Assessment of pressures impacting the environment of the WP6 Pilot cases in socio-economic terms

Deliverable Nr. 2.3

SEVENTH FRAMEWORK PROGRAMME

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EXECUTIVE SUMMARY / ABSTRACT

This report presents the economic and social analysis of the human activities which exert pressures on marine and coastal ecosystems of four pilot cases areas: Balearic Sea and Gulf of Lyon, Northern Adriatic, Aegean Sea/Saronikos Gulf in the Mediterranean and Western Black Sea. Analysis has been done on main marine sectors such as fisheries and aquaculture, maritime transport and ports, recreational activities and coastal tourism, submarine cable and pipeline operations and marine hydrocarbon (oil and gas) extraction as well as on the main land-based activities impacting the coastal marine.

This work completes the identification of human pressures and their impact on coastal ecosystems carried out in parallel, both being preliminary to the design of programme of measures to achieve or maintain good environmental status (GES). This is done in the background of the experimental implementation of an innovative Adaptive Policy Framework in these pilot cases areas. Methods for socioeconomic assessment have been adapted from guidance issued for the MSFD implementation. It is also attempted to estimate the cost of degradation due to differences between the present environmental status and the GES to be achieved. Another innovative feature is that human activities impacting coastal water are distinguished from those impacting open waters beyond 200m depth. This approach is in coherence with the distinctive characteristics of these two categories of ecosystems but raise difficulties due to lack of data and its limited relevance when designing programme of measures, rather framed by jurisdictional responsibilities. Gap analysis has shown that part of the required data to perform these assessments are missing or not publicly available, especially those needed to assess value added and employment wages as well as the cost of degradation, even though the initial assessments performed by Member states for the MSFD have provided a lot of new data.

SCOPE

The EU Marine Strategy Framework Directive (MSFD) 2008/56/EC presents a further set of challenges in its requirements relating to marine environmental policy. Article 8.1 (c) calls for 'an economic and social analysis of the use of those waters and of the cost of degradation of the marine environment'. It is within this scope, and the further interest in socio-economically assessing the pressures impacting the Mediterranean and Black Sea marine and coastal environments, that the deliverables of WP2, task 2 D2.2 and D2.3 have been delivered. This deliverable follows the D2.2, the scope of which was the whole Mediterranean and Black Seas, and provides a focus on the four WP6 Pilot cases areas, thus preparing the experimentation of the PERSEUS Adaptive Policy Framework (APF) in these Pilot cases. As for the D2.2, this deliverable presents distinctly the main activity sectors possibly impacting ecosystems in coastal areas and in open sea (>200m), D1.4 of WP1, task 2 dealing more specifically on open sea areas.

This analysis focusing on the Pilot Cases is an extension of the DoW, possible because D2.2 went far beyond the gap analysis requested by the DoW and will provide a useful background for the testing of the APF planned in Task 6.4.

1 INTRODUCTION

1.1 The MSFD context

As already recalled in the Scope of this report, the EU Marine Strategy Framework Directive (MSFD) 2008/56/EC presents a further set of challenges in its setting out of community action relating to marine environmental policy. The MSFD, in particular, requires EU MS to perform an economic and social analysis describing the economic importance of sectors that impose pressures on, or benefit from, marine ecosystems, and the costs imposed on society because of the degradation of these ecosystems. This information is then used for supporting the selection of measures that will cost-effectively contribute to improving the ecological status of marine ecosystems. More precisely, Article 8.1 (c) calls for 'an economic and social analysis of the use of those waters and of the cost of degradation of the marine environment'.

All uses of the waters have economic, social and environmental dimensions which are even interconnected. However, each and one of these dimensions mostly seek to achieve sustainability, which implies maximizing its capacity and outcomes (in economic, social and environmental terms).

Acknowledging this interconnection, one of the more significant challenges faced in coastal management today is to better refine our understanding of the linkages between the social costs/benefits associated with human pressures and determine ways of measuring (Bowen & Riley, 2003).

Social and economic indicators may be useful as tools by providing criteria for a better management as imbalances, on those and other indicators may cause unsustainability and resources limitations.

Therefore, the assessment of the pressures impacting the environment of the WP6 Pilot cases in socio-economic terms will allow us not only to give an answer to the MSFD requirements, but also to acknowledge the socio-economic issues that arise from certain pressures impacting the marine environments at the four PERSEUS WP6 Pilot Case areas, named as: The Balearic Sea and Gulf of Lyon; the Northern Adriatic Sea; the Aegean Sea/Saronikos Gulf and the Western Black Sea.

The social and economic assessment of a marine or coastal zone set of issues must be underpinned by biophysical research and data relating to the various ecosystem processes, structures, stocks, flows and dose response relationships. Together, the socio-economic and environmental assessments would, however, serve to identify data gaps and could set the foundations for a more extensive analysis which would facilitate the decision making process for policy-makers (Turner et al., 2010).

1.2 Links with other deliverables

D2.3 follows the deliverable D2.2 titled "Pressure on the coastal seas in socioeconomic terms, gap analysis on data and knowledge". Deliverable D2.2 has the same objective and the same timeline as the deliverable D1.2 of Task 1.2 (Analysis of socio-economic activities in open sea areas) titled "Pressure in the SES open waters in socio-economic terms, Gap analysis on data and knowledge", the only difference being that the first is devoted to the coastal areas whereas the second to the open sea.

It should be noted that the analysis of the pressures in socioeconomic terms have been never attempted before at the scale of the Mediterranean Sea and the Black Sea. When done elsewhere, generally at national scale, no distinction has been done so far between coastal waters and open sea.

Working on D1.2 and D2.2, it appeared clearly that the distinction between coastal areas and open sea- defined as areas with a depth >200m -is relevant regarding ecosystems but without incidence on how to analyse pressures in socio-economic terms. Moreover, socioeconomic data are currently collected irrespectively of the water depth and thus analyses of pressures on coastal areas or open sea can only be derived from the analysis of pressures on the marine waters as a whole. In order to avoid useless duplication of text, it has been decided to develop the complete analysis in D2.2, including both coastal areas and open waters presented distinctively as far as possible and to focus D1.2 on the open sea specificities.

The same approach has been followed for the deliverable D2.3 and D1.4, the first one presenting the analysis done for coastal areas and open waters, the second being devoted on the open waters.

D2.3 and D1.4 follows also the same methodology as for the D2.2 and D1.2adapting to the PERSEUS case guidance provided by the Working Group on the Economic and social analysis established in the setting out of the MSFD Common Implementation strategy (CIS).

The main difference between D2.3 and D1.4 on the one hand and D2.2 and D1.2 on the other hand is the spatial scope: D2.3 and D1.4 are focusing on the four WP6 Pilot cases areas although D2.2 and D1.2 were dealing with the Mediterranean Sea and the Black Sea.

Furthermore, the socioeconomic analysis delivered in this report complements the ecological assessment of pressure presented in D2.1: Pressures and their impacts on coastal ecosystems in the SES, Gap Analysis- Preliminary report and in the similar deliverable on the open sea (D1.2), as well as the ensuing characterization of the main risks of non-achievement of the Good Environmental Status (GES) in the WP6 Pilot cases areas carried out within the Task 2.1 and T 1.1 (Milestone M17, Identification of the socio economic issues to be treated by WP4) thus setting the background for the Task 6.4, Implementation of the PERSEUS Adaptive Policy Framework (APF) and lesson learned at Pilot cases level.

1.3 Objectives of the deliverable

In this context, the objectives of the work underlying this deliverable are:

- To offer an economic and social analysis of the use of the waters and of the cost of degradation of the marine environment, waters being here a generic term including the seabed and subsoil;
- To carry out this analysis at the scale of the four WP6 Pilot cases,
- To cover as distinctly as possible both the coastal areas and the open sea
- To follow the methods recommended for the MS initial assessment
- To use existing and available data and in particular the MSFD EU Member State initial assessments, when relevant.

- To be complementary of the work done under the T2.1 (Identification of pressures and processes and their impact on the ecosystems and gap analysis) and accordingly focused on the coastal areas

1.4 Content of the deliverable

The report is divided into five chapters. After the Introduction, chapter 2 presents the methodology used, details the spatial scope of the work, discusses the distinction required between open waters and coastal areas and defines the range of the economic and social analysis of the drivers and pressures impacting the marine and coastal waters. The following chapter 3 provides views on the data used to perform the socio economic assessment. Chapter 4 and chapter 5 present respectively the socioeconomic analysis of marine activities and the cost of degradation as far as possible at Pilot case scale. Final chapter 6 presents conclusions of the study in terms of findings and next steps.

2 METHODOLOGY

2.1 Scope of the analysis

The scope of the socio economic analysis of pressures on coastal and marine waters in the present report follows the preliminary analysis of issues at risk of non-achievement of GES in SES (see Deliverable D6.2) by focussing on the following sectors possibly using or impacting coastal and marine waters.

- Fisheries
- Aquaculture
- Maritime transport and cruises
- Recreational activities, coastal tourism
- Submarine cable and pipeline operations
- Marine hydrocarbon (oil and gas) extraction
- Population, Urban areas and WWTPs

Fisheries, aquaculture, cruises, recreational activities and coastal tourism constitute predominant market sectors substantially depending on a resilient marine environment while at the same time impacting on it. For other sectors, the status of the marine environment is not essential.

A consistent, economic and social analysis of the uses of waters has been performed for all these sectors. Effort has been undertaken to quantify as fully as possible the parameters describing the socio-economic importance of the sectors examined but wherever this is not possible - within the time and resource constraints of the present research - analysis takes a more qualitative aspect. Studied parameters include:

- Production parameters
- Production value
- Gross value added (when possible), and
- Employment

Finally, the cost-of-degradation objective is to provide a first assessment of the gap between present status and GES for marine environments in SES in the Pilot Case areas. Cost of degradation will be assessed on the basis of information available in the national preliminary assessment reports of MS, supplemented by information on marine non-market valuation assembled within research in task 6.3 (Deliverable D6.8).

At this stage of our research, the overall analysis referring to both the economic characterization of marine uses and sectors as well as the cost of degradation intents to fulfil the needs of a gap analysis, and when possible to provide assessments. It does not pretend to present new data and/or methodological applications in relation to the issue of socio-economic assessment of pressures in the SES marine environment.

2.2 Coastal and open waters

In agreement with the European Nature Information System (EUNIS), the PERSEUS DoW defines the coastal domain as the one including the continental shelf, broadly the marine area from a depth of 0 to 200 m. This is in coherence with most of the marine ecosystem processes, which are different in the two domains. However, this distinction is not present in the MSFD approach which should be implemented by MS in marine water under national jurisdictions without specific distinction between coastal and marine waters, in line with the objective to develop national programs of measures aiming to achieve or maintain GES, while insuring a regional cooperation.

In the Mediterranean Sea, where few EEZ have been claimed due to the complexity of many territorial situations, waters under national jurisdiction range from 12 nautical miles (nm), or less in straights, up to a theoretical maximum of 200 nm (Montego Bay convention) in case of EEZ. This situation could change, as illustrated by the recent claim by France of an EEZ in the Mediterranean Sea, replacing a former Ecological Protection Zone (EPZ). More recently, Italy has deployed an EPZ in the Western Mediterranean and Spain has also claimed its EEZ for the Mediterranean Sea, with potential disputes with the French EEZ. It should be noted that if each Mediterranean Country would deploy its maximum EEZ, the whole Sea would be under National jurisdictions, as it is the case for the Black Sea.

This distinction also increases the data constraints as most of the statistics related to marine activities exercising pressure on marine ecosystems are assessed in reference the waters under national jurisdictions, , without taking depth into consideration.

A pragmatic examination of the marine activities shows that most of them are mainly impacting coastal areas (see Table 1). Practically, it has been decided that most of the assessments presented in the D2.3 deliverable deal distinctly with coastal waters and open sea areas giving thus a complete picture, while the open sea deliverable (D1.4) is mostly devoted to qualitative considerations about the impacts of some marine activities in open sea. The same convention regarding the segregation between coastal areas and open sea activities has been adopted for the D2.2 (Coastal areas and open sea) and in the D1.2 (open areas).

Table 1. Broad analysis of the coastal sea / open sea segregation of human marine activities

Marine Activities	Coastal Sea (< 200 m depth)	Open sea (>200 m depth)
Fisheries	All	Focus on some high sea species.
Aquaculture	All	
Maritime transport, cruises and ports	Coastal shipping	High sea shipping (Quantitative considerations when possible)
Recreational activities and coastal tourism	All	
Underwater pipeline and cables	Coastal sea lay out and operations (if segregation possible)	High sea lay out and operations (Quantitative considerations when possible)
Oil and gas offshore extraction	Most	Few deep sea explorations (Quantitative considerations when possible)
Desalinisation	All	
Population, Urban areas and WWTPs	All	Considerations of the land based pollutions impact on the open sea (pollution, eutrophication)

2.3 Spatial considerations

In order to identify pressures and drivers, the spatial aspect of the analysis needs to be determined. This is a key consideration, given an assessment results may be markedly different depending on the scale at which it is carried out. It is also important that the chosen geographic assessment scale allows for the evaluation of the functioning of ecosystem at the scale where they may be compromised. For these reasons, the PERSEUS project considers different geographic scales from the SES basins to local pilot cases areas and distinguishes coastal waters from open waters. There are some differences with the approach to be followed for the implementation of the MSFD, for which each Member State should "develop a marine strategy for its marine waters which, while being specific to its own waters, reflects the overall perspective of the marine region or sub region concerned". One of the main objectives of PERSEUS being to promote across the SES the MSFD principles, these differences and their practical consequences have been considered for this study in terms of definition of the Mediterranean sub regions and their relationships with the marine waters under the jurisdiction of the riparian states. Moreover reporting format of pressures is necessarily influenced by the fact that most of the publically available socioeconomic data are generally collected at the levels of national administrative territorial units. Finally this specific study should prepare the work to be done in the WP6 sub regional Pilot Cases. In this context, this section presents first the sub regions considered in this project then the PERSEUS Pilot cases.

2.3.1 Mediterranean sub regions

First tasks of the WP1 (Pressures and Impacts at basin and Sub basin scale) dealing with the open sea and of the WP2 (Pressures and impacts at coastal level), the conjoint initial analysis of pressures and process and their impacts on the ecosystems have been chosen to be presented at the intermediate scale of large sub-regions for the Mediterranean Sea and of the sea as a whole for the Black Sea. In order to be compatible with the deliverables resulting of these tasks, the same intermediate scale has been adopted for the reporting of the pressures in socio economic terms in D1.2 and D2.2.

The PERSEUS marine sub-regions are:

- The West Mediterranean
- The Central Mediterranean
- The East Mediterranean
- The Black Sea

These sub-regions are not strictly those stated in the Article 4.2 of the MSFD regarding the Mediterranean Sea:

- The Western Mediterranean Sea
- The Adriatic Sea
- The Ionian Sea and the Central Mediterranean Sea
- The Aegean-Levantine Sea

The Mediterranean Action Plan, in charge of the application of the Barcelona Convention, is currently implementing an Ecosystem Approach for the management of human activities has selected the same sub region breakdown (see Figure 1.).

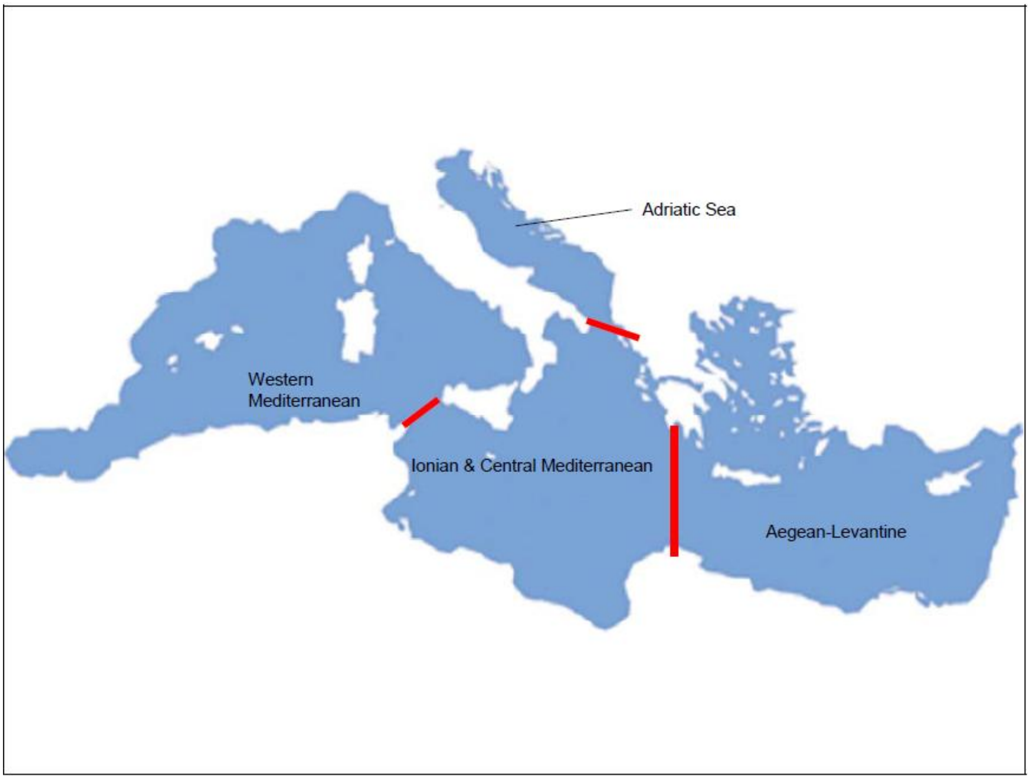

Figure 1. MSFD and MAP Mediterranean sub-regions Source: UNEP/MAP, 2011.

2.3.2 The WP6 Pilot Cases

This assessment should also prepare the work to be done in the WP6, "Adaptive policies and scenarios", which aims to develop an Adaptive Policy Framework to be implemented and tested in four sub-regional Pilot Cases and at basin scale.

The building of adaptive policies requires having a good knowledge of the socioeconomic context in which these policies will be implemented. As such, Article 8(c) of the MSFD requires Member State to provide an economic and social analysis of the use of the waters and an assessment of the cost of degradation of the marine environment, which shall be carried out as a part of the initial assessment to prepare the development of marine strategies aiming to reach or maintain GES.

In this context, the PERSEUS four Pilot Cases are examined, namely:

- the Balearic Sea and Gulf of Lyon (abbr. W. Med)
- the Northern Adriatic Sea (abbr. N. Adriatic)
- the Aegean Sea/Saronikos Gulf (abbr. Aegean)
- the Western Black Sea (abbr. W. Black Sea)

They presented in Figure 2. Some details regarding the areas covered by the pilot cases are provided below.

Figure 2. The four WP6 Pilot Cases.

Balearic Sea and Gulf of Lyon

This Pilot Case includes the Balearic Sea, also known as Catalan Sea (i.e. the Community of Catalonia, the Community of Valencia and the Balearic Islands), and the Gulf of Lyon.

The Balearic Sea lies between the Iberian coast and the Balearic Islands in the north-western Mediterranean. At its southeaster it merges with the Alboran Sea, which is the westernmost element of the Mediterranean Sea. It is separated from the Tyrrhenian Sea to the east by Sardinia and Corsica and abuts the sea to the west. The bathymetry is dominated by the Balearic Abyssal Plain, which covers over 77,700 square kilometres, covering the majority of the basin floor at depths ranging from 2700 to 2800 meters (Hogan, 2013).

The Gulf of Lions is located in the north-western Mediterranean Sea, covering a total area of 20,000 square kilometres from the coastal area up to 2500 m depth (Indicators for the Seas, unknown).

Northern Adriatic Sea

The very northern part Adriatic Sea covers an area of 18,900 square kilometres, representing a small portion of the total area (i.e. 139,000 square kilometres) of the Adriatic Sea (Degobbis and Gilmartin, 1990) but in fact the area considered here is larger, including marine waters of Slovenia, Croatia and Italy down to the south of the Abruzzi province.

It should be noted that this area is totally in the coastal area category, as the water depth is everywhere inferior to 200m.

Aegean Sea/Saronikos Gulf

The Aegean Sea is located between the Greek peninsula on the west and Asia Minor on the east. It is about 612 kilometres long and 299 kilometres wide, it has a total area of some 215,000 square kilometres (Britannica, unknown).

The Saronicos Gulf has an area of about 2,600 square kilometres and its maximum depth is 450 meters (Dassenakis et al., 2001).

Western Black Sea

The Western Black Sea involves the regions Sud-Est in Romania and Severoiztochen and Yugoiztochen in Bulgaria, thus stretching from the Danube delta to the Rezovo river. The EEZs of Bulgaria and Romania cover together nearly 65,000 square kilometres or roughly 15% of the Black Sea surface area (Sea around us, unknown). The shelf area is around 30,000 square kilometres with an average depth of 140 m (Lampert et al., 2007).

2.4 Environmental Risk analysis

The analysis of the ecosystem status and the analysis of pressures and impacts, presented in the D1.1 and D2.1 deliverables, identified the most important environmental risks for not achieving GES in the Mediterranean and Black Seas, in relation to each of the 11 GES descriptors of the MSFD. These risks were categorized into risks in coastal and open sea areas (see for example Figure 3 and Figure 4) in order to be further analysed in the four selected pilot cases.

Although the environmental risks affect a number of the ecosystem services of the marine areas, both final (e.g. food provisioning, raw materials and energy, recreation, maritime transport) and intermediate (e.g. habitat, climate regulation, eutrophication mitigation, and resilience), due to the absence of appropriate data, at this stage, the cost of degradation for each of the four pilot cases was based on appropriate scaling of available information provided from the MSFD Initial Assessment reports of the Member States. For this purpose, the geographic area covered by each pilot case was considered.

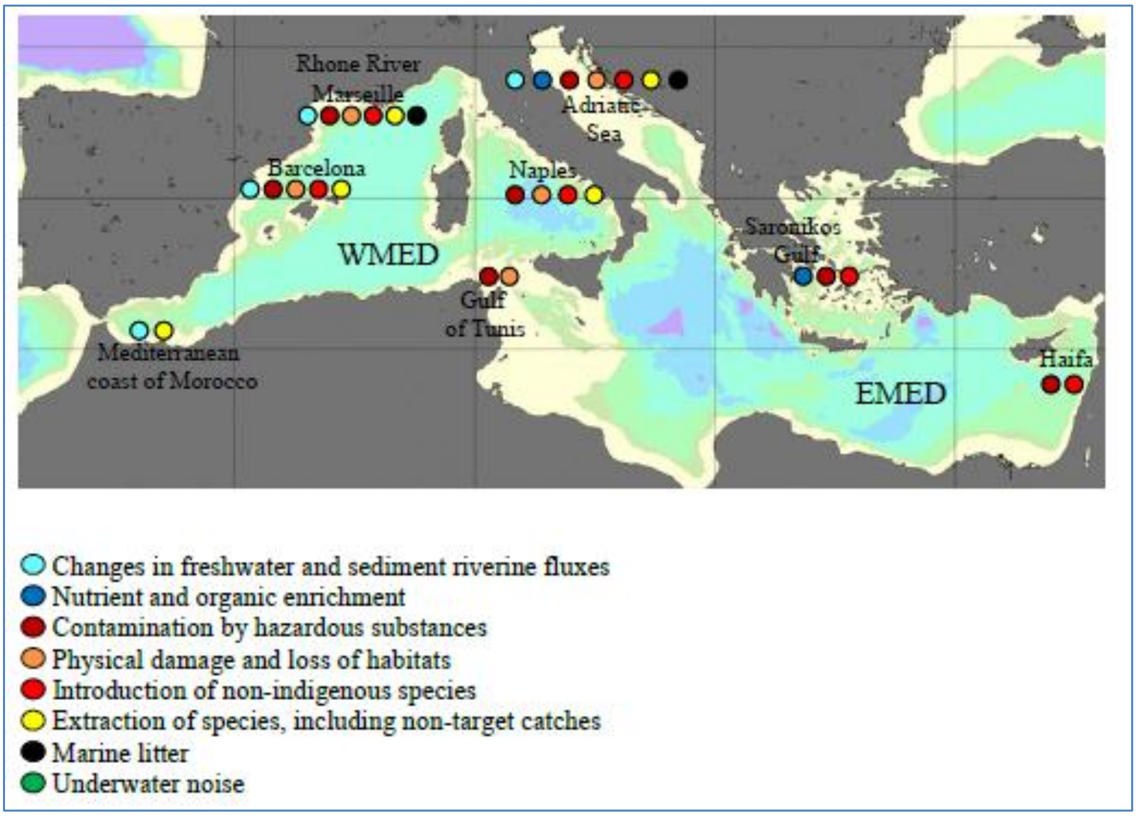

Figure 3. Areas identified as "most impacted" with regard to the investigated pressures in the Mediterranean Sea.

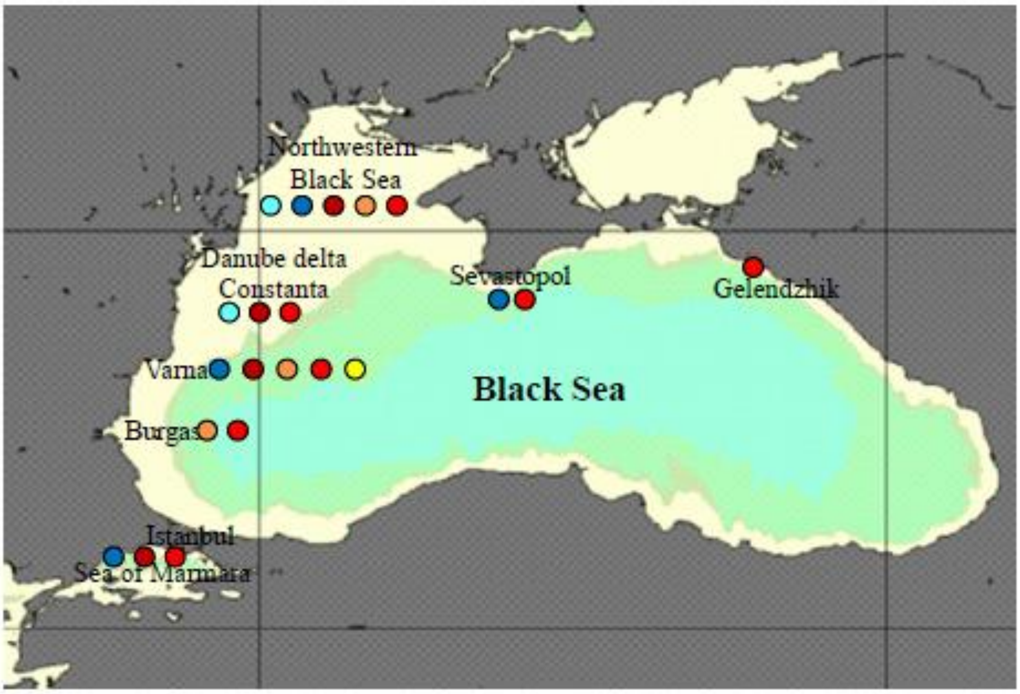

Figure 4. Areas identified as "most impacted" with regard to the investigated pressures in the Black Sea.

Main selected risks to be treated within the WP6 Pilot Cases are shown in **Error! Reference source not found.**, taking into consideration the environmental importance of the risks as well their adequacy with the capacity of PERSEUS scientific expertise.

