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Integrating Dynamic Route Planning : Feasibility of integrating dynamic route planning in Maritime Spatial Planning

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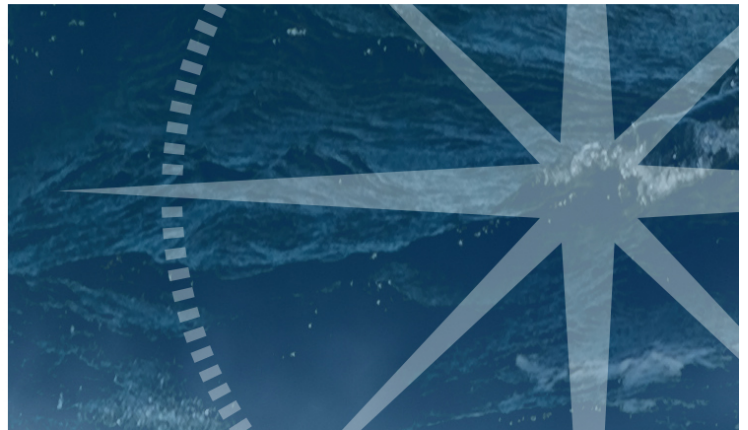
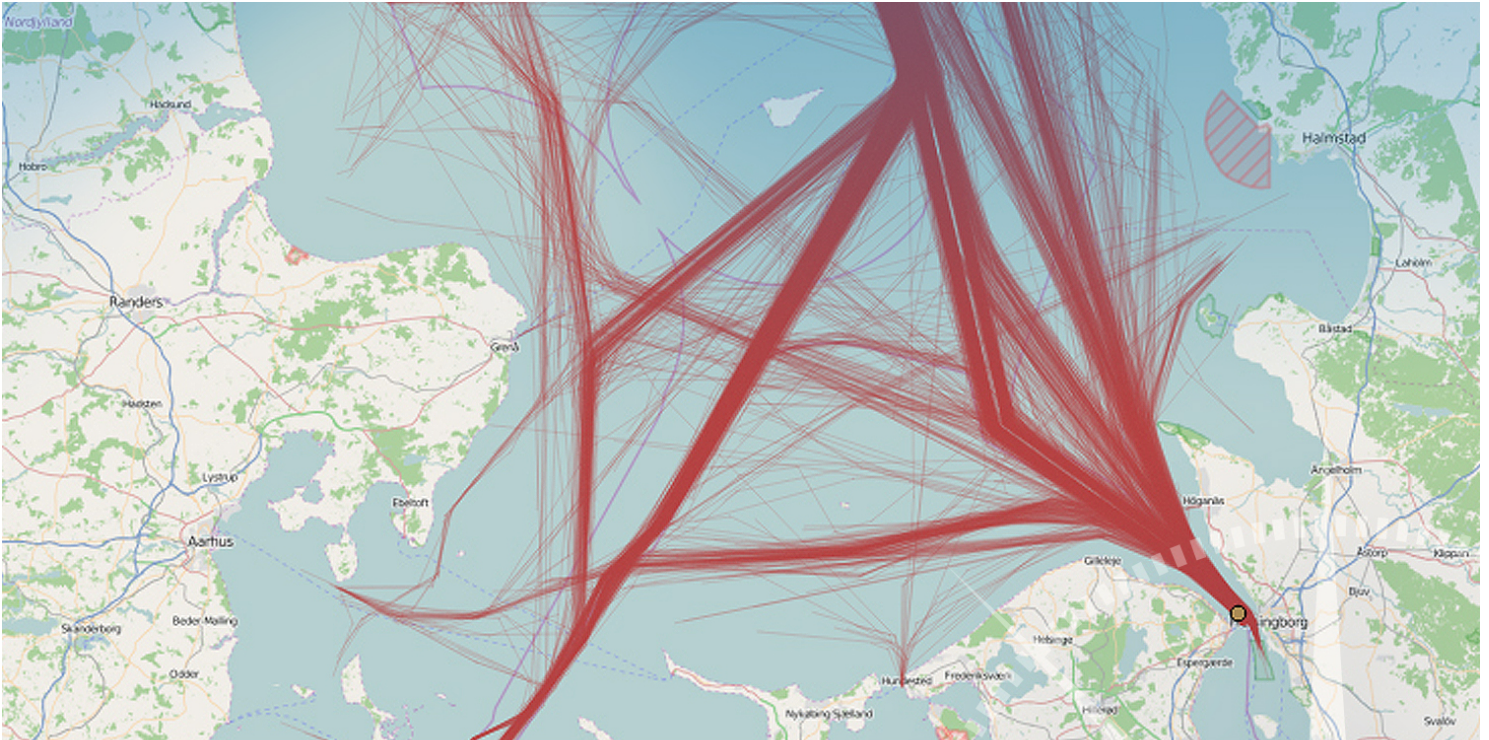
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MONALISA 2.0 – Sub-activity 1.7

Integrating Dynamic Route Planning

Feasibility of integrating dynamic route planning in Maritime Spatial Planning

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1. A general description of MSP policies and regulations

1.1. A short overview on policies and laws

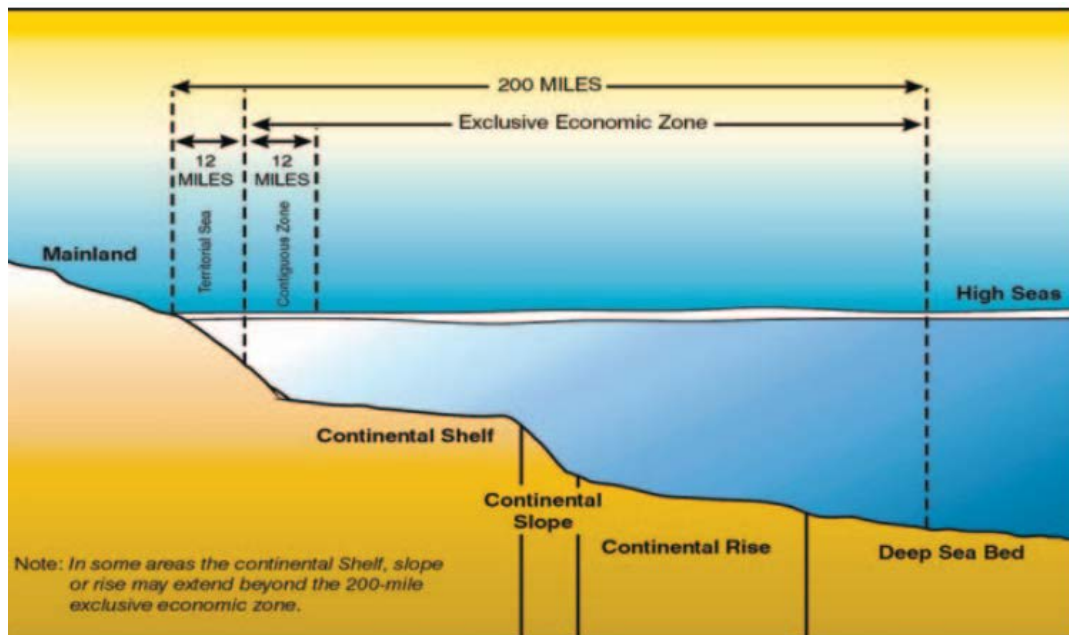
There are a lot of policies and laws to refer to with when MSP-Maritime Spatial Planning is considered¹.

The United Nations Convention on the Law of the Sea (1982) defines different maritime zones for coastal states, for which maritime spatial plans may be established:

- Territorial sea: a coastal state enjoys full sovereignty in a zone up to 12 nautical miles (NM) from the coast.
- Exclusive economic zone (EEZ): a coastal state may establish an exclusive economic zone not extending beyond 200 nautical miles from its coast. In this zone, the coastal state has sovereign rights to explore and exploit, conserve and manage natural living or non-living resources of the waters, the seabed and its subsoil, and to exploit the zone for other purposes, such as the production of energy from the water, currents and winds. It has jurisdiction with regard to the establishment and use of artificial islands, installations and structures, marine scientific research and environmental protection.
- Continental shelf: a coastal state exercises sovereign rights over the resources of the seabed and subsoil. Coastal states have jurisdiction over their continental shelf with regard to the establishment and use of artificial islands, installations and structures; drilling of the continental shelf; cables and pipelines used in connection with exploration or exploitation of the continental shelf. The continental shelf may extend up to 400 nautical miles from the coast, depending on the depth of the seabed.

1

<http://www.europarl.europa.eu/document/activities/cont/201305/20130521ATT66342/20130521ATT66342EN.pdf>



Marine zones

The integrated maritime policy (IMP) for the EU (COM (2007) 575) and the corresponding action plan (SEC (2007) 1278) provide a framework to coordinate the development of sea-based activities in an ecosystem-focused approach.

The Marine Strategy Framework Directive (2008/56/EC), the environmental pillar of the IMP, aims to achieve 'good environmental status' of the EU's marine waters by 2020, and to protect the resource base on which marine-related economic and social activities depend. It requires Member States to develop a sea-basin based strategy for their marine waters, using an approach covering whole ecosystems. This strategy must include an environmental assessment, targets and monitoring programs.

Other relevant environmental legislations and EU initiatives include:

- The Water Framework Directive, which applies to coastal waters
- The Birds and Habitats Directives, which establish the Natura 2000 network of protected areas
- Directive 85/337/EEC requiring an environmental impact assessment for public and private projects
- Directive 2001/42/EC, which requires a strategic environmental assessment at an early stage for major plans and projects, including maritime planning
- The Biodiversity Strategy includes actions to complete the Natura 2000 network, especially in the marine environment, and to combat overfishing and improve marine biodiversity

- The 'blue growth' initiative and Limassol declaration,
- The Marine Knowledge 2020 initiative
- The ICZM Recommendation
- The common fisheries policy
- The Renewable Energy Directive
- The Motorways of the Sea initiative
- The strategy on climate change adaptation.

1.2. Understanding MSP-Maritime Spatial Planning

This chapter is not a comprehensive overview of marine policies and laws. It will consider a few policies and laws linked with the aim of Activity 1.7 of MONALISA 2.0 project, i.e. “to provide elements to understand the feasibility of integrating Dynamic Route Planning with the environmental aspects of Maritime Spatial Planning”.

Therefore, the aim of this paragraph is to provide the reader with an understanding of the meaning of Maritime Spatial Planning and the framework of its implementation.

The main references for the paragraph are the following documents that can easily be found on the web:

- DIRECTIVE 2014/89/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 July 2014 establishing a framework for maritime spatial planning²
- Communication from the Commission of 25 November 2008, “Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU”³
- Legal aspects of maritime spatial planning, study done on behalf of the European Commission, ISBN 978-92-79-12064-04

For the purpose of the activity 1.7 it is important to understand what MSP is or is not.

² <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0089&from=EN>

³ <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52008DC0791&from=EN>

⁴ <http://bookshop.europa.eu/en/legal-aspects-of-maritime-spatial-planning-pbKL8009613/>

The directive stated that:

- It establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources
- ‘Maritime spatial planning’ means a process by which the relevant Member States’ authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives
- When establishing and implementing maritime spatial planning, Member States shall consider economic, social and environmental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach, and to promote the coexistence of relevant activities and uses.
- Through their maritime spatial plans, Member States shall aim to contribute to the sustainable development of energy sectors at sea, of maritime transport, and of the fisheries and aquaculture sectors, and to the preservation, protection and improvement of the environment, including resilience to climate change impacts. In addition, Member States may pursue other objectives such as the promotion of sustainable tourism and the sustainable extraction of raw materials.

Simply saying that MSP is equal to planning or zoning does not suffice.

MSP is the concept of integrated decision making and managing the uses of maritime space.

Planning will always exist in the case of human activity (e.g. location plans exist for wind farms, shipping lanes are regulated in busy areas like the English Channel, etc.).

Hence, MSP is a collection of actions leading to (among other things) the designation of zones for certain activities with the objective of creating the preconditions for human activity. In order to do so sensibly, data and knowledge are needed on a wide scope, for example the geological properties of the area involved, the environmental impact of an activity in such an area and the existence and intensity of other activities in the same area. But Europe’s maritime regions are very different from one another, i.e. in terms of geological richness, knowledge base, economic development, environmental status, cultural elements etc. Due to these large differences, a single way of organising MSP would not suffice.

This is why the European Commission created a Roadmap on Maritime Spatial Planning. In this roadmap, the Commission provides ten instruments (key principles) that can be used to organise MSP in a proper manner.

The key principles are:

1. Use MSP according to area and type of activity: this principle emphasises that a detailed maritime spatial plan may not be necessary for an entire sea area but only in densely used or vulnerable areas. Furthermore, it implies that adequate MSP should incorporate three dimensions: (1) the seabed, (2) the water column and (3) the surface.
2. Define objectives to guide MSP: this principle prescribes that MSP should be based on a clear strategy with detailed objectives, which should allow arbitration in case of conflicting interests.
3. Develop MSP in a transparent manner: in order to create acceptance, the steps followed in developing MSP should be easily understandable to all stakeholders involved.
4. Encourage stakeholder participation: the quality and acceptance of the maritime spatial plan largely determine its successful adoption. It is therefore essential to encourage stakeholders to participate in the process of Maritime Spatial Planning.
5. Coordinate within Member States – simplify decision processes: coordination mechanisms within a Member State can be significant obstacles for maritime activities and/or environmental programs. MSP aims to integrate and subsequently simplify and speed up procedures.
6. Ensure the legal effect of national MSP: MSP should be legally binding if it is to be effective.
7. Implement cross-border cooperation and consultation: maritime activities take place across borders of Member States' sea areas. Hence, Member States should ensure coherence in their plans across ecosystems.
8. Incorporate monitoring and evaluation in the planning process: knowledge building and flexibility are crucial elements of every plan to prevent excessive rigidity. This principle therefore emphasises the need to incorporate monitoring and evaluation in the planning process.
9. Achieve coherence between terrestrial and maritime spatial planning – relation with ICZM: Successful MSP should be aligned with other planning mechanisms in order to prevent incompatibilities and/or discrepancies.
10. Create a strong data and knowledge base: a sound knowledge base is crucial for every plan to succeed. So this final principle underlines the need to obtain a comprehensive understanding of both the necessity and expected impact of MSP.

A detailed analysis of the key principles of MSP reveals basic differences between the characteristics of the ten principles.

Three types of principles can be distinguished: (1) input, (2) process and (3) effect principles.

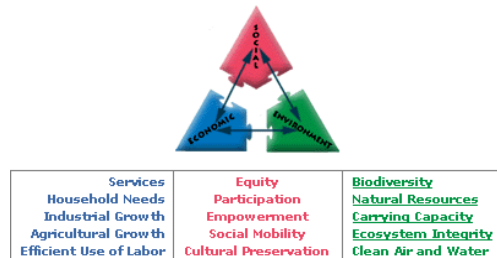
On the input side, three principles need to be incorporated: (a) MSP according to area and type, (b) defining objectives and (c) data & knowledge. These three principles largely determine the scope of MSP, i.e. knowing what to achieve with MSP in which area. The second type of principles, the 'process principles' are dedicated to organising MSP in such a way that its objectives can be reached. The third type of principles, the 'effect principles', help define the objectives to be realised via MSP and are: (a) simplified decision process, (b) establishment of a legal framework, (c) cross-border cooperation and (d) coherence with other planning systems.

