EMOVE

*Estuaries on the move*

# Work Package 3 – European Joint Fact Finding

## Part 1

## Problem Identification


BAW

Küste und Raum
Ahlhorn & Meyerdirks GbR

The Interreg IVB North Sea Region Programme
Investing in the future by working together for a sustainable and competitive region

# Estuaries on the Move

## Work Package 3 – European Joint Fact Finding

## Part 1

## Problem Identification

***Suggested citation:***
EMOVE Project (2014): Work Package 3 - European Joint Fact Finding Part 1 –Problem Identification Study conducted within the framework of the project EMOVE (Estuaries on the move) in the EU Interreg IVB North Sea programme.

**EMOVE Project partners**

Rijkswaterstaat – Zee en Delta, The Netherlands

Flemish Ministry of Mobility and Public Works, Belgium

COWI AB, Sweden

Bundesanstalt für Wasserbau, Germany

**Work Package 3 Responsible:**

Reiner Schubert, Holger Rahlf (Bundesanstalt für Wasserbau)

BAW – Bundesanstalt für Wasserbau
Wedeler Landstr. 157
D - 22559 Hamburg
Germany
www.baw.de

**Study conducted by:**

*Jürgen Meyerdirks, Frank Ahlhorn*

Küste und Raum – Ahlhorn & Meyerdirks GbR
Katrepeler Landstr. 27
D – 28357 Bremen
Germany
www.kueste-und-raum.de

Study prepared within the framework of the EU Interreg IVB project EMOVE co-funded by the North Sea Region programme.

May 2014

# Content


Preface ..... 4

1 Objectives of Work Package 3 ..... 5

2 Methodology ..... 6

3 Results ..... 9

3.1 Driving forces and Pressures ..... 9

3.1.1 Göta Älv ..... 10

3.1.2 Scheldt ..... 13

3.1.3 German Estuaries, Elbe, Ems, Weser ..... 15

3.1.4 Synopsis ..... 19

3.2 Prioritised Pressures ..... 20

3.2.1 Göta Älv Estuary ..... 21

3.2.2 Scheldt Estuary ..... 21

3.2.3 Weser Estuary ..... 22

4 Discussion ..... 23

5 References ..... 25

6 Annex ..... 26

# Abbreviations

| | |
|---|---|
| DPSIR | ***D***river-***P***ressure-***S***tate-***I***mpact-***R***esponse |
| WP | ***W***ork ***P***ackage |
| WFD | **W**ater **F**ramework **D**irective |

# List of Figures and Tables

Figure1: The relevance of identified Pressures in the Göta älv estuary 11
Figure 2: The relevance of identified Pressures in the Scheldt estuary 14
Figure 3: The relevance of identified Pressures in the Elbe estuary 16
Figure 4: The relevance of identified Pressures in the Ems estuary 17
Figure 5: The relevance of identified Pressures in the Weser estuary 18

Table 1: Workflow and timelines in Work Package 3 8
Table 2: Pressures with high relevance identified in the Göta älv estuary 12
Table 3: Pressures with high relevance identified in the Scheldt estuary 14
Table 4: Pressures with high relevance identified in the Elbe estuary 16
Table 5: Pressures with high relevance identified in the Ems estuary 17
Table 6: Pressures with high relevance identified in the Weser estuary 19
Table 7: Questions to identify the most important problem situation – Prioritised Pressure 20
Table 8: Prioritised Pressure in the Göta älv estuary 21
Table 9: Prioritised Pressure in the Scheldt estuary 21
Table 10: Prioritised Pressure in the Weser estuary 22
Table 11: Driving forces and Pressures of the EMOVE estuaries 26

# Preface

The Estuaries on the MOVE partnership (EMOVE) consists of four organisations and institutions working together in a European Interreg IVB project co-funded by the North Sea Region programme: Rijkswaterstaat – Dienst Delta en Zee, the Flemish Department of Mobility and Public Works (MOW), the German Federal Waterways Engineering and Research Institute (BAW) and the Swedish company COWI AB.

The EMOVE project identifies existing knowledge and elaborates on shortcomings (by research or pilots) to maintain accessible, flood safe and ecological resilient estuaries. By a community-led approach it is aiming at convincing stakeholders to become shareholders and to develop a joint vision on how to maintain these estuaries.

The estuaries within the EMOVE project are as follows: Scheldt (NL, B), Weser, Ems, Elbe (GER) and Göta Älv (S). In the course of the project three of them will be investigated extensively: Scheldt (NL/B), Göta Älv (S) and Weser (GER). To get a deeper insight into high relevant Pressures and Impacts of these estuaries and to identify promising stakeholder constellations that become shareholders makes it necessary to concentrate on one estuary per partner.

The main objectives of EMOVE are as follows

1. Jointly identify technical and governance problems in the estuaries together with all relevant stakeholders in a joint-fact-finding process in order to identify their shared values, point of views, opinions and experiences as well as the physical/technical and governmental state of the art and problems.
2. Jointly develop integrated solutions for adaptive estuarine management together with all relevant stakeholders; identify possible solutions and necessary studies and pilots for adaptive estuarine management and governance to maintain accessible and sustainable estuaries.
3. Develop the will-power among the stakeholders to develop a joined strategy towards adaptive estuarine management
4. Publish a European estuarine management and governance vision based on the experiences of the first three objectives
5. Realise, try out and evaluate an Innovative Virtual Communication Platform as tool for virtual national and transnational meetings and for easy and attractive communication about the project and the estuaries.

# 1 Objectives of Work Package 3

To achieve the previously mentioned objectives it is crucial to involve all relevant stakeholders from the beginning of the EMOVE project. Most important is to motivate an active engagement of these stakeholders that they finally become shareholders

Work Package 3 (WP3) “European Joint Fact Finding” concentrates on the first three objectives of the EMOVE project.

To ensure a cooperative working environment for the EMOVE partnership it was necessary to apply a collaborative investigation approach. The EMOVE partnership selected the Driver-Pressure-State-Impact-Response (DPSIR) concept as joint approach for the “European Joint Finding” task. A five step process was developed and applied:

1. **Problem Identification:** Identification of the most important Driving forces and Pressures in the partner estuaries: Weser, Elbe, Ems, Scheldt, Göta Älv.
2. **Identification of Impacts and Responses:** Comprehensive enhancement of the DPSIR concept for the EMOVE case estuaries Weser, Scheldt and Göta Älv
3. **Transnational workshop:** Discussion platform for the outcomes of the DPSIR analysis together with EMOVE partnership and stakeholders.
4. **Identification of suitable solutions** for existing problems.
5. **Documentation and evaluation of existing solutions** that are able to mitigate the existing problems.

First objective of WP 3 is to identify the most urgent problems in the EMOVE partner estuaries. Although, there are obviously differences between these estuaries, but problems with a changing climate, morphological changes and changes in land use pattern are affecting all partner estuaries similarly.

This interim report reflects and summarises on the first objective of WP3.

# 2 Methodology

The fact finding process of WP 3 was based on a shared methodology to ensure the comparability of estuary specific outcomes. The identification process of similarities and differences between the EMOVE partner estuaries has been facilitated by the DPSIR concept.

DPSIR is a causality based concept which highlights the relationship between human activities and environmental degradation (Pirrone et al. 2005):

- The **Driving forces** are processes and anthropogenic activities (production, consumption, recreation etc.) able to cause pressures;
- The **Pressures** are the direct stresses, deriving from the anthropogenic system, and affecting the natural environment, i.e. pollutant release;
- The **State** reflects the environmental conditions of natural systems (air, soil and water quality);
- The **Impact** is the measure of the effects due to changes in the state of environmental system;
- The **Response** is the evaluation of actions; oriented to solve environmental problems in terms of management strategies.

