Fisheries management

Background Paper

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Preface

BalticSTERN (Systems Tools and Ecological-economic evaluation – a Research Network) is an international research network with partners in all countries around the Baltic Sea. The research focuses on costs and benefits of mitigating eutrophication and meeting environmental targets of the HELCOM Baltic Sea Action Plan. Case studies regarding fisheries management, oil spills and invasive species have also been made, as have long-term scenarios regarding the development of the Baltic Sea ecosystem.

The BalticSTERN Secretariat at the Stockholm Resilience Centre has the task to coordinate the network, communicate the results and to write a final report targeted at Governments, Parliaments and other decision makers. This report should also discuss the need for policy instruments and could be based also on results from other available and relevant research.

The final report “The Baltic Sea – Our Common Treasure. Economics of Saving the Sea” was published in March 2013. This Background Paper Fisheries management is one of eight Background Papers, where methods and results from BalticSTERN research are described more in detail. In some of the papers the BalticSTERN case studies are discussed in a wider perspective based on other relevant research.
Summary

The Baltic Sea is a complex ecosystem that changes over time. Adding to the ecological complexity, the various social and economic components broaden the complexity in the Baltic Sea social-ecological system. The Baltic Sea is an important resource that is utilised for various purposes by the nine countries that surrounds the water basin. The complexity that characterises the Sea and its user patterns complicates management. Notably, existing management strategies have its limits. Current management approaches are challenged by not actively addressing the complexity, or dealing with conflicting goals as there is limited policy cohesion and adaptability.

For the BalticSTERN project, we have performed an economic analysis of the implication of different priorities of goals for fisheries, including social, economic or ecological goals. Our analysis suggests that different types of goals (social, economic and ecological) generate different results. Decreasing fishing effort contributes to long-term sustainable yields and higher long term profits, but poor data quality makes it difficult to make an adequate assessment of costs and benefits of fishing. Fish stocks dynamics (in the past and future) are also critically dependent on multiple drivers of change, illustrating the need for an integrated approach and efforts beyond the fisheries sector.

We suggest that addressing the complexity and uncertainty that characterise the Baltic Sea fisheries requires that a) a common vision and a prioritized target is identified; b) a fisheries governance approach that is “fit for purpose” is distinguished and that a; c) policy coherence is addressed using an “integrated” approach across different sectors that are influencing, or are influenced by fisheries.
1. Introduction

Like fish stocks in most ecosystems, the Baltic Sea stocks are influenced by a number of different driving forces (Jackson et al., 2001). These driving forces change over time, as does the Baltic Sea ecosystem. Long term (100 years) historical analyses (Österblom et al., 2007; Eero et al., 2008; Eero, 2012) has illustrated that the Baltic Sea has changed substantially, from one with high numbers of seals, low levels of nutrients and likely low fish productivity in the beginning of the century (Hansson et al., 2007) - to an ecosystem that at present have few (but recovering) seals, high nutrient levels and high fish productivity.

Long-term changes in ecosystems often contribute to a “shifting baseline” (Pauly, 1995), leaving room for policy makers and user groups to debate on what “normal” really is. In depth analyses of ecological dynamics over the last thirty years (Casini et al., 2008; Möllmann et al., 2009) illustrate that ecological change can be relatively rapid. A historical high abundance of cod (Gadus morhua) in the 1980s, followed by a decrease in cod due to overfishing and environmentally unfavorable conditions, resulted in a shift to increased abundance of sprat (Spattus sprattus), subsequently followed by a recent increase in cod (Eero et al., 2012).

Motorized vessels were introduced in the early 20th century and fishing capacity increased continuously during most of the century (Hammer et al., 2008). The rapid decline of the cod stock after the historical peak in the early 1980s was driven by recruitment failures, as well as by overfishing from a fleet with problems with overcapacity. From being mainly a fishery for supply of local markets, the fishery today is more integrated in the global market, where supply and demand dynamics at global and regional scales change the conditions for local Baltic Sea fisheries. Recent data suggests continued overcapacity, leading to low profitability and noncompliance with fishing regulations (European Commission, 2007; Hentati-Sundberg, 2011; Zeller et al., 2011).

