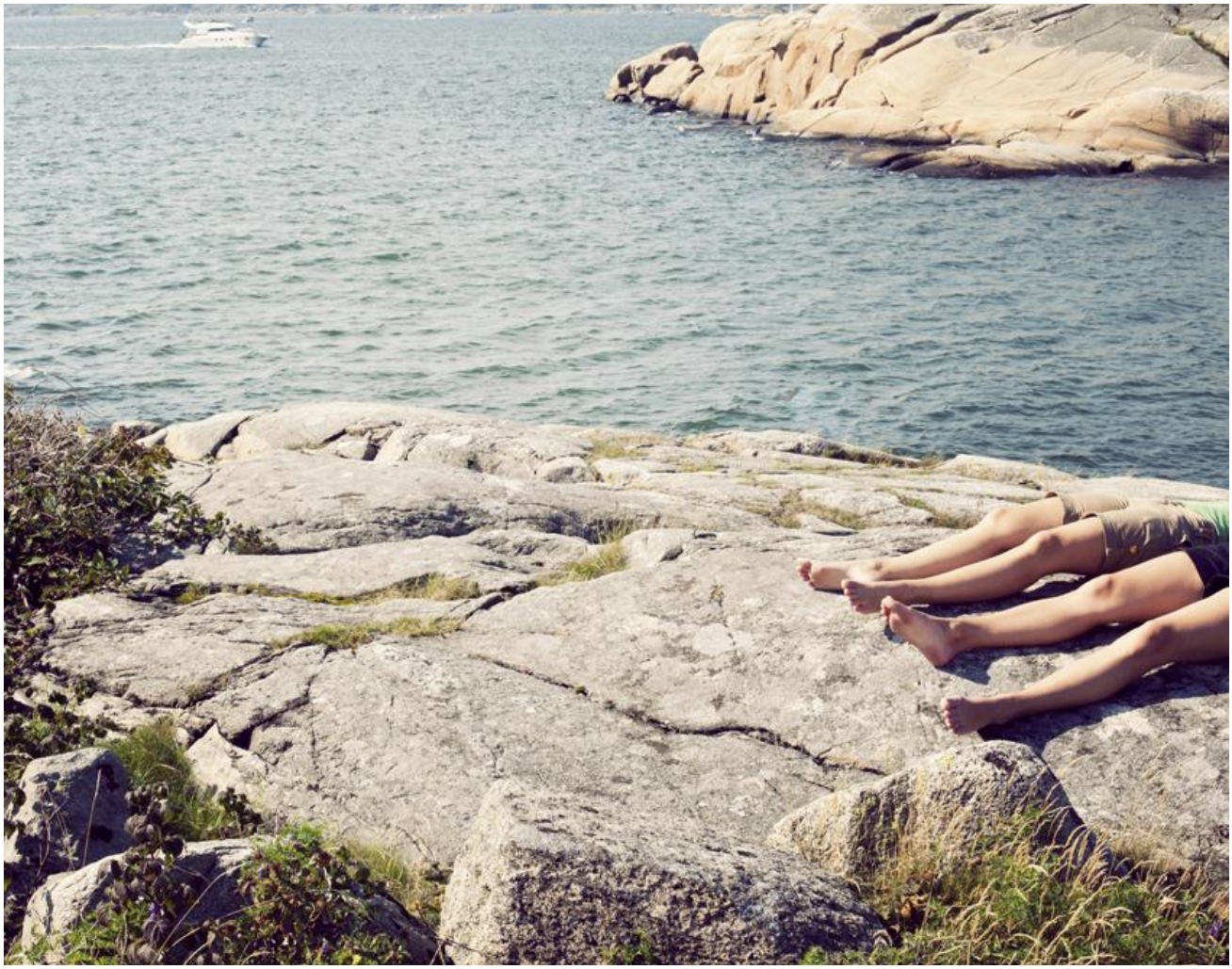
Havs och Vatten myndigheten

Social Analysis: a Marine Societal Analysis

Report Prepared for Sweden's Initial Assessment as Required by the Marine Environmental Ordinance (SFS 2010:1341)



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Foreword

This study was commissioned by the Swedish Agency for Marine and Water Management, SwAM. (Havs- och vattenmyndigheten). It was published by both the Swedish Institute for the Marine Environment (Havsmiljöinstitutet) and SwAM.

The full report has been published in Swedish by the Swedish Institute for the Marine Environment in the form of a main report and three case studies, each of which constitutes a separate report. These studies are:

Social analys – en havsrelaterad samhällsanalys (Social analysis: A marine societal analysis). Havsmiljöinstitutets rapport nr 2012:1.
Fallstudie: Förekomst och tillförsel av näringsämnen (P). (Case study: The presence and input of nutrients (P)). Havsmiljöinstitutets rapport nr 2012:2.
Fallstudie: Selektivt uttag av torsk. (Case study: Selective cod extraction). Havsmiljöinstitutets rapport nr 2012: 3.
Fallstudie: Kvicksilver. (Case study: Mercury). Havsmiljöinstitutets rapport nr 2012:4.

The SwAM has also published the main report in Swedish, report 2012:5. The present English-language version is an abbreviated version of the main report.

The study is an initial attempt to develop and test a method of social analysis of problems in the marine environment in Sweden. We wish to express our deep gratitude to all who have contributed by providing their expertise and advice and by reviewing earlier versions of this work. We hope that the reader will find sections that are useful and thought-provoking. We would welcome anyone who wishes to contact us to offer comments or contributions to our efforts to support measures to improve the marine environment.

August 15, 2012
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CONTENTS

SUMMARY 7

1 INTRODUCTION 8
1.1 People affect and are affected by the environmental condition of the sea 8
1.2 How are social analyses carried out? 9

2 PURPOSE OF THE STUDY 11
2.1 Purpose and limitations 11
2.2 Questions 12
Analysis questions for case studies 12
2.3 Selection of case studies 13
Presence and input of the nutrient phosphorus (P) 13
Selective cod extraction 13
The presence and input of mercury (Hg) 13

3 METHOD 14
3.1 Conceptual model for the analysis 14
3.2 Data collection and analysis method 15

4 RESULTS OF THE CASE STUDIES 17
4.1 Compilation of affected groups in the phosphorus study 18
4.2 Compilation of affected groups in the cod study 18
4.3 Compilation of affected groups in the mercury study 20
4.4 Comparison of case studies as regards actor groups' hierarchical levels 21
Affected groups in the 'Impact on society' component (Table 1) 22
Affected groups in the 'Response' component (Table 2) 23
Groups affected by 'Direct driving forces' (Table 3) 24
Affected groups in the 'Indirect driving forces ' component (Table 4) 26

5 CONCLUSIONS 27
5.1 Introduction 27
5.2 Conclusions as regards actors 27
What might the identification of different actors be used for? 27
High complexity on a general level requires specific handling 28
Indirect actors and driving forces 28
Rational behaviour by individuals 29
5.3 Conclusions regarding the methods used 30
Access to material 30
Evaluation of the DPSIR, the question template and the use of case studies 30

5.4 How might social analyses be further developed? 31
What is important? 31
Future indicators to use for societal analysis and follow-up 31
5.5 Final considerations 33

REFERENCES 34
Appendix A. Marine Strategy Framework Directive (MSFD) and Annex, Table 2 35
Appendix B. Millennium Ecosystem Assessment (MEA): Ecosystem service, Consequences of ecosystem change for human well-being, and a MA Framework 38

Summary

The Marine Environmental Ordinance (SFS 2010:1341) is part of a strategy to bring about ecosystem-based management and sustainable use of the marine environment in accordance with the EU's the Marine Strategy Framework Directive (MSFD, 2008/56/EC). The ordinance is intended to maintain or achieve good environmental status in the marine environment. Under the Marine Environmental Ordinance, the Swedish Agency for Marine and Water Management (SwAM) must ensure that an initial assessment is carried out on the marine environment in the Swedish waters of the two regions, the North Sea and the Baltic Sea (Articles 13–16). The initial assessment, which is to be completed by 15 July 2012 and reported to the European Commission not later than 15 October of the same year, is to provide a basis for the establishment of good environmental status, environmental targets and environmental monitoring programmes, as well as the preparing of programmes of measures by which established targets may be achieved.