DPSIR is a widely used concept enabling the organisation of information about the state of the environment including stresses causing impacts as well as the actions taken to avoid those system changes. Therefore, DPSIR is able to indicate the main objectives of EMOVE: identifying problems, impacts and existing solutions as well as support in strategy building. DPSIR is capable to focus on physical, environmental and socio-economic items. This assures a community-led approach considering the demands of the involved stakeholders during the whole process and supports a proper translation of the five steps of the process into the terminology of the DPSIR concept (see Table 1).

The first step was to identify the most urgent Pressure and its triggering Driving forces. This step was executed by every partner linked to their estuary.

After identifying the main problem the next steps were conducted by the involvement of stakeholders. This encompassed the description of the State as well as the analysis of Impacts and existing Solutions. During a transnational work-

shop existing deficits evolving from the mismatch of stakeholder demands and already existing solutions are identified (see Table 1). Appropriate solutions will be selected and assessed to be able to develop different options for action that lead to a joint strategy towards an adaptive estuarine management. It will serve as the basement for the development of an implementation strategy in WP 4.

The main focus of this report is to document the identification of the most urgent problem(s) occurring in every EMOVE estuary. To assure every aspect is covered the EMOVE partners used a template (see Table 11) showing Driving forces and Pressures already identified by literature and in former projects (Pirrone et al. 2005; Kristensen 2004; Borja et al. 2006; Nobre 2009; Bosch 2000; Aliaume et al. 2007).

Ranking the identified Driving forces and Pressures by the EMOVE partners lead to a detailed overview of the problem situation in every EMOVE partner estuary (see Table 11). Additionally, after the identification of the urgent Pressure existing in each estuary the main Driving forces and other surroundings like Impacts and Responses and involved stakeholder-groups were identified by a questionnaire.

| Workpackage 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Activities EU** | **1) Problem identification** | | | | **2) Impact identification** | | **3) Transnational Workshop (TWS)** | **4) Identification of existing solutions** | **5) Documentation & evaluation of existing solutions** |
| **DPSIR-Step** | **Driving forces** | **Pressures** | **State** | | **Impacts** | **Responses** | | | |
| **Step WP3** | **1** | | **2** | | | | **3** | **4** | **5** |
| **Contents / Action** | Identification of the most important Driving forces and Pressures in the estuaries | Identification of the prioritised Pressure for the estuaries | Complete DPSIR framework for the estuary executing the prioritised Pressure | Description of status quo of physical / ecological system and values, opinions, experiences of stakeholders | Correlation of impacts and affected compartiments in the ecolocical and socio-economic system | Identification of existing Responses of legal frameworks and individual adaptability | 1) Analysing deficits reflecting the gap between user demands (State) and Responses.<br>2) Identify promising Responses | Identification of appropriate Responses | Identification and evaluation of options identified by the partner countries to cope with the pressures |
| **Input WP 3 lead** | | | Templates prepared by WP 3 | | | | Synopsis of the completed DPSIR frameworks of the estuaries | Synopsis of TWS. Analysing Responses by project phase approach | Synopsis of aggregating analyses of the identified options for action |
| **Output partner** | List of the most important Driving forces and Pressures | Prioritised Pressure | Complete DPSIR framework for the identified prioritised Pressure | List of system compartiments affected. List of demands, opinions of stakeholders | List of Impacts (ecological, socio-economic) | List of Responses delivered by law and guidelines or alternative land use pattern | Feedback to Synopsis. List of deficits. List of promising Responses | Reviewed lists of deficits and promising Responses | Identification of stakeholders becoming shareholders |
| **Deadline** | January 2014 | | February 2014 | | | | May 2014 | June 2014 | July 2014 |
| | | | **Carried out with one Pressure per Estuary most promising for stakeholders willing to become shareholders** | | | | | | |

**Table 1: Workflow and timelines in Work Package 3.**

# 3 Results

The results of this report concentrate on the identification of the main problems of the EMOVE partner estuaries. The outcomes have been generated by the expertise and the experience of the EMOVE partners: Rijkswaterstaat Delta en Zee together with Deltares (The Netherlands) and the Flemish Department of Mobility and Public Works from Belgium for the Scheldt, COWI AB as consultant for the Göta Älv in Sweden and the Federal Waterways Engineering and Research Institute supported by Küste und Raum for the German estuaries Ems, Weser and Elbe.

## 3.1 Driving forces and Pressures

The identification of the occurring Driving forces and the Pressures has separately been investigated in every partner country.

The national expert-group ranked in every estuary the relevance of problems against a list of at least 120 Pressures identified by literature research and expert knowledge. In total 13 different Drivers have been identified. The number of Pressures assigned shifts from only one to 22 Pressures for the different Drivers. The largest numbers of Pressures are assigned to the Drivers Urbanisation (22), Agriculture (15), Transport/Logistic (14) Mining/Underground (12) and Climate Change (12).

The classification of the ranking was divided into four classes ranging from none to high relevance. If necessary, hints referring to special local situations or uncertainties were added.

The assessment was a quick scan of existing Drivers and Pressures in each partner estuary and is based on expert-knowledge. The outcomes are categorised values done by the knowledge based experience of different groups consisting of people with different professional backgrounds and fields of responsibility.

This method delivers a reasonable description and weighting of the existing Drivers and Pressures for each partner estuary. The EMOVE project aim was not to compare the partner estuaries, hence, the outcomes of this methodological approach cannot serve for a comparability study. Qualitative analysis reflecting the ranges and rankings of the different Drivers and Pressures are the largest extend of acceptable interpretation.

### 3.1.1 Göta Älv

**Spatial extension of the Investigation area**

Gothenburg is situated at the west coast of Sweden and the Göta river flows through the city. The city centre is exposed to high water flows of the river and flooding's through the North Sea.

The Göta River splits up north of Gothenburg into Nordre Älv and Göta Älv. The Göta Älv runs south through Gothenburg. The southern part of the Göta Älv estuary has no agriculture driving force.

The main sources of contamination in Gothenburg are run-off, shipping emissions and long distance transportation but not agriculture fertilizers. Only the nearby sources, such as from the Möldnals ån and Säven ån coming from the south east and east of Gothenburg and confluence into the Göta river, show agricultural run-off.

**Group of experts**

COWI is a large international company with a lot of international projects and co-operations including planning, construction and management. COWI Sweden has been involved in different EU projects such as CPA, SAWA and DiPol.

COWI Sweden is involved because of their knowledge and network related to the Göta Älv and the problems related to the estuary.

**Driving forces and Pressures in the Göta Älv Estuary**

The Göta Älv estuary, including the Nordre Älv, shows a high amount of pressures with medium and high relevance. Both categories contain 45 pressures reflecting 38 % of all Pressures identified. 30 (25 %) Pressures are addressed as little relevant while none relevant Pressures have not been declared. Except Aquaculture, all Driving forces show Pressures with medium and high relevance. Focusing on the Pressures with high relevance the most important Driving forces in the Göta Älv estuary are Urbanization (13) Climate Change (9), Transport/Logistic (7) and Agriculture (5)(Figure 1, Table 2).