At present, as illustrated in the FishStern report, the type of fishing vessels operating in the Baltic Sea range from smaller coastal vessels using passive fishing gears and landing comparably less amounts of high-quality fish for human consumption, to larger, ocean going pelagic trawlers that catch great quantities of sprat and herring, mainly used for fish meal and fish oil production. Apart from different ecological impacts, fishermen operating such different fishing operations likely have different motifs behind their activities, which also make them respond to management in different ways. For instance, price fluctuations may have larger impacts on more vulnerable parts of the fishing fleets. Large scale fishing activities may be better equipped to adapt to changing ecological conditions as they can operate over substantially larger geographical range compared to small scale fishing activities.

It may also be more demanding to stay up to date with changing regulations in one-man fisheries operations than in larger fishing companies. Monitoring compliance will also be substantially different between numerous, small-scale and diverse fisheries, compared to larger scale and more specialized fishing operations. For instance, social control mechanisms may be more easily developed in coastal communities and fishing operations close to shore
and landing in the local harbor, compared to large scale, offshore operations landing in distant locations.

A major challenge if sustainable fisheries management is to be achieved is how to implement an ecosystem approach for fisheries. An ecosystem approach requires goals for fisheries policy beyond single-stock targets on a year-to-year basis. Based on a general goal related to ecosystem health, it needs to define targets in a broader context, including how different species interact with each other or how fishes are influenced by habitat characteristics adopting a long-term perspective. There is an increased interest in ecosystem-based management; for example, EU-policy is developing tools to adopt such an approach (CFP, 2002). Scientists (e.g., within ICES) and fishing industry representatives are developing methods (i.e., multispecies models and large-scale experiments) and tools (bycatch reduction technologies), which contribute to the development of an ecosystem based approach, but existing initiatives have not had a systemic impact on fisheries governance in the region (Österblom et al., 2010).

Meanwhile, the environmental sector is developing indicators and other policy tools for making the ecosystem approach operational (MSFD, 2008; BSAP, 2007). Whereas the HELCOM Baltic Sea Action Plan mainly has a focus on measures relating to eutrophication, the Marine Strategy Framework Directive (MSFD) has a broad approach on ecosystem health. Thus far, there has been limited efforts directed at ensuring coherence between environmental and fisheries policies, which is likely necessary for achieving ecosystem related sustainability goals.

The existing goals of fisheries management in the Baltic Sea are not only driven by ecological targets. Equally strong in the 2002 Common Fishery Policy of EU (CFP) is the goals of a sustainable and prosperous fishing sector. Thus far, the results of the efforts to balance ecological and socio-economic goals in policy have not been satisfactory, not least shown in the overcapacity in the fishing fleet (European Commission, 2012). Re-defining socio-economic goals in cohesion with ecosystem goals, making trade-offs between goals and dividing responsibility between international, national and local decision bodies can be a first step towards a coherent ecosystem based management of the Baltic Sea. It is currently uncertain to what extent the ongoing CFP-reform will address the issue of potentially conflicting goals. In its two resolutions adopted on 12 September 2012, the European Parliament endorsed the Commission's call for a thorough and ambitious reform of the CFP to ensure long-term environmental sustainability and to secure economic and social viability. In June 2012, the Council of Ministers agreed on a joint approach to the reform, in which the Fisheries Ministers also confirmed the commitment to sustainability as the guiding objective for the policy. In January 2013, the European Parliament will finalise its position.

The aim of this chapter is to describe different ecosystem services derived from fisheries and the diverse stakeholders utilizing such services. We conduct a comparison of a number of different policy options, focusing on the effects of prioritizing different goals. We also investigate, using scenarios, potential future developments in the Baltic Sea, given different potential changes in climate, water quality and fishing efforts. Using this information
as basis, we then discuss a number of future options related to the use of fish stocks and related ecosystem services.

2. The values at stake

2.1. Who cares about fish?

Fish stocks provide a range of ecosystem functions but are primarily used for their provision services. Commercial fishing has been carried out during most of the last century, although the technologies and species targeted has changed markedly. All Baltic Sea coastal states carry out substantial fishing activities, with Sweden, Denmark and Poland being the major commercial fishing nations.

