COEXIST

Interaction in coastal waters: A roadmap to sustainable integration of aquaculture and fisheries

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Matrices of Interaction
Aquaculture & fisheries vs. other activities

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Summary

COEXIST is a project using a broad multidisciplinary approach to evaluate interactions between competing activities and protection in the coastal area focusing on fisheries and aquaculture in particular. The project looks at six different case studies: the Hardangerfjord, the Atlantic Coast of Ireland and France, the Algarve Coast, the Adriatic Sea, the Coastal North Sea and the Baltic Sea. The ultimate goal of the project is to provide a roadmap to better integration, sustainability and synergies among different activities in the coastal zone.

This report compiles the information on matrices provided by the case studies. It provides a first inventory of relevant interactions between aquaculture & fisheries and other activities in coastal zones.

Matrices were developed with the help of a questionnaire template and an excel file template. The data has been provided by the scientists that are involved in COEXIST. From the matrices it can be concluded that synergies exist between tourism and fisheries and aquaculture. Another synergy for the future might be the combination of aquaculture with wind parks in the North Sea case. Conflicts mainly exist between fisheries and conservation such as Natura 2000 areas. These conflicts often relate to spatial-temporal overlap. Conflicts also exist between non-fixed fisheries and fixed other activities such as cables, pipelines, platforms, coastal defense, wind parks.
1. Introduction

1.1. About COEXIST

Coastal areas are subject to an increase in competing activities and protection (i.e. Natura 2000, Marine Strategy Directive) and are a source of potential conflict for allocation of space. The maintenance and/or the development of coastal fisheries and aquaculture are highly dependent on the availability and accessibility of appropriate sites. This is the case for all types of development, either consolidation, decline or expansion of activities. In the same trend other activities have similar or competing claims. These activities include not only fisheries and aquaculture, but also tourism, wind farms, transport, Marine Protected Areas (MPAs) etc. There is good reason to believe that the competition for such sites will increase, emphasizing the need for improved management tools supporting policies for space allocation along the entire European coastline (COEXIST 2010).

COEXIST is a project that uses a broad multidisciplinary approach to evaluate interactions between competing activities and protection in the coastal area focusing on fisheries and aquaculture in particular. The ultimate goal of the project is to provide a roadmap to better integration, sustainability and synergies among different activities in the coastal zone (COEXIST 2010). COEXIST consists of thirteen European countries, coordinated by the Norwegian Institute of Marine Research and is funded by the European Commission Seventh Framework Programme (COEXIST 2011). The project has been divided into several work packages.

The aim of the report is to make a first exploration of present interactions between aquaculture and fisheries in the coastal waters of the case studies, which are defined in the project. The synthesis of conflicts and synergies on aquaculture and fisheries and other activities will be reported separately.

1.2. Work Packages

Work package one sets the baseline for COEXIST providing a reference description of fisheries, aquaculture and other activities in the coastal zone both at the generic level and at an ecosystem specific level (COEXIST 2011). As part of this work package, matrices of interaction between aquaculture and fisheries aiming to clarify how aquaculture and fisheries activities interact with each other were to be delivered (COEXIST 2010).

As an information exchange, these matrices contribute to work packages 2, 3 and 4. Work package 2 reviews and documents the current governance regimes applicable to the management of fisheries and aquaculture. As a part of this work package a stakeholder analysis will be carried out and a stakeholder map and database will be developed. The matrices are complemented and checked with information from stakeholders (COEXIST 2010).
Work package 3 aims at to apply and integrate different types of dynamic models to examine and assess interactions between fisheries, aquaculture, and other uses of the coastal zone. In this work package, models need to be adapted, improved and integrated to be fit for purpose. The interactions found in the matrices will be weighted, after which they will be used in the models (COEXIST 2010).

Work package 4 assesses spatial management of coastal activities for each selected case study and proposes improvements. In this work package the matrices contribute to the identification and the weighing of spatial management objectives, the measurements of cumulative impacts and by establishing how individual spatial management of coastal activities influence key activities (COEXIST 2010).

### 1.3. Case Studies

Data to feed into these matrices are derived from six different case studies, representing the specific conditions and combinations of activities of European coastal areas focusing on aquaculture and fisheries. The case studies contain the Hardangerfjord, Atlantic Coast of Ireland and France, Algarve Coast, Adriatic Sea Coast, Coastal North Sea and the Baltic Sea.
2. Methodology

2.1. Introduction

The following chapter describes how significant information for the matrices was obtained and how the matrices were constructed. A more thorough analysis of the matrices will follow in other work packages.

This report compiles the information on matrices provided by the case studies. It provides a first inventory of relevant interactions between aquaculture & fisheries and other activities. This report also functions as a preliminary report of the working document in work package one.

2.2. Connections with other work packages

According to the Description of Work of COEXIST, the matrices of interaction should feed into the following work packages:
T2.4  Conduct a stakeholder analysis
D2.1  A stakeholder map and database for each case study area
T3.6  Adaptation, improvement and integration of models
T4.2  Identify and weight spatial management objectives
T4.4  Measure cumulative impacts
T4.5  How spatial management tools influence key activities
T4.7  Evaluate adaptations to spatial management tools and propose adaptations
D4.2  Cumulative impacts, influence SMTs on activities

2.3. Scope

This set of matrices focuses on current interactions between aquaculture & fisheries and other activities, with a geographical focus on the case studies. See the table below for an overview.

Table 1: scope of the matrices

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time span</th>
<th>Geography</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Past</td>
<td>Present</td>
</tr>
<tr>
<td>Fisheries</td>
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<td></td>
</tr>
<tr>
<td>Aquaculture</td>
<td></td>
<td></td>
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<tr>
<td>Other activities</td>
<td></td>
<td></td>
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<tr>
<td>Matrix Fish&amp; Aqua vs others</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>x</td>
<td>x</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>
2.4. Definitions

In this report several concepts are used. Below an overview follows including definitions. They are derived from the List of Definitions (Task 1.1 of COEXIST):

Coastal activity Human activity that takes place in a coastal area/zone (Bolman & Nijman 2010)

Coastal zone The interface between land and sea, delineated as the part of the land affected by its proximity to the sea, and the part of the sea affected by its proximity to the land (Coastal Wiki 2010).

Conflict A state of disharmony between incompatible or antithetical persons, ideas, or interests; a clash (Free Dictionary 2010)

Marine Protected Areas Any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment (Kelleher 1999)

Socio-economic Field of study that examines social and economic factors to better understand how the combination of both influences something (Business Dictionary 2010)

Stakeholder Individuals or organizations who stand to gain or lose from the success or failure of a system (Nuseibeh & Easterbrook, 2000).

Synergy The combined power of a group of things when they are working together which is greater than the total power achieved by each working separately (Cambridge 2010)

Zoning The regulation (and allocation) of access to and use of specific marine geographic areas to help protect the environment, support economic development, and create equitable access to the ocean (Weinstein et al. 2007)

2.5. Data collection

The information to feed into the matrices was gathered using a questionnaire. The questionnaire consisted of three parts:

- Activities in coastal zones
- Conflicts in coastal zones
- Synergies in coastal zones

The questionnaire include inquiries on the past, the present and the future situation in the coastal zone. This document only focuses on the synergies and conflicts between aquaculture & fisheries and other activities.

Data collection was performed by the national contact points, in the role of case study leaders and participants. Since work package one functions as a first identification of interactions (had a broad scope), case study leaders were asked to fill out the questionnaire and matrices, with the assistance of the involved institutes. If necessary, case study leaders could consult policy makers or other experts. Stakeholder consultations are not part of the current inventory. Case study leaders were asked to use literature resources from projects.
such as WindSpeed, EMPAS and ICES, where applicable. The questionnaire can be found in Appendix 8.

The information from the questionnaire was converted and summarized into the designed matrix. To facilitate and standardize this exercise an excel file was provided (example in figure 2). Conflicts are marked in red, synergies are marked in green. Interactions between two activities that involve both conflict and synergy were marked in orange. If no interaction exists, the cell is marked yellow.

In the format excel file conflicts, conflicts and/or synergy, synergy or no conflict/synergy between the different activities could be marked. Table 1 illustrates the format file.

**Figure 1: Excel template**

<table>
<thead>
<tr>
<th>Fisheries &amp; aquaculture</th>
<th>Type A</th>
<th>Type B</th>
<th>Type C</th>
<th>Type D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other activities</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type A</td>
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<td></td>
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</tr>
<tr>
<td>Type B</td>
<td></td>
<td></td>
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<tr>
<td>Type C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conflict  
Conflict and/or synergy  
Synergy  
No conflict/synergy

Source: Bolman & Jak, 2010
3. Interactions

The interactions between fisheries and aquaculture, provided by the different case studies, are outlined here. The input for the matrices is further explained with relevant information from the questionnaires. For additional information on raw data, see the completed questionnaires appendices. For the matrices, please consult the appendices.

3.1. Case Study 1 – Hardangerfjord

3.1.1. Introduction

The Hardangerfjord is located in the south western part of Norway, between Bergen and Rosendal (figure 3). The ecosystem in the Hardangerfjord serves many functions, for fisheries and aquaculture, for recreation, tourism and cultural identity, as a climate moderator in the fruit growing districts, as a recipient and as a transportation route for people and cargo (COEXIST 2011).

Figure 2: Case study area

Source: COEXIST 2011
3.1.2. Fisheries & aquaculture and other activities

The Hardangerfjord has a minor fishing industry, mainly based on a sprat (Sprattus spratus) fishery. Additionally there is recreational tourist fishing, which is closely linked to recreational salmon fishing (Salmo salar) in the rivers. Recreational salmon fishing in rivers is not quantitatively significant, in terms of amounts of Atlantic salmon landed, but is both culturally important and economically significant, as a significant component of the tourist industry. The Hardangerfjord is also a major area for salmon farming, with a large number of cage farms as well as hatcheries, located in the Hardangerfjord area. Furthermore, a number of cod farms (Gadus morhua) exist and one cod hatchery as a research station is active. Permits for the production of the blue mussel (Mytilus edulis) are present, but the present production is low. A small cluster of oyster farms (Ostrea edulis) exist in the outer part of the region, which is a traditional activity which has existed in varying forms for several hundred years. For more information consult the questionnaire in appendix 1.

Apart from fisheries and aquaculture there are several other activities in the Hardangerfjord. There are very major resources for hydroelectric power in the area. Most of it is utilized, and no new major plants are in construction. The power plants were the reason for several metallurgical industries in various parts of the region, producing aluminum, ferrosilisium, and ilmenite. The high-voltage cables that are associated with the power plants will be updated in the near future. Tourism and conservation are closely interlinked in this area. There are several national parks, including Norway’s largest park, Hardangervidda, with two major glaciers, Folgefonna and Hardangerjøkelen. Lastly the Hardangerfjord is an old cultural area, populated since the stone age. Several of the place names are associated with old Norse religion.

3.1.3. Conflicts between fisheries and aquaculture

It has been hard to combine salmon farming (Salmo salar) with conservation and ecology needs. This relates primarily to problems with salmon lice and escapees, with nutrient release considered less important. Culturally salmon farming is perceived as a new “unnatural” activity, compared to other activities such as land-based farming. The salmon industry tries to cope with this perception by searching for combinations between salmon farming and tourism.

Hydroelectric power is also hard to combine with conservation and ecology needs. Problems relate to landscape destruction, the alteration of the fjord’s hydrography and impact on salmon lice and wild salmon. The latter due to a reduction in the freshwater that flushes into the fjord. A major political conflict emerged in 2010 following plans for new high-voltage cables, leading to strong protests against the plans. They are presently delayed, and the plans are being reconsidered by the (central) government.

3.1.4. Synergies between fisheries and aquaculture

There is a strong connection between the tourist fisheries, including recreational salmon angling on the rivers river, and the overall tourist industry. To some extent this is also in synergy with conservation interests, although there are some conflicts, including road building to improve access for anglers, the use of motorized transport in protected areas (both road and waterway traffic), fishing in salmon rivers containing vulnerable, small
natural stocks. There are also plans to develop associations between salmon farming and tourist industry (see above). So far, only the small oyster industry has to some extent developed this.

Figure 3: Interactions between fisheries & aquaculture and other activities

<table>
<thead>
<tr>
<th>Other activities</th>
<th>Fisheries &amp; aquaculture</th>
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<td></td>
<td>Miscellaneous fisheries</td>
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<td>Oyster cultivation</td>
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<td>Saithe fishery</td>
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<tr>
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<td>Salmon fishery in rivers</td>
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<td>Salmon fishery on sea</td>
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<tr>
<td></td>
<td>Cod cultivation</td>
</tr>
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<td></td>
<td>Cod hatcheries</td>
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<td>Mussel cultivation</td>
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<td>Salmon cultivation</td>
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<td>Hydroelectric power</td>
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<tr>
<td>Marine Protected Areas</td>
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<td>Military activities</td>
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<td>Oil and gas extraction</td>
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<tr>
<td>Shipping and transport</td>
<td>Yellow</td>
</tr>
<tr>
<td>Tourism</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
3.2. Case study 2a - Atlantic coast of Ireland

3.2.1. Introduction

The Atlantic coast of Ireland is located in the east and south-east of Ireland. Important cities along the coastline include the capital of Dublin and Cork. The area is used for aquaculture, fisheries, wind parks, conservation, cables/pipelines, shipping and transport and tourism and recreation.

Figure 4: Case study area

Source: Google Earth

3.2.2. Fisheries & aquaculture and other activities

Fisheries in this case study area consists of whelk (Buccinum undatum) and crab potting (Cancer pagurus), beam trawling for scallops (Pecten maximus) and trawling for white fish (mainly Cod, Gadus morhua; Haddock, Melanogrammus aeglefinus; Hake, Merluccius merluccius; Whiting, Merlangius merlangus) Additionally, mussel seed dredging (Mytilus edulis) takes place, in association with some mussel trestle culture in Rosslare Harbour.

Several other activities occur in this case study area. The Arklow Bank Wind Park was completed in 2002 and is located 10km off the Co. Wicklow coastline on the east coast. It
consists of 7 turbines and has a capacity of 25.2 MW. Consent is in place for a total of 200 wind turbines with a total capacity of 520 MW. No information is available as to when construction of Phase 2 will begin. There are also Natura 2000 sites in the case study area, in which several NGOs are involved such as Coastwatch and Irish Seal Sanctuary. North Dublin Bay and Malahide Estuary are OSPAR MPAs.

Concerning cables, the Irish Sea is a busy area mainly because of cables running between the UK and Ireland. The main international ports are Dublin and Rosslare. Tourism and recreation take place from Dublin, Dun Laoghaire, Bray, Greystones, Wicklow, Arklow, Courtown and Wexford Harbour.

3.2.3. Conflicts between fisheries and aquaculture

No conflicts have been detected between fisheries & aquaculture and other activities.