Summarising:

1. Sustainable development is a central point of the MSP Directive*¹.
2. MSP is a tool for improved decision-making. It provides a framework for arbitrating between competing human activities and managing their impact on the marine environment. Its objective is to balance sectoral interests and achieve sustainable use of marine resources in line with the EU Sustainable Development Strategy*².

*¹ There are many definitions of sustainable development, including this landmark one which first appeared in 1987 (Brundtland Commission): "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Others definitions are available and the discussion about the feasibility of a "sustainable development" is still ongoing. Eurostat in its report on "Sustainable development in the European Union" adopted more than 100 indicators to give an overall picture of whether the European Union has achieved progress towards sustainable development in terms of the objectives and targets defined in the strategy.

Eurostat publication's main purpose is to assess progress towards sustainable development based on the objectives and targets set out in the EU SDS and other relevant policy initiatives such as the Europe 2020 strategy. The object of the evaluation is the relative direction and rate of change in light of sustainable development objectives, not the 'sustainability' of the situation at any point in time. It is therefore a relative, not an absolute assessment. People concerned about sustainable development suggest that meeting the needs of the future depends on how well we balance social, economic, and environmental objectives--or needs--when making decisions today. Some of these needs are itemized around the following puzzle diagram



*² With an established spatial plan, the decision making process for individual projects can be simplified and accelerated, and costs can be reduced.

A study on the economic effects of MSP estimates that maritime activities in the EU created value added of €104 billion in 2010. It identifies three categories of MSP impacts:

- Lower coordination costs
- Lower transaction costs

3. Therefore, Priorities are set by a political, not a scientific or technical decision-making process
4. MSP operates within three dimensions, addressing activities (a) on the seabed; (b) in the water column; and (c) on the surface. This allows the same space to be used by different purposes.
5. Time should also be taken into account as a fourth dimension, as the compatibility of uses and the “management need” of a particular maritime region might vary over time.
6. The ecosystem approach is an overarching principle for MSP^{*3}.
7. MSP has to be based on sound information and scientific knowledge. Planning needs to evolve with knowledge (adaptive management)^{*4}.
8. MSP is a process that consists of data collection, stakeholder consultation and the participatory development of a plan, the subsequent stages of implementation, enforcement, evaluation and revision.

To avoid misunderstandings, it must be clear that MSP⁵

1. Is not an end in itself, but a practical way to create and establish a more rational use of marine space and the interactions between its uses, to balance demands

The study estimates that MSP could bring the following economic effects by 2030: a reduction of transaction costs by €0.4 to €1.8 billion, and gains of €0.155 to €1.6 billion through acceleration of investments in offshore wind and aquaculture.

The UK estimates that its marine planning system cost around £34 million to set up and £1 million per year to maintain. On the other hand, the benefits are estimated at around £47 million.

- In Germany, the cost of an environmental assessment for a wind farm (normally around €1 million) can be reduced or eliminated because the federal government has already produced a strategic environmental assessment for its spatial plan that includes priority areas for wind farms.

^{*3} Ecosystem approach implies that the pressure of human activities (wind farm, fishing, navigation, dredging, etc) on environmental components (fish, birds, mammals, seagrass, coral, etc.) must be estimate, evaluate according to some scientific criteria. See for example “Human pressure and their potential impact on the Baltic ecosystem” by S. Korpinen, L. Meski, J.H.Andersen, M. Laamanen – Ecological Indicators 15 (2012) 105-114

^{*4} The Commission has started several scientific and data gathering tools that will assist MSP in this process. These include a European Marine Observation and Data Network (EMODNET), an integrated database for maritime socio-economic statistics (currently under development by ESTAT), the European Atlas of the Seas (to be delivered in 2009) and the Global Monitoring for Environment and Security (Kopernikus)

⁵ http://www.unesco-ioc-marinesp.be/marine_spatial_planning_msp

for development with the need to protect the environment, and to achieve social and economic objectives in an open and planned way.

2. Is not a substitute for single-sector planning and management.

Strategic and operational plans for fisheries, transportation, energy, recreation, and conservation, for example, will continue even when integrated MSP is put into practice. Integrated MSP can provide a guide to single-sector management that should increase compatibilities and reduce conflicts across sectors, balance development and conservation interests, increase institutional effectiveness and efficiency, and address the cumulative effects of multiple human uses of the same marine space.

3. Is not a one-time plan. The context for planning is constantly changing.

Science contributes new knowledge. Monitoring and evaluation adds new information about the effectiveness, efficiency, and equity of alternative management measures. Technology improves. Social, economic, and political conditions change over time. Plans should be updated periodically to reflect these changing conditions.

4. Marine spatial planning is not only conservation planning.

While a network of marine protected areas might be one outcome of MSP, it seeks to balance economic development and environmental conservation, and not focus on only on the goals of conservation or protection.

2. MSP best practises - Scandinavia

2.1. MSP in Sweden

In many ways humans are dependent of the sea, as it provides a variety of services and resources, and at the same time we need to protect the sea for the future. The different uses are many, maritime transport, fishery, tourism, energy production, military defence to mention some of them. Some of the interests can be coordinated and stakeholders work together within a marine area, while others do not.

Maritime Spatial Planning is an important tool for the long-term management and development concerning the marine areas. The MSP implies that human uses, development and marine protection are weighed against each other. The plans should lead to that marine areas are used as efficient as possible making sure that the marine ecosystems are well-functioning and that the precautionary principle is applied.

2.1.1. Legislation

The regulation in Sweden of the governmental maritime spatial planning has its starting point in a maritime spatial planning investigation that was summoned in November 2009.

In October 2013 a memorandum about the management of the Swedish marine areas was sent out by the Swedish Ministry of the Environment

In March 2014 the Swedish government approved a proposition to the Swedish parliament concerning the implementation of a governmental maritime spatial planning.

On the 10th of June 2014 Sweden got a new legislation that implied that the government would establish a system for planning the marine areas. Doing so will increase the possibility for citizens and businesses to have insight and participation of the planning of marine areas.

The new regulation implies changes in the Swedish Environmental Code and in the Planning and Building Act and came into force in September 2014.

On the 17th of June 2015 the government adopted a Marine Planning Regulation that controls the implementation of the regulatory framework in the Swedish Environmental Code. The Marine Planning Regulation came into force the 15th of July 2015⁶.

2.1.2. EU directives

In July 2014 an EU directive on maritime spatial planning was approved, officially named Directive 2014/89 EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 July 2014 establishing a framework for maritime spatial planning.

By 2016 the directive should be implemented in the legislation of each country.

By 2021, member states should have developed their national maritime plans.

According to the Directive 2014/89 EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 July 2014 the maritime spatial plan shall support a sustainable development and economic growth in the maritime sectors while the ecosystem-based approach should be applied⁷.

The ecosystem based approach is as according the Article 1(3) of Directive 2008/56/EC referred as

“the aim of ensuring that the collective pressure of all activities is kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while contributing to the sustainable use of marine goods and services by present and future generations. In addition, an ecosystem-based approach should be applied in a way that is

⁶<https://www.havochvatten.se/hav/samordning--fakta/havsplanering/havsplanering-i-sverige/svensk-havsplanering.html> Publ. 2014-02-03

⁷ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014L0089>

adapted to the specific ecosystems and other specificities of the different marine regions and take into consideration the ongoing work in the Regional Sea Conventions, building on existing knowledge and experience. The approach will also allow for adaptive management which ensure refinement and further development as experience and knowledge increase, taking into account the availability of data and information at sea basin level to implement that approach. Member states should take into account the precautionary principle and the principle that preventive action should be taken, as laid down in Article 191(2) of the Treaty on the Functioning of the European Union”⁸.

2.1.3. Responsible authorities

As previously mentioned the Swedish Marine Planning Regulation came into force the 15th of July 2015.

The Swedish Agency for Marine and Water Management (SwAM) has been given the overall responsibility by the Swedish government to develop the MSP together with the coastal county administrative boards and in cooperation with the coastal municipalities. The final decisions and implementation of the MSP are done by the government. The MSP should among other things be implemented in the municipal planning and in decisions concerning various activities in the marine areas⁹.

A MSP status report was finalised in 2014 by SwAM with aggregated information about how the Swedish marine resources are used, what the future claims will be and how the preconditions are. All the views and information that has been presented from stakeholders and other concerned have been analysed and taken into consideration. Also supplementary information has been obtained from sectoral agencies and county administrative boards and formed the basis for the final MSP status report.

The ambition with this MSP status report is to mediate an intersectoral perspective that can provide the starting point for the first cycle of national MSP¹⁰.

The SwAM will lead the national MSP work while three appointed County Administrative Boards will lead and coordinate the regional work. Three MSP will be developed constituting three marine regions, together covering the whole coast of Sweden¹¹ (Fig 1).

The marine regional areas with corresponding county administrative board that are responsible are:

- MSP region Gulf of Bothnia will be coordinated by the county administrative board of Västernorrland
- MSP region Baltic Sea will be coordinated by the county administrative board of Kalmar

⁸ <http://eur-lex.europa.eu/legal-content/EN-SV/TXT/?uri=CELEX:32014L0089&from=EN>

⁹ <https://www.havochvatten.se/hav/samordning--fakta/havsplanering/havsplanering-i-sverige/svensk-havsplanering.html> Pupil. 2014-02-03

¹⁰ <https://www.havochvatten.se/hav/samordning--fakta/havsplanering/havsplanering-i-sverige/havsplanering---nulage-2014.html>

¹¹ <https://www.havochvatten.se/hav/samordning--fakta/havsplanering/havsplanering-i-sverige/svensk-havsplanering.html> Pupil. 2014-02-03)

- MSP region Skagerrak and Kattegat will be coordinated by the county administrative of Västra Götaland

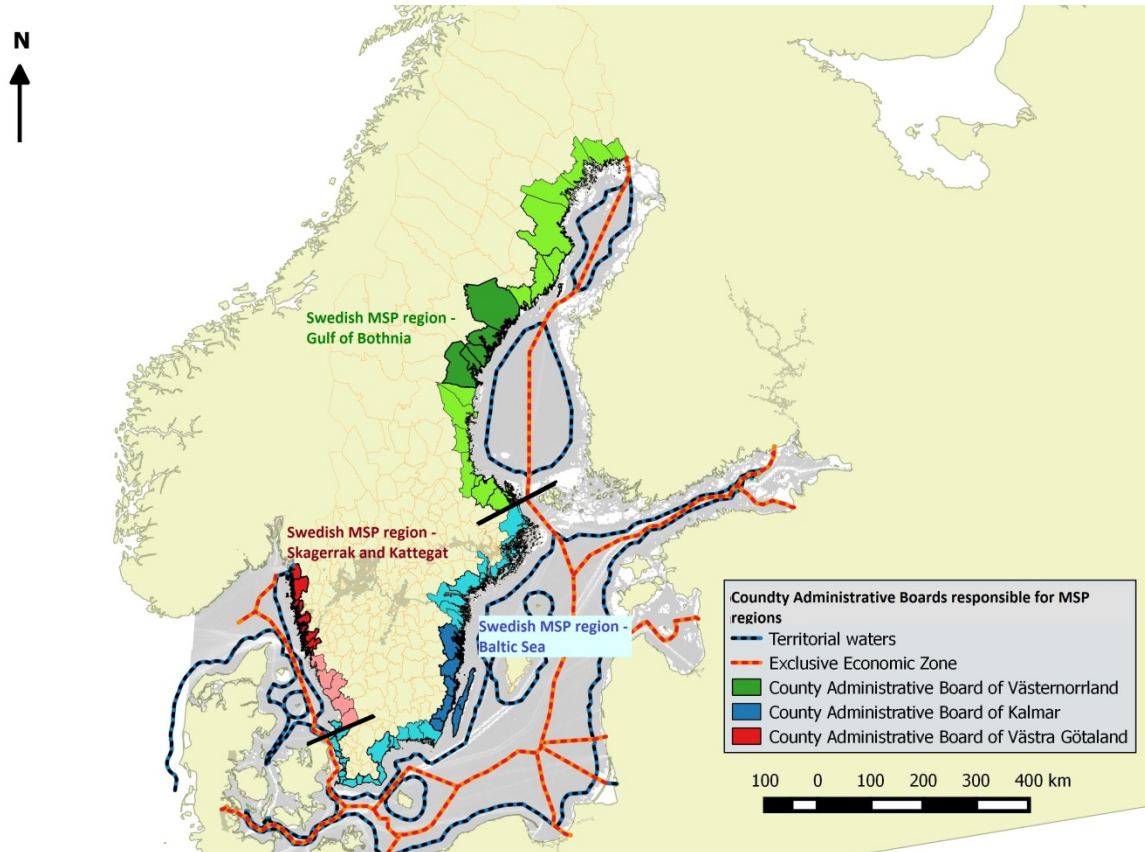


Fig 1. Sweden's division of three MSP regions i.e. Gulf of Bothnia, Baltic Sea and Skagerrak and Kattegat for future maritime spatial plans. Source: WMU, Lilitha Pongolini 2015

2.1.4. Geographic allocation

The Swedish Maritime Spatial Plans are going to include the Territorial Sea and the Swedish Economic Zone (EEZ), but not the area closest to the coast. The planning of the area closest to the coast is proceeded trough the comprehensive planning of the municipality.

The Maritime Spatial Plans will geographically start 1 nautical mile from the baseline and covers the major part of the territorial sea and the whole Exclusive Economic Zone. In the Territorial Sea the maritime spatial plan will overlap the municipality comprehensive plans.

The Swedish Marine Environment decree (the EU Marine Strategy Framework Directive incorporated in the Swedish legislation) and the Swedish Water Management decree (the EU Water Framework Directive incorporated in the Swedish legislation) are regulating

how the marine and water environment is managed and is thereby connected to the Maritime Spatial Planning ¹²(Fig 2).