The commercial fisheries industry is complex and includes diverse fishing strategies, including at one end of the scale, small-scale coastal gillnet operators primarily conducting one-day fishing trips for for example flatfish or cod, and at the other end of the scale, fishermen operating large-scale, technologically advanced fishing vessels, conducting week-long fishing trips and primarily fishing for pelagic species (sprat and herring).

Notably, the Baltic Sea has a value that goes beyond commercial fishing. There is a cultural aspect of fishing that is not a provisioning service in itself but an ecosystem service that should be considered in this context. In addition, recreational fishing is carried out along the shores of the Baltic Sea and can be substantial in some areas (Swedish EPA, 2010). Indeed recreational fishing is a comparably popular spare time activity that also can have a considerable effect on fish communities.

In European fisheries politics the interaction among different fish populations and between fish populations and the Baltic Sea environment is rarely considered. However, fish also play important roles in sustaining the structure and function of ecosystems. The dynamics of the ecosystem represent one important aspect that influences the capacity for different groups of commercial fishermen to sustain economically viable operations. For instance, a reduction of cod stocks and increase in sprat stocks, is likely beneficial to pelagic fishermen, while at the same time, less favourable to coastal gillnetters.

The fishing industry should not be considered a homogenous group with similar aims and ambitions, but rather one with diverse values, interests and priorities.

Citizens with an interest in the environment, living around the Baltic Sea, have likely not missed the discussions during the last decade related to the status of this ecosystem and its fish stocks. Environmental non-governmental organizations (NGO) have invested substantially in efforts to communicate how fragile the Baltic Sea environment is (e.g., consumer guides, annual score cards, national campaigns, lobbying, education and participation in meetings). Fish consumer guides that NGOs have produced have had substantial impact on consumer preferences in some Baltic Sea countries.

Fish stocks represent important ecosystem services for a wide set of users in the region, and environmental concerns related to the Baltic Sea have also contributed to shaping the conditions for fishermen operating in the area.

A third important driver of change, and factor that influence fishing
activities, is political agendas and the policies developed, at national and international levels. The countries around the Baltic Sea have diverse priorities related to fisheries development or environmental protection, which is influencing not only international negotiations, but also national implementation and enforcement of existing policy tools. The different national policy priorities will result in different levels of success in terms of keeping sustainable fish stock, especially those species that are not regulated through CFP.

2.2. How are fish stocks managed in practice and who is in charge?
The Common Fisheries Policy (CFP) represents the most important policy tool for Baltic Sea fisheries. Commercial EU-fisheries is a common policy area that compares with the EU Common Agriculture Policy (CAP). This means that the EU council takes the final decision on how to manage fish stocks, based on for example scientific advice from ICES. The EU-Member States then has to adopt the rules that were decided by the EU council. The EU parliament is also part of the decision-making process. Fishing quotas for the Baltic Sea are decided each year, although some stocks are currently managed with multi-annual plans. However, these decisions are often based on various national priorities (i.e., the policies of some countries are more directed towards conservation and others towards more intense resource use) and the CFP framework may in some instances leave much room for interpretation. The policy specifies no priorities between social, economic and ecological goals, which leave room for political negotiation with a give and take situation among Member States.

The Common Fisheries Policy is however not the only international policy tool with implications for fisheries. There are also other policies, from the environmental sector, such as the EU Marine Strategy Framework Directive, that could influence the fishing sector. It involves a number of policy targets (descriptors) that, if implemented, could affect fishing activities. Targets include, for example, maintaining biodiversity, targets for age and size distribution in fish stocks, ambitions to secure ecosystem structure and function and minimizing impacts on benthic ecosystems. At present, much work is directed towards a better definition of these targets, and it is currently unclear how policy makers can ensure how these targets, when operational, can be made consistent with other targets from the fisheries policy. This example of unclear, or different targets, raise the important question of how to ensure cohesive policies. It also raises the question of responsibility. What organisation will take on responsibility for ensuring such consistency and which targets should have precedence?