The initial assessment will include conducting an economic and social analysis. The former can be divided into two parts, the first of which is designed to analyse the use of the marine region and the second to describe the cost of the degradation of the marine environment (Marine Environmental Ordinance, Article 13, para. 4, and the Marine Strategy Framework Directive, Article 8.1c).

The primary purpose of the social analysis in the initial assessment is to create a picture of the underlying conditions of the upcoming work to achieve the aims of the directive, that is, good environmental status (GES, Article 9). The analysis is also intended to provide basic information for the establishment of environmental targets (Article 10) that will subsequently form the foundation of programmes of measures and administrative funding (Article 13). The assessment includes an analysis of how different groups in society can be affected by how the sea is used and by marine environmental problems and measures taken to address them. This study presents a method by which such an analysis can be conducted. The method includes a conceptual model that consists of the components 'Indirect driving forces, 'Direct driving forces , 'Environmental pressures, state and impact', 'Impact on society', and 'Response'. The model is used in combination with a question template to analyse actors, activities and driving forces. Case studies involving three environmental problems – selective overfishing of cod and the unwanted dispersion of mercury and phosphorous – show that a large number of actors are involved, directly and indirectly. In addition, these actors operate on several levels –local/regional, national and international.

Every environmental problem requires its own analysis and has its own set of conditions. The study shows that the information needed for making decisions regarding the measures that should be taken is relatively extensive. The determination of the amount of information necessary and therefore how much should be systematically collected in future can have a great impact on the development of society and the environment. Finally, suggestions are given as to how future social analyses relating to the marine environment might be carried out.

1 Introduction

1.1 People affect and are affected by the environmental condition of the sea

Under the surface of the sea are major natural values that are affected in various ways by human activities and attitudes. From recent years' evaluations of the condition of the marine environment, it is apparent that condition falls short of the target status prescribed by both the EU and Sweden, namely, that the ecological status of the marine environment should be good (Article 1, Marine Environmental Ordinance). The greatest threats to the sea are considered to be eutrophication, overfishing and the loss of biological diversity. But other threats, such as the dumping of dredged sediment, fish farming and sand and gravel extraction, contribute to the situation.[1]

The specific pressures identified by the Swedish Agency for Marine and Water Management as the most serious are:

1. Selective extraction of fish – that is, the manipulation of fish populations in terms of species and age group through trawling and net fishing.
2. The input of organic material and the nutrients sulphur and phosphorus.
3. The input of non-synthetic toxic substances, such as lead, cadmium and mercury.[2]

To improve the environmental situation in the sea, all EU member states are required, under the Marine Strategy Framework Directive (MSFD), to take certain measures. Before any measures can be taken, however, there must be a body of underlying data that describes the problems, their causes, and possible ways to deal with them. In Sweden, the directive has been implemented through amendments to the Environmental Code (1998:808, particularly Chapter 5) and through the Marine Environmental Ordinance (2010:1341). This ordinance indicates that the Swedish waters (the Baltic Sea region and the North Sea subregion of the North Atlantic) shall actively be managed in six-year management periods. The agency primarily responsible for this administration is the Swedish Agency for Marine and Water Management (SwAM), which is officially responsible for a number of tasks during the following five phases of the management cycle[3]:

[1] See, for example, Helcom Report No. 125 (2010), Towards a tool for quantifying anthropogenic pressures and potential impacts on the Baltic Sea marine environment.

[2] See, for example, Helcom Report No. 125 (2010), Towards a tool for quantifying anthropogenic pressures and potential impacts on the Baltic Sea marine environment.

[3] Article 13 of the Marine Environmental Regulation: The Swedish Agency for Marine and Water Management shall ensure that an initial assessment is made of the marine environment in the North Sea and the Baltic Sea. The assessment shall serve as the foundation of the administration referred to in Article 9.

1. Make an initial assessment of the environmental status,
2. Establish what characterises a good environmental status (GES),
3. Develop environmental quality standards, including the indicators to be used to assess whether or not a good environmental status is being maintained,
4. Develop and implement a monitoring programme to ensure that the environmental quality standards are followed, and
5. Develop and implement a programme of measures to be taken to maintain or achieve a good environmental status.

Each phase shall, according to the directive, be carried out in accordance with an established schedule. The first task – carrying out an initial assessment of the environmental status – shall be completed by 15 June 2012. It includes an analysis of fundamental characteristics and environmental status, an analysis of load and pressure, a description of the activities and actors in society that impact and are impacted by these conditions, and an economic and a social analysis.[4] (See Appendix A).

The initial assessment shall, as a whole, encompass a description of:

A. The essential features and characteristics, and current environmental status of Sweden's marine waters.
B. The factors and human activities that impact the environmental status.
C. An economic analysis of the use of Swedish marine regions and the cost of degradation of the marine environment.
D. How different groups may be affected by the use of the sea, marine-related environmental problems and responses taken to address them (i.e., a social analysis).

The results of the initial social analysis will be available for use in later phases of the management cycle. Social aspects must also be taken into account in decisions on environmental targets and corrective action programmes.

1.2 How are social analyses carried out?

The Marine Environmental Ordinance encompasses many new tasks. A social analysis of the type prescribed in the Marine Environmental Ordinance has not been done before in Sweden. The instructions as to how it is to be done and

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1. an analysis of the fundamental characteristics and circumstances of the marine region,

2. an analysis of the current environmental status in the marine region,

3. an analysis of the most important qualitative and quantitative factors, noticeable trends and human activities that affect the environmental condition of the marine region, and

4. an economic and social analysis of the use of the marine region and the costs that would result from the degradation of the marine environment.

what is to be included are not particularly extensive in either the EU directive or the Swedish regulation. In the first management cycle, the social analysis of the initial assessment may therefore be considered a first step. Hence, this document represents the result of an analysis that can be reused and refined in later phases of the same management cycle as well as in subsequent management cycles. The aim is to develop a general model of social analyses that could eventually be extended to include all relevant areas. It is too early to decide on the strategy to achieve this development; however, it should be connected to the other analyses done in the management cycle that affect policy incentives and prioritisation of environmental targets.

The Commission has had the Working Group on Economic and Social Assessment (WG ESA), which has developed a guidance document.[5] However, this group has focused primarily on the economic assessment. Consequently, the document contains neither advice nor requirements regarding the design or format of the social analysis. In future phases of the current management cycle and in the next management cycle we can expect greater opportunities than existed before to integrate the underlying data with the various parts of the initial assessment.[6]

While there is no established procedure for generating shared and comparable results, there is value in taking advantage of others' experiences and, if possible, using the same methods. This makes it possible to compare some information.

In 2009 the Dutch government commissioned a study to establish what a social analysis could be and how it could be done.[7] Its recommendations of ways to proceed can be summarised as follows:

- Select social indicators on the basis of an inventory of the stakeholders that exert the greatest pressures on the marine environment and on the social drivers of change behind these pressures. Including only the most relevant environmental impacts ensures that the discussion can be conducted on a relevant (that is, high) level.
- Determine which stakeholders are most adversely impacted by measures included in the MSFD. Available cost analyses can provide a starting point for this. Determine also which stakeholders stand to benefit most from the anticipated improvements in the marine environmental state. In this case, available benefit studies can provide a starting point.

[5] COM 2010:17.

[6] An economic report on recreation by Enveco contains sections that relate to social analysis. It identifies ecosystem services for marine regions, analyses current state, load and impact, identifies and evaluates the benefits produced by ecosystem services, and identifies drivchanging forces and pressure linked to the ecosystem services.

[7] Witteveen & Bos, 2009

- Other stakeholders, such as policy makers and research institutions, that are involved in the implementation of the MSFD, need to be identified and consulted to clarify social impacts of the process.

