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Public Policies Towards Marine Protection: Benchmarking Estonia to Finland and Sweden

Tea Nõmmann and Sirje Pädam

Introduction

The EU Marine Strategy Framework Directive (MSFD) aims at protecting the marine environment across Europe. It requires EU member states to put in place measures to achieve Good Environmental Status (GES by 2020, through the development of national marine strategies. Since eight of the nine coastal countries of the Baltic Sea are EU member states, MSFD provides substantial geographical coverage.

In its objective to protect the marine environment, the Directive also calls for due consideration of sustainable development and the

T. Nõmmann (✉)
Department of Finance and Economics, Tallinn School of Economics and Business administration, Tallinn University of Technology, Tallinn, Estonia
e-mail: tea.nommann@seit.ee

S. Pädam
Chair of Environmental Economics, Tallinn School of Economics and Business administration, Tallinn University of Technology, Tallinn, Estonia
e-mail: sirje-ilona.padam@ttu.ee

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assessment of social and economic impacts of proposed measures. MSFD explicitly asks member states to ensure that planned measures are cost-effective and technically viable, and that impact assessments, including cost-effectiveness analysis (CEA) and cost-benefit analysis (CBA), have been carried out prior to their introduction. Based on these analyses, the most cost-effective and beneficial measures can be selected. Since the motivation of the measures is to achieve environmental targets, economic analyses also serve as grounds for the application of exemptions by member states.

The Directive introduces the ecosystem approach to the management of human activities affecting the marine environment. As European seas are shared by many countries, MSFD stresses the importance of cooperation at the regional level and urges the coordination of implementation of MSFD via existing Regional Sea Conventions. For the Baltic Sea region, the Helsinki Convention of 1974 (HELCOM), provides a coordination platform.

Carrying out CEA and CBA on the marine environment is a challenging task. Sea ecosystems are complex and there are substantial knowledge gaps about the impacts on ecosystems due to changes in human activity. Other gaps include the welfare implications of improvements in marine ecosystems. Given that the first cycle of MSFD is presently under way, countries have had to adopt an experimental approach. In order to build knowledge for the next cycle, valuable inputs are expected from reviewing and comparing the CEA and CBA carried out by Estonia, Finland and Sweden, three countries that share the same marine area but have different prerequisites concerning administrative and research capacity.

The purpose of this chapter is to compare the CEA and CBA of the proposed new measures of the National Marine Strategies of Estonia, Finland and Sweden. The analysis is mainly based on the study of documents. The comparison covers each country's process of choosing new measures and the chosen approaches for carrying out CEA and CBA. The framework of the analysis is based on the analytical steps of CEA and CBA.

Section "Theoretical Background" provides a theoretical background and in Sect. "Empirical Background", we present an empirical background

of the national Programme of Measures (PoM). Section "Cost-Effectiveness" describes the CEA carried out in the selected countries and in Sect. "Cost-Benefit Analysis", we present the review of CBA. This is followed by a conclusion along with recommendations for the coming cycles of MSFD.

Theoretical Background

Member states are requested by MSFD to show that the suggested new measures are cost-effective and prior to the introduction of any new measure, member states need to carry out CBA (European Commission 2008). Since these two kinds of economic analysis aid makers while evaluating policy alternatives, the requirements imply sound policy analysis. However, EU legislation does not provide guidance on what CEA and CBA should involve or how to quantify and find values for benefits and costs. The experiences from various countries on implementing environmental CEA and CBA have been reported by background and working group documents (European Commission 2015; Working Group on Economic and Social Assessment 2010).

Cost-Effectiveness Analysis

CEA is an exercise in comparing the costs and outcomes of different actions, thus assisting policy makers in choosing measures that can reach the policy goal at minimum cost. In order to define a cost-effective allocation of measures, Elofsson (2010: 50) recommends the following three steps. "The first step is to interpret the politically determined environmental target into a measurable target indicator if the target is broadly defined. The second is to calculate costs of measures at the sources and the third to quantify the impact of measures on the target." There is a substantial complication in the first step of a CEA of the Programme of Measures (PoM), owing to the multidimensionality of the environmental objective, i.e. achievement of Good Environmental Status (GES). In order to define GES, the Directive describes 11 qualitative descriptors (see Table 5.1).

Table 5.1 Qualitative descriptors for determining good environmental status

Descriptors	Abbreviation
Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions	D1
Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems	D2
Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock	D3
All elements of marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity	D4
Human-induced eutrophication is minimized, especially its adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters	D5
Seafloor integrity is at a level that ensures that the structure and functions of ecosystems are safeguarded and benthic ecosystems in particular, are not adversely affected	D6
Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems	D7
Concentrations of contaminants are at levels not giving rise to pollution effects	D8
Contaminants in fish and seafood for human consumption do not exceed levels established by Community legislation or other relevant standards	D9
Properties and quantities of marine litter do not cause harm to the coastal and marine environment	D10
Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment	D11

Source Marine Strategy Framework Directive (MSFD) 2008/56/EC

The descriptors are broadly defined in qualitative terms. For this reason, it is helpful to define measurable target indicators. The Directive has introduced criteria and indicators to help with the interpretation of the descriptors as well as appraising their current status regarding GES targets. The quantitative operationalization of GES has been left to the member states (Oinonen et al. 2016). It is, therefore, expected that prior operationalization of GES is useful for the purpose of CEA.