2.3. Scenarios in FishSTERN – main results
Different social, economic and ecological goals within the Common Fisheries Policy and additional environmental goals within environmental policies may create conflict within or between policies. Conflicts could also occur between different segments of the fisheries sector, as well as between commercial fishermen and other user groups.

In the following section, we look at different scenarios, where a number of
different goals are prioritized. We focus on the commercial fishing industry to highlight some effects of policies focusing on either maximizing profits, employments, ecosystem function or a mix of the three. We used data from all Baltic Sea countries, including between 5000-6000 vessels depending on year analysed, representing a mix of large, medium and small fishing activities. This sub-sample represents part of the complex system described above, but still present some challenges associated with identifying coherent policies in complex systems with diverse goals.

Model tools are useful to simulate different management scenarios and their potential ecological and economic impacts. The pre-requisite that such scenarios using model projections are relevant and realistic is the availability of high quality data to calibrate such models. In the FishSTERN project an existing but more advanced version of the Baltic Nest Institute food-web model has been applied to explore possible impacts of different fishery management scenarios (Swedish EPA, 2011). This model is calibrated to high quality and long-term ecological data spanning more than three decades of monitoring data from hydrological (e.g. temperature, salinity) and biological variables (e.g. plankton, benthos, fish). The model is built within the Ecopath with Ecosim (EwE) software (www.ecopath.org), one of the most used software applications in ecological modelling connected to fish and fisheries. Thereafter, four management scenarios were calculated using an economic module, which already exists in the EwE software. This module was calibrated with all the economic data, which were collected from the Baltic Sea countries, involved in the FishSTERN project.

Economic fisheries-related data from seven countries around the Baltic Sea were collected, which formed the basis for the modelling and management. It appears that, depending on the fishing fleet segment, different dominant harvested fish species can be identified. Cod is, in terms of value, the most important species for the passive gear segment as well as for the demersal segments (Swedish EPA, 2011).

In general, the Baltic Sea fishing fleet employs more than 9400 persons and in 2007, it generated more than 160 million Euros of value added (Swedish EPA, 2011). Obviously, the profitability depends on the different fishing fleet segments. The passive gear segment generated losses, while the pelagic segment seems to balance on the edge, changing from profits one year to losses another. The demersal gear segment, with vessels with a minimum size of 24 m, shows stable profits, while in the length class below 24 m, the situation resembles the pelagic segment.

The economic module in the model used in the FishSTERN project performs optimization scenarios for fisheries policies based on certain economic, social and ecological assumptions. This management optimization module searches for fishing effort patterns that optimizes specific management and policy goals. The following management scenarios were considered:

- Maximization of fisheries profit (net present value, NPV).
- Maximization of social benefits, expressed as number of jobs per catch value.
- Maximization of ecosystem health.
- A combination of all three previous scenarios equally weighted.
The aim was to optimize the fleet efforts over the whole simulation period, that is 2006-2026, for the four above-mentioned conditions. The resulting fleet efforts are translated to fishing mortalities in food-web module, which are then used to evaluate yield and fish biomasses in the Baltic Sea.

The first two management scenarios reflect policy settings from a strictly socio-economic point of view, where the main objectives were to maximize the cash flow and the employment of the fishery, respectively. The third scenario reflects the policy setting from a biological point of view, where the main objective was to (re)generate healthy fish stocks with long lifespans (i.e., analogous to the age and size distribution criteria in the Marine Strategy Framework Directive). The fourth, combined scenario reflects that optimal management should be based on a biological as well as an economic point of view, and that an optimal fishing policy must thus take into account viability of fishing fleets, reflected through earnings and employment, as well as ecosystem health. Based on these pre-defined conceptual scenarios we obtained the following results focusing on the first three scenarios:

1. The profit scenario resulted in a higher total fleet net present value than the other management scenarios.
2. The employment scenario resulted in the highest total fleet landings value of the four management scenarios.
3. The ecosystem health scenario resulted in the lowest total fleet landings value of the four management scenarios.
4. The fishing effort of all fleet segments except of one (the dominant cod fleet) was approximately set to zero based on the above named optimizations in all the management scenarios.
5. The biomass changes of all functional groups, and especially for the target fish species, over the optimization period were approximately the same for the four management scenarios.