Social analyses can bring various structures into sharper focus. For example, in the Millennium Ecosystem Assessment (MEA), the drivers of change behind impacts on ecosystems have a key role. They are categorised as direct drivers of change and indirect drivers of change, the latter being more general.[8]Another example is the social analysis carried out by the World Bank, which investigates the context in which the bank operates. The bank stresses the utility of conducting social analyses on several levels. For the bank, the country level, the sector level, and the project level are relevant.[9]

As the above indicates, the need for a social analysis can be perceived in various ways. In our perspective, it is primarily the societal aspects as expressed in the MSFD that must be investigated and described. In this study, social refers to the relationships and interactions between people or groups, such as citizens, production sectors, institutions and government agencies. The rules that characterise these relationships can be both informal and formal.[10] A social analysis, then, encompasses an analysis of the relationships or the interactions between the people and the groups.

The Marine Environmental Ordinance stipulates that the initial assessment shall include an economic analysis and a social analysis. In the present study, that has not been considered synonymous with a socio-economic analysis.[11] We draw the conclusion that the social analysis should include the impact on well-being, but in values and perspectives other than solely economic ones.

2 Purpose of the study

2.1 Purpose and limitations

The purpose of this study is to describe various groups' main needs for and use of marine resources, and how groups are impacted by marine environmental problems and by the measures taken to address them. Human activities are the cause of today's marine environment problems, and corrective measures should therefore be focused on changing human behavioural patterns. The

[8] Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being Synthesis. Island Press. Washington, DC.

[9] World Bank

[10] Witteveen & Bos, 2009.

[11] Witteveen & Bos, 2009, page 2.

present analysis focuses on driving forces both direct and indirect – that is, on human activities and their underlying causes. This study describes the current situation and current trends in society. The initial assessment shall[12] be based on existing data material.

It is not possible to perform a full analysis of all areas and aspects. On the one hand, there are no established methods to do so, and on the other, the experience necessary to determine what is important to analyse does not exist. Consequently, it is also uncertain what basic data is required and what form it should take. We initially conduct three case studies based on documents and official statistics. General conclusions based on the case studies are then presented. We elect to focus the case studies on marine environment problems that are understood to be extremely serious, where demands for further corrective measures are highly likely. We also draw conclusions on our method and suggest methods by which future social analyses might be conducted.

Geographically, the analysis is limited by existing boundaries between administrative areas and sea basins, and distinguishes between the Baltic Sea (all water south and east of Sweden) and the North Sea (Kattegat and Skagerrak, including Öresund).[13]

2.2 Questions

The study examines the questions of how different groups affect the marine environment, and how groups may be affected by the use of the sea, marine-related environmental problems and corrective measures taken to address them (see page 3 point D). These questions are analysed via case studies. Which groups will be affected by the corrective measures will depend on the measures that are implemented. That is decided in subsequent phases of the management cycle, which means the groups cannot be identified as anything other than groups that are currently affected or that directly or indirectly govern the operations.

Analysis questions for case studies

Based on the premise that environmental stress arises through society's use of resources, the following questions are asked:

- What societal groups use marine resources in Swedish waters?
- How do different groups use these resources?
- Why do people use marine resources?
- What groups are affected by environmental destruction at sea?
- How and to what extent are these groups affected?

[12] COM, 2010

[13] The official boundary, proposed recently, runs along the Öresund Bridge.

- What interests, structures and other factors drive the adverse change in the environmental condition of the sea?
- What factors counteract the adverse changes in the environmental condition of the sea?

The above questions are further developed into a template for data collection (Section 3) that is applied in three case studies.

2.3 Selection of case studies

The selection of case studies, carried out in consultation with the Swedish Agency for Marine and Water Management, is based on the following criteria:

- A key environmental problem that entails substantial stress on marine ecosystems and tangible impacts on society that will require reparative measures within the near future
- Relevance for both the North Sea and the Baltic Sea
- Data availability

The cases are presented, with supporting arguments, below.

Presence and input of the nutrient phosphorus (P)

Phosphorus is a substance that is essential for life for all living organisms in the sea, and also for people. It is a finite resource that is extracted primarily for use in artificial fertiliser. Phosphorus reaches the sea through leaching from agricultural land and emissions of wastewater, and can contribute to over-fertilisation. In addition to actors that directly affect the input of phosphorus to the sea (wastewater treatment plants, individual sewers, industries and agriculture), groups of actors, such as consumers and households, indirectly play a key role.

Selective cod extraction

Selective fishing gives rise to undesired patterns of size and age distribution – in cod, through the removal of the larger, older fish. The cod play a key role in marine ecosystems, and their reduction contributes to other marine environmental problems (such as eutrophication). Several Swedish cod stocks in the North Sea and the Baltic seas are threatened. Cod fishing is an economically important segment of the fishing industry. It is also valuable in recreational fishing and as a source of food.

The presence and input of mercury (Hg)

Mercury is highly toxic and can seriously impact people and the environment. A non-toxic environment is one of Sweden's environmental objectives, the achievement of which requires that measures be taken. Sweden has national legislation that is more restrictive than the legislation that applies to the rest of Europe. Considering Sweden's role as an international promoter of multilateral action within the EU and globally, a focus on the situation in Swedish society is of value for cross-border dialogue.

3 Method

This study takes a broad-based approach in a theoretical model that in combination with a data collection template provides a structure.

3.1 Conceptual model for the analysis

Sweden has elected to build the initial assessment required by the Marine Environmental Ordinance on the so-called DPSIR model, which is based on the ecosystem approach.[14] DPSIR is an abbreviation for 'Driving forces, Pressure, States, Impacts and Responses'. The DPSIR model was developed to describe and analyse environmental problems through the various components. The model represents a system in which *Driving forces* for societal and economic development *Pressure* the environment and as a result alter the *State* of the environment. This leads to *Impacts* on society and the environment that can trigger a *Response* in society (for example, through government agencies) that in turn changes the operating conditions of the driving forces, changes the environmental impact, or directly alter the status of the environment. The model provides clearly defined steps in a causal chain that can be modified through responses in the form of policy measures.

The present study focuses on societal development. Therefore, it employs an adapted version of the DPSIR model, illustrated in Figure 3-1.[15] This conceptual model employs a broad definition of societal driving forces that includes activities, the actors that conduct activities and the reasons why they conduct the activities. We would like to make it clear that driving forces may be direct or indirect. By direct driving forces change we mean actors and activities that exert pressure directly. By indirect driving forces we mean indirect actors and activities and the underlying reasons and structures associated with them. Indirect actors can have great significance for a social analysis and are therefore included as an individual component in our model. There is also reason to consider social and environmental contexts as they impact several components of the model.[16] The boundary between the social context and indirect driving forces is unclear. Our analysis is limited to components within the box in Figure 3.1 and does not include social and environmental contexts.

[14] European Environment Agency (EEA)

[15] Burkhardt & Müller (2008), cited in Fehlin (2009), is taken as the point of departure as they focus on the marine environment and balanced roles for society and the environment. The EEA's (http://ia2dec.ew.eea.europa.eu/knowledge_base/Frameworks/doc101182) DPSIR model stresses the response.

[16] Petschel-Held et al. in MEA (Ch. 7, Drivers of Ecosystem Change in Ecosystems and Human Well-being; Subglobal Assessment) also employ the terms 'endogenous' (subject to pressuring via societal decision-makers) and 'exogenous' (not subject to pressuring via decision-makers inside the system).

The model can be used in discussing the social and natural conditions. In the conceptual model, we elect to avoid focusing on the natural science aspects and their mutual impacts. Consequently, we use a common component to illustrate 'Pressures on the marine environment; State of the marine environment, and Impacts on the environment'.

There are many links between components in the conceptual – for example, between societal impact and driving forces. Environmental or resource conflicts, for example, can arise in society based on awareness of competition or environmental destruction.