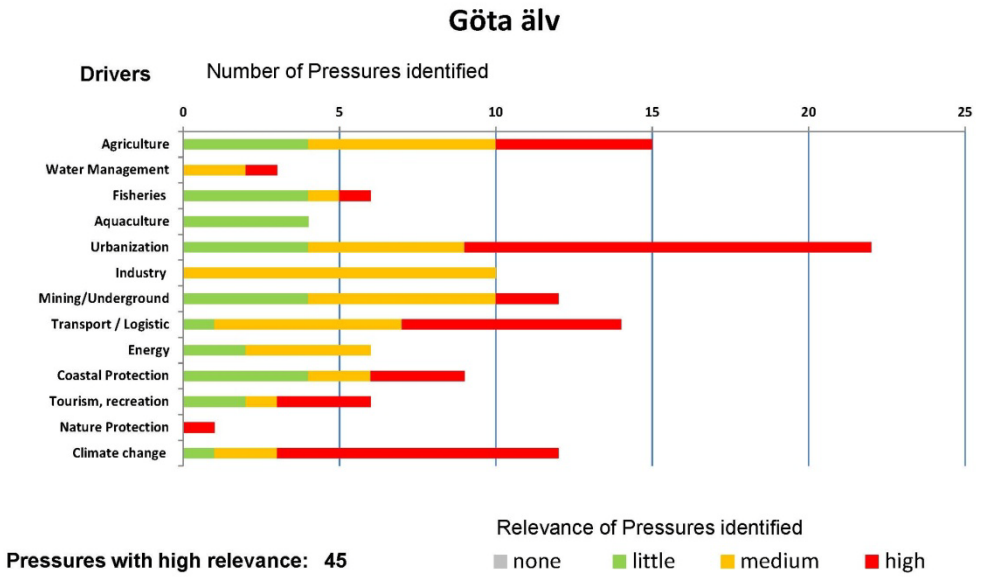


Figure1: The relevance of identified Pressures in the Göta Älv estuary.

| Driving forces | Pressures with high relevance |
|---|---|
| **Agriculture and land use change** | **Consumption** |
| | Agricultural land use |
| | **Pollution / Agriculture discharges** |
| | Diffuse source |
| | Nitrogen load |
| | Atmospheric input |
| | Nitrogen deposition |
| **Watermanagement** | **Changes in hydrological system** |
| | Changing water levels |
| **Fisheries** | **Changes in morphology** |
| | Trawling, dredging |
| **Urbanization** | **Consumption** |
| | Soil impermeabilisation |
| | Demand for waste disposal |
| | **Pollution / Urban discharges** |
| | Inputs of nutrients/hazardous substances via rivers |
| | Type of waste water treatment plants |
| | Classes of waste water treatment plants |
| | Wastewater production |
| | Volume of sewage |
| | Storm water and overflow |
| | Outfall (treated/untreated) |
| | Storm water and overflow |
| | Outfall (treated/untreated) |
| | **Infrastructure** |
| | Tunnel |
| | **Changes in morphology** |
| | Landfills / Disposalof masses |
| **Mining/Underground** | **Exploitation of natural resources** |
| | Sand and clay |
| | **Changes in morphology** |
| | Sand and clay extraction |
| **Transport / Logistic** | **Consumption** |
| | Land reclamation (harbours) |
| | **Pollution / Transport discharges** |
| | Maritime transport discharges |
| | Polluted sediments |
| | **Infrastructure** |
| | Commercial harbours |
| | Occasional anchorage |
| | Dumping of dredged sediments |
| | **Changes in morphology** |
| | Dredging activities |
| **Coastal Protection** | **Infrastructure** |
| | Jetties |
| | Barrier |
| | **Changes in morphology** |
| | Dredging |
| **Tourism, recreation, leasure** | **Consumption** |
| | Recreation demands |
| | **Pollution / Touristic sector** |
| | Private (maritime) traffic |
| | **Infrastructure** |
| | Marinas |
| **Nature Protection** | **Consumption** |
| | Area demand for nature protection |
| **Climate change** | **Meteorology** |
| | Temperature increase |
| | Storm events |
| | Floods |
| | Flood-storm events |
| | **Hydrology** |
| | Sea-level rise |
| | Changes in geohydrology |
| | **Morphoplogy** |
| | Changes in runoff and sediment transport |
| | **Ecology** |
| | Changes in biodiversity |
| | Introduced species |

**Table 2: Pressures with high relevance in the Göta Älv estuary.**

### 3.1.2 Scheldt

**Spatial extension of the Investigation area**

The Pressures were valued taking into account the whole estuary. The area is defined as 'from the mouth' up to the sluices at Ghent. Depending on the context the Scheldt is divided into different parts, such as the Mouth, Western Scheldt and Sea Scheldt (may be split up into eastern, central and western part). The Sea Scheldt may be split up into upper Sea Scheldt (Ghent – Rupelmonde) and lower Sea Scheldt (Rupelmonde – border) and the tributaries Durme and Rupel.

**Group of experts**

The Dutch Rijkswaterstaat (RWS) and the Flemish Department of Mobility and Public Works (MOW) are the managers of the Scheldt estuary. Accessibility of the ports of Antwerp, Ghent, Terneuzen and Vlissingen, not only from the sea but also from inland navigation, is essential for the countries and a matter of cross-border significance.

To reconcile the often competing interests of The Netherlands and Flanders, the Scheldt Development Outline 2010 was created and published in 2005. It integrates goals for nature conservation, accessibility of the Port of Antwerp, and flood safety issues. It is also the starting-point for joint policy–making by the Flemish and Dutch governments, aiming at a more sustainable development in the Scheldt estuary. Based on the Scheldt Development Outline 2010 four treaties were negotiated between The Netherlands and Flanders, about the implementation of the Scheldt Development Outline 2010, about the cooperation in policy-making and management in the Scheldt estuary and about the joint nautical management in the Scheldt area. The Flemish-Dutch Scheldt Commission (VNSC) is the instrument for the realisation of these objectives (http://www.VNSC.eu).

**Driving forces and Pressures in the Scheldt Estuary**

For the Scheldt estuary Pressures with medium or high relevance have been identified in five of the 13 Driving forces. Eight high relevant Pressures (7 %) within the Driving forces Coastal Protection (4), Transport/Logistic (3) and Nature

Protection (1) have been identified. Climate change shows six Pressures with medium relevance as an important Driving force. Pressures of all other Driving forces only show little relevance, none relevant Pressures have not been declared (Figure 2, Table 3).

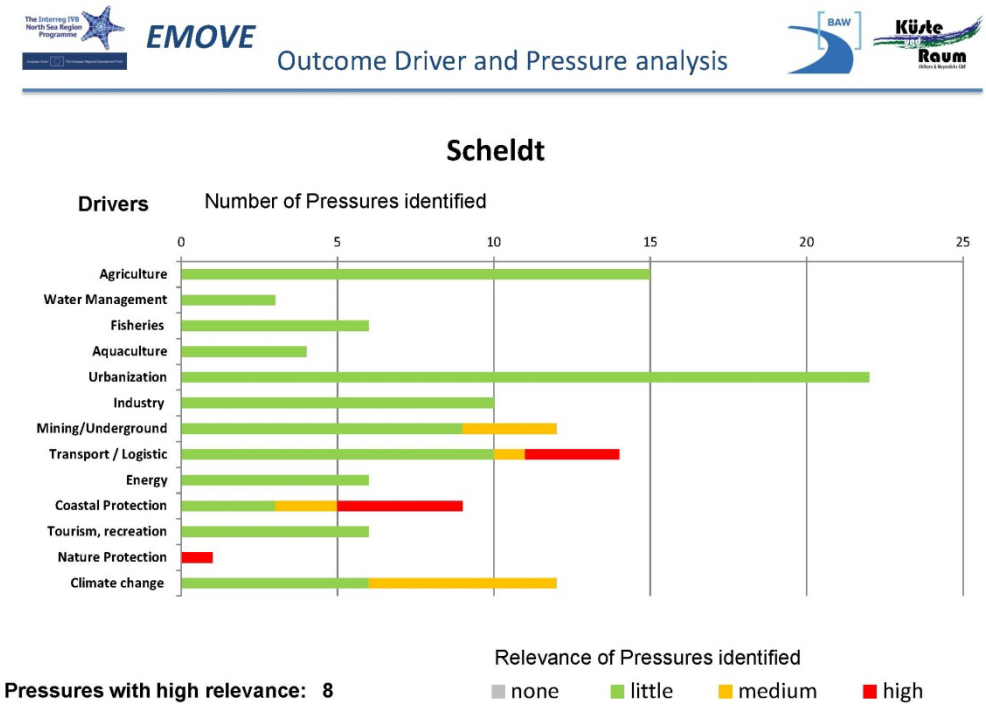


Figure 2: The relevance of identified Pressures in the Scheldt estuary.

| Driving forces | Pressures with high relevance |
|---|---|
| **Transport / Logistic** | **Infrastructure** |
| | Dumping of dredged sediments |
| | Salt Water Intrusion |
| | **Changes in morphology** |
| | Dredging activities |
| **Coastal Protection** | **Infrastructure** |
| | Sea walls |
| | Barriers |
| | Dams |
| | **Alteration of hydrological regime** |
| | Sediment |
| **Nature Protection** | **Consumption** |
| | Area demand for nature protection |

Table 3: Pressures with high relevance in the Scheldt estuary.