Overlap between plans

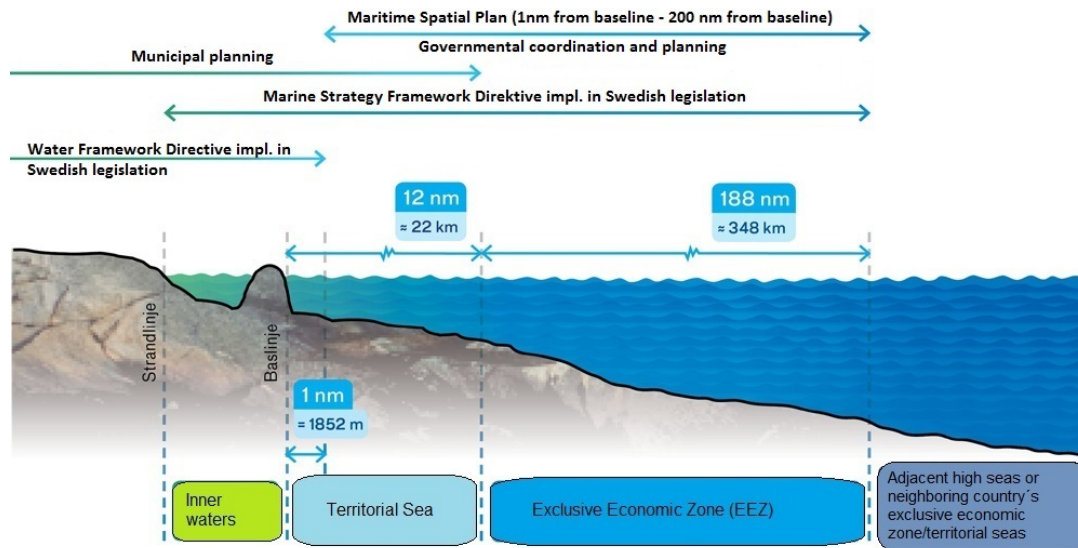


Fig 2. The separations concerning borders and planning responsibility areas of the Swedish sea. Source: SwAM, (<https://www.havochvatten.se/hav/samordning--fakta/havsplanering/havsplanering-i-sverige/svensk-havsplanering.html>)

The maritime spatial planning will be an important tool as it gives information about what activities are best suited for different marine areas and to reach the national environmental quality goals. The planning is also needed in the work to reach the EU goals of good environmental status in the Seas.

2.2. Best Practice Lomma

Lomma, a municipality on the west coast of Skåne County, is dominated by a long coast that comprises Lomma Bay. The Bay constitutes of a large shallow area that is of a high value from the perspective of marine environment and fisheries. As there are sandbanks and seagrass meadows it is also an important area for resting and wintering birds.

¹²<https://www.havochvatten.se/hav/samordning--fakta/havsplanering/havsplanering-i-sverige/svensk-havsplanering.html> Pupil. 2014-02-03

2.2.1. Municipality comprehensive plan

Lomma is a good example of how a well-developed municipality comprehensive plan can contribute to the maritime spatial plan. The purpose of the comprehensive plan is to present the fundamentals of land and water use and to be the basis for balancing the various public interests in the municipality. The plan is not legally binding, but indicative of future decisions on the detailed development plans, building permits and other positions related to land and water use.

All the detailed development plans within a municipality are legally binding. The detailed development plan regulates the rights and obligations not only between the landowners and the community but also landowners in between. The plan is mandatory for the examination of permission.

The visions and goals of Lomma Municipality is that the municipality, by 2030, will be a place where people, companies and the natural environment with its flora and fauna will prosper¹³.








As Lomma has both land and water to consider when working with their comprehensive plan, the municipality has developed a map of the land-based plans as well as a map of the plans for the coastal waters.

The whole area of Lomma Bay is classified as a marine sensitive area with a rich flora and fauna. To protect as much natural values as possible in Lomma Bay, and to contribute to good conditions for recreational activities, the coastal area is proposed to be divided into zones. The division in zones would facilitate for the planning of the municipality as it displays what considerations to prioritise, depending on the natural values of the area and the degree of exploitation.

Within these mapped areas the high environmental values is given significant weight and if there is a conflict with other interest the natural values should be prioritised. Marine coastal areas or zones of consideration in the Bay of Lomma are “particularly valuable marine areas”, “valuable marine areas” “high environmental values” and “bathing and recreation”. There are also zones that are dedicated as suitable for mussel farming¹⁴ (Fig 3).

¹³ Municipality comprehensive plan 2010 of Lomma municipality – Adopted by the municipality council 2011-02-10
<http://www.lomma.se/huvudmeny/byggaboochmiljo/samhallsplanering/oversiktsplan.4.7a48a90b12c665dedb4800017885.html>

¹⁴ Municipality comprehensive plan 2010 of Lomma municipality – Adopted by the municipality council 2011-02-10
<http://www.lomma.se/huvudmeny/byggaboochmiljo/samhallsplanering/oversiktsplan.4.7a48a90b12c665dedb4800017885.html>

-  Bathing area
-  Particularly valuable marine areas
-  Valuable marine areas
-  Areas of consideration: High environmental values
-  Areas of consideration: Bathing and recreation
-  Shipping lane and harbour
-  Area suitable for mussel farming

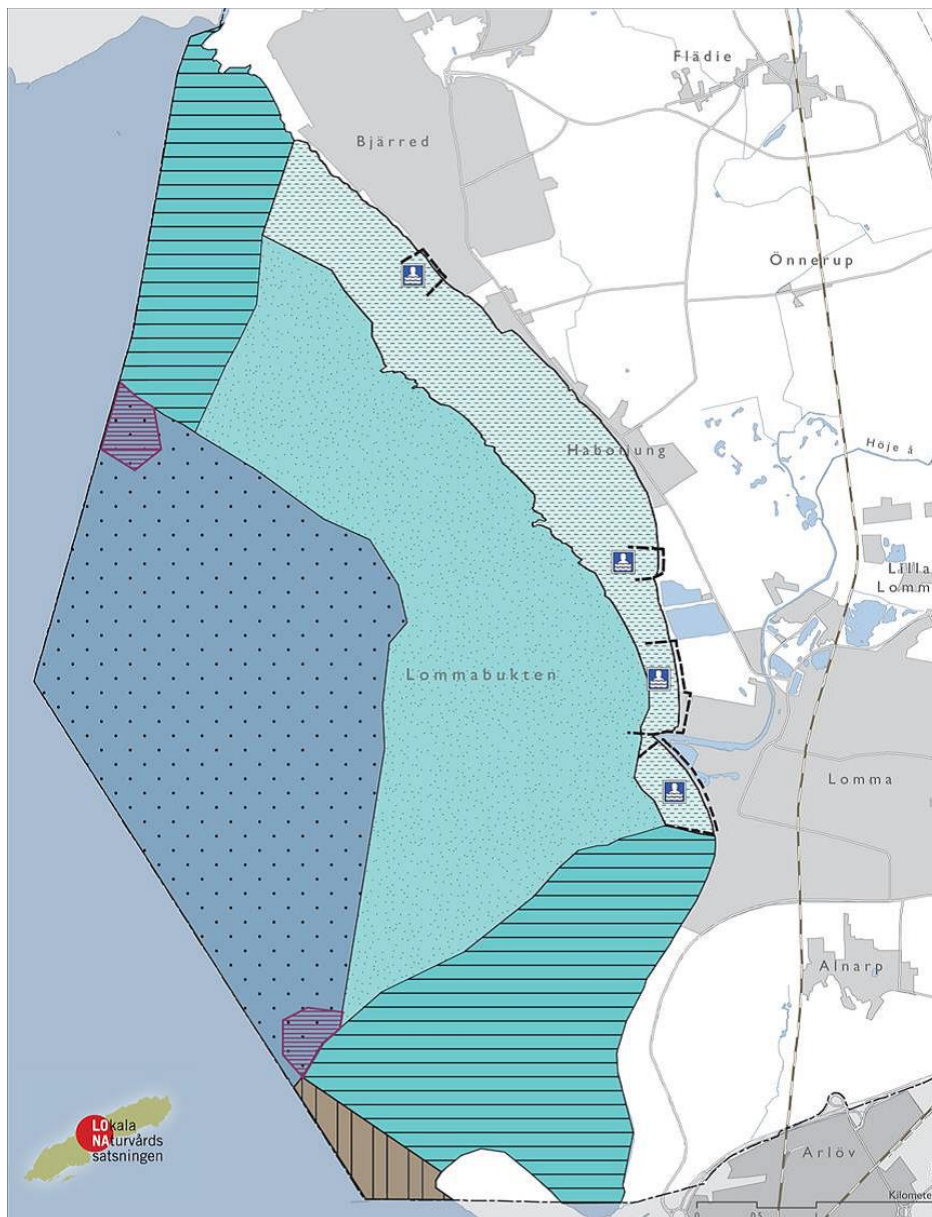


Fig 3. Map for planning the coastal area of Lomma Bay. Source: Municipality comprehensive plan 2010 of Lomma municipality.

2.2.2. Areas or zones of consideration – “high environmental values”

Within these zones of ‘High environmental values’ the importance to protect them as quiet, noise-free oases where the natural coastal environment is prioritised. In these areas artificial lighting shall also be avoided to maintain the natural light conditions along the beaches.

Other examples of recommendations in these zones of High environmental values are:

- No extraction operations may take place
- No new bridges or buildings along the beaches
- Motorboats are restricted to drive under five knots
- Water sports such as windsurfing and kitesurfing in this area should be completely avoided even in areas not covered by no trespassing
- No removal of seaweed / seagrass from the beaches¹⁵

2.2.3. Areas or zones of consideration – “valuable marine areas” and “particularly valuable marine areas”

The shallow areas in the Lomma Bay are environmentally sensitive with high biological values. The areas within 10 m depth are particularly valuable marine areas due to the large spreading of eelgrass meadows, the important areas for spawning and nursery areas for fish. The recreational activities such as water sports, fishing and boating need to take these areas into account. Sand extraction, dredging and other physical disturbances that effect the seafloor constitutes a treat to this marine environment so following recommendations are given to avoid these threats:

- No construction of wind farms should take place in the bay as a whole.
- Sand extractions should not take place especially in the areas of particular marine value.
- Constructions for protection against erosion that can affect the environmental values should not be built in the water.
- Any activity that has a negative effect on the marine wildlife should be avoided¹⁶.

¹⁵ Municipality comprehensive plan 2010 of Lomma municipality – Adopted by the municipality council 2011-02-10
<http://www.lomma.se/huvudmeny/byggaboochmiljo/samhallsplanering/oversiktsplan.4.7a48a90b12c665dedb4800017885.html>

¹⁶ Municipality comprehensive plan 2010 of Lomma municipality – Adopted by the municipality council 2011-02-10
<http://www.lomma.se/huvudmeny/byggaboochmiljo/samhallsplanering/oversiktsplan.4.7a48a90b12c665dedb4800017885.html>

2.2.4. Areas or zones of consideration – “bathing and recreation”

This zone in Lomma Bay stretches out to three meters deep water. Wind and kitesurfing as other water sports should be coordinated with bathing and other recreational activities.

Other examples of recommendations in this “bathing and recreations” zone are:

- Allowing sand to be supplied to the beach.
- Allows the active removal of seaweed / seagrass from the beach during summer.
- In time, the number of berths along the beach should decrease¹⁷.

The comprehensive plan over the marine areas of Lomma is not legally binding but recommendations for various activities.

Maritime spatial plans are developed in many European countries and around the world. In the Swedish planning the cooperation with neighbouring countries, international authorities and organisations is a central undertaking.

2.3. HELCOM and MSP

2.3.1. MSP roadmap

The Regional Baltic Maritime Spatial Planning Roadmap (2013-2020) was created to fulfil the goal of drawing up and applying maritime spatial plans throughout the Baltic Sea region by 2020 which are coherent across borders and apply the ecosystem approach.

The Roadmap outlines the anticipated Baltic Sea regional work on MSP to be done by the HELCOM and VASAB Members – the nine Baltic Sea coastal countries, as well as Norway, Belarus and the European Commission – including seven steps necessary for reaching the goal:

1. Intergovernmental cooperation on MSP
2. Public participation
3. Ecosystem approach in MSP
4. Information and data for MSP
5. Education for MSP
6. National and Baltic Sea regional frameworks for MSP in place
7. Evaluation and follow-up

¹⁷ Municipality comprehensive plan 2010 of Lomma municipality – Adopted by the municipality council 2011-02-10
<http://www.lomma.se/huvudmeny/byggaboochmiljo/samhallsplanering/oversiktsplan.4.7a48a90b12c665dedb4800017885.html>

The Roadmap takes into account regional priorities, and for Baltic EU Member States, the European context, including the EU Strategy for the Baltic Sea Region and the EU Directive on Maritime Spatial Planning.

The Roadmap has been produced within the HELCOM-VASAB MSP Working Group and has been developed based on expert input and with the support of University of Eastern Finland Law School.

The Roadmap was adopted at the HELCOM Ministerial Meeting held in Copenhagen on 3 October 2013 and the VASAB Ministerial Conference on 26 September 2014 committed to the implementation of the Roadmap. The Roadmap has been turned into the HELCOM-VASAB MSP Working Group Work Plan 2014-2016¹⁸

The Helcom-VASAB Baltic Sea Broad-scale Maritime Spatial Planning Principles were adopted by HELCOM and VASAB in the end of 2010, fulfilling the commitment set out in the HELCOM Baltic Sea Action Plan on creating MSP principles.

The following ten principles provide guidance for achieving better coherence in the development of MSP systems in the Baltic Sea Region¹⁹:

1. Sustainable management
2. Ecosystem approach
3. Long term perspective and objectives
4. Precautionary Principle
5. Participation and Transparency
6. High quality data and information basis
7. Transnational coordination and consultation
8. Coherent terrestrial and maritime spatial planning
9. Planning adapted to characteristics and special conditions at different areas
10. Continuous planning

2.3.2. Maritime spatial planning data

Geodata is a central component and prerequisite of maritime spatial planning (MSP). In order to ease access to MSP relevant data in the Baltic Sea region the HELCOM Secretariat has carried out an online survey in November-December 2013 on:

- Data needed in the region
- How to improve accessibility of MSP data in the region

¹⁸ <http://www.helcom.fi/action-areas/maritime-spatial-planning/msp-roadmap/>

¹⁹ <http://www.helcom.fi/action-areas/maritime-spatial-planning/msp-roadmap/>

- Clear increase in demand for MSP data (i.e., oil spills, shipping traffic, etc.)

According to the results of this study HELCOM data & maps service will be during spring 2014 restructured in order to:

- Give the existing MSP data more visibility
- Highlight gaps in available MSP data
- Be available as a depository of Baltic MSP project GIS data

The HELCOM GIS has taken as a starting point for these developments as it is currently the only open access GIS server specialised in providing best available Baltic Sea regional data free of charge.

HELCOM GIS is served by trained and experienced GIS and data management staff at HELCOM Secretariat (both permanent and project contracts), working with a full suite of professional ESRI ArcGIS licences²⁰.

2.3.3. Planning the Bothnian Sea

The project 'Planning the Bothnian Sea' was coordinated by the HELCOM Secretariat and has tested transboundary Maritime Spatial Planning in the Baltic Sea. The project used the Bothnian Sea area between Sweden and Finland as a case study of Baltic transboundary MSP.

The project was a Baltic Sea MSP "preparatory action" funded by EU Commission DG MARE under the EU Integrated Maritime Policy, and run 18 months between 2. December 2010 and 1. June 2012.