Table 2. Main risks identified per WP6 Pilot Cases by PERSEUS experts

Pilot cases	G.of Lion and Balearic sea		Northern Adriatic		Agean Sea, Saronikos Gulf		Western Black Sea	
Main Risks	**Coastal**	**Open Sea**	**Coastal**	**Open Sea**	**Coastal**	**Open Sea**	**Coastal**	**Open Sea**
Alteration of hydrographical conditions (D7)								
Chemical Pollution (D8, D9)	x		x				x	
Nutriments and organic enrichment (D5)							x	
Physical damanges and losses of habitats (D6)								
Introduction of non-indigenous species (D2)		x	x	x		x		x
Overfishing (D3)		x	x	x	x	x		x
Marine litters (D10)	x				x		x	
Underwater noise (D11)								
Jelly blooms (D1, D4)								

These risks are expressed as risks of excessive pressures to achieve or maintain GES if specific programmes of measures are not implemented. These pressures are induced by the main human activities potentially impacting marine environment.

Using the indicative list of human activities and their possible pressures on the marine environment of matrix in Annex 4 of the Commission working paper entitled "Relationship between the initial assessment of marine waters and the criteria for good environmental status" (EC, 2011a) it has been possible to derive Table 3, indicating what are the main risks induced by each analysed activities per Pilot cases.

Table 3. Main risks induced by main human activities per WP6 pilot cases

Cases		Risks	Fisheries	Aquaculture	Martime T & ports	Recreationnal activities & tourism	Submarine cables	Offshore exploitation	Land based activities
W. Med /GL, BS	Coastal Areas	CP ML	ML	CP	CP ML	ML		CP ML	CP ML
	Open Sea	NIS OF	OF	NIS	NIS				
N. Adriatic	Coastal Areas	CP NIS OF	OF	CP NIS	CP NIS	NIS		CP	CP
AEGEAN	Coastal Areas	OF ML	OF		ML	ML		ML	ML
	Open Sea	NIS OF	OF	NIS	NIS				
W. Black Sea	Coastal Areas	CP ML	ML	CP	CP ML	ML		CP ML	ML
	Open Sea	NIS OF	OF	NIS	NIS				

Legend:

CP	Chemical Pollution (D8, D9)
NIS	Introduction of non-indigenous species (D2)
OF	Overfishing (D3)
ML	Marine litters (D10)

For example, main risks to be considered regarding the coastal area of the West Mediterranean case are Chemical Pollution (CP) and Marine Litters (ML). These pressures on the marine ecosystems are potentially induced by Fisheries (lost gears: Marine Litters), Aquaculture (Pharmaceutical contamination due to animals treatments: Chemical Pollution) Maritime transport and Port activities generate both Chemical contamination and Marine litters and so on.

These pressures are subject to specific analyses, including their trends for the years 2020-2030 in the paragraph "Links to environmental pressures" of each human activity presented in the chapter 4, Results of the socioeconomic analysis.

3 DATA

3.1 Data sources

Data on marine water uses and economic sectors are scattered in a variety of sources: EU publications, MS official statistical compendia, ad hoc databases within specific International Agencies and Conventions, private sector associations, marine NGOs, etc. WG ESA 2010 (pp. 49-61) provides a thorough listing of available data sources for European seas spanning EU-level and international organizations, regional sea conventions, programmes and projects. We note here two:

- The European Environment Agency (EEA[1]), which disseminates mostly physical data, and
- EUROSTAT[2] with a vast amount of economic information relevant to water management issues in the EU MS marine regions.

Complimentary to the above sources, the present report has been benefited by the specific non-market marine valuation database designed and populated within PERSEUS (see Deliverable D6.8). The marine valuation database of PERSEUS covers peer reviewed published literature on marine ecosystem good and services in Mediterranean and Black Sea.

3.1.1 National initial assessment of Member States

Relevance of the National Initial Assessments for this study

The MSFD provides that Member States (MS) may, in order to take into account the specificities of a particular area, implement this Directive by reference to subregions. It is in particular the case of the initial assessments due by the MS for July 2012. WP6 Pilot cases have not been sized initially to fit to national waters or MSFD subregions. However, Table 4 shows that differences between WP6 Pilot Cases areas and aggregation of the closest MS subregions are nil (cases of East Mediterranean and west Black sea) or small.

In consequence, it has been considered that MS initial assessments could be used for the socioeconomic analysis of the WP6 Pilot cases.

[1] www.eea.europa.eu

[2] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

Table 4. Geographical scope WP6 Pilot Cases areas versus MSFD subregions

PERSEUS WP6 PC (D1.4, D2.3 scope)	Closest Member States MSFD subregions	Differences
West Mediterranean (Gulf of Lion and Balearic Sea)	Spain (Levantine Balearic Area) France (Western Med)	In excess: Comunidad Autónoma Murcia and Provincia de Almeria In excess: Corsica
Adriatic Sea (Northern Adriatic Sea)	Italy (Adriatic) Slovenia Croatia	In excess: South of Adriatic Idem Idem
East Mediterranean (Aegean Sea/Saronikos Gulf)	Greece (Aegean-Levantine Sea)	Idem
Western Black Sea	Bulgaria Romania	Idem Idem

Progress of the MSFD initial assessments

The Initial Assessment reports of the Member States riparian of the PERSEUS Pilot cases were publicly available for this work, both regarding the Mediterranean Sea and the Black Sea, with the exception of Croatia.

It should be mentioned that Table 5 does not give any indication as to whether the notified reports conform to the requirements of the Directive, and the Commission intends to present an assessment report later in 2013.

Table 5. ESA IA reports for MS riparian of the Pilot cases

Italy:http://cdr.eionet.europa.eu/Converters/run_conversion?file=it/eu/msfd8910/madit/envuxzwa/MSFD8cESA_20130506_101824.xml&conv=385&source=remote
Greece:http://cdr.eionet.europa.eu/Converters/run_conversion?file=gr/eu/msfd8910/madgr/envux5bcg/MADGR_MSFD8cESA_20130430.xml&conv=337&source=remote
France :http://cdr.eionet.europa.eu/Converters/run_conversion?file=fr/eu/msfd8910/mwefr/envuwqs1q/MWEFR_MSFD8cESA_20130405.xml&conv=337&source=remote
Spain :http://cdr.eionet.europa.eu/Converters/run_conversion?file=es/eu/msfd8910/mwee

s/envuwavra/MWEES-ESAL_MSFD8cESA_20130521.xml&conv=337&source=remote

Bulgaria :http://cdr.eionet.europa.eu/bg/eu/msfd8910/msfd4text/envubapw and

http://cdr.eionet.europa.eu/Converters/run_conversion?file=bg/eu/msfd8910/msfd4text/envubapw/art.8_I_SUMMARY_EN_1_.pdf&conv=tohtml&source=local

Romania: http://cdr.eionet.europa.eu/ro/eu/msfd8910/msfd4text/envux98hw

3.1.2 Other data sources:

In general, sources other than the MS countries initial assessment considered for this report have been:

- National Statistical Authorities
- Private sector and trade associations
- Non-European, international organizations (e.g. FAO, FishStat)
- Reports that inter alia contain data on SES marine sectors (e.g. Douglas-Westwood Ltd, 2005)

4 RESULTS OF THE SOCIOECONOMIC ANALYSIS

4.1 Fisheries

Prepared by Benjamin Boteler, ECOLOGIC and by Aleksandar Shivarov, BSNN for the Black Sea.

4.1.1 The context in the SES

It is generally agreed that the European fishing industry is in a state of severe decline. Additional losses to European fish stocks will have immense socio-economic consequences. Impacts to the industry are likely to include reduced fishing opportunities, increased illegal fishing, and decreased profitability resulting in a high level of government subsidy for the sector (EEA, 2010). Other consequences may include employment and income loss to fishing communities, reduced numbers of locally caught fish and higher dependency on imports meaning weakened food security. At the same time, fish consumption throughout Europe remains high and is even expanding. Aquaculture production is often considered a solution to help meet demand for fish and fishery products, yet it is unable to do so. Europe is only able to meet its demand for fish with imports (NEF, 2011). The fishing and aquaculture industry also represent a major challenge to policy makers and fisheries management. While capture fisheries are unable to meet demand, aquaculture also brings with it a number of questions regarding its sustainability and its contribution to fishing overcapacity, as it is dependent on caught fish for feed.

Reforming the European fishing industry requires reforming the Common Fisheries Policy, which is currently underway, and the management of European fish stocks and resources. This therefore also includes Illegal Unreported and Unregulated (IUU) fishing, which can be economically lucrative for fishermen and which not only contributes to the exhaustion of fish stocks but makes it more challenging to fisheries management because of unreported data. It is also recognised that many subsidies may stimulate the problems facing European fisheries management by creating artificial profits for the industry and adding to the problem of overcapacity. Spain, France, and Italy are among the top five receivers of fisheries subsidies in the EU.

In the following report the catch and socio-economic data of the countries bordering the areas of the PERSEUS pilot areas are used, referring to fishing activities in those regions. Most fishing activities are coastal fisheries.

Mediterranean fisheries are dominated by small-scale fisheries, as 82.0 % of the registered vessels in the Mediterranean are less than 12 metres long and therefore have a limited range and more appropriate for coastal fishing (Collet 2011). Thus, in the Mediterranean Sea, Member States generally tend to fish off their own coast and a majority of a country's catches are taken in the fishing areas adjacent to it.

The Black Sea hosts about 200 fish species (Black Sea Commission, 2009). However, no more than two dozen species have any significant economic value and they comprise 98% of the catch (between 1996-2008) (Shlyakhov and Daskalov, 2008). Only Bulgaria and Romania are EU Member States fishing in the Black Sea.

Intensive fishing and overfishing is a major environmental pressure and is causing losses of biodiversity and valuable marine resources and ecosystem services (e.g. food supplies). The effects of fishing on habitats are related to the physical disturbance by bottom gears in contact with the seafloor. These include removal of large physical features, reduction in structural biota and a reduction in complexity of habitat structure (leading to increased homogeneity). However, quantitative data for environmental impacts of different gear types are generally not available. Fisheries impacts may be direct, such as impacts on marine populations or habitats from unselective gear, destruction of the seabed or interactions with rare or endangered species. Fishing impacts may also be indirect, for example contributing to climate change via the carbon emissions of fishing vessels.

The concept of Maximum Sustainable Yield (MSY) has a long history in fisheries management. Conceptually, it calls for fisheries to make the best use of the productivity of the marine system. MSY is used rather loosely defined in political statements. According to the EU Common Fisheries Policy fish stocks should be brought to and maintained in healthy conditions, and exploited at maximum sustainable yield levels. These levels can be defined as the highest catch that can be safely taken year after year and which maintains the fish population size at maximum productivity. This objective is set out in the United Nations Convention on the Law of the Seas (UNCLOS) (UNCLOS, 1982), and was adopted at the 2002 World Summit on Sustainable Development as a world target for 2015.

This assessment was conducted by accessing publically available datasets. Statistics in regard to landings and catches were predominantly gathered from FAO Stat. Fleet specific statistics were collected from the 'Annual Economic Report on the European Fishing Fleet', which is produced by the Scientific, Technical, and Economic Committee for Fisheries (STECF) of the European Commission's Joint Research Centre.

4.1.2 Open sea fisheries

It should be noted that data issues remain a major challenge to assessing the socio-economics of European fisheries. The following, is therefore an attempt to provide a comprehensive overview of fishing in the Mediterranean Sea and Black Sea. It is very challenging to distinguish between coastal and open sea fisheries data, as statistics are collected by local authorities and often presented nationally. Moreover, most fisheries in the Mediterranean and Black Sea are considered coastal fisheries as these are defined as less than 200 metres depth. In this regard, the data represents a combination of data from various sources, though it can be assumed that the data is primarily covering coastal fisheries.

In regard to data on landings, open sea fisheries activities are defined as those targeting some specific species selected according to expert judgment (Pantazi M., HCMR, 2013, Pers. Com.)

<u>Pelagic fishes:</u>

- Bluefin tuna (Thunnus thynnus)
- Swordfish (Xiphias gladius)

<u>Demersal fishes:</u>

- Hake (Merluccius merluccius)
- Norway lobster (Nephrops norvegicus)
- Blue and red shrimp (Aristeus antennatus)
- Giant red shrimp (Aristacomorpha foliacea)

Landing data regarding these species have been extracted from FAO Fishstat. However it has not been found any economic or social data specific to these species. For this reason, these indicators are presented indistinctly for coastal areas and open sea fisheries.

4.1.3 Sector and socio-economic analysis

This section provides information for three sections – sector, economic and social data. The analysis is made for the Black Sea and the Mediterranean Sea four pilot case areas. However, because data is only available on a National basis, the statistics presented here are according to national fleets. When possible, future projections are provided.

W. Med Sea

The Western Mediterranean Sea PERSEUS pilot area includes Spain and France. In the Western Mediterranean Sea pilot area, open sea waters contribute 7,750 tons of landings and coastal areas for 99,904 tons.

Sector Analysis

Table 6. Landing statistics for the Western Mediterranean Sea pilot area

	Open sea	Coastal areas	Total
	2010	**2010**	**2010**
Landings (t)	7,750	99,904	107,654

Source: FAO STAT, 2012 Notes: Fishing areas in the Balearic, Gulf of Lion and Sardinia. Data is for Spain and France. Open sea data includes France (European Hake and Norway Lobster), Spain (Blue and Red Shrimp, European Hake, Giant Red Shrimp, and Norway Lobster).

Fleet capacity statistics aggregate coastal areas and open sea.

Table 7. Sector statistics for the Western Mediterranean Sea pilot area.

	Spain	France	Total
	2011	**2010**	**2010**
Fleet			
Vessels (nr)	1,821	6,100	7,921
GT (1000)	142	164	306
kW (1000)	257	885	1,142
Effort			
Days at sea (1000)	n.a.	507	

Source: For France EC, 2012, for Spain: Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013, Cataluña, Valenciana and I. Baleares

Economic Analysis

Economic analysis aggregates coastal areas and open sea.

Table 8. Economic statistics for the Western Mediterranean Sea pilot area (Million Euros).

	Spain	France	Total
	2011	**2010**	**2010**
Landings value	308	924	1,232
Gross value added [a]	141	503	644
Gross profit	119	116	235
Net profit excluding subsidies	29	39	68

Source: for France EC, 2012 for Spain: Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013, Mediterrranean façade

Social Analysis

Social analysis aggregates coastal areas and open sea.

Table 9. Social statistics for the Western Mediterranean Sea pilot area.

	Spain	France	Total
	2010	**2010**	**2010**
Total employed	8,310	10,871	19,181
Full Time Equivalent (FTE)	7,279	8,410	15,689

Source: for France EC, 2012 for Spain: Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013, Mediterrranean façade

North Adriatic Sea

In the following section, data on fishing activities in the North Adriatic pilot Case focus on fishing activities of Italy and Slovenia as they are main fleets active in the Adriatic. Italy has by far the largest share in total landings in the Adriatic Sea and generates the highest income with its fisheries sector compared to the other countries. Italian and Slovenian landings show an overall decreasing trend. The Slovenian fisheries sector is still negatively affected by the independence in 1991. The fisheries segment of small vessels is the most important segment in both Italy and Slovenia in terms of numbers of vessels and employed workers (EC, 2012).

Sector analysis

In the North Adriatic Sea Pilot case area, open sea waters provided about 3,223 tons and coastal areas about 90,784 tons. It should be noted that all the North Adriatic Sea pilot area is included in the coastal area domain defined as areas where the depth is inferior to 200m. Open sea data are concerning here data on species generally fished in open sea and landed in the pilot case areas.

Table 10. Landing statistics for the North Adriatic Sea pilot area.

	Open sea	Coastal waters	Total
	2010	**2010**	**2010**
Landings (t)	3,223	90,784	94,007

Source: FAO STAT, 2012 - Notes: Fishing areas includes the Adriatic Sea. Includes data for Italy and Slovenia. Open sea data Includes data for Italy only (European Hake and Norway Lobster)

In 2011, 14 715 vessels were registered in Italy and 186 in Slovenia, see Table 11. In the Mediterranean, 35% of vessels registered belong to the Italian fleet. The capacity of the Italian fleet has followed a decreasing trend between 2008 and 2011. The number of vessels declined by 2% while the total GT and kW of the fleet declined by 7% and 3%, respectively during the same period (EC, 2012). The capacity of the Slovenian fishing fleet followed a stable trend between 2008 and 2011. The number of vessels increased by 3% (or 5 vessels) while total GT and kW both increased by 2% during the same period of time (EC 2012).

Fleet capacity statistics aggregate coastal areas and open sea.

Table 11. Sector statistics for the Adriatic Sea pilot area.

	Italy	Slovenia	Total
	2011	**2011**	**2011**
Fleet			
Vessels (nr)	14,715	186	14,901
GT (1000)	185	1	186
kW (1000)	1,236	11	1247
Effort [a]			
Days at sea (1000)	167	8	175

Source: FAO STAT, 2012; EC 2012
Notes: a, Days at sea for Italy and Slovenia is for 2010.

Economic analysis

In 2010 the total landings income for the Italian fleet was about €1115 million. This consisted of €1115 million in landings value and €22 million in direct subsidies (EC, 2012). In terms of landings, in 2011 European hake accounted for the highest value of landings (€90 million), followed by crustaceans (€84 million), European anchovy (€75.9 million) and then Deep water rose shrimp (€75.6 million) (EC, 2012). Demersal trawlers represent the most important fisheries segment in terms of value and volume of landings. In terms of profitability in 2010, the total gross value added (GVA) was €653 million, gross profit was €335 million and net profit (excluding subsidies) €114 million (EC, 2012). The subsidies that the Italian fleet receives vary across the years. In 2010 €22.2 million direct subsidies were received, accounting for 1.9% of the total income. In 2009 €12.6 million direct subsidies were received whereas in 2008 €30 million were received by the Italian fleet (EC, 2012).

The total amount of income generated by the Slovenian fleet in 2010 was €2.4 million (EC, 2012). Landings accounted for a value of almost 2€ million. The value of landings is stable since 2008. In 2010 European pilchard accounted for the highest value of landings (€0.57 million), making up 29% of the total landed value, followed by European squid (€0.28 million) and accounting for 14% respectively (EC, 2012). In terms of profitability, the total amount of GVA, gross loss and net loss generated by the Slovenian fleet in 2010 was €0,46 million, -€0,8 million and -€1,1 million, respectively, see Table 12 (EC, 2012). Data on previous years is not available. In 2008 €0.08 million direct subsidies were received, accounting for 3.3% of the total income. Since then no subsidies were received in Slovenia.

Economic statistics aggregate coastal areas and open sea.

Table 12. Economic statistics for the Adriatic Sea (Million Euros) pilot area.

	Italy	Slovenia	Total
	2010	**2010**	**2010**
Landings value [a]	1,115	2	1,117
Gross value added	653	0.46	654
Gross profit	335	-0.8	334
Net profit excluding subsidies	114	-1.1	113

Source: EC, 2012
Notes: a: Data for landings value i for Slovenia is for 2011;

Social analysis

In Italy the total employment was around 28982 jobs in 2010, equalling to 22 002 full-time equivalents (FTEs) (EC, 2012). The level of employment shows a stable trend between 2008 and 2010. The total number of employed decreased by 1% while the number of FTEs increased by 3%. In 2010 9789 fishing enterprises were operating in the Italian fleet. With 91% the greater part of these enterprises owned a single vessel. 7% of the enterprises owned two to five fishing vessels and only 2% of the enterprises owned six or more fishing vessels. Enterprises with more than 6 vessels are mostly represented in fishing cooperatives. The fisheries segment of passive gear, small vessels 6-12m is the most important segment in terms of numbers of employed workers.

In Slovenia, the fisheries sector insignificantly influences the national economy. It however has a social impact on employment within the sector. In 2010 total employment was 116 jobs and 82 FTEs in the Slovenian fleet (EC, 2012). Whereas the level of employment increased between 2008 and 2010, with the total number employed increasing by 6%. Living from marine fisheries became more difficult due to the reduction of fishing capacity, weight and value of landings. As a consequence the FTEs decreased by 3.5%. 134 fishing enterprises were operating in the Slovenian fleet in 2011. 62.7% of these enterprises owned a single vessel, 36.57% of them owned two to five fishing vessels. There existed only one fishing enterprise that owned six or more fishing vessels.

Table 13 below provides the statistics for the Italian and Slovenian fleets.

Social statistics aggregate coastal areas and open sea.

Table 13. Social statistics for the Adriatic Sea pilot area.

	Italy	Slovenia	Total
	2010	**2010**	**2010**
Total employed	28,982	116	29,098
Full Time Equivalent (FTE)	22,002	82	22,084

Source: EC, 2012

Projections

In Italy a reduction in the demand of seafood and a consequent reduction in fish prices were observed in 2010. As a consequence the economic performance of the sector showed a decrease. Moreover the landed volume of seafood shows a decreasing trend. As no relevant change has been registered in these factors, it is expected that the economic performance will also be influenced by those in 2011 and 2012 (EC, 2012).

In Slovenia number of vessels, GT and kW are expected to remain relatively stable in 2011 and 2012 (EC, 2012). Effort is expected to increase in 2011 and 2012, because of low fish stocks in the Adriatic Sea. Therefore landings are also expected to decrease in 2011 and 2012. Because of the fleet is old, reduced catches and increased costs may be expected, so that profit might decline in 2011 and 2012. Due to the poor profitability of the Slovenian fleet, no increases in GVA, gross profit and net economic profit is expected as well (EC, 2012).

Aegean-Levantine Sea

The Aegean-Levantine Sea pilot case area is focused on Greece. Greek fishing takes place in the territorial waters, the high-sea and the deep-sea. It is both commercial and recreational. Structural measures by the EU, the Common Fisheries Policy and other regulations concerning the Aegean Sea as well as declining fish stocks have led to a decrease in the Greek fishing fleet since 2000, with more than 90% of the fleet comprised of small-scale coastal fishing vessels (Kousta, 2012). The main fishing areas are inshore around the islands and along the extensive mainland coast, as well as certain areas of the Mediterranean. The fleet's quality has also decreased with a decrease in average tonnage and horsepower. The most common species landed in the Aegean Sea are the two pelagic species European anchovy and pilchard. The highest value of landings however comes from European hake, a deep-water demersal species. With more fishing vessels than any other country in the EU, Greece landed tonnage only makes up approximately 4.6% of the EU total. Significant data is missing for the Greek fleet and its corresponding fishing activities. No data was submitted to 'The 2012 Annual Economic Report on the European Fishing Fleet' compiled by the European Commission, and limited data was provided for 'The 2011 Annual Economic Report on the European Fishing Fleet'.

Sector analysis

The whole Greek fishing fleet, not only fishing in the Aegean Sea shows a decreasing trend since 2000. With 17 657 registered vessels in 2008, with a combined gross tonnage of 84.4 thousand GT and total power of 506.1 thousand kW, see Table 12, the Greek fleet has the most vessels in the Mediterranean and Black Sea. Its share of vessels in the EU fleet was 45% in 2009, but in terms of tonnage it corresponds to 19.5% of the total catches (Collet 2011).

The Cypriot fleet decreased significantly between 2008 and 2012, and the number of vessels decreased by 47%, total GT by 49%, and total kW by almost 44%.

In 2010 in the Aegean-Levantine Sea pilot area, 4,517 tons landings came from open sea and 65,266 tons landings came from coastal waters.

Table 14. Landing statistics for the Aegean-Levantine Sea pilot area.

	Open sea	Coastal waters	Total
	2010	**2010**	**2010**
Landings (1 tons)	4 ,517	65,266	69,783

Source: FAO STAT, 2012

Notes: Fishing areas includes the Aegean-Levantine Sea. Open sea includes data for Greece (European Hake and Norway Lobster).

Fleet capacity aggregate coastal area and open sea.

Table 15. Sector statistics for the Aegean-Levantine Sea pilot area.

	Greece / Total
	2008
Fleet	
Vessels (nr)	17,657
GT (1000)	84
kW (1000)	506
Effort	
Days at sea (1000)	2721

Sources: EC, 2011

In 2010, European anchovy accounted for the highest volume of landings in the Greek landings with 12,042 tonnes followed by European pilchard, a sardine species (6511 tonnes), hake (4601 tonnes) and bogue (3201 tonnes). The type of gear used in the Greek fleet are surrounding nets, seine nets, trawls, dredges, gillnets and entangling nets, traps, hooks and lines. In 2008 the Greek fishing fleet spent a total of 2721 thousand days at sea, showing a decreasing trend of 12% since 2003.

Economic analysis

The total amount of income generated by the Greek fleet in 2008 was €714.7 million, which consisted of €544 million in landings values (EC, 2011). These numbers refer to all Greek fishing activities, not only in the Aegean Sea. European Hake accounted for the highest value of landings (€84.7 million) by the Greek fleet, followed by swordfish (€53.7 million) and then European pilchard (€40.6 million) (EC, 2011). Recent data on the other profitability indicators is only available until 2006 (see Table 14). In 2006 the Gross Value Added (GVA) of the Greek fishing fleet was 591 million Euros, and the Economic profit € 477.1 million (EC, 2011).

The total income of the Cypriot fishing fleet in 2010 was 12.19 million Euros which was made up of 10.2 in value from landings. However, when including fleet expenditures, the fleet created a gross value added of -€5.7 million.

Economic statistics aggregate coastal area and open sea.

Table 16. Economic statistics for the Aegean-Levantine Sea pilot area (Million Euros).

	Greece / Total
	2008
Landings value	544

Gross value added	n.a.
Economic profit	n.a.

Source: EC, 2011

A study on the characteristics of small-scale coastal fisheries in Europe (Macfadyen et al. 2011) analysed the Greek fishing fleet according to the categories small scale fleet (<12 m) which predominantly fishes in coastal areas and large-scale fleet (>12 m) which mostly fishes in open sea areas. The study indicated an average value of landings between 2006 and 2008 of 601.1 million Euros for the small-scale fleet and 220.5 million Euros for the large-scale fleet. This shows that the small-scale fleet is economically more important than the large-scale fleet in Greece.

Social analysis

Social statistics aggregate coastal area and open sea.

Table 17. Social statistics for the Aegean-Levantine Sea pilot area.

	Greece/ Total
	2008
Total employed	23 862
Full time equivalents	n.a.

Source: EC, 2011

Total employment in the Greek national fleet was 23,862 jobs in 2008 (EC 2011). It shows a decreasing trend with a decrease of 15% between 2003 and 2008. Small-scale coastal fisheries employ the most people in the Greek fleet. Between 2006 and 2008 in average 21 608 people were employed in the small-scale sector (<12 m) whereas 4,163 people were employed in the large-scale fleet (>12 m) (Macfadyen et al. 2011). The Greek statistical authority estimates a total of 12169 employees in 2010 (EL.STAT, 2012). Seasonal employment however accounts for about 27.5% of the total employment (EC, 2011).

Western Black Sea

The Western Black Sea PERSEUS pilot area includes Bulgaria and Romania. The two EU member states with access to the sea account for about 2% of the total landings in the Black Sea during the period 2000-2010. The bulk of the catch, over 80%, goes to Turkey. All the catches in this pilot case area are considered to be coastal ones.