3.2.4. Synergies between fisheries and aquaculture

Improved infrastructure and services such as harbor development might enforce each other. The reason for this synergy is combining industries/services that are required for multiple sectors/activities.

Figure 4: Interactions between fisheries & aquaculture and other activities
3.3. Case study 2b - Atlantic coast of France

3.3.1. Introduction

The Iroise Sea is located in the west of Bretagne in France (figure 7). In this western part of French Brittany, seaweed and bivalve fisheries provide an original example of interaction between coastal fisheries and sea-ranching (COEXIST 2011).

Figure 5: case study area

Source: ICES, Shom, Ifremer, AAMP

3.3.2. Fisheries & aquaculture and other activities

Considering fisheries activities in this area, the shellfish (*Argopectin irradians*, *Venus verrucosa*) and seaweed (*Laminaria Digitata*) sectors are important. Other fishery activities include cuttlefish (*Sepia officinalis*) and crab potting (*Necora puber, Carcinus maenas*) and diving for abalone (*Haliotis tuberculata*). Aquaculture activities focus on oyster (*Crassostera gigas*) and mussel (*Mytilus edulis*) cultivation in the bay of Brest and in the Aber Benoit estuary. There is also a sea ranching program for scallop (*Pecten maximus*) in the Bay of Brest.

Considering other activities, it is important to note that, since 2006, the Marine Natural Park of the Iroise Sea has been established, together with several other Natura 2000 sites. In the Bay of Brest, civil and military cables and pipelines exist for a number of different uses.
Naval military activities in the Bay of Brest are among the largest in France. The naval base involves a variety of settlements onshore on the different sides of the bay. Also, there are some closed offshore military areas. The international Port of Brest is an important site for commercial vessels repairs. In addition, some areas in the bay are also used for temporary parking of vessels. There are also recreational harbours for sailing and fishing activities and many touristic trips to islands in the Marine Natural Park. The watershed that is connected to the bay of Brest stretches over 2,800 km². Therefore urban and agricultural residues from rivers such as the Aulne, Elorn and Hyère can also be regarded as an activity.

3.3.3. Conflicts between fisheries & aquaculture and other activities

Due to agricultural residues from rivers, unicellular seaweed bloom occurs in the area. This negatively influences the fishery on scallop. The water quality of the rivers also influences the daily treatment capacity for seaweed processing and the number of seaweed harvesting boats in the fleet.

3.3.4. Synergies between fisheries & aquaculture and other activities

No synergies have been detected between fisheries & aquaculture and other activities.

Figure 5: Interactions between fisheries & aquaculture and other activities
3.4. Case study 3 – Algarve coast

3.4.1. Introduction

The Algarve area is located in the south west of the Iberian peninsula and on the south coast of Portugal. The Algarve coastal waters are among the most productive of the Iberian Peninsula. However, due to the high diversity of the available resources and generally calm ocean conditions, there are heavily exploited fisheries. Moreover, there is a high level of aquaculture production occurring in inshore estuarine-lagoon system pressures (COEXIST 2011).

Figure 6: Case study area

Source: Google Earth

3.4.2. Fisheries & aquaculture and other activities

Industrial fishing is undertaken by larger trawlers and pelagic purse seiners. In the area there is a tuna trap (*Thunnus thynnus* & *Thunnus albacares*) operated by a joint-venture. They catch large pelagic fish from the wild and feed them into a large tuna trap. They let the fish grow and when fish reach a certain size or weight they are marketed. Artisanal fishermen use a large range of gear and fishing devices. Catches are mainly high valued finfish or bottom species and cephalopods.

Most of the aquaculture activities are related to mollusk culture in inland waters where the preferred species are clams and oysters (e.g. *Ruditapes decussatus*, *Venerupis decussata*, *Venerupis pullastra*). A small proportion is retained for domestic consumption with the
majority exported. Long-lines for mussel culture (*Mytilus spp.*) is a newer activity and production is mostly for export, as there is low domestic demand for this species. Finfish culture (e.g. *Sparus aurata*, *Dicentrarchus labrax*, *Solea senegalensis*, *Diplodus sargus*, *Anguilla anguilla*) in inland waters, using extensive rearing systems, still exists, but is mainly a subsistence activity with cultured fish destined for self consumption. Fish culture in ponds using semi-intensive rearing systems is still low scale, and some firms have even ceased producing recently.

Tourism is the sector that involves large numbers of people. It involves activities such as sport fishing, game fishing and sailing. Some dredging activities also occur in the area. This relates to erosion caused by tidal currents. Shellfish gatherers extract sand and shell to re-establish the ground level of their clam beds. There is some military activity, in terms of surveillance and maritime police patrolling for fishing practices and illicit activities. Towards the middle of the island of Culatra there is an area which is property of the Portuguese Navy and is accordingly patrolled and marked. The University of Algarve, IPIMAR and some other research institutions carry out monitoring routines in diverse ecologic and biological aspects. Salt production is an ancient activity that has recovered in the last decade somewhat from a much declined state. Vessel construction and repair in the study area is reduced and there are few firms active. There are some firms that trade a variety of boat equipment including engines and hulls.

### 3.4.3. Conflicts between fisheries & aquaculture and other activities

There is a conflict between sand extraction activity and bottom fishing. Where sand extraction activity exists, clam dredging and bottom trawling are forbidden. There is also a conflict between cabling activity and bottom fishing. Where there are cables, clam dredging and bottom fishing gear (e.g. bottom trawling and bottom purse seining) is forbidden. Shellfish gatherers that have clam and oyster beds are sometimes inconvenienced with dredging and cabling/piping works, because they may disturb their sediment beds where mollusks are produced. Fish aquaculture operators also claim that shell and sand extraction impoverishes water quality, due to turbidity and the suspension of solids. Tourism, namely ordinary tourists using coastal waters for swimming or bathing, may also complain if there are dredgers nearby, which, can, albeit rarely, occur.. The same applies for land based anglers that use beaches where people go swimming or bathing. Land based anglers can also claim they have the right to fish in ponds and rivers used for other activities. Diving operators that take their clientele for tourist SCUBA diving purposes can also complain if certain marine features appear destroyed or damaged due to irregular diving, fishing, or other human activities.

### 3.4.4. Synergies between fisheries & aquaculture and other activities

Tourism in general in the area benefits from sport fishing as it attracts a number of visitors, not only for the actual fishing activity they undertake, but also for the other services (e.g. lodging, food and beverages, boat rental, etc.) they require. Ecological and oceanographic research benefits from data obtained from the tuna trap firm, where they report their fishing/husbandry activities. It helps to maintain sustainability of marine biological resources. Industrial ice production makes ice for several fishing activities. Vessel construction and repair assist most of the fishing activities in the area.
Figure 6: Interactions between fisheries & aquaculture and other activities

<table>
<thead>
<tr>
<th>Fisheries &amp; aquaculture</th>
<th>Bottom purse seine</th>
<th>Clam fishery</th>
<th>Crustacean fishery</th>
<th>Fixed gears</th>
<th>Line fishery</th>
<th>Pelagic purse seine</th>
<th>Pelagic trawling</th>
<th>Tuna trap fishery</th>
<th>Clam cultivation</th>
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3.5. Case study 4 – Adriatic Sea

3.5.1. Introduction

The Adriatic Sea is located between Italy and the Balkan countries. The area chosen for the Adriatic Sea lies on the Italian part of the Adriatic sea coast (COEXIST 2011). The area is used for fisheries, aquaculture, tourism, recreational fishery, gas platforms and oil terminals.

![Figure 7: case study area](source: COEXIST 2011)

3.5.2. Fisheries & aquaculture and other activities

A small-scale fishery is carried out seasonally within the 3 Nautical mile (Nm) zone targeting cuttlefish (*Sepia officinalis*), gastropods (*Nassarius mutabilis*) and the common Sole (*Solea solea*) using traps, gillnets and fyke nets. Hydraulic dredging for baby clams (*Chamelea gallina*) takes place on the sandy bottom all year round between 1 and 2 Nm from the coast. Mussel harvesting (*Mytilus galloprovincialis*) on the wild banks is carried out from late summer till late spring on three natural rocky areas close to the coast and at some of the artificial reefs. In addition, a limited fishing season is established in a few of the Maritime Districts (usually from middle spring to late summer). Recreational fishing consists of rod and line anglers, spearfishing and the setting of traps for cuttlefish. Rod and line fishing and spearfishing are carried out mainly in summer, while trap fishing for cuttlefish is carried out in spring during the spawning season of the target species. Occasionally Illegal trawling inside the 3 Nm area takes place by larger vessels normally fishing outside the 3 Nm.
The aquaculture sector consists of 21 mussel farms (*Mytilus galloprovincialis*) on suspended long lines that are deployed along the coast of the study area.

Tourism is mostly a summer activity. Much of coastline is sandy and a number of leisure activities are carried out along the shore of the study area (beach tourism, aquatic sports, recreational diving, recreational sailing, etc.). A total of 11 tourist harbours are located in the study area. The current national legislation on recreational fishing establishes a limited number of pots and hooks in long lines, and quotas for molluscs, crustaceans and fish. Recreational fishing takes place everywhere, overlapping with all the above fishing activities. In the study area a number of off-shore gas platforms and two oil terminals are located. All these artificial structures are connected to the land with pipelines. Most of the gas platforms are located offshore, but a limited number in the southern part of the Marche Region are placed inside the coastal area.

### 3.5.3. Conflicts between fisheries & aquaculture and other activities

In the case study area some conflicts exist between recreational fishing and small-scale fisheries for space and resources, as well as between recreational fishing and professional harvesting of mussels on wild banks for the exploitation of the resource. A conflict for space exists between small-scale fishery and mussel cultures vs. recreational sailing, as set gear and long lines buoys often bar the sailing route. In addition, there is a conflict for space between cruise activities and fisheries, because in the wide channels dedicated to transit of vessels all fishing activities are forbidden. Similarly, artificial structures devoted to gas and oil exploitation remove space for fishing activities.

### 3.5.4. Synergies between fisheries & aquaculture and other activities

Gas platforms, oil terminals and pipelines may have a positive effect on marine resources similarly to mussel cultures. Tourism is a very relevant sector in the case study area especially in summertime. It provides increased income for all the coastal fishing activities and aquaculture. Moreover, it may contribute towards reducing/solving the problems connected with some coastal fisheries by offering alternative/integrative opportunities related to recreational fishing.
Figure 7: Interactions between fisheries & aquaculture and other activities

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<tr>
<th>Other activities</th>
<th>Clam fishery</th>
<th>Fixed gears</th>
<th>Mussel fishery</th>
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<th>Rapido trawling</th>
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3.6. Case study 5 – Coastal North Sea

3.6.1. Introduction

The Coastal North Sea case study comprises the coastal areas of the Netherlands, Germany and Denmark in the southern and south-eastern North Sea. The major part of the area belongs to the territorial waters of the Wadden Sea, which is characterized by large tidal flats and is bordered to the open North Sea by a chain of islands. This case study also includes the adjacent part of the Exclusive Economic Zone (EEZ) and thus reach beyond the 12 Nm zone of the territorial waters. The area is highly productive with tidal mixing and discharges from large rivers being the major sources of nutrient supply (COEXIST 2011).

Figure 8: case study area

Source: Google Earth

3.6.2. Fisheries & aquaculture and other activities

The most important forms of fisheries include the following activities. Pelagic trawling occurs in all three countries of this case study area. The main species involved include sprat (Sprattus sprattus), sandeel (Ammodytes marinus), herring (Clupea harengus) and mackerel (Scomber scombrus). Bottom trawling also occurs in the three countries, with (Solea solea),
and plaice (*Pleuronectes platessa*) being the main species captured. Different classes of trawlers are used for beam trawling, i.e. those more than 221 KW and those less than 221 KW. Beam trawling also involves the catching of shrimp (*Crangon crangon*). This occurs in the three countries, however, there are differences in distribution patterns and total effort (Beare et al. 2010). Otter trawling uses boards in front of the net in order to keep the net open. Twinrig, multirig, outrig, and flyshoot are the different types of otter trawling employed. Species captured include cod (*Gadus morrhua*), whiting (*Merlangius merlangus*), herring (*Clupea harengus*), sole (*Solea solea*), mackerel (*Scomber scombrus*), plaice (*Pleuronectes platessa*) (Productschap Vis 2010).

Bottom culture mussels (*Mytilus edulis*) are by far the most important aquaculture activity. This takes place in the Netherlands and Germany. Rope culture mussels only take place in Dutch waters. Mussel seed collectors, are used in Dutch and German waters. Oyster cultivation (*Crassostrea gigas, Ostrea edulis*) takes place in the Delta area of the Netherlands at a significant scale. In Germany there is only one Oyster company (*Crassostrea gigas*), in Denmark there are none.

In 2010 there were two wind farms operational in the Dutch North Sea. The first park has 36 turbines with a capacity of three megawatts each. The second park has 60 turbines with a capacity of two megawatts each. In 2010 twelve more concessions were granted with a total capacity of 3,250 megawatt. Germany is also seeking to install offshore wind farms, with a total planned capacity of 25,000 MW. The first German offshore wind park is in operation, several are under construction, and many applications for parks are currently under review. In general, in Germany wind farms are only planned for offshore areas, whereas in Danish and Dutch waters, wind farms are built or planned to be closer to shore. In the Danish part of the North Sea, two wind farms are at present in operation. These are Horns Rev 1 – built in 2002 (160 MW), and Horn Rev 2, built in 2009 (209 MW). They are located within two zones, approximately at 10 km and about 20-30 km off the coast. New wind farms are currently under review and 14 potential sites in the North Sea have been proposed.

Shipping in Dutch waters consists of cargo ships, tankers and container ships. In coastal zones, ships are obligated to navigate in buoyed water ways. Rotterdam is visited each year by approximately 33,000 ships. In German waters, shipping is considered a primary activity around which the current marine spatial plan is centered. In Denmark the most important harbor for fishing is Thyborøn, while the most important harbor for cargo and other ship traffic is Esbjerg. Esbjerg is visited each year by 18,000 ships.

In the Dutch EEZ, approximately 130 oil and gas locations are in use. Only 10 of them are for oil exploitation, the other 120 locations are for gas. In 2009 1.3 million m$^3$ oil and 23,000 million m$^3$ gas was produced. In the Danish EEZ the total oil and gas production in 2009 was respectively 15 million m$^3$ oil and 70 million m$^3$ gas.

Dredging takes place to keep water ways at a sufficient depth. On average, 30 million m$^3$ sediment is extracted and disposed in Dutch waters every year. Approximately 6% of the dredged material is so polluted that it has to be brought to special depots. The rest can be disposed in specific (designated?) places in the marine environment. Aggregates, such as sand, gravel and clay, are also extracted from the marine environment. These are used for the building trade, beach maintenance and large coastal constructions, such as harbours and
industrial estates. For beach maintenance 20-30 million m³ is used each year. While Rotterdam harbor is being extended, the requirement for that project is more than 100 million m³ per year. In Danish waters sand, gravel, pebbles and stones are extracted from the marine environment. A total of more than 740,000 m³ was removed in 2009.