2.3.4. The pilot plan

The Plan Bothnia project was a maritime spatial planning (MSP) preparatory action for the Baltic Sea. Through such MSP the future of a wide variety of issues like maritime traffic, fisheries, wind power and nature protection are planned together, instead of considering them one at a time.

A pioneering feature is that the initiative has, with good results, been carried out jointly by the two countries. It used the Bothnian Sea area between Sweden and Finland as a Baltic Sea case study to provide Europe and the world at large an example of a state of the art transboundary MSP.

The final result is a MSP document "Planning the Bothnian Sea" which was created as a collective effort by six partners and numerous participants from regional and national authorities in Sweden and Finland.

²⁰ Ref: <http://www.helcom.fi/action-areas/maritime-spatial-planning/msp-data/>

In the report the following categories of human activities are brought up:

- Maritime traffic
- Fishing and aquaculture
- Energy
- Nature protection areas
- Defence and scientific research
- Sand and gravel extraction
- Tourism and recreation
- Cultural heritage

These activities are investigated in more detail regarding their geographical distribution, how they affect the study area now and in the future and how the compatibility is with other maritime activities and demands²¹.

2.3.5. Maritime traffic

Looking specifically at the maritime traffic, following information is addressed in the report.

Transportation in the Bothnian Sea is the most important in the maritime sector, generating 2000 jobs or 30 per cent of all maritime jobs. This includes water transport, warehousing and support activities, as well as passenger transport in archipelagos. Rauma, Pori and Sundsvall are home to the highest maritime transport jobs.

Most of the transport to and from Finland and Sweden is seaborne, which makes sea traffic of great economic importance to the region. Although the traffic intensity in the Bothnian Sea is relatively low comparing to the rest of the Baltic Sea, shipping is of great importance to the region. Around 5000 vessels operated in the Bothnian Sea during 2010. General information is brought up about the main cargos transported in the area that constitutes of wood products, ores, minerals, oil, coal chemicals (including hazardous substances) and steel. Due to the large forest industry products such as paper, pulp and sawn wood are the largest commodity group transported from Bothnian Sea ports.

Mentioned as a special type of transport is the nuclear waste that is transported to the two nuclear waste deposits in the region, Olkiluoto in Finland and Forsmark in Sweden. Due to the variability in the ice conditions during winters the maritime transport needs to be flexible and adaptive in this region. The planning of shipping routes and operation of ships needs to take into consideration the variation and different conditions that comes with the sea being ice covered. Depending on the conditions there might be a need of

²¹Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

icebreakers, towing boats and the preparedness and adaptation of routes due to drifting of large ice sheets. Due to the extensive requirement of ice breaking services the Baltic Sea countries, within HELCOM, have agreed on a joint Baltic policy on winter navigation.

Concerning the compatibility most other activities are able to coexist with the shipping industry. The only two activities that cannot be in the same place as maritime traffic are wind farms and aquaculture.

Concerning wind farms ships must keep a distance of 500m from wind parks and anchoring is usually forbidden within a safety zone of 500 m from cables connected to wind power parks.

Offshore aquaculture installations cannot be established within main shipping routes as they create an obstacle for shipping and can interfere with safe navigation.

Other activities where temporary dangerous situations can occur or temporary restrictions can be imposed on shipping are:

- Large-scale fishing with limited ability to manoeuvre; large-scale commercial extraction of sediments by stationary vessels may create an obstacle for shipping, dredging activities, cables and pipelines, small-scale leisure fishing, tourism and leisure boating.
- Nature protection and shipping are seen as compatible activities, provided that ships comply with laws and regulations for the Baltic Sea area²².

2.3.6. Nature protection areas

Nature protected areas are described as legally designated areas aiming to protect specific ecosystem features within their boundaries. MSP should, however, take as its starting point the ecological features of the whole planning area, which means addressing environmental issues beyond protected areas to ensure the long-term integrity of the entire planning area.

Nevertheless protected areas are, as spatially defined legal entities, important components of MSP. In marine areas protection can be based on national laws, international agreements, or EU directive such as the Natura 2000 sites, a pan-European network for nature reserves.

The consequences of designating protected areas vary depending on their legal basis, specific management plans and site designation documents. In many cases designations carry only limited restrictions regarding usage, beyond other applicable laws and spatial plans. No restrictions apply for shipping or commercial fisheries, for example, within Bothnian Sea protected areas. In principle it would be possible to apply restrictions or

²²Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

recommendations through the IMO, national fishery regulation or EU common fisheries policy.

Designating protected areas, however, depends on the discovery and description of such highly valuable areas. The offshore areas of Bothnian Sea are still practically uncharted in terms of natural values, especially regarding flora and fauna. However, features such as shallow waters with sand and rocky seabed, fish spawning grounds and seabed complexity can indicate areas with high natural values. These features can be used as a first step towards recommending future protected areas²³.

2.3.7. Planning regime and political organisation

Planning the Bothnian Sea gives a description of the present spatial planning regime in the two countries Finland and Sweden, considering relevant strategies and discussions about possibilities for joint planning of Bothnian Sea.

Both Finland and Sweden have planning regime in force for their territorial seas, but not for the exclusive economic zone (EEZ).

For its territorial sea, Finland has a regime with both regional plans created by regional councils, and more detailed plans created by individual municipalities. The regional plans cover larger areas than municipal plans and are more strategic in character. Municipal authorities draft more detailed and exact plans. The report states that so far no municipal plans have so far been drafted exclusively for marine areas but some plans have markings at sea. In Finland no concrete initiatives currently exist regarding spatial planning of EEZ areas. Decisions are made on a case-by-case basis using national laws implementing UNCLOS.

In Sweden, planning of the coastal waters is carried out only at a municipal level. Like in Finland the Swedish municipalities cover the territorial sea out to the border with the EEZ. The spatial planning is almost exclusively a municipal responsibility. Municipalities must have an obligatory comprehensive plan, which covers the whole municipal area, including its part of the territorial sea, but in practice, most plans leave sea areas blank. In addition to municipalities Sweden is divided to counties, where County Administrative Boards represent the central government. There are 80 coastal municipalities and 14 counties in Sweden and the Intermediate municipal and governmental issues are coordinated by the county administrative boards. The Swedish Agency for Marine and Water management (SwAM) will be responsible for MSP in both territorial sea and the EEZ²⁴.

²³ Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

²⁴ Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

2.3.8. Draft of Maritime Spatial Plan for Bothnian Sea

As a result of the pilot project “Planning The Bothnian Sea” the conclusion is that discussions are still held about how to include the sea in the spatial planning in both Finland and Sweden. It is nevertheless possible to outline how a maritime plan for a joint sea area like the Bothnian Sea could become a reality.

After presenting and assessing various activities and future scenarios the project “Planning The Bothnian Sea” provide a draft plan of the Bothnian Sea. The idea is to have a long-term comprehensive planning across the Finland-Sweden borders. If not there is a danger that offshore development within this sea basin will be carried out in an uncoordinated way. The vision suggested was to implement a long-term transboundary co-operation so the Bothnian Sea remains a place of natural beauty where human activities take place without damaging the Sea’s ecological status, contribute to combating global climate change and enable communities in the region to prosper. This vision should be implemented by six objectives covering:

- Ecosystem integrity
- Protected areas
- Marine traffic
- Renewable energy
- Fisheries
- Regional development

Highlighting the vision when it comes to the protected areas and shipping industry in the report, the following was stated:

- There is a need of creating a framework for a healthy ecosystem. Although industrial needs are important, the overall objectives are to obtain the healthy status of the entire Bothnian Sea ecosystem and to preserve and strengthen its ecosystem services. Offshore areas in the Bothnian Sea identified as especially ecologically valuable should be designated as protected areas with efficient management measures, including Natura 2000.
- The future visions and goals for the maritime traffic is to safeguard this activity since the volume of goods transported by shipping in the Bothnian Sea is expected to increase in the coming decades. Sustainable transport systems demand a large part of land transports to move to sea. The report states that possibilities for increased shipping should be secured, including the development of ports. In the perspective of diminishing the emission it would be recommended that wherever possible, ships should be allowed to travel the shortest possible route.

The draft plan that was developed jointly through discussions by a group of Finnish and Swedish participants is visualised through a map (Fig 4) and the corresponding recommendations for certain designated issues (table 1).

The planning area includes offshore Bothnian Sea waters 1 nautical mile from the baseline. By focusing on offshore areas, the plan offers a new dimension to both Finnish and Swedish planning systems. The area includes both Finnish and Swedish territorial sea and the EEZ. Timewise, the planning horizon is around 15 years. A maritime plan would set the framework for the agreement of future development projects²⁵.

²⁵ Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

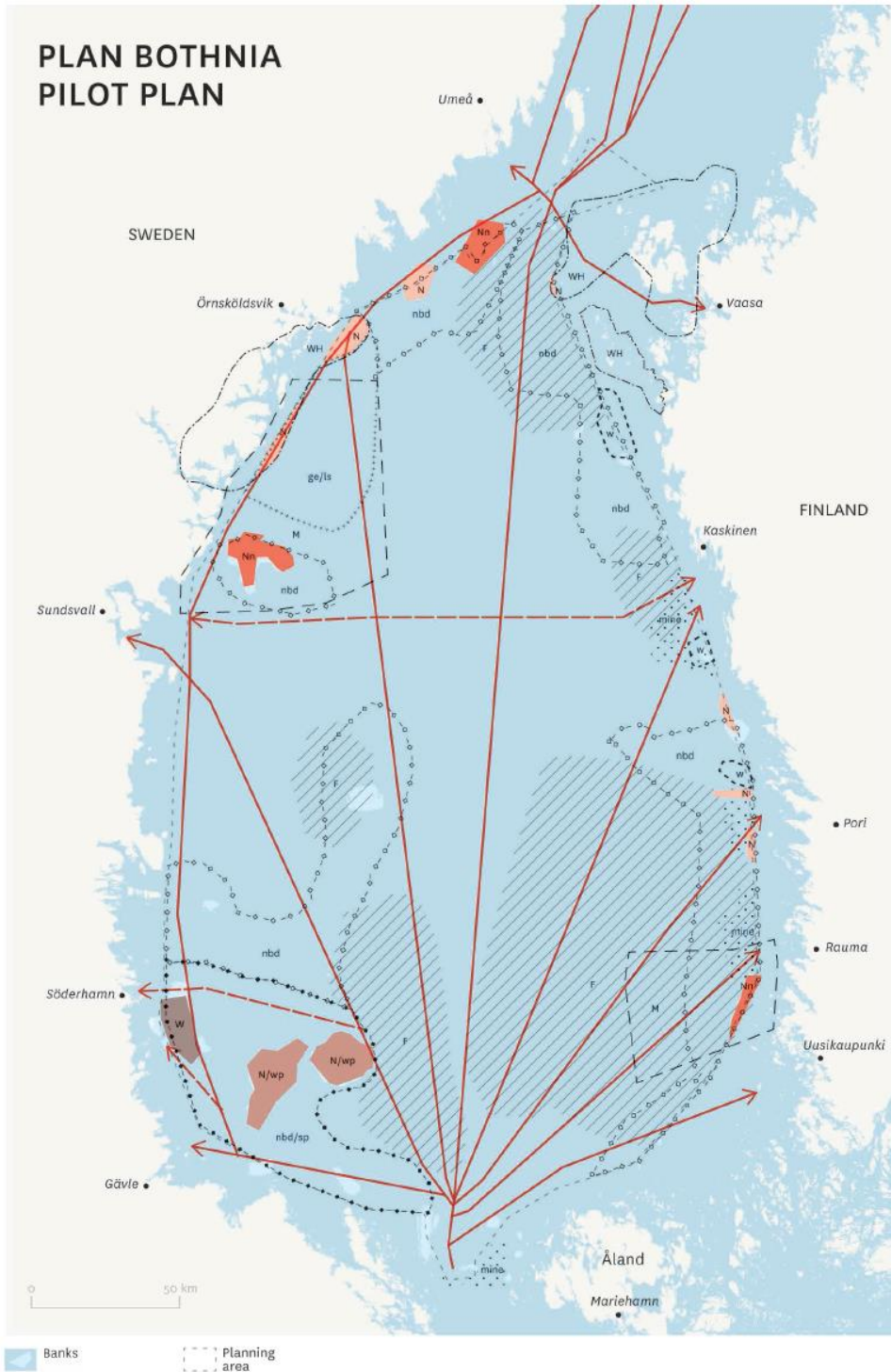


Fig 4. Draft of maritime spatial plan covering the Bothnian Sea visualised with a map. Source: Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>















PLANNING THE BOTHNIAN SEA	PART V OF VII	PLAN BOTHNIA
<p>Guidelines for areas referred to on the plan map</p> <p>Nature protection, Natura 2000  Area with high natural value. The entire area or a large part of it belongs to the EU Natura 2000 network. Areas off the Finnish coast also to a maritime national park. RECOMMENDATION: <i>Natura 2000 values should be protected and activities harmful to these values should not be allowed. The National Park regulations must be followed.</i></p> <p>Nature protection and wind power  Shallow banks of high ecological value and conditions for wind power. Part of Finngrundet has sand and gravel extraction interests, but this would be harmful to its natural/ecological values and wind power interests. RECOMMENDATION: <i>Natural values should be protected. Shipping and fishing harmful to these values should not be allowed. New activities that could significantly harm the possibilities for wind power in the area should not be permitted.</i></p> <p>Nature protection, other  Area with high natural and ecological value that should be protected. RECOMMENDATION: <i>The biological and ecological conditions that create its high natural values should be protected. Activities harmful to these values should be made to avoid the area.</i></p> <p>Important fishing area  Area identified as of particular importance for commercial fishing. RECOMMENDATION: <i>The possibilities of sustainable fishing should be ensured. The conditions that are fundamental to its natural values and rich fish stocks should not be harmed.</i></p>	<p>Potentially high natural value, spawning and nursery area  Area of particular significance for spawning or nursery of fish. Due to the shallowness and varied seabed, the area is expected to be of higher natural/ecological value than most of the Bothnian Sea. RECOMMENDATION: <i>The area's qualities for spawning of fish should be preserved. The effects of new activities on the area's values should be assessed, harmful activities should be avoided. Existing activities such as fishing should be performed in a way that does not harm.</i></p> <p>Potentially high natural value  Due to the relatively shallowness and varied seabed conditions the area, particularly the banks, could be expected to be of higher natural value and biodiversity than most of the Bothnian Sea. RECOMMENDATION: <i>The natural and ecological values in the area should be preserved. New activities should not be allowed unless their environmental effects have been assessed. Existing activities such as fishing should be performed in a way that is not harmful.</i></p> <p>Valuable geology and landscape view from land  An important part of UNESCO High Coast World Heritage is that the views from the high coastal cliffs are free of visible constructions. RECOMMENDATION: <i>Permanent constructions that could be visible from land and harm cultural values should be avoided.</i></p> <p>Military practice area  Area used for live ammunition practice by the military. RECOMMENDATION: <i>The area should be protected against uses that can significantly harm its use for military purposes.</i></p>	<p>Shipping route  Recommended route for commercial shipping. RECOMMENDATION: <i>Constructions, activities and other measures that would hinder passage should only be allowed if the measures are of great importance for society and if no other acceptable place can be found.</i></p> <p>Future shipping route  Future potential fairway for cross-Bothnian shipping. RECOMMENDATION: <i>Measures that could prevent the establishment of the route should be avoided.</i></p> <p>Mine/dumped ammunition risk  Site where mines or other kinds of ammunitions have, or are supposed to have, been dumped. RECOMMENDATION: <i>Activities that could lead to risks of explosions should be avoided, or carried out with great caution.</i></p> <p>World heritage  Area in the UNESCO World Heritage list, mainly coastal. RECOMMENDATION: <i>When granting permission for new activities and measures, within or close the area, the impact on world heritage values should be assessed. Activities and measures that could harm world heritage values should not be allowed.</i></p> <p>Wind power  Area for wind power production. The area is also of relatively high natural value. RECOMMENDATION: <i>Activities and measures that could harm wind power production should not be allowed. Natural values should be preserved as far as possible.</i></p> <p>Good wind power conditions  Area with good wind power production conditions. RECOMMENDATION: <i>Activities and measures that could harm the potential to use the area for wind power production should not be allowed.</i></p>

Table 1. Recommendations for certain designated issues in the draft of the maritime spatial plan covering the Bothnian Sea. (The image will be replaced with a better one)

Source: Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

2.3.9. Impact assessment

The importance of assessing the environmental impact, for plans and programmes concerning various human activities that are likely to have a significant environmental effect, is also stressed. This is according to the EU's Strategic Environmental Assessment (SEA) directive (2001/42/EC). The SEA protocol of UNECE's EIA convention, also called the Espoo convention, has the same requirements. Both Sweden and Finland have implemented the directive and ratified the protocol. The Sea directive only concerns plans that meet certain criteria, such as those being prepared or adopted by an authority and being required by law or administrative provisions. Both existing Finnish regional and municipal plans and Swedish municipal plans fall under these criteria, as do Sweden's proposed new national MSP plans.