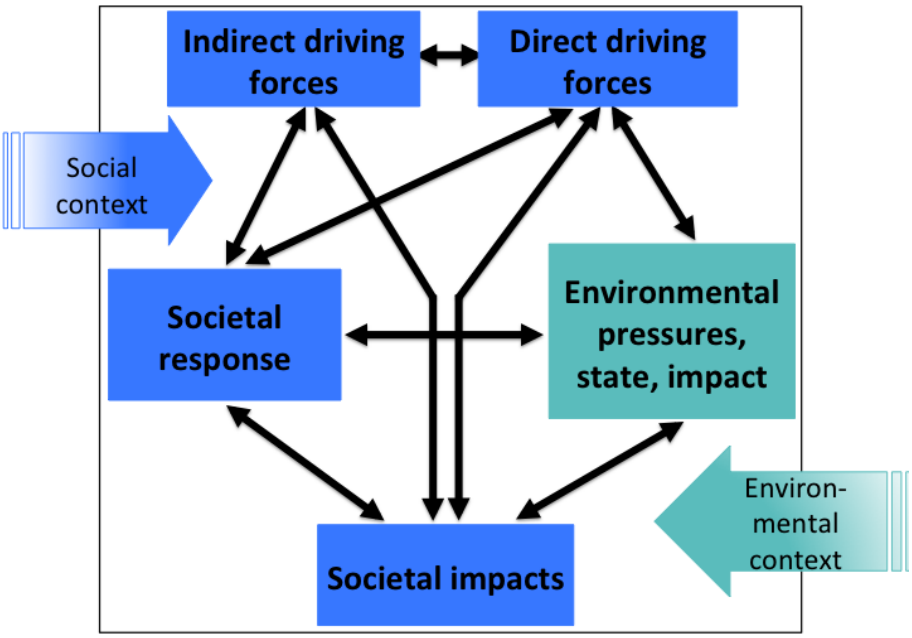

Figure 3.1: Conceptual model for social analysis (adapted version of DPSIR model).

DPSIR and our model are most useful for discussions of new environmental problems. If, on the other hand, the environmental problem remains or becomes worse, an earlier response – in the form of a regulation, for example – may subsequently serve as an indirect driving force. In other words, the model does not fully support an analysis of what happens over time.

Taking the conceptual model as the point of departure, actors and the relationships between them are analysed. This means we examine the actors and roles found in the society-related components of the model (in Figure 3.1, marked in blue). For some questions, it is valuable to discuss the relationship between the components (in Figure 3.1, marked as arrows) and the strength of the connection.

3.2 Data collection and analysis method

In the three case studies, a nine-point template is used to collect actor-oriented information for the various components. As far as possible, the information is

quantified and presented in a geographically restricted form including a description of the trend over time. There are points in the template that provide information for several components of the theoretical model, as is indicated in Figure 3.2. The template is shown below:

1. *Describe the pressures, state and impact on the environment*. The point of departure of the case studies is the impact on the environment. They describe the pressures, state and impact on the environment, focusing on the primary ecosystem services affected (MEA, 2005. See also Appendix B). This point describes what is included in the component 'Environmental pressures, state and impact'.
2. *Describe the activity that gives rise to the pressure*. The activity is included in the component 'Direct driving forces '.
3. *Identify direct actors*. This refers to groups in society that use marine resources in Swedish waters, and they are included in the component 'Direct driving forces '. How the actors use the sea and its resources is also described here.
4. *Identify indirect actors*. This refers to groups in society that indirectly drive or are dependent on the use of marine resources/ecosystem services in Swedish waters. These actors are included in the 'Indirect driving forces ' component.
5. *Identify groups affected by marine environmental destruction*. The Societal Impact component contains information on what groups are affected, how large these groups are, and where they are located.
6. *Describe the way in which and the extent to which these groups are affected*. Societal impact is described using building blocks in the MEA (2005) for human well-being (see Appendix B). These are: security, basic material for a good life, health, good social relations, and freedom of choice and action. These groups are part of the 'Societal impact' component.
7. *Identify factors driving the adverse pressures on the environmental state of the sea*. Factors that drive the adverse pressures and are equivalent to the components 'Direct driving forces ' or 'Indirect driving forces ', but may also comprise 'Response', are described here. Categories that may be relevant include demography, economy and socio-politics (which includes the power to participate in decisions, conflict-resolution mechanisms and the role of the state versus the private sector), culture and religion (which includes values, perceptions and standards/norms), and science and technology.[17]
8. *Identify factors that impede the adverse pressures on the environmental condition of the sea*. These factors may be included in the components 'Response' and 'Indirect driving forces ', and may form the same categories exemplified under point 7, above.

[17] MEA (2005), p. 64, five drivers of change on the global level. See Appendix B. There are also other drivers of change, such as global trade.

9. *Describe the primary uncertainties that impede decision-making relating to the marine ecosystems*. These factors affect the component 'Response'.

The basic data for the case studies is taken primarily from official statistics, research reports and literature reviews. Information has also been collected from contacts with responsible officials and experts at government agencies.

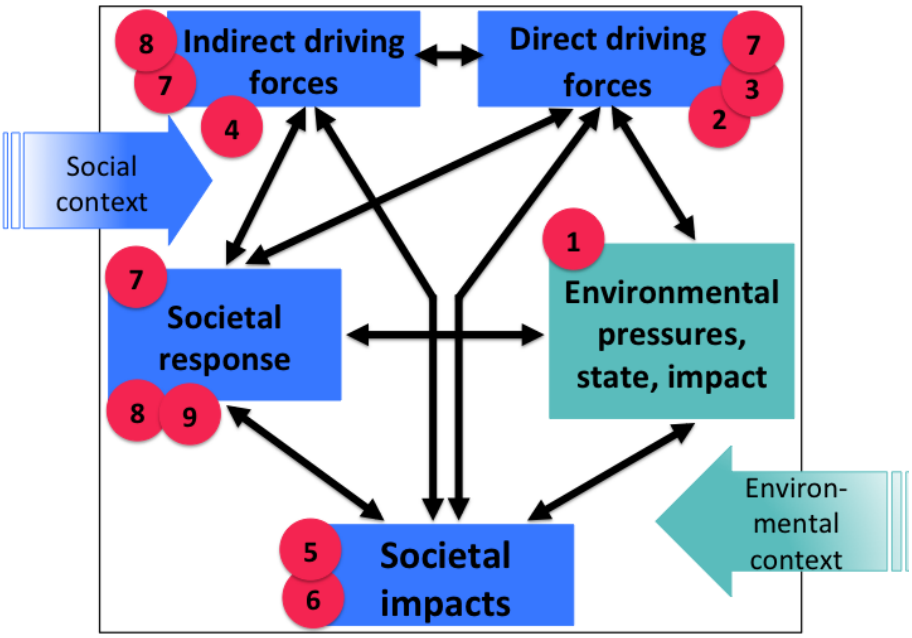

Figure 3.2. Links between the components of the conceptual model and the points in the template.

4 Results of the case studies

The case studies show that societal pressures on the marine environment are connected with various factors. For each case study, specific actors and factors are involved. Over and above the direct activities that contribute to the problems, there are also indirect driving forces. A summary of how various groups impact and are impacted by the use of the sea, its problems and the manner in which they are addressed, is provided below. This is followed by a brief analysis of the distribution of the primary actors across local, regional, national and international levels. More extensive presentations of the case studies including quantitative data are given in separate reports (in Swedish).