There are many cables and pipelines in the Dutch EEZ. Pipelines are mainly used for gas, oil, hydrocarbons and condensate. Cables are mainly used for electricity and telecommunication.

The military uses a number of areas for live firing practice (?), exercises and the air force. Two areas are used for live firing practice, five areas for exercises and three areas for the air force. In Denmark there are two areas, connected to the Oksbøl Military facility, that are used for exercises.

Tourism & recreation consists of many activities. Examples are kite surfing, sport diving, wave surfing, wind surfing, sailing, yachting, seal cruises. Most of them only occur in the coastal zones.

Natura 2000 areas are the most relevant MPAs. In the Netherlands these areas include the Wadden Sea, North Sea Coastal Zone, Delta Area, Vlakte van de Raan, Dogger bank, Clover bank and Frisian Front. Natura 2000 areas will contain closed areas from 2012 onwards. They will also contain specific areas for sustainable fisheries and research. Some non-sustainable fisheries might be banned. Both the Dutch and the German Wadden sea is World Nature Heritage area. In Denmark about 10 Natura 2000 sites are within the Danish EEZ. Most of them are in the coastal area.

Groynes, dikes and constructions regulating flow are constructed in order to protect the mainland. These occupy space and change the environment by influencing erosion and sedimentation. The most important new coastal construction in the Netherlands is the expansion of the Rotterdam harbor. Approximately 240 million m³ sand is being used to reclaim 1,000 hectares of new land from the North Sea.

3.6.3. Conflicts between fisheries & aquaculture and other activities

Aquaculture activities are not allowed by the wind park operators since there are restrictions set on the entry of larger ships into these areas by insurance companies. This conflict involves competition for space. Off bottom aquaculture (rope culture, mussel seed collectors) are in conflict with shipping, since these may damage the nets. Aquaculture is generally not practiced in shipping lanes. Aquaculture activities often take place in specified areas (by permits), for six months over the summer time period. All aquaculture activities may compete for space with other site-specific activities, such as extraction of oil and gas, and activities related to dredging activities. Aquaculture activities may be restricted or banned from Marine Protected Areas. All types of fisheries may conflict with MPAs, depending on the specific ecological conservation objectives of the MPA and the type of impact of the fishery activities. Trawling activities are not allowed in the safety zone around wind parks, and those around offshore oil and gas installations. Beam trawling with tickler chains which penetrate the sediment may cause damage to cables. Crab fisheries are not allowed in the safety zones of oil and gas activities, and may also be in conflict with the
ecological protection aims of MPAs. Mussel seed fisheries is not allowed within wind farms and near O&G activities. Mussel seed may not be present where dredging activities occur regularly, e.g. in shipping lanes and disposal sites. Mussel seed fisheries may conflict with the ecological protection aims of MPAs.

### 3.6.4. Synergies between fisheries & aquaculture and other activities

Tourism and recreation involves many different activities and there are no real conflicts with fisheries and aquaculture. In the case of shrimping, there may be synergy because tourists like the picturesque vessels and pay good prices for the local product, which is of benefit for the small scale fisheries. In areas with rope culture and seed collectors, trips are taken to view them by tourists.

Figure 8: Interactions between fisheries & aquaculture and other activities

**Netherlands**

<table>
<thead>
<tr>
<th>Other activities</th>
<th>Fisheries &amp; Aquaculture</th>
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Germany

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Denmark

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<td>Oil and gas extraction</td>
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<td>Shipping and transport</td>
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<td>Tourism</td>
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<td>Urban and rural residues</td>
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<td>Wind parks</td>
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3.7. Case study 6 - Baltic Sea

3.7.1. Introduction

The Baltic Sea is landlocked between several countries in the North of Europe. This case study approaches the Baltic Sea from a Finnish perspective. The main activities in this case study include commercial fishing, aquaculture, recreational fishing and tourist fishing takes place.

![Figure 9: Case study area](source: Google Earth)

3.7.2. Fisheries & aquaculture and other activities

Coastal commercial fishing occurs on a small scale, mainly through family-based entrepreneurship. Fishing techniques include gill nets and trap nets. Tourism and recreation activities related to the fisheries is very popular in this area. A wide variety of techniques are used, such as rods and gill nets, often combined with boating. Aquaculture activities consist of trout (Oncorhynchus mykiss) and whitefish farming. The technique for these activities is cage culture. However compared to Norway this takes place on a small scale.

Recreational fishing is a very popular, and diverse, leisure activity, with a wide variety of fishing gear, from rod and for line methods to gill nets, employed. Organized fishing excursions with services, and often with an experienced guide, are also undertaken.

3.7.3. Conflicts between fisheries & aquaculture and other activities

Recreational fishers and boaters have occasionally caused problems to commercial gill net fishing and disturbed summer house dwelling. Conservation areas restrict professional fish farming or fishing tourism. Conservation of seal and cormorant populations hamper commercial fishing. Use of the sea as a nutrient dumping ground causes problems for
commercial and recreational fishing. Use of the sea bottom material, and or area, as raw material for disposal or construction, disturbs fishing or recreational use.

3.7.4. Synergies between fisheries & aquaculture and other activities

Local residents support commercial fishing and fish farming. Recreational dwellers, i.e. summer house owners, and tourists buy fish products of commercial fishers and fish farmers. Commercial and recreational fishing benefits from the infrastructure in the archipelago. Recreational fishermen catch valuable fish produced in fish farms.

Figure 9: Interactions between fisheries & aquaculture and other activities
4. Conclusions

This report has made a first identification of interactions between fisheries & aquaculture and other activities in the coastal areas of the six case studies. It can be concluded that all case studies have synergies with tourism in combination with fisheries and aquaculture. Another synergy for the future might be the combination of aquaculture with wind parks in the North Sea case. Apart from these two synergies there are not many other forms of combinations. However, in all case studies there are far more conflicts than synergies. Conflicts mainly exist between fisheries and conservation such as Natura 2000 areas. These conflicts often relate to spatial / temporal overlap. Conflicts also exist between non-fixed fisheries and fixed other activities such as cables, pipelines, platforms, coastal defense, wind parks.
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## Appendix I - Hardangerfjord

### Fisheries activities

Name activity: Sprat (*Sprattus spratus*) fishery  
Description: This is only a minor fishing industry  
Sub-activity: N.a.

### Aquaculture activities

Name activity: Salmon (*Salmo salar*) cultivation  
Description: Hardanger is a major area for salmon farming, probably only rivaled by the Puerto Montt region in Chile. A high number of cage farms are located in the area. Ongrowth of salmon takes place in floating cage farms in the sea.  
Sub-activity: N.a.

Name activity: Salmon (*Salmo salar*) hatcheries  
Description: The salmon hatcheries are land-based enclosed farms, using the local freshwater sources from rivers. Salmon is reared in freshwater during the first life stages, until they reach the “smolt” stage, at which they are capable of transferring to sea water. They are less in contact with the environment than the cage farms, contact is limited to effluent water, which is treated to a varying degree, according to limitations of the aquaculture permit.  
Sub-activity: Salmon eggs are delivered to hatcheries by a small number of specialized farms, rearing broodstock and producing fertilized eggs only.

Name activity: Cod (*Gadus morhua*) cultivation  
Description: A number of cage farms for cod exist in the CS area.  
Sub-activity: N.a.

Name activity: Cod (*Gadus morhua*) hatchery  
Description: Until recently a cod hatchery was operational in the CS area (Stord), but now only the research station (belonging to IMR) at Austevoll operates a cod hatchery. It is uncertain whether the commercial hatchery will reopen. At present, this hatchery has switched its operation produce wrasse for de-lousing of salmon.  
Sub-activity: N.a.

Name activity: Blue mussel (*Mytilus edulis*) cultivation  
Description: There are a number of permits for blue mussel (*Mytilus Edulis*) production in the area, although production presently is low.  
Sub-activity: N.a.
Name activity: European oyster (*Ostrea edulis*) cultivation
Description: A small cluster of European oyster farms exist in the outer part of the region (pond culture). This is a traditional activity which has taken place in various forms for hundreds of years. It has been recognized as a slow-food concept, with some interest from tourism.
Sub-activity: One hatchery is presently operating at the island of Bømlo. The hatchery is operated by the traditional pond culture method. There are several sites in the region used for ongrowth of oysters. In general these farms have low income.

Other activities
Name activity: Hydroelectric power.
Description: There are vast resources of hydroelectric power in the area as in most of Western Norway (Norway gets almost all its electric power from hydroelectric plants). Most of available resources are utilized, and no new major plants are in construction. A few important rivers (Veig, Kinso) have been protected as part of National parks or similar legislation. There is, however, continuous interest in developing small-scale hydroelectric power plants based on small rivers with limited conflicts.
Sub-activity: Several metallurgical industries dependent on the hydroelectric power are or have been in operation in various parts of the region (aluminum, ferrosilisium, ilmenite). Large scale hydroelectric power plants, small-scale hydroelectric power plants.

Name activity: Cables and pipelines
Description: The power plants are associated with high-voltage cables, which are planned to be updated. Whether the cables are to be on land or subsea is a matter of political debate in each case, which is in some cases intense, also on the national level. Both have strong implications for spatial conflicts. There are no oil or gas pipelines in the region, and no plans for such.
Sub-activity: Sub-sea cables and land-based cables

Name activity: Oil service industries
Description: There is a large cluster of shipbuilding and platform construction at Stord, and other shipyards present in the region.
Sub-activity: Platform construction and maintenance (Stord), ship construction and maintenance (several sites)

Name activity: Tourism
Description: Apart from fish farming and hydroelectric power, tourism is the main industry of the area.
Sub-activity: Cruise ships, several large hotels aiming mainly at the international and national tourist markets, with activities closely connected to tourist fisheries in sea and rivers. There is also small scale “farm tourism” developed together with farmers. Furthermore private
Cabins are popular as elsewhere in Norway, generally owned by private persons outside the area.

**Name activity:** Conservation  
**Description:** There are several national parks in the area, including Norway’s largest (Hardangervidda). There are also two major glaciers (Folgefonna and Hardangerjøkelen), both are protected areas. The area and landscape is widely considered of prime importance also in a cultural context.

**Sub-activity:** National parks and “landscape protection areas”, slightly different degrees of protection, although based on national laws and governance, it is partly administered locally.

**Name activity:** Tourist fisheries  
**Description:** Closely connected to tourism industry, closely connected to salmon fishing in rivers. Not quantitatively important, but culturally significant and a part of the tourism industry. Access rights to rivers are owned by local farmers. The farming (agriculture) is generally not very profitable, and the rights may be of importance to the individual farmers. Wild salmon is generally considered an important part of the national natural heritage.

**Sub-activity:** River fisheries and sea fisheries.

"The wedding in Hardanger" by Tiedemand and Gude, National Gallery, Oslo

**Name activity:** Culture  
**Description:** Old cultural area, populated since the stone age, several place names are associated with the old Norse religion. Hardanger, its landscape, culture and, to some extent, history, played an important part in the cultural nation-building during the 1800’s leading to Norway’s independence (see picture).

**Sub-activity:** Fishing in sea and river part of socio-economic fundament since the area was populated Cultural landscape (agriculture) with roots back to younger stone age. Wild rain deer in mountains surrounding the fjord still hunted by locals, as it was by the first inhabitant in the stone age, when glaciers withdrew after the end of the Ice Age.
## Conflicts

<table>
<thead>
<tr>
<th>Conflict</th>
<th>Location</th>
<th>Category</th>
<th>Reason</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon cultivation vs. conservation and salmon fisheries</td>
<td>Hardangerfjord and connected rivers</td>
<td>Ecology, socio-economic</td>
<td>Salmon lice, escapees and considered less important: Nutrient loading</td>
<td>Conflicts involving salmon farming are partly technical and partly biological. Less escapees and less production of salmon lice larvae (for instance by developing a vaccine or better treatments) will reduce conflict.</td>
</tr>
<tr>
<td>Salmon cultivation vs. culture</td>
<td>Hardangerfjord</td>
<td>Socio-economic</td>
<td>Involving the perception of salmon farming as a new, “unnatural” activity compared to traditional land-based farming (which has ancient roots)</td>
<td>The industry is attempting to solve this by involving the collaboration of the tourist industry. The display of well-run farms as a tourist destination, comparable to vineyards has been considered.</td>
</tr>
<tr>
<td>Hydroelectric power vs. salmon cultivation</td>
<td>Hardangerfjord</td>
<td>Ecology</td>
<td>Impact on salmon lice</td>
<td>Conflicts involving salmon farming are partly technical and partly biological. Less escapees and less production of salmon lice larvae (for instance by developing a vaccine or better treatments) will reduce conflict.</td>
</tr>
<tr>
<td>Hydroelectric power vs. conservation</td>
<td>Fjords</td>
<td>Ecology, natural resources</td>
<td>Landscape destruction, alteration of fjord’s hydrography</td>
<td>Solutions have been sought through governmental demands for cosmetic repairs of landscape. These demands apply to the owners of the hydroelectric plants. The demands are combined with emphasis on technology as CO2-neutral and environmentally friendly. There is an internal disagreement among conservationists on whether one should oppose hydroelectric power development due to classical nature conservation, or promote such development due to its eco-friendliness in a climate-change-context. The debate is similar to that of wind power (which is presently of no importance in this particular region). So far effects on fjord hydrography are not addressed.</td>
</tr>
</tbody>
</table>
Conflict: Hydroelectric power vs. tourist fisheries and salmon fishing on sea and rivers
Location: Hardangerfjord
Category: Socio-economic
Reason: Impact on salmon lice, and wild salmon
Solution: Conflicts with salmon can only be changed by releasing more freshwater during the spring, mimicking the natural conditions (pre-industrial) of the fjord.

Conflict: Tourist industries and tourist fisheries vs. conservation
Location: Rivers
Category: Ecology and natural resources
Reason: Road building, motorized transport in protected areas, fishing in salmon rivers on vulnerable small natural stocks
Solution: Specific demands on the tourist industry to avoid motorized transport in vulnerable areas, and to use environmentally friendly technology, to avoid fishing in rivers where salmon stock is threatened.

