrogen reduction of 4.44 and 2.23 EUR²⁰⁰⁷ (37.2 and 18.6 SEK¹⁹⁹⁹) for northern and southern Sweden, respectively.

Markowska A., Zylicz T., 1999. Costing an International Public Good: The Case of the Baltic Sea. Ecological Economics 30: 301-16.

The article addresses the question of how to optimize Baltic-wide eutrophication-abatement programmes with respect to benefits and costs in different regions (the specific ecosystem services that are valued are not explicitly specified). The authors use a series of contingent valuation studies performed in Sweden, Poland and Lithuania for obtaining national aggregate willingness to pay results. In order to obtain estimations of willingness to pay in the other Baltic Sea countries, benefit transfer was used, where the results from the Swedish study was taken as representative for the Western Europe market economies, the results from the Lithuanian study was taken as representative for the former Soviet Union republics, and the results from Poland was assumed to be valid for Poland only.

³⁸ A previous version of this paper was available in 1996 as a working paper.

The Chandler-Tulkens model of cost-sharing is used to determining a hypothetical allocation of costs for nutrient-reductions across the Baltic Sea countries. This application is based on data on national abatement costs as well as estimations of national willingness to pay for less eutrophication. One conclusion from the paper is that Sweden, Denmark and Poland are the largest beneficiaries of the 1992 Helsinki Convention for joint nutrient abatement efforts, since Swedes and Danes have a high willingness to pay for less eutrophication, and since the population in Poland is large.

The authors also calculate hypothetical money transfers required to motivate countries to participate in the Joint Comprehensive (environmental action) Programme, JCP.

Results for Sweden: The average Swede's willingness to pay for reduced eutrophication in the Baltic Sea is estimated to 197 EUR²⁰⁰⁷ (252 USD¹⁹⁹⁵) per year, which corresponds to an aggregate of 1 261 MEUR²⁰⁰⁷ (1 615 MUSD¹⁹⁹⁵) per year.

Turner, R. K., Georgiou S., Gren I-M., Wulff F., Barrett S., Söderqvist T., Bateman I.J., 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.

The article reports costs and benefits of a general 50 % reduction of nitrogen and phosphorus loads in the Baltic Sea (the specific ecosystem services that are valued are thus not explicitly specified). For the benefit/valuation part of the article, the authors refer to two WTP studies that are presented in Georgiou et al. (1995), which were carried out in Sweden and Poland. The results from these two studies are then extrapolated to comprise the whole Baltic Sea area population.

The two studies that are referred to are contingent valuation-studies, performed through mail questionnaire surveys. They thus include both use- and non-use values. The results are extrapolated in the following way: The WTP-estimations are adjusted for Gross domestic product, and the average yearly WTP in Sweden is taken as representative for Finland, Germany, Norway and Sweden. For Estonia, Latvia, Lithuania, Poland and Russia, the average yearly WTP in Poland is taken as representative. The average WTP-results are then multiplied by the adult population in each country, which gives the total basin-wide WTP estimate 8 300 MEUR²⁰⁰⁷ per year, or 4 500 MEUR²⁰⁰⁷ per year if non-respondents' WTP are assumed to be zero rather than equal to the average respondent WTP (69 310 MSEK¹⁹⁹⁵ and 37 892 MSEK¹⁹⁹⁵ respectively).

The authors conclude that most countries would gain economically from a 50 % reduction of nitrogen and phosphorus loads in the Baltic Sea.

Benefit estimations for Sweden: The corresponding WTP estimations for Sweden is 2 500 MEUR²⁰⁰⁷ per year, or 1 400 MEUR²⁰⁰⁷ per year if non-respondents' WTP are assumed to be zero (20 723 MSEK¹⁹⁹⁵ resp. 11 591 MSEK¹⁹⁹⁵).

Conclusions

In Sweden, most of the valuation studies focus on topics connected to eutrophication and the value of cultural services such as recreation and aesthetic values. Few of the eutrophication studies are related to supportive services, s.a. resilience and habitats. No studies are found, that relate to valuation of atmospheric regulation. Regarding the valuation of provisioning services, there is one study (Paulsen, 2007) that links eutrophication directly to the *values* of the provisioning of fish. This link might be of high importance, since the (somewhat measured) losses in recreational values from eutrophication are likely to constitute only a subset of the full value-loss. The other way around; given that the (somewhat measured) recreational benefits of nutrient reduction are correctly estimated, these benefits don't present the whole picture. In order to get closer to the full value of nutrient reduction in the Baltic Sea, the potential benefits from fisheries should be further investigated.

Within the sector of recreational values of less eutrophication, both contingent valuation methods and indirect approaches have been used. There are, however, few studies that pinpoint marginal benefits of reducing nitrogen and phosphorus loads. More accurate studies relating to this would be of high importance for decision-making, since marginal costs for reducing nitrogen and phosphorus loads are more thoroughly described in the literature.

The Swedish literature regarding oil spills, from Räddningsverket, makes a contribution to the valuation of different cultural and in some respect also provisioning services, by setting up scenarios of (not "yet" occurred) oil spill accidents in different regions. For these scenarios, potential socioeconomic consequences are presented, and in some cases quantified. The links between further biological consequences of oil-spill and the values of ecosystem services are, though, not investigated in the Swedish literature. According to the results from Garpe (2008), oil spill might cause negative consequences for the values of supportive ecosystem services, such as diversity, habitat and resilience. In order to, for example, be able to more correctly use fines as a method to reduce oil spill risks to an "efficient level" (with respect to costs of reducing risks and the costs of accidents), these potential consequences should be examined more thoroughly.