### 3.1.3 German Estuaries, Elbe, Ems, Weser

For all three German estuaries Drivers and Pressures were identified for the whole estuary 'from the mouth' to the flood barriers in Bremen (Weser), Geesthacht (Elbe) and Herbrum (Ems).

**Group of experts**

The Federal Waterways Engineering and Research Institute (BAW) is a service provider for the WSV (Federal Waterways and Shipping Administration) that is the technical and scientific federal authority of the Federal Ministry of Transport, Building and Urban Development (BMVBS). BAW is the central provider of consultancy and expertise services to the BMVBS and the WSV relating to their waterways engineering tasks and in particular concerning their supervision responsibility to ensure that all federal waterway structures and facilities comply with safety and other regulations. This implies technical, economic and ecological demands and is based on scientific methods to ensure high quality standards.

**Driving forces and Pressures in the German estuaries of Elbe, Ems and Weser**

Although, the three estuaries differ in size, structure and several structure parameters they show comparable outcomes with respect to the identified Driving forces and Pressures.

For the Elbe estuary 13 medium (11 %) and six high (5 %) relevant Pressures in six Driving forces have been identified. Highest relevance occurs in the Drivers Transport/Logistic (3 high, 1 medium), Coastal protection (2 high, 3 medium) and Climate change (1 high, 4 medium). Seven Driving forces show none (Aquaculture, Energy) or none to little relevance (Agriculture, Water Management, Urbanization, Tourism/Recreation, Nature protection). In total 58 Pressures (48 %) were marked with none and 43 (36 %) with little relevance (Figure 3, Table 4).

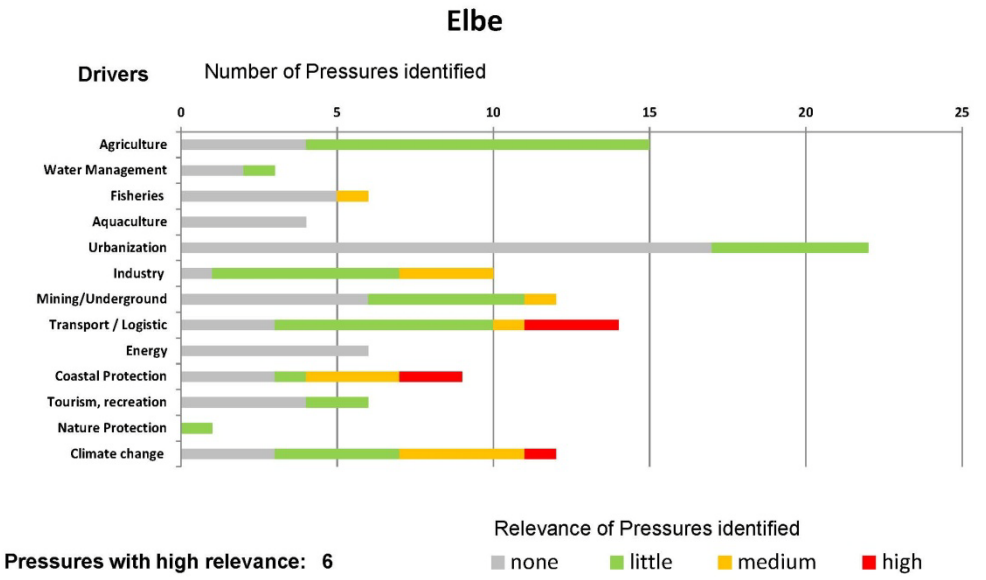


Figure 3: The relevance of identified Pressures in the Elbe estuary.

| Driving forces | Pressures with high relevance |
|---|---|
| **Transport / Logistic** | **Consumption** |
| | Land reclamation (harbours) |
| | **Infrastructure** |
| | Commercial harbours |
| | Salt Water Intrusion |
| **Coastal Protection** | **Infrastructure** |
| | Barriers |
| | Dams |
| **Climate Change** | **Ecology** |
| | Changes in biodiversity |

Table 4: Pressures with high relevance in the Elbe estuary.

For the Ems estuary ten high relevant Pressures occur in the Driving forces Coastal protection (5), Transport/Logistic (4) and Climate change (1). Medium relevant Pressures could be found in Industry (3) and Climate change (5). All other Pressures show little (38 Pressures = 32 %) or none relevance (64 Pressures = 53 %)(Figure 4, Table 5).

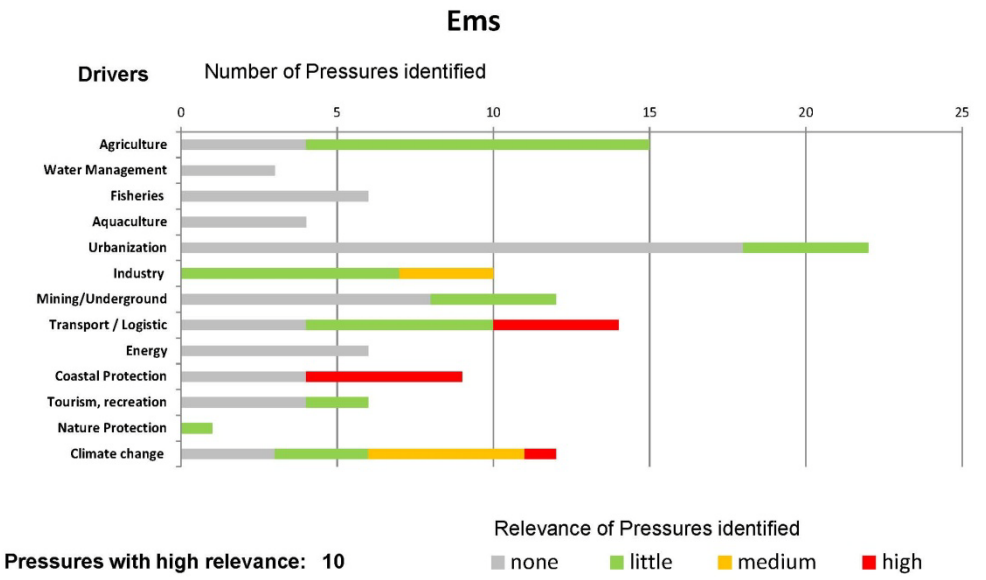


Figure 4: The relevance of identified Pressures in the Ems estuary.

| Driving forces | Pressures with high relevance |
|---|---|
| **Transport / Logistic** | **Consumption** |
| | Land reclamation (harbours) |
| | **Infrastructure** |
| | Salt Water Intrusion |
| | Commercial harbours |
| | **Changes in morphology** |
| | Dredging activities |
| **Coastal Protection** | **Infrastructure** |
| | Barrier |
| | Dams |
| | **Alteration of hydrological regime** |
| | Currents |
| | Sediment |
| | Saltcontent |
| **Climate change** | **Ecology** |
| | Changes in biodiversity |

Table 5: Pressures with high relevance in the Ems estuary.