Estonia, for example, has used a number of indicators among the GES targets that define the gap with respect to each descriptor. There are a total of 44 indicators describing targets. Several descriptors are defined by more than one target. However, this becomes more complicated because of potential interlinkages between the indicators, descriptors and the lack of guidance on how to weigh gaps in the attainment of different GES descriptors (Oinonen et al. 2016).

In addition, Oinonen et al. (2016) point out that uncertainties and the lack of multidisciplinary models of sea ecosystem management, call for expert-based qualitative assessments.

In a review of economic analyses concerning marine and water management, Söderholm et al. (2015) note that a common approach among previous studies has been a focus on measures to reach environmental (GES) targets rather than on implementation. Most often, there is only a weak link between measures and how they are to be put into practice, i.e. the policy instruments. The choice of policy instruments has an influence on CEA as it affects both costs and the behavioural response. The implications of taxes differ to a significant extent from those of information. Experiences from plastic bag regulation show that policy instruments like taxes, bonuses and information imply significant variation in effectiveness (Convery et al. 2007; Collins et al. 2003; Homonoff 2013).

Another observation made by Söderholm et al. (2015) is that the costs of measures are evaluated ex ante rather than based on ex post analysis. Ex ante evaluation is impaired by greater uncertainty as it does not draw from experience.

Cost-Benefit Analysis

CBA is a tool to assess whether the economic value that is expected to follow from a particular action is in balance with the associated costs. It is a method of social appraisal, and is being used according to criteria derived from welfare economics. The most common purpose of CBA is to provide ex ante policy evaluation. This is also the case with the CBA of PoM.

In the widely used textbook on CBA, Boardman et al. (2011) outline nine steps involved in CBA. Hanley and Spash (2003) describe an alternative structure of CBA in eight steps. Both approaches are similar and the steps overlap to a significant degree. Hanley and Barbier (2009) suggest a six-step approach that has recently been applied by Börger et al. (2016) while comparing CBAs of PoMs in UK, Spain and Finland. In order to be comprehensive, we choose the nine-step structure as the framework for comparing CBAs. The nine steps are as follows:

Step 1: Specify the set of alternative projects;
Step 2: Decide whose benefits and costs count (standing);
Step 3: Catalogue the impacts and select measurement indicators;
Step 4: Predict the impacts quantitatively over the life of the project;
Step 5: Monetize all impacts;
Step 6: Discount benefits and costs to obtain present values;
Step 7: Compute the net present value (NPV) of each alternative;
Step 8: Perform sensitivity analysis;
Step 9: Make a recommendation based on the NPV and sensitivity analysis.

The first step is to define alternative projects or policies. In the case of the PoM, this is applicable to the measures. It is equally important to define the business-as-usual scenario, which outlines the choice of not implementing the project or policy. In their review of CBAs, Söderholm et al. (2015) found that there are substantial challenges related to the definition of the business-as-usual scenario. They point out that unless it is clear what is meant by the choice of "doing nothing", policy alternatives also become indistinct. Since the PoMs are national, it is reasonable to expect that the standing is the population of the country in question (step number 2). At the same time, national population might be too narrow if measures give rise to cross-border benefits or costs.

Identification of the impacts and selecting measurement indicators is the third step of CBA. In this step, the costs and impacts regarding the marine environment are, in principle, available from the CEA. However, determining the benefits to humans from the improvement of marine ecosystem requires additional methods. In order to cover further

aspects, for example, indirect costs of measures, criteria for households and businesses should be added. The fourth step involves predicting the impacts and expressing them in quantitative terms. For the same reason as with CEA, CBA will run into difficulties because of the multidimensionality of GES. The fifth step is valuation, i.e. monetization. For the monetization of benefits, it must be possible to measure the value of the improvement of the environment. Issues such as clean beaches, protection from contaminants or any of the descriptors shown in Table 5.1 need to be interpreted, in terms of either willingness to pay or avoidance of degradation costs. Estimates of the monetary costs of measures are available from the CEA. These cost estimates need to be complemented by indirect costs.

Through monetization, all impacts become commensurable. It becomes possible to express the benefits and costs of each choice. However, comprehensive monetization is seldom possible when it comes to environmental impacts. The improvement of the Baltic Sea's marine environment is a non-market good and its value cannot be easily derived from ordinary market activities. In addition, there are knowledge gaps between the impact of the improvement in marine ecosystem services and their implications on welfare indicators. As a result, finding the appropriate monetary values will prove to be either too complex or too costly. For these reasons, CBA is often performed in terms of a qualitative assessment (Söderholm et al. 2015). The steps that follow in the list (discounting, see steps six and seven) require monetization, and are omitted here.

Step 8 includes sensitivity analysis, which is meant to test how variations among uncertain variables affect the result. In qualitative CBA, this can be done by presenting intervals of the outcome or by illustrating how ranking is affected by uncertainty. The final step, the ninth step, is to make recommendations. Doing this on the basis of qualitative CBA is more challenging than on the basis of monetized CBAs. Although Söderholm et al. (2015) point out that there are good quality examples of previous CBAs, they refer to qualitative CBAs which list impacts in various dimensions, without aggregating benefits and costs. In these circumstances CBA provides little or no help in policy choices.

Beyond Economic Analyses

The economic analyses make up one part of the process of approval of the national marine strategy. Beside CEA and CBA, it includes scientific appraisal, public discussions and consultations with public agencies and ministries. Proposals of new measures originate primarily from scientific gap analyses of the status of marine ecosystems relative to GES. In this work, protection, cleaning up or the reduction of pollutants have been identified as essential in order to reach some target or indicator. The proposals of new measures may also be influenced by expectations of what is acceptable to policymakers. Another factor that contributes to the choice of measures is the tight timelines for approval, which reduce the time available to analyse and design relevant policy instruments.