The SEA directive has for many years been implemented in Swedish and Finnish legislation and its application has become an accustomed procedure for planners. Performing an environmental assessment for a maritime plan covering new areas and dimensions for planning will be a challenge, however. New concepts and methods will be needed. Carrying out an environmental assessment means preparing an environmental report and performing consultation, including with other states. The result of the report and the consultations then inform about the adoption of the plan. Since the project "Planning the Bothnian Sea" was in such time limitation there was no proper environmental assessment carried out, although some vital elements are considered and brought up in the report.

An environmental impact assessment should include a description of the likely significant environmental effects of implementing a particular plan and reasonable alternative. These effects should concern broad issues such as biodiversity, population, human health and climate factors as well as material assets and cultural heritage. Applying the ecosystem approach should mean that the conditions for biodiversity, flora and fauna and the effects of various uses on these factors have been considered, depending on the level of knowledge concerning each issue.

A transboundary maritime planning would automatically include consultations between the countries directly involved. According to the SEA directive and protocol, transboundary consultations should also be performed with other EU member states or parties to the protocol if they are likely to be significantly environmentally effected by the plan, or if they request such consultation. There are established procedures for these consultations and Sweden and Finland have developed an efficient system of cooperation throughout the planning process²⁶.

As a conclusion the report states that although a maritime plan using an ecosystem approach in itself would require a systematic inquiry into the environment and the ecology of the maritime planning area, a separate description of the different steps and choices made in the planning process is necessary in order to produce a satisfying environmental

²⁶Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

report. Proper involvement of relevant stakeholders and the public at an early stage in the planning process is important for adequate and effective consultations. The challenge will be to raise interest in marine issues and to consolidate the vision and aim of the spatial plan.

The Bothnian Sea pilot planning initiative described how the project illustrates how two countries, in a joint planning effort for their shared sea, can assess planning condition, formulate a vision and draft a common plan that could, in theory, be legally operational in both countries. The function of planning as a tool for identifying and solving acute conflicts between various maritime uses has often been highlighted. However its strategic role as an activity where the public sector lays down guidelines for the future use of large sea areas is perhaps more crucial for the long-term sustainable development of the sea. The report brings up wind power installations as the most acute issue in the Bothnian Sea. The scale of these developments and their fixed nature makes them different from most other uses of the sea. All large shallow offshore areas can expect to be subject of interest from wind power installations in the near future. These are used by other interests and at the same time have high ecological values as near-pristine underwater environments. The possible expansion of wind power is a good example of an issue that should be considered on the scale of the whole basin. The combined effect of all such developments in the basin might influence the whole ecosystem, beyond the perspective of individual permit applications. The report also stresses the importance of a good description and visualisation of the issues taking place in the offshore transboundary sea areas such as the Bothnian Sea. Without such information, the general public or even civil servants have little chance to reflect on and form opinions about, offshore planning issues.

In the case of a transboundary plan that is aiming for political adoption, it is naturally crucial to establish which authority is responsible for this kind of joint transboundary plan, and who will adopt it. As an example, if both governments decide upon a joint maritime plan, it could potentially be a strong document giving direction to respective national authorities. In this kind of scenario, a common transboundary plan must be based on governance structure of both countries and formulated in such a way that it is possible to either directly, or via corresponding plans in either country, lay down legally effective recommendations or regulations. Each country may find they have to transpose common recommendations for certain areas into more detailed regulations in their own national plans covering the sea areas. Regulations forbidding wind power installations or sand or gravel extraction in certain sensitive areas are relevant examples. Issues such as management of fisheries and shipping are highly dependent on regulations based in EU or international legislation. Depending on the governance structure of plans involved, however, it might be possible for an MSP to influence such policies. To have a shared understanding regarding a joint plan will prove very useful, saving time and resources when embarking on a joint MSP exercise²⁷.

²⁷ Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

In practical terms, the differences in planning traditions and practices also play a role. Giving an example from the project “Planning the Bothnian Sea” that visualise the issue is the different ways professionals from the two countries execute their planning. Due to the central role of municipal planning in Sweden, Swedish planners are perhaps more accustomed to exact definitions. As for Finland the larger geographical areas covered by Finnish regional planning, and the need to leave some flexibility for interpretation at a municipal level, seemed to foster a more general, strategic approach.

As suggested an option to embark the Maritime Spatial Planning would be to start with an overview of the facts, followed by a joint MSP approach.

Another important topic is the full implication of implementing the ecosystem approach, the role of nature conservation issues in general. The limitations of this particular Bothnian Sea initiative, in terms of available time and resources, left many questions open for further national and international initiatives.

All planning tasks start by gathering information on the planning area as it is necessary to identify, describe and visualise issues that might be essential for planning. With such information it is possible to start to formulate objectives, and recommendations for reaching these.

Information on maritime issues is often scarce, meaning maritime planning needs a long preparatory phase where accurate information on offshore areas is gathered and processed into an understandable format.

A real planning process would naturally have required a more comprehensive approach. There is an obvious danger that only those issues where information is ready, abundant and is of good quality are highlighted in the planning process. These include human activities such as wind power, fisheries and shipping. Information on ecological features and many other topics is generally much less comprehensive, requiring a precautionary approach. Openly accessible public data on transboundary maritime issues is necessary for a participatory offshore planning initiative. In terms of basic regional data sets, this initiative started off with material available from HELCOM’s GIS service. This open transboundary data infrastructure greatly helped the pilot Bothnian Sea process, as national datasets remain closed, or are limited by national borders²⁸.

²⁸Planning the Bothnian Sea, (Digital edition 2013) <http://www.helcom.fi/action-areas/maritime-spatial-planning/plan-bothnia/>

3. Evaluation of human pressure in MSP

Human activities have a significant impact on the marine ecosystem. The coastal marine environments and marginal seas in particular have experienced ecosystem regime shifts, altered food web structures, heavily contaminated sediments and damaging effects from hazardous substances²⁹. The EU Marine Strategy Framework Directive (MSFD) requires member states not only to make assessments of the pressures and impacts but also to assess the state of the marine environment and then take measures towards reaching a good environmental status (GES) by 2020. Despite the tight implementation schedule of the MSFD, there has yet been very few attempts to assess the cumulative impacts in the European seas.

There is no clear obligation to perform an environmental impact assessment for the maritime shipping activities in comparison with other maritime activities such as dredging and sand/gravel extraction, aquaculture, offshore wind farm constructions and other constructions at sea. As there are few scientific field studies investigating the impact of the shipping industry there is a need of assessing the overall impact of human activities on the marine ecosystem. This would enable the maritime spatial planner to regard and evaluate the shipping traffic on this information basis.

The study “Human pressures and their potential impact on the Baltic Sea ecosystem” by Korpinen et al. (2011) has provided information and a tool to proceed with this kind of evaluation.

In this study a cumulative impact index (Baltic Sea Impact Index, BSII) is calculated and used for various modelling scenarios. This Baltic Sea Impact Index is suggested to be used as a tool that can be applied to maritime spatial planning, environmental impact assessments, placement and management of marine protected areas, permitting processes. Also it would give the opportunity to evaluate environmental status as well as pressure and impact assessment, such as required by the EU MSFD³⁰

3.1. The Baltic Sea

The study by Korpinen et al. (2011) estimates the distribution and magnitude of different human activities both at sea and on land, associated pressures and their potential impacts on the marine ecosystem. They used an assessment tool that converts pressure to potential impacts on selected components of the ecosystem and sums up all the impacts in predefined assessment units. The tool used in the study of Korpinen et al. (2011) was based on the method and global assessment by Halpern et al. (2007, 2008). The assessment relies on the best available compilation of data on human activities and ecosystem in the area which has been possible to compile due to the long standing regional cooperation of the Baltic Sea coastal countries and the EU under the umbrella of

²⁹ M Casini M et.al. 2008. Multi-level trophic cascades in a heavily exploited open marine ecosystem. *Proceedings of the Royal Society B* 275, 1793-1801.

³⁰ S Korpinen et.al. *Ecological Indicators* (2012) 105-114

the Helsinki Commission (HELCOM). This assessment should be seen as the first step towards more comprehensive impact assessments and better validate quantification of impact.

3.2. Measuring cumulative impact

In the study of Korpinen et al (2011) they defined an anthropogenic pressure as a human-derived stress factor causing either temporary or permanent disturbances or damage to loss of one or several components of an ecosystem.

According to their definition **potential anthropogenic impact** is the possible negative change a pressure may cause on an ecosystem component. The impact is only considered potential, because our estimates rely on the current, still imperfect, expert knowledge on the relationships between pressure and impacts on the ecosystem and the actual impact can be reduced or increased by natural variability and other stochastic factors.

By **cumulative impact** they mean the sum of all potential impacts in an area, not taking into account synergistic or antagonistic effects.

By an **ecosystem component** they mean biological parts of the ecosystem, such as species, biotopes formed by habitat-forming species or abiotic biotopes with a clear linkage to certain species.

The method to calculate an **impact index value (I)** for the set of anthropogenic pressures in a given area was based on the following formula³¹

$$I = \sum_{i=1}^n \sum_{j=1}^m P_i \times E_j \times \mu_{i,j}$$

- I = Impact index value
- P = Anthropogenic pressure
- i = Assessment unit (5km x 5km)
- P_i = The log-transformed and normalised value (scaled between 0 and 1, and with 1 being the highest value of the pressure measured) of an anthropogenic pressure in an assessment unit *i*,
- E_j = The presence or absence of an ecosystem component

³¹ Halpern et al., 2008. Science 319, 948-952

- j = Ecosystem component (i.e. populations, species, biotopes or biotope complexes; 1 or 0, respectively)
 - μ = Weight score that is given a value from 0 to 4 depending on the estimated impact of a pressure data layer on a species/biotope/ biotope complex. The
 - μ_{ij} = Weight score for P_i in E_j (range 0-4, cf. Halpern et al., 2007).
-
- The impact of any $P \times E \times \mu$ combination will be zero if a pressure is zero or an ecosystem component is absent.
 - Thus the more ecosystem components an area contains and the higher is the number of pressures in that area, the higher the index value.
 - The final index value was calculated for 5 km x 5 km squares, i.e. the assessment units (i).

3.3. Compilation of data on anthropogenic pressure

In the study Korpinen et al. (2012) the determination of pressures to the marine environment was used out of the Marine Strategy Framework Directive (MSFD) (Anon, 2008). The MSFD recognises 18 pressure types, although since data on litter and on “other substances” being unavailable and the impacts of non-indigenous species were unknown, this study employed 15 pressure types (table 1).

Table 1. Anthropogenic pressure types in the marine environment, included in the study of Korpinen et al. (2012)³²

Category	Pressure type
Physical loss of seabed	Smothering by dumped material Sealing of seabed
Physical damage to seabed	Changes in siltation Abrasion of seabed Selective extraction of non-living resources
Other physical disturbance	Underwater noise
Interference with hydrological processes	Changes in thermal regime Changes in salinity regime
Contamination by hazardous substances	Introduction of synthetic compounds Introduction of non-synthetic substances and compounds Introduction of radio-nuclides
Nutrient and organic matter enrichment	Inputs of nutrients Inputs of organic matter
Biological disturbance	Introduction of microbial pathogens, Selective extraction of species (eg.fishing)

These 15 pressure types were in their turn divided into 52 Baltic Sea-wide datasets of anthropogenic pressures (Table 2), which were:

- Direct pressure data
- Proxies for pressures
- Presence/absence data of an activity or pressure

Baltic Sea environmental experts considered the data sets as evenly distributed and to include all relevant sources of each pressure. Since there are no direct measurements for some pressures, they were estimated on the basis of the causative human activities³³.

³² S Korpinen et.al. Ecological Indicators (2012) 105-114

³³ S Korpinen et.al. Ecological Indicators (2012) 105-114

3.4. Spatial distribution of species, biotopes and biotope complex

There exists relatively accurate spatial distribution data on some biotope complexes, biotopes and species in the Baltic Sea. Six benthic and two pelagic biotope complexes were chosen for the index (based on Al-Hamdani and Reker (2007) and the EUSeaMap project).

6 benthic biotopes

- Photic sand
- Photic soft bottom
- Photic hard bottom
- Non-photoc sand
- Non-photoc soft bottom
- Non-photoc hard bottom

2 pelagic biotopes

- Photic water column
- Non-photoc water column

2 benthic biotopes

- Mussel beds
- Zostera meadows

4 species related distribution data sets

- Harbour porpoises (*Phocoena phocoena*)
- Grey seal (*Halichoerus grypus*) ringed seal (*Pusa hispida botnica*) harbour seal (*Phoca vitulina*)
- Wintering grounds of sea birds
- Spawning and nursery areas for cod (*Gadus morhua*)

Overall, there were 14 ecosystem components in the index.