For the Weser estuary 12 medium (10 %) and six high relevant Pressures (5 %) in seven Driving forces have been scanned. High relevant Pressures could be found in the Driving forces Transport/Logistic (3), Climate change (2) and Coastal protection (1). All these Drivers include also 2 to 4 medium ranked Pressures. Other Drivers with one medium ranked Pressure are: Urbanization, Industry, Mining/Underground and Nature Protection. Six Driving forces show none (Aquaculture) or none to little relevance (Agriculture, Water Management, Fisheries, Energy and Tourism/Recreation. In total 36 Pressures (30 %) are marked with none and 66 (55 %) with little relevance (Figure 5, Table 6).

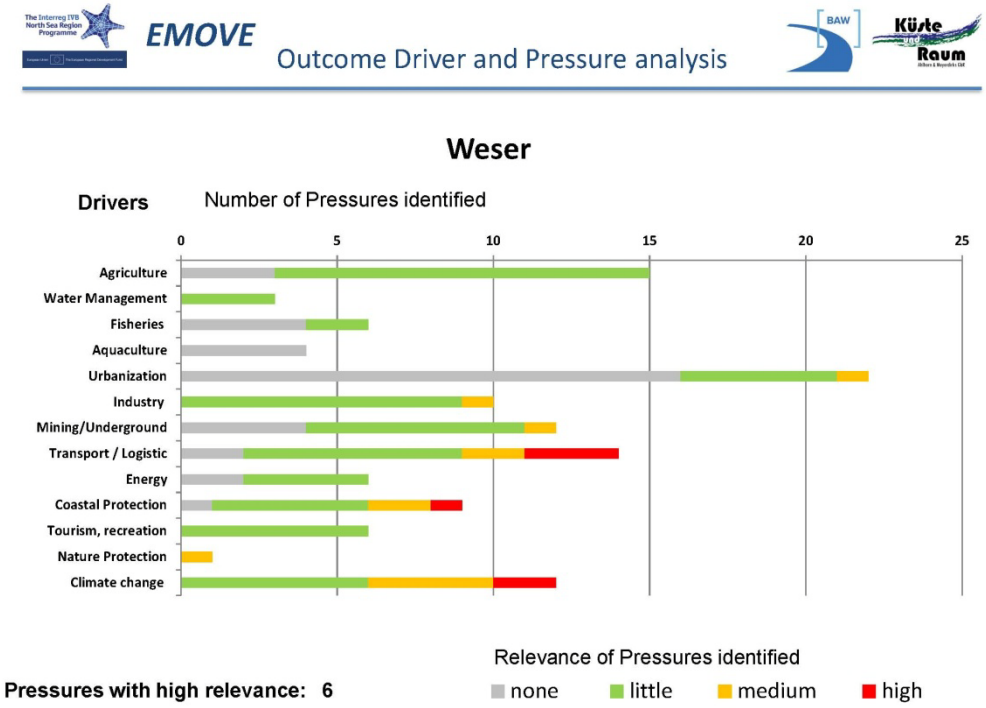


Figure 5: The relevance of identified Pressures in the Weser estuary

| Driving forces | Pressures with high relevance |
|---|---|
| **Transport / Logistic** | **Infrastructure** |
| | Commercial harbours |
| | Salt Water Intrusion |
| | **Changes in morphology** |
| | Dredging activities |
| **Coastal Protection** | **Infrastructure** |
| | Dams |
| **Climate change** | **Meteorology** |
| | Floods |
| | Changes in biodiversity |

Table 6: Pressures with high relevance in the Weser estuary

### 3.1.4 Synopsis

Reflecting the outcomes of the problem identification there are similarities between the German estuaries (Elbe, Ems, Weser) and the Scheldt, while the amount and distribution of Drivers and Pressures slightly differ according to the Göta Älv.

In all German estuaries the amount of medium and high ranked Pressures reaches 15 to 16 % which accords to the 17 % identified for the Scheldt. Pressures without relevance occur in Elbe (48 %), Ems (53 %) and Weser (30 %) while the experts of the Scheldt declare all remaining Pressures as little relevant (83 %). Looking at the important issues the German estuaries and the Scheldt show a comparable situation. Eight of 13 Driving forces got medium or high relevant Pressures in all these estuaries. Except Fishery (Elbe) and Urbanisation (Weser) which occurs only as medium relevant in one estuary all other Driving forces are more prominent and at least double mentioned. Mining/Underground and Nature Protection occurs in two estuaries (Scheldt, Weser) and Industry in all German estuaries. Climate change, Transport/Logistic and Coastal Protection are identified in all four estuaries. Those three Drivers show the highest amount of high relevant Pressures in the German estuaries and have also very strong relevance in the Scheldt.

The problem identification at the Göta Älv shows in total much higher amount of medium and high ranked Pressures. Comparing the most important Driving forces to the other estuaries Transport/Logistic and Climate change issues also play a prominent role. The most important Driver is Urbanisation and also Agriculture with tendencies to more local high values.

## 3.2 Prioritised Pressures

The identification and ranking of Driving forces and Pressures based on literature and carried out by experts secures an almost complete overview of the problem situation in different estuaries (Chap. 3.1.). Nevertheless, the long-time experienced interdisciplinary groups of experts almost have already a differentiated view on the problems occurring in the system. The comparison of those two approaches (DPSIR and Prioritised Pressures) could lead to a broad and comprehensive system description of the existing problem situation.

To specify this knowledge based and expert oriented approach the national expert groups have filled in a questionnaire in order to get a more concise idea of the prioritised Pressure per estuary. Finally, one issue of interest for every estuary has been identified. Main goal was to gain better insight into the investigation areas, timelines, problem initiating processes, possible impacts and the people involved.

To structure this step the national expert groups answered these questions:

| | |
|---|---|
| Prioritised Pressure | •Which is the most important Pressure in the estuary? |
| Where? | •Which parts of the estuary are under investigation? |
| Why? Which Drivers? | •Why is that the case? Which **Driving forces** lead to this situation? Anthropogenic activities (e.g. production), environmental subjects (e.g. climate change) |
| How long? | •How long do these circumstances exist? |
| Who? User group | •Who (which user group) appointed that Pressure? Do other groups agree to this nomination? Is the Pressure commonly accepted? |
| Impacts | •Which are the most important impacts triggered by this Pressure? |
| Responses | •Are there responses targeting at this Pressure? Are these responses already fixed by law or societal structures? |

**Table 7: Questions to identify the most important problem– Prioritised Pressure - in the case/partner estuary.**

### 3.2.1 Göta Älv Estuary

| | |
|---|---|
| Prioritised Pressure | •**Increased Flooding**: increased frequency and extended areas affected<br>•**Disposal of Masses**: excavated masses for sea disposal |
| Where? | •**Increased Flooding**: river outlet of the estuary up to the branching to Nordre Älv<br>•**Disposal of Masses**: estuary near Gothenburg |
| Why? Which Drivers? | •**Increased Flooding**: climate change, increased precipitation and sea level<br>•**Disposal of Masses**: urban development of transport sector (tunnel) |
| How long? | •**Increased Flooding**: new operable barriers persist on the long time scale<br>•**Disposal of Masses**: ecological and morphological effects up to decades |
| Who? User group | •**Increased Flooding**: of widespread recognition and known among public<br>•**Disposal of Masses**: politicians on municipal level, industry, commuters |
| Impacts | •**Increased Flooding**: damage to infrastructure, increasing pollution<br>•**Disposal of Masses**: ecological and morphological changes |
| Responses | •**Increased Flooding**: building operable flood barriers<br>•**Disposal of Masses**: assessment of alternative management strategies |