Synergies
Synergy: Tourist fisheries, tourist industry and conservation
Location: Fjords and rivers
Category: Natural resources
Reason: There are partly joint interests between salmon river owners, conservation interests and tourist fishermen – limited to common economic interests.
Continuation: There is interest on both sides to develop this collaboration, mainly because they have a “common enemy” in the aquaculture industry.
Appendix 2a – Atlantic Coast of Ireland

Fishery activities
Name activity: Whelk (*Buccinum undatum*) fishing with fixed gears.
Description: Fishing method is with pots.
Sub-activity: Port infrastructure activities related to fishing

Name activity: Crab (*Cancer pagurus*) fishing with fixed gears
Description: Fishing method is with pots.
Sub-activity: Port infrastructure activities related to fishing

Name activity: Beam trawling
Description: Target species is scallops (*Pecten maximus*)
Sub-activity: Port infrastructure activities related to fishing

Name activity: Trawling bottom purse seine
Description: Target species is white fish (mainly Cod, *Gadus morhua*; Haddock, *Melanogrammus aeglefinus*; Hake, *Merluccius merluccius*; Whiting, *Merlangius merlangus*)
Sub-activity: Port infrastructure activities related to fishing

Name activity: Mussel (*Mytilus edulis*) seed fishery
Description: Mussel seed fishery
Sub-activity: There is an important mussel seed fishery in our case study area. It is targeted by vessels from Ireland and the UK using dredges. The seed mussels are relaid in other areas outside of the case study area for ongrowing.

Aquaculture activities
Name activity: Mussel (*Mytilus edulis*) cultivation
Description: Occurs in Rosslare Harbour.
Sub-activity: Port infrastructure activities related to aquaculture

Other activities
Name activity: Wind Parks
Description: Arklow Bank Wind Park was completed in 2002 and is located 10km off the Co. Wicklow coastline on the east coast, it consists of 7 turbines and has a capacity of 25.2MW. Consent is in place for a total of 200 wind turbines with a total capacity of 520MW, no information is available as to when construction of Phase 2 will begin.
Sub-activity: N.a.
Name activity: Conservation
Description: Natura 2000 sites in CS area, North Dublin Bay and Malahide Estuary are OSPAR MPAs. There are also some NGOs involved including (e.g. Coastwatch, Irish Seal Sanctuary)
Sub-activity: N.a.

Name activity: Cable and Pipeline
Description: The Irish Sea is a busy area for cables mainly running between the UK and Ireland.
Sub-activity: Port infrastructure activities related to cable maintenance work.

Name activity: Shipping and Transport
Description: Main international ports are Dublin and Rosslare
Sub-activity: N.a.

Name activity: Tourism and Recreation
Description: Main water based activities take place from Dublin, Dun Laoghaire, Bray, Greystones, Wicklow, Arklow, Courtown and Wexford Harbour
Sub-activity: Port infrastructure activities related to sailing.

Name activity: Marine Spatial Planning
Description: Responsibility for consenting of offshore developments has been assumed by the DEHLG who are in the process of designing a new consenting regime. Legislation to enable this is anticipated to be drafted and enter into force in 2011. MSP is seen as an integral part of the offshore consenting regime however currently no information is available on what the future MSP regime will look like.
Sub-activity: N.a.

Name activity: Coastal constructions
Description: Development of the deep water shipping terminal in Rosslare
Sub-activity: The construction of the deep water harbour has impacted on space available for shellfish fishery (fixed gears).

Name activity: Urban and rural residues
Description: Eutrophication
Sub-activity: Impacts shellfish cultivation through the issue of hazardous algal blooms.

Conflicts
Conflict: Mussel seed fishery vs. shellfish fishery using fixed gears
Location: Atlantic coast of Ireland
Category: Ecology and spatial
Reason: Dredgers taking juvenile whelk (*Buccinum undatum*) and scallop (*Pecten maximus*) along with mussel (*Mytilus edulis*) seed and fishing gear being towed away by dredgers
Solution: N.a.
<table>
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<tbody>
<tr>
<td>Location</td>
<td>Rosslare Harbour</td>
</tr>
<tr>
<td>Category</td>
<td>Spatial</td>
</tr>
<tr>
<td>Reason</td>
<td>Reduced space for shellfish pot fishing due to dredging of deep water channels</td>
</tr>
<tr>
<td>Solution</td>
<td>Probably none</td>
</tr>
<tr>
<td>Conflict</td>
<td>Urban and rural residues and shellfish (<em>Mussel, Mytilus edulis</em>; <em>Oyster, Crassostrea virginica</em>) cultivation</td>
</tr>
<tr>
<td>Location</td>
<td>Wexford Harbor</td>
</tr>
<tr>
<td>Category</td>
<td>Integrated management</td>
</tr>
<tr>
<td>Reason</td>
<td>Eutrophication causing aquaculture harvesting problems due to harmful algal blooms.</td>
</tr>
<tr>
<td>Solution</td>
<td>Control of agricultural runoff and nitrate use.</td>
</tr>
</tbody>
</table>

**Synergies**

**Synergy:** Improved infrastructure and services e.g. harbor development, Coastal construction

**Location:** Atlantic coast of Ireland

**Category:** Socio-economic and spatial

**Reason:** The reason for this synergy is combining industries/services that are required for multiple sectors/activities

**Continuation:** The synergy can be expanded by clustering of sectors means there will be clustering of services helping all industries.

**Synergy** Mussel cultivation and mussel seed fishery (*Mytilus edulis*)

**Location** Wexford Harbor

**Category** N.a

**Reason** Cultivation of mussels is dependent on the seed mussel fishery for a supply of seed.

**Continuation** Probable
Appendix 2b – Atlantic Coast of France

Fishery activities

<table>
<thead>
<tr>
<th>Name activity</th>
<th>Description</th>
<th>Sub-activity</th>
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<tbody>
<tr>
<td><strong>Shellfish fisheries</strong></td>
<td>In the bay of Brest, the current fleet is constituted between 50 to 60 vessels. Two types of dredge are used depending the target species, common scallop or warty venus (<em>Argopectin irradians</em>, <em>Venus verrucosa</em>). The activity is very old in the bay, it existed since the middle of the nineteen century. Today, this fisheries is seasonal from the middle of October to April.</td>
<td>Some boat are active in the summer seaweed fisheries, others are in the line fishery or crustacean fisheries.</td>
</tr>
<tr>
<td><strong>Seaweed fisheries (Laminaria Digitata)</strong></td>
<td>Today, 31 vessels constitute this fleet. This fishery is mainly located in the north coast of the Finistere department. The fishing gear named scoubidou is specific to harvest this kelp. In general, each fisherman works in his area. Without official rules, the harvested zone is shared between the fishermen.</td>
<td>Most of the vessels are dredgers during the rest of the year.</td>
</tr>
<tr>
<td><strong>Common cuttlefish fisheries</strong></td>
<td>Specific traps are used to target cuttlefish (<em>Sepia officinalis</em>). In general, the traps are large with 2 little opening. The fishing bottom are mainly characterized by sand and located in shallow water. This fishery is seasonal from beginning of March to May.</td>
<td>Most of the vessels are dredgers during winter and potters in summer.</td>
</tr>
<tr>
<td><strong>Crab fishing using fixed gears</strong></td>
<td>In the bay of Brest, this fishery mainly target the velvet crab (<em>Necora puber</em>) and the green shore crab (<em>Carcinus maenas</em>). Only few vessels are present in the bay during spring and summer.</td>
<td>In complement activities, the vessels are dredgers in Autumn and Summer.</td>
</tr>
<tr>
<td><strong>Abalone fishery</strong></td>
<td>Diving is the technic used to target abalone (<em>Haliotis tuberculata</em>). An individual quota is delivered for each diver and corresponds to a defined quantity of tag. Indeed, all abalones has to be tagged in order to respect the quotas and to control the legal market and to prohibit illegal one. During summer the fishery is closed, period where the abalones reproduce.</td>
<td>Abalone fishery is complementary to activities like the line fishery or dredge fishery.</td>
</tr>
</tbody>
</table>
Name activity: Crustacean fishery
Description: This crustacean fishery targets lobster (*Homarus gammarus*), spider crab (*Cancer pagurus* or *Maja brachydactylas*) in the Iroise Sea during spring, summer and autumn. The vessels differ in size with a crew from 1 to 5 fishermen. The number of pot is limited with a maximum of 200 per fisherman aboard.
Sub-activity: The complementary activity uses the gillnet.

Name activity: Line fishery
Description: This fishing technique is used to target seabass (*Dicentrachus labrax*) and seabream (*Spondylisoma cantha*). This fishery is located in the whole case study area. The activity occurs in summer and autumn.
Sub-activity: Some are dredgers or target cuttlefish in spring.

Name activity: Oyster fishery
Description: With a specific dredge, few vessels target this oyster (*Ostrea edulis*) in the bay of Brest. During a long period, this stock was very low and the fishery was closed. Even if the landings increase, the volume yet are low today.
Sub-activity: These vessels belong to the largest shellfish fishery.

**Aquaculture activities**

Name activity: Oyster cultivation
Description: Oyster cultivation (*Crassostera gigas*) occurs in the bay of Brest and in the Aber Benoit estuary
Sub-activity: Port infrastructure activities related to aquaculture and transport of food and material for islands.

Name activity: Mussel cultivation
Description: Mussel cultivation (*Mytilus edulis*) occurs in the bay of Brest and in the Aber Benoit estuary
Sub-activity: N.a.

Name activity: Sea ranching program for scallop
Description: Sea ranching for scallop (*Pecten maximus*) occurs in the Bay of Brest.
Sub-activity: N.a.

**Other activities**

Name activity: Conservation
Description: Since 2006 the Marine Natural Park (MNP) of Iroise Sea and several Natura 2000 sites in CS area, also species and ground from the European Directive of Habitat.
Sub-activity: N.a.
Name activity: Cable and Pipeline
Description: In the bay of Brest, some civil and military cables and pipelines exist for different uses.
Sub-activity: N.a.

Name activity: Military Activities
Description: Naval military activities in the bay of Brest are among the largest in France. The naval base consists of onshore settlements on the different sides of the bay and closed areas but also movements of surface vessels and submarines within the bay.
Sub-activity: N.a.

Name activity: Shipping and Transport
Description: Brest is an international port and is the main French site for commercial vessels repairs, some areas in the bay are also used for temporary parking of vessels.
Sub-activity: Port infrastructure activities related to transport of food and material for islands.

Name activity: Tourism and Recreation
Description: Many recreational harbors for sailing and fishing activities and many tourism to visit islands in the MNP.
Sub-activity: Port infrastructure activities related to tourism and recreation activities

Name activity: Urban and rural residues
Description: A number of different rivers (Aulne, Elorn, Hyère, ...) and all their tributaries drain into the bay of Brest. The watershed stretches over 2800 km² in which the influence of agricultural activities and urban runoff on water quality is significant.
Sub-activity: N.a.

Name activity: Industrial Seaweed (Laminaria Digitata) Processing
Description: Two processing plants, located near the landing areas, buy more than 95% of the harvest, and extract the alginates contained in the algae.
Sub-activity: Port infrastructure activities related to transport of food and material for islands.

Conflicts
Conflict: Due to a change in water quality from rivers there is an increase in seaweed (Laminaria Digitata) growth. This increases the number of seaweed processing and harvesting boats. This reduces the space for other activities such as fisheries.
Location: In the Bay of Brest, seaweed (Laminaria Digitata) areas along the coast and the watersheds.
Category: Ecological because it is the quality of the water which drive the situation and spatial because fishermen are in a competition system to get the better fishing place.

Reason: N.a.

Solution: N.a.

Conflict: Conflicts between the dredger and seaweed fleets.

Location: In the Bay of Brest, seaweed (*Laminaria Digitata*) areas along the coast and the watersheds.

Category: Spatial because fishermen are in a competition system to get the better fishing place.

Reason: Competition

Solution: N.a.

Conflict: Urban and rural residues vs. scallop fishery

Location: In the Bay of Brest, seaweed (*Laminaria Digitata*) areas along the coast and the watersheds.

Category: Ecological because it is the quality of the water which drive the situation

Reason: Unicellular seaweed bloom some years (in relation with human run off activities) that lead to decrease of the fishing activity on scallop (*Pecten maximus*).

Solution: The conflicts might be solved by the decrease of the daily seaweed production. This situation need to be analyzed. The spatial conflict for seaweed areas should be studied in this project. Actually, there isn't specific solution to ban the unicellular seaweed bloom.

**Synergies**

**Synergy:** Scallop hatchery and scallop fishery (*Pecten maximus*)

**Location:** Coastal zone

**Category:** Socio-economic and spatial

**Reason:** The production and harvesting can go hand in hand.

**Continuation:** The synergy can continue if the final product is always asking on markets and if the concurrence on price is not too important (alginate).

**Synergy:** Seaweed processing and seaweed harvesting

**Location:** Coastal zone

**Category:** Socio-economic and spatial

**Reason:** The synergy exists because production and harvesting can go hand in hand.

**Continuation:** The synergy can continue if the final product is always asking on markets and if the concurrence on price is not too important (alginate).
Appendix 3 – Algarve coast

**Fishery activities**

**Name activity:** Crustacean fishery  
**Description:** A large number of species are captured including red shrimp (*Aristeus antennatus*), deep-water rose shrimp (*Parapenaeus longirostris*) and Norwegian lobster (*Nephrops norvegicus*). Both work directly with the fishing processors and the branded companies. The tonnage of the trawling fleet is more or less stable and vessels are the property of limited number of ship-owners. The species are captured by fewer numbers of crew than in the past.

**Sub-activity:** Industrial ice production, fishing equipment (e.g. nets, engines, electronics), restaurants, fish markets, shipyards.

**Name activity:** Fish Trawlers  
**Description:** Target species for fish trawlers include hake (*Merluccius merluccius*), horse mackerel (*Trachurus spp.*), and monkfish (*Lophius lophius* and *L. budegassa*). Both work directly with the fishing processors and the branded companies. The tonnage of the trawling fleet is more or less stable and vessels are the property of limited number of ship-owners. The species are captured by fewer numbers of crew than in the past.

**Sub-activity:** Industrial ice production, fishing equipment (e.g. nets, engines, electronics), restaurants, fish markets, shipyards.

**Name activity:** Larger bottom purse seiners  
**Description:** Mainly catch fish to be processed by the canning industry, which is largely based in Olhão. However, in the last decade there has been a reduction in this activity and consequently jobs have been reduced from hundreds to less than 50. A single vessel may employ almost 20 men. Each small purse seine employs a smaller crew and its main catch goes to the fish auction markets. There has been a reduction of both types of purse seines in the last decade.

**Sub-activity:** Industrial ice production, fishing equipment (e.g. nets, engines, electronics), restaurants, fish markets, shipyards.