The results are generally as expected; the total fleet net present value is expected to be highest in the profit scenario, and the total fleet landings value is expected to be highest in the employment scenario, while the ecosystem health scenario should decrease the fishery, and thus the earnings of this, as much as possible. Overall, the fishing intensity needed to be reduced drastically in all scenarios, as the effort cost would otherwise be too high to make profits.

These management scenarios illustrate the interaction between the effort cost and the number of fish available. In the long run, it is only profitable to have a low fishing at a relatively low fish biomass, as otherwise the effort cost would be too high to make profits, in particular when no subsidies are given. This low fishing pressure will lead to an increase in the fish stock, in particular for cod, which, in the long run, will lead to higher profits.

Notably the data collected for the study should be treated with some caution as cost indicators were lacking for certain countries. It should further be noted that the aggregated total landing data for the fleets did not correspond to the landings data of the International Council for the Exploration of the Sea (ICES) in the Central Baltic Sea. Data problems could explain some
unrealistic results, such as that all fleets but one was forced to stop fishing in the management optimisations.

To improve a fisheries-related ecosystem assessment, the type of economic data needs to be improved and a regional Baltic economic assessment is required (probably also for the Marine Strategy Framework Directive).

Despite the data deficiencies presented here, our analysis illustrate that different policy priorities can have very diverging impacts. At present, there are little or no policy instruments available the could provide guidance on how to make priorities between such goals, nor is it clear if any sector has precedence over others. In addition to these considerations within the fisheries sector, it is clear that other policy areas have substantial impact on the potential to produce healthy fish stocks.

2.4. Interacting drivers of change – a scenario study

Fish stock dynamics are dependent on fishing mortality but are also influenced by other factors. For example climate change is expected to influence Baltic Sea fish through changes in temperature and salinity, which could affect food access, reproduction, recruitment and migratory patterns. An overload of nutrients such as nitrogen and phosphorus may cause oxygen depletion that will have a direct negative impact on the survival of cod eggs. Complex interactions between fishing pressure, climate variability and eutrophication will complicate the situation further (e.g. McKenzie & Köster, 2004; Eero et al., 2011).

In the BONUS funded ECOSUPPORT project, climate, catchment, and marine biogeochemical and food-web models have been linked to simulate the future (until 2100) importance of eutrophication and fishery management on the Baltic Sea ecosystem using modelled future climate change (Meier et al., 2012). Overall, these model simulations indicate that interaction of both management options and climate change affects the dynamics of fish stocks in the Baltic Sea. For example; the best case scenario (the implemented Baltic Sea Action Plan, with substantially reducing nutrient inputs, thereby improving water quality and oxygen levels) and the implementation of the cod recovery plan (maintaining low fishing pressure and thus increasing size and age class diversity of the cod stock), caused an increase in the cod stock in the middle of the century. This was followed by a decrease due to unfavourable recruitment conditions for the cod (decrease in the salinity due to changes in climate). In the worst-case scenario, that is the business-as-usual continuation in terms of both the agriculture and fishery, the water quality decreased with associated heavy summer algal blooms, large anoxic bottom areas and an almost extinct cod stock. The simulations illustrate the importance of incorporating the range of factors that actually regulate fish numbers if successful sustainable management of fish stocks is to be achieved. These simulations illustrate the importance of an ecosystem approach, which would consider fisheries, eutrophication and climate in an integrated way, rather then as separate from each other.
3. Fisheries Governance in an uncertain future

Fisheries can be seen as complex adaptive systems with interacting social, ecological and economic variables (Mahon et al., 2008; Österblom et al., 2011). Managing such complexity requires not only a reasonable understanding of the dynamics of the whole system, but also an understanding of what management tools that can deal with the complexity and adapt policies accordingly. Governing fisheries at multiple scales is one such aspect. Today’s arrangement of fisheries and environmental policy in the European Union with some regulations (fishing quotas and technical regulations, e.g. gear use) at the international scale complemented with various national and local regulations needs to be strengthened, and division of responsibilities between international, national and local levels of governance needs to be better defined.