**Table 8: Prioritised Pressure in the Göta Älv estuary.**

### 3.2.2 Scheldt Estuary

| | |
|---|---|
| Prioritised Pressure | •**Tidal intrusion**: amplification of the tidal range with related problems: loss of estuarine dynamics, import of fine sediments, higher flood risk |
| Where? | •River outlet of the estuary up to the sluices at Ghent |
| Why? Which Drivers? | •The loss of large-scale estuarine dynamics: Reclamation of salt marshes, consolidating of embankments, sediment management, climate change |
| How long? | •Amplification of tidal range occurs since ages. Increase due to maintenance for shipping (interacting with sand mining) is occurring since 1970's |
| Who? User group | •Tidal intrusion has been appointed by the estuarine managers. Stakeholders frame the problem in terms of safety, loss of dynamics, ecological values |
| Impacts | •Rise of high waters, loss of large scale estuarine dynamics , strong currents hindering shipping, sediment import, concentration of suspended sediments |
| Responses | •Flexible disposal of dredged sediment, Nature restoration including controlled flooding, joint vision development of Flanders and Netherlands |

**Table 9: Prioritised Pressure in the Scheldt estuary.**

### 3.2.3 Weser Estuary

| | |
|---|---|
| Prioritised Pressure | •**Salt Water Intrusion**: Encroachment of Salt Water into ground- and surface water bodies and soils of coastal landscapes and river banks |
| Where? | •River outlet of the estuary up to the freshwater border |
| Why? Which Drivers? | •Natural process in the transition of marine and terrestrial coastal zone. The up-stream movement is triggered by deepening the estuary and climate change |
| How long? | •Accelerated Salt Water Intrusion is directly time dependent to the deepening of the estuary. First great changes after deepening in 1890`s |
| Who? User group | •The upstream movement of the salt/freshwater border is of widespread recognition. Particularly affected are farmers and water suppliers |
| Impacts | •Salinisation of water/soil : habitat loss and changes in species composition, affecting water suppliers, water management and agriculture |
| Responses | •Assessment of impacts of deepening and compensatory measures , measures to prevent deterioration of surface water bodies (WFD) |

**Table 10: Prioritised Pressure in the Weser estuary.**

# 4 Discussion

The main goal of this interim report is to summarise the outcomes of the Problem Identification in the partner estuaries: Weser, Elbe, Ems, Scheldt and Göta Älv (Chap. 1). For the joint identification of technical and governance problems occurring in the case/partner estuaries two different methodological approaches have been applied. By using one analytical survey (DPSIR concept) the estuary specific outcomes with their similarities and differences could be presented in one structure (Chap. 2, 3.1). The expert oriented approach was applied in order to get differentiated knowledge on special problems using a questionnaire (Chap. 3.2).

For a responsible interpretation it is indispensable to know that the realised assessments have been done by national expert teams valuing the estuary in their area of operations. Nevertheless, standardised methodologies were applied to enable a quick scan of the most important problems occurring in the case/partner estuaries (Chap. 3.1).

Every team has its own background of values for assessing the list of Drivers and Pressures. It led to a noticeable shifting of the overall intensity of Pressures affecting the estuaries. Also the handling of uncertainty was individual. This emerges by assessing a Pressure as none or little relevant considering the whole spatial extent of the estuary. It highlights a slightly difference of these methods. While the identification of the most important Drivers and Pressures according the DPSIR concept was executed for the whole estuary, the questionnaire focuses on the identified Prioritised Pressure which can gain importance only in some parts of the estuary.

Nevertheless, both methods rely on comparable problem situations of the investigated estuaries. Especially, the German estuaries and the Scheldt show large importance of the alteration of the hydrological and morphological regime. The importance of infrastructure is demonstrated through their ranking as high relevance in these estuaries. This coincides with the outcome of the questionnaire where the items causing this are identified as the loss of natural structures and dynamics. This is triggered and manifested by the artificial infrastructure in those estuaries.

For the Göta älv it has been concentrated on two items that slightly differ from the other estuaries. The prioritised Pressure Disposal of Masses is a regional Problem focussing on the area of Gothenburg. Nevertheless, this coincides with the outstanding high relevant Pressures of the Driver Urbanisation. Also the recognition of Climate change as an important Driver is affirmed in the questionnaire by the declaration of Increased Flooding as a Prioritised Pressure.

The application of the DPSIR concept and the questionnaire seems to be able to generate consistent outcomes. This could be justified by the different perspectives of the method. Both approaches enable an appropriate overview of the Problems occurring in different estuaries.

The ability of the DPSIR concept to support an effective integrated management of coastal zones and river environments has been approved by other Projects. EUROCAT (European Catchments – Catchment Changes and their Impacts on the Coast) focussed on changing fluxes of nutrients, pollutants and other materials and their linkage to individual socio-economic drivers and pressures at catchment level in the North Sea (Elbe, Rhine, Humber) the Baltic Sea (Vistula River), the Adriatic Sea (Po, Idrija Rivers), the Aegean Sea (Axios River), and the Black Sea (Provadijska River) - see e.g. Cave et al. 2002, Meybeck et al. 2000, Lükeville 2003. Parts of the methodological and practical knowledge gained in EUROCAT build the foundation of the identification of most important Drivers and Pressures in EMOVE (Pirrone et al. 2003)

More information could be derived from the EU Interreg IVB project TIDE (Tidal River Development) which addresses the necessary ingredients for an integrated estuarine management strategy. Particularly, the work on the existing conflicts between different users in the four estuaries Elbe, Humber, Scheldt and Weser provided a good overview on existing challenges in managing estuarine systems.

The great attention given to the demands of users as well as to the Driving forces and Pressures interfering their full implementation is the reason for focussing on the detailed identification of problems in the first activity of a joint fact finding as it is aspired in Work Package 3.

# 5 References


Aliaume, C. et al., 2007. Coastal lagoons of Southern Europe: recent changes and future scenarios. Transitional Water Monographs, 1, pp.1–12.

Borja, Á. et al., 2006. The European Water Framework Directive and the DPSIR, a methodological approach to assess the risk of failing to achieve good ecological status. Estuarine, Coastal and Shelf Science, 66(1-2), pp.84–96. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0272771405002714 [Access December 13, 2013].

Cave et al., 2002. The Humber Catchment and its coastal area. Work Package #2: Impacts, indicators and critical loads of the receptor (coastal sea), EUROCAT (European Catchments – Catchment Changes and their Impacts on the Coast), University of East Anglia, 26 p.

Bosch, P., 2000. Questions to be answered by a state-of-the-environment report. The first list. (47), p.116.

Kristensen, P., 2004. The DPSIR Framework, pp.1–10.

Lükeville, A., 2003 Report on Relevant National and International Treaties and Regulations for the EUROCAT Catchment Case Studies (North Sea, Baltic Sea, Adriatic Sea, Aegean Sea, Black Sea). EUROCAT (European Catchments – Catchment Changes and their Impacts on the Coast) Edited by Anke Lükewille (CEE-NILU, Norway), 157 p.

Meybeck, M. et al., 2000, River Coast Integration in European Regional Seas. Work Package 5.3. EUROCAT (European Catchments – Catchment Changes and their Impacts on the Coast), Université Paris VI, UMR Sisyphe, 68 p.

Nobre, A.M., 2009. An ecological and economic assessment methodology for coastal ecosystem management. Environmental management, 44(1), pp.185–204. Available at: http://www.ncbi.nlm.nih.gov/pubmed/19471999 [Access December 13, 2013].

Pirrone, N. et al., 2005. The Driver-Pressure-State-Impact-Response (DPSIR) approach for integrated catchment-coastal zone management: preliminary application to the Po catchment-Adriatic Sea coastal zone system. Regional Environmental Change, 5(2-3), pp.111–137. Available at: http://link.springer.com/10.1007/s10113-004-0092-9 [Access December 13, 2013].