**Name activity:** Tuna trap fishery  
**Description:** In the area there is a tuna trap operated by a joint-venture. This enterprise has practiced sea ranching since 1996. They catch large pelagic fish (especially tuna species as *Thunnus thynnus* and *T. albacares*) from the wild and release them into a large tuna trap. They let the fish grow and when they reach a certain size or weigh they are marketed both in Japan and more recently all around Europe (especially for sushi delicacies).
Sub-activity: Selling fishing equipment, artisanal gear construction (e.g. cages and nets), industrial ice production

Name activity: Angling, trawling, jugging
Description: Artisanal fishermen use a large range of gear and fishing devices. Some of them keep several gear licenses, but use just a few. Usually gear use depends upon the season. Catches are mainly high valued finfish (e.g. Sparidae spp., Mullus surmuletus) or bottom species (e.g. Soleidae spp.) and cephalopods (e.g. Octopus vulgaris, Sepia officinalis). Their catches are sold in the local fish auction markets. In order to retain their fishing and gear licenses fishermen have to sell a certain amount of fish in the official market. Most buyers are domestic (local public and restaurants). Many retired fishermen practice sea angling, trolling and jigging onboard small vessels. Usually they practice this activity in order to get additional income (typically complaining that their pensions are low). Some low income or unemployed people are involved in this activity as well. Their catch is easily sellable to hotels and restaurants which usually pay good prices, particularly for larger fish.

Sub-activity: Industrial ice production, fishing equipment (e.g. nets, engines, electronics), restaurants, fish markets, shipyards.

Aquaculture activities
Name activity: Clams, mollusk & oyster cultivation (e.g. Ruditapes decussatus, Venerupis decussata, V. pullastra, Crassostrea gigas, C. angulata, Ostrea edulis).
Description: In inland water. A small part is for domestic consumption being the major part to export. The activity has existed since the 19th century, but the claim for property rights over the clam beds started in the 1950s. Today there is a large area used as clam beds (Ruditapes decussatus, Venerupis decussata, V. pullastra) sited especially in the Ria Formosa lagoons (over 4 million m² of clam beds). Shellfish gatherers (called viveiristas) pay a biannual fee to the Portuguese government in order to have some property rights and keep their licenses. Many of these shellfish gatherers make their livelihoods from this activity.
Many mollusk culture plots suffer from erosion caused by tidal currents especially those most exposed inside the Ria Formosa lagoon. Many shellfish gatherers extract sand and shell to re-establish the ground level of their clam beds.
Sediment accretion in the Ria Formosa lagoon occurs where it is connected to the sea (Atlantic Ocean). Action is occasionally needed, to dredge sediments to facilitate sea transport and fishing activity.

Sub-activity: Viveiristas have raised their standards of living since they organized themselves into associations sharing common facilities, such as a depuration station, a certificate of product quality and exportation channels. It is a métier that employs several hundred people, both directly and indirectly, as well as supporting others.
Name activity: Mussel cultivation (*Mytilus spp.*)
Description: Long-lines for mussel culture are quite recent and the production is mostly for exportation, once there is a low domestic demand for this species.
Sub-activity: Fishing equipment, export

Name activity: Finfish (e.g. *Sparus aurata*, *Dicentrarchus labrax*, *Solea senegalensis*, *Diplodus sargus*, *Anguilla anguilla*) cultivation in inland waters
Description: Predominantly extensive culture systems, mainly for self-consumption. Fish culture in ponds in semi-intensive regime is scarce and some firms ceased recently. Only one firm is currently operating near the study area,
Sub-activity: Fishing equipment (e.g. nets, engines, electronics), restaurants, fish markets, shipyards.

Name activity: Sea cages
Description: Sea cages have been operated by the local research institute for more than a decade. New investments have also been applied in this area recently.
Sub-activity: Selling fishing equipment, artisanal gear construction (e.g. cages and nets).

**Other activities**
Name activity: Recreational land based angling
Description: Land based angling is common, especially during the weekends or bank holidays. Most anglers fish for self-consumption, either as a recreational activity or in competition.
Sub-activity: Selling fishing equipment (both professional and sport fishing), and bait selling (usually live bait either locally caught or imported).

Name activity: SCUBA diving
Description: SCUBA diving to catch razor clams (*Ensis spp.*) and high valued crustacean (e.g. European spider crab *Maja squinado*) is practiced. Although not the most prolific for this activity, dive boat operators take their customers to a diverse range of dive spots.
Sub-activity: Sport fishing and SCUBA diving equipment.

Name activity: Tourism
Description: Tourism is the sector that involves the most people
Sub-activity: Angling activities, or sport fishing. Big game fishing exists, but occurs in the deeper waters. A few firms take their clients on sea trips to the study area. Most of these activities are seasonal, with the majority taking place during the summertime, with a peak in July and August. Cave trips are not common in this area of the Algarve. Sailing and boating are common, but at a lower level, when compared with other areas of the Algarve.
Sub-activity: Sport fishing and SCUBA diving equipment, boat trips, a large variety of shops, restaurants

Name activity: Beach houses on windward Algarve
Description: Most of the coastal area in the windward Algarve is composed by sandy barrier islands, that are the interface between the ocean and the Ria Formosa lagoon. Most of these islands have buildings that are used as second homes (beach houses), especially the islands of Culatra (including Farol and Hangares settlements) and Armona.

Sub-activity: Both sandy barrier islands have connections with the mainland through water pipelines, electricity and communication cables that pass underneath in the shallow waters. Transportation takes place in the inland waters of Ria Formosa (e.g. sea taxi and ferries).

Name activity: Military activities
Description: Surveillance and maritime police patrolling for illegal fishing and other illicit activities. Approximately in the middle of Culatra island there is an area which is property of the Portuguese Navy that is marked and patrolled.

Sub-activity: N.a.

Name activity: Oceanographic studies and monitoring
Description: The University of Algarve, IPIMAR and other research institutions carry out monitoring routines in diverse ecologic and biological aspects. Their focus is mainly related with fish, shellfish and benthic organisms (IPIMAR, University of Algarve), birds, algae (University of Algarve). Similar oceanographic studies, including monitoring, are carried out by the above institutions and a few others (e.g. Water Administration body).

Sub-activity: Sampling and laboratory equipment, electronics

Name activity: Salt production
Description: Salt production is an ancient activity that has recovered in the last decade from a moribund state. Recently there has been an increase in production and a diversification in the products produced (including the recent production of highly valued salt skin). The major problem of this activity is the seasonality of employment as the salt producers usually work from April to October.

Sub-activity: Canning fish and other food products for industry, restaurants, chemicals industry, road maintenance (cold regions and export)

Name activity: Vessel construction and repair
Description: Vessel construction and repair in the study area is reduced and there are only a few firms active. There are some firms that trade a variety of boat equipment, including engines and hulls.

Sub-activity: Fiber glass, metal industry, wood industry, fishing electronics, naval electricity, vessel painting
Name activity: Coastal construction
Description: There is some construction (e.g. quays and jetties, artificial construction of dunes to re-establish them after winter-storm damage).
Sub-activity: Building engineering (plus metal, wood and cement industries).

Conflicts
Conflict: Fisheries based on use of multipurpose gear and pelagic purse seine vs. fish produced in inland aquaculture
Location: Algarve coast
Category: Socio-economic
Reason: There is some discontent due to the perceived competition from fish produced in inland aquaculture. However, consumers reportedly notice the difference between fish of the same species but that have come from the different sources. This will likely affect the prices paid.
Solution: Product certification including labeling the origin of fish

Conflict: Commercial fishery vs. recreational fishery
Location: Algarve coast
Category: Natural resources
Reason: Anglers can sell high valued fish, which can upset the commercial fishermen who view this as dishonest competition.
Solution: More enforcement through black market fish selling or legalize this type of fish sellers.

Conflict: Clams and oysters gatherers vs. dredging activities
Location: Inside Ria Formosa lagoon
Category: Ecology
Reason: Shellfish gatherers claim that the turbidity due to dredging activities causes a loading of suspended solids which can damage shellfish beds
Solution: Some dredging is carried out to facilitate boating and local transportation and should be done if possible away from mollusk beds in order to minimize risks

Conflict: Clams and oysters gatherers vs. cables and pipelines
Location: This conflict is located at sea in areas where cables and pipes exist (offshore of the Armona sandy-barrier island – Olhão and Faro boroughs).
Category: Spatial
Reason: Potential to disturb their sediment beds where mollusks are produced.
Solution: The entities responsible for cables and pipelines should provide some compensation to eventual clam and oyster production loss.
Conflict: Dredgers vs. development of offshore constructions (for use of finfish - e.g. *Sparus aurata, Dicentrarchus labrax* - production in sea cages and mussel - *Mytilus spp.* - long-lines).

Location: Algarve coast

Category: Spatial

Reason: Loss of available sea dredging area since the development of offshore structures. This has already taken place where artificial reefs were constructed.

Solution: A synergistic approach should be developed involving both those who had a 'historical' record use of the former fishable area and those who now occupy offshore structures.

Conflict: Sand extraction activity vs. bottom fishing

Location: Algarve coast

Category: Spatial

Reason: Where sand extraction activity exists, clam dredging and bottom trawling are forbidden.

Solution: Persuade trawlers to operate elsewhere.

Conflict: Cables and pipelines vs. bottom fishing

Location: This conflict is located at sea in areas where cables and pipes exist (offshore of the Armona sandy-barrier island – Olhão and Faro boroughs).

Category: Spatial

Reason: Where there are cables, clam dredging and bottom fishing gear (e.g. bottom trawling and bottom purse seineing) are forbidden. The conflict arises because those practicing bottom fishing claim their fishing area is not only reduced, but there is also always the concern of damaging gear and the sunken structures.

Solution: If possible, persuade trawlers to operate elsewhere.

Conflict: Fish cultivation (e.g. *Sparus aurata, Dicentrarchus labrax, Solea senegalensis, Diplodus sargus, Anguilla anguilla*) vs. shell and sand extraction

Location: Algarve coast

Category: Natural resources

Reason: Extraction impoverishes water quality due to turbidity and solids suspension.

Solution: The companies responsible to sand dredging activities should give some compensation to eventual fish production loss.

Conflict: Tourism vs. dredging activities

Location: Coastal waters

Category: Spatial

Reason: Ordinary tourists using coastal waters for swimming or bathing are disturbed by dredgers operating nearby to them, which can on occasion occur.
Solution: Dredging activities should occur only in the low season (i.e. winter to spring) and/or during the very early morning (i.e. before the opening hours of the beaches).

Conflict: Tourism vs. land based anglers
Location: Coastal waters
Category: Spatial
Reason: Ordinary tourists using coastal waters for swimming or bathing are disturbed by land based anglers nearby to them, which, can on occasion occur. In turn, land-based anglers may claim they have the right to fish there.

Solution: Keep land based angling only in the low season (i.e. mid-autumn, winter to mid-spring), and/or later at night to early morning (i.e. before the opening hours of the beaches), or in areas where there is no swimming or bathing.

Conflict: Tourism, diving operators vs. irregular diving, fishing, or other human activities
Location: Coastal waters
Category: Spatial
Reason: Diving operators that take their clientele for tourist SCUBA diving purposes are concerned when marine features appear to have been destroyed or damaged due to irregular diving, fishing, or other human activities.

Solution: Establishment of MPAs

Synergies
Synergy: Tourism and recreational fishing
Location: Occurs at a small scale in the area, but nearby there is more activity (e.g. boroughs of Tavira, Faro, and Loulé).
Category: Spatial and economic
Reason: Tourism may benefit from sport fishing due to the attraction of of clients, who come, not only for the fishing activity, but also for other services (e.g. lodging, food and beverages, boat rental, etc.). The synergy between tourism and sport fishing is a way of diversifying tourism products and attracting investment for both types of operators.

Continuation: The synergies can be continued if all the activities are ecological and economically sustainable.

Synergy: Ecological and oceanographic research and data obtained from the tuna trap cultivation (joint-venture)
Location: Olhão
Category: Mainly concerned with natural resources (biological)
Reason: Ecological and oceanographic research benefits from data obtained from the tuna trap firm (joint-venture), where they report their
fishing/husbandry activities. The synergy between ecological/oceanographic research and the tuna trap exists in order to maintain the sustainability and accountability of fish resources.

Continuation: The synergies can be continued if all the activities are ecological and economically sustainable.

Synergy: Industrial ice production and several fishing activities
Location: Olhão
Category: Mainly temporal
Reason: Industrial ice production makes ice for several fishing activities to keep recently caught fish species fresh.

Continuation: The synergies can be continued if all the activities are ecologically and economically sustainable.

Synergy: Vessel construction and repair, assisting fishing activities
Location: In the area
Category: Socio-economic
Reason: Vessel construction and repair assist most of the fishing activities in the area.

Continuation: The synergies can be continued if all the activities are ecologically and economically sustainable.

Synergy: Clam cultivation & Clam cultivation (e.g. Ruditapes decussatus, Venerupis decussata, V. pullastra)
Location: Algarve coast
Category: Socio-economic and natural resources
Reason: Synergies among those activities that rely to some degree on mutual cooperation, establishing rules in terms of area cultivated or OP (clam cultivation). Accordingly, all activities show a degree of internal synergy (economies of scale, shared distribution and marketing, shared equipment etc.).

Continuation: Because bivalve producers are able to produce multiple species in order to increase resilience of their economic activity, they are synergistic activities. Move to external certification and the establishment of a hatchery would also further develop these internal activity synergies.

Synergy: Finfish cultivation & Finfish cultivation (e.g. Sparus aurata, Dicentrarchus labrax, Solea senegalensis, Diplodus sargus)
Location: Algarve coast
Category: Socio-economic and natural resources
Reason: Synergies among those activities that have some degree of mutual cooperation, established rules in terms of area cultivated.

Continuation: Cooperation and establishment of a producers organization and hatcheries in order to increase resilience.
Synergy: Mussel cultivation & Mussel cultivation (e.g. *Mytilus sp.*)
Location: Algarve coast
Category: Socio-economic and natural resources
Reason: Potentially, but not evaluated yet.
Continuation: N.a.

Synergy: Oyster cultivation & Oyster cultivation (*Crassostrea gigas, C. angulata*).
Location: Algarve coast
Category: Socio-economic and natural resources
Reason: Synergies among those activities that rely to some degree on mutual cooperation, establishing rules in terms of area cultivated or OP (clam cultivation). Accordingly, all activities show a degree of internal synergy (economies of scale, shared distribution and marketing, shared equipment etc.).
Continuation: Because bivalve producers are able to produce multiple species in order to increase resilience of their economic activity, they are synergistic activities. Move to external certification and the establishment of a hatchery would also further develop these internal activity synergies.

Synergy: Sea bass and sea bream & Sea bass and sea bream (e.g. *Sparus aurata, Dicentrarchus labrax*).
Location: Algarve coast
Category: Socio-economic and natural resources
Reason: Synergies among those activities that have some degree of mutual cooperation, established rules in terms of area cultivated.
Continuation: Cooperation and establishment of a producers organization and hatcheries in order to increase resilience.
Appendix 4 – Adriatic Sea

Fishery activities
Name activity: Fixed gears
Description: In the study area a total of 426 small-scale vessels with an average gross tonnage (GT) of 1.7 tons and an average engine power of 32 kW are reported on the Fisheries Register of the Ministry for Agriculture and Forestry Policies. However direct observations at landing sites showed that only around 50% of these vessels are operating. Small-scale vessels are located in 18 mooring sites (harbours and beaches). They carry out seasonal fishing activity inside 3 nm from the coast. From autumn to early spring the main fishing gear is the basket trap for the gastropod *Nassarius mutabilis*. Traps are positioned at sea at the beginning of the fishing season and checked at 24-48 h intervals to both harvest the catch and change the bait (frozen fish). From late spring to autumn the main gear is the gillnet for the common sole (*Solea solea*), which is fished from dusk to dawn (about 12 h). In spring the most important gear are pots and fyke nets for cuttlefish (*Sepia officinalis*), which are deployed at sea at the end of winter and checked at 24-48 h intervals. Spring is the spawning season for cuttlefish and the coastal area is the main spawning ground.