Taking system complexity into account when designing policy may also be achieved through combining regulatory and directive measures with enabling inputs to promote self-organization (Mahon et al., 2008). In practice, Mahon et al. (2008) suggest an approach where fisheries governance moves away from a “one size fits all” approach, and instead suggest an approach where management focuses on either top-down management approaches, or enabling bottom up management approaches, depending on the characteristics of the fleets involved. Critical for such a division is however that all aspects of the fishing sector, regardless of management approach, all share the same fundamental guiding principles and values. There should thus not be any substantial questions regarding which goals to prioritize. A technocratic, classic and primarily top-down way of managing natural resources is largely based on a command-and-control approach (Holling & Meffe, 1996). This approach, which shares many of the properties of the fisheries management system today at the international and national level in the European Union, is best suited for controllable resources and actors with predictable behaviour. To work well, it will require detailed data, not only on the economic side, but also data relating to the ecosystem. This approach also requires increased monitoring (e.g., including onboard observers) and enforcement (regular inspections), as suggested by the numerous infringements observed due to restrictive TACs in the Baltic Sea during the previous years (European Commission, 2007, CFCA, 2010).

The alternative approach is more dynamic, less driven by top-down control and more focused on bottom up driven self-organization of the fisheries system. This type of management is better suited for dynamic, unpredictable and complex fisheries. This type of management is often conducted more at the local level, but similar ideas are processed within the work of the Regional Advisory Councils for fisheries in the EU, although those councils do currently only have an advisory role. Methods within this management approach include shared information gathering, transparency and inclusion and empowerment of stakeholders (Mahon et al., 2008).

A governance mix between regulatory (command and control) and enabling input may be one way forward in searching for sustainable policy for the Baltic Sea fisheries. Some fleets identified in the FishSTERN (2011) report are large-scale, efficient and homogenous. Those fleets are typically
also land the highest proportion of catches, and thus probably have the largest ecological impact. With increased monitoring, control and data collection, effective regulatory management of such fleets would be a viable alternative. In contrast, small-scale fleets with multiple target species, low efficiency and high heterogeneity are much more complicated to understand, predict and control. Those are also the types of fleets that are often considered important for local communities for socioeconomic or cultural reasons. For such fleets, apart from general agreement on basic guiding principles and values, management approaches more focused on enabling and self-organization could be a future alternative to top-down regulatory approaches.
4. Potential responses/policy recommendations

4.1. Defining guiding principles for desired goals

The Baltic Sea fisheries may appear as an issue that is simpler to address than problems associated with water quality and eutrophication. In contrast to high levels of nutrient loading, which take years to reduce and decades before effects of such reductions can be observed, fishing pressure can effectively be reduced immediately, with likely rapid responses in fish stocks. Our scenarios, however, indicate that fishing pressure is only one driver of change that is influencing fish stocks and a reduction of fishing pressure is likely to have less of an effect if not (on a decadal scale) water issues, are also addressed, and (on longer time scales), climate change is also addressed. The goals for fish stocks thus have to be realistic and take these interacting drivers of change into account.

Another important issue that separates issues associated with fish stocks and eutrophication is the question of desired goals. With the HELCOM Baltic Sea Action plan (2007) an agreement of a common vision among Baltic Sea Ministers of Environment was achieved, stating what the desired goal of eutrophication should be. Notably, there is no such vision for Baltic Sea fish stocks.

The cod and sprat population is interacting through a predator-prey relationship, and the high abundance of sprat in the 1990s was partly due to the overfished cod stock. Recovery of the cod stock, as has happened in recent years, could reduce the abundance of sprat. This is taken into account in current stock assessment models, implying that an increased cod stock can lead to advice for decreased sprat fishing quotas. If such trade offs are made explicit, they could potentially lead to conflict between different user groups in the fishing sector. The scientific community is developing a multi-species assessment and advice as a tool for ecosystem based management. However, problems associated with shifting baselines (see introduction) and unclear targets represent a significant challenge. The scenarios presented in this report illustrate the importance of interacting drivers of change, and the increasing risk of large-scale ecological change in the future. These dynamics underline the importance of arriving at a common vision for Baltic Sea fish stocks. A “desired state” for the fishery should also be achieved. Mahon et al. (2008) defines such a vision is an important starting point for any management approach. We suggest that the BaltFish project, Baltic Sea RAC, HELCOM or other relevant bodies or platforms, initiate an inclusive process to define such goals, based on existing policies. This goal would represent an overarching vision for all fisheries governance in the region.