Empirical Background

Sources of empirical data include background documents of economic analyses of the Marine Strategies of Estonia, Finland and Sweden as well as the approved programmes of measures of Finland and Sweden (SA Stockholmi Keskkonnainstituudi Tallinna Keskus, Tartu Ülikooli Eesti Mereinstituut ja Tallinna Tehnikaülikooli Meresüsteemide Instituut 2016; Havs-och vattenmyndigheten 2015a, c; HELCOM 2016; Oinonen et al. 2015, 2016; Vretborn 2015).

Measures by Descriptor

A comparison across national marine strategies shows that measures to protect marine biodiversity and food webs via new marine protected areas or better management of those areas are most frequently suggested (especially in Sweden and Finland) (see Fig. 5.1). Measures to reduce eutrophication are emphasized by Finland. Estonia and Sweden suggest only a few new measures in addition to those of the Water Framework Directive.[1] All countries find it important to impose additional measures on commercially exploited population of fish and shellfish. While

	Estonia	Finland	Sweden		
D1. Biodiversity & D4. Foodwebs	2	6	6	14	
D5. Eutrophication	2	8	3	13	
D3. Populations of commercially exploited fish	4	2	6	12	
D8. Hazardous subst. & D9. Contaminants	2	6	4	12	
D10. Marine litter	3	1	5	9	
D2. Non-indigenous species	2	0	3	5	
D6. Seafloor integrity	0	2	2	4	
D11. Underwater energy & noise	1	3	0	4	
D7.Hydrographical conditions	0	1	2	3	
	16	29	31	76	

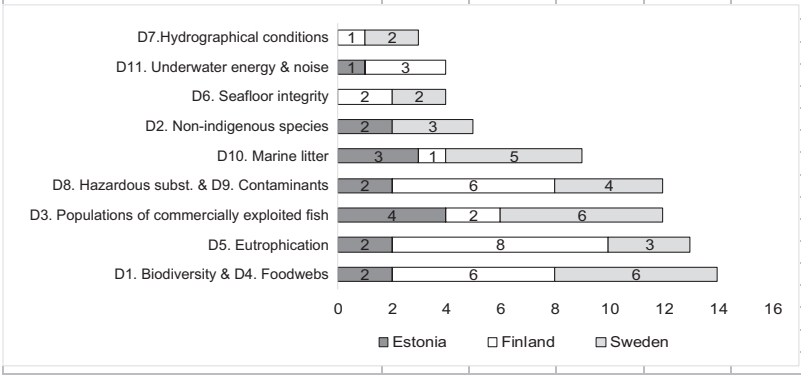

Fig. 5.1 Distribution of measures of the national marine strategies by descriptor

Sweden and Estonia recommend fishing restrictions, Finland proposes national strategies for several fish species in need of protection.

The management of risks from hazardous substances is emphasized by all countries. While the focus in Estonia is on strengthening preparedness and training for combating possible accidents, as well as on minimizing risks during bunkering, in Sweden and Finland, the emphases is on the identification of hazardous substances (chemicals, pharmaceuticals) in water and sediments and providing guidance to relevant stakeholders. All countries mention the reduction in the use of plastics and plastic bags as important priorities. According to the descriptions of measures, this is to be achieved mainly by awareness-raising information activities. Seafloor integrity measures are developed by Finland and Sweden. As for non-indigenous species, Estonia and Sweden include measures to improve awareness of the problem. Measures for identifying

underwater noise issues are being developed by Estonia and Finland. Finally, regarding hydrographical conditions, Sweden suggests measures to prepare guidelines for marine-related impact assessment and guidelines for municipal marine spatial planning, while Finland foresees measures to improve coastal flow conditions.

Classification of Measures

The classification of measures according to the Directive is rather complex.[2] Based on an analysis of countries' planned measures, the present study employs a simpler classification based on economic theory suggested by the Swedish Environmental Protection Agency (2012): information (e.g. labelling, education, influence public opinion); administrative (e.g. laws, standards, agreements); research and development (R&D e.g. development, demonstration, assessment of technology); and economic (e.g. taxes, subsidies, grants, permit trade). These measures are often based on combinations of various instruments. Söderholm et al. (2015) observe that these measures focus on reaching the environmental targets (GES) rather than on implementation. In the classification of measures, we have merely selected the main types. Table 5.2 shows the division of measures by type in national PoMs.

The preferred focus in Sweden is on information, including education and awareness-raising measures. While this is also common in Estonia and Finland, the majority of measures are administrative in nature. In Sweden, these are the second most preferred choice, followed by R&D-related measures. Countries have different strategies towards

Table 5.2 Measures by type in the national programme of measures

Type of measures	Estonia		Finland		Sweden	
Information	6	38%	8	28%	14	45%
Administrative	7	44%	10	34%	7	23%
R&D[a]	2	13%	10	34%	7	23%
Economic	1	6%	1	3%	3	10%
Total number of measures	16	100%	29	100%	31	100%

[a]*Note* R&D measures refer mainly to piloting and development activities

presenting further needs of research due to current knowledge gaps, which partly explains the low number of R&D measures in Estonia. Estonia suggests 21 topics for further research in addition to its new measures. Finland proposes research stemming from Water Framework River Management Plans that have implications on marine issues. In Sweden, the discussion on further research needs is broader. Economic measures are in clear minority.