Sector analysis

The coastal waters of the Western Black Sea contribute 9,899 tons of landings. The most common species landed in terms of weight and value in 2010 was Thomas rapa whelk and European sprat.

Table 18. Landing statistics for the Western Black Sea pilot area

	Open waters	Coastal areas	Total
		2010	2010
Landings (t)	Nil	9,900	9,900

Source: FAO STAT, 2012

In 2012, 1010 active vessels were registered in Bulgaria and 510 in Romania. The size of the Bulgarian fishing fleet has fluctuated between 2008 and 2012. There was a net increase of 18,3% in the number of vessels, while the fleet underwent a net decrease of 7.8% in total tonnage over the same period. A comparable increase in the number of the Romanian vessels by 16% was observed between 2008 and 2010, while the total tonnage and power of the fleet declined by 55% and 38%, respectively during the period. Both the Bulgarian and Romanian fleet are rather outdated with an average age of 22 and 17.4 years, respectively. (EC, 2012)

Table 19. Sector statistics for the Western Black Sea pilot area.

	Bulgaria	Romania	Total
	2011	2011	2011
Fleet			
Vessels (nr)	1010	488	1498
GT (1000)	5.0	0.9	5.9
kW (1000)	33.7	7.0	40.7
Effort			
Days at sea (1000)	16.1	6.5	22.6

Source: EC, 2012

Economic Analysis

The total amount of income generated by the Bulgarian fishing fleet in 2010 was €4.65 million. This consisted of €2.15 million from landings, €1.67 million in other income and €0,83 thousand in direct income subsidies. At the same time total fleet operating costs in 2010 amounted to €8.03 million, almost 173% of total income. In terms of profitability the Bulgarian national fleet performed negatively in 2010, generating an overall gross value added (GVA) of -€1.7 million. The Bulgarian fleet suffered a gross loss of € 4.2 million and a net loss (excluding subsidies) of €5.4 million in 2010. The data suggests that the profitability of the Bulgarian fleet has significantly worsened in recent years, due to a fall in income from landings accompanied by simultaneous increase in total operating costs in 2008-2010. The data for 2011 point at a slight recovery, leading to a smaller gap between income and expenditures. (EC, 2012)

The total income generated by the Romanian national fleet in 2010 was €0.49 million. It shrank by one third between 2008 and 2010. Total expenditure by the Romanian fishing fleet in 2010 was €0.45 million, amounting to 92% of total income. The largest expenditure items were fuel costs and wages. In terms of profitability, the total amount of GVA, gross profit and net profit generated by the Romanian fleet in 2010 was €0.24 million, €0.05 million and €0.03 million, respectively. The economic indicators improved slightly during 2011, mainly due to increased catches of Thomas rapa whelk. (EC, 2012)

Table 20. Economic statistics for the Western Black Sea pilot area (Million Euros).

	Bulgaria	Romania	Total
	2011	**2011**	**2011**
Landings value	2.70	1.41	4.11
Gross value added	-2.19	1.29	-0.9
Gross profit	-4.38	0.75	-3.63
Net profit excluding subsidies	-4.83	0.74	-4.09

Source: EC, 2012

Social Analysis

The total employment in the Bulgarian fishing sector was estimated at around 3933 jobs and 2889 full time equivalents (FTEs) in 2010 (EC, 2012). The data for 2011 point at 1668 FTEs (NAFA, 2012), which is more in line with the estimates for 2008 and 2009 – 1507 and 1430 FTEs, respectively (EC, 2012). At the same time other studies support the higher number of employed in the marine fisheries sector, indicating 3 430 jobs on average for the period 2006–2009. There were a total of 99 fishing enterprises in the Bulgarian fleet in 2011. The vast majority of them, 68%, owned a single vessel and 30% of enterprises owned two to five fishing vessels. Only 2 fishing enterprises owned six or more fishing vessels (EC, 2012). The processing sector provides about 2 230 jobs, nearly 90% of them occupied by women, mostly on a seasonal basis. The fishing sector may play an important role for the labour market in small coastal municipalities providing 5 to 7% of all local jobs. (EC, 2011c)

Total employment in the Romanian fleet was around 444 jobs and 403 FTEs in 2010. The level of employment increased between 2009 and 2010, with the total number of employed increasing by 53% and the number of FTEs increasing by 65% over the time period. The total number of fishing enterprises in the Romanian fleet was 105 in 2011. The vast majority of fishing enterprises, 83%, owned a single vessel and 19% of enterprises owned two to five fishing vessels. Only 3 fishing enterprises owned six or more fishing vessels. (EC,2012).

For both Black Sea countries the fishing sector has only a minor contribution to the national economy, but it may play a sizeable role in smaller coastal communities.

Table 21. Social statistics for the Western Black Sea pilot area.

	Bulgaria	Romania	Total
	2010	**2010**	**2010**
Total employed	3933	444	4377
Full Time Equivalent (FTE)	2899	403	3302

Source: EC, 2012

4.1.4 Links to environmental pressures

Pressures caused by Fisheries

Fisheries are associated with a variety of environmental pressures and impacts. These vary according to factors such as local ecosystem dynamics, intensity of fishing activities, and types of fishing practices used. The MSFD uses eleven descriptors of GES of marine waters. These descriptors include: 1) biological diversity; 2) non-indigenous species; 3) commercially exploited fish and shellfish are within safe biological limits; 4) marine food webs occur at a normal abundance and diversity; 5) human-induced eutrophication; 6) sea-floor integrity; 7) alteration of hydrographical conditions; 8) concentrations of contaminants; 9) contaminants in fish and other seafood for human consumption; 10) marine litter; 11) introduction of energy, including underwater noise (EC, 2008). Several GES descriptors are affected by fishing activities.

Biological diversity affects the capacity of living systems to respond to changes in the environment, underpins ecosystem function and provides the ecosystem goods and services that support human well-being. It is therefore important for the future sustainability of marine natural resources, including commercial fisheries. Intensive fishing and overfishing is causing losses of biodiversity and valuable common property marine resources and ecosystem services (Worm et al., 2006; World Bank and FAO, 2008; Pusch and Pedersen, 2010).

Non-indigenous species (i.e. invasive species) can threaten ecological and economic well-being. Invasive species can carry disease, alter ecosystem processes, change biodiversity, disrupt cultural landscapes, reduce the value of land and water for human activities and cause other socio-economic consequences. Fisheries activities and vessels act as a pathway for non-invasive to enter new areas of Europe (DAISIE, 2010).

Fishing can overexploit stocks and damage habitats. Population assessments of *commercially exploited fish* are available for only a small fraction (<100 populations, <30 species) of Europe's marine species and the long-term viability of many targeted and non-targeted fishes is unknown. This situation applies to large parts of the Mediterranean and to deepwater species that are particularly vulnerable to overexploitation (de Juan and Lleonart. 2010).

Overfishing and excessive fishing can reduce the spawning biomass of a fishery below desired levels such as maximum sustainable or economic yields which may reduce the capacity of marine food webs to occur at a normal abundance and diversity (FAO, 2012).

Fisheries may impact marine populations or habitats because of unselective gear and *destruction of the seabed*. The effects of fishing on habitats are related to the physical disturbance by bottom gears in contact with the seafloor. These include removal of large physical features, reduction in structural biota and a reduction in complexity of habitat structure.

Marine litter is a common and costly problem for coastal local communities, organisations and the private throughout the world. Marine litter has a large impact on the marine environment and it is estimated that more than 1 million birds and 100 000 marine mammals die each year from becoming entangled in or ingesting marine litter. Fishing-related litter are lost or abandoned fish/lobster traps, crab pots, fishing lines, floats and nets. Derelict fishing gear, including nets, lines, tarps and floats and are a major worldwide concern (Ten Brink et al., 2009).

Underwater noise is an environmental pressure of ships, including from fishing vessels. The noise pollution caused by sonar, vessel engines and acoustic deterrent devices may have an effect on distributions of marine mammal species (Nowacek et al., 2007). Fishing activities may cause stress, impact food availability, and by-catch marine mammals (Herr et al., 2009).

Pressures caused by deep sea fisheries

A recent study (Villasante et al., 2012) found that increased fishing depths put new pressure on vulnerable deep-sea species. The study also suggests that deep-sea populations are often more vulnerable to fishing activities and that as a result, the ecological impact of fishing in deep-sea areas may be greater than in shallow waters. Fishing is moving to deeper waters as resources in shallow coastal areas are overexploited and technological advances enable fishing in these waters. However, fish in deep sea waters often live longer, grow slower, mature later and also have a slower fertility rate than species in shallow waters. This makes them more vulnerable to the pressures placed on them by fishing activities. Indeed, the data shows that the average age of fish caught in shallow waters was 13, while this was 25 for fish caught in deeper waters (Villasante et al., 2012).

In 2005, the General Fisheries Commission for the Mediterranean (GFCM) banned bottom trawling at depths beyond 1000m. Sea beds below 1000m have not yet been explored by Mediterranean fleets and the ban is a precautionary one to protect the still-intact and poorly understood deep sea ecosystems. Over half the area of the Mediterranean is banned from the harmful impacts of bottom trawling. Over a quarter of Mediterranean marine fauna are endemic and the percentage of endemism is higher in deep waters. Fragile areas of ecological significance are found in the deep waters of the Mediterranean, and new ecosystems have been recently discovered in the area. Vulnerable deep sea ecosystems include seamounts or submerged mountains, submarine canyons and cold-water corals. Deep water systems are also highly vulnerable to commercial exploitation due to the low turnover rates of the species adapted to these environments. Furthermore, protecting deep sea habitats benefits fisheries. The nursery area for deep water shrimps are at below 1000m, and excluding this area from trawling means protecting juvenile shrimps and thus the shrimp fisheries.

4.1.5 Gap analysis

Data issues remain a major challenge to assessing the fisheries sector in the Mediterranean and Black Seas, especially for open waters. Reporting differences (e.g. temporal coverage) also creates challenge for assessment, as fleets or regions are not comparable. In addition, because data (especially socio-economic data) is often available for national fleets it is often not possible to assess specific marine or coastal regions in terms of socio-economics.

Greece did not submit significant amounts of data for evaluation of the overall economic performance of its fleet. Data is not available on the number of fishers employed, complete data on weight and value of landings by species, income, Gross Value Added (GVA), Operating cash flow (OCF) and economic profit of the fleet and incurred subsidies since 2009. For the 2011 Annual Economic Report on the EU Fishing Fleet there is no data available from Greece.

4.1.6 Inventory of data sources

Table below provides an overview of the main data sources used for the above assessment.

Table 22. Overview of main data sources.

Name	Link
EC, 2011, The 2011 Annual Economic Report on the European Fishing Fleet	http://stecf.jrc.ec.europa.eu/documents/43805/256769/11-11_STECF+11-16+-+2011+AER+on+the+EU+fishing+fleet_JRC67866.pdf
EC, 2012, The 2012 Annual Economic Report on the European Fishing Fleet	http://stecf.jrc.ec.europa.eu/documents/43805/366433/12-08_STECF+12-10+-+AER+EU+Fleet+2012_JRC73332.pdf
FAO Stat, 2012	http://www.fao.org/fishery/statistics/gfcm-capture-production/en

Note: additional sources used throughout the assessment are included in the reference list.

4.2 Aquaculture

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4.2.1 Introduction

Context

Marine aquaculture is practiced in all the PERSEUS case study areas. The Aegean and Balearic pilot areas have the most significant and varied production, followed by the northern Adriatic and the western Black Sea which has very little production. The pilot cases are broadly representative of activities within the aquaculture sector and impacts over all Perseus regions. Although scales and types of production vary from country to country, it is the fastest growing food production sector. Spain, France, Italy and Greece are among the top seven European aquaculture producers (EEA 2011). In Spain, Italy and Greece the majority of production is marine-based. Countries bordering the Black Sea have smaller production but the potential for growth is high. The potential for profits is high, making mariculture increasingly attractive as an investment, as a source of foreign exchange and ancillary activities such as processing, transport and marketing which often generate more employment than on-farm activity. This is especially true in areas traditionally reliant on fishing. Concomitant with rapid growth, there has been increasing pressure exerted by aquaculture activities on the surrounding environment, locally, regionally and globally. These are summarized in Table 24. In addition, because mariculture is reliant on environmental resources, in particular water quality, space and wild fish stocks for feed and brood stock, it is also subject to natural ecosystem dynamics and pressures emanating from other users of marine resources.

Activity Description

Current mariculture activities in the SES were described in dliverable D2.2 and many of the details are relevant for the four pilot cases. Mariculture is conducted using a variety of methods. Most carnivorous finfish are reared in coastal or offshore net cages. Bivalves are grown on lines and rafts. Benthic enclosures are also used for detritivorous finfish such as mullet and a variety of flatfish as well as crustaceans. Seaweed cultivation is insignificant because of the oligotrophic conditions in the Mediterranean basin. The scale of mariculture activities varies from small artisanal enterprises to multinational industrial operations.

Mariculture has two distinct phases, the first focusing on the supply of juveniles and the second on the rearing and harvesting of mature fish. Juveniles may be supplied from wild capture or from hatcheries. In larger enterprises, the capture or hatchery is often vertically integrated with the grow-out phase. Where possible, data on hatchery activities is reported; however, reporting should be considered as partial.

Mariculture is supported by services including transport (for example of juveniles to the farm or harvested fish to the market), processing, supply of materials, fish feed and chemicals, veterinary, inspection and engineering services, consultancy and research and development. Although these activities are not explicitly included in the calculation of economic variables, some, such as processing may be included in employment figures.

4.2.2 Sector and socio-economic analysis

Methods, data and assumptions

Mariculture practice is highly non-uniform and the sectoral structures depend on a range of variables including historical dependence on marine fisheries and aquaculture, environmental conditions and public policy. Aggregate data at the regional and national levels tend to mask fundamental structural differences. To a certain extent this is also true for the pilot cases. For example, small scale operations located in remote areas may be a critical link in supporting rural communities. Ancillary activities (eg: transport and processing) may magnify the reported value added of artisanal and small-scale commercial enterprises; however, these values could not be reported here. All monetary values of production, GVA and employment are reported in €. No indirect values or spillovers are recored and no corrections for cross-border effects or different reporting practices have been made. No distinct data for shallow and deep waters was available.

Balearic Sea and Gulf of Lyon

The coastal areas of Catalonia, Valencia, the Balearic Islands and the Gulf of Lyon are the source of a large and varied production. Within this study, data for employment and the production quantities and values was available for Catalonia, Valencia and the Balearic Islands from MAGRAMA (2013). Numbers of firms and macroeconomic data for the pilot area could not be isolated and therefore the national figures for Spain are shown here. It was more difficult to isolate data specific to the Gulf of Lyon mariculture. As a proxy, data on the main marine species were extracted from Guillen and Motova (2013).

<u>Sector analysis</u>

Spain: Data extracted from MAGRAMA (2013) puts production for the pilot area at 30,415 tons in 2011. Spain is a major mariculture producer and the pilot area produces a wide variety of species. By weight, bivalves account for the largest share of end product. Catalonia is the largest producer in the pilot area. The region also has a highly developed hatchery and nursery segment. In the case of the Balearic Islands, output from this segment (sea bream 13 million individuals and sea bass 7 million individuals) exceeds the production of market-sized fish. Marine finfish production is dominated by sea bream and sea bass; however in Catalonia, tuna fattening is significant. In total, Spain has 5,150 mariculture enterprises of which over 90 percent are marine based (MAGRAMA 2013).

France: French Mediterranean mariculture is also dominated by the culture of molluscs, mainly oysters (139,100 tonnes; 2011) and mussels (85,000 tonnes; 2011) (Guillen and Motova, 2013). Cage culture of sea bream and sea bass takes place only along France's Mediterranean coast; however most of the 2,700 tons produced in 2011 comes from ponds near the North Sea and Atlantic coast. Marine finfish are produced by 21 companies and shellfish are farmed in 55,000 concessions owned by 3,700 companies (FAO-NASO, 2013; Guillen and Motova, 2013).

Economic analysis

Spain: Data extracted from MAGRAMA (2013) values production for the pilot area in 2011 at 118 million €. The data includes both market sized fish and juveniles. No breakdown of coastal and offshore production is available. A comparison shows that the revenue potential of different species is highly variable, with tuna fetching the highest value per kg produced, followed by finish and then shellfish. Hatchery and nursery operations are also highly profitable, particularly for sea bream and sea bass. The mariculture sector for Spain as a whole had revenues of 503 million € in 2011. Following deduction of costs including amortisation, the GVA of the sector was 151 million €.

France:. For sea bass and sea bream, mussels and oysters turnover was 701 million € and GVA for 2011 was 355 million € (Guillen & Motova 2013). These figures do not distinguish Mediterranean from other production areas.

Social analysis

Spain: Direct on-farm employment in 2011 for the Spanish areas of the pilot study are provided in Table 23.

Table 23 Employment - Balearic Sea 2011

	SALARIED		UNSALARIED (OWNER LABOUR)		TOTAL	
	FTE*	# PERSONS	FTE*	# PERSONS	FTE*	# PERSONS
CATALONIA	256	1,013	26	115	281	1,238
VALENCIA	331	512	8	18	329	530
BALEARIC ISLANDS	65	85	1	5	66	90
TOTAL PILOT AREA	653	1,610	35	138	676	1,858

*Full time equivalent

France: The total number of employees in farms growing mussels, oysters and sea bream and bass in 2011 was 16,010 or 8,700 FTEs.

Projections

Both Spanish and French maricultures are among the more developed in the region. Continued diversification of fish species and processed products is expected as is growth in hatchery and juvenile production. In terms of the spatial orientation of mariculture in the pilot area, competition for coastal space, especially from tourism is expected to push larger numbers of producers offshore. This is expected to significantly change the cost structure of the sector because generally offshore farms require more sophisticated engineering. It may also shift the production mix in favour of finfish since they are more suited to open water environments.

Northern Adriatic Sea

Sector analysis

Italy: In 2010 the Italian aquaculture sector (freshwater and marine) produced 162,325 tons or about 42% of all fish landings (fisheries and aquaculture combined). The sector is very diverse containing sizable marine and freshwater production of multiple species in different production systems, enterprise sizes and locations. In 2009 there were 877 active farms of which 642 use salt water (MIPAAF, 2011). Not all of these are located in marine waters. The Northern Adriatic contains the largest concentration of seawater plants. Among them, 212 (32.6%) are in the Veneto region and 118 (18.2%) are in Emilia Romagna, 46 farms in Friuli Venezia Giulia and eight in Abruzzio and Molise (UNMAR, 2008). Shellfish dominates production in all of these areas and the Northern Adriatic region produces over half of the country's marine molluscs (in the range of 60,000 tons). Production is concentrated in several large firms each having multiple sites. The composition of production between 2005-2010 was stable for major fish species, declining for mussels and stable for clams.

Croatia: Croatian production (freshwater and marine) in 2012 was 11,127 tons. The main marine finfish species are sea bass (2,400 tons) and sea bream (2,600 tons)(FEAP, 2013). Atlantic Bluefin tuna is another important marine species that accounted for 25% (1,500 tons) of marine production in 2011 (Guillen and Motova, 2013). Mariculture also includes a long tradition of cultivating Mediterranean mussel (*Mytilus galloprovincialis*) and the European flat oyster (*Ostrea edulis*) (NASO 2013). The majority of farms are small enterprises, private investments and family run businesses. There are approximately 35 marine finfish farms and 120 shellfish farms (NASO 2013).

Slovenia: Slovenian marine production in 2009 was 377 tonnes comprised of finfish (65 tons; mostly sea bream) and shellfish (312 tons). Fish farming takes place in coastal net cages and mussel farming takes place in using lines of floating buoys linked together, with longline nets hung from them. In 2007, three large areas were designated for marine aquaculture in Slovenian territorial waters. In 2009, the areas were separated into 22 plots, for which concessions were granted. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. Of the 22 farms, 20 grow shellfish and two grow finfish.

Economic analysis

Italy: The value of Italian production (freshwater and marine) in 2011 was 475 million € or about 30 % of the value of all fish landings (fisheries and aquaculture combined) (Osservatoria Nazionale della Pesca, 2011). In 2011, GVA of the sector was 155 million € (Guillen and Motova, 2013).

Croatia: Fisheries and aquaculture combined contribute between 0.2-0.3% of GDP (NASO 2013). Tuna's contribution is notable since it represents 38% the sector production value compared to 13% by volume in 2011(Guillen and Motova, 2013).

Slovenia: The average production value of the fisheries sector (fishing and aquaculture) in 2009 was around 4.67 million €. Fisheries and aquaculture together account to 0.016% of GDP.

Social analysis

Italy: The Italian aquaculture sector (freshwater and marine) employs 7,642,000 FTE positions.

Slovenia: In 2009, 30 people were employed in mariculture, of whom 24 are paid and rest are family-owner labour. Eighteen of these are engaged full time and 12 are part-time or seasonal. Most farms are small, family owned with few paid employees (NASO 2013).

Projections

Italy: The Italian sector is highly price sensitive and has recently experienced consolidation stemming from increased energy and feed costs that were only partly offset by price increases. Many, possible most family and traditional farms closed, while the other companies tried to reduce fixed costs by expanding and by developing management techniques based on the industrial model to reduce waste and optimize resources MIPAAF (2011).

Croatia: The strategic goal for mariculture is to increase the production and variety of cultivated fish to 10 000 tonnes/year, and of molluscs to 20 000 tonnes/year, whilst at the same time improving competitiveness within the European market. Thus the reduction of costs, improved product quality and constant advancement of ecological and health standards are the main tasks for further development of mariculture in Croatia (NASO 2013).

Slovenia: The main constraint to growth is spatial restrictions. There are no plans to expand the 22 designated plots due to lack of territorial waters. The main strategic objectives for the sector are to improve production techniques and encourage private investment (NASO, 2013).

Aegean Sea/ Saronikos Gulf

Sector analysis

Greek aquaculture production is in the range of 110,000 tons and the trend is upward. Almost all fish is sold whole either fresh or chilled. Most activity is along marine coasts. Marine finfish (mainly sea bass and bream) make up 80% of the volume. Most marine finfish farms are large and vertically integrated.

Economic analysis

According the MFSD Greek Initial Assessment, the value of Greek production is in the range of 192 million € of which 92% comes from marine finfish. It should be noted that there is a major discrepancy regarding the value of production between the census figures reported in the MFSD (section 8 1(c)) and Guillen and Motova (2013). According to the latter it is 523 million €, to be compared to 192 million €. This may be due to the inclusion of hatchery activities; however, there are ongoing issues regarding the reliability of reported data and lack of comprehensive surveys of the Greek sector. The added value of the sector is 18-19 million € according to the MFSD Greek IA.

Social analysis

The Federation of Greek Aquaculture estimates that 10,000 people are employed by the sector (5,000 FTE).

Projections

The upward trend is expected to continue with diversification as a strategic goal. In particular, certified products such as organic are regarded as an important niche market. Expansion could also be in investments in processing as well as into research and development of low cost production (Guillen and Motova, 2013).

Western Black Sea

Sector analysis

Romania: Ninety-nine percent of Romanian aquaculture is freshwater. Marine culture is dominated by Mediterranean mussels. Data are available on only one year of production (2010) 8,000 tons. For the three years, for which data is available, the industry size has fluctuated significantly; in 2009 there were 315 enterprises, in 2010 444 enterprises and in 2011, 201 enterprises (Guillen and Motova, 2013).

Bulgaria: Marine production in 2010 was 1,126 tons, largely unchanged from 2009 (1,121 tons) but up significantly from 2008 (842 tons) (Guillen and Motova, 2013). The Black Sea mussel (Mytilus galloprinciallis) is the most important marine aquaculture species grown in Bulgarian marine waters, mainly in small and medium sized enterprises.

Economic analysis

Romania: Production value fluctuated significantly: 2010-33,000 € and 2011-132,000 Euros. GVA of the entire aquaculture sector in 2011 was 12.4 million € or 37% of GDP.

Bulgaria: The value of marine production was 2.7 million € in 2008, 3.7 million € in 2009 and 3.9 million € in 2010, about 5% of the sales value of the aquaculture sector as a whole. GVA of the entire sector (freshwater and marine) was 8.1 million €.

Social analysis

Romania: Employment in the sector as a whole (freshwater and marine) was 1,316 FTE down from 3,933 FTE in 2010 and 2,669 FTE in 2009.

Bulgaria: Total employees and FTEs were equal, 1,100 in 2008, 1,375 in 2009, 218 in 2010 and 270 in 2011

Projections

Romania: Although domestic demand for fish, especially of marine species is growing, domestic aquaculture remains largely in the hands of artisanal producers and is poorly integrated with the domestic fish processing industry. There is no sectoral planning for aquaculture in Romania and though the growth observed in 2012 is expected to continue, the current extensive farming infrastructure is not expected to change without improved planning, extension and support and this will limit growth.

Bulgaria: Poor marketing insfrastructure and the absence of a strategic plan are barriers to development; however, currently, Bulgaria has adopted the Strategic Approach to national targets of the EU Member States and has prepared strategic documents from the relevant institutions, responsible for the implementation of sectoral policies in the country. The main objectives are set out in the draft partnership agreement in the Republic of Bulgaria and the EU for the period 2014-2020 (Guillen and Motova, 2013).

4.2.3 Gap Analysis

The major data challenge is the highly variable quantity and quality of reporting in different countries. For the pilot areas in particular, the isolation of marine productions in clearly defined geographic areas was for the most part impossible.

4.2.4 Links to environmental pressures

Typically, to sustain production, aquaculture needs to take place in water of high quality and one of the main pressures of concern at the farm and local levels is the impact of aquaculture effluents (i.e. uneaten food and metabolic waste products) on the quality of water and the benthos. These impacts depend both on the amount of effluent and the baseline carrying capacity of the receiving ecosystem. More oligotrophic systems and those with stronger currents generally have higher carrying capacities. In contrast, sensitive habitats and areas with high background levels of nutrients are more vulnerable. Loadings that exceed carrying capacity may lead to hypernutrification, increased biological oxygen demand and in some cases eutrophication, and possibly harmful algal blooms (HABS) (EEA 2011). These are directly related to MSFD descriptors 5 (eutrophication) and 6 (sea floor integrity).

The principal indicator for this pressure is the level of organic matter, mainly nitrogen, phosphorous and carbon. The use of pharmaceuticals and antifouling agents on the farm may also lead to discharge of contaminants that can negatively affect water quality and local flora and fauna (MSFD descriptor 8) and marine foodwebs (MSFD Descriptor 4). In certain circumstances may also impact the quality of fish and seafood intended for human consumption (either produced at the farm or in the wild) (MSFD descriptor 9). Because local degradation can lead to production problems on the farm, and because manufactured fish feed is generally the most expensive single input, there are built-in incentives for farmers to limit nutrient loadings, by avoiding excess feeding and through other sustainable management and production techniques (IUCN 2009).

Other important pressures exerted by aquaculture stem from the possibility that submerged farm structures and additional food may attract large aggregations of fish, marine birds and mammals to the farm area (MSFD Descriptor 1-biological diversity (mainly local)) and escapes of specially bred species and their possible reproduction in the wild (MSFD Descriptor 2-non-indigenous species and MSFD Descriptor 3-population of commercial fish/shellfish (mainly on local and sub-regional levels). Similarly, the possibility of pathogen transfer may directly affect wildstocks and more generally elements of marine food webs (MSFD Descriptor 4). Finally, the physical structure of individual farms or aggregations of farms may alter hydrographical conditions, interfere with marine fishing and shipping and disturb amenities (especially visual and odour) that are important for the tourism and real estate.