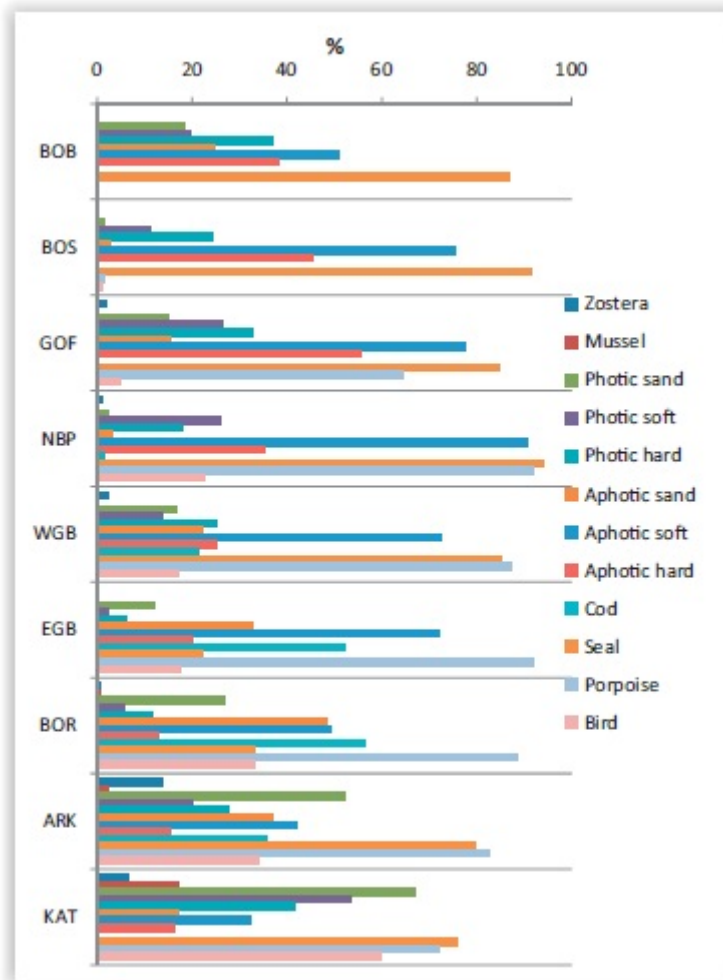


Fig 2. Proportions of ecosystem components in the main sub-basins, defined as their presence in all assessment units of the sub-basin. Since “photic water” covers entirely and “non-photic water” almost entirely all sub-basins, they were omitted from the graph. Sub basins: Bothnian Bay (BOB), Bothnian Sea (BOS), Gulf of Finland (GOF), Northern Baltic Proper (NBP), Western Gotland Basin (WGB), Eastern Gotland Basin (EGB), Bornholm Basin (BOR), Arkona Basin (ARK) and the Kattegat (KAT). For full names of the ecosystem components, see Section 2.

3.5. Weighting coefficients

A weighting coefficient is constant, which was used to transform a pressure to a potential impact and could be specific to any combination of pressure and ecosystem components. All weighting coefficient was based on a wide questionnaire among experts (from all parts of the geographical area in question and from different fields of environmental sciences). The score were given on a scale of 0-4 and aims to estimate the degree of destructiveness of pressures:

- 0 - No impact
- 1 – Low impact
- 2 – Moderate impact
- 3 – Strong impact

4 – Massive impact

When filling the questionnaire, experts gave consideration to 3 aspects in setting the score (0-4) with the aim of specifying the sensitivity of the ecosystem components to the pressures:

1. Recovery time of the ecosystem component after pressure
 - <1 year
 - 1-5 years
 - >10 years

2. Resilience or vulnerability of the ecosystem component to the pressure
 - Very high
 - High
 - Moderate
 - Low

3. Functional effects i.e. whether the pressure effects
 - One or several species
 - One or few trophic levels
 - The whole community

An average of these 3 criteria was the final weighting coefficient (i.e. transformation of a pressure to a potential impact). The weighting coefficients were provided by national experts in six countries around the Baltic and the scores were discussed in an expert workshop organised by HELCOM (Baltic Marine Environment Protection Commission).

The pressures which have the greatest contribution to the final index value are present in Table 1. The sum of impacts of each pressure shows that the inputs of nutrients and organic matter (25% impact), inputs of hazardous substances (30% impact) as well as fishing (30% impact) have the greatest overall impact on the Baltic Sea ecosystem³⁴.

³⁴ S Korpinen et.al. Ecological Indicators (2012) 105-114

Table 1. Summary statistics of the 52 pressures. Minimum, maximum and mean impact scores and the standard deviation of them in the assessment units as well as the sum of impacts over the sea area are shown. The contribution of each of the pressures to the final index value is presented by coefficient of determination (R^2). Each pressure has been converted to impacts (I) in an assessment unit (5 km x 5 km). Pressures are ordered by sum of impacts in all assessment units in the Baltic Sea.

Pressure type and pressure	Min	Max	Mean	SD	Sum	R^2
Full model	6.81	456.44	111.52	48.86	2,149,710	1.00
Extraction of species/mid- and surface water trawling+ long lines	0	26.81	10.04	5.11	193,711	0.36
Inputs of nutrients/atm. deposition of N	0	27.26	9.99	4.64	192,485	0.73
Inputs of nutrients/waterborne N	0	25.54	8.78	4.23	169,190	0.65
Inputs of org. Matter/Riverine organic matter	0	24.08	7.56	2.98	145,797	0.50
Changes in siltation/organic matter	0	22.34	7.36	2.95	141,856	0.49
Non-synthetic substances/atm. deposition of Pb	0	24.17	7.22	3.81	139,177	0.78
Inputs of nutrients/waterborne P	0	24.79	6.83	3.12	131,663	0.48
Extraction of species/gillnet fishery	0	25.14	6.15	4.68	118,574	0.46
Extraction of species/bottom trawling	0	35.01	6.04	6.58	116,413	0.34
Non-synthetic substances/atm. deposition of Cd	0	18.37	5.82	3.05	110,533	0.77
Non-synthetic substances/atm. deposition of Hg	0	21.86	5.06	2.96	96,187	0.62
UW noise/all shipping	0	22.82	4.09	3.55	77,387	0.37
Non-synthetic substances/waterborne Zn	0	20.38	4.00	2.97	75,914	0.11
Non-synthetic substances/atm. depos. of dioxins	0	20.62	3.86	3.03	73,505	0.48
Abrasion/bottom trawling	0	26.09	3.85	4.42	73,166	0.38
Non-synthetic substances/waterborne Ni	<0.01	19.65	3.19	2.97	60,585	0.05
Extraction of species/Bird hunting	0	18.07	2.27	3.60	43,319	0.18
Non-synthetic substances/waterborne Pb	0	19.71	2.17	2.86	41,274	0.14
Extraction of species/trap and pot fishery	0	19.26	1.61	2.86	30,531	0.13
Extraction of species/seal hunting	0	12.55	1.42	2.66	26,960	<0.01
Non-synthetic substances/waterborne Cd	0	18.64	1.04	2.44	19,696	0.12
Changes in siltation/coastal shipping	0	17.77	0.92	2.17	17,447	0.23
Synthetic compounds/population density	0	17.51	0.36	1.49	6986	0.02
UW noise/recreational boating	0	17.53	0.31	1.38	5941	0.03
Introduct. of pathogens/passenger ships	0	15.84	0.31	1.01	5937	0.03
Inputs of radioactive subst./radioactive substances	0	10.53	0.28	1.17	5363	0.03
Non-synthetic substances/waterborne Hg	0	14.90	0.21	0.83	4084	0.05
Changes in siltation/beaches	0	13.65	0.17	0.88	3242	0.04
Synthetic compounds/harbours	0	25.40	0.17	1.33	3220	0.03
Synthetic compounds/oil spills	0	16.13	0.16	0.88	3037	0.03
Sealing/harbours	0	20.55	0.17	1.08	2577	0.50
Sealing/coastal defence structures	0	24.77	0.13	1.33	2488	0.03
Introduct. Of pathogens/Waste water treatm. plants	0	13.04	0.09	0.65	1638	0.02
Changes in siltation/Dredging	0	20.22	0.08	0.93	1598	0.03
Extraction of non-living resources/dredging	0	19.11	0.08	0.87	1482	0.03
Abrasion/dredging	0	18.81	0.08	0.87	1478	0.03
Changes in salinity/waste water treatm. plants	0	13.31	0.08	0.58	1439	0.03
Smothering/Disposal of dredged matter	0	19.02	0.04	0.64	812	0.01
Changes in salinity/coastal dams	0	20.00	0.04	0.56	674	<0.01
Sealing/coastal dams	0	17.80	0.03	0.47	553	<0.01
Inputs of nutrients/aquaculture	0	22.50	0.03	0.49	523	<0.01
Inputs of org. matter/Aquaculture	0	22.50	0.03	0.48	512	<0.01
Introduct. of pathogens/Aquaculture	0	8.35	0.02	0.28	399	<0.01
UW noise/construction of cables	0	25.25	0.02	0.54	389	<0.01
Smothering/construction of cables	0	24.20	0.02	0.44	314	<0.01
Synthetic compounds/Industries	0	16.72	0.02	0.33	313	<0.01
Changes in thermal regime/Nuclear power plants	0	18.20	0.01	0.27	97	<0.01
UW noise/operational windfarms	0	12.20	<0.01	0.20	86	<0.01
Synthetic compounds/polluting ship accidents	0	16.64	<0.01	0.20	69	<0.01
UW noise/oil rigs	0	11.35	<0.01	0.14	37	<0.01
Smothering/construction of windfarms	0	14.50	<0.01	0.11	22	<0.01
UW noise/construction of windfarms	0	13.60	<0.01	0.11	20	<0.01

The circled pressures are connected to impact of shipping. Data on pressure and ecosystem components were linked to a grid of the assessment units (5km x 5 km). Altogether 19,276 assessment units were calculated in the Baltic Sea area.

The results show that the cumulative impact values (Baltic Sea Impact Index) in the assessment units varied between 2.8 (in the Bothnian Bay) and 456.4 (in the Sound)(fig 5). The theoretical maximum of the impact value would be 2912 if assuming that all weighting coefficients and pressure values are maximal and all ecosystem components were present in an assessment unit (5 km x 5 km).

The spatial presentation of the cumulative impact showed that the highest potential impact on the Baltic Sea ecosystem take place in the south-western sea areas (the Kattegat, Belt Sea, Kiel Bay and Mecklenburg Bay), the Gulf of Gdansk and the Gulf of Finland. The least cumulative impacts were found from the Gulf of Gulf of Bothnia in the north (Fig. 5).

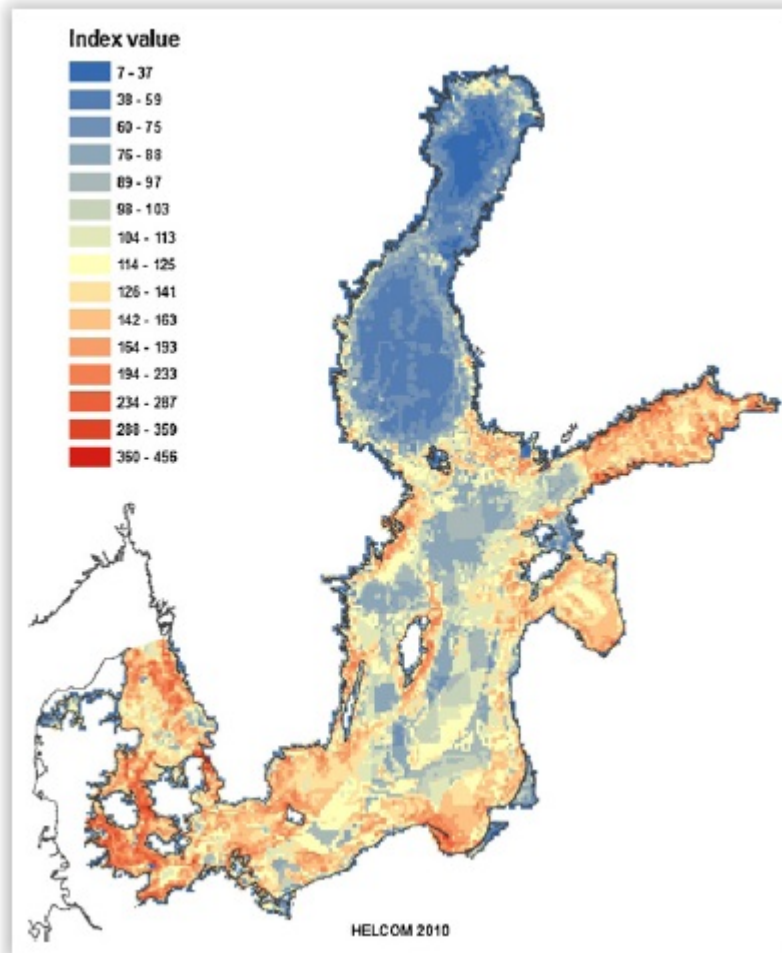


Fig 5. Presentation of cumulative potential anthropogenic impacts by the Baltic Sea Impact Index in 5 km x 5 km assessment units. The index in each assessment unit consists of the sum of anthropogenic impacts on selected ecosystem components present in the unit.

Another feature in the cumulative impact index was the difference between the open sea and the coastal areas. In the coastal areas all over the Baltic Sea, the multitude of coastal pressure e.g. fish farms, municipal waste water treatment plants, river estuaries, industries, warm-water outflows from power plants, and coastal structures – create a heavy burden on the marine environment. Moreover, the index showed also high cumulative impacts in the vicinity of larger cities, such as Copenhagen, Gdansk, St Petersburg and Stockholm.

The method used in this study was based on a linear response of ecosystem components to anthropogenic pressure. It was a simplification of reality where thresholds or other non-linearities can be expected to occur. The authors of this study suggest that these

simplifications do not however affect the main message of the end result, which shows a clear geographical gradient of potential cumulative impacts in the Baltic Sea. Overall the study emphasizes the need for further study of pressure-impact relationships and mechanisms, as well as the need of scientific evaluation.