4.1 Compilation of affected groups in the phosphorus study

The groups that are primarily affected by the use of the sea (as recipient) are

- physical and legal persons in agriculture, the food industry, wastewater treatment plants, the pulp and paper industry, and employees of such operations
- consumers of products manufactured in agriculture or the pulp and paper industry in Sweden and in other countries, or services (waste treatment)

The groups primarily affected by marine-related environmental problems are

- occupational groups in the hospitality industry, such as camping areas, hotels, restaurants, boat rental companies, diving companies, etc.
- visitors (bathers, sport fishermen, divers, boat tourists, and others pursuing recreation on the coast)
- residents and property owners in the coastal zone
- the public and future generations
- professional and recreational fishermen, who are affected in that fish populations decline, but also in that they are compelled to find new fishing areas

There are many groups that may be affected by measures taken to address the phosphorus problem:

- physical and legal persons in industries that contribute to emissions or to ground leaching (agriculture, wastewater treatment plants, the pulp and paper industry)
- consumers of goods and services whose production/provision can contribute to the input of phosphorus
- political decision-makers who acquire tasks but can also be indirectly affected in that they may appear politically as either decisive or uninvolved
- taxpayers who pay for research, environmental monitoring, supervision, various measures, etc.
- employees of public agencies, consulting companies and researchers involved in monitoring and addressing the problems, as well as those who can commercialise various forms of solutions
- future generations, through reduced risk of accidents and damage, and the costs that would result from them

4.2 Compilation of affected groups in the cod study

The groups or actors that primarily use the sea and contribute to selective overfishing are

- Swedish and non-Swedish professional fishermen who compete with each other and with recreational fishermen
- employees of the fish processing industry, distributors and restaurants, as well as consumers who are dependent on cod products
- indirect stakeholders in the management chain: advisory bodies/consultants who acquire business through regulation and monitoring, EU agencies, Swedish government agencies, Norwegian government agencies
- indirect stakeholders in the social network: fishing interest groups, fishing service companies/organisations, fishing families and coastal communities that are dependent on the viability of fishing

Parties affected by overfishing and the resulting environmental problems:

- consumers who lose a good, tasty source of protein
- fishermen and their families who risk losing their income if fishing ceases to exist
- recreational fishermen and fishing tourism companies that lose their opportunities to fish, which could also affect coastal communities
- fish processing and distribution companies, which would lose income if the cod were to disappear
- fishing service companies and organisations, which would lose income if fishing were to cease to exist
- the media and interest organisations, which generate public debate about the problems
- politicians, who would be forced to act (local, regional, national, EU)
- management bodies and advisory bodies: EU, Sweden, the Swedish county administrative boards, researchers, consultants whose business is based on investigating sectoral and resource problems
- taxpayers who pay an administrative apparatus on several levels
- future generations that will not have cod

Groups that may be affected by measures taken to combat selective fishing:

- entrepreneurs (fishermen) who might have to modify their fishing method or deal with changed business conditions, and would possibly be forced to change jobs
- the fish processing and distribution chain that could be forced to adapt their operations due to fish quality, availability, change of species or periodicity
- consumers who could eventually gain access to better quality fish
- government agencies, which would acquire tasks associated with regulations and integration, monitoring, etc.
- instrument developers, researchers and consultants, who would acquire tasks associated with advising government agencies and industry,

certifying sustainable fishing operations, developing better methods, and monitoring.

- politicians who could further their understanding of the environmental problems of the sea and decide on appropriate measures
- environmental organisations that could play the role of alarm clock, and disseminate knowledge about sustainable fishing
- future generations that could have access to cod and to healthier seas

4.3 Compilation of affected groups in the mercury study

Mercury is a societal problem that has a relatively minor connection to marine sectors.

The groups that are primarily affected by the utilisation of Swedish seas (as recipient) are:

- companies and their employees. Companies in the metal industry and coal power plants emit mercury into the air and water, which may eventually impact Swedish marine regions. Like many other countries, Sweden is heavily impacted by mercury emissions from operations in other countries. Consequently, major improvements stand to be achieved on the national or supranational level.
- consumers of products. The use of goods that contain (small amounts of) mercury means this substance may eventually reach the sea if the producer responsibility for collection is not designed in an effective manner.

The groups primarily affected by marine-related environmental problems are:

- consumers of fish that are exposed to health hazards when they consume fish that has accumulated mercury in polluted areas
- Special risk groups are women who are or who may become pregnant, and small children

Measures taken to address the mercury problem may affect certain groups adversely (through costs associated with the measures) whereas others may be favourably affected. The primary groups are:

- companies that previously used mercury and must absorb costs associated with the transition
- companies that develop new products or create new markets within the extraction sector
- employees in operations that handle mercury or mercury-containing products and can see their own exposure to mercury reduced
- consumers of foods or other products who may see their exposure to mercury reduced, but may also be affected by the impact on the performance or price of the product.

- taxpayers who pay for decontamination (in certain cases) but also for the exercise of public authority, research, environmental monitoring, etc.
- government agencies and decision-makers on various levels who are assigned new tasks
- future generations that may see their risk of injury, and costs involved in responding to injuries, reduced

4.4 Comparison of case studies as regards actor groups' hierarchical levels

The different case studies involve actors on various hierarchical levels in society, from individual citizens, households, companies of various sizes, and regional government agencies, up to international organisations such as the UN. The actors in the three cases are listed below in accordance with the hierarchical administrative levels of the components in the conceptual model.[18] Actor groups and the themes we perceive to be most relevant are discussed in connection with each component.

[18] Administrative scales need not necessarily overlap with geographic scales – for example, municipal federations and county administrative boards are both regional-level agencies with certain responsibilities for environmental and planning issues. It is important to be aware of this in connection with actor analyses and with the design of future policy measures.

Affected groups in the 'Impact on society' component (Table 1)

Table 1. Affected groups on various levels in relation to the 'Impact on society' component.

	Phosphorus	Cod	Mercury
Locally	Coastal zone inhabitants and visitors whose recreational opportunities are impacted by algae blooming, turbidity and excessive proliferation of vegetation. Occupational groups working in the hospitality industry. Recreational and professional fishermen who see their fishing opportunities dwindle.	Current and future occupational and recreational fishermen who will catch fewer cod. Residents and visitors who are affected in that fishing as part of their cultural heritage dwindles and eutrophication becomes more difficult to deal with.	Individuals who may suffer effects that can be linked to local or old emissions.
Regionally	Residents and visitors on the east coast, as well as in certain local sites along the west coast, who are affected by the environmental impact of eutrophication.	The fish processing industry on the west coast, which loses a key species for processing and, consequently, also jobs.	–
Nationally	Consumers, who find their access to certain fish species changed. Farmers, who are blamed. The public, which become anxious. Future generations, in that the functioning of the ecosystem services to which they will have access will be poorer.	Consumers, for whom cod will be less widely available, more expensive, or not available at all. Professional fishermen, who will be blamed.	Consumers, who face greater risks from fish consumption. Women of child-bearing age, and small children. Industry, which will be blamed.
Internationally	Countries with phosphorous to extract, which will reap ongoing demand as run-off leads to phosphorous disappearing out into the sea.	Sweden and its neighbouring countries involved in fishing, in conflict over cod use versus preservation (EU, Norway).	Countries and sectors potentially in conflict (e.g., over energy requirements versus environmental requirements).

Affected groups in the 'Response' component (Table 2)

Table 2. Affected groups on various levels as regards the 'Response' component.

	Phosphorus	Cod	Mercury
Locally	Individual farmers who adapt their methods of fertiliser storage and application. Owners of individual sewers who implement corrective measures. Government agencies and farming consultants who provide advice.	Individuals and NGOs that warn of the disappearance of the cod. Consumers who buy less cod.	Individuals in risk groups who eat less of particular fish species.
Regionally	Waste water treatment plants that are subjected to more frequent, more extensive requirements of further phosphorous removal.	Small-scale fishermen (including sport fishermen) who react against industrial fishing.	–
Nationally	Decision-makers who impose bans and precautionary measures. Government agencies and organisations that conduct information campaigns (e.g. 'Focus on Nutrients'). Environmental organisations (the WWF, the Swedish Society for Nature Conservation, and Greenpeace) that conduct various campaigns.	Sweden, which increasingly incorporates environmental perspectives in its fisheries policy and lobbies the EU. NGOs that promote the cause (WWF, etc.). Industry organisations that seek ecolabelling for certain fish stocks. The KRAV and MSC ecolabels that are applied to certain cod products. The business community, government agencies that create events and prizes.	Government agencies that act in a manner supportive to emission producers through dialogue, collaboration, bans and regulation. Government agencies that issue food recommendations. Enterprises driven by bans and phase-out projects to undertake technical development.
Internationally	Sweden, which promotes the issues internationally – for example, in HELCOM and in the EU. HELCOM, which has a coordinating role in the Baltic Sea, particularly through BSAP. The EU, which regulates eutrophication in various ways, such as through the Water Directive and the Marine Environment Directive.	The EU, which takes action against national fishing fleets and individual fishermen. Environmental organisations and the food industry, which create ecolabels and ranges of choice for consumers.	Regulation is being prepared by the EU and by the UNEP. The EU regulates import and export, and establishes requirements on business operations.