Many of the impacts can be mitigated through good practice, including efficient feeding and fallowing. Many have a high level of reversibility.

Table 24. Pressures and impacts stemming from mariculture (Sources: Angel 2013; EEA 2011)

Pressures stemming from aquaculture		**Impact**
Biological disturbances	Non-indigenous species and translocations	Alteration of genetic patterns of wild populations
	Microbial pathogens	Occurrence of diseases outbreaks
	Dependence on wildstocks for juveniles	Depletion of wildstocks (local, sub-regional and regional)
	Rising trophic level of farmed species (except Italy) and dependence on fish oil and meal	Depletion of wildstocks (global)
Hazardous substances	Volume of synthetic compounds (treatments including pharmaceuticals and antifouling)	Water toxification Antibiotic pathogen resistance
	Volume of non-synthetic substances (mainly pharmaceuticals)	
Nutrient and organic matter enrichment	Inorganic matter	Nutri/eutrophication of benthos & watercolumn Oxygen depletion HABs
	Organic matter (primarily food and animal waste)	
Physical Alterations hydrology and substrates	Placement of farm structures	Changing currents, habitat destruction or alteration

Pressures on mariculture stem from natural sources such as predation, seasonal runoff from rivers and storm damage. Anthropogenic risk factors include industrial effluent that can be toxic to farmed fish, hypernutrification from urban and agricultural organic waste and its consequences and stakeholder conflicts that may make it difficult to obtain/renew licenses and maintain farming activities. These are summarized in Table 25.

Table 25. Pressures and impacts on fish farms from the surrounding environment

		Impact
Biological disturbances	Predation	Damage to physical structure and crop loss
Hazardous substances	Industrial effluent	Crop loss, failure to meet food safety standards
Nutrient & organic enrichment	Nutrient rich runoff from agriculture and cities	HABs blooms, low oxygen causing crop loss
Socioeconomic	Competition for space, hostile governance	High compliance costs, stakeholder conflict

Scales, zones of influence and impacts

The pressures exerted and their impacts depend on a combination of the type and scale of culture, the attributes of different zones of influence (i.e. farm/local, sub-regional/regional, basin, global) (Karakassis and Angel 2011a). For example, for local impacts, pressures that matter most are those affecting water and benthic quality, sensitive habitats and amenity. Biological disturbance, in particular diversity, genetic changes and pathogens tend to be more relevant beginning at the sub-regional level. Issues related to wildstock depletion and overfishing related to aquafeeds are global in scale. In general, intensive cage culture of carnivorous finfish (the dominant form of finfish culture in the basin) pose the greatest risk of effluent and the reliance on fish meal and oil contribute to overfishing on a global level. Escapes from cages potentially pose risks of introducing non-indigenous species (IUCN 2009).

Throughout the Mediterranean, improvements have been made in farm management and structures to minimise food waste and prevent escapes (FAO 2012). There have been advances in developing varieties of species that are sterile or unable to survive in the wild or are otherwise incapable of cross-breeding with wild stocks (Brake et al., 2004; Cal et al., 2006; Gagnaire et al., 2006). In the Black Sea, the sector which is just developing is well positioned to benefit from these advances.

While in recent years, advances in hatchery technology for major Mediterranean species such as sea bream have been made, the capture of juveniles of certain species (eg: mullet) from the wild remains a threat to regional fishstocks (Benet-Perelberg 2013). All types of mariculture structures (cages, rafts, lines) can act as fish aggregating devices and may alter local diversity (Sanchez-Jerez et al. 2011). The same is true of pathogen transfer. Large farms or assemblages of farms have been shown to alter hydrographical conditions by blocking currents. Socioeconomic pressures stemming from stakeholder conflicts in crowded coastal zones where most mariculture is located is also a major challenge (Fezzardi et al. 2013).

The impacts of different pressures manifest themselves at different temporal and spatial scales, ranging from a matter of hours within metres of fish cages in the case of nutrient loadings to upwards of ten years in the case of gene-pool modifications to wildstocks (Karakassis 2001). Table 26 summarises the main temporal and spatial scales of impacts for the Mediterranean.

Table 26. Spatial and temporal scales of processes caused by or related to aquaculture (Source: Karakassis et al. 2001)

Table Nutrient Increases (Nitrogen & Phosphorous)	10-100 m	hours
Thickness of sediment beneath farm	cm	Weeks-months
Distance of anoxic area around cages	5-50m	months
Recolonisation of anoxic sediments by microfauna	m	years
Residence time of antibiotics in wild species	km	days
Propagation of microbial strains resistant to antibiotics or introduced parasites	10-100 km	2-10 years
Replacement of biota by introduced species	Depends on motility and larval propagation	Depending on lifecycle
Modification of gene pool wildstocks	10-100 km	Several generations (>10 yr)

Mediterranean Sea region in general

Mariculture in the Mediterranean per km of coastline is among the highest in Europe (EEA 2012). Intensive production of sea bream and sea bass is among the methods that exert the greatest pressure on the environment. It has also grown more rapidly than the culture of other species. Intensive farming of sea bream and sea bass is responsible for more discharges of nutrients, antibiotics and fungicides than the culture of lower trophic species and less intensive production methods. In addition, feeding efficiency differs from farm to farm and therefore food waste discharges are highly variable. Most of the Mediterranean is oligotrophic and therefore less vulnerable to hypernutrification and eutrophication and farming is generally practiced at sites with reasonably good flushing (Angel 2013). These two attributes make the region somewhat less vulnerable to organic enrichment of the sea floor and degradation of the water column. Nevertheless, local effects, especially in closed bays and lagoons occur and Karakassis 2001 concluded that the growth of intensive finfish culture could raise levels of both nitrogen and phosphorous basin-wide in the long-term.

Recent estimated loadings of the two main waste products from Mediterranean finfish cages (per ton of fish produced) were 69 kg Nitrogen and 11 kg phosphorous (Hoffher et al. 2011). The nitrogen estimates are vastly improved over those of UNEP/MAP/MEDPOL (2004) which reported 110 kg/t. Phosphorous has been more-or less stable over the last decade. While bivalve culture may decrease loadings (Karakassis and Angel, 2011), it also creates pressures including the removal of plankton and this can be an issue in oligotrophic systems such as the Mediterranean (EEA 2011).

The effect of nutrient loading on the benthos is the major environmental impact of concern. The greatest risk of degradation is in shallow waters with weak currents and fine sediments where particulate matter is not dispersed. Accumulation large volumes can cause anoxia in the vicinity of cages. Another risk is to sensitive habitats, in particular Posidonia seagrass meadows which are endemic to parts of the Mediterranean and have very poor resilience (Angel 2013 and references therein).

The amount of antibiotics used has been reduced drastically in recent years following the introduction of vaccines and improved husbandry. This has reduced the risks associated with discharges into the environment.

Wildfish used in the preparation of manufactured fishfeed remains a concern for the depletion of global fishstocks, especially small pelagic species. Estimates of feed input to fish output (kg) vary from 5:1 (Tacon et al. 2008) to 1.4:1 (IFFO 2013). For Europe, the average fishmeal component of total feed was 450 kg/ton fish produced and for fish oil, the average was 240 kg/ton (Hoffherr et al. 2011). According to Tacon et al. 2005, around 30% of all fish and shellfish landings were destined for conversión into fishmeal and oil. For the pelagic species, most commonly used in the production of fishfeed, the percentage is much higher this sector is the main economic driver in the overfishing of several anchovy, mackerel, pilchard and sprat species (Olsen 2011; FAO 2011).

Balearic Sea and Gulf of Lyon

Both Spanish and French maricultures have effluent loads that are higher than the EU average (Hoffherr et al. 2012). The Gulf of Lion tends toward eutrophy and is therefore more sensitive to effluent (Zenetos et al. 2011). In much of Spain, the number of farms located in unprotected or offshore sites with good flushing is high, meaning that the potential impact of these effluents may be mitigated (Sánchez Montañés & Torrent Bravo 2001). Spain is home to the largest tuna fattening conglomerate. With feed conversion ratios of between 10:1 and 20:1, tuna fattening releases the highest amounts of nitrogen, phosphorous and carbon into the marine ecosystem. In addition, the capture of stock from the wild is considered to be a major factor in overfishing of Mediterranean tuna stocks (FAO 2012).

Stakeholder conflicts are not uncommon, especially in places where farm structures are regarded as “new” and disruptive for visual amenity; however, this negative perception is not universal. In Galicia, where 3,500 rafts have been in place since the 1950's, the structures are regarded as integral to the landscape (Sánchez Montañés & Torrent Bravo 2001). Conflicts for space with tourism, especially in France have at times been extremely intense (FAO 2013).

Posidonia sea grass beds are notable in the Balearic Sea and Gulf of Lion and several studies point to the potential for damage caused by sediment and light changes caused by mariculture. Diversity changes around many farms due to aggregations of wild fish are also under surveillance (Sánchez Montañés & Torrent Bravo 2001).

Northern Adriatic

The northern Adriatic Sea is subject to eutrophy and hypernutrification, especially in seasons when runoff from rivers is high. It is not particularly well flushed and as a result, industrial waste, sewage and other effluents have potentially larger impacts that in other areas of the Mediterranean. Aquaculture is no exception (UNEP/MAP/MEDPOL 2004; Angel 2013). A 2003 case study conducted in the Bay of Piran is one of very few published directly comparing environmental performance of cage farms. Overall, particulate matter suspended at 5m depths and in the sediments was measurably higher in the fish farming area than at the control sites, demonstrating the contributions of uneaten food and faeces to carbon and nitrogen(Kovac et al. 2004). These trends mirrored an earlier study in the Gulf of Trieste (Faganeli et al. 1995); however, measured values were comparatively low. Ammonia, orthophosphate and other inorganic compounds were highest in sampling sites in the vicinity of the cages. Long-term impacts on meiofauna communities under the cages was observed, in particular lower abundance and diversity. Sediment chlorophyll a and phaeopigment concentrations was highest directly under the cages.

Tuna fattening is a potential problem for the reasons noted in Spain. Croatia pioneered techniques and there are a number of farms throughout the Adriatic.

Aegean Sea/Saronikos Gulf

The Aegean Sea with its large number of protected, poorly flushed bays has a somewhat higher level of primary production that most of the Mediterranean and there have been a number of cases of poorly sited and /or managed fish farms causing nutrient loading that have caused local degradation (Zenetos et al. 2011; Angel 2013). Cage farms in the Aegean tend to be large and cultivation is intensive and thus, the potential impacts of pressures from effluent loading are higher than in the other pilot case areas.

Greece has a relatively high demand for fishmeal and a somewhat lower demand for fish oil compared to the European average. Its effluent load is high compared to the rest of Europe.

Black Sea – West

As indicated in Marine aquaculture in the western Black Sea is relatively underdeveloped. With the exception of Turkey where European sea bream and sea bass are cultivated intensively, most mariculture focuses on molluscs, with Bulgaria dominating. As extractive species tend to exert fewer pressures on the environment, and because the size of the mariculture sector is small and poorly monitored, no dramatic environmental impacts from mariculture have been noted to date.

4.2.5 Gap Analysis

The two main gaps regarding environmental pressures emanating from mariculture are lack of comprehensive data on environmental pressures exerted by fish farming activities and documentation of links between pressures and impacts on the receiving environments. In many places, monitoring of farm effluents and environmental quality indicators has improved as legislative frameworks have become more established. There is still substantial variation from country to country with the biggest differences between EU and non-EU member states. More importantly, the variability of the characteristics of different aquaculture sites means that the same pressure will have different potential impacts over time and space. Isolating mariculture's impact on MSFD Descriptors 5, 6 and 8 will therefore remain a challenge. To the extent that capture fisheries can be documented, mariculture's contribution to overfishing either as a consequence of demand for manufactured fishmeal and brood stock could be estimated though with a degree of uncertainty. The same is true for non-indigenous species introduced through fish escapes to the extent that they appear in the wild. Documenting pathogen transfer between farms and the wild is likely to remain elusive.

Employment imputed employment for owner/operator/worker family

4.2.6 Future Trend Analysis

The size of the mariculture sector and the intensity of production is expected to increase especially since the cultivation of new species, such as cod, halibut and turbot, is becoming more viable and there is a desire to increase diversification within the finfish sector. This increase represents a rise in pressure on adjacent water bodies and associated ecosystems, resulting mainly from nutrient release from aquaculture facilities. The precise level of local impact will mainly vary according to species, production techniques and local natural characteristics (EEA 2011).

While the expected increase in the production of carnivorous finfish will increase the demand for manufactured feed, greater feeding efficiencies and the development of formulations based on alternative protein sources (eg: soy) may mitigate the pressures on fisheries (Olsen 2011). Tacon et al. 2010 projected that fishmeal use will decline while fish oil will remain constant. As governance frameworks become more established and monitoring standardized, it is reasonable to expect that data and knowledge gaps will become smaller and potential for understanding and mitigating a number of pressures will improve.

4.3 Maritime transport & ports, Cruises

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4.3.1 Introduction

Maritime transport is the transport of both people (passengers) and goods (cargo) by sea-going vessels. The international trade and the exchange of goods and commodities are essential to improve the quality of the life of human beings all over the world. Shipping is the main mean of transport for international trade and the United Nations Conference on Trade and Development (UNCTAD) estimates that more than 80% of world trade is transported by the shipping industry (United Nations, 2012).

There are over 50 000 merchant ships trading internationally, transporting every kind of cargo, such as raw materials and commodities, finished goods, food or fuel. The world fleet is registered in over 150 nations and manned by over a million seafarers of almost every nationality (Shipping Facts, 2011).

Most freight cargo is transported from the producer to the consumer using various modes of transport and passing through a number of nodal points. Sea ports play a crucial role because they are the point of contact between water and land and they constitute one of these nodal points. There are more than 2,900 commercially active ports worldwide (Lloyd's Marine Intelligence Unit, 2007), being the United States the country with the largest number of ports (364) (Freight Transport for Development, 2012). The world's busiest port is the Port of Shanghai (China) in terms of both total cargo throughput and container traffic (American Association of Port Authorities, 2010).

In Europe, there are more than 1200 ports along the 100 000 kilometres of coastline, providing more than half a million direct and indirect jobs (European Commission, 2011).

The Mediterranean Sea is one of the world's busiest areas for maritime activity. There are 480 ports and terminals with recorded ship movements in the Mediterranean Sea, almost half of which are located in Greece and Italy (Lloyd's Marine Intelligence Unit, 2008). Regarding the Black Sea, the website World Port Source (2012) identified 62 active ports located in that sea area.

Shipping presents advantages to transporting goods compared to highway, railway and air transportation. The main strengths of marine transport are: i) it is an economical mode of transportation; ii) it consumes less energy than other forms of transportation; iii) it is an environmentally friendly transport mode, producing fewer exhaust emissions; and iv) it is a safe transport method having less frequency of accidents (St Lawrence Seaway, 2011).

4.3.2 Sector and socioeconomic analysis

This section presents facts and figures on the performance of the port sector and the maritime industry, initially from a Mediterranean and Black Sea level and later in a PERSEUS Pilot Cases sub-regions. These data provide the reader with information on the current status of the sector and its trends year over year.

Mediterranean and Black Sea

Error! Reference source not found. displays the gross weight of goods handled year-over-year since 2001 in the EU ports as a whole, in the Mediterranean and in the Black Sea ports.

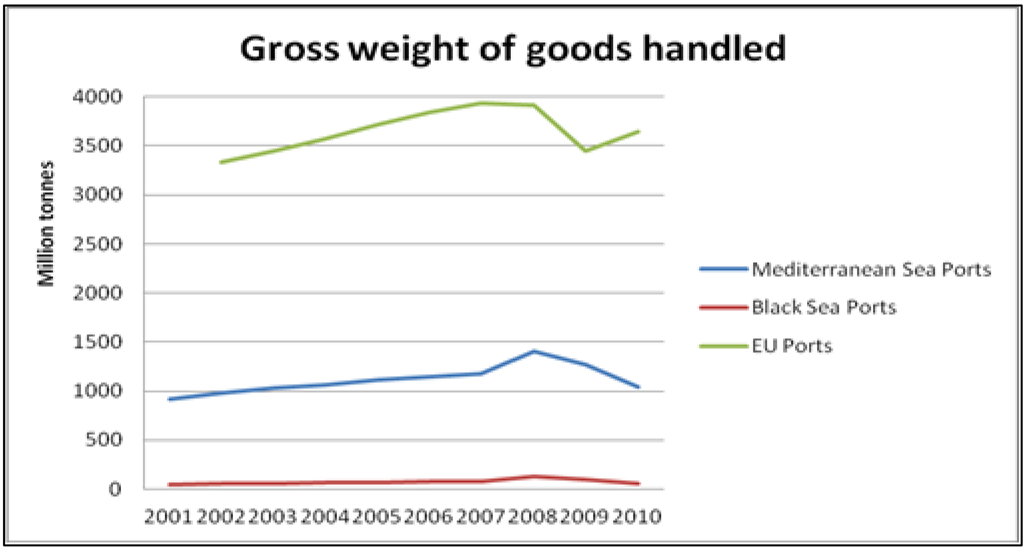

Figure 5. Gross weight of goods handled in Mediterranean, Black Sea and EU ports from 2001 to 2010. Source: Eurostat, 2012b.

According to Figure 5, in general, Mediterranean ports had a positive growth of their gross weight of goods handled from 2001 to 2010, handling a total amount of 1,046 million tonnes of goods in 2010, representing a 28.8 % of the goods handled in all the EU ports (Eurostat, 2012e).

Around 61 million tonnes of goods passed through the EU Black Sea ports in 2010 (See Table 27**Error! Reference source not found.**), representing a 1.7% of the gross weight handled the same year in all EU ports (Eurostat, 2012e). Although it cannot be properly distinguished in Figure 11, from 2008 to 2009, the gross weight of goods handled in the Black Sea ports fell sharply by almost 25%, much more than the EU port as a whole which fell by 12%. However, the overall change from 2001 to 2010 was a growth of 27.7%, higher than the EU average which was 9.2%.

In 2010, almost 232 million passengers passed through the Mediterranean and Black Sea ports, accounting for more than half (58.6%) of EU passenger seaborne traffic. Between 2009 and 2010 the number of passengers in the EU Mediterranean and Black Sea ports decreased by 4.2%, whereas in the same period the number of passengers in all EU ports fell by 2% (Eurostat, 2012i).

The number of vessels that entered in Mediterranean and Black Sea ports in 2010 was 1,358,717 vessels (based on inwards declarations), representing this figure the 68% of the total EU calls (Eurostat, 2012d), and therefore proving the high maritime and port activity existing in these coastal regions.

This deliverable focuses on the PERSEUS Pilot Cases. In each sub-region the traffic statistics are presented in terms of gross weight, liquid bulk, dry bulk, containers, ro/ro, and general cargo. In addition, the number of passengers embarked and disembarked in each sub-region is provided. Finally, the number of vessels that entered yearly in ports (based on inwards declarations) is given.

Balearic Sea and Gulf of Lyon

This Pilot case comprises of the coastal Member States of Spain and France. The statistics of this region are provided in Table 27.

Table 27. Traffic statistics of the West Mediterranean sub-region (MS of Spain and France)

West Med	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gross weight	328030	333579	352713	373355	398822	414969	419773	414093	366714	376412
Liquid bulk	158984	158938	163597	166264	174825	177453	175524	178634	166760	167368
Dry bulk	66221	68825	69601	72429	80170	81270	81573	70409	51799	54028
Containers	6219	6435	7755	7415	10166	10727	12204	12335	11103	11835
Ro-ro	12266	12522	13467	14599	16281	19988	18480	18523	17674	15105
General cargo	14401	14957	14661	15713	15831	16631	16110	13984	11419	12323
Passengers	21776	22622	23711	25391	26423	26768	27737	27302	25758	27005
Vessels	189630	197202	202948	203023	196626	187791	207027	195538	117095	122889

Source: Adapted from Eurostat, 2012d,e,g,h,i. Units: thousands of TEUs (containers), thousands of tonnes (cargo), thousands of people (passengers), and units (vessels).

The traffic statistics about the West Mediterranean demonstrate that this sub-region has a high level of maritime activity, despite the fact that they only include data from the Mediterranean coast of Spain and France.

In fact, Spain is the second EU Mediterranean country, after Italy, in the volume of goods handled by the maritime transport. Out of the 376 million tonnes handled in all the Spanish ports, 284 were transported in the Mediterranean Sea (75.5%) (Eurostat, 2012e). France is ranked as the third country in the overall gross weight of goods handled; however, only a 30% of its port activity is done in the Mediterranean Sea, the rest is handled in the Atlantic Ocean.

Container traffic has, undoubtedly, increased rapidly in the recent years in almost all ports, in a global, European, Mediterranean and Black Sea level. According to Eurostat (2012h), between 2001 and 2010 the transport of containers in the Mediterranean ports has increased, on average, almost 61%. In the West Mediterranean sub-region it has increased 90.3%, the highest rise of the Mediterranean sub-regions.

In Spain, this rate has been exceeded, having an increase of +97.4%. The Port of Valencia (Spain) is the port that handles the largest number of TEUs among the whole Mediterranean ports (Eurostat, 2012h). Although almost all types of commodities have increased its annual cargo handled (except dry bulk and general cargo), the number of vessels has dropped. It may be understood as there are less vessels calling at ports but they are transporting more cargo in the ship.

Northern Adriatic

The Northern Adriatic Pilot case includes Italy, Slovenia, and Croatia. Table 28 provides the performance of this area:

Table 28. Traffic statistics of the Central Mediterranean pilot case (MS of Italy, Slovenia and Croatia)

Central Med	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gross weight	473006	504431	528456	547539	573973	588316	613374	601219	529989	557340
Liquid bulk	203586	203303	206257	200862	226615	224458	228305	221896	197141	204491
Dry bulk	88196	85150	90823	95513	116825	121064	122932	127204	119805	85157
Containers	6378	7267	8019	8123	8182	8300	9210	8721	7861	9237
Ro-ro	23699	27149	30746	32523	33811	34813	43024	39398	31183	53943
General cargo	20407	24376	26651	25799	28416	32007	33647	43003	23566	33875
Passengers	16867	36862	39013	43080	44399	46152	49273	52138	52130	50287
Vessels	527578	511204	516044	522639	798831	859811	851415	860730	870510	911229

Source: Adapted from Eurostat, 2012d,e,g,h,i. Units: thousands of TEUs (containers), thousands of tonnes (cargo), thousands of people (passengers), and units (vessels).

The previous table provides the results of the shipping sector of the Central Mediterranean countries of Italy, Slovenia, and Croatia. This area is clearly the one with the higher port's and shipping commercial activities in the whole Mediterranean Sea, with a total amount of 557 million tonnes of gross weight in 2010.

There are several reasons that contribute to explain why this region has the most intense maritime traffic in the Mediterranean. The first is that it includes two emerging countries that have had the highest growth in the gross weight of goods handled from 2001 to 2010, which are Slovenia (+59.5%) and Croatia (+27.7%) (Eurostat, 2012e).

The second reason is that Italy, with a long shipping tradition, is the country that handles the highest amount of gross weight of goods in the Mediterranean Sea, around 494 million tonnes in 2010, and representing 47% of the seaborne trade of the Mediterranean (Eurostat, 2012e) and 13.6% in the overall EU ports (Eurostat, 2012f).

In addition, Italy is, by large, the country that handles the largest quantity of liquid bulk, almost a 50% of all Mediterranean Sea liquid bulk traffic and a 13% of the whole EU ports in 2010, followed by Spain and France (Eurostat, 2012g). In general, small countries have faced the highest growth in trading liquid bulk from 2001 to 2010, such as Malta (+63.3%) or Slovenia (+46.5%), the latest included in this report.

Concerning the ro-ro traffic, in these countries there has been an overall increase of 127.6% since 2001, from 23 to almost 54 million tonnes. Italy is again the Mediterranean country that handles the highest amount of ro-ro cargo, with an impressive increase of a 121.5% since 2001 until 2010 and a 74.2% in the last year (2009-10). All Mediterranean Sea ports experienced an increase in the ro-ro cargo traffic, except Croatian ports that reduced it by -4.6% (Eurostat, 2012g).

Italy is again the country with major general cargo activity, representing 60% of non-containerised cargo traffic for the whole Mediterranean countries (Eurostat, 2012g). However, in this category most ports have not recovered from the global downturn of 2008 because their levels of activity in 2010 are below from the recorded in 2001. Only Italy and Slovenia register higher levels than 2001.

In general, there has been a drop in the trade of dry bulk products in the Mediterranean sea compared with 2001, being the largest decrease in Malta (-46.7%), Cyprus (-27.9%), and Italy (-24.5%) (Eurostat, 2012g). The overall decrease of the dry bulk traffic in EU ports is about -14%.

Although it is not mentioned in the table, Italy is the highest country dealing with cruise passengers; 60% of EU Mediterranean cruise passengers departed or arrived in Italy, 27% in Spain and 8% in Greece in 2009. The major cruise port is the Port of Barcelona, followed by the two Italian ports of Napoli and Genova (Eurostat, 2012b).

Italy remained as the country with more vessels calling at its ports, with a share of 38% out of the total Mediterranean and Black Sea ports, followed by Greece (36%) and Croatia (14.4%). Malta had the highest growth (+656.3%) in terms of number of vessels, evolving from 3,045 vessels in 2003 to 23,030 vessels in 2010 (Eurostat, 2012d).

Aegean Sea/Saronikos Gulf

The East Mediterranean sub-region includes the EU coastal country of Greece. Traffic statistics are displayed in Table 29.

Table 29. Traffic statistics of the Agean Pilot case (Greece)

East Med	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gross weight	86420	96772	110460	106889	103816	107320	108318	100469	92989	88284
Liquid bulk	34634	37211	36608	36575	36789	40706	40702	46074	44087	41717
Dry bulk	24591	26054	27046	28361	28904	27537	28599	26653	22424	21214
Containers	1395	1652	1884	1867	1767	1760	1336	830	1001	1132
Ro-ro	7078	12846	23239	19072	16059	16856	18111	16083	14494	11051
General cargo	6874	6703	5623	5603	5723	5537	5468	5432	4285	4106
Passengers	50149	101210	102760	96744	86068	90402	92423	91101	88351	83993
Vessels	194362	331893	370094	461244	470083	493146	517143	487922	477841	489100

Source: Adapted from Eurostat, 2012d,e,g,h,i. Units: thousands of TEUs (containers), thousands of tonnes (cargo), thousands of people (passengers), and units (vessels).

According to the gross weight showed, this is the area with less port activities in the Mediterranean Sea and with the minor growth since 2001. This is the only Mediterranean sub-region that has a negative growth from 2009 to 2010. This may be caused because in the period 2009 - 2010 most ports recovered and had a positive growth, except only in Greece (-8.2%) and France (-0.6%) (Eurostat, 2012a).

Surprisingly, Greece is the second Mediterranean country in terms of tonnes handled per capita (11), after Malta (14.4) (Eurostat, 2012f). Since Greece does not have a high number of cargo handled, it may be justified by the low population of this country compared to other Mediterranean regions.