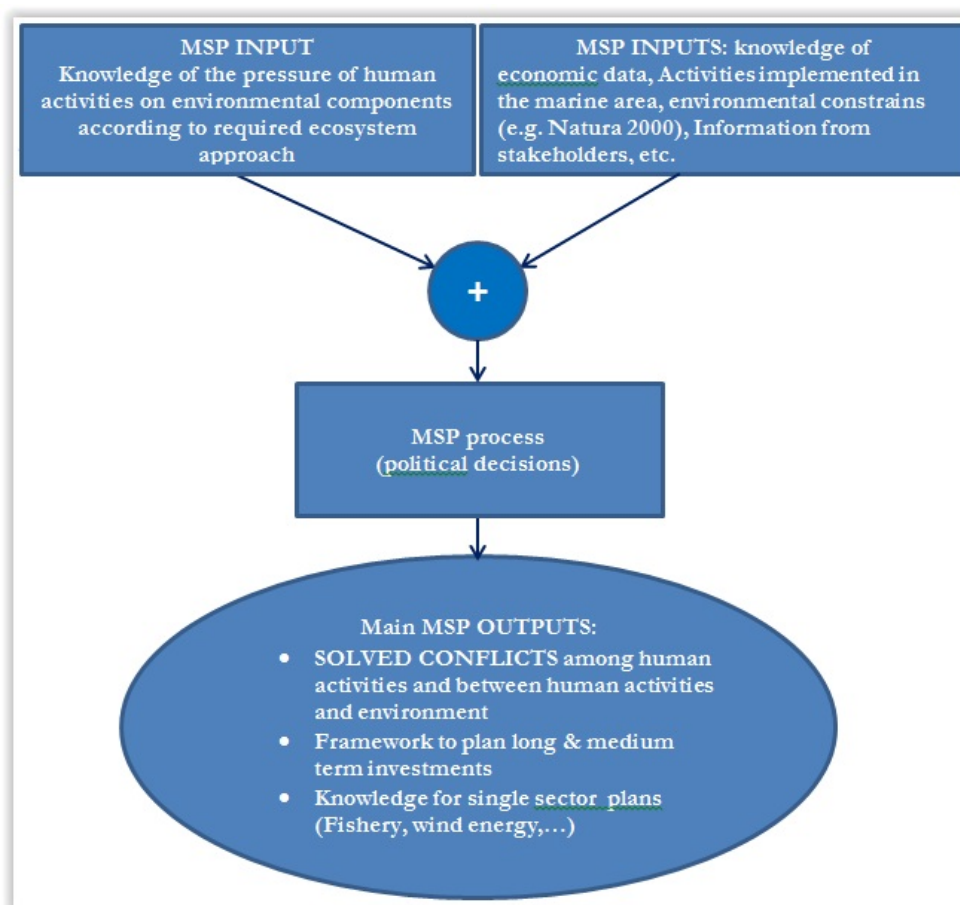
4. Integration of environmental aspects in route planning

4.1. Relation between Maritime Spatial Planning and Route Planning

As highlighted in chapter 1, Maritime Spatial Planning (MSP) provides a framework for arbitrating between competing human activities and managing their impact on the marine environment. Its objective is to balance sectoral interests and achieve sustainable use of marine resources in line with the EU Sustainable Development Strategy.

The ecosystem approach is an overarching principle for MSP.

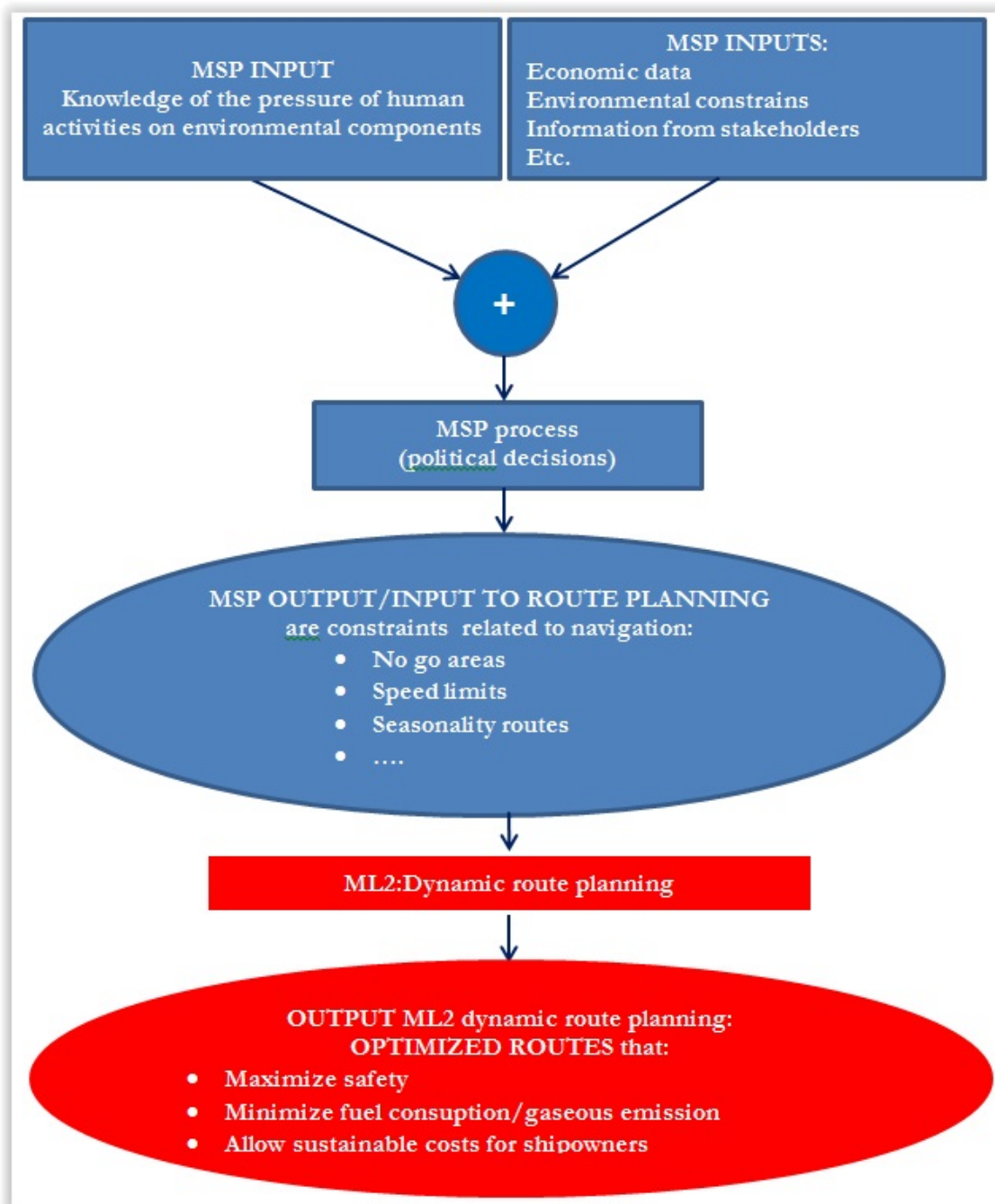
Ecosystem approach means that the pressure of human activities on marine environmental components must be estimated/evaluated according to methodologies presented in chapter 3. The following flowchart tries to sketch the MSP process as a whole.



MSP output may entail constraints to navigation that result in no go areas and rerouting of ship traffic. Nevertheless it must be underlined that IMO is recognised as the only international body for defining regulations for ships' routing systems.

Navigation constraints from MSP are to be considered of course as inputs in the MONALISA 2.0 dynamic route planning, whose purpose is to optimise routes to maximise safety and minimise fuel consumption and gaseous emission.

Therefore the previous sketch can be modified in the following way by considering ML2 route planning.



4.2. The meaning of “Integrating Dynamic Route Planning with the environmental aspects of MSP”

The aim of Activity 1.7 of MONALISA 2.0 project is “to provide elements to understand the feasibility of integrating Dynamic Route Planning with the environmental aspects of Maritime Spatial Planning”.

The environmental aspects of Maritime Spatial Planning are those coming from the “Knowledge of the pressure of human activities on environmental components” as presented in chapter 3.

Lets assume that a MSP has been carried out. That means:

- Area and routes where navigation is allowed are known with relevant constrains (e.g. speed limit), if any.
- The pressures of human activities on environmental components in the studied area have been estimated (due to the required ecosystem approach to carry out MSP).

“Integrating Dynamic Route Planning with the environmental aspects of Maritime Spatial Planning” means to use the “knowledge of the pressure of human activities on environmental components” as input of the dynamic route planning.

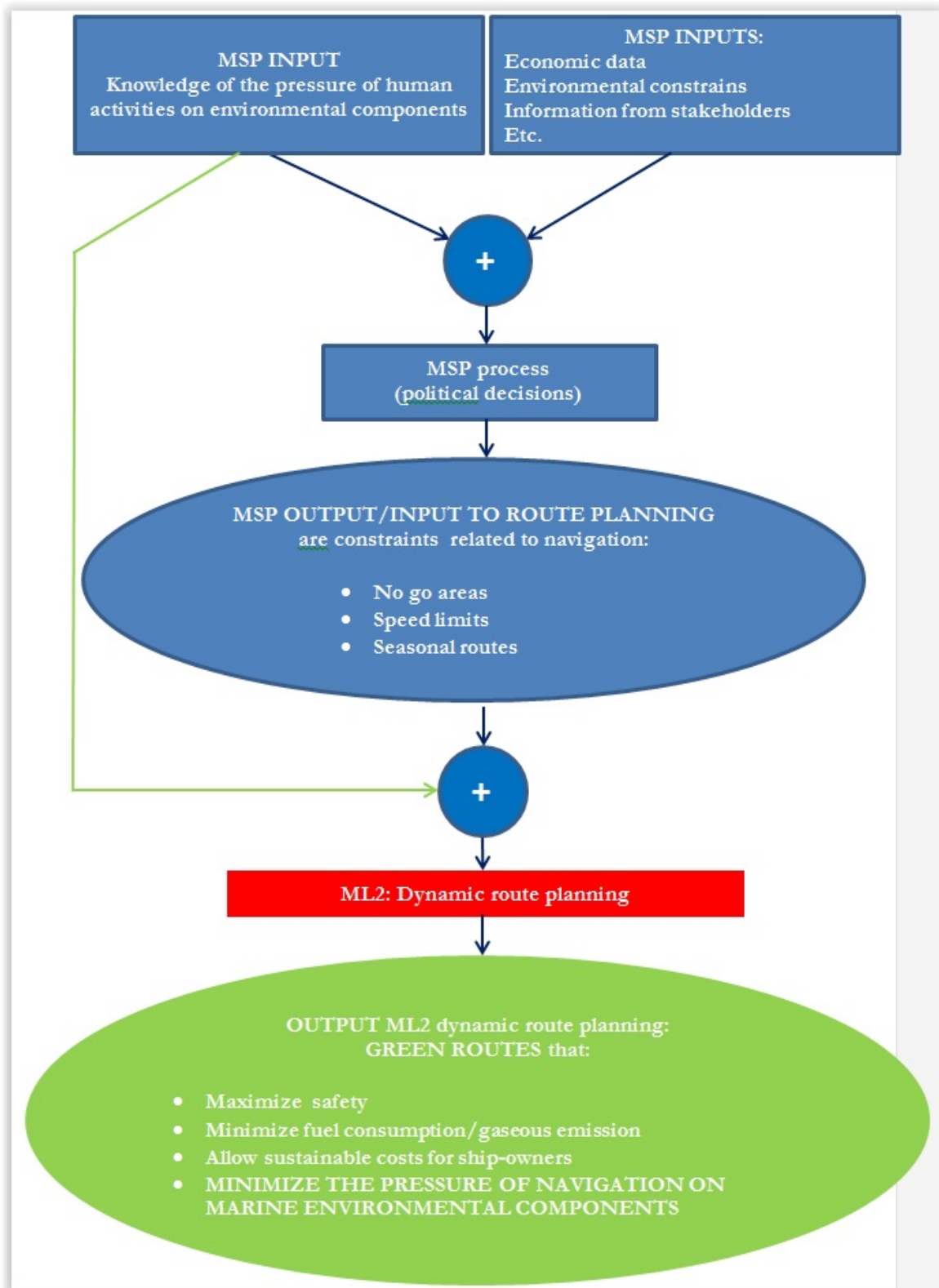
This way dynamic route planning should optimise routes to:

- Maximise safety
- Minimise fuel consumption and gaseous emission
- Allow sustainable costs for ship-owners
- Minimise the pressure of navigation on environment components

The result of the dynamic route planning which takes into consideration also the environmental aspects of MSP should be the identification of a “green route” that could be defined as:

“An optimised route (through ML2 dynamic route planning) where the pressures due to shipping on the marine environmental components are minimised.”

Flowchart can be updated with the MSP environmental data flux.



4.3. Understanding the feasibility of integrating Dynamic Route Planning with the environmental aspects of MSP.

Summarising the two previous paragraphs, two scenarios can be compared:

1. ML2 dynamic route planning WITHOUT environmental aspects of MSP.
 - It optimise route to allow:
 - a. Maximum safety
 - b. Minimum fuel consumption and gaseous emission
 - c. Sustainable costs for ship-owners

From a general point of view, the optimised route will be as shorter and quicker as possible under the existing constraints.

2. ML2 dynamic route planning WITH environmental aspects of MSP.
 - It optimise route to allow:
 - a. Maximum safety
 - b. Minimum fuel consumption and gaseous emission
 - c. Sustainable costs for ship-owners
 - d. PLUS, to reduce pressure due to navigation on the environmental components.

Optimised route will be longer and/or slower than the scenario 1 because of the need to reduce pressure on environmental components.

If a route is longer and/or slower three kinds of negative effects could arise.

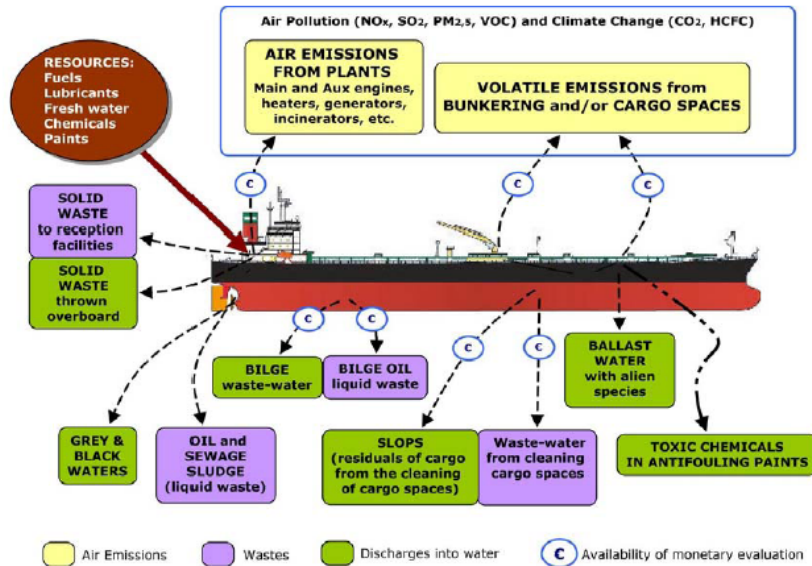
1. External costs due to navigation increase (see chapter 6).

Although ships remain the most environmentally efficient form of commercial transportation, ships do consume a significant amount of fuel. They also, as with any carbon fuel user, emit certain toxins such as Sulphur oxides (SO_x) and nitrogen oxides (NO_x); and although the shipping industry is currently reducing these emissions (in compliance with MARPOL Annex VI), any increase in miles will have a resultant increase on fuel consumption, and therefore on the related environmental impact. Increase in miles impacts also on CO emission whose external cost can vary depending on the adopted model for estimation from 20 to close 200 €/T(CO).³⁵ The following figure sketched a few causes of external costs.

Other causes of external cost can be added such as underwater noise that may have great negative effects on the marine environment.