4.2. Targeted management approach defined by fleet complexity

A practical application of the approach suggested by Mahon et al. (2008) would mean a division of management approaches directed towards Baltic Sea fishing fleets. Such an approach would focus regulatory and enforcement activities on the fishing fleet segments with lowest diversity in terms of fishing practices and target species, and highest ecological impact. Although all
information for making relevant divisions of the Baltic Sea fishing fleets has not been available for this study, an illustration of some aspects of the fleet diversity show some of the differences (Figure 1). As two contrasting examples, the pelagic fishing fleet with vessels over 24 meters catch 55 per cent of the total catches but only represent 2 per cent of the number of vessels. In contrast, the passive gear segment with vessels under 12 meters represent 74 per cent of the Baltic Sea fleet but catches only 6 per cent of the total quantity.

In the pelagic trawl with vessels over 24 meters, management tools such as mandatory and partial industry funded observer coverage on all large-scale vessels are options, combined with prioritization of landings inspections for this part of the fleet. Real time, digital, and partly industry funded observed coverage is implemented in other profitable fisheries with individual quotas, in e.g., coastal British Columbia, Canada. Several large-scale (e.g., Australian) fisheries also operate with individual observers on board. Policy measures including digital or real life observers provide a strong incentive for compliance (Österblom et al., 2011) and are also important for the credibility of large-scale fisheries. Maintaining a top-down approach, including a combination of annual quotas, effort regulations and other policy means to monitor and control this fleet will remain critical for securing sustainability. Increased monitoring of the large scale fishing fleet will contribute to reducing uncertainty in fish stock assessments, which can otherwise be used as an argument not to follow scientific advice. This study illustrate that there are substantial data limitations when attempting to perform an analysis of costs and benefits related to fisheries. The FishSTERN analysis emphasize the problem with access to data, and several important sources of data that are currently not publicly available due to integrity reasons or corporate disclosures policies could substantially add to the understanding of the dynamics of fishing fleet, of relevance to the analysis presented here. Much information is available within agencies and ministers. Such material may not be openly presented but can still be available upon request. Our analysis underline the importance of making data available in a format where these aspects are safeguarded, while simultaneously enabling analysis of such data, in an anonymous format. Several studies of fisheries have illustrated the problem of non-compliance, or IUU (illegal, unreported and unregulated) fisheries (Agnew et al., 2009). Recent estimates (Zeller et al., 2010) suggest historical and systematic problems with non-compliance also in the Baltic Sea region. Non-compliance and non-disclosure of accurate catch and landings data constitute and important barrier for adequate stock assessment and reduces the legitimacy of the fisheries regime for the Baltic Sea (Zeller et al., 2011; Österblom et al., 2011). Several of these data-related issues related to social, economic and ecological dynamics thus represent a real challenge when understanding the dynamics of the Baltic Sea fisheries and the values at stake.

The bulk of the fishing fleet contains small vessels using passive gear (e.g., gillnets). In comparison to the larger vessels these smaller vessels have less impact on the marine ecosystem. It should be noted in this context that small-scale fishing might have additional values, such as being important to local economies, employment and tourism values. Management of the entire
fisheries is characterized by a top-down command and control approach. It has been suggested by Mahon et al. (2008), that the management would be more successful if it to a larger extent recognized the complexity of the fleet. This would include less focus on rules and regulations for the small-scale fleet and more on co-management; that is empowerment of stakeholders enhanced transparency and shared information gathering.

Figure 1. Data on the size of the fishing fleets and catches for Denmark, Estonia, Germany, Lithuania, Poland and Sweden. Data shown is the average for 2005-2007, except for pelagic vessels which show data for 2006 only. Width of bars represent size of the fishing fleet segment. Numbers above bars show percentage of the total catch quantities and percentage of the total fleet, respectively. Fleets are ordered with increasing number of vessels per fleet from left to right.