Sub-activity: Small scale fisheries using set gears are connected to fishing gear servicing and manufacturing industries, fish restaurants, fish markets, shipyards and marine electronics industries.

Name activity: Clam fishery
Description: The main species are baby clams (*Chamelea gallina*). A total of 221 hydraulic dredges with an average GT of 15 and an average engine power of 107 kW operate in the study area. They carry out the fishing activity all year round on sandy bottoms from 3 m to 12 m of depth (0.1 – 2.0 nm from the coast). This fishing activity is regulated through a license and daily quota system.

Sub-activity: This is connected to the clam fishery Management Consortium, shipyards, marine electronics industries, canned clam industries.
Name activity: Mussel fishery
Description: *Mytilus galloprovincialis* grows on the wild banks. In total, approximately 30 small-scale vessels carry out mussel harvesting. This is a traditional local activity carried out on three natural rocky areas close to the coast and at some of the artificial reefs from late spring to late summer. It is regulated year by year through a license system and daily quotas. In addition, a limited fishing season is established in a few Maritime Districts (usually from middle spring to late summer). In this case the fishermen’s activity follows a seasonal trend, with mussel harvesting in spring and summer and set gears used in the autumn and winter. The number of vessel may vary year by year on the basis of mussel abundance. Minimum landing size for *Mytilus galloprovincialis* is 50 mm. They are monitored for the possible presence of dioxins periodically by the local authority, which can close areas for harvesting.

Sub-activity: This activity is connected to fish restaurants, fish markets, shipyards and the marine electronics industries.

Name activity: Trawling
Description: A total of 257 fishing vessels, using otter, rapido and pelagic trawls, with an average GT of 56 and an average engine power of 221 kW operate in the study area. Trawl fishing inside the 3 nm limit is forbidden but occasionally some vessels illegally enter into the coastal area.

Sub-activity: This activity is connected to fish markets, shipyards, marine electronics industries.

### Aquaculture activities

Name activity: Mussel cultivation
Description: A total of 21 mussel (*Mytilus galloprovincialis*) farms on suspended long lines are deployed in the study area.

Sub-activity: Mussel farms on suspended long lines are connected to fish restaurants, fish markets, shipyards, marine electronics industries.

### Other activities

Name activity: Tourism
Description: Tourism is mostly active during summer. Most of coastline is sandy and a number of leisure activities are carried out along the shore of the study area. Beach tourism, Aquatic sports, Recreational diving, Recreational sailing. A total of 11 touristic harbors are located in the study area. Recreational fishery: the recreational fishery consists of rod and line anglers, spearfishers and traps for cuttlefish (*Sepia officinalis*). Rod fishing and spearfishing are carried out mainly in the summer, while trap fishing for cuttlefish is carried out in spring during the spawning season of the target species. The current national legislation on recreational fishing establish a limited number of pots and hooks in
long lines, and quotas for mollusks, crustaceans and fish. Recreational fishing takes place everywhere, overlapping with all the above fishing activities.

Sub-activity: Hotels, restaurants, diving shops and centers, shipyards, marine electronics industries. Fishing gears industries and shops, harbors, shipyards, marine electronics industries.

Name activity: Oil and gas extraction
Description: In the study area a number of off-shore gas platforms and two oil terminals exist. The most of gas platforms are located offshore, but a low number in the southern part of the Marche Region are placed inside the coastal area.

Sub-activity: All these artificial structures are connected to the land with pipelines. Maintenance and assistance activities are also related.

Name activity: Coastal constructions
Description: 11 harbours, many breakwater structures, and dikes
Sub-activity: Maintenance

Name activity: Dredging
Description: Seven areas are located in the study area, where the muds dredged inside the harbours are discharged
Sub-activity: This activity is connected to maritime traffic

Name activity: Marine Protected Areas
Description: In the study area there is the MPA of Piceno and there will be a future MPA in the Conero Promontory
Sub-activity: Monitoring

Name activity: Urban and rural residues
Description: Around 15 rivers flow in the study area and inland rural activities are well developed
Sub-activity: Monitoring for pollution, and algae and bacterial contamination

Conflicts
Conflict: Trawling and clam fishery (Chamelea gallina) vs. fixed gears
Location: Adriatic coast
Category: Spatial and/or resources
Reason: These often interfere with each other, as they often damage the set gears, as well as competing for resources. Trawling exploits the same resources as the small-scale fisheries, whilst hydraulic dredges can destroy the eggs and juveniles of fish and cephalopods which reproduce and/or spend their earlier life stages in the coastal area.
Solution: Construction of medium/large scale artificial reefs to create physical obstacles against illegal trawling; re-distribute resources, creating suitable habitats for reef-dwelling fish such as sea breams (Sparus aurata), sea bass (Dicentrarchus labrax) and corbs (Umbrina cirrosa and Sciaena umbra); improve small-scale fisheries diversifying target species and catches and saving fuel to reach the fishing grounds;
Conflict: Tourism vs. fixed gears  
Location: Adriatic coast  
Category: Spatial and/or resources  
Reason: Often interfere each other  
Solution: National legislation allows fishermen, on releasing of specific licences, to integrate their usual fishing activity with “fishing charters” and/or “pesca-turismo”. Tourists rent the vessel to go for a sea walk, for fish watching or fish with hooks and lines. They normally have a low impact over the resources. Regional authorities support the development of this activity by providing funds. However, due to the lack of an overall integrated coastal management plan, these measures do not in themselves appear sufficient, to solve the existing conflicts.

Conflict: Tourism vs. mussel (*Mytilus galloprovincialis*) fishery  
Location: Adriatic coast  
Category: Natural resources  
Reason: Professional harvesting of mussel on wild banks  
Solution: Implementation of control on recreational harvesting

Conflict: Mussel cultivation (*Mytilus galloprovincialis*) vs. fishing activities  
Location: Adriatic coast  
Category: Natural resources  
Reason: Especially set gears and hydraulic dredges. Mainly related to the reduction of space availability for the latter, whose fishing grounds are going to become progressively more restricted due to the further development of mussel culture. Moreover, the remaining inshore coastal area is often made unsuitable for set nets by the release of lost material from the culture systems (e.g. rafts, broken buoys, etc.). In addition, suspended mussel cultures act as fishing aggregating devices (FADs) attracting many finfish species, especially sea breams (mainly *Sparus aurata*) and corbs (*Umbrina cirrosa* and *Sciaena umbra*) which may not be exploited by gill netters who are not allowed to fishing close to the culture systems. Conversely, in recent years the increasing population of gilthead sea bream is causing heavy damage to mussel cultures, as they feed on mussel seed. Hence, a regulated removal by gill netters could be advantageous for both small-scale fisheries and aquaculture.

Solution: To date, the Marche regional authority, with the support of CNR ISMAR, has been the only authority, along the Italian Adriatic coast, to establish “aquaculture zones”, to avoid the mussel farms spreading out along the coast and, to instead, concentrate them in specific areas.
Conflict: Mussel cultivation vs. mussel fishery (*Mytilus galloprovincialis*)
Location: Adriatic coast
Category: Socio-economic
Reason: Economic interference (competition) exists as the latter product is of higher quality and hence more valuable
Solution: Create new extensive mussel cultures to sustain harvesting of mussels on wild banks

Conflict: Local vs. national authorities
Location: Adriatic coast
Category: Socio-economic
Reason: There are some conflicts over who is responsible for governance of some activities between the local and national authorities.
Solution: Integrated management of the coastal area

Conflict: Fixed gears & mussel cultivation (*Mytilus galloprovincialis*) vs. tourism
Location: Adriatic coast
Category: Spatial
Reason: Set gear and long lines buoys can obstruct the sailing routes
Solution: Integrated management of the coastal area

Conflict: Shipping and transport vs. fisheries activities
Location: Adriatic coast
Category: Spatial
Reason: The wide channels dedicated to transit of vessels are forbidden to all fishing activities.
Solution: Integrated management of the coastal area

Conflict: Oil and gas extraction vs. fishing activities
Location: Adriatic coast
Category: Spatial
Reason: Artificial structures devoted to gas and oil exploitation reduce space available for fishing activities.
Solution: Integrated management of the coastal area

Conflict: Cables and pipelines vs. Clam fishery (*Chamelea gallina*), Fixed gears, Pelagic Trawling, Otter trawling, Rapido trawling
Location: Inside and outside the 3 nm limit from the coast
Category: Spatial
Reason: Reduction of available space for these fishing activities
Solution: To bury pipelines and cables into the seabed
| Conflict | Coastal constructions vs. Clam fishery (*Chamelea gallina*) and Fixed gears |
| Location | inside the coastal area |
| Category | Spatial |
| Reason | Coastal constructions reduce the space availability for these coastal fishing activities |
| Solution | A rational spatial management plan |

| Conflict | Tourism vs. all fishing and aquaculture activities |
| Location | Inside and outside the 3 nm limit from the coast |
| Category | Space |
| Reason | Sailing and recreational fishery compete for space with all professional fisheries and aquaculture activities |
| Solution | Spatial management plan |

| Conflict | Dredging vs. Pelagic trawling, Otter trawling and Rapido trawling |
| Location | Outside the 3 nm limit from the coast |
| Category | Space |
| Reason | Reduction of suitable areas for fisheries |
| Solution | Areas of discharge must be located taking into account the spatial distribution of fishing activities |

| Conflict | Marine Protected Areas vs. Clam fishery (*Chamelea gallina*) and Mussel cultivation (*Mytilus galloprovincialis*) |
| Location | Inside the coastal area |
| Category | Space |
| Reason | Clam fishery and Mussel cultivation are forbidden inside the MPA area |
| Solution | Regulation of fisheries inside MPAs and/or reconversion of fishing activities in control activities inside the MPA |

| Conflict | Shipping and transport vs. clam fishery (*Chamelea gallina*), fixed gears, otter trawling, rapide trawling and pelagic trawling |
| Location | Inside and outside the coastal area |
| Category | Space |
| Reason | Limitation of space for fishing activities |
| Solution | Spatial management plan |

| Conflict | Marine Protected Areas vs. Fixed gears and Mussel fishery (*Mytilus galloprovincialis*) |
| Location | Inside the coastal area |
| Category | Space |
| Reason | Small reduction of space for these activities |
| Solution | Regulation of fisheries inside MPAs and/or reconversion of fishing activities in control activities inside the MPA |

| Conflict | Urban and rural residues and all fishing and aquaculture activities |
Location: Inside the coastal area  
Category: Ecological  
Reason: Pollution may negatively affect production  
Solution: More controls to inland Industries

Conflict: Oil and gas extraction vs. pelagic trawling, otter trawling and rapido trawling  
Location: outside the coastal area  
Category: Space  
Reason: Reduction of space for these activities  
Solution: Mitigation measures

Synergies:
Synergy: Tourism, fishery activities and mussel cultivation (*Mytilus galloprovincialis*)  
Location: Adriatic coast  
Category: Natural resources  
Reason: The area occupied by the farms provide shelter, additional food and protection from fishing for many fish species. Spillover from mussel culture to the fishing grounds can contribute to the enhancement of many heavily exploited fish stock. In addition, mussel culture grounds located to the 3 nm limit act as barriers for illegal trawling inside the coastal area and, hence, protect the set gears used by the small-scale fisheries.

Continuation: N.a.

Synergy: Oil and gas extraction, cables and pipelines, and mussel cultivation (*Mytilus galloprovincialis*)  
Location: Adriatic coast  
Category: Natural resources  
Reason: Gas platforms, oil terminals and pipelines may have a positive effect on marine resources similarly to mussel cultures.

Continuation: N.a.

Synergy: Tourism and fishing activities  
Location: Adriatic coast  
Category: Natural resources  
Reason: It induces an increased income for all the coastal fishing activities and aquaculture. Moreover, it may contribute to somewhat extent to reduce/solve problems connected with some coastal fisheries offering alternative/integrative opportunities related to recreational fishing (e.g. “pesca-turismo”).

Continuation: N.a.

Synergy: Marine Protected Areas vs. Fixed gears  
Location: Inside the coastal area  
Category: Space  
Reason: Reduction of spatial conflict between Fixed gears and clam fishery.
Synergy | Marine Protected Areas vs. Mussel fishery (*Mytilus galloprovincialis*)
---|---
Location | Inside the coastal area
Category | Ecology and socio-economic
Reason | The sediment re-suspended by the clam fishery covers the natural hard substrates, making them unsuitable for the settlement of mussel larvae. Banning of clam fishery inside the MPA reduces this conflict.
Continuation | N.a.

Synergy | Urban and rural residues and all fishing and aquaculture activities
---|---
Location | Inside the coastal area
Category | Ecological
Reason | Eutrophication may enhance production
Continuation | N.a.

Synergy | Oil and gas extraction vs. pelagic trawling, otter trawling and rapido trawling
---|---
Location | outside the coastal area
Category | Resources
Reason | Offshore platforms act as artificial reefs and contribute to stock recovering
Continuation | N.a.

Synergy | Oil and gas extraction vs. mussel fishery (*Mytilus galloprovincialis*)
---|---
Location | outside the coastal area
Category | Socio-economy
Reason | Mussels settled on the submerged part of the platform can be harvested by authorized fishermen
Continuation | N.a.

Synergy | Tourism vs. all fishing and aquaculture activities
---|---
Location | Inside the 3 nm limit from the coast
Category | Socio-economic
Reason | Tourism profits by availability of fresh products from fisheries and aquaculture
Continuation | N.a.
Appendix 5 – Coastal North Sea

Fishery activities
Name activity: Pelagic trawling
Description: This type of fishery involves fishing in the water column. A cone-shaped net is towed behind a single boat and spread by trawl doors. The net can be also towed behind two boats (FAO 2011; Gabriel et al. 2005). In Denmark, according to the RCM Report (2010), pelagic trawling targets sprat (*Sprattus sprattus*), sandeel (*Ammodytes marinus*), herring (*Clupea harengus*) and mackerel (*Scomber scombrus*). Furthermore, trawl and purse seine fisheries target small pelagics (primarily herring and mackerel) for human consumption.
Sub-activity: N.a.