It is interesting to point out that the number of vessels in this PERSEUS Pilot Case region has increased the most compared to the rest of the regions, by 151.6% since 2001.

Western Black Sea

In this area, there are two EU countries, Bulgaria and Romania.

Table 30. Traffic statistics of the Black Sea Pilot case (MS of Bulgaria and Romania)

Black sea	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gross weight	47811	53088	57283	63719	72535	74222	73828	131046	102184	61068
Liquid bulk	7825	16726	17335	21150	25005	26340	25091	29860	24043	19945
Dry bulk	8675	9801	9267	27817	29033	27416	24515	50183	42158	26897
Containers	39	70	82	496	976	1290	1577	1623	758	690
Ro-ro	499	443	499	519	740	580	329	1493	1235	274
General cargo	2569	2178	3210	9023	8979	7916	9189	14137	10056	6069
Passengers	3	6	4	6	13	15	10	8	0	1
Vessels	2821	2834	3076	6018	6629	7283	73439	40851	34331	4990

Source: Adapted from Eurostat, 2012d,e,g,h,i. Units: thousands of TEUs (containers), thousands of tonnes (cargo), thousands of people (passengers), and units (vessels).

As it may appear obvious, the level of port activity in the Black Sea is less intensive as it is in the Mediterranean Sea. For example, there are only a few thousands of passengers in the Black Sea, whereas the Mediterranean Sea there is millions of passengers.

As stated previously, in 2010 around 61 million tonnes were handled in the EU ports of the Black Sea (see Table 30**Error! Reference source not found.**). Out of the 61 million tonnes, 62.5% was handled in Romanian ports and a 37.5% in Bulgarian ports (Eurostat, 2012e).

Analysing the results individually by ports, the Port of Constanta (Rumania) maintains the top position as the major dry bulk centre not only in the Black Sea but also compared to ports in the Mediterranean Sea (Eurostat, 2012g). Overall, the growth of the gross weight handled from 2001 to 2010 in the Black Sea is 27.7%. In Romania this growth has been particularly significant, increasing 38% in the same period of time (Eurostat, 2012e). However, the highest rise has been in the transport of containers (1669.2%), increasing mostly in Bulgaria. The Port of Constanta handles the largest number of containers in the Black Sea with 548,000 TEUs in 2010 (Eurostat, 2012h). The ro-ro traffic decreased dramatically in 2010. Turkey handles, by large, the largest amount of ro-ro traffic, followed by Bulgaria and Romania. Bulgarian ports faced a reduction of a -70.5%, and Romanian ports an increase of a 273.5% from 2001 to 2010 (Eurostat, 2012g).

Selected examples of port's employment and turnover

According to the European Port Performance Dashboard (European Sea Ports Organisation, 2012) the major indicators to express the seaport sector's contribution to the European economy are the direct employment and the turnover of the ports. The turnover (or revenue) is the income that a company receives from its normal business activities, usually from the sale of goods and services to customers. No aggregated data about the turnover of the Mediterranean and Black Sea ports was available, and therefore these data was taken from individual ports, provided in Table 31 a compilation as an example.

The shipping industry contributed an estimated EUR 26 billion added value to the economy of the EU 27[3] in 2010, which equated to about 26% of the value added generated by maritime activities (Policy Research Corporation, 2010).

Table 31. Turnover of selected ports.

Country	Port	Year	Amount (million €)
Spain	Barcelona	2010	167
		2011	158
	Valencia	2008	112
	Algeciras	2010	101
France	Marseille	2002	151
		2003	154
		2004	165
Greece	Piraeus	2010	122
	Thessaloniki	2007	66
Italy	Genoa	2012	72
Slovenia	Koper	2010	128
Bulgaria	Burgas	2011	17
	Varna	2010	20
Romania	Constanta	2011	64

Source: website of port authorities

Ports are becoming more and more a key node of the global logistic chain and less an isolated place as it used to be in the past. Therefore, ports are important generators of employment at the local, regional, national and even European level (Notteboom, 2010). Notteboom (2010) states that ports create direct port employment through cargo handling services, ship operations and nautical services. Typical direct jobs include dock workers, ship agents, pilots, tug boat operators, freight forwarders, port authority employees, ship chandlers, warehouse operators, terminal operators and stevedores. Indirect jobs of ports' activities are, for example, jobs in local office supply firms, equipment suppliers, maintenance and repair, insurance companies, consulting and other business services.

[3] Excluding Bulgaria

A report from the European Sea Ports Organisation (ESPO) provided data on average employment in ports in countries in the Mediterranean and Black Sea, although this data is not directly aggregated for the specific seas. The study results are presented according to region (based on a geo-governance typology) being Region 1 France, Portugal, Spain, Malta, Italy, Greece, Cyprus and Israel, and region 2 Slovenia, Croatia, Romania and Bulgaria (European Sea Ports Organisation, 2010).

Table 32. Average number of employees working in a port authority (full time equivalents), 2011

Country group	Administrative	Nautical	Engineering	Equipment drivers	Dock workers	Other	Total
Region 1	103.5	17.8	43.7	34.9	16.8	49.3	265.9
Region 2	83.9	40.4	4.3	30.3	5.3	166	330.1

Source: European Sea Ports Organisation, 2010

Notes: Data is averaged for the country groups, so estimates include data not relevant to the Mediterranean or Black Sea.

4.3.3 Conclusion of the socio economic analysis

The results of the industry, economic and social indicators have demonstrated that shipping is a vital element to the economy as it is essential to the transport of materials and goods and ports play an indispensable role as a node in the global logistic chain. Shipping is also considered one of the most environmentally friendly and energy efficient modes of transporting cargo. As it has been demonstrated in this report, European shipping is recovering progressively from the economic downturn suffered in 2009 and, in general, the industry indicators and the economic records are increasing gradually in ports. It also demonstrates that the Central Mediterranean is the sub-region that has more volume of marine and port's activity in terms of gross weight, followed by the West Mediterranean and by East Mediterranean. Finally, the Black Sea is in the last position because its level of activity is less intensive and it has fewer EU ports.

4.3.4 Links to environmental pressures

Port and shipping activities produce a variety of pressures and impacts on the marine environment. These can be understood as any change to the environment, whether adverse or beneficial, wholly or partially resulting from activities, products or services (ISO 14001, 1996). In this section, the pressures that the ships and ports may cause on the environment are presented, following the 'pressures and impacts' specified in the table 2 of the Annex III of the Marine Strategy Framework Directive (MSFD), which are physical loss and damage, other physical disturbance, biological disturbance, and contamination by systematic and/or intentional release of (hazardous) substances as well as air pollution.

Physical loss and damage

Port construction involves the expansion of port facilities to accommodate loading and unloading of goods; it may entail smothering coastal land as well as the destruction of terrestrial habitats, but it may also involve the filling of wetlands to acquire land for port development. Land reclamation, which is creating new land from sea beds and sand, is often used to increase port capacity to handle ships. This may generate the destruction of natural areas and disturbances to flora and fauna (EcoPorts Foundation, 2004). In addition, dredging activities may impact the physical environment through changes in bathymetry (underwater depth), hydrography (tidal flow, currents, velocity, and waves), sediment transportation (deposition or erosion), elimination of contaminated sediments or by altering the biological environment through disturbances to benthic habitats, increase in turbidity, and re-suspension of contaminants that may lead to a loss of fishery resources (Paipai, 2009). Disposal of dredged material on land may cause destruction of plants, loss of vegetation, and odour and unsightly view to the local community (EcoPorts Foundation, 2004).

Other physical disturbance (noise and marine litter)

Noise has become a widespread form of marine pollution, especially in areas of intense maritime traffic operations (IUCN, 2008). Noise in ports is generated by ship traffic, road traffic and cargo operations. It may create stress, reduced working efficiency, and even hearing loss to port and ship employees, as well as be a nuisance and cause sleep loss to nearby residents. The most powerful noises may directly injure animals in the vicinity of the source (IUCN, 2008). In the 'ESPO/Ecoports Port Environmental Review 2009', port managers identified noise as the current top environmental priority of the sector. In coastal zones with high vessel traffic, ships are a dominant source of low frequency noise (OSPAR, 2010). Noise from ships can impact fish and sea mammal behaviour by distracting them and impairing their ability to retrieve vital information. For example, fish can be hindered from finding suitable habitats and protection, making them more susceptible to predators and other threats, because of exposure to artificial noise (University of Bristol, 2010). Estimates suggest that background marine noise has doubled each decade since the 1950s in some areas due to the development of faster and larger ships as well an increase in vessel traffic (OSPAR, 2010).

Shipping is considered a major source of marine waste and the most significant source of marine litter from sea-based activities (Sheavly, 2005). Marine litter can harm the marine environment by physical damage and smothering of reefs, sea grasses, mangroves, and transport of invasive species as well as being ingested by fish. Economically, it can cause serious losses, especially in coastal communities (increased expenditures for beach cleaning, public health and waste disposal), shipping (costs associated with fouled propellers, damaged engines, litter removal and waste management in harbours), and fishing (reduced and lost catch, damaged nets, etc.) (UNEP, 2009). From a human health perspective, marine litter poses risks through exposure to medical and sanitary waste in bathing water, as well as bioaccumulation up the food chain (GESAMP, 2010; UNEP 2009). In particular, micro plastics (preproduction plastics and deteriorated fragments of larger pieces) are emerging as a major environmental and health issue. Tiny plastic fragments can concentrate persistent organic pollutants (POPs), which then can be ingested by species and make their way up the food chain to humans (GESAMP, 2010).

Nutrient and organic matter enrichment

The introduction of organic matter, such as sewage, fertilisers and other nitrogen and phosphorus-rich substances into the environment can lead to potential harmful effects on human and wildlife health, the environment, fisheries and recreational pursuits (EcoPorts Foundation, 2004). Eutrophication, for example, leads to an increase of phytoplankton in a water body as a response to increased levels of nutrients. Negative environmental effects include the depletion of oxygen in the water, which induces reductions in specific fish and other animal populations. Other species may experience an increase in population that negatively affects other species.

Contamination by the release of (hazardous) substances

The Mediterranean Sea is crossed by thousands of oil tankers sailing along the main routes each year (IUCN, 2008). Oil spills, leakages and discharges of hazardous or toxic substances (e.g. oils and hydrocarbons discharged into the water, chemical substances, lubricants, fuels, and oily wastes) can severely affect marine ecosystems and air, water, soil or sediment quality (OSPAR, 2010). The release of gases may cause problems such as toxic material emission, explosions, fumes, odours and hazardous air emissions (United Nations, 1992). On land, runoff from raw material storage, spills from bulk cargo handling, and wind-blown dust are possible sources of contamination. Soil pollution may lead to contamination of the surrounding land and groundwater, reduce land value, prevent future development and be an environmental or health hazard (EcoPorts Foundation, 2004). Groundwater contamination may affect specific plants and organisms, but also the natural biological communities (Trozzi and Vaccaro, 2000). Sediment pollution occurs when hazardous substances reach the bottom of the sea (EcoPorts Foundation, 2004) and poses a serious threat to the benthic environment, which includes worms, crustaceans, and insect larvae that inhabit the bottom of a water body. Pollution can lead to their death, reducing the food available to larger animals such as fish. When larger animals feed on contaminated benthic organisms; the toxins are transmitted to their bodies. As a result, fish and shellfish, as well as benthic organisms, may be affected by contaminated sediments (United Nations, 1992). Ultimately, this creates potential harmful effects on the health of humans and wildlife, the environment, fisheries and recreational pursuits (EcoPorts Foundation, 2004).

Biological disturbance

Marine ecology includes aquatic fauna and flora composed of a large number of species of bacteria, phytoplankton, zooplankton, benthonic organisms, coral, seaweed, shellfish, fish and other aquatic biota (United Nations, 1992). The surrounding terrestrial areas of some ports include flora and fauna such as mangroves, wetlands, woodlands, wildlife corridors and Natura 2000 sites (protected areas) (EcoPorts Foundation, 2004). Port activities may disturb the habitat of these species and their natural behaviour. At sea, alien species are also transported in the ballast of ships, and when a ship discharges water they are then introduced into new marine environments (DAISIE, 2010). The risk from invasive species is associated with the amount of water transported, the frequency of ship visits and the similarity of environmental conditions for the species (OSPAR, 2010). According to the DAISIE Project (2010), the main way for the introduction of alien aquatic species in Europe is by vessel. In the Mediterranean, 925 exotic species have been inventoried and over half of these have established populations which have prospered, about 28% entered through maritime transport (UNEP, 2009). Non-indigenous species can create considerable changes in marine ecosystems, causing economic loss and even threatening human health. Alien species place pressure on the environment by transporting diseases, altering ecosystem processes, changing biodiversity, disrupting cultural landscapes, and reducing the value of land and water for human activities (DAISIE, 2010). Collisions between ships and marine animals are regularly reported from all the world’s oceans. The Mediterranean Sea is particularly susceptible to ship-associated collisions because of the high volume of shipping routes. This can be a major cause of human-induced mortality (IUCN, 2008).

4.4 Recreational activities, coastal tourism

Prepared by José A Jiménez (UPC-LIM) and by Aleksandar Shivarov (BSNN) for the Black Sea.

4.4.1 Introduction

Tourism is one of the main motors for the economic development of coastal areas worldwide (Houston, 2008; Plan Blue, 2009). In the Mediterranean countries, tourism attracts about 30% of global international tourism arrivals (in 2007, 275 million of international tourists visited the region) being mostly concentrated during summer months. As an example of the importance of this economic sector in the region, Spain and France are within the top 3 recreational tourism destinations in the world in number of arrivals and revenues (their position in revenues and visitors is usually alternated between with USA). To illustrate the importance of the coast in the tourism sector, Figure 6 shows the spatial distribution of tourism intensity in NUTS 2 regions measured by using the total nights spent by tourists where a clear concentration in coastal regions is observed.

Coastal areas provide important and varied ecosystem functions, goods and services (de Groot et al. 2002). Among them, recreation is the function mostly valued by the tourism sector, which "exploit" provided ecosystem services such as scenery use of nature with cultural/artistic or spiritual/historic purposes, provision of water for consumptive use, storm protection and fishing.

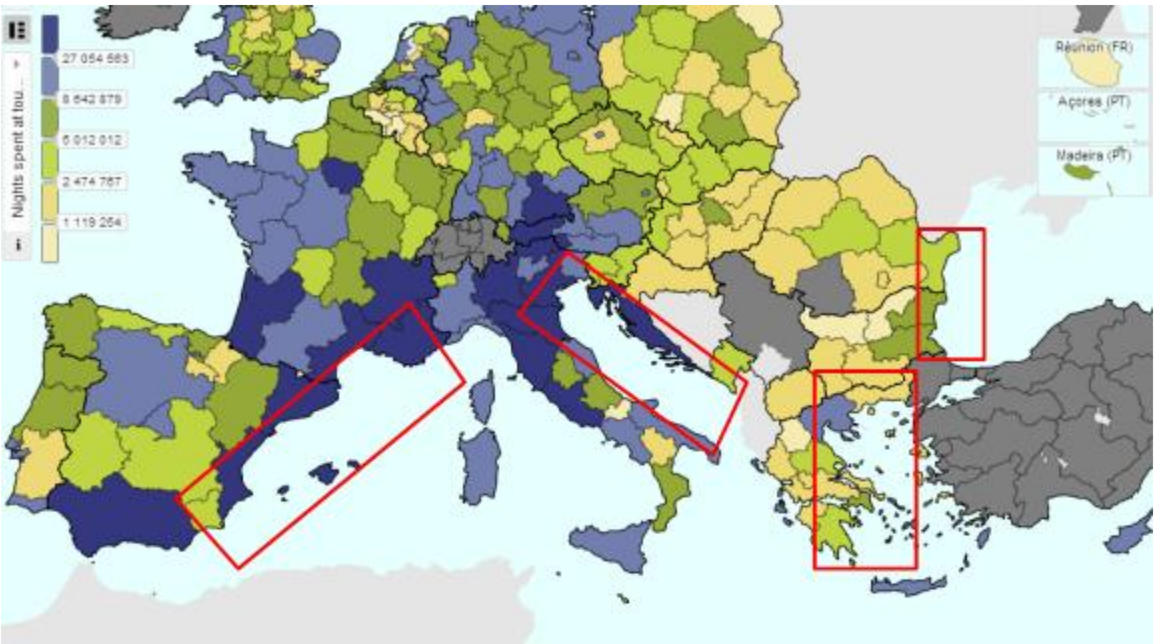

Figure 6. Tourism intensity in NUTS 2 regions indicated by means of total nights spent (Eurostat, 2013)

Within this context, the main aim of this report is to characterize the importance of the tourism sector in the PERSEUS pilot areas in socio-economic terms and to provide information on pressure and impacts originated on the marine environment. Finally, gaps on existing information are identified. A similar section but providing data for the entire Mediterranean basin was presented in deliverable D2.2.

4.4.2 Sector and socioeconomic analysis

In order to measure the importance of tourism in the selected areas, different indicators have been based on their relevance and, in practical terms, taking into account the availability of data and/or statistics in the study area at the selected scale. Some of the selected indicators are complementary to the already employed in Deliverable 2.2 where National statistics were presented. In this work, statistics is compiled at the scale of regions to be later integrated for each pilot site (see included regions in Table 33).

Table 33. Coastal regions included in each Pilot site.

Pilot site (abbreviation)	Country	Region
Balearic Sea and Gulf of Lyon (W Med	ES	Catalunya Com Valenciana Illes Balears Murcia
	FR	Languedoc-Roussillon Provence-Alpes-Côte d'Azur
Northern Adriatic Sea (N Adriatic)	IT	Veneto Friuli-Venezia Giulia Emilia-Romagna Marche Abruzzo Molise Puglia
	SI	Zahodna Slovenija
	HR	Jadranska Hrvatska
Aegean Sea/Saronikos Gulf (E Med)	GR	Anatoliki Makedonia, Thraki Kentriki Makedonia Thessalia Sterea Ellada Peloponnisos Attiki
Western Black Sea (W Black Sea)	RO	Sud-Est
	BG	Severoiztochen Yugoiztochen

The selected indicators to measure the **intensity of the activity** are (i) number of tourist *bed- places* and (ii) total *nights spent at tourist accommodation establishments*. Data used to characterize these indicators have been obtained from the data published for the NUTS 2 regions by Eurostat office and they only include coastal regions composing each pilot site (see Table 33). These two indicators are complementary to the already used in D2.2 where the main used variable was *number of international arrivals*.

The intensity of tourism in the PERSEUS pilot sites during the first decade of the 21st century measured in terms of number of tourist bed-places is shown in Figure 7 and Table 34. This indicator should be measuring the *potential intensity* of tourism since it is measuring the "offer" and not the occupancy. It should also provide information about tourism-induced land transformation because it is measuring built tourism infrastructures.

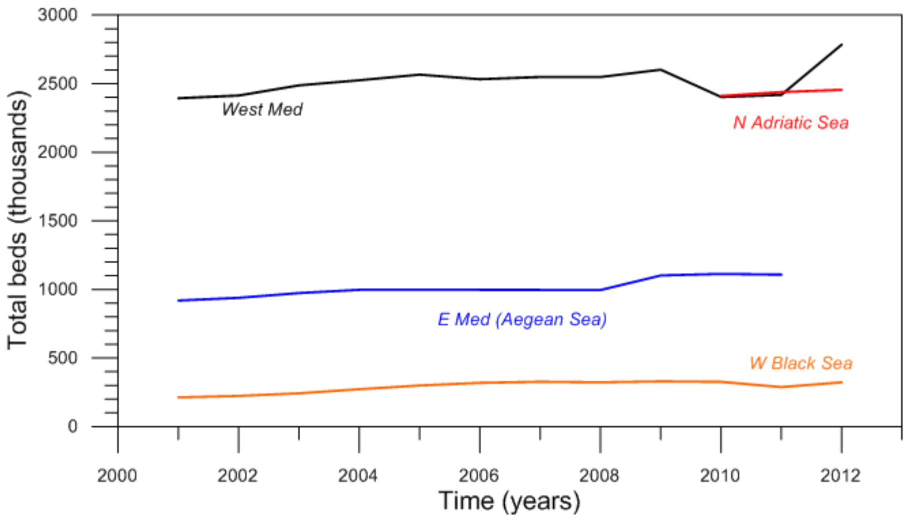

Figure 7. Time evolution of total number of bed-places in the coastal regions composing the four PERSEUS Pilot sites.

As it can be seen, the number of offered bed-places is significantly larger for the W Mediterranean and N Adriatic sites (and of similar order of magnitude) than in the other two sites, being the W Black Sea the pilot site offering a smaller number of bed-places. This is consistent with the existence of a mature and well developed tourism industry in these 2 pilot sites which are among the most important tourism regions in three of the most tourism-developed countries of the world (France, Spain and Italy).

In the pilot site with the less developed tourism industry, the W Black Sea, the sector has experienced further growth and massive investments until 2008. The main seaside resort in Romania is Mamaia and, in the Bulgarian coast, Albena, Golden Sands and Sunny Beach. The importance of coastal tourism in these areas is reflected in the fact that coastal areas concentrate the 34% of all bed-places in Romania and 70% of all bed-places in Bulgaria.

Table 34. Time evolution of total number of bed-places (in thousands) in the coastal regions composing the 4 PERSEUS Pilot sites.

Time	W Med	N Adriatic	E Med	W Black Sea
2001	2393.6	(*)	919.2	213.1
2002	2413.4	(*)	938.7	223.6
2003	2487.5	(*)	973.6	243.1
2004	2524.8	(*)	996.9	272.8
2005	2565.8	(*)	996.9	299.8
2006	2532.2	(*)	997.1	319.3
2007	2548.7	(*)	996.7	326.9
2008	2548.6	(*)	995.7	322.7
2009	2601.7	(*)	1101.7	330.0
2010	2402.8	2410.6	1113.0	326.3
2011	2418.3	2438.5	1107.9	288.1
2012	2784.5	2455.5	1111.4	323.1

Table 35. Time evolution of total nights (million) spent in tourist accommodations in the coastal regions composing the 4 PERSEUS Pilot sites.

Time	W Med	N Adriatic	E Med	W Black Sea
2001	224.427	(*)	17.665	5.602
2002	217.109	(*)	16.377	12.504
2003	215.305	(*)	16.594	14.429
2004	213.403	(*)	16.987	16.129
2005	221.155	(*)	18.851	17.252
2006	228.928	(*)	19.859	17.637
2007	230.158	(*)	22.940	18.019
2008	226.785	(*)	23.162	17.983
2009	216.025	(*)	28.053	14.984
2010	249.896	178.377	26.827	15.250
2011	264.742	185.604	26.783	17.723
2012	265.285	205.538	(*)	14.403

If the **intensity** is measured by means of the number of total nights spent in tourist accommodations, a slightly different behaviour is detected (Figure 8 and Table 35). It has to be mentioned that this is an indicator of *real intensity* since it is measuring occupation. Thus, the observed pattern is similar to the general behaviour already described at National scale for the entire Mediterranean, where the W basin included 2 of the most important tourism destinations of the world. Thus, the West Mediterranean site clearly emerges as the most tourism influenced (visited) site, followed by the N Adriatic. The number of total nights spent in the E Mediterranean and the Black sea is of the same order of magnitude and about 10 times lower than in the W Mediterranean.

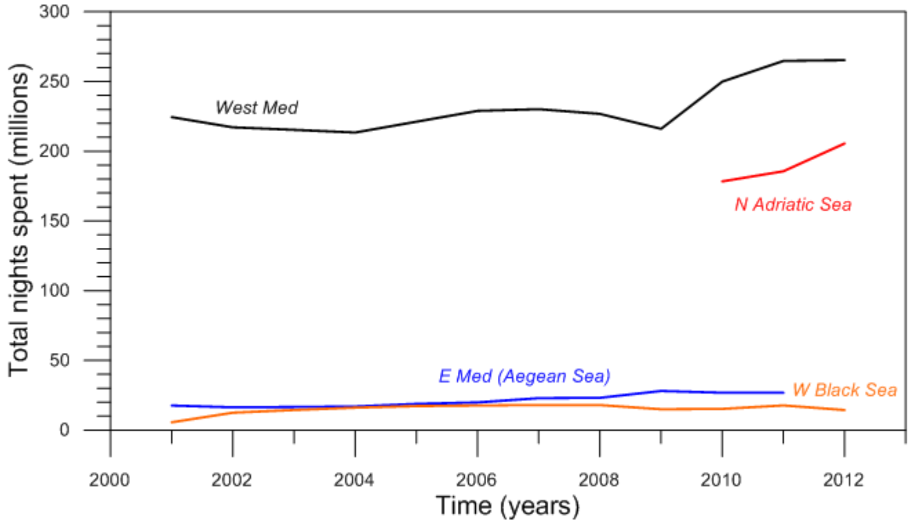

Figure 8. Time evolution of total nights spent in the coastal regions composing the 4 PERSEUS Pilot sites.

In order to put in context the importance of tourism in the PERSEUS pilot sites, it has to be taken into account that 7 of the Top 20 EU-27 tourist regions (measured in terms of number of nights spent in tourism accommodations) belong to the pilot sites (5 in the W Med and 2 in the N Adriatic, see Figure 9). In addition to this, it has to be considered that in the other countries included in the pilot sites not appearing in the list of Top 20 EU-27 tourist regions, some of the most popular regions are coastal and they are included in the study area (Greece: Kentriki Makedonia; Croatia: Jadranska Hrvatska; Romania: Sud-est; Bulgaria: Yugoitztochen; Slovenia: Zahodna Slovenija, Eurostat, 2013)

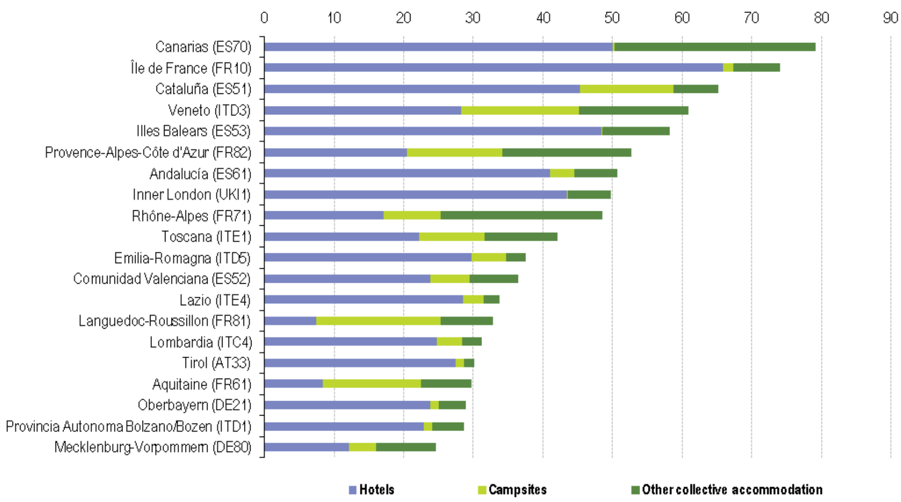

Figure 9. Top 20 EU-27 tourist regions in number of nights spent in tourist accommodations in 2010 (Eurostat, 2012).

As it has been already mentioned, Tourism and Travel is one of the most important economic activities in the area, with significant direct and indirect/induced economic impacts on Mediterranean countries. The World Travel & Tourism Council (WTTC) quantifies its total contribution by capturing its indirect and induced economic impacts (Figure 10).