Several organisational levels implement measures in all three cases, and the measures have been implemented over time. The cycle of this conceptual model has consequently been completed several times. In all three cases, the government agencies have primarily directed their response toward the primary driving forces and less toward the indirect driving forces.

Over the years, the handling of the phosphorus problem has developed into a complicated web of administrative processes, sets of regulations, controls, information, and advice, as well as more informal and temporary collaborations between actors on all levels. The case study for cod shows that measures are implemented on all actor levels. Over the past few years, not only have these measures involved government agencies but they have also entailed development of other types of incentives (environmental prizes, ecolabelling, development projects) through new constellations (the business community and NGOs). Measures in the mercury case are implemented at the national and EU/international levels, whereas local measures are limited.

Groups affected by 'Direct driving forces' (Table 3)

Table 3. Affected groups on various levels in relation to the 'Direct driving forces ' component.

	Phosphorus	**Cod**	**Mercury**
Locally	The farmers who spread fertiliser so their crops will grow and food, etc., will be produced. The pulp and paper industry, which produces waste emissions. Municipal wastewater treatment plants that purify wastewater. Owners of individual sewers who fail to meet waste treatment requirements.	Professional and recreational fishermen who compete with each other for a scarce resource.	Government agencies and the business community, which collaborate in opposition to the across-the-board phasing out of mercury.
Regionally	-	Professional fishermen (primarily from the west coast) who trawl for cod.	Same as for 'Locally'.
Nationally	-	Same as for 'Regionally'.	Same as for 'Locally'.
Internationally	Other countries impact the Baltic Sea through their emissions.	Industrial-scale professional fishermen from other countries who continue to fish in Swedish waters.	Today, Sweden is primarily impacted by the emissions of other countries.

Phosphorus is necessary for agriculture, but contributes to the eutrophication of the sea. Cod fishing is one of the most income-bearing segments of Swedish professional fishing, on both the local/regional level and the national level, which means the sector is vulnerable to the disappearance of the cod stocks.

Sweden has no strong driving forces for the use of mercury. National regulation favours the phasing out of the element. Instead, it is actors in other countries that comprise the primary sources of pressure from mercury that occurs in Sweden.

Affected groups in the 'Indirect driving forces ' component (Table 4)

Table 4. Affected groups on various levels in relation to the 'Indirect driving forces' component.

	Phosphorus	Cod	Mercury
Locally	Consumers who demand and purchase food and cleaning agents, paper products, etc. Households, companies and public institutions that use their toilets.	Families of fishermen, and employees of the fish processing industry who want to keep their incomes/jobs. Buyers on Sweden's west coast, who constitute a complete processing chain.	Among the public and companies in Sweden, the driving force for the use of mercury is not strong; rather, the preference is for the phasing out of the element.
Regionally	–	Same as for 'Locally'.	Same as for 'Locally'.
Nationally	Consumers who demand and purchase food and cleaning agents, paper products, etc. Sweden's politicians, who protect food and pulp and paper manufacturing. Consumers, who demand ecologically grown food and reject products grown in soil on which waste sludge has been spread. Food chains and wholesalers who import food.	The administration's focus on protecting both the resource and the industry has impacted its governance. Industrial-scale fishing interests have long been better represented in the administration than small-scale fishing and recreational fishing. Government agencies' monitoring and penalty procedures that have not been sufficiently active to prevent noncompliance with regulations.	Same as for 'Locally'.
Inter-nationally	Baltic Sea countries that promote the development of the Baltic region, for example, through the Baltic Sea Strategy, which may increase the need for food, etc.	Government agencies that support low fuel costs and efficiency-promoting subsidies have provided effective but environmentally detrimental tools. Industry, which has had major opportunities to influence decisions through fisheries ministers. The EU's structural and support measures led to concentration. Countries fall short in monitoring and penalising breaches.	Population increases, economic development and increasing energy requirements in different countries continuously exert pressure, particularly through the ongoing use of coal as an energy source, thus continuing their emissions of mercury to air.

5 Conclusions

5.1 Introduction

This study contributes to an analysis of how groups of societal actors affect and are affected by the marine environment in the Baltic and the North seas. By employing a conceptual model based on DPSIR, this study reveals both direct and indirect driving forces in the actors that adversely impact the marine environment. Just which societal groups impact and are impacted by the three case studies' marine problems and the responses to them is analysed with the help of the question template.

This initial analysis of societal aspects of marine environment problems creates a foundation that can support the establishment of targets and subsequent decisions as to response measures. The report may also be used to structure future analyses and create a common frame of reference for case studies. Presented below are conclusions as regards: 1) which groups of actors impact and are impacted by the problems of the marine environment and the measures taken to address them, 2) the methods used, and 3) the possible further development of social analyses in relation to the state of the marine environment.

5.2 Conclusions as regards actors

What might the identification of different actors be used for?

Identifying the affected groups is important for future efforts to address the problems of the marine environment. It creates a basis for determining which groups should be consulted prior to decisions on response measures. Future generations have also been identified as a group that is impacted by marine environmental impact and response measures. This group is difficult to reach for consultation, for obvious reasons. Consequently, the responsible government agency should ensure that the group's interests are taken into consideration if possible.

The analysis can also provide a basis on which to assess causes and mechanisms that led to marine environment problems, particularly by identifying not only direct but also indirect actors. This knowledge may contribute to identifying important indicators to watch in the future. Similarly, an analysis of groups that impact and are impacted could be significant in decisions on how the burdens that arise as a result of response measures taken should be distributed among various groups of actors. Just which groups are favoured by the response measures could also be clarified in a similar manner. Placing a focus on all groups that could be affected and on how they are affected is a key step in preparing for decisions on various types of measures, to enable different options to be weighed against each other.

High complexity on a general level requires specific handling

The descriptions of the case studies clearly show that there is a complex set of factors that together contribute to marine environment problems. By means of precisely formulated descriptions, the connections between different actors that impact and are impacted by the problems become more readily comprehensible. The case studies show that the different environmental problems are driven by actors on all levels – the local, the regional, the national, and the international.

In all of the case studies, it has been difficult to quantify impacts on society and connect them to the causes. There is extremely little regular 'societal monitoring' that might show how the impacts change over time. At present, information must be investigated for each problem and geographical area, often based on data collected for some other purpose. This implies that the information will be of low quality, which could be an impediment to the achievement of a foundation that could support powerful, resource-demanding decisions.

Having comparable, easily accessible data on important groups and sectors that use the sea is important for future inter-country collaboration. Generally speaking there is very little information about indirect actors, but somewhat more about direct actors that conduct activities that impact the condition of the marine environment. Information on the extent to which the actors impact other actors is in many cases impossible to find. This applies, for example, to information on how consumers' use of food affects the amount of phosphorus that the wastewater treatment plants must deal with, or how increased demand for ecolabelled fish impacts the entire fish processing chain right down to the fisherman. This shortage of facts makes it difficult to assess which relationships are important to investigate and manage.

Indirect actors and driving forces

To date, the response from government agencies has focused primarily on direct actors. Many of them have endeavoured for some time to reduce their impact. Our work on this study has made it clear that there is a shortage of information about indirect driving forces and societal impact (such as consumption patterns and attitudes toward response measures, effects of previous regulation and response measures) or connections between these driving forces. There is therefore a risk that they will be neglected, which may affect efforts to implement response measures.

As the analyses in the case studies indicate, many indirect actor groups are invisible as they are not included in the responses of government agencies. They contribute to the problems without receiving any relevant feedback about their actions. For example, there are no restrictions on how much phosphorus a household may contribute to the wastewater treatment plant, nor how much food individuals may consume. Consequently, it is up to the individual or to the consumer collective to decide whether to take responsibility for their indirect

impact. Nor is there much information on the extent of the impact of one's own actions. So it can be difficult to make effective decisions.