Cost-Effectiveness

In order to compare the CEA undertaken by Estonia, Finland and Sweden, we first give a brief overview of the approach adopted by each country. The review is based on how the countries have appraised effects, estimated costs and presented the results of CEA.

Estonia

In Estonia, the process of developing a national PoM was coordinated by the Ministry of Environment and the work was carried out between fall 2014 and summer 2016 by a consortium consisting of experts in the fields of marine environment at the Marine Systems Institute of the Tallinn University of Technology and the Institute of Economics, the Estonian Marine Institute of the University of Tartu and SEI Tallinn (the Tallinn Centre of the Stockholm Environment Institute). At the time of writing, the Estonian PoM is in the process of inter-ministerial approval with the aim of adoption in 2016.

Assessment of effectiveness: During the development process of the PoM in 2014–2015, the assessment of the environmental status of the Estonian marine areas carried out in 2012 was revised. Environmental targets ensuring the achievement of GES were specified and pressures affecting the environmental status were assessed together with possible changes until 2020 by the experts. During this revision process, environmental targets of the descriptors were quantified as far as possible. However, the definition of quantifiable targets requires further study.

Based on a gap analysis of existing measures and the distance to GES, a total of 46 new measures were proposed initially by the experts to achieve GES. The 46 candidate measures were further analysed in three separate ad hoc working groups consisting of relevant officers, experts and stakeholders. Working groups were formed based on the grouping of the descriptors: (1) biodiversity, fisheries and invasive species; (2) eutrophication and hazardous substances; and (3) marine litter, underwater noise and energy. The task of the working groups was to assess the technical feasibility and effectiveness of the candidate measures.

The effectiveness of the new measures was assessed against Estonia's 44 GES targets. Participants in the working groups had to give their expert opinions on the extent to which each measure would help achieve GES, i.e. to reduce the gap between the business-as-usual trend and the GES target. The expected impact of the measure was assessed with respect to the relevant subset of the 44 targets. A seven-point scale was used: 1—there is no impact; 2—the impact is very small; 3—the impact is small; 4—the impact is average; 5—the impact is important; 6—the impact is very important; and 7—GES will be achieved fully. The effectiveness of each measure was assessed independently against the individual GES target and no interrelated impacts between measures were assessed. The assessment was done in groups and in the case of difference of opinions among experts, the results were discussed until consensus was achieved. The overall effect of the measures was derived from the highest score given to each measure by the experts. This is because it proved very difficult to determine any meaningful way to describe the contribution of an individual target to overall GES. No weighting or summing up of the scores was used.

In parallel, experts commented and gave feedback on the proposed new measures. In several cases, they recommended further research in order to determine the extent of the problem as well as to define activities or policy instruments suitable for dealing with the problem. In few cases, measures were combined, and finally, some proposed measures were re-classified as existing but not yet implemented—for example, better enforcement—which implied that they were not new measures according to the Directive.

After this assessment process, 21 new measures were pending further analysis. These, together with the results of the initial economic analysis, were presented during public discussions in September–October 2015. After the public discussions and during the final round of internal consultations in the ministries to approve the list of new measures and their planned costs, the number of new measures was further reduced to 16.

Assessment of costs: The identification of the cost of measures was carried out via interviews, desktop studies and expert assessment. This work was carried out by a subgroup of the consortium team. Initially, all direct costs of the public institutions were assessed, i.e. personnel costs, subcontracting costs and investment costs. At a later stage, personnel costs were excluded as these were considered as part of the normal work of public officials. Thus, only subcontracting and investments costs, when relevant, were included. The cost estimates were mostly experience-based, and put together in a bottom-up process. In some cases, ex ante studies were consulted. No ex post studies were available.

Presentation of cost-effectiveness: Based on the effectiveness score and the costs, cost-effectiveness was assessed and measures were ranked based on the assessment. For purposes of presentation, cost-effectiveness was grouped into three categories: high, average and low. But given the rather short list of measures and their relatively modest costs (excluding two expensive fisheries measures), the grouping does not provide high information value.

Finland

In Finland, the process of developing the national PoM was coordinated by the Ministry of Environment and the work was carried out in cooperation with the Ministry of Agriculture and Forestry and the Ministry of Transport and Communication as well as other public agencies. Several working groups were established to develop the PoM during 2013–2014. The working groups consisted of planning and other relevant officials from government organizations, researchers and representatives of non-governmental organizations. In all, over 60 people participated in the preparation of the national PoM. The Finnish government adopted the PoM in December 2015.

Assessment of effectiveness: The working group whose mandate was to carry out the CEA was established after the candidate measures had been identified by other working groups (Oinonen et al. 2016). The candidate measures were identified on the basis of gap analysis between current status and GES. Further selection of candidate measures was based on their technical feasibility and social acceptability. In all, 31 candidate measures were presented to the working group that was responsible for CEA.

Due to the lack of applicable economic-ecological models for several descriptors, it was decided to employ expert knowledge and structural interviews in order to assess the effects of the measures. According to Oinonen et al. (2016), effectiveness was defined as a probability distribution describing the likelihood that a candidate measure will achieve a given proportion of the gap between the present environmental status and the threshold for the GES. The method was chosen as other qualitative approaches were not supported by the experts in subgroups. When assessing the effectiveness of the measures, it was assumed that impacts are mutually independent, even though in reality the descriptors are interrelated. Data collection was tested in various ways (including pilot email questionnaire), though finally group interviews were conducted in predefined thematic expert working groups.