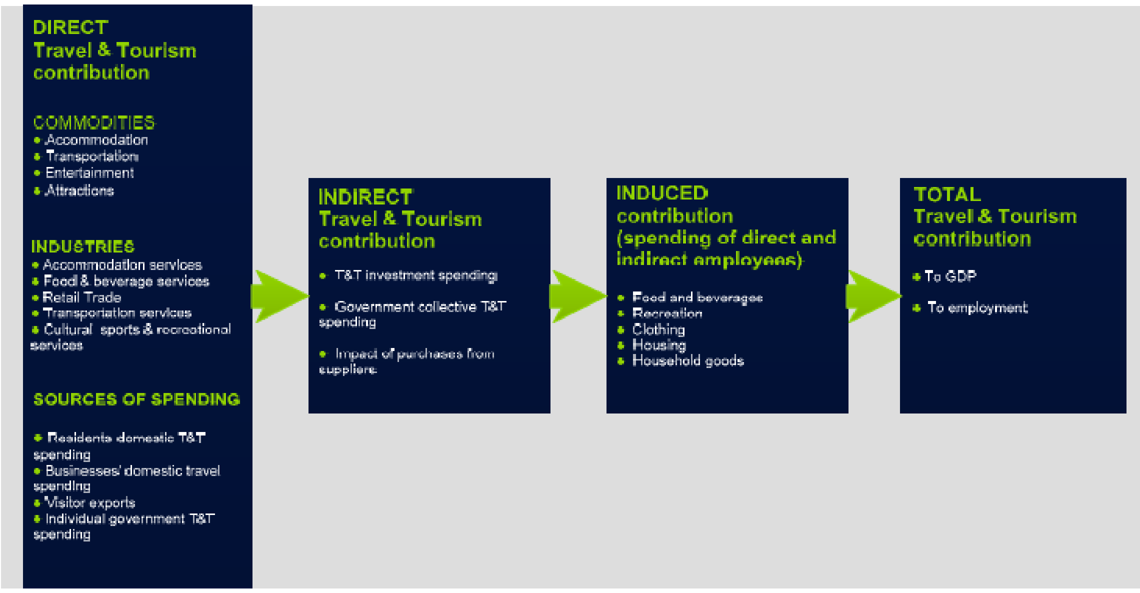

Figure 10. Direct and indirect components to calculate the tourism and travel total contribution to GDP and employment (World Travel & Tourism Council 2012).

Table 36. Travel & tourism total contribution to GDP (%) of countries of each pilot site (World Travel & Tourism Council, 2013).

	PERSEUS pilot site							
Time	W Med		N Adriatic			E Med	W Black Sea	
	Spain	France	Italy	Slovenia	Croatia	Greece	Romania	Bulgaria
2001	16.9	12.6	13.3	11.5	18	17.1	4.5	24.1
2002	16.9	11.9	12.5	11.4	18.1	16.5	4.3	23.8
2003	16	11.3	11.9	10.9	26.7	15.9	4.6	25.2
2004	16.5	11.6	11.7	11	26.2	16.3	4.8	26.6
2005	16.8	11	11.2	11.5	27.9	17.6	6.2	25.7
2006	15.7	10.7	11.4	11	28.6	17.8	5.3	24.1
2007	15.5	10.4	11.3	11	27.8	17.5	5.5	16.6
2008	15.5	10	10.6	11.4	29.1	16.8	5.7	15.5
2009	15.4	9.8	10.1	12	25.3	15.9	5.3	14.8
2010	15	9.4	10.1	12.2	26.9	16	5	14.1
2011	15.3	9.7	10.4	12.6	26.3	15.8	4.7	13.7
2012	15.2	9.7	10.2	12.8	27.8	16.4	5.1	13.6

Table 36 shows the evolution of the total contribution of Travel & Tourism sector to National economies of countries included in each pilot site in terms of % of the GDP (%). Individually, the largest contribution of this sector to individual GDP is observed in Croatia, with an average value during the period 2001-2012 of 25.73 %. On the other hand, the lowest contribution occurs in Romania with a value of 5.08 % of the GDP. When values are averaged for countries forming pilot sites, the largest contributions are in the E Mediterranean (16.63 %) and N Adriatic (16.19 %).

When this is considered in absolute terms (Table 37), the picture drastically changes and, the most important pilot site regarding the economic importance of tourism is clearly the W Mediterranean where the sector contributes with a total yearly average value of 369.43 billion €. This is followed by the N Adriatic, where the total contribution to the GDP is about the half (193.3 billion €), the E Mediterranean with a total value 1 order of magnitude lower (33.32 billion €) and, finally, the lowest absolute total contribution to the GDP occurs in the W Black Sea with 12.96 billion €.

Table 37. Travel & tourism total contribution to GDP (billion €) of countries of each pilot site (World Travel & Tourism Council, 2013). [Note.- Original data in 2011 US$; conversion rate 1 US$ = 0.775 €].

	PERSEUS pilot site							
Time	W Med		N Adriatic			E Med	W Black Sea	
	Spain	France	Italy	Slovenia	Croatia	Greece	Romania	Bulgaria
2001	151.64	229.81	206.64	3.36	5.61	29.61	4.12	6.50
2002	155.34	219.36	195.87	3.45	6.01	29.82	4.14	6.73
2003	152.24	209.47	185.89	3.37	9.33	29.94	4.75	7.51
2004	161.91	219.94	186.60	3.54	9.45	32.16	5.33	8.46
2005	170.53	211.85	180.97	3.88	10.50	35.26	7.24	8.72
2006	166.53	212.72	187.69	3.95	11.18	37.41	6.59	8.71
2007	170.01	211.32	189.52	4.22	11.46	38.27	7.34	6.42
2008	171.26	202.58	175.13	4.49	11.98	37.64	8.05	6.35
2009	163.66	192.74	158.51	4.37	10.05	34.78	7.01	5.72
2010	159.31	186.76	160.23	4.46	10.56	33.86	6.52	5.46
2011	162.62	195.78	166.64	4.65	10.30	31.00	6.23	5.40
2012	159.21	196.57	160.38	4.62	10.68	30.12	6.80	5.39

Table 38. Travel & Tourism total contribution to employment (%) in countries of each PERSEUS pilot site (World Travel & Tourism Council 2013).

	PERSEUS pilot site							
Time	W Med		N Adriatic			E Med	W Black Sea	
	Spain	France	Italy	Slovenia	Croatia	Greece	Romania	Bulgaria
2001	16.9	13.8	14.1	11.8	22.9	19.4	4.7	17.8
2002	16.8	13.1	13.5	11.7	22.4	19	4.9	17.3
2003	15.9	12.4	12.9	11.1	32.3	18.1	5.3	22.7
2004	16.6	12.7	12.8	11.3	30.9	18.2	5.7	23.9
2005	17	12.1	12.4	11.8	32.4	19.5	7.6	23
2006	16	12	12.7	11.3	32.7	19.8	6.3	21.8
2007	15.8	11.6	12.7	11.3	31.5	19.4	6.6	15
2008	15.9	11.2	11.8	11.7	32.7	18.7	6.8	14
2009	15.9	11.2	11.4	12.4	28.2	17.7	6.3	13.5
2010	15.3	10.5	11.3	12.5	29.7	17.8	6	13.1
2011	15.4	10.9	11.8	12.9	28.8	17.6	5.3	12.5
2012	15.5	10.8	11.6	13.1	30.2	18.3	5.6	12.4

Finally, Table 38 shows an indication of the economic importance of Tourism in social terms in the study area by means of the contribution of the sector to the total employment of each country (relative terms) and, the number of jobs in the sector. In overall, Tourism & Travel sector has contributed to employment in the countries of pilot sites between a minimum of 6 % in Romania (W Black Sea) and a maximum of 29.5 % in Croatia (N Adriatic) in averaged terms during the period 2001-2012 (Table 39In relative terms and comparing between pilot sites, the largest contribution of this sector to national employment rates occurs in the E Mediterranean and N Adriatic sites, with averaged contribution to total jobs of 18.62 % and 17.96 % respectively. The lowest relative contribution to employment occurs in the W Black Sea with 11.59 % whereas in the most developed tourist area, the W Mediterranean, the average contribution is 13.97 %.

Table 39. Travel & Tourism total contribution to employment (thousands) in countries of each PERSEUS pilot site (World Travel & Tourism Council 2013).

	PERSEUS pilot site							
Time	W Med		N Adriatic			E Med	W Black Sea	
	Spain	France	Italy	Slovenia	Croatia	Greece	Romania	Bulgaria
2001	2739.8	3591.6	3102.3	91.9	237.4	796.6	412.4	482.8
2002	2800.9	3426.9	3001	91.9	235.7	796.2	417.9	475.1
2003	2765.5	3253.9	2882.1	87	346.7	776.3	450.6	643.9
2004	2992	3344.4	2877.9	88.8	339.7	785.3	480.3	701
2005	3242.2	3202.2	2813.4	96.5	362.6	855.1	635.5	687.7
2006	3168.3	3202.1	2928.1	93.8	372.5	885.6	541.1	678.1
2007	3229.2	3151	2954.6	97.1	363.8	878.2	569.4	489
2008	3234	3061.4	2781	103.3	383.8	854.4	598.5	473.6
2009	3004.8	3003.2	2635.6	106.4	324.7	798.6	541.5	439.3
2010	2834.7	2828.8	2606.7	104.6	322.4	786	506.8	401.1
2011	2801.8	2933	2716.8	106.4	310.7	720.6	457.3	371.1
2012	2690.9	2924.6	2680.7	105.7	318.8	688.8	478.9	366.7

When these percentages are converted in number of jobs (Table 39), the total number of generated jobs in the countries composing the different PERSEUS pilot sites varies between a maximum value (averaged during the period 2001-2012) of 6.2 million in the W Mediterranean and a minimum of 0.8 million in the E Mediterranean. The second area in importance is the N Adriatic with 3.3 million followed by the W Black Sea with 1 million of generated jobs.

Previous figures have been calculated considering the entire country included in each pilot site. However, although in some cases this could be acceptable (e.g. Croatia, Slovenia) due to the dimension and configuration of the country, in other cases, this is not representative. Thus, France and Spain face to different Seas Atlantic Ocean and Mediterranean Sea) and, moreover, they have important tourist attraction poles in their capitals (in the centre of the country). On the other hand, Italy faces to the Tyrrhenian and the Adriatic Sea, with important tourist developments in both sides. This is also applicable to Greece which faces to the Aegean and the Ionian seas.

Due to this, it is desirable to disaggregate the National tourism accounts to estimate the importance of the tourism sector just in coastal regions composing each pilot site. Since in most of the cases, original data are not able to be found in disaggregated manner, these values have been compiled from specific National reports where they are obtained following different ways and hypotheses. Due to this, presented values are not necessarily comparable between them and, in any case, the original report is referenced to know how the value was obtained. Table 40 presents a preliminary estimation of main economic indicators of tourism for the pilot sites and, as it can be seen, it just reflecting the already observed dominant position of the W Mediterranean site in coastal tourism.

Table 40. Contribution of tourism to GDP (billion €) and employment (number of jobs) in PERSEUS pilot sites (just coastal regions of each country located in each site).

PERSEUS pilot site	Country	Employments	Income (billion €)
W Med	Spain [1]	713,900	35.9
	France [1]	131,000	13.4 §
N Adriatic	Italy [1]	488,400	10.5
	Slovenia [1]	105,700*	0.081
	Croatia	318,800*	10.68*
E Med	Greece [1]**G**	583,900	8.08
Black Sea	Romania [1] **R**	45,600	0.194
	Bulgaria [1]	49,400	0.240

[1] National initial assessments for MSFD

* National values

§: calculated applying the same methodology than in Spain (applying the % of employment in target regions with respect to the country coast to total income which was reported to be 34 billion €)

G: These figures have been obtained by applying the distribution of total beds in the Aegean Sea (77%) reported by SETE (Association of Tourism Enterprises of Greece) to values reported for Greece in the initial MFSD assessment (758,300 jobs and 10.5 billion €).

R: reported value of 1.23 % GDP

4.4.3 Links to environmental pressures

The development of this economic sector in coastal areas induces a series of pressures and impacts on coastal ecosystems (e.g. Davenport and Davenport 2006) which are originated by tourists and their demands as well as by their transport. Under the first heading (direct tourists' pressures) we can include the consequences of the construction of coastal resorts, roads and other infrastructures such as marinas, which can induce habitat fragmentation and affect marine biodiversity.

Along the Mediterranean coast the main identified direct pressures related to Tourism are (e.g. MAGRAMA, 2012): (i) Physical losses; (ii) physical damage; (ii) other physical perturbations (marine/beach litter), (iii) biological perturbations (pathogens introduction - Bathing areas- and allochthonous species –ships/cruises-). Indirectly, other tourism-driven pressures (although not specifically exerted on the coast) are water and energy consumption, and waste and sewage production.

Any activity developed in marine waters should induce an impact, that following the MSFD can be characterized through a set of proposed descriptors of GES of marine waters. These descriptors are: 1) biological diversity; 2) non-indigenous species; 3) commercially exploited fish and shellfish are within safe biological limits; 4) marine food webs occur at a normal abundance and diversity; 5) human-induced eutrophication; 6) sea-floor integrity; 7) alteration of hydrographical conditions; 8) concentrations of contaminants; 9) contaminants in fish and other seafood for human consumption; 10) marine litter; 11) introduction of energy, including underwater noise. Linked to the identified Tourism-related pressures the main induced impacts should be: (i) Artificialization of the coast and destruction of natural communities; (ii) Change in the sedimentation process; (iii) Change in the beach morphology and burial of natural communities; (iv) Organic matter introduction; (v) Presence of litter; (vi) Presence of microbial pathogens and (vii) introduction of allocthonous species. They will correspond to the GES descriptors (1), (2), (5), (6), (9), (10)

One of the environmental impacts of tourism is related to the environmental costs of transportation to and from the destiny. In coastal tourism, in addition to this, we can also include a specific kind of tourism, **cruises**, which include both type of pressures (direct due to tourist presence and transport) and associated impacts (e.g. Carić 2011). The Mediterranean is one of the most important cruise areas in the world, with a share of the global cruise offer (calculated in bed days) rising from 11.65% in 2000 to 18.25% in 2009 (Torbianelli, 2011). Cruise is a type of tourism which is widespread across the entire Mediterranean basin (Figure 11) and, to give an indication of the magnitude of its potential impact, it has to be considered that, in total, Mediterranean ports handled about 26 million passengers in 2009 (Torbianelli, 2011), with the activity showing a continuous increase in the total number of passengers, with the largest increase occurring from 2007 to 2008 (about 3.8 millions).

Figure 11. MedCruise member ports (MedCruise, 2012).

Table 41. Number of cruise passengers and total calls during 2011 in Ports located in each PERSEUS Pilot site (MedCruise, 2012).

<table>
<tr><th>Ports</th><th>Country</th><th>Pilot site</th><th>Total Pass (thousands)</th><th>Total Calls</th><th>Total Pass (thousands)</th><th>Total Calls</th></tr>
<tr><td>Barcelona</td><td>ES</td><td rowspan="12">W Med</td><td>2,657</td><td>881</td><td rowspan="12">6,859</td><td rowspan="12">3,235</td></tr>
<tr><td>Palamós</td><td>ES</td><td>38.77</td><td>36</td></tr>
<tr><td>Tarragona</td><td>ES</td><td>0.752</td><td>2</td></tr>
<tr><td>Baleares</td><td>ES</td><td>1,600</td><td>746</td></tr>
<tr><td>Valencia</td><td>ES</td><td>390</td><td>205</td></tr>
<tr><td>Castellón</td><td>ES</td><td>1.3</td><td>2</td></tr>
<tr><td>Cartagena</td><td>ES</td><td>88</td><td>77</td></tr>
<tr><td>Sète</td><td>FR</td><td>21</td><td>23</td></tr>
<tr><td>French Riviera</td><td>FR</td><td>702</td><td>464</td></tr>
<tr><td>Marseille</td><td>FR</td><td>810</td><td>380</td></tr>
<tr><td>Toulon-Var-Provenc</td><td>FR</td><td>265</td><td>205</td></tr>
<tr><td>Monaco</td><td>MC</td><td>284.914</td><td>214</td></tr>
<tr><td>Venice</td><td>IT</td><td rowspan="10">N Adriatic</td><td>1,786.416</td><td>654</td><td rowspan="10">3,986.3</td><td rowspan="10">2662</td></tr>
<tr><td>Ravena</td><td>IT</td><td>156.374</td><td>79</td></tr>
<tr><td>Trieste</td><td>IT</td><td>28.251</td><td>21</td></tr>
<tr><td>Bari</td><td>IT</td><td>600</td><td>210</td></tr>
<tr><td>Koper</td><td>SI</td><td>108.820</td><td>78</td></tr>
<tr><td>Rijeka</td><td>HR</td><td>15.12</td><td>269</td></tr>
<tr><td>Sibenik</td><td>HR</td><td>13</td><td>113</td></tr>
<tr><td>Zadar</td><td>HR</td><td>28.363</td><td>99</td></tr>
<tr><td>Split</td><td>HR</td><td>181.963</td><td>253</td></tr>
<tr><td>Dubrovnik/Korcula</td><td>HR</td><td>1,068</td><td>886</td></tr>
<tr><td>Kavala</td><td>GR</td><td rowspan="4">E Med</td><td>2.7</td><td>10</td><td rowspan="4">2,542.2</td><td rowspan="4">980</td></tr>
<tr><td>Volos</td><td>GR</td><td>9.171</td><td>14</td></tr>
<tr><td>Piraeus</td><td>GR</td><td>2,517.335</td><td>936</td></tr>
<tr><td>Thessaloniki</td><td>GR</td><td>13</td><td>20</td></tr>
<tr><td>Constantza</td><td>RO</td><td>W Black Sea</td><td>23.878</td><td>43</td><td>23.9</td><td>43</td></tr>
</table>

Table 41 shows the total number of cruisers and cruise calls in main ports affiliated to the Association of Mediterranean Cruise Ports (MedCruise, which comprise about the 86 % of cruisers movements and 81 % of cruise calls in the area) at each Perseus Pilot site. As it can be seen, the W Mediterranean site is the most important in terms of total number of cruisers and cruise calls, followed by the N Adriatic and the E Mediterranean. The Black Sea is an area where cruise business is starting to be developed and, in comparison to the other sites is of very low intensity.

One of the characteristics of this specific sector is that although each cruise will have their own base in a specific port (Figure 11 and Table 41), its activity and environmental impact are developed in a larger geographical area which in many cases can cover different Mediterranean regions (Figure 12). These tourists are travelling along this area in more than 12,000 ship movements - cruise calls- with a clear seasonality (Figure 13), being the period between May and October the busiest one.

Figure 12. Examples of cruises crossing different Perseus pilot sites.

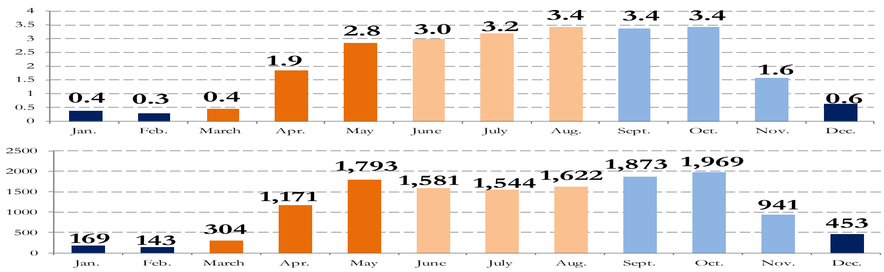

Figure 13. Distribution of cruise calls in the Mediterranean (MedCruise, 2013).

One of the direct impacts of tourism is the transformation of the coastal zone by means of **urbanization**. This implies to change the territory by artificializing the coastal fringe. One possible way to measure is to assess the surface occupied by tourism related developments in the coastal area. However, this data is seldom available and, moreover, in some cases is difficult to associate a given infrastructure to tourist or urban use. Thus, a possible way to assess an idea of the importance of this pressure (tourism developments and infrastructures) and impact (land occupation) is through the use of an indicator of tourism intensity such as the number of tourist bed places. Table 34 shows the number of total bed places in tourist accommodations in the Perseus pilot sites, where it can be clearly seen that the W Mediterranean is the site most influenced by tourism (and where the largest induced pressure on the coastal zone should be expected).

One of the most representative tourism infrastructures in coastal areas are **marinas or recreational ports**. They originate impacts such as *artificialization of the coast and destruction of natural communities*; *change in the sedimentation process*; *change in the beach morphology and burial of natural communities*; *source of pollution*; *presence of litter* and *potential introduction of allocthonous species* (e.g. Petrosillo et al 2010). To illustrate the potential magnitude of this impact in the Mediterranean, Table 42 shows the *total number of marinas* in the Perseus pilot sites. As it can be seen the most affected areas (in terms of existing number of infrastructures) are West Mediterranean and the North Adriatic, with the W Med area showing the highest density (shortest distance between marinas), with a minimum average distance of 14 km between marinas in Spain and France.

Perseus pilot site	Country	Number of marinas
W Med	Spain	165 *
	France	132 *
N Adriatic	Italy	253 ¢
	Slovenia	3
	Croatia	81 ¢
E Med	Greece	13***
Black Sea	Romania	6
	Bulgaria	11**

Table 42. Number of marinas in Mediterranean Countries (*: National MFSD initial assessments;

: www.bg-sail.org; *: www.visitgreece.gr; ¢: www.understaindingitaly.com)**

In addition to these port infrastructures, another indicator of human influence on the coast is the **length of artificial coastline**. This includes the length of coastline modified by human action including any type of coastal works (breakwaters, reclamation areas, nourishment, etc.). However it has to be considered that although many of these modifications in the Mediterranean will be related to the maintenance and/or improvement of beaches from the recreational standpoint, not all the existing works are related to tourism. Table 43 shows the percentage of the artificial coastline in the Perseus pilot sites according to the initial assessment of MSFD when possible and, in the other cases, figures have been obtained from statistics reported in Eurosion (2004). This indicator has been specifically included in the initial assessment of the MSFD and European countries have started to evaluate it. As an example, in the Spanish Mediterranean coast it has been estimated that the 17.93 % of the coast is affected by coastal structures inducing sealing.

Perseus pilot site	Country	Region	Coastline length (km)	% artificial coast	% eroding coast *
W Med	Spain	Catalonia	3953	17.93 %	33.2 %
		Valencia			26.2 %
		Murcia			15.4 %
		Baleares			0.3 %
	France	PACA	853	19.1 %	16.8 %
		Lang-Rouss	226	19.5 %	23.4 %
N Adriatic	Italy	Veneto	196.5*	19 % §	10.2 %
		Friuli	116.9*	24 % §	6 %
		Emilia-Romagna	169.3*	5 % §	16.6 %
		Marche	185.8*	11 % §	29.1 %
		Abruzzo	139.3*	10 % §	47.4 %
		Molise	31.3*	9 % §	89.5 %
		Puglia	836.8*	7 % §	24.9 %
	Slovenja		45.7 *		30.6 %
E Med	Greece	Anat Maked, Thraki	436*	14.7% *	31.9 %
		Kent Maked	821.8*	10.2 % *	45.2 %
		Thessalia	697.3*	7.7 % *	36.7 %
		Sterea Ellada	1491.8	20.9 % *	39. %
		Peloponnisos	1164.1	7.9 % *	26.2 %
		Attiki	1047.9*	11.8 % *	22.6 %
Black Sea	Romania	Sud-Est	226*	13.7 % *	61.9%
	Bulgaria	Varna*	63.1*	23.7 %*	15.8 %
		Burgas*	61.4*	37.4 % *	11.4 %

Table 43. Length of the coast, eroding coastline, artificially protected coastline, eroding coastline in spite of protection and total coastline impacted by coastal erosion in 2001 in km (data source: * Eurosion 2004; § Ispra).

Figure 14 shows the different types of structures that can be found along the Spanish Mediterranean coastline. One of the consequences of the different anthropogenic pressures along the coastal zone which change current patterns as well as actions altering the hydrological cycles in drainage basins (affecting riverine sediment supply to the coastal zone) is coastal erosion. To show the potential magnitude of this process along the Perseus pilot sites, Table 43 presents the percentage of eroding coastlines in each site, where it can be seen that, in general, these coasts can be classified as erosive. To understand these figures, it has to be considered that the included percentage has been calculated over the total coastline length which in many cases includes a significant portion of rocky coasts. If this ratio should only be calculated over the sandy shorelines, it should be significantly higher.

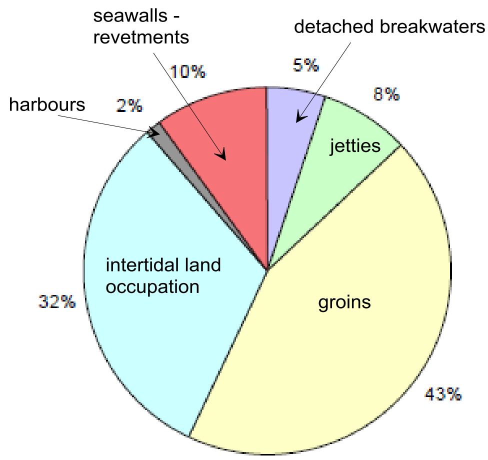

Figure 14. Percentage of coastal infrastructures along the Spanish Mediterranean coast (MAGRAMA, 2012).

As it has been already mentioned, **Marine litter** is an increasing common and costly problem in coastal zones. Marine litter is an aggregated indicator of human activity in the coastal zone and, in this sense; each activity will contribute to it according to its nature and representativeness. To illustrate its importance, one possible indicator of the tourism-induced impact is the amount of waste/litter on beaches. Table 44 shows the results of a survey performed by UNEP/MEDPOL in 14 Mediterranean countries in the framework of the *Regional Strategy for the Sustainable Management of Marine Litter in the Mediterranean*.

Country	Perseus Pilot site	Land			Underwater			Total		
		People	kg	km	People	kg	km	People	Kg	Km
Spain	W Med	1,424	20,090	79	340	3,051	56	1,764	23,141	135
France		315	3,761	20	160	4,215	38	475	7,976	58
Greece	E Med	6,052	26,402	208	465	23,614	47	6,517	50,016	255
Italy	N Adriatic	2,905	19,835	111	371	2,510	90	3,276	22,345	201
Croatia		42	377	8	14	100	1	56	477	9

Table 44. Data of marine litter in countries of the different Perseus pilot sites from Mediterranean beach & underwater cleanups.

ICC campaigns 2002-2006 (UNEP/MAP 2011).

Marine litter has different origins and not only will be due to recreational activities. To illustrate the contribution of this sector in Mediterranean coast, Figure 15 shows the sources of the monitored litter, where it can be seen that 52% of marine litter in the Mediterranean originates from shoreline and recreational activities which are highly connected to Tourism.