Name activity: Beam trawling
Description: Same methods as described above, but with trawling conducted along the sea floor. Different classes of beam trawls operate in the area and target different species of fish and shellfish. A distinction of vessels ≤ 300 hp (221kW) and >300 hp is used, as fishing restrictions for the larger vessels exist, particularly in the “Plaice Box” (Beare et al. 2010). Métiers investigated in COEXIST: Beam trawls ≤ 300 hp, mesh >80 mm (mixed flatfish fisheries), Beam trawls > 300 hp, mesh >80 mm (mixed flatfish fisheries). Additional differentiation can be done where the information is available, regarding e.g. the lengths or weight of beams applied or the use of tickler chains.
Sub-activity: N.a.

Name activity: Shrimp trawling
Description: This form of trawling uses mesh sizes of 16-31 mm and < 300 hp. Shrimp fisheries (*Crangon crangon*) operate mainly in the Wadden Sea and are concentrated in the waters up to 20 nautical miles from the shore. The Dutch, German and Danish fleets show different distribution patterns and total effort (Beare et al. 2010).
Sub-activity: N.a.

Name activity: Otter trawling (twin, multi, outrig, flyshoot)
Description: This type of fishery involves fishing very close to the sea floor. Otter boards in front of the nets keep the net open. The boards scrape over the sediment. Otterboard trawling mainly targets the following species: cod (*Gadus morhua*), whiting (*Merlangius merlangus*), herring (*Clupea harengus*), sole (*Solea solea*), mackerel (*Scomber scombrus*), plaice (*Pleuronectes platessa*) (Productschap Vis 2010). With the flyshoot the main target species are hake (*Merluccius merluccius*), cod, plaice and sole. The Danish seine focuses primarily on plaice and cod.
Sub-activity: N.a.
Name activity: Long line fishery
Description: This type of fishery only occurs in the Danish waters. The target species are gadoids. Two to three vessels operate in this sector during autumn to spring.
Sub-activity: N.a.
Name activity: Gill net fishery
Description: This is a fixed form of fishery. Rectangular nets are vertically anchored to the sea floor, with buoys floating above the nets (FAO, 2011; Jongbloed et. al. 2010 in prep). Gillnet fishing in the case study area is mainly undertaken by the Netherlands and Denmark. Only relatively few German vessels (< 10 total) use gill nets, mainly fishing for sole. Fisheries applying gillnets with floats operate in the Dutch coastal area with nets up to 1500m in length. Gill- and trammel net fisheries are also conducted by Danish vessels, focusing on cod (Gadus morrhua), plaice (Pleuronectes platessa), sole (Solea solea) and hake (Merluccius merluccius). There are 75-100 vessels operating year round (RCM Report 2010).
Sub-activity: Fishery boats function here as transportation devices, not as part of the fishing technique.
Name activity: Fishery with fixed gears
Description: Single or multiple funnel shaped nets are connected to wooden poles in the sea floor. Small baskets, boxes and conical nets with inside funnels (here called pots) may be employed. These are connected to each other or individually attached to a small buoy floating at the surface. Species in the Netherlands include eel (Anguilla Anguilla) and crab (Cancer pagurus) (Jongbloed et. al. 2010 in prep). In Germany there are only a few vessels involved in pot fisheries for crab, that only occurs in specific years. In Denmark the target species is also crab (Cancer pagurus). Only one vessel is active during May-December.
Sub-activity: Fishery boats function here as transportation devices, not as part of the fishing technique.
Name activity: Cockle fishery (hand) (Cerastoderma edule)
Description: This activity only occurs in Dutch waters. An iron rake with a net attached is pulled manually, and in a backwards movement over the sea floor. This happens in shallow waters (Jongbloed et. al. 2010 in prep).
Sub-activity: N.a.
Name activity: Cockle fishery (dredge) (Cerastoderma edule)
Description: This activity only occurs in Dutch waters. An iron sledge with a knife is pulled over the seabed. The sledge is connected to a flexible tube.
A nozzle on the sledge removes the sand between the cockles. The cockles are brought onboard with a form of vacuum cleaner (Ecomare 2010b).

Sub-activity: N.a.

Name activity: Ensis (Ensis directus) fishery
Description: This activity only occurs in Dutch waters. See mechanical cockle fishery. However, there is a difference in the depth. Ensis is located deeper in the sea floor at app. 30 cm (Wijsman et al. 2006). The area covered by this fishery is very small compared to the Cockle fishery.

Sub-activity: N.a.

Name activity: Oyster fishery (hand)
Description: Japanese oysters (Crassostrea gigas) are manually gathered in the Wadden Sea at low tide (Waddengoud 2010). In Germany and Denmark there are only a few individual collectors.

Sub-activity: Often occurs in combination with hand catch cockles

Name activity: Mussel seed fishery
Description: Mussel seed (Mytilus edulis) is collected from the seabed with drag nets pulled by a trawler. The net is connected to a frame of 1.9 meters. A trawler can pull up to four frames (Ecomare 2010c). In Germany, this activity also exists. In some cases, there are synergies with shrimp fisheries, as fishers offer information on seed mussel occurrence. Seed fishery does not exist in Danish waters. Only market size mussels can be fished here.

Sub-activity: This activity is connected to bottom culture mussels (see aquaculture activities)

Aquaculture activities
Name activity: Mussel cultivation: bottom culture mussels
Description: Mussel seed is placed on shallow parcels. When the mussels (Mytilus edulis) are 4-5 cm they are relayed to deeper waters. After approximately 2 – 2½ years the mussels are ready for harvest. In the Netherlands, this activity occurs in the Wadden Sea and the Delta region (Ecomare 2010d). In German waters, bottom cultures exist in Schleswig Holstein and in the Wadden Sea of Lower Saxony. This activity does not occur in Danish waters.

Sub-activity: This activity is connected to mussel seed fishery (see fishery activities)

Name activity: Mussel cultivation: rope culture mussels
Description: Mussel seed (Mytilus edulis) is placed in cotton socks that perish after approximately four weeks. The socks are connected to vertical ropes (Aquacultuur 2006). This activity does not occur in German and Danish waters.

Sub-activity: N.a.

Name activity: Mussel Seed Collector
Description: Alternative for mussel seed fishery. Mussel (Mytilus edulis) larvae are collected during spring on fixed vertical nets or ropes of various proportions. During summer the mussel seed is collected and brought to the parcels (Ecomare 2010e; Scholten et al 2007). This activity occurs in the Dutch Wadden Sea, the Delta region, and also in German waters. It does not take place in Danish waters.

Sub-activity: This activity is connected to bottom culture mussels (see aquaculture activities)

Name activity: Oyster cultivation
Description: First the oyster larvae are collected in fixed parcels with the help of empty mussel shells or purchased from breeders. During grow out, the oysters will be replaced approximately 2 times a year. This is done using iron framed nets. The technique is similar to the mussel seed fishery. Crassostrea gigas takes 3 years for cultivation, Ostrea edulis takes 5 to 6 years (Nederlandse Oestervereniging 2010). In German waters, oyster cultivation occurs on a small scale. Only one company is operating cultures near the island of Sylt. Oysters (Crassostrea gigas) are cultivated in sacks, which are turned and moved several times to prevent aggregation. During the winter oysters are moved indoors. This activity does not take place in Danish waters.

Sub-activity: The technique is similar to the mussel seed fishery.

Other activities
Name activity: Wind parks
Description: In 2010 there were two wind farms operational in the Dutch North Sea. The first park has 36 turbines with a capacity of three megawatts each. The second park has 60 turbines with a capacity of two megawatts each. In 2010 twelve more concessions were granted with a total capacity of 3,250 megawatt (Noordzeeloket 2010a; VROM 2008:8). Germany is also seeking to install offshore wind farms, with a total planned capacity of 25,000 MW (Marine Spatial Plan, BMVBS 2009). The first German offshore wind park is in operation, several are under construction, and many applications for parks are currently under review. In general, in Germany wind farms are only planned for offshore areas, whereas in Danish and Dutch waters, wind farms are built or planned to be closer to shore. In the Danish part of the North Sea, two wind farms are at present in operation. These are Horns Rev 1 – built in 2002 (160 MW), and Horn Rev 2, built in 2009 (209 MW). They are located within two zones, approximately (10 km) and about 20-30 km off the coast. New wind farms are currently under review and 14 potential sites in the North Sea have been proposed (Energistyrelsen 2007).

Sub-activity: This activity relates to offshore constructions and shipping.
Name activity: Shipping and transport
Description: Shipping in Dutch waters consists of cargo ships, tankers and container ships. In coastal zones, ships are obligated to navigate in buoyed water ways. Rotterdam is visited each year by approximately 33,000 ships (Jongbloed et. al. 2010 in prep). In German waters, shipping is considered a primary activity around which the current marine spatial plan is centered (BMVBS 2009). In Denmark the most important harbor for fishing is Thyborøn, while the most important harbor for cargo and other ship traffic is Esbjerg. Esbjerg is visited each year by 18,000 ships (Esbjerg Harbor 2011).
Sub-activity: This activity relates to offshore activities such as oil and gas extraction, wind parks and mussel seed collectors.

Name activity: Oil and gas extraction
Description: In the Dutch EEZ, approximately 130 oil and gas locations are in use. Only 10 of them are for oil exploitation, the other 120 locations are for gas. In 2009 1.3 million m$^3$ oil and 23,000 million m$^3$ gas was produced (Waddenzee 2010; Noordzeeloket 2010b). In the Danish EEZ the total oil and gas production in 2009 was respectively 15 million m$^3$ oil and 70 million m$^3$ gas (Energistyrelsen 2010).
Sub-activity: This activity relates to shipping and cables and pipelines.

Name activity: Dredging (extraction / disposal)
Description: Dredging takes place to keep water ways of sufficient depth to be navigable. On average 30 million m$^3$ sediment is extracted and disposed of in Dutch waters. Approximately 6% of the dredged material is polluted to such an extent that it is has to be brought to a special depots. The rest can be disposed in specific places in the marine environment (Noordzeeloket 2010c; Havenbedrijf Rotterdam 2010a; Vereniging van Waterbouwers 2010). In German waters dredging occurs in estuaries of large rivers for maintenance of shipping channels. The disposal occurs elsewhere (www.bsh.de; reference for disposal sites of dredged material). In all three countries aggregates (sand, gravel, clay) are extracted from the marine environment. In Danish waters sand, gravel, pebbles and stones are extracted from the marine environment. A total of 740,000 m$^3$ was removed in 2009 (By-og Landskabsstyrelsen 2010)
Sub-activity: This activity relates to coastal constructions

Name activity: Cables and pipelines
Description: There are many cables and pipelines in the Dutch, German and Danish EEZ. Pipelines are mainly used for gas, oil, hydrocarbons and condensate. Cables are mainly used for electricity and telecommunication (Windspeed 2010).
Sub-activity: This activity is connected with oil and gas extraction.

Name activity: Military activities
The military uses a number of areas for ammunition, exercises and air force. In the Netherlands two areas are used for ammunition, five areas for exercises and three areas for the air force (Lindeboom et al 2008). In Denmark two areas in connection to Oksbøl Military facility are used for exercises.

Sub-activity: N.a.

Name activity: Tourism & recreation
Description: This consists of many activities. Examples are kite surfing, sport diving, wave surfing, wind surfing, sailing, yachting, seal cruises, fishing. Most of them only occur in the coastal zones.
In all three countries tourism along the coast is expected to be influenced by fishing and aquaculture activities, at least in some harbour towns.

Sub-activity: This activity is related to some types of commercial fisheries.

Name activity: Marine Protected Areas
Description: Dutch Natura 2000 areas are the most relevant MPA’s. These areas include the Wadden Sea, North Sea Coastal Zone, Delta Area, Vlakte van de Raan, Dogger Bank, Clover bank and Frisian Front. Natura 2000 areas will contain closed areas from 2012 onwards. They will also contain specific areas for sustainable fisheries and research. Some non-sustainable fisheries might be banned (Van der Wal 2010). In Germany the marine Natura 2000 sites are not defined yet. The Dutch and German Wadden Sea is World Nature Heritage. In Denmark there are 10 Natura 2000 sites within the EEZ. Most of them are coastal area.

Sub-activity: N.a.

Name activity: Coastal constructions
Description: Groynes, dikes and constructions regulating flow are constructed in order to protect the mainland. These occupy space and change the environment by influencing erosion and sedimentation. The most important new coastal construction in the Netherlands is the expansion of the Rotterdam harbor. Approximately 240 million m³ sand is used to reclaim 1,000 hectares of new land from the North Sea (Noordzeeloket 2010c; Havenbedrijf Rotterdam 2010a; Vereniging van Waterbouwers 2010).

Sub-activity: This activity relates to dredging.
Conflicts
Conflict: Aquaculture vs. fisheries
Location: Dutch Wadden Sea, Delta region
Category: Spatial, temporal
Reason: All four aquaculture activities (bottom culture mussels, rope culture mussels, mussel seed collectors (Mytilus edulis) and oyster cultivation (Crassostrea gigas, Ostrea edulis) require space. In contrast to fisheries the space is confined and clearly defined (buoys, stakes, constructions or lines on maps and charts). Most conflicts are related to spatial aspects. Rarely, secondary aspects are also important (carrying capacity, natural resources etc.). Therefore, the main (potential) conflicts are with the trawling fisheries occurring in the same area, including the demersal fish and shrimp (Crangon crangon) fisheries.
Solution: Agreements between NGOs, fisheries, government on utilization & zones.

Conflict: Cockle fishery (Cerastoderma edule) (dredge) and Ensis (Ensis directus) fishery vs. aquaculture activities
Location: Dutch Wadden Sea, Delta region
Category: Spatial, temporal
Reason: The reason for this conflict is because of competition for space, although these activities mainly occur in seasons when the suspended cultures are removed from the water (in areas with strong winter storms and floating ice).
Solution: Agreements between NGOs, fisheries, government on utilization & zones.

Conflict: Fisheries vs. MPAs
Location: Dutch, German and Danish EEZ
Category: Spatial, temporal
Reason: All types of fisheries may conflict with MPAs, depending on the specific ecological conservation objectives of the MPA and the type of impact of the fishery activities.
Solution: Agreements between NGOs, fisheries, government on utilization & zones.

Conflict: Fisheries vs. wind parks and offshore oil and gas extractions
Location: Dutch, German and Danish EEZ
Category: Spatial
Reason: Trawling activities (pelagic, beam, otter and shrimp trawling) are not allowed in the safety zone around wind parks, and those around offshore oil and gas installations.
Solution: N.a.