In the Swedish media, there has been a lot said about the risks with alien species in the Baltic. In Gren et al. (2007), the authors conclude that the estimated costs of

impacts on biodiversity are their least reliable estimates for this issue, while the effects related to human and animal health impact are more reliable. In order to go through with more precise valuation studies related to this topic, the next step has probably to be taken by biologists rather than economists, in order to gain better knowledge of ecosystem effects.

Regarding the Swedish benefits of a cleaner Baltic Sea, with respect to physical garbage (“marine debris”), more has to be done. Only two studies on this topic were found (Hall, 2000 and Franzén et al., 2006). In Hall (2000), benefit estimations were made through the damage costs caused by debris to fisheries (fouled propellers, congested nets etc.). In Franzén et al. (2006), the estimations are made through beach cleaning costs in Bohuslän on the Swedish west coast. It is concluded that the costs for beach cleaning in this area (approx. 1.1 MEUR or 10 MSEK per year) is likely to be an underestimation of the true costs of marine debris. The authors suggest more research on this topic, preferably through a primary study of the public willingness to pay for cleaner coasts, not the least since more information on this might be an important component in a cost-benefit analysis. The contribution of this literature review is a reinforcement of that suggestion, since just one more report has been found on the values of less marine debris during this project.

The benefits of reduced marine pollution of hazardous substances in the Baltic Sea, is also an area where further research is recommended. To our knowledge, there are no reports directly related to this in Sweden. This is an important area, since hazardous substances in the Baltic Sea might have consequences for supportive, regulating, provisioning and cultural ecosystem services. The existence of hazardous substances in food is also, obviously, a potential problem. Although outside the framework of this project, we have the feeling that there are also very few studies related to the *costs* of reducing the effluents of hazardous substances into the Baltic Sea. In order to make cost-benefit analyses, this could be an important area for further research. For the case of PCB, Pedersen et al. (2004), could be a starting point for further studies, since this report connects amounts of PCB with health effects (e.g. section D4).

The welfare loss from physical damage has been investigated by Ek (2002) and Liljestam & Söderqvist (2004). These articles focus on the willingness to pay for different locations of windmill parks. The results rely on choice experiment/contingent valuations, and thus they might not reflect the potential biological/ecosystem effects of different locations if scientists know more about these effects than people in general do. It is therefore suggested that these studies are followed up by studies using different valuation approaches, in cooperation with marine biologists.

Regarding cultural heritage, there seems to be a knowledge gap on the potential value of preserving “fishery-villages” along the coastlines. Coastal fisheries are

declining in Sweden, and potentially important cultural heritage values might be lost if the activities related to fisheries in these villages decrease or disappear. More research on these values (and the related values for recreation, aesthetics, the importance for the tourism industry etc.) are recommended for decision-making in fishery politics.

Last but not least; after having gone through the Swedish valuation studies related to the Baltic Sea, there seems to be a huge knowledge gap in the areas of valuing regulating services, such as e.g. atmospheric regulation, pollution control and eutrophication mitigation (see also Garpe, 2008). Table SE.4 summarizes the conclusions in terms of the ecosystem services specified in Garpe (2008).

Table SE.4. Summary of conclusions in relation to ecosystem services.

Supportive services	S1	Biochemical cycling	Five studies (the oil spill studies). However, this link is very weak.
	S2	Primary production	No studies found
	S3	Food web dynamics	No studies found
	S4	Diversity	Six studies, of which five provide a very weak link. One study values diversity with choice experiment
	S5	Habitat	Five oil spill studies and two direct studies, linking habitat to profits in the fishery industries
	S6	Resilience	A very weak link through the five oil spill studies. One study focuses on unwanted resilience.
Regulating services	R1	Atmospheric regulation	No studies found
	R2	Regulation of local climate	No studies found
	R3	Sediment retention	No studies found
	R4	Biological regulation	No studies found
	R5	Pollution control	No studies found
	R6	Eutrophication mitigation	No studies found
Provisioning services	P1	Food	Nine studies. One of the most described areas regarding valuation in Sweden.
	P2	Inedible resources	One study (the one on alien species)
	P3	Genetic resources	One study, very loose link
	P4	Chemical resources	Five studies (the oil spill studies). This link is very indirect, and the chemical consequences of oil spill is not described.
	P5	Ornamental resources	No studies found
	P6	Energy	No studies were found which value the Baltic sea as an energy provider.
	P7	Space & waterways	No studies found
Cultural services	C1	Recreation	Well described in many of the studies. Most valuation studies in Sweden focus on recreational- and aesthetic values. However, little is known on the marginal effects of reduced nutrient loads
	C2	Aesthetic value	Well described in many of the studies. Most valuation studies in Sweden focus on recreational- and aesthetic values. However, little is known on the marginal effects of reduced nutrient loads
	C3	Science & education	No studies found
	C4	Cultural heritage	No studies found. More research is recommended relating to these values of "fishery villages" along the Swedish coastlines.
	C5	Inspiration	No studies found
	C6	The legacy of nature	Loosely linked to the recreation value studies (if some of the stated WTP in contingent valuation studies relates to this type of service).

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The economic value of ecosystem services provided by the Baltic Sea and Skagerrak

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Existing information and gaps of knowledge

Marine ecosystems give society a multitude of ecosystem services. This report contains the results of an international survey of studies that have put an economic value on services provided by the Baltic Sea. The report also identifies present gaps of knowledge and discusses what gaps are most crucial to fill. The report is part of the project Economic Marine Information assigned by the Swedish Government.