The extent to which all actors can be made participants in the larger problem is up for discussion. In connection with response measures, it may therefore be effective to consider different policy incentives that would lead both direct and indirect actors toward the agreed target.
Also noteworthy is the fact that concerning the environmental problems dealt with in the case studies, which still require corrective measures, the indirect driving forces plays a key role.

Rational behaviour by individuals

People function rationally in accordance with the perceived conditions and limitations of their existence. Attention is limited, as are time and other resources. Therefore, individuals prioritise matters and form habits to benefit from earlier experience. Information on people's perceptions of the components of our theoretical model (pressures, state, and impact) is valuable per se, but it does not necessarily mean it will guide behaviour. It is important to distinguish between the logical conceptual model and how people function.

Often, the blame is laid on the party that directly impacts the environment or the resource. This may be because it is the most visible activity. On the other hand, the indirect driving forces and the actors are more difficult for the public to identify.

Dealing with marine environment problems such as eutrophication or overfishing requires attitude changes. This means that more actors will have to be exposed to different types of incentives and pressure. This is easier if the party exerting pressure is considered legitimate. It is perhaps important to clarify how the public, companies, and other actors view the government in its role of protector and regulator, how they think decisions should be made, and how extensive lobbying should be. Answers to these questions have not been easy to find in the case studies – however, there is reason to believe that they are different for different environmental problems.

All the case studies indicate that geographic distance between cause and effect as well as time lags; contribute to uncertainty as regards causal relationships. There may be considerable time between the emission occasions and the resulting damage, for example, in the case of low-concentration emissions of mercury that accumulate in the food chain. It may also be a question of a slow transformation that is difficult to detect and therefore changes the perception of what is baseline. Individuals may then have difficulty determining the impact of a particular emission, where it arises and how great it actually is.

In several of the case studies, actors encounter conditions that do not encourage them to act in ways favourable to the marine environment. This may be due to the regulatory apparatus or to other societal conditions, but it can also be due to the nature of the environmental problem. For example, an

individual property owner with a private sewer is not a major environmental villain. As a group, however, property owners have a substantial impact. From the individual's perspective, it is expensive to install a sewerage system and the impact is negligible unless most of the neighbours adapt their emissions also. Similarly, individual fishermen may claim that the fish they catch are not a problem as long as all other parties behave properly. Such social dilemmas are known in environmental contexts and may be affected by the creation of physical, social and financial incentives that lead in the desired direction.[19] However, a societal analysis is also required, one that identifies key factors and how they interact with each other.

5.3 Conclusions regarding the methods used

Access to material

Material was taken from the case studies to enable the authors to identify actors and the connections between them. It was found that there is an enormous amount of information on all problem areas. However, retrieving official data sorted according to the questions we posed – that is, in relation to the various marine regions and to the various groups of actors, both those that impact and those that are impacted – has proven highly resource-intensive. It has been particularly difficult to obtain relevant information on indirect driving forces and societal impact. Acquiring the knowledge necessary to permit an overview would require an enormous amount of work. These difficulties may be interpreted as a lack of systematic structure in the organisation of government agencies. It may also be an effect of previously called-for knowledge. There is extremely little data that would substantiate relationships between different actions. This lack of knowledge could have repercussions on the entire system, giving rise to a situation in which individuals focus on optimising that which lies within their own perspective.

Evaluation of the DPSIR, the question template and the use of case studies

The DPSIR model shall provide the foundation for work relating to the Marine Environmental Regulation. The DPSIR is an attempt to link up marine environmental problems with societal processes. As mentioned in the introduction, the model is underdeveloped as regards driving forces and relationships. Nor does it distinguish much between actors, their actions, and other types of promoting or retarding factors. Our expansion of the model by adding our own component for indirect driving forces was highly fruitful. It has even proven possible to carry out, by means of the question template, a supplemental actor analysis and an embellishment of the existing concepts of driving forces and impediments.

The question template has been highly valuable in helping us acquire societal information and maintain our focus on the type and the sorting order of the

[19] E.g., Messick and Brewer, 1983

data that we sought. As previously mentioned, there is a great deal of information relating to the subjects of the various case studies, but a lack of material that directly answers the questions. Nevertheless, we maintain that the questions were correctly articulated in relation to our intention in conducting this initial social analysis.

The case-study method was selected as a way to limit the analysis and still obtain a comprehensive view of the problem field. The method has given the authors important insights. The case studies provide an overview in the form of a condensed image that is reduced in some cases to a list of points to be observed. One weakness has been that it has been difficult to gain access to completed syntheses or to individuals capable of having an overview of several fields. Given that so many areas of research are involved, it would have been preferable to use seminars to an even greater degree to synthesise the material. However, that would have required more time and planning.

5.4 How might social analyses be further developed?

What is important?

Section 1.2 describes a proposal by Witteveen & Bos as to how a social analysis could be implemented.[20] When the intention is to identify key groups of actors, they propose starting with activities that entail significant pressures on the environment. The present study has followed that advice as regards case studies. The criterion would also seem relevant after the fact. However, we must also ask ourselves how we might identify key actors and relationships.

From the case studies we conclude that the next criterion may be that the actor's pressure can in fact be changed. One example might be that while farmers' use of phosphorus is extensive, this group will not necessarily be significant for future response measures, as many such measures have already been taken. The next step might then be to access individual sewers or the treatment plants. In other words, it is a matter of assessing the relationship between the necessary intervention/investment and the potential change, and making a choice based on this.

Future indicators to use for societal analysis and follow-up

Some relevant questions are what information should be available about the current condition, how far it is from the objective, and how effective the various measures adopted are. Suggestions of processes, perspectives and overall criteria by which to identify indicators, including examples, are presented here. The cases have been described in broad, general terms to create an initial basis for the selection of indicators that are useful for tracking activities that impact the environment. We developed the method by which the cases are described as

[20] Witteveen & Bos 2009

our work progressed. A DPSIR-based conceptual model forms the foundation, in combination with an actor-oriented template for analysing driving forces and actors in society. The descriptions provide, for each case study, a knowledge base containing the advantages, errors and shortcomings that may be due to methodology, to our basic knowledge, or to the people with whom we succeeded in establishing contact. The broad-based approach was necessary considering it was not possible to establish at the start what factors were important.

Initially we had the implicit hypothesis that several of the components could impact each other. That hypothesis is supported by all three case studies. This makes it difficult to point to a small number of factors that should be measured so that they may indicate how the environment will develop. Similarly, it is difficult to decide which factors the response measures should address to bring the environment to the desired status.

Based on the results of the case studies, we can discuss which of the factors having major impact on the direct activities are responsible for the current environmental situation. In most cases, there is a lack of scientifically verified knowledge about interconnections, the direction in which such interconnections may be developing, and the strength of the interconnections. This makes it impossible to determine what the most important factors are. Establishing the strength of a particular impact and sorting out what is cause and what is effect is often a question of new research that may belong to a range of disciplines. These might be, for example, marine biology, engineering, and other disciplines within the natural sciences. However, social sciences such as law, environmental sociology, organisational science, political science, and psychology are also relevant to questions of individuals' perceptions of and behaviour in nature, decision issues for individuals and groups, and legal and government aspects.

A more pragmatic method, in the absence of scientific knowledge, could be to have experts make supported assessments as to what circumstances are important. Such assessments may be based on general models or on research from other areas. Each environmental problem should be assigned a separate team of experts. The teams should be given opportunities to interact with each other wherever connections exist – for example, between fishing and eutrophication. The activities of the expert teams could be initiated with seminars. These could be followed by testing of the indicators. The expert team could then serve as a future reference group for societal analysis.

It is too early to draw conclusions as to what societal indicators should be identified and monitored. On the other hand, it is possible to discuss the path ahead that is to lead to the selection of indicators. One key aspect is that the selection should be based on Sweden's environmental objectives (de svenska

miljömålen).[21] This includes not only the objectives of the European directives but also the environmental quality objectives at lower levels.