Conflict: Beam trawling with tickler vs. cables
Location: Dutch, German and Danish EEZ
Category: Spatial
Reason: Beam trawling with tickler chains which penetrate the sediment may cause damage to cables.
Solution: Make sure that cables are located deep enough in the seabed

Conflict: Crab fisheries vs. oil and gas activities
Location: EEZ, Wadden Sea, Delta region
Category: Spatial
Reason: Crab (Cancer pagurus) fisheries are not allowed in the safety zones around oil and gas extraction sites.
Solution: Regulations

Conflict: Crab fisheries vs. MPAs.
Location: EEZ, Wadden Sea, Delta region
Category: Spatial
Reason: Crab (Cancer pagurus) fisheries may be in conflict with the ecological protection aims of MPAs.
Solution: Regulations

Conflict: Mussel seed fisheries vs wind farms and near Oil and Gas extractions
Location: EEZ, Wadden Sea, Delta region
Category: Spatial
Reason: Mussel seed (Mytilus edulis) fisheries are not allowed in the safety zones around oil and gas extraction sites.
Solution: Research economic feasibility & technical possibilities

Conflict: Mussel seed fisheries vs dredging activities
Location: Dutch Wadden Sea, Delta region
Category: Spatial
Reason: Mussel seed (Mytilus edulis) may not be present where dredging activities occur regularly, e.g. in shipping lanes and disposal sites.
Solution: Regulation

Conflict: Off bottom aquaculture vs. shipping
Location: Wadden Sea, Delta region
Category: Spatial
Reason: Since these may damage the nets, or aquaculture is abandoned from shipping lanes.
Solution: Regulation

Synergies
Synergy: Tourism and recreation and shrimp fishery
Location: Along the coastal zones of the Netherlands
Category: Spatial, socio-economic
Reason: Tourism and recreation involves many different activities and there are no real conflicts with fisheries and aquaculture. In the case of shrimping (Crangon crangon) there may be synergy because tourists like the picturesque vessels and pay good prices for the local
product which is of benefit for the small scale fisheries. In areas with rope culture and seed collectors there are also trips with tourists.

Continuation: Invest in PR of local products & markets, experiencing products.

Synergy: Bottom culture mussels and mussel seed fishery
Location: Wadden Sea, Delta region
Category: Spatial, socio-economic
Reason: Older and mature mussels (*Mytilus edulis*) produce larvae during spring which are crucial for mussel seed fishery.

Continuation: Encourage structural cooperation between mussel fisheries and gill net fisheries, e.g. by knowledge circles (kenniskringen).

Synergy: Oyster cultivation and Mussel seed fishery
Location: Delta region
Category: Spatial, socio-economic
Reason: Oyster cultivation (*Crassostrea gigas, Ostrea edulis*) and mussel seed (*Mytilus edulis*) fishery is carried out with the same techniques, therefore they can strengthen each other in relation to efficiency.

Continuation: Encourage structural cooperation between mussel fisheries and gill net fisheries, e.g. by knowledge circles (kenniskringen).
## Appendix 6 – Baltic Sea

### Fishery activities

<table>
<thead>
<tr>
<th>Name activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed gear fishery: Gill nets &amp; trap net fisheries</td>
<td>Small scale coastal fishery targeting valuable fish for direct consumption and trying to avoid less valuable fish species, partly artisanal and very traditional, partly professional and commercial.</td>
</tr>
<tr>
<td>Sub-activity:</td>
<td>Processing, e.g., smoking, and small scale marketing and selling of the products.</td>
</tr>
</tbody>
</table>

### Aquaculture activities

<table>
<thead>
<tr>
<th>Name activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainbow ((\text{Oncorhynchus mykiss})) trout cultivation</td>
<td>Occurs in cages made from nets. Small scale compared, e.g., to Norway.</td>
</tr>
<tr>
<td>Sub-activity:</td>
<td>Processing. Gutting, filleting, smoking, packing and transport etc. Processing waste goes to fur animal farming feeds or, e.g., diesel oil manufacturing</td>
</tr>
<tr>
<td>Whitefish ((\text{Coregonus lavaretus})) cultivation</td>
<td>Occurs in cages made from nets. Small scale compared, e.g., to Norway.</td>
</tr>
<tr>
<td>Sub-activity:</td>
<td>Processing. Gutting, filleting, smoking, packing and transport etc. Processing waste goes to fur animal farming feeds or, e.g., diesel oil manufacturing</td>
</tr>
</tbody>
</table>

### Other activities

<table>
<thead>
<tr>
<th>Name activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishing tourism</td>
<td>Organized fishing excursions with evolved services and often with an experienced guide.</td>
</tr>
<tr>
<td>Sub-activity:</td>
<td>Accommodation, restaurants etc.</td>
</tr>
<tr>
<td>Recreational fishing</td>
<td>Very popular leisure activity. Varied fishing gear, from rod methods to gill nets, and reasons (motivations) behind activity.</td>
</tr>
<tr>
<td>Sub-activity:</td>
<td>Mostly combined to other activities like boating and summer house dwelling.</td>
</tr>
<tr>
<td>Cables and pipelines</td>
<td>Construction, laying down</td>
</tr>
<tr>
<td>Sub-activity</td>
<td>N.a.</td>
</tr>
<tr>
<td>Military activities</td>
<td>Live firing exercise areas</td>
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<tr>
<td>Sub-activity</td>
<td>N.a.</td>
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<tr>
<td>Conflicts</td>
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<td>-----------</td>
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</tr>
</tbody>
</table>
| **Conflict:** Nutrient dumping vs. commercial and recreational fishing.  
**Location:** The Archipelago Sea  
**Category:** Governance, ecological  
**Reason:** Eutrophication, use of the sea as a place to ‘dump;’ nutrients causes problems for commercial and recreational fishing.  
**Solution:** Make the protection of the Baltic Sea water more efficient (from effects of agriculture, big Russian cities etc.) |

| **Conflict:** Conservation areas vs. fish cultivation or fishing tourism.  
**Location:** The Archipelago Sea  
**Category:** Spatial, political  
**Reason:** Conflict of values. The rules, in some cases, prohibit these activities.  
**Solution:** Negotiations, participatory spatial planning |

| **Conflict:** Conservation of seal and cormorant populations vs. commercial fishing.  
**Location:** The Archipelago Sea  
**Category:** Spatial, political  
**Reason:** Conflict of values. The rules, in some cases, prohibit these activities.  
**Solution:** Negotiations, participatory spatial planning |

| **Conflict:** Recreational fishers and boaters vs. commercial gill net fishing and summer house dwelling.  
**Location:** The Archipelago Sea  
**Category:** Social  
**Reason:** Recreational fishers and boaters have occasionally caused problems to commercial gill net fishing and disturbed summer house dwelling. Lack of knowledge or appreciation of the local codes of conduct.  
**Solution:** Information. Public discussions concerning recreational fishers’ respectful behavior. |

| **Conflict:** Use of the sea bottom material and or area as raw material, dispose or construction vs. fishing or recreational use.  
**Location:** The Archipelago Sea  
**Category:** Spatial, natural resources  
**Reason:** Spatial competition  
**Solution:** By prudent planning |

| **Conflict:** Cables and pipelines and commercial fishermen  
**Location:** The Archipelago Sea  
**Category:** Spatial  
**Reason:** Commercial fishermen against in many cases  
**Solution:** Better access to fishing grounds |
Conflict: Military activities and commercial and household fishermen
Location: the Archipelago Sea
Category: Spatial
Reason: Commercial and household fishermen may resent the limitations imposed
Solution: Patience as not a major problem. The activity is undertaken in very narrow periods

Synergies
Synergy: Local residents support commercial fishing and fish cultivation.
Location: The Archipelago Sea
Category: Social
Reason: Strong cultural importance of fish-based livelihoods.
Continuation: By not endangering the vitality of the archipelago and its fish-based livelihoods.

Synergy: Commercial and recreational fishing benefits from the infrastructure in the archipelago.
Location: The Archipelago Sea
Category: Socio-political, economic
Reason: The society has invested in enhancing e.g. good connections between the islands, which is beneficial to both commercial and recreational fishing.
Continuation: By further development of access to fishing sites.

Synergy: Recreational dwellers, i.e. summer house owners, and tourists buy fish products of commercial fishers and fish farmers.
Location: The Archipelago Sea
Category: Economic
Reason: Fresh fish meals are appreciated as an important element of visiting archipelagos.
Continuation: By enhancing options for local marketing and developing new products.

Synergy: Recreational fishers catch valuable fish produced in fish farms.
Location: The Archipelago Sea
Category: Natural resources, social
Reason: Fish stocking culture in Finland. Fingerlings are produced by aquaculture.
Continuation: By continuing the activity.
### Appendix 7 – Overview of matrices

#### 1. Hardangerfjord

<table>
<thead>
<tr>
<th>Other activities</th>
<th>Fisheries &amp; aquaculture</th>
</tr>
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<tbody>
<tr>
<td>Cables and pipelines</td>
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<td>Hydroelectric power</td>
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<td>Marine Protected Areas</td>
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<td>Military activities</td>
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<tr>
<td>Oil and gas extraction</td>
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<td>Shipping and transport</td>
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<td>Tourism</td>
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<table>
<thead>
<tr>
<th>Fishery</th>
<th>Cod fishery</th>
<th>Miscellaneous fisheries</th>
<th>Oyster cultivation</th>
<th>Saithe fishery</th>
<th>Salmon fishery in rivers</th>
<th>Salmon fishery on sea</th>
<th>Cod cultivation</th>
<th>Cod hatcheries</th>
<th>Mussel cultivation</th>
<th>Salmon cultivation</th>
<th>Salmon hatcheries</th>
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2a. Atlantic Coast of Ireland

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2b. Atlantic Coast of France

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#### Other activities

- Cables and pipelines
- Coastal constructions
- Dredging
- Marine Protected Areas
- Military activities
- Salt production
- Shipping and transport
- Tourism
- Urban and rural residues

### 4. Adriatic Sea

#### Fisheries & Aquaculture

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#### Other activities

- Cables and pipelines
- Coastal constructions
- Dredging
- Marine Protected Areas
- Oil and gas extraction
- Shipping and transport
- Tourism
- Urban and rural residues
5. Coastal North Sea

Netherlands

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## Germany

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6. Baltic Sea

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### Activities in coastal zones

#### Present

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<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>T1.2, D1.2, D1.3</td>
<td>Which activities occur in your study area?</td>
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<tr>
<td>2</td>
<td>T1.2, D1.2, D1.3</td>
<td>Describe each activity</td>
</tr>
<tr>
<td>3</td>
<td>T1.2, D1.2, D1.3</td>
<td>What other sub-activities are connected to each activity? (e.g. shipping as part of harvest &amp; maintenance of cage culture)</td>
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#### Past

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<td>T1.2, D1.2, D1.3</td>
<td>Which activities do not exist anymore?</td>
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<td>2</td>
<td>T1.2, D1.2, D1.3</td>
<td>Why do these activities not exist anymore?</td>
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#### Future

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<td>T1.2, T1.3, D1.2, D1.3</td>
<td>What are the future plans for existing fishery and aquaculture activities?</td>
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<tr>
<td>2</td>
<td>T1.2, T1.3, D1.2, D1.3</td>
<td>Which new fishery and aquaculture activities might be started in the future?</td>
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<td>T1.2, T1.3, D1.2, D1.3</td>
<td>What is needed to start these fishery and aquaculture activities?</td>
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### Conflicts in coastal zones

#### Present

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<td>Which conflicts between activities occur today?</td>
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<td>What is the location of the conflict?</td>
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<td>T1.2, D1.2, D1.3</td>
<td>How would you categorize the conflict? (spatial, temporal, ecology, natural resources, socio-economic....)</td>
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<tr>
<td>4</td>
<td>T1.2, D1.2, D1.3</td>
<td>What is the reason of the conflict?</td>
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<td>T1.2, D1.2, D1.3</td>
<td>How can the conflict be solved?</td>
</tr>
</tbody>
</table>

#### Past

<table>
<thead>
<tr>
<th>#</th>
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<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>T1.2, D1.2, D1.3</td>
<td>Which conflicts between activities occurred in the past?</td>
</tr>
<tr>
<td>2</td>
<td>T1.2, D1.2, D1.3</td>
<td>What was the location of the conflict?</td>
</tr>
<tr>
<td>3</td>
<td>T1.2, D1.2, D1.3</td>
<td>How would you categorize the conflict? (spatial, temporal, ecology, natural resources, socio-economic....)</td>
</tr>
<tr>
<td>4</td>
<td>T1.2, D1.2, D1.3</td>
<td>What was the reason of the conflict?</td>
</tr>
</tbody>
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### Future

<table>
<thead>
<tr>
<th>#</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>T1.2, D1.2, D1.3</td>
<td>Which conflicts between activities might occur in the future?</td>
</tr>
<tr>
<td>2</td>
<td>T1.2, D1.2, D1.3</td>
<td>What would be the location of the conflict?</td>
</tr>
<tr>
<td>3</td>
<td>T1.2, D1.2, D1.3</td>
<td>How would you categorize these conflicts? (spatial, temporal, ecology, natural resources, socio-economic....)</td>
</tr>
<tr>
<td>4</td>
<td>T1.2, D1.2, D1.3</td>
<td>What would be the reason of the conflict?</td>
</tr>
<tr>
<td>5</td>
<td>T1.2, D1.2, D1.3</td>
<td>How could the conflict be solved?</td>
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### Synergies in coastal zones

#### Present

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<tbody>
<tr>
<td>1</td>
<td>T1.2, D1.2, D1.3</td>
<td>Which synergies between activities occur today?</td>
</tr>
<tr>
<td>2</td>
<td>T1.2, D1.2, D1.3</td>
<td>What is the location of the synergy?</td>
</tr>
<tr>
<td>3</td>
<td>T1.2, D1.2, D1.3</td>
<td>How would you categorize the synergy? (spatial, temporal, ecology, natural resources, socio-economic....)</td>
</tr>
<tr>
<td>4</td>
<td>T1.2, D1.2, D1.3</td>
<td>What is the reason of the synergy?</td>
</tr>
<tr>
<td>5</td>
<td>T1.2, D1.2, D1.3</td>
<td>How can the synergy be expanded/continued?</td>
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<td>Which synergies between activities occurred in the past?</td>
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<td>What was the location of the synergy?</td>
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<td>3</td>
<td>T1.2, D1.2, D1.3</td>
<td>How would you categorize the synergy? (spatial, temporal, ecology, natural resources, socio-economic....)</td>
</tr>
<tr>
<td>4</td>
<td>T1.2, D1.2, D1.3</td>
<td>What was the reason of the synergy?</td>
</tr>
<tr>
<td>5</td>
<td>T1.2, D1.2, D1.3</td>
<td>Why has the synergy ended?</td>
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#### Future

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<td>What would be the location of the synergy?</td>
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<td>3</td>
<td>T1.2, T1.3, D1.2, D1.3</td>
<td>How would you categorize these synergy? (spatial, temporal, ecology, natural resources, socio-economic....)</td>
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<td>4</td>
<td>T1.2, T1.3, D1.2, D1.3</td>
<td>What would be the reason of the synergy?</td>
</tr>
<tr>
<td>5</td>
<td>T1.2, T1.3, D1.2, D1.3</td>
<td>What is needed to start the synergy?</td>
</tr>
</tbody>
</table>