³⁵ <http://www.nautinst.org/en/forums/msp/>

External costs can range from a few thousands euros per navigation hour to around ten thousand/h depending on ship and other factors.



[source: EXTERNAL COSTS OF MARITIME TRANSPORT, UE, IP/B/TRAN/FWC/2006-156/Lot4/C1-SC2]

2. Costs for shipping industry

Increased route distances will increase the costs of shipping and goods not only due to the extra cost of fuel, but also due to the significant ship operation costs such as wages, insurance, maintenance and consumables

3. Competitiveness of maritime transport mode towards road transport is reduced

In spite of the many external cost causes showed in the previous figure, maritime transport shows very low specific external costs (€/T*km) in comparison with those of road transport. Due to this reason EU policies push to reduce road transport in favour of maritime and rail transport. In the EU white paper on transport it is stated that 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050, facilitated by efficient and green freight corridors.

So to identify a “green route” ML2 route planner should find a sort of balance between the previous negative effects and benefit to marine environment. The balance could be found if negative effects (disadvantages) and benefit (advantages) can be expressed in monetary terms through models that can be integrated in the ML2 route planner.

Nevertheless:

- The main external costs can be estimated through models available in literature (see chapter 6).

- Costs of shipping industry can be estimated (see chapter 6)
- The estimation in monetary terms of competitiveness of maritime transport mode towards road transport seems possible only if a specific case study is considered. It seems difficult to have a general model for this kind of analysis to be integrated in the ML2 route planner.
- A general model would depend also by many figures (like fuel cost) or policies (even local) that can change very quickly.
- Last but not least, there is a lack of knowledge to estimate in monetary terms the benefit to marine environment due to the reduction of pressure of navigation on environmental components.
- Interaction among navigation pressure and environmental components are too complicate, time and spatial variant, based on stochastic processes, many effects on long term are not known.

Summarising the chapter:

- MSP states the areas where navigation is allowed.
- Within the areas where navigation is allowed, and under IMO rules, ML2 route planner can find “optimised routes” able to:
 - Maximise safety,
 - Minimise fuel consumption and emission,
 - Allow sustainable costs for shipping industry
- Furthermore “green routes” able to reduce the pressure on the marine environment could be find thank methodologies described in chapter 3.
- Nevertheless these “green routes” are expected to be longer and/or slower than the previous “optimised routes”.
- If “green routes” are longer and/or slower they imply disadvantages:
 - Higher external cost
 - Higher cost to shipping industry
 - A lower competitiveness of maritime transport mode
- Therefore ML2 route planner should compare advantages and disadvantages of “green routes” towards “optimised routes”. To perform such a goal it needs verified and accepted models able to describe advantages and disadvantages in monetary terms.
- Not all the needed models are available.
- Due to the lack of models the so-called “green route” can have more disadvantages, even toward the environment, than advantages.

Then, the integration of the environmental aspects of MSP in the Dynamic Route Planning seems not feasible up to now.

In the future the gap of knowledge could be overcome thanks to new studies. Perhaps a wide and well-coordinated research should be launched by EU having in mind the example of the Externe project on external cost of transport.

It could be highlighted that even the Communication from the Commission “Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU” states that strong data and knowledge base are required:

“MSP has to be based on sound information and scientific knowledge. Planning needs to evolve with knowledge (adaptive management). The Commission has started several scientific and data gathering tools that will assist MSP in this process. These include a European Marine Observation and Data Network (EMODNET), an integrated database for maritime socio-economic statistics (currently under development by ESTAT), the European Atlas of the Seas (to be delivered in 2009) and the Global Monitoring for Environment and Security (Kopernikus)”.

5. How to incorporate the shipping industry and route planning in the MSP procedure

5.1. Introduction to MSP and Route Planning

The sea is home of a large variety of human activities creating social, economic and even strategic value for Europe's inhabitants. Maritime activities have been concentrated around fishing, defence and shipping, although other human activities are increasingly taking place in marine areas. Some of those new activities have been growing substantially creating significant value for Europe's maritime economy.

Governments are aware of the need to better and more coherently management of seas in the European Union, being the Integrated Maritime Policy an umbrella for this approach. Maritime Spatial Planning is defined as a process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives.

The Mediterranean Sea is a vast area covering twenty-two states from three continents, predominantly known for its cultural and significance as well as its outstanding beauty. An increasing number of stakeholders in the area have become aware of the urgency to find the right balance between economic benefits and (in their relation with the environment) the use of maritime space.

There are studies and approaches that have provided information on the potential for applying MSP in the Mediterranean Sea and in sub-areas where this potential is higher. Then a methodology was elaborated to identify those areas, having it upon ten key principles of MSP and focusing on the purpose of MSP in the area, its feasibility, conditions, and cross-border and international cooperation. One of the four areas qualified for further analysis to explore the potential of MSP has been the Mediterranean.

5.2. The concept

There are clearly identified potential economic, ecological and administrative benefits from the implementation of the Maritime Spatial Planning (MSP).

As stated by some authors that have been publishing on MSP subject, they consider it as an "evolving idea", i.e. a concept subjected to evolution and improving processes.³⁶ The place-based character of ecosystems for spatial and temporal development of human activities. The utilisation of those resources can then bring to use conflicts.

It is understood that there is the need to develop human uses in coastal areas and at sea. The conflicts that can arise during this development needs to be solved and at the same time having the aim of minimizing the negative impacts on important marine environments. For example in the terrestrial environment, spatial planning is used also and is considered an essential tool for managing the development and environmental

³⁶ Ehler, C. Conclusions: Benefits, lessons learned and future challenges of marine spatial planning. Marine Policy 32 (2008) pg. 840-843.

planning. Over the past years, this management has passed from a traditional case-by-case basis and an unplanned outcome of this approach, replaced by a more strategic planning process that affords a vision that can guide individual sectorial planning.³⁷ Now, some guidelines outlining the steps that need to be taken to implement ecosystem-based, sea use management in marine areas has been considered but up to that point, sea use has been regulated increasingly, but little effort has been done to anticipate conflicts.

As it has been explained in chapter 4, that MSP may entail constraints to navigation that result in no go areas and rerouting of ships' traffic. Those constraints to free navigation are to be considered as inputs in the MONALISA 2 dynamic route planning, stated to optimise routes to maximise safety and minimise bunker consumptions and pollutant emissions.

Being the aim of Activity 1.7 of MONALISA 2 project, *to provide elements to understand the feasibility of integrating Dynamic Route Planning with the environmental aspects of Maritime Spatial Planning*: Then as clarified again in previous chapter 4, integrating Dynamic Route Planning with the environmental aspects of Maritime Spatial Planning, *means to use the knowledge of the pressure of human activities on environmental components as input of the dynamic route planning*.

The route optimisation by means of dynamic route planning would, maximise safety, minimise fuel consumption and pollutant emissions, allows sustainable costs for ship-owners and minimise the pressure of navigation on environment components. The compliment of those requirements would drive the ship to a green route proposal, which is defined as a route where the pressures coming from shipping activity on the marine environment components would be minimised. Then the immediate issue will be a longer and /or slower route than the originally planned, because of the need to reduce pressure on environmental components.

The negative effects of this last scenario, can be detailed as:

- External costs due to navigation time increase.
- Cost for shipping industry
- Competitiveness of maritime transport mode towards road transport reduction inter alia.

Once known those negative effects, this chapter will explore the ways to convince marine stakeholders of the goodness of its implementation, remarking also their potential benefits.

³⁷ Ehler, C. Conclusions: Benefits, lessons learned and future challenges of marine spatial planning. Marine Policy 32 (2008) pg. 840-843.

5.3. Potential benefits of MSP³⁸

From the economic point of view:

- The identification of compatible uses and areas for the development of maritime activities
- Reduction of conflicts among uses and between uses and the environment
- Early identification of potential conflicts
- Greater provision of certainty to investors.

The ecological benefits:

- Management of whole marine ecosystem
- Approach respective environmental limits
- Identification of areas of biological or ecological interest
- Biodiversity commitments at heart of MSP
- Allocation of space for biodiversity
- Context for a network of marine protected areas

From the administrative point of view:

- Improvement of decision-making and better regulation
- Reduction of the cost of information provision and management
- Assessment of multiple objectives and balance of the benefits acquired
- Management approach from a control role to a planning attitude
- Stakeholder involvement
- Improvement in quality and availability of information.

Some of the foreseen benefits of dynamic route planning in itself and in its application to MSP and the green routes definition, could be highlighted the following topics:

- Safer Marine Operations
- Connection of ship and marine stakeholders
- Efficient shipping
- Low Carbon Energy
- Environment friendly shipping routes

³⁸ Ehler, C. Conclusions: Benefits, lessons learned and future challenges of marine spatial planning. Marine Policy 32 (2008) pg. 840-843.

5.4. Safe Marine Operations

There is a clear public demand for improved safety that together with more stringent regulatory pressure and new technologies would rapidly accelerate the developments in safe operations during next years. These advances should be accompanied by the adoption of a more proactive and preventive approach by the owners and operators, side. This new safety culture would be a critical indicator of safety performance, supported by advanced risk methodologies and new technologies. It is assumed that by 2030, *user-centric bridge control systems will be the industry standard*,³⁹ improving the communication of all staff in the bridge. At the same time, *sea traffic control systems in some ports will migrate from just tracking vessels to offering routing advice*.⁴⁰

It is assumed also that regulators could put in force new regulations requiring the industry to be more transparent.

5.5. Maritime connectivity opportunities

Within the maritime community a set of new opportunities can be opened by the new ships' connectivity.

The advance of Information and Communication Technology (ICT), and the availability of large amounts of data coming from the growing development of ship technical and electronical systems related to data acquisition and its use to control the ship; will increase the efficiency and safety of shipping operating procedures. Data collection from ships, will not only be related to navigation procedures, but the on-board machinery monitoring, [that](#) allow owners to perform diagnostic testing and know when to inspect, overhaul or replace; any component. This monitoring is not only focused on the ship itself but also on the ship's cargo. This huge amount of data and condition monitoring sensors and actuators, would mean that there would be a need for software algorithms to process such a large volume of information for decision support. Cloud computing could be the way to efficiently distribute that information to the ship owner, administration and traffic stakeholders allowing an efficient Sea Traffic Management.

In 2015 the first prototype of fully autonomous ship appeared under the name of ReVolt (DNV-GL), being conceivable in 2035 that many types of ships may have autonomous operation capabilities and the container transportation would be fully automated in 2050.⁴¹

5.6. Efficient shipping

Nowadays, technologies and solutions that are either available today or in the in near future, are thought to be enough to improve shipping efficiency. The path to get this

³⁹ DNV . GL. A broader view. The Future of Shipping. Safer, smarter, greener. 2014. Hovik. Norway.

⁴⁰ DNV . GL. A broader view. The Future of Shipping. Safer, smarter, greener. 2014. Hovik. Norway.

⁴¹ DNV . GL. A broader view. The Future of Shipping. Safer, smarter, greener. 2014. Hovik. Norway.

efficiency is the integration of supply chains with transparent information for all stakeholders in the shipping industry. If there is a common commitment among all stakeholders in the maritime transport sector it would be one of the steps towards sustainable shipping. ⁴²

5.7. Low Carbon Energy

Even considering that an alternative green route would be less sustainable than a traditional one, because of the need to increase the distance / time of navigation; the chance to get environmental information from weather, waves, currents and other external forces and use them after to optimise the route through a software algorithm to optimise it, would provide better outputs in the long term balance of cost benefit of the ship.

5.8. Environment friendly shipping routes

As mentioned before, the greener route is not always the more sustainable route in terms of fuel consumption and time. Nevertheless, more distributed activities at sea may create less environmental pressure in specific congested areas. An equilibrium point shall be met with more optional routes.

The use of optimisation programmes focused on acquiring the best efficiency among the maritime commercial activities will need the help of dynamic external information. Up to now the ship has used the own information (Company voyage plans, climatic and meteorological information, SMS procedures, etc) to select the best route. With data coming from different sources feeding the MSP, a safer and more sustainable navigation could be obtained.

5.9. Marine industry and stakeholder's engagement

The maritime industry, and its related stakeholders, should have a clear benefit on the application of the Maritime Spatial Planning and its ecosystem based approach. If the industry does not obtain any kind of economic benefit, such as a green label or some kind of subsidies favourable to the maritime entrepreneurship, it will not be engaging towards an ecosystem awareness in its corporative development. Other options would then be to enforce the engagement through legal compulsory measures.

Despite the seek benefit, we can consider the following different stakeholders main groups:

Ship owners and operators. The directly affected collective as ships' managers. They are going to assume the MSP constraints regarding specific routes or limitation of speed

⁴² DNV . GL. A broader view. The Future of Shipping. Safer, smarter, greener. 2014. Hovik. Norway

during navigation. But as it has been said, the same limitations can be translated to a quality or sustainable label for their economic activity.

Crew. They are the persons that operate the ship and they must receive the orders from the previous group. It is a group that could feed the company with their experience, maintaining a reciprocal information exchange on the application of MSP.

Yards and ship equipment vendors. Not directly affected but they can gain knowledge and experience about the operational performance of the manufactured ships and improve their design.

Marine authorities and regulators. They are one of the best positioned to make compulsory the application of MSP, enforcing its compliment through legislative and coercive, measures. There are precedents like Communications (COM (2008) 791 final. Roadmap for Maritime Spatial Planning: Achieving Common principles in the EU, COM (2010) 771 final. MSP in the EU – Achievements and future developments), studies (European Commission study (2011). Exploring the potential of maritime spatial planning in the Mediterranean) and European Directives; to manage the MSP implementation.

Classification societies. Not directly affected. However they can upgrade their own rules, standards and services; from available data coming from classified ships.

Charterers and cargo owners. They can act as a group of pressure to require an operator complying with the MSP principles and limitations. The benefits acquired from a connected vessel can improve the logistics of cargo and its condition.

Insurers. Not directly related but can exert influence in the insurance pricing and incentivize safe and sustainable sailing; depending on the compliment or not of the MSP limitations.

Communication operators and companies. Easing exchange protocols of information flow between ships and authorities, mainly when we are considering dynamic information that should be quick and safely exchanged.

Academia: Developing and application of new procedures, new applications and training to operators that board for the first time the MSP.

5.10. Engagement of stakeholders and human dimension integration

The MSP is only one piece of the toolbox for ecosystem-based sea use management to influence the performance of human activities. *In fact, an early and continued engagement of stakeholders in a management process is critical to the long-term success, generating trust and ownership of the process. The integration of the human dimension into MSP requires them to put themselves on the map.*⁴³

⁴³ Ehler, C. Conclusions: Benefits, lessons learned and future challenges of marine spatial planning. Marine Policy 32 (2008) pg. 840-843.

It is understood that the way to involve stakeholders and dynamic route planning task in the MSP, is to remark the future benefits that they would obtain as economic actors and the added value that dynamic routing will bring to the green routes establishment.

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