Questions were asked on the common understanding of the gap to arrive at the GES of the descriptor, understanding of the cause-effect mechanism of the measure, effectiveness and cost of each measure. In a similar way, questions were put forth about the difficulty of assessing effectiveness as well as the joint and cross-effects of candidate measures. Each expert was given seven votes per measure. The results were discussed by the group and the facilitator captured the variation among opinions—the wider the variation, the higher the uncertainty of the effects of the measure. The results were determined by consensus reached within each group after discussion.

The effectiveness of the candidate measures of the Finnish PoM was defined using discrete conditional probability distribution (Oinonen et al. 2016). The distribution and related scores were as follows: 1—the measure does not have impact (score 0), 2—the measure bridges up to 12.5% of the gap (score 0.063), 3—the measure bridges 12.5–25% of the gap (score

0.188), 4—the measure bridges 25–50% of the gap (score 0.375), 5—the measure bridges 50–75% of the gap (score 0.625), 6—the measure bridges 75–100% of the gap (score 0.875) and 7—the measure achieves GES by 2020 (score 1.000). The effects of the measures were appraised in relation to each descriptor. No target indicators were employed.

Assessment of costs: The same group of experts was engaged for the assessment of costs. The conditional probability distribution method was used during appraisals. Both direct and indirect costs were included. Costs were distributed into seven classes: €0–0.1 million (score 0.05), €0.1–0.5 million (score 0.3), €0.5–1 million (score 0.75), €1–5 million (score 3), €5–10 million (score 7.5), €10–50 million (score 30), over €50 million (score 50). Each expert had seven votes per measure. The results of the scores on costs were discussed by the group and the facilitator captured the variation in votes. As for the effects, uncertainty was captured based on the range of difference between expert opinions. The cost estimates are solely based on expert elicitation. Other sources were not consulted.

Presentation of costs-effectiveness: Ranking of measures based on cost-effectiveness was carried out by using cost-to-effect ratios of the estimates of expected costs and expected effectiveness. Joint effectiveness of two or more measures in closing the gap of a descriptor was calculated for a large number of combinations. Based on these cumulative distributions, various budget constraints were applied in order to identify alternative packages or combinations of measures with high probability of achieving GES. The results showed that dropping two of the least cost-effective measures would not affect the probability of achieving GES. One of the measures that was dropped had a low impact on merely one of the descriptors, and the other was the most expensive among all measures. The analysis also shows that it is possible to capture 60–70% of the maximum joint effect if the budget is cut down from €90 million to €20 million.

Sweden

In Sweden, the process of developing the national PoM was coordinated by the Swedish Agency for Marine and Water Management (SwAM)[3] in

collaboration with relevant authorities and scientific experts. The proposed new measures mainly affect public authorities and municipalities. Most measures are directed towards SwAM's own structure. According to Swedish legislation, SwAM has the authority to regulate fishing and develop guidelines on how marine environments and streams may be used. The national marine strategy was approved by SwAM in December 2015.

Assessment of effectiveness: Following the guidelines proposed by MSFD, measurable targets of GES in Swedish marine waters were based on a set of national indicators, including habitats of key species and the input of nutrients to different sea areas. As an additional dimension, Sweden applied environmental standards stated in legislation, which outline the desired condition of the marine environment. In order to appraise the impact of the Swedish PoM on the marine environment, Sweden employed expert assessments. Experts from SwAM and the Swedish Institute for the Marine Environment (SIME) were engaged for this purpose. The appraisal of the impacts of measures was carried out in reference to a business-as-usual scenario until 2020. Experts assessed the level of improvement from the business-as-usual scenario to GES, i.e. complete attainment of the environmental target, as well as the improvement from the business-as-usual scenario as a result of measures. This was done measure by measure on a four-point scale. In order to consider uncertainties, an interval of low and high impact was provided by the experts.

Assessment of costs: Costs were put together by another team at SwAM. Most cost estimates were experience based. To some extent, ex post information was available, for example, costs concerning municipal waste collection. The measures in the Swedish PoM entail, to a great extent, direct costs to the public sector, for example, subsidies for beach cleaning projects, the development of tools to make available information on non-indigenous species and costs of personnel. Indirect costs were also collected. Measures that contain indirect costs include, for example, fishing restrictions, which entail indirect costs on commercial and recreational fishing. However, only the direct costs were used in the CEA.

Presentation of cost-effectiveness: For the purpose of the analysis, the qualitative expert assessments were compared to direct costs, which were split into four categories. Four-times-four matrices with costs and effects were used to illustrate outcomes. High-cost measures with small impacts were judged not cost-effective and assigned 1 point on a scale of 1–4. High-cost measures with large impacts were assessed as potentially cost-effective and this was also the case with low-cost measures with small impact. Most measures were found to be potentially cost-effective: 19 of 31 measures received 3 points each. Two measures were assigned 2 points each and assessed as possibly cost-effective; another two were appraised based on their cost per hectare. Eight measures lack assessments. These include measures for knowledge and capacity building. The results of the analysis did not lead to the exclusion of measures or any other adjustments.

Comparison

The broad definition of descriptors was a challenge for all countries. In Finland, assessments were done towards descriptors, while Estonia and Sweden used a richer set of indicators. Although some target indicators were quantitative, the lack of scientific knowledge placed limits to the application of quantitative assessments.