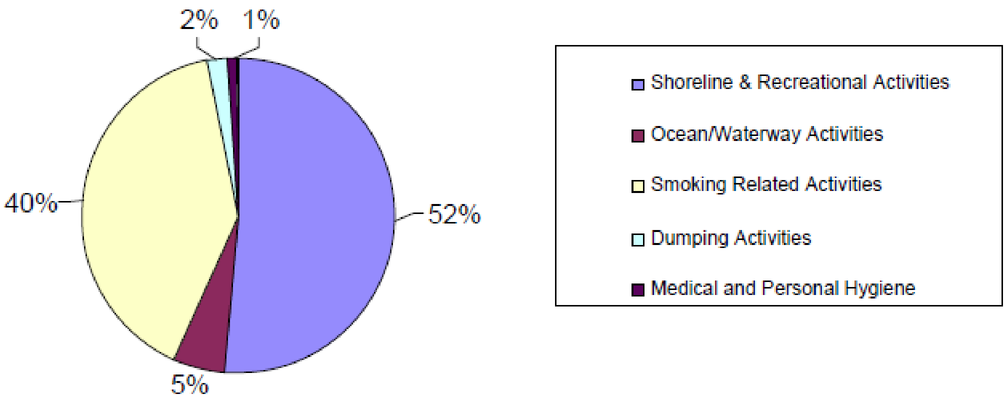

Figure 15. Sources of marine litter (2002 - 2006) (UNEP/MAP, 2011).

4.4.4 Gap analysis

Tourism economic indicators: Main statistics on tourism intensity (number of visitors and offered beds and nights spent) can be found at disaggregated level for coastal regions along the study area. However, the corresponding economic indicators are seldom found and, when present, in most of the cases are estimations based on the application of % over the total values using a series of hypotheses that, in many cases, are not comparable between countries. Therefore, it is important to obtain comparable data so that a consistent comparison between regions could be performed.

Regarding coastal artificialization, it is important to propose a standard method to isolate the direct contribution of tourism.

There is not enough information about real contribution of tourism to marine litter nor pollution.

4.5 Submarine cable and pipeline operations

Prepared by Marta Pascual, Anil Markandya and Elena Ojea, Basque Centre for Climate Change (BC3, Spain).

4.5.1 Introduction

Context

International trade and sea transport of hydrocarbons represent a vital link in the chain of oil and oil services, since the centres of production of oil and gas are generally far from the centres of consumption. The European Union's hydrocarbon energy supply depends heavily on imports. While the European Commission has recommended diversifying and increasing domestic resources, notably with renewable resources which should grow to 20% by 2020, dependence on hydrocarbon imports will remain not only important, but will increase (Nies, 2011). It is in this context that the scenario of oil and gas pipelines ought to increase too.

Communications are an important part of our nowadays society. As of 2006, overseas satellite links accounted for only 1% of international traffic, while the remainder was carried by undersea cable. The reliability of submarine cables is high, especially when (as noted above) multiple paths are available in the event of a cable break. Also, the total carrying capacity of submarine cables is in the terabits per second, while satellites typically offer only megabits per second and display higher latency.

Activity Description

Both, the oil and gas pipelines and the submarine cables activity description and current situation in the SES was described in detail at D2.2.

Amongst the most important oil chokepoints by volume state the Suez Canal (between the Mediterranean and the Red Sea) and the Turkish Straits (between the Mediterranean Sea and the Sea of Marmara) at the Mediterranean and the Black Sea.

Table 45. Six most important oil chokepoints by volume worldwide.

	Bodies of water	High per capita GDP (2009)	Low per capita GDP (2009)	Oil traffic (2006) million bbd
Strait of Hormuz	Gulf of Oman, Arabian Gulf	UAE: \$36,500 (15)[a]	Iran: \$11,200 (71)	17
Strait of Malacca	Indian Ocean, Pacific Ocean	Singapore: \$50,500 (4)	Indonesia: \$4,200 (120)	15
Suez Canal	Mediterranean Sea, Red Sea	N/A	Egypt: \$6,100 (101)	4.5
Bab el-Mandeb Strait	Red Sea, Gulf of Aden	Djibouti: \$2,500 (135)	Eritrea: \$700 (177)	3.3
Turkish Straits	Sea of Marmara, Mediterranean Sea	N/A	Turkey: \$12,500 (65)	2.4
Panama Canal	Atlantic Ocean, Pacific Ocean	N/A	Panama: \$11,800 (69)	0.5

a. Rank out of 186 countries. The United States ranked sixth with a per capita GDP of \$46,300 in 2009 [5].

Source: Komiss and Huntzinger, 2011.

These chokepoints, as well as any possible closure of the main pipelines, should be taken into account when analysing the socioeconomics of oil and gas pipelines as they could cause disruption or divert the oil and gas transport into tankers with the consequent increase in both costs and shipping time.

Table 46. Durations that would cause GDP to drop by 1 percent in one quarter, 100-percent disruption.

	Suez Canal	Bab el-Mandeb Strait	Turkish Straits
Estonia	164	193	266
Greece	317		
Hungary	293	346	
Netherlands	212	251	345
Slovakia	205	243	334
Slovenia	285	336	

Source: Komiss and Huntzinger, 2011. Note: The authors state that disruptions durations are calculated as those mitigated with pipelines and alternative sea routes assuming that mitigation starts at the beginning of the disruption and ignoring travel delays caused by the use of alternative sea routes, for simplicity.

The stability of oil exporting countries is also something to take into account as disruptions might also cause the unemployment rate to increase as well as increases in the oil price inflation rate (Komiss and Huntzinger, 2011).

Regarding submarine cables (telecommunication and electricity submarine cables), the socioeconomic aspects of the activity should not just look at the use and production aspect of the transport of power and information, but also to the installation, operation and dismantling socioeconomic aspects. Furthermore, in an era of cyber-warfare, the need to protect the vulnerabilities of the undersea cable systems has increased and there is a further need to determine how a disruption of submarine communication cables will impact the world's economies.

4.5.2 Sector and socio-economic analysis

Mediterranean Sea region in General

In the Mediterranean region, seven gas pipelines are in operation (7 + 2 projected). In northern Mediterranean countries, many expansions of the existing liquefied natural gas (LNG) terminals have increased over the last few years (from 82 bcm in 2007 to 120 bcm in 2009, expected to reach 189 bcm by 2015) (The LNG Industry in 2011, GIIGNL, 2011). 35.2 and 39.3 billion cubic meters of gas was transported through the Mediterranean, according to the last 2012 and 2013 (respectively) BP Statistical Review of World Energy. Through the data at this 2013 report, it was stated that the turnover of gas transportation via pipeline in the Mediterranean Sea was approximately €1.5 billion, in 2012, excluding €200 million from transit charges levied by third countries through which the pipelines pass. The added value of the gas transportation for the same year, 2012, was approximately €800 million, excluding also €200 million from transit charges (BP, 2013; Factor value based on Pugh, 2008).

Regarding oil pipelines, several different, international oil pipelines connect the Mediterranean region with neighbouring countries and regions by land. However, if compared to the ship or tanker transport, the transport of oil through pipelines crossing the Mediterranean can be considered as marginal. The Mediterranean has extensive marine traffic giving access to the Middle East (and the Suez Canal), the Black Sea and Southern Europe; much of this traffic is oil tankers. The result of such traffic is a high risk of pollution and even ecological disaster, worsened by the fact that it is a near-closed sea. At this section, when data becomes available, the socioeconomics of oil-tankers will be analysed, based on ports landings (SAFEMED, 2008).

Regarding electric and communication cables, and observing the investment costs related, we see large differences among them with an investment of about €2 million for electric cables and a little more than €40,000 for telecommunication cables.

However, the total investment costs related to submarine telecommunication cables in the Mediterranean accounted for €3.2 billion; the investment cost of electrical cables accounted for 674 million and the a total of 460 direct jobs were created on seven cable ships (MED-IMP, 2010; ICPC, 2009; UCTE, 2008). The impact of installation and operation of submarine cables direct employment seems very low, in contrast to the impact on the indirect and induced employment.

Below the existing main oil routes, gas pipelines (Figure 19) and submarine cables (Figure 20) at the Mediterranean PERSEUS Pilot Areas are gathered.

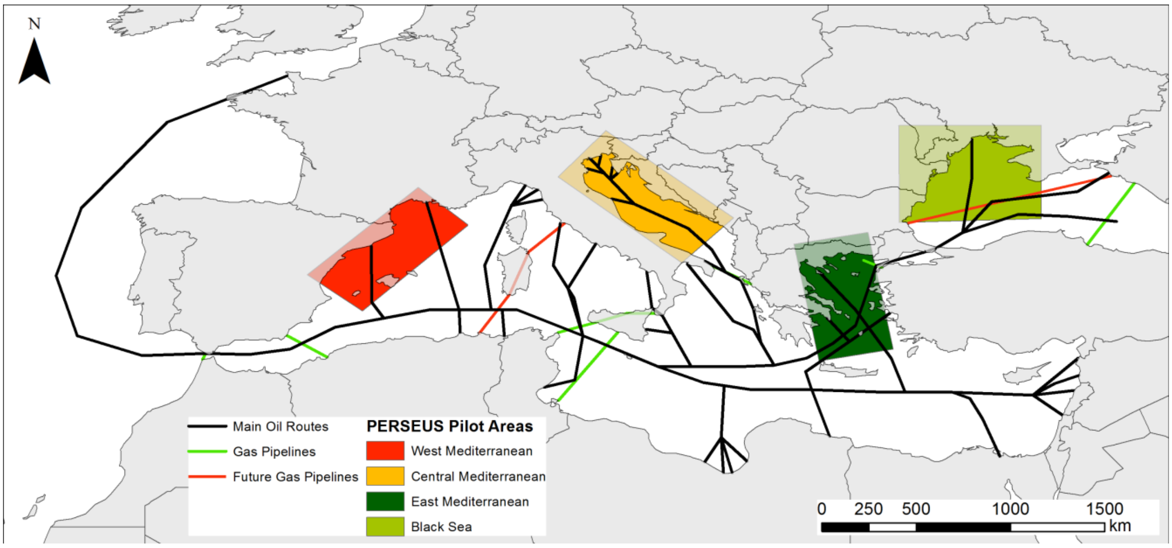

Figure 16. Oil-tanker tracks and gas pipelines at the PERSEUS Pilot Areas at the Mediterranean.

Source:Gathered from www.submarinecablesmap.com, [GIWA Black Sea graphics](); Nies, 2011; Astiaso Garcia et al., 2013.

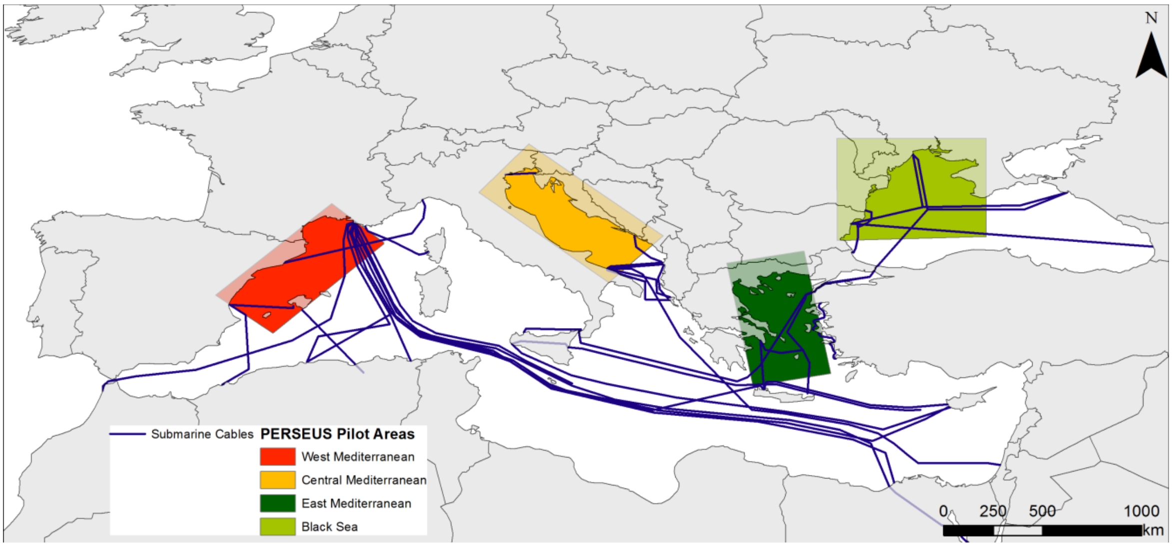

Figure 17. Submarine cables at the PERSEUS Pilot Areas at the Mediterranean.

Source: Gathered from www.submarinecablesmap.com.

Here below we will analyse the socioeconomics of submarine cable and pipeline operations at each of the already described PERSEUS pilot case areas: West Mediterranean; Central Mediterranean; East Mediterranean and Black Sea.

West Mediterranean

No submarine gas pipeline exists at the West Mediterranean Pilot Area. However, as the PERSEUS West Mediterranean Pilot Area accounts for Spain and France as countries, the general socioeconomics of the gas markets in these two countries have been analysed.

At southern Spain, the Medgaz and the Pedro Durán Farell (PDFG) pipelines can be found. The Medgaz pipeline cost was of 900 M€ (630 M€ for the submarine part) and the number of employees at the construction phase was higher than 2000 (>100 employees at the operation phase).

Furthermore, the market of the gas and the Liquefied Natural Gas (involving the regasification, storage, transport, distribution and commercialisation phases) was estimated to be around 5000 M€, in 2010, and increasing. The Gross Value Added (GVA) has also increased along the years; however the GVA is still a 15% lower than that of the remaining of Europe (despite being superior to the one in the UK and Holland).

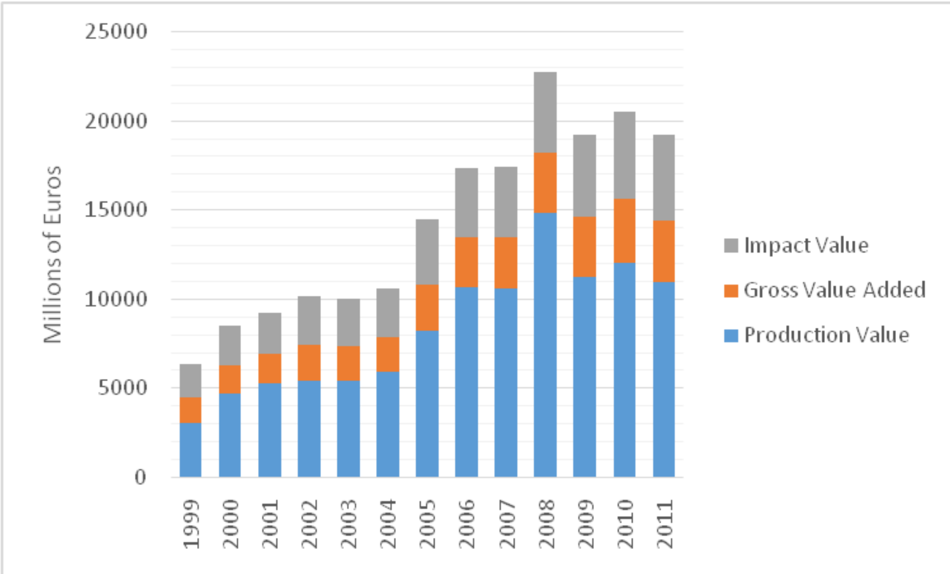

Figure 18. Impact Value, Gross Value Added and Production Value of the Gas Market in Spain
Source: Modified from EMI (Energy Markets International), 2011.

These tendencies in the gas market give us the idea of the importance of the sector for the Spanish economy. This impact is further highlighted if we take into account that the gas industry employs thousands of people in Spain at the construction, gas production, installation, fixing, pipelines supervision, inspection and maintenance phases.

If we look at the direct employment rates, the amount of people employed by the businesses in the gas industry has increased year after year, with a total of 6516 people employed in 2011.

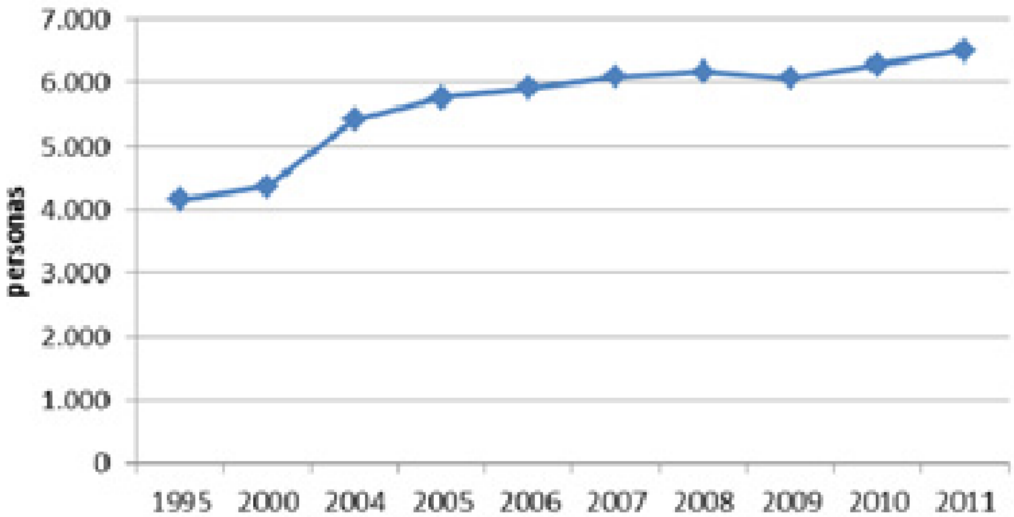

Figure 19. Direct employment of number of people in the Spanish gas sector since 1995

Source: Sedigas, 2012.

Table 44. Existing gas pipelines in Spain.

Linking	**Gas pipeline name**	**Capacity Gm³/yr**	**In service since**	**Km underwater**
Algeria – Spain (via Marocco)	Pedro Duran Farell –PDFG- (ex-GME Maghreb-Europe)	13	1997 & 2004	45
Algeria - Spain	Medgaz	8-10	March 2011	210

At France, gas import dependence is close to 100%. French natural gas imports are relatively well diversified with significant imports from Algeria, the Netherlands, Norway and the Russian Federation. LNG has traditionally been sourced from Algeria, but a growing proportion now comes from other sources including Qatar. Entry capacities to the French gas network were 260 mcm/d at the end of 2010 – with 77% of this for gas pipelines and 23% for LNG terminals. France has numerous cross - border gas pipelines, with a total import capacity of 187.5 mcm/d. Also, there are three LNG port terminals in France – one at Fos Cavaou near Marseilles, another nearby at Fos Tonkin, and one at Montoir - de - Bretagne on the Atlantic coast.

Many oil tanker routes pass along the West Mediterranean Pilot Area. However, no data was able to be gathered on the most profitable routes and their socioeconomic data.

Among submarine cables at the West Mediterranean Area, the following table gathers their names, start year and lengths.

Table 47. Existing submarine cables at the PERSEUS West Mediterranean Pilot Area.

Name	Year	Length (km)	Involved Companies	Company size (nº employees)	Cost (M€)
Algeria-Spain	2013	500			
ALPAL-2	2002	312		Pirelli Submarine Telecom Systems Italia = 1000-5000.Rest >10000.	17.6
Ariane 2	1995	2269	AT&T, Belgacom, Cypress Telecommunications Authority, France Telecom, OTE, Verizon	Cypress Telecommunications Authority = 51-200. Rest >10000	70
Atlas Offshore	2007	1634	Maroc Telecom	> 10000	26
BalaLink	2001	274	IslaLink	1000-5000	30
BARSAV	1996	773	Telecom Italia, Telefónica	>10000	39
I-ME-WE	2010	1320	Bharti Airtel, Etisalat, France Telecom, Ogero , PTCL , STC , Tata Communications, Telecom Egypt, Telecom Italia Sparkle		
Med Cable	2005	1215	Med Cable		
SEA-ME-WE-4	2005	18800	Algerie Telecom, BSCCL, Bharti Airtel, CAT Telecom, Du, France Telecom, Pakistan Telecommunication Company Limited, STC, SLT, Tata Communications , Telecom Egypt, Telecom Italia Sparkle , Telekom Malaysia, Tunisie Telecom, Verizon		500
Tamares Telecom	2012	3123	Tamares Telecom	201-500	
TE North	2011	2983	Telecom Egypt	> 10000	150

Central Mediterranean

Existing gas pipelines in Italy are: the Enrico Mattei –EMG (ex-Transmed) pipeline (connecting Algeria and Italy via Tunis); the Greenstream pipeline (connecting Libia and Italy) and the Interconnector Greece-Italy (IGI). From these gas pipelines the IGI pipeline is the only one that falls within the PERSEUS Central Mediterranean Pilot Area.

Table 48. Existing gas pipelines in the PERSEUS Central Mediterranean Pilot Area.

Linking	Gas pipeline name	Capacity (Gm^3/yr)	In service since	Underwater Km
Algeria – Italy (via Tunis)	Enrico Mattei –EMG (ex-Transmed)	27	1983 &1994	155
Libia – Italy	Greenstream	8	2004	516
Greece – Italy	IGI (Interconnector Greece-Italy)	8-10	2012	217
Algeria - Italy (Sardinia)	Galsi	8-10	Planned 2014	285

Gas pipeline	Turnover (M€) (2010)	Labour forces (employees)
IGI	557	21,800

Another forthcoming gas pipeline is envisaged for the forthcoming year 2014, named as the Galsi pipeline. Amongst the strategic advantages of the Galsi pipeline we have that it represents a precious resource for the Italian market as a whole and especially for Sardinia, which still lacks access to a supply of natural gas. When the pipeline goes on stream in 2014, it is thought that it will:

- Increase the reliability of Italy's entire energy system. The gas pipeline will provide an alternative at competitive prices to supply sources from Eastern Europe.
- Lower energy bills for families and businesses in Sardinia. Natural gas will replace more expensive fuels used in that region (LNG, propane air mixes, diesel fuel, etc.) with savings estimated at 30-40%. This savings will provide a significant boost to Sardinia's economy, specifically benefiting businesses that are high energy users.
- Reduce the impact on the environment. Natural gas produces less polluting emissions than coal and oil, currently the fuels most frequently used in Sardinia. The use of natural gas will provide a major contribution to protecting the environment and improving air quality.

The Galsi pipeline is considered a priority project for the development of the Trans-European Energy Network and has been included in the **European Recovery Plan.** The European Union allocated 120 M€ to finance its construction.

Many marine oil tanker routes pass also through the Central Mediterranean Pilot Area.

Table 49. Existing submarine cables at the Central Mediterranean Pilot Area.

Name	Year	Length (km)	Involved Companies	Company size (nº employees)	Cost (M€)
ADRIA-1	2000	394	Deutsche Telekom AG, OTE	>10000	13.4
Balkans-Italy Network (BIN)	2011	263	Unifi	10-50	
Greece-Western Europe Network (GWEN)	2004	700	OTE		
Italy-Albania	1998	259	Telecom Italia Sparkle	500-1000	450
Italy-Croatia	2004	230			
JONAH	2012	2160	Bezeq International	1000-5000	

East Mediterranean

Pipelines

The only existing gas pipeline in Greece is the Interconnector Turkey-Greece (ITG) which also falls within the PERSEUS East Mediterranean Pilot Area.

Table 48. Existing gas pipeline at the PERSEUS East Mediterranean Pilot Area.

Linking	Gas pipeline name	Capacity (Gm^3/yr)	In service since	Underwater Km
Turkey - Greece	ITG	11	2007	17

However, there is also the prospective of constructing another gas pipeline, named as Interconnector Turkey-Greece-Italy (ITGI) whose offshore section is estimated that would cost €500 million. This development will close the ITG connection with Italy and its surplus to Bulgaria and is thought that will benefit in the followings:

- Diversify supply routes for Italy and Europe
- Enhance supply security in Southern East Europe (through Greece and Bulgaria) and in other European countries (through Italy).

- Implement solidarity mechanisms in Eastern Europe in case of supply interruption thanks to the connection to the multiple gas import routes Italy has and to the wide storage capacity towards these markets.

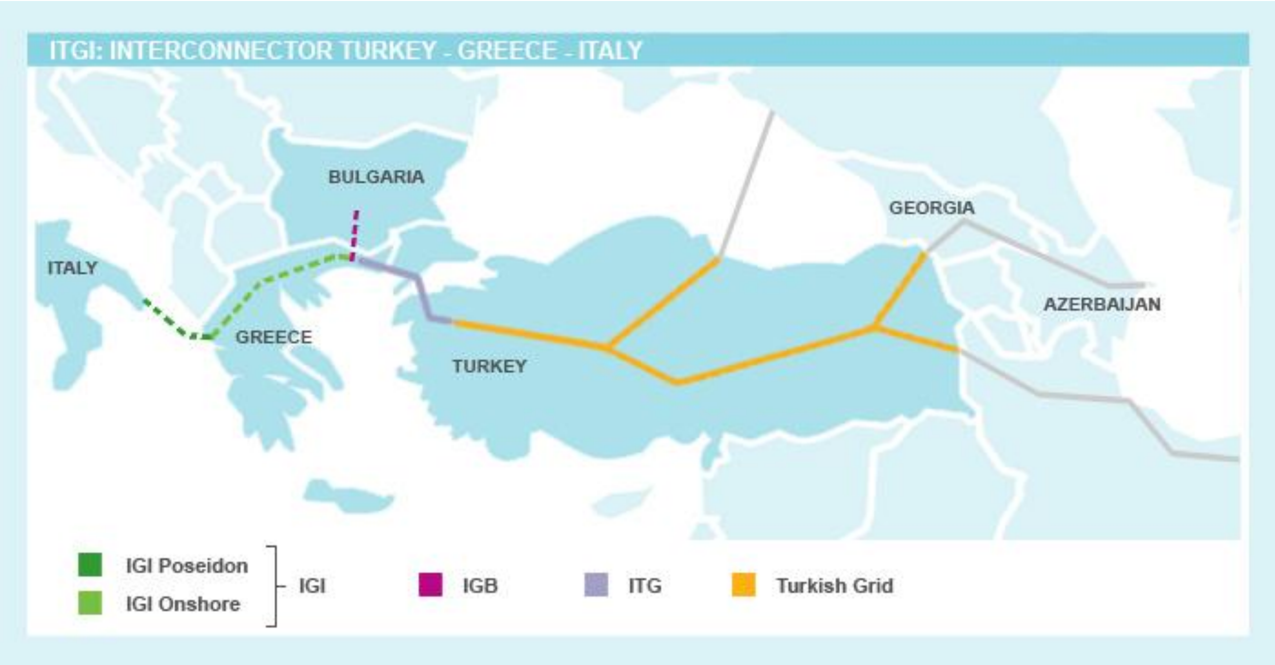

Figure 20. Map of the location routes of the ITGI.

Source: http://www.edison.it/en/company/gas-infrastructures/itgi.shtml

Many marine oil tanker routes pass through the East Mediterranean Pilot Area. The Aegean Sea might represent an extreme example of a marine safety risk area where an undesirable event may occur. The risk of an accident occurrence is even more aggravated by the existence of several other conditions, such as high maritime traffic density, transportation of large quantities of crude oil and refined products through the region (high transport density of vessels from and to the Black Sea passing narrow straits that are formed by over 1600 islands dispersed all over the Aegean), narrow and congested straits through which ships enter and exit (Giziakis et al., 2013).