Cutts, N.D. & K.L. Hemingway, 2013. Analysis of the TIDE Estuarine - Conflict Matrices. TIDE (Tidal River Development). Institute of Estuarine and Coastal Studies (IECS), University of Hull, UK, 107 p. [Access March 2013]


## *Websites*


www.VNSC.eu

http://www.iia.cnr.it/big_file/EUROCAT/elbe%20german.htm

http://www.tide-project.eu/

# 6 Annex

| Driving forces | Pressures | Schelde | | | | Göta älv | | | | Elbe | | | | Ems | | | | Weser | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| List of edxisting Driving forces in coastel zones | List of Pressures triggered by Driving forces | none | little | nedium | high | none | little | nedium | high | none | little | nedium | high | none | little | nedium | high | none | little | nedium | high |
| | **Consumption** | | | | | | | | | | | | | | | | | | | | |
| | Agricultural land use | | x | | (x)L | | | | x | | x | | (x)L | | x | | | | x | | (x)L |
| | Increase in farmed land and livestock | | x | | | | x | | | | x | | (x)L | | x | | | | x | | (x)L |
| | application on land and wastewater | | x | | | | | x | | x | | | | x | | | | x | | | |
| | use freshwater consumption for irrigation manure | | x | | | | x | | | x | | | | x | | | | x | | | |
| **Agriculture and land use change** | delivery from livestock reclamation of wetlands, marginal lands | | x | | | | | x | | x | | | | x | | | | | x | | |
| Characteristic of: | Radiation | | x | | | | x | | | (x) | | | | (x) | | | | (x) | | | |
| Production patternn | **Pollution / Agriculture discharges** | | | | | | | | | | | | | | | | | | | | |
| Consumption pattern | Point source | | x | | | | | x | | | o | | | | o | | | | o | | |
| Amount agricultural production | Diffuse source | | x | | | | | | x | | o | | | | o | | | | o | | |
| Degree of innovation in agricultural practices | Fertilizer use | | x | | | | | x | | | o | | | | o | | | | o | | |
| | Nitrogen load | | x | | | | | | x | | o | | | | o | | | | o | | |
| | Phosphorus load | | x | | | | x | | | | o | | | | o | | | | o | | |
| | Atmospheric input | | x | | (x)L | | | | x | | o | | | | o | | | | o | | |
| | Nitrogen deposition | | x | | (x)L | | | | X | | o | | | | o | | | | o | | |
| | Pesticide use | | x | | | | | x | | | o | | | | o | | | | o | | |
| | Livestock units | | x | | | | | x | | | o | | | | o | | | | o | | |
| | **Changes in hydrological system** | | | | | | | | | | | | | | | | | | | | |
| **Watermanagement** | Changing water levels | | x | | | | | | x | | x | | | x | | | | | o | | |
| | Changing depth to water table | | x | | | | | x | | (x) | | | | (x) | | | | | (o) | | |
| | Changing soilmoisture | | x | | | | | x | | (x) | | | | (x) | | | | | (o) | | |
| | **Resource exploitation** | | | | | | | | | | | | | | | | | | | | |
| | Fishing/angling intensity (catches, Fishing quotas, Tonnage of fishing vessels) | | x | | | | x | | | | | x | | x | | (x)L | | | x | | |
| **Fisheries** | Shellfishing | | x | | | | x | | | x | | | | x | | | | x | | | |
| | Algae exploitation | | x | | | | x | | | x | | | | x | | | | x | | | |
| | By-catch | | x | | | | x | | | x | | | | x | | | | x | | | |
| | **Infrastructure** | | | | | | | | | | | | | | | | | | | | |
| | Fishing harbours | | x | | | | | x | | x | | | | x | | | | x | | | |
| | **Changes in morphology** | | | | | | | | | | | | | | | | | | | | |
| | Trawling, dredging | | x | | | | | | x | x | | | (x)L | x | | | (x)L | | x | | (x)L |
| | **Infrastructure** | | | | | | | | | | | | | | | | | | | | |
| | Increase in fish and shellfish farm area | | x | | | | x | | | x | | | | x | | | | x | | | |
| **Aquaculture** | **Pollution / Aquaculture discharges** | | | | | | | | | | | | | | | | | | | | |
| | Nutrient load (fodder) | | x | | | | x | | | x | | | | x | | | | x | | | |
| | Drug input | | x | | | | x | | | x | | | | x | | | | x | | | |
| | introduction of farmed species | | x | | | | x | | | x | | | | x | | | | x | | | |

Table 11: Driving forces and Pressures of the EMOVE estuaries. (x) at none = relevance uncertain, (x)L local relevance, o relevance assumed

| Driving forces | Pressures | Schelde | | | Göta älv | | | Elbe | | | Ems | | | Weser | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urbanization<br>For example:<br>Urban and tourism development<br>Population pattern<br>Innovation in waste water treatment techniques | **Consumption** | | | | | | | | | | | | | | | |
| | Increase in resident and seasonal population | x | | | | x | | x | | | x | | | | | x |
| | Growth of urban areas | x | | | | x | | x | | | | | | x | | |
| | Use of resources | x | | | x | | | x | | | x | | | | x | |
| | Freshwater consumption | x | | | x | | | x | | | | | | | x | |
| | Wetland reclamation | x | | | x | | | x | | | | | | x | | |
| | Soil impermeabilisation | x | | | | | x | | x | | | x | | | x | |
| | Demand for waste disposal | x | | | | | x | | x | | | x | | | x | |
| | **Pollution / Urban discharges** | | | | | | | | | | | | | | | |
| | Inputs of nutrients and hazardous substances via rivers | x | | | | | x | | o | | o | | | o | | |
| | Type of waste water treatment plants | x | | | | | o | x | (o)L | | o | | | o | | |
| | Classes of waste water treatment plants | x | | | | | o | x | (o)L | | o | | | o | | |
| | Wastewater production | x | | | | | x | x | (o)L | | o | | | o | | |
| | Volume of sewage | x | | | | | x | x | (o)L | | o | | | o | | |
| | Storm water and overflow | x | | | | | x | x | (o)L | | o | | | o | | |
| | Outfall (treated/untreated) | x | | | | | x | x | (o)L | | o | | | o | | |
| | Treated submarine outfall (treated/untreated) | x | | | | | o | x | (o)L | | o | | | o | | |
| | Diffuse source | x | | | | | o | x | (o)L | | o | | | o | | |
| | **Infrastructure** | | | | | | | | | | | | | | | |
| | Bridges | x | | | | x | | x | | | x | (x)L | | o | | |
| | Tide mills | x | | | x | | | x | | | x | | | x | | |
| | Submarine ways | x | | | | x | | x | | | x | | | x | | |
| | Tunnel | x | | | | | x | x | | | x | | | o | | |
| | Promenade | x | | | | x | | x | | | x | | | | x | |
| | **Changes in morphology** | | | | | | | | | | | | | | | |
| | Landfills / Disposal of masses | x | | | | | x | x | | | x | | | x | | |
| Industry<br>For example:<br>Industrial development<br>Degree of industrial activity | **Consumption** | | | | | | | | | | | | | | | |
| | Land reclamation for industrial buildings | x | | | | x | | | x | | (x)L | | x | | | x |
| | freshwater consumption for processing/cooling | x | | | | x | | | x | | (x)L | | x | | (x)L | o |
| | **Pollution / Industrial discharges** | | | | | | | | | | | | | | | |
| | Industrial mixed discharges | x | | | | x | | | | x | (x)L | | x | | | x |
| | Lixiviates | x | | | | x | | (x) | | | | | | x | | o |
| | Volume of industrial effluent | x | | | | x | | | o | | | o | | | | x |
| | pollutant emission soil impermeabilisation | x | | | | x | | | o | | | o | | | | x |
| | Production of waste | x | | | | x | | | o | | | o | | | | x |
| | Production of noise | x | | | | x | | | o | | | o | | | | x |
| | **Infrastructure** | | | | | | | | | | | | | | | |
| | Increase in number and magnitude of industrial establishments | x | | | | x | | | | x | | | x | | | x |
| | **Changes in morphology** | | | | | | | | | | | | | | | |
| | Land reclamation (industrial) | x | | | | x | | | | x | (x)L | | x | (x)L | | x |