Estonia and Sweden put together the costs of measures in a bottom-up process. The cost estimates were primarily experience-based. Hardly any relevant ex post analysis seems to have been available. The Finnish approach differed, as expert assessments were applied to estimate costs. All countries presented costs in monetary terms, but for the purpose of the analysis, monetary estimates were expressed using points. This is reasonable considering that the effectiveness of measures was assessed qualitatively. The Finnish qualitative approach of probabilistic assessment differed from the other two countries and allowed for much richer analyses.

One challenge faced by all CEAs was the existence of only one or few alternative measures for closing a certain gap. For this reason, it remains uncertain whether the chosen measures provide the lowest cost

alternative. Ranking can only be done on an overall level, which implies that GES targets are of equal weight. For example in the Finnish PoM, the measure to concentrate deposition of sediments was ranked highest in terms of cost-effectiveness. In Sweden's and Estonia's CEAs several measures received the same score. The latter approaches only make possible rough classification of cost-effectiveness.

Cost-Benefit Analysis

In this section, we review the CBA following the steps suggested by Boardman et al. (2011). Preparations for CBA took place during 2014–2016. The review is based on written reports prepared by the CBA teams in Estonia, Finland and Sweden.

Specification of Alternatives

The CBA conducted by the three countries used different approaches in their specification of alternatives. The Finnish CBA applied aggregation of measures. This implies that there are two policy choices—implementing and not implementing the PoM. The business-as-usual scenario is the same as in the CEA. The Estonian and the Swedish CBAs appraise each measure separately, thus suggesting that there is a policy choice per measure. Both the Estonian and Swedish CBAs describe the business-as-usual scenario and expected developments until 2020. All three CBAs assume a national perspective when it comes to counting costs and benefits.

Choice of Impact Categories, Predicting the Impacts and Monetization

There is variation between the CBAs regarding the choice of impact categories. While Estonia and Sweden expand the set of impact categories as compared to the CEA, Finland only appraises the aggregate benefits of a subset of descriptors.

The Estonian CBA uses the CEA as an input in the analysis concerning the costs and impacts of measures in the environmental indicators. Valuation is based on expert assessment regarding 12 criteria. These include the impact on different stakeholders and sectors, as well as the complexity of implementation and the time from implementation until the impact of the measure takes effect. The assessment of each criterion is done on a five-point scale. The criteria pertaining to stakeholders and sectors are, to some extent, overlapping, which implies that there is a risk of double counting. Another issue is that the impacts relative to the business-as-usual scenario are not clearly reported. The Estonian CBA makes no attempt to monetize the benefits, as no national background studies on relevant topics were conducted prior to developing a PoM. A small number of international studies that include Estonia have been carried out. The results of these were not available at the start.

The impact categories of the benefits of the Finnish CBA are based on the five descriptors that cannot be achieved in the business-as-usual scenario. These include: biodiversity (D1), marine food webs (D4), human-induced eutrophication (D5), concentrations of contaminants (D8) and contaminants in fish and other seafood (D9). Monetization is based on benefit transfer from prior valuation studies concerning the benefits of coastal habitats (D1 and D4) and nutrient reduction in the Baltic Sea (D5). Monetary values from previous studies are scaled down in accordance to the expected percentage of gap closure vis-à-vis GES. The percentage is based on the expert assessments of CEA.

The Swedish CBA applies the qualitative assessment of CEA regarding the impact of each measure on a set of environmental standards. Benefit transfer of consumer surplus is extracted from Ahtiainen et al. (2014). In a similar vein as the Finnish CBA, benefits are scaled vis-à-vis the percentage estimates of the contribution to gap closure with respect to GES. Additionally, the Swedish CBA assesses benefits from measures on two industries: commercial fishing and marine tourism. Monetization is carried out by connecting improvements in ecosystem services to monetary estimates.

Expert appraisals of impacts on ecosystem services are reported in a background study (Havs-och vattenmyndigheten 2015b). These appraisals concern a subset of measures which are expected to have an

impact on either commercial fishing or marine tourism. In a second step, the percentage of gap closure is determined relative to GES (ibid.). This percentage is then used as a weighting factor. The CBA team provides an estimate of the expected increase in fishing activity between the business-as-usual scenario and GES, and how the improvement in ecosystem services affects the demand for marine tourism. There is, however, no discussion in the CBA report on whether the cause-and-effect relationship between improvement in marine ecosystem services and tourism on the one hand, and improvement in marine ecosystem services and commercial fishing on the other, are accurately modelled by the studies that provide inputs for monetization. In addition, there is some confusion about the welfare measures. The value added is applied to commercial fishing and producer surplus to marine tourism.

Presentation of CBA Results

In the Finnish report, results are discounted to 2014 with a discount rate of 3% during the time period 2016–2021. The results are presented in aggregate terms and reveal that benefits exceed the costs, with reasonable certainty. In order to capture uncertainty, an interval of benefits and costs is presented. On an aggregate level, the CBA shows that benefits will exceed costs if the Finnish PoM is implemented, but there is no information concerning the benefits and costs of specific measures.

The Swedish report presents both measure-by-measure estimates of costs supplemented with qualitative assessments, and discounted benefit-and-cost estimates on the aggregate level. The measure-by-measure summaries use several dimensions, which makes it difficult to compare them. No attempt is being made by the CBA team to provide recommendations at the level of specific measures. On the aggregate level, benefits and costs are discounted during the time period 2016–2030 with a discount rate of 3.5%. Based on the interval of high and low estimates, it is shown that benefits exceed costs with reasonable certainty.