The proposed approach is illustrated here through suggestions for indicators of activities in society relating to the environmental toxin mercury (see Box 5.1). The mercury problem is subdivided into three areas: a) mercury load, b) the amount of mercury in society, and c) the amount of mercury being phased out.

Indicators of mercury in the environment and in society. Target: a toxin-free environment

a) Indicators of mercury input:
- amount of energy from coal-fired power
- amount of mercury emitted
- number of employees in the mercury-emitting operation
- number and scope of regulations restricting emissions

b) Indicators for mercury in society:
- content of mercury in the hair of individual members of risk groups
- people's perceptions of their own risk
- people's perceptions of government agencies' legal authority to implement response measures
- content of mercury in edible fish
- number of people suffering from mercury-related problems

c) Indicators for the amount of mercury being phased out of society:
- number of mercury-containing products collected
- amount of mercury collected that is derived from products collected
- number of people involved in the phasing out of mercury in various sectors in society
- amount of mercury delivered for permanent disposal in rock chambers

The number of indicators is a trade-off between anticipated utility and cost. Restricting that number to one or two indicators, however, entails risk. Yet another consideration is the manner in which the objective is to be achieved. This may be, for example, to reach a balanced environmental condition quickly, or cheaply, or without conflicts.

5.5 Final considerations

The study is an attempt to develop and test a method for conducting a social analysis of problems in the marine environment in Sweden. It has entailed two months of intensive effort to explore the potential reach of a description of society and the marine environment.

The selection of references and actors for the case studies was based on a broad-based search that included many reports and communications with experts. We welcome any comments on the content and results of the case studies, and on the development of methods of societal analysis – all in the interests of supporting measures to improve the marine environment.

[21] This also applies as regards the objectives of the directives, as well as to the environmental quality objectives – however, discrepancies between them may exist.

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Appendix A. Marine Strategy Framework Directive (MSFD) and Annex, Table 2

Article 8 Assessment

1. In respect of each marine region or subregion, Member States shall make an initial assessment of their marine waters taking account of existing data where available and comprising the following:

(a) an analysis of the essential features and characteristics, and current environmental status of those waters, based on the indicative lists of elements set out in Table 1 of Annex III,

and covering the physical and chemical features, the habitat types, the biological features and the hydro-morphology;

(b) an analysis of the predominant pressures and impacts, including human activity, on the environmental status of those waters which: (i) is based on the indicative lists of elements set out in Table 2 of Annex III, and covers the qualitative and quantitative mix of the various pressures, as well as discernible trends; (ii) covers the main cumulative and synergetic effects; and (iii) takes account of the relevant assessments which have been made pursuant to existing Community legislation;

(c) an economic and social analysis of the use of those waters and of the cost of degradation of the marine environment.

2. The analyses referred to in paragraph 1 shall take into account elements regarding coastal, transitional and territorial waters covered by relevant provisions of existing Community

legislation, in particular Directive 2000/60/EC. They shall also take into account, or use as their basis, other relevant assessments such as those carried out jointly in the context of

Regional Sea Conventions, so as to produce a comprehensive assessment of the status of the marine environment.

3. In preparing assessments pursuant to paragraph 1,Member States shall, by means of the coordination established pursuant to Articles 5 and 6, make every effort to ensure that:

(a) assessment methodologies are consistent across the marine region or subregion;

(b) transboundary impacts and transboundary features are taken into account.

Table 2. Pressures and impact in the Marine Strategy Framework Directive. (Annex III)

Physical loss

- Smothering (e.g. by man-made structures, disposal of dredge spoil),
- sealing (e.g. by permanent structures).

Physical damage

- Changes in siltation (e.g. by outfalls, increased run-off, dredging/disposal of dredged spoil),
- abrasion (e.g. impact on the seabed from commercial fishing, boating, anchoring),
- selective extraction (e.g. exploration and exploitation of living and non-living resources on seabed and subsoil).

Other physical disturbance

- Underwater noise (e.g. from shipping, underwater acountic equipment),
- marine litter.

Interference with hydrological processes

- Significant changes in thermal regime (e.g. by outfalls from power stations),
- significant changes in salinity regime (e.g. by constructions impeding water movements, water abstraction).

Contamination by hazardous substances

- Introduction of synthetic compounds (e.g., priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides, anti-foulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances),
- introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration and exploitation, atmospheric deposition, riverine inputs),
- introduction of radio-nuclides.

Systematic and/or intentional release of substances

- Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or intentional release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions.

Nutrient and organic matter enrichment

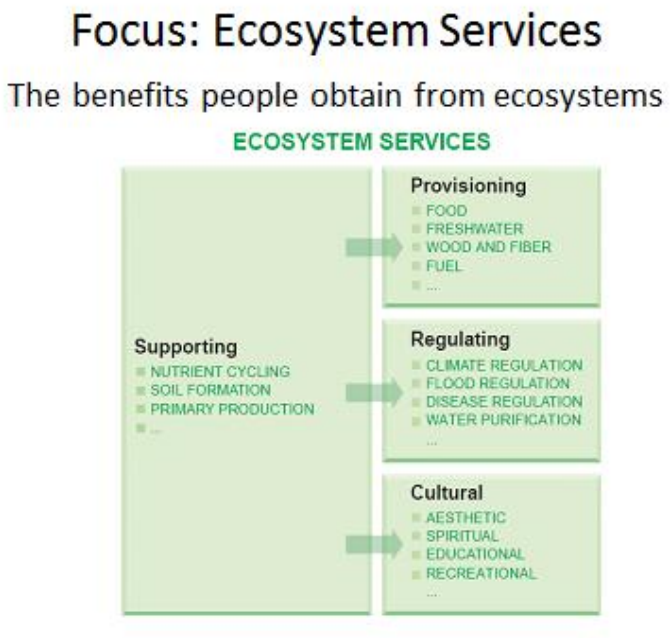
- Inputs of fertilisers and other nitrogen – and phosphorus-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition),
- Inputs of organic matter (e.g. sewers, mariculture, revering inputs).

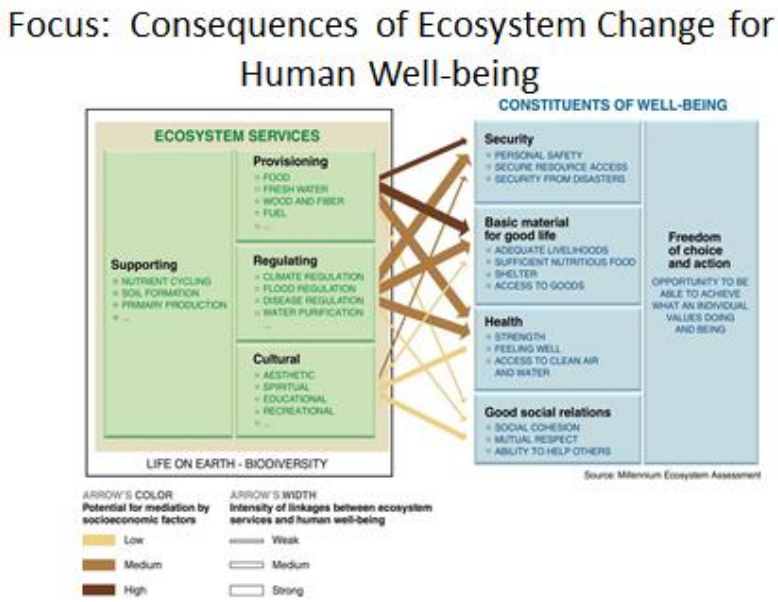
Biological disturbance

- Introduction of microbial pathogens,
- Introduction of non-indigenous species and translocations,

- selective extraction of species, including unintentional catches of non-target catches (e.g. by commercial fishing and recreational fishing).

Appendix B. Millennium Ecosystem Assessment (MEA): Ecosystem service, Consequences of ecosystem change for human well-being, and a MA Framework





MA Framework