Table 11: Driving forces and Pressures of the EMOVE estuaries. (x) at none = relevance uncertain, (x)L local relevance, o relevance assumed

| Driving forces | Pressures | Schelde | | | Göta älv | | | Elbe | | | Ems | | | Weser | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mining/Underground<br>For Example:<br>Refineries | **Exploitation of natural resources** | | | | | | | | | | | | | | | |
| | Gas and oil | x | | | x | | | x | | | x | (x)L | (x)L | x | | |
| | Sand and clay | x | | | | | x | x | | | | x | | | x | |
| | Groundwater | x | | | x | | | | | | | | | | | |
| | **Changes in morphology** | o | | | | | | o | | | o | | | o | | |
| | Sand and clay extraction | | x | | | | x | | x | | | x | | | x | |
| | Groundwater abstraction | | x | | x | | | o | | | o | | | o | | |
| | **Pollution / Mining discharges** | | | | | | | | | | | | | | | |
| | Storage (slag, rubbish) lixiviation | x | | | | x | | o | | | o | | | o | | |
| | Oil pump | x | | | x | | | | x | | | x | | | x | |
| | Oil spills | x | | | | x | | | x | | | x | | | x | |
| | Direct emissions to air, water and soil | x | | | | x | | o | | | o | | | | o | |
| | Indirect emissions to air, water and soil | x | | | | | | o | | | o | | | | o | |
| | Emissions of greenhouse gases | x | | | | x | | o | | | o | | | | o | |
| | Salt Water Intrusion | | x | | | x | | | | x | o | | | | | x |
| Transport / Logistic<br>For Example:<br>Shipping | **Consumption** | | | | | | | | | | | | | | | |
| | Land reclamation (harbours) | | x | | | | x | | | x | | | x | | | x |
| | **Pollution / Transport discharges** | | | | | | | | | | | | | | | |
| | Maritime transport discharges (atmosphere and direct discharges) | x | | | | | x | | x | | | x | | | x | |
| | Contaminated land | x | | | | o | | | x | | | x | | | x | |
| | Polluted sediments | x | | | | | x | | x | | | x | | | x | |
| | **Infrastructure** | | | | | | | | | | | | | | | |
| | Commercial harbours | x | | | | | x | | | x | | | x | | | x |
| | Permanent anchorage | x | | | x | | | x | | | x | | | | x | |
| | Occasional anchorage | x | | | | | x | x | | | x | | | x | | |
| | Dumping of dredged sediments | | | x | | | x | | | x | (x)L | x | | | | x | (x)L |
| | Signposting | x | | | | o | | | x | | | x | | | x | |
| | Engineering works | x | | | | o | | | x | | | x | | | x | |
| | Military sites | x | | | | x | | | x | | x | | | x | | |
| | Shipyards and boat repair | x | | | | x | | x | (x)L | | x | | (x)L | | x | |
| | Salt Water Intrusion | | | x | | x | | | | | | | x | | | x |
| | **Changes in morphology** | | | | | | | | | | | | | | | |
| | Dredging activities | | | x | | | x | | x | (x)L | | | x | | | x |
| Energy<br>For Example:<br>Energy use<br>Energy production | **Consumption** | | | | | | | | | | | | | | | |
| | Land reclamation (power and conveyor plants) | x | | | | x | | x | | | x | | | | x | |
| | Energy demand for industry | x | | | | x | | x | | | x | | | | o | |
| | **Pollution / Energy produktion** | | | | | | | | | | | | | | | |
| | Emmissions from power plants | x | | | | | | x | | | x | | | | o | |
| | **Infrastructure** | | | | | | | | | | | | | | | |
| | Power plants | x | | | | | | x | | (x)L | x | | | | o | |
| | **Alteration of hydrological regime** | | | | | | | | | | | | | | | |
| | Water abstraction | x | | | x | | | x | | (x)L | x | | | x | | |
| | Hydroenergy | x | | | x | | | x | | | x | | | x | | |

Table 11: Driving forces and Pressures of the EMOVE estuaries. (x) at none = relevance uncertain, (x)L local relevance, o relevance assumed

| Driving forces | Pressures | Schelde | | | Göta älv | | | Elbe | | | Ems | | | Weser | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coastal Protection | **Infrastructure** | | | | | | | | | | | | | | | |
| | Sea walls | | | x | x | | | x | | | x | | | x | | |
| | Jetties | x | | (x)L | | | x | x | | | x | | | | x | |
| | Barrier | | | x | | | x | | | x | | | x | | x | |
| | Dams | | | x | x | | | | | x | | | x | | | x |
| | **Changes in morphology** | | | | | | | | | | | | | | | |
| | Dredging | | x | | | | x | x | | | x | | | x | | |
| | Landfills | x | | | | ? | | | x | | x | | | x | | |
| | **Alteration of hydrological regime** | | | | | | | | | | | | | | | |
| | Currents | | x | | x | | | | x | | | | x | x | | |
| | Sediment | | | x | | x | | | x | | | | x | x | | |
| | Saltcontent | x | | | x | | | | x | | | | x | x | | |
| Tourism, recreation, leasure | **Consumption** | | | | | | | | | | | | | | | |
| | Recreation demands | x | | | | | x | x | | | x | | | x | | |
| | Number of tourist | x | | | | x | | x | | | x | | | x | | |
| | Number of holiday home | x | | | x | | | x | | | x | | | x | | |
| | Seasonal population change | x | | | x | | | x | | | x | | | x | | |
| | **Pollution / Touristic sector** | | | | | | | | | | | | | | | |
| | Private (maritime) traffic | x | | | | | x | | x | | | x | | x | | |
| | **Infrastructure** | | | | | | | | | | | | | | | |
| | Marinas | x | | | | | x | | x | | | x | | x | | |
| Nature Protection | **Consumption** | | | | | | | | | | | | | | | |
| | Area demand for nature protection | | | x | | | x | | x | | | x | | | x | |
| Climate change | **Meteorology** | | | | | | | | | | | | | | | |
| | Temperature increase | x | | | | | x | | x | | | x | | x | | |
| | Storm events | | x | | | | x | x | | | | x | | x | | |
| | Change in seasonal weather patterns | x | | | | | | | | | | | | x | | |
| | Floods | | x | | | | x | x | | | | x | | | | x |
| | Droughts | | x | | | x | | | x | | | | x | x | | |
| | Flood-storm events | | x | | | | x | x | | | x | | | x | | |
| | **Hydrology** | | | | | | | | | | | | | | | |
| | Sea-level rise | | x | | | | x | | | x | | | x | x | | |
| | Freshwater consumption in all sectors | | x | | x | | | | x | | | | | | | |
| | Changes in geohydrology | x | | | | | x | | x | | | | | | x | |
| | **Morphoplogy** | | | | | | | | | | | | | | | |
| | Changes in runoff and sediment transport | x | | | | | x | | (x) | x | (x) | | (x) | x | (x) | | | x | |
| | **Ecology** | | | | | | | | | | | | | | | |
| | Changes in biodiversity | x | | | | | x | | | x | | | x | | | x |
| | Introduced species | x | | | | | x | | x | | | | x | | | x |
| | Introduced diseases | x | | | | x | | | x | | | | x | | | x |

Table 11: Driving forces and Pressures of the EMOVE estuaries. (x) at none = relevance uncertain, (x)L local relevance, o relevance assumed