The Estonian CBA applies semi-quantitative expert assessments, making it possible to rank measures. Several information measures receive high scores: they are acceptable, have no indirect costs and their

budgetary costs are low, for example, information about non-indigenous species and awareness-raising activities concerning marine litter. High-cost measures, with significant indirect costs and predicted difficulties in the course of implementation, typically receive the lowest scores, including measures to manage storm water discharge in coastal areas. Although the result seems reasonable, the aspect of gap closure relative to GES, remains vague. As an illustration of sensitivity, the CBA team show the relationship between points and costs in a diagram.

There is no aggregate valuation of the monetary benefits. In order to provide a benchmark, the Estonian report refers to recent contingent valuation studies of improved marine environment. The CBA refers to a study (Tuhkanen et al. 2016) that has estimated values for three descriptors using choice experiments: non-indigenous species (D2), water quality improvement (D5 and D8) and oil spills (D8).

Comparison

A comparison of CBAs reveals that the monetization of benefits has been a great challenge. No monetization has been possible at the level of measures. Only descriptor and aggregate-level benefit transfers are presented. Estonia refers to a relevant contingent valuation study, but does not transfer benefits. Sweden and Finland have transferred benefits from recent contingent valuation studies. In these contingent valuation studies, environmental quality improvements have been significant and scenarios differ from those of the National Marine Strategy. The CBA teams have solved this difference by transferring the share of benefits that matches the expected percentage of the gap closure with respect to GES. This suggests an implicit assumption that benefits are linear with respect to quality improvement. In the Swedish report, benefits from nutrient reduction have been transferred to all dimensions of GES. It is not evident whether this assumption is valid. The authors propose that the improvements from attaining other dimensions of GES have similar qualities.

The business-as-usual scenario is explicitly reported in the Swedish CBA, while in the Estonian CBA, it remains vague. Being at an aggregate level, the business-as-usual scenario of the Finnish CBA lends itself

to that of the CEA. The Swedish CBA is the only one that uses an ecosystem service approach for identifying benefits. The linkages between the ecosystem services approach and the connection to business growth of commercial fishing and the increase in marine tourism demand are, however, not transparent. While there is an absence of comparisons between measures in the Swedish and Finnish reports, the Estonian CBA illustrates the ranking of measures on the basis of points received during expert assessments. The ranking provided by the CBA differs to that of the CEA, suggesting that the wider perspective of CBA has added information.

International Collaboration

During the first cycle of MSFD and the development of the (PoM), international collaboration among the studied countries has been rather modest. This concerns the work of identifying new measures, choosing the methodology for CEA and CBA. Since there already is an institutional body for cooperation to improve the environmental status of the marine environment among the Baltic Sea countries, collaboration on the issues of MSFD would have been expected via HELCOM and through the coordinated Baltic Sea Action Plan (BSAP).[4]

The issue areas and identified marine environmental problem areas of the BSAP fit rather well with MSFD's descriptors. In addition, HELCOM has several working groups that are dealing with selected issues and provide recommendations for participating countries within issues that match those of MSFD (eutrophication, hazardous substances in water and food, as well as accidental pollution at sea, protection of fish resources, biodiversity protection and marine protected areas). The most recent coordinated area is marine litter.[5] The existing platform for cooperation, and the overlap between issue areas between MSFD and HELCOM, suggest that collaboration could be helpful in many ways, including the selection of measures with beneficial cross-border impacts.

So far, HELCOM has not had the competence to assess the socio-economic impact of human activities on the marine environment or to estimate the monetary value of marine ecosystem services and the

cost of their degradation. The need for this competence and coordination of methodologies has been recognized and the first steps are being taken to identify issue areas and methodologies for socio-economic assessment during the next cycle of MSFD. An example of this is the planned work of the HELCOM TAPAS project. The assessments this project will carry out are meant to be developed so that national governments can use the results in the 2018 reporting under MSFD. Among several sub-goals, there is also the aim to develop a framework for economic and social analyses in the Baltic Sea region that will contribute to harmonized reporting under MSFD Article 8. This article includes the reporting need for marine uses of the national marine areas. The aim is to extend the collaboration platform used by the project to include the requirements of the second cycle of MSFD, i.e. development of the programme of measures and the coordinated approaches and methodologies for CEA and CBA.

Based on the experience of the first cycle, a regional informal network of national experts on economic analysis has emerged, and the outlook for the next cycle looks more promising in terms of coordinated methodologies and comparable results. It is already clear that the differences among countries in terms of timing of preparatory processes, administrative capacities and financial resources as well as research capacities on economic and social analysis pose a challenge.

Conclusions and Recommendations

By the logic of the process proposed by MSFD, the countries are required to suggest new measures in response to gaps between the expected status of the marine environment in 2020 and the target of GES. Suggested measures are, in many cases, expressed in terms of what the measure intends to achieve, for example, the restriction on fishing, clean beaches, use of liquefied natural gas (LNG) in shipping and reduction in the use of plastic bags. In line with the observation of Söderholm et al. (2015), the reviewed economic analysis of the national programmes of measures of Estonia, Finland and Sweden focus on measures rather than on implementation. Awareness raising, research

and development and other means of information provision are frequent in the first national PoM, but as means of implementation, information alone most often has only a minor impact. Uncertainty about take-up complicates both the appraisal of the impact on the environmental target and the estimation of costs and benefits.