This would not mean a complete “hands-off” approach to these segments, but rather a “freedom under responsibility contract”. If so, all fleets, would be committed to defined guiding principles (see above). As a consequence, fisheries would be less subjected to detailed, top-down regulations and inspections. They would instead be expected to define and implement local and regional plans for quotas, fishing effort, closed areas, monitoring and control. The role of national authorities would primarily be to restrict their control to evaluating and approving local or regional plans and secure sustained funding for enabling the development and implementation of such plans. Several ongoing “experiments” with local co-management of fisheries (Österblom et al., 2010) has increased the capacity of the industry to embark on such an initiative. It further showed that lack of a clear mandate and sustained funding are critical barriers for the sustainability of such efforts (Fiskeriverket, 2007).
4.3. Policy cohesion – the way forward

a) Ensure consistency in approaches by diverse institutions

The Common Fisheries Policy, combined with national fisheries legislation and national fisheries agencies, primarily govern Baltic Sea fisheries. However, since fishing activities can have direct influence on other components of the ecosystem (the bottom habitat, unwanted catch of seabirds and marine mammals), indirect ecosystem effects (due to changing fish stocks) and since ecosystem conditions (e.g., hypoxia and temperature) influence fish stocks, there are also a number of other decision making bodies and policy frameworks directly relevant for fisheries.

Both fisheries and environmental policies explicitly express the ambition of addressing their respective policy areas with an ecosystem approach (CFP, 2002; MSFD, 2009). The environmental sector is increasingly developing policy frameworks and tools for addressing interactions with fisheries and the environment. One example is the European Marine Strategy Framework Directive, which contains a number of descriptors for an acceptable environmental status, with direct implications for fisheries. The descriptors will form part of international and national environmental targets related to fisheries. The Baltic Sea Action Plan, developed by HELCOM, also includes recommendations related to fisheries. HELCOM has, since a few years, initiated cooperation in a Fisheries/Environment group in order to address issues related to ecosystem considerations related to fisheries, while other organizations, including the Baltic Sea Regional Advisory Council (RAC), is also increasingly developing their understanding of the ecosystem approach.

Other relevant institutions include Baltfish, a recently established forum for cooperation between fisheries ministries in the region. Ensuring that there is consistency in how these diverse policy frameworks and institutions address fish stocks and environmental aspects related to fisheries represent an important challenge. Achieving such consistency would require substantially improved collaboration and coordination between existing institutions. The development of common goals for fisheries, as defined above, would constitute an important first step in formalizing cooperation between existing institutions.

b) Call for cross-sectoral and ecosystem-based approach to marine spatial planning

Marine spatial planning is increasingly used as a method that can facilitate ecosystem considerations in relation to fisheries. HELCOM is, together with VASAB, currently engaged in developing a strategy for the development of this tool in the Baltic Sea, and several national agencies are increasingly using this methodology in the region. There is also currently an ongoing European process that may lead towards more formalized requirements for Marine Spatial Planning (MSP) in the Baltic Sea. Implementation of MSP may fall short of an ecosystem approach, and experience has showed that such initiatives can instead focus primarily on specific issues (i.e., either conservation or offshore wind farm development). Ecosystem based marine spatial planning should be developed in collaboration across sectors and benefit from international and national databases including social, economic and ecological
information.

5. Conclusion
The Baltic Sea ecosystem and its users are complex and change over time. Managing institutions are relatively less dynamic and primarily reactive to these dynamics. As a consequence, current management approaches do not actively address complexity, neither does it actively deal with conflicting goals, as there is limited policy cohesion. We analysed the outcomes of prioritizing different types of goals (social, economic or ecological) and our analysis consistently suggest that fishing intensity needs to be reduced, regardless of goal prioritized. Fish stocks dynamics (in the past and future) are critically dependent on multiple drivers of change, which illustrate the need for an integrated approach and efforts beyond the fisheries sector. Within the fishing sector, we suggest that addressing complexity and uncertainty would require to define a common vision and a prioritized target, defining a “needs, or risk-based” management approach and addressing policy coherence. “Integrated” approaches are addressed different from different sectors and there is an increasing need to ensure policy cohesion.
References


Natuvårdsverket, Report 6348.