In the work process, gap analysis relative to environmental targets is carried out early. For obvious reasons, gap analysis on the environmental status and targets should be done by natural scientists who are experts on marine ecosystems. It is not clear, though, how the proposals for new measures have been put together. In some cases, these proposals appear to have been suggested by experts on marine ecosystems while in others, they seem to have been put forward by public officials. It seems that measures have been identified mainly based on technical feasibility or social and political acceptability. Experts on economic analysis have been contracted at a later stage, when there is limited or no opportunity to influence the design of measures or to suggest policy instruments for implementation. In addition, as it is the first cycle of MSFD, there is a lack of earlier studies to rely on and this, along with the limited time frame for the PoM process, has affected the depth of the analyses.

The review suggests that there is only a weak link between those who have been involved in the designing of measures and those who have expert knowledge about implementation. The reason for this is obvious in the case of all three countries. The superior capacity concerning background studies and research funding in Sweden and Finland has not made a difference. All three countries suggest measures with vague implications on implementation. In order to prepare for the next cycle, it is important to build up knowledge about policy instruments and implementation. There is a need for reviews of existing ex post studies and further studies that evaluate existing policy instruments to protect the marine environment.

All three countries have chosen expert assessments as the desired mode for carrying out CEA. As a result, the assessments of the impact on the marine GES targets have been qualitative. Due to current gaps in scientific knowledge and quantitative models of sea ecosystems, there are no good alternatives to expert assessments and qualitative appraisal. While Sweden and Estonia have applied standard methods to appraise

the effect of a measure on gap closure, Finland has adopted an innovative probabilistic approach. Using this approach has made it possible for the Finnish CEA team to make use of the uncertainties of appraisals within the scientific community. This methodology needs to be further developed in order to allow for a richer set of indicators as the base of appraisal.

Another important aspect of the CEA and CBA is the definition of the business-as-usual scenario. All countries present a business-as-usual scenario for 2020. It is uncertain, though, whether the business-as-usual scenario reflects only current policies or also includes policies that have been adopted but not yet implemented. The addition of policies that have not yet been implemented further increases the requirement of information and calls for extended gap analysis on existing policies (Water Framework Directive, Habitats Directive, etc.) and the implementation of their measures, which should be carried out by officers responsible for regulating and enforcing relevant issue areas.

Cost estimates can be put together using different methods, including ex post studies, collection of information using a bottom-up approach and expert assessments. In the reviewed studies, bottom-up and expert assessments have been used to estimate costs. The precision of cost estimates from expert assessments depends on the knowledge of the participants. Ideally, estimation of costs based on expert assessments should be the task of other experts than those who appraise the impact on the marine ecosystem. The accuracy of the bottom-up methods that have been applied is judged better than expert assessments. For future purposes, it is important to build knowledge about costs, preferably via ex post studies.

The most challenging task of CBA has been the monetization of benefits. No attempt has been made to assign monetary values to the benefits of individual measures. When monetization has been possible, benefit transfer has been used for assigning monetary value at the level of descriptors. Two approaches have been adopted: benefit transfer from recent contingent valuation studies, and appraisal of business implications for commercial fishing and marine tourism based on the improvement of ecosystem services. For the purpose of benefit transfer, CBA teams had to adjust contingent valuation scenarios to the scenarios of

national marine strategies. Assumptions have been made about linearity in benefits. This might be a reasonable approximation. However, further studies are required to assess the validity of this assumption. Ecosystem service analysis provides an important link between the improvement of marine ecosystems and welfare measures. The cause-and-effect relations concerning individual welfare implications and business opportunities deserve further research.

Another challenge pertaining to CBA concerns the estimation of indirect costs. This is related both to the lack of ex post studies and the fact that the appraisal concerns measures rather than policy instruments. Finding cost estimates when implementation is unclear implies that less is known about indirect costs and, for this reason, indirect costs might be overlooked. It is, therefore, highly probable that the cost estimates of the CBAs suffer from downward bias.

The reviewed CBAs have presented sensitivity analyses. At the level of recommendations, only the qualitative CBA of Estonia compares the scores and provides a ranking at the level of individual measures. At the same time, it is not possible to conclude whether the benefits of the measures—either separately or at the aggregate level—exceed their costs. This is due to the lack of monetization of benefits. The Finnish and the Swedish CBA provide net present values at the aggregate level. Valuation that can enable the monetization of disaggregate benefits is another area that deserves further research.

Regional coordination of economic analyses has been rather modest during the first cycle of MSFD for different reasons. For the second cycle, HELCOM has initiated activities to coordinate the approaches and methodologies of economic and social assessments of MSFD. In order to achieve GES in the whole regional sea area, it is important to consider cross-country coordination of measures since measures taken by individual countries are not sufficient to achieve GES in their national marine area. Moreover, in the face of limited public resources at the national level to conduct the required valuation studies, coordination opens up opportunities for collaborations at the regional sea level and for valuation studies across neighbouring countries.

Notes

1. The Marine Strategy Framework Directive calls for additional measures to those relevant to other directives and EU policies and concern the quality of marine waters. The Directive states that: "In so far as particular aspects of the environmental status of the marine environment are not already addressed through Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (2) (WFD) or other Community legislation, so as to ensure complementarity while avoiding unnecessary overlaps".
2. Annex vi of MSFD presents eight types: input and output controls, spatial and temporal distribution controls, management coordination, traceability measures, economic incentives, mitigation and remediation tools, and communication, stakeholder involvement and public awareness.
3. Havs-och Vattenmyndigheten in Swedish.
4. Baltic Sea Action Plan (BSAP): http://helcom.fi/baltic-sea-action-plan.
5. HELCOM approved the Baltic Sea Marine Litter Action Plan in 2015.

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