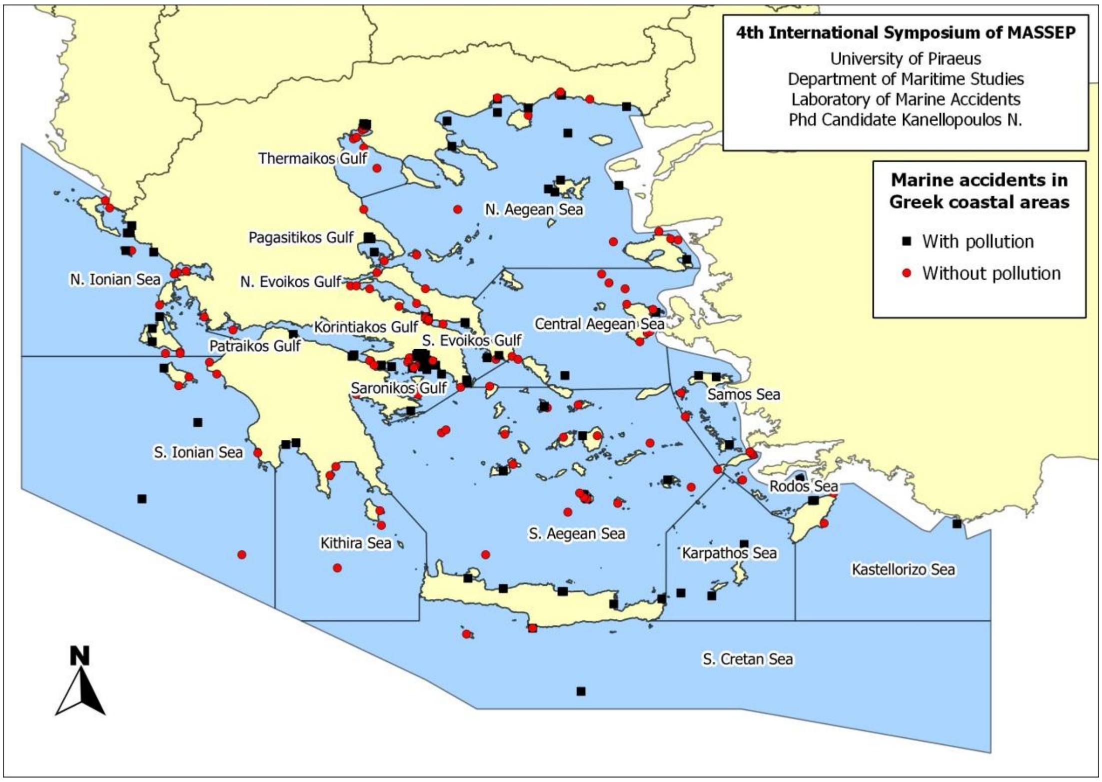

Figure 21. Marine accidents in the Greek Coastal Areas that occurred from 2001 to 2011
Source: Giziakis et al., 2013.

Table 50. Existing submarine cables at the PERSEUS East Mediterranean Pilot Area.

Name	Year	Length (km)	Involved Companies	Company size (nº employees)	Cost (M€)
APHRODITE-2	1994	876	AT&T, Belgacom, British Telecom, Cyprus Telecommunications Authority , France Telecom, OTE, Sprint, Verizon	> 10,000	30
Ariane 2	1995	2269			
ITUR	1996	3466	Telecom Italia	> 10,000	
MedNautilus	2001	5729	Telecom Italia Sparkle	> 10,000	
MINERVA	2007	3970	Telecom Italia Sparkle	> 10,000	
Turkey Marmara-Aegean Sea Fiber Optic System (TURMEOS-1)	2011	211			

Black Sea

Only one gas pipeline exists at the moment at the Black Sea since 2004, named ad "Blue Stream" and which connects Russia and Turkey directly through an underwater offshore pipeline of 396 km long. It is considered yet one of the deepest pipelines in the world. It is laid in depths as low as 2.2 km which exceeds the average depths of well-known subsea pipelines.

Table 51. Existing submarine gas pipeline at the PERSEUS Pilot Area at the Black Sea.

Linking	Gas pipeline name	Capacity (Gm^3/yr)	In service since	Underwater Km
Russia–Turkey	Blue Stream	15	2004	396

The Blue Stream gas pipeline cost was of US$3.2 billion, including US$1.7 billion for its submarine segment. The construction costs are passed on to gas consumers, as has been the case with Blue Stream in Turkey. Amongst other values, the Blue Stream pipeline aim was to bring gas from the Caspian area to Europe.

Another gas pipeline is prospected, for 2015, for the Black Sea Regions named as "South Stream" and which foresees laying pipeline subsea pipeline directly from Russia to Bulgaria. The South Stream project is seen as a rival to the projected

Nabucco pipeline and there are doubts about the feasibility of South Stream project, since it may cost twice as much as Nabucco, which was initially expected to cost €12–15billion.

Figure 22. Map of the projected "South Stream" pipeline through the Black Sea.

Source: http://iberorusa.com/es/blog/2012/01/27/la-construccion-de-south-stream-comenzara-en-diciembre/

No submarine oil pipelines exist at the Black Sea. However the region is intensively being used and routed by many oil tankers. The Turkish Straits are one of the world's most difficult waterways to navigate due to its sinuous geography. With 50,000 vessels, including 5,500 oil tankers, passing through the straits annually it is also one of the world's busiest chokepoints. Shipping oil by tankers through the Black Sea costs 20 cents per barrel, which makes a total of about €2.5 billion passing through the straits annually.

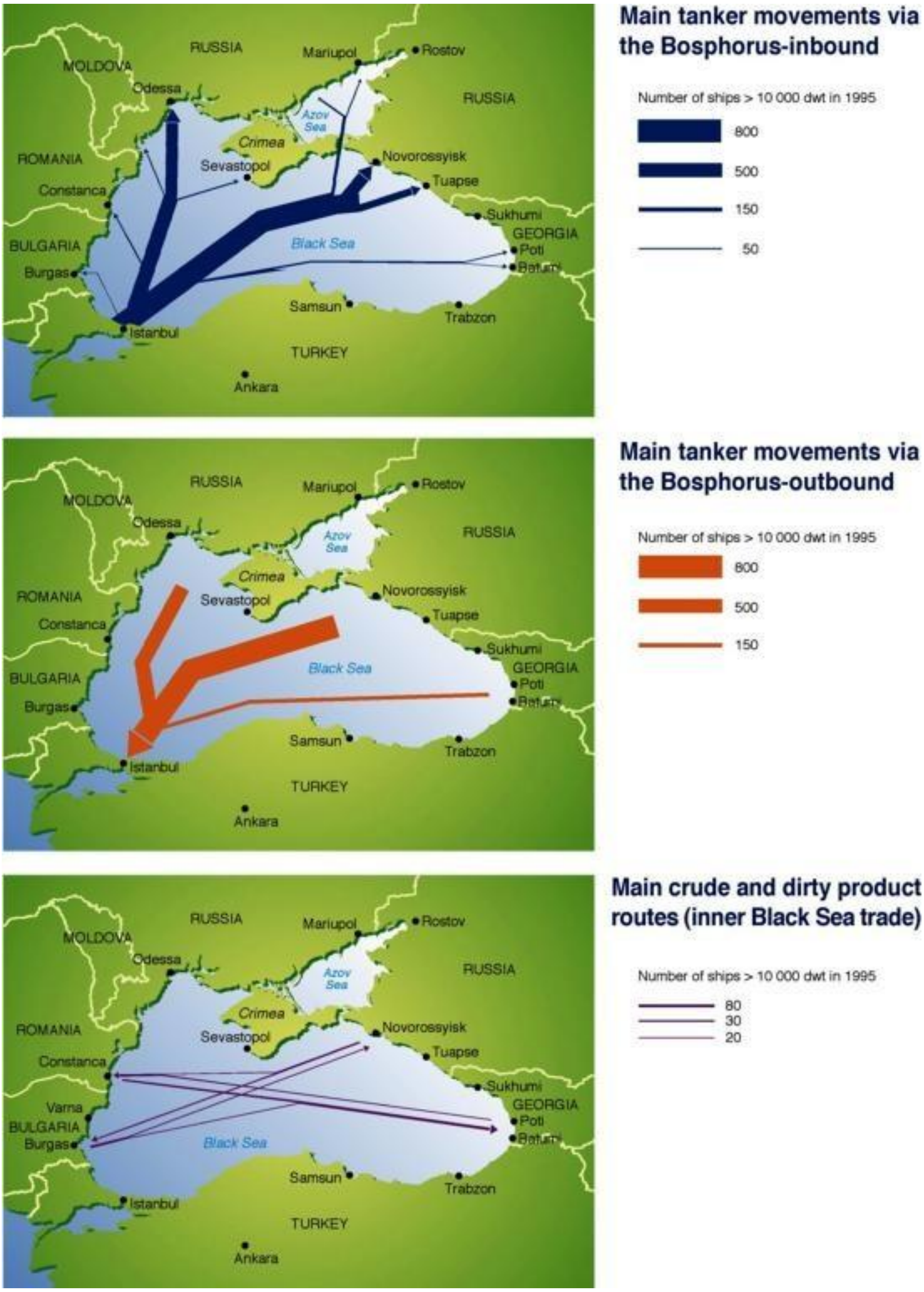

Figure 23. Main tanker routes through the Black Sea and the Bosphorous.

Source: From GIWA Black Sea Graphics. Available at: http://www.grida.no/graphicslib/collection/giwa-black-sea-graphics.

Submarine cables

Various submarine cables pass through the Black Sea as shown at the following Figure.

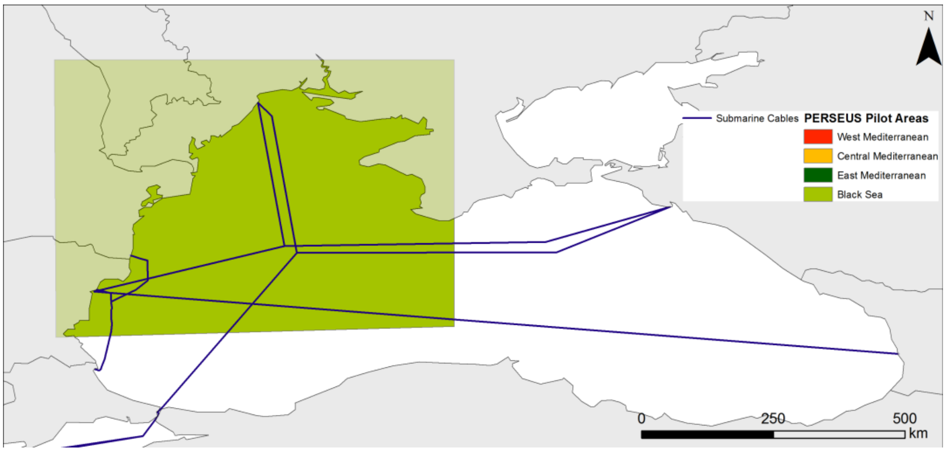

Figure 24. Submarine cables at the PERSEUS Pilot Areas at the Black Sea.
Source: Gathered from www.submarinecablesmap.com.

Table 52. Submarine cables at the PERSEUS Pilot Areas at the Black Sea.
Source: Gathered from www.submarinecablesmap.com.

Name	Year	Length (km)	Involved Companies	Company size (nº employees)	Cost (M€)
BSFOCS	2001	1300	Armentel, AT&T, BTC, Cypress Telecommunications Authority, DTAG, HT, KDDI, OTE, Rostelecom, Telecom Slovenia, Ukrtelecom	Cypress Telecommunications Authority, DTAG, HT, KDDI, OTE: 50-500. Armentel, BTC: = 5000-1000 AT&T, Rostelecom, Telecom Slovenia, Ukrtelecom >10,000.	51
Caucasus Cable System	2008	1374	Caucasus Online	500-1000	76
Italian-Turkish-Ukrainian-Russian (ITUR)	1996	3466	Telecom Italia	>10,000	
Karadeniz Fiber Optik Sistemi (KAFOS)	1997	504	BTC, Turk Telecom	BTC = 5000-10,000 Turk Telecom >10,000	
MEDTURK	2004		Turk Telecom	> 10,000	

Also, at the Black Sea, there is the intention to build two new fiber-optic submarine cable route which would be named as Poti-Constantsa (with a branch to Odessa) and Poti-Istanbul (see Figure 28). The Poti-Constantsa route would have an estimated length of 1200km and its costs are estimated to be around 22 M€. While the Poti-Istanbul route´s estimated length is 1059km and its cost is estimated to be of 20 M€. The maximum term of construction is of 2 years and its construction turnover term is of 6-7years.

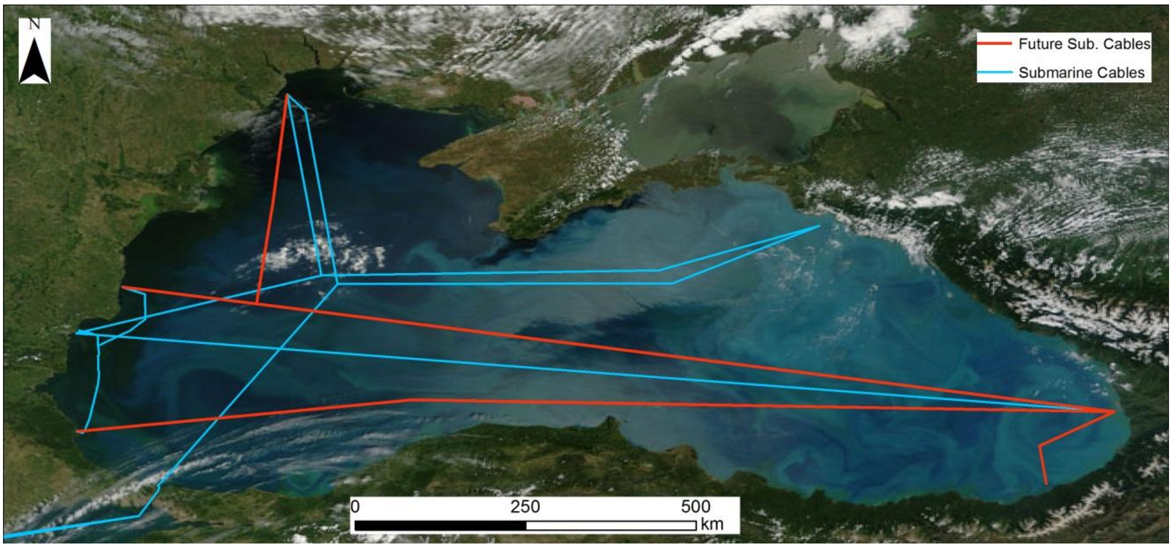

Figure 25. Current and Future submarine cables at the PERSEUS Pilot Areas at the Black Sea.
Source: Authorship: Marta Pascual, BC3.

4.5.3 Gap Analysis

When analysing the Gaps in socioeconomic terms for the submarine cables and pipelines, as anthropogenic stressor, we observe that not many information is publicly available and, when available, averages for the entire Mediterranean or Black Sea are being offered.

Among the most important data acquaintance gaps we found that not much information is available for the production value of oil-tanker vessels or LNG terminals. On the same hand, for the economic value, some information was available in terms of the turnover values, whilst information was not easily obtained for gross value added, transit charges or even the investments being made. For the social value of submarine cables and pipelines, at the Mediterranean and the Black Sea, labour costs, employment rates, or number of direct and indirect jobs was seldom found. Furthermore, for certain aspects, such as oil-tanker routes, even locating these routes seemed quite hard.

While this information is key in assessing possible impacts to various sectors, it is often the most difficult to obtain. Few people are willing to disclose information regarding personal income, profit margins and expenses for the sake of economic assessments. Information for social assessments often involves both time consuming qualitative and quantitative data collection regarding stakeholders, their activities and their communities. Yet detailed information is needed in order for the Council to make better decisions to balance impacts and meet requirements.

Thus, we can conclude saying that more effort should be put into making statistics on the costs/benefits and value indicators of these marine uses in order to put into value their activities and determine if they could be impacted or not if some other use happens to occur in the area.

On the other hand, if we look not only to the costs and benefits of submarine cables and pipelines for the socio economics but also for the environment, most costs, related to the environmental degradation attached to submarine cables and pipelines, rely on the installation, maintenance and decommissioning phases as they may result in benthic disturbance (in a limited extent). Furthermore, prior to the cable or pipeline installation phase, the selected route is usually cleared so that they are installed in a debris-free zone. All these phases are usually followed by a brief overview of seabed recovery after disturbance (ICPC-UNEP –WCMC, 2009).

Thus, knowing the cost of this environmental degradation, in terms of loses or restoration costs should also be determined and further studies should be encouraged for their better measure.

4.5.4 Future Trend Analysis

Oil and Gas pipelines

As stated in the context section 4.5.1, the scenario of oil and gas pipelines ought to increase in the near future regarding the high dependency of the European Union on hydrocarbons. Mediterranean countries currently import half of their oil and gas requirements, and continue to depend on these imports to cover growing domestic demand. The infrastructure for both oil and gas (ranging from pipelines to liquefied natural gas (LNG) terminals, and from oil tankers to oil export terminals) is significantly expanding across the region. The largest shares of the future LNG terminals additions to capacity concern Italy (+16 bcm), Spain (+13.6 bcm), Portugal (+5 bcm) and France (+4.5 bcm) (The LNG Industry in 2011, GIIGNL, 2011).

The Statistical Review of World Energy, BP (2011) and Cedigaz report stated that the area covered by Algeria, Egypt, Libya, Morocco, Tunisia and Turkey along with 5 other south-eastern Mediterranean countries (Israel, Jordan, Lebanon, Palestine and Syria) has almost 5% of the world's proven oil reserves (about 6,145 M tons) and nearly 5% of the world's proven gas reserves (about 8,500 bcm), accounting for most of the hydrocarbon reserves of the overall Mediterranean region. Most of these reserves are located in three North African countries: Libya, Algeria and Egypt (Figure 29).

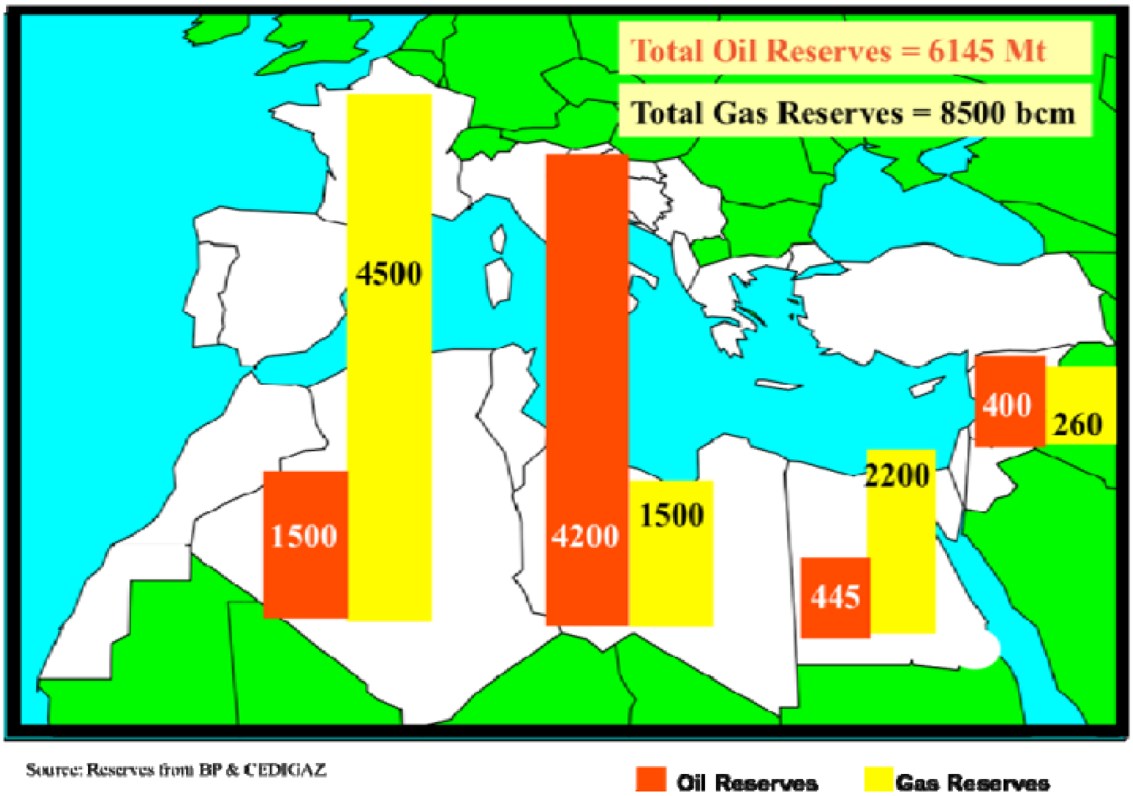

Figure 26. Oil and gas reserves in the Mediterranean.

Source: MEDPRO Technical Report No. 18/October 2012, based on data from BP and Cedigaz.

These areas account for 31% of the Mediterranean region's overall energy demand, a level set to rise to 47% by 2030 according to the MEDPRO (Prospective Analysis for the Mediterranean Region) Energy Reference Scenario, growing by an average annual rate of 3.3% between 2009 and 2030. However, if oil demand is likely to increase – particularly because of an expanding transportation sector – natural gas is set to overtake oil as the dominant fuel by 2030 in the MEDPRO Energy Reference Scenario. In fact, natural gas is expected to rise significantly in the primary energy mix over the next two decades, reaching 38% of the Mediterranean energy demand by 2030.

Considering that the overall potential for oil and gas exports is projected to rise, it is possible to realize the great prospects within the Mediterranean region for energy cooperation between oil- and gas-producing countries on the one hand and oil- and gas-consuming countries on the other.

Among the Mediterranean and Black Sea countries the followings should be highlighted if the future trend analysis of oil and gas pipelines in these regions is to be made.

Turkey: Turkey is increasingly at the crossroads of the world's energy trade. A web of pipelines already crosses Turkey, carrying hydrocarbons along east–west and north–south energy corridors. Indeed, because of tanker traffic through the Bosporus and

Dardanelles Straits, Turkey has become an important north–south transit route for oil.

Traffic through the Straits has grown as the crude production and exports of Azerbaijan and Kazakhstan have risen. Moreover, the Baku–Tbilisi–Ceyhan (BTC) oil and Baku–Tbilisi–Erzurum natural gas pipelines make Turkey an important east–west route as well. Other pipelines already operative include the Kirkuk–Ceyhan oil pipeline and the Blue Stream gas pipeline. A terminal located in Ceyhan – on Turkey's Mediterranean coast – allows the country to export oil from Iraqi and Caspian sources: the first route extends from northern Iraq via a pipeline from Kirkuk and the second route from Azerbaijan via the BTC pipeline.

Egypt: Egypt plays a strategic role in the scenario for regional energy transit, notably because of three important structures: the Suez Canal, the Suez–Mediterranean (SUMED) oil pipeline and the Arab Gas Pipeline. The Suez Canal is increasingly significant for LNG trade. In 2010, about 30 bcm of LNG from Qatar crossed the Canal for the EU market. This represented more than a third of total European LNG imports. For the UK and Belgium, LNG from Qatar crossing the Suez Canal represents about 80% of these countries' LNG imports.

Algeria: Algeria is a major oil and gas exporter in the region and has a well-established system of infrastructure. Algeria is also looking forward to solidifying its standing as a regional transit hub for West African gas and its access to the Mediterranean and European markets. This aspiration explains the planned Trans-Saharan Pipeline, a proposed 4,128-km-long gas pipeline from Nigeria to Algeria with an annual capacity of 30 bcm/yr.

Communications cables

The International Cable Protection Committee (ICPC) determined the "New routes, new technologies, new players and evolving challenges", which was designed to capture the remarkable advances of the submarine cable industry and its future challenges in the face of an increasing human presence offshore. Other key outcomes of the 2013 Plenary were:

- The representation of many new members from different parts of the industry, reflecting the ICPC's drive to open up membership to the entire Submarine Cable Industry.
- Inclusion of new Government members, reflecting the growing importance of Government-Private partnerships to help resolve the new challenges for the critical infrastructure network of submarine cables.
- Reminder of the need for education around the fact that almost all transoceanic communications are now carried on submarine cables.
- The expected growth of offshore renewable energies and the need to share an increasingly crowded seabed.

Maritime activities have a cross-border dimension. National decisions have an impact on adjacent countries. Thus, trans-boundary problems might arise from the localizing of new pipelines or cables. Countries sharing a common marine space in the same basin should find ways to cooperate and promote common approaches to avoid or tackle potential cross-border impacts such as those at the TRACECA EU project, which promoted the development of regional transport links initiatives, promoting, thus, the regional economy on the whole.

4.6 Marine hydrocarbon (oil and gas) extraction

Prepared by D. Sauzade, Plan Bleu

4.6.1 Introduction

General context

According the EU Offshore Authorities Group (EU OAG, 2013), offshore oil and gas production constitutes an important indigenous energy source of hydrocarbons in Europe. In 2011, offshore production in the continental shelves of different EU member states corresponded to almost 11% for oil and 26% for natural gas of the Gross Petroleum Products Consumption.

As shown in Figure 27, major offshore installations in the Mediterranean Sea are concentrated in the Adriatic, in the gulf of Gabes and in the Libyan Sea. In the Black sea, production is mostly located in the North West part.

Production in the Mediterranean WP6 Pilot cases areas is concentrated in Adriatic for Italy, but other areas are potentially promising as offshore of Western Mediterranean (Catalonia and France) or North West of the Black Sea.

The future development of the offshore oil and gas production in European waters of the Mediterranean and in the Black sea is now mostly conditioned by evolution of the energy price and environmental considerations.

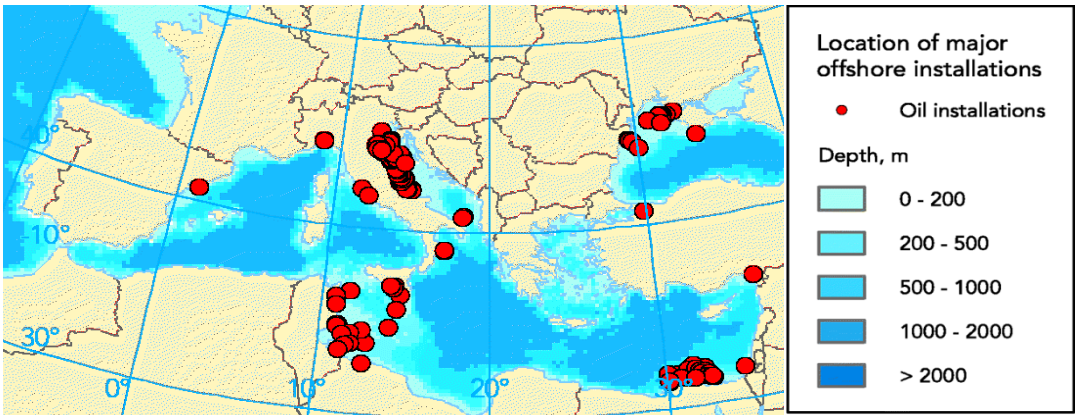

Figure 27. Major offshore installations in Mediterranean and Black Sea (2003)

Source EEA, Locations of major offshore installations, 2003.

Activity description

The oil and gas activities include offshore exploration and extraction of oil and gas at sea. The offshore activities comprise different phases linked to exploration of gas and oil reservoirs: i) the exploration phase to probe the position and the geological characteristics of wells, ii) the installation of the production platform iii) the production phase to extract oil and gas and iv) the decommissioning phase when the commercial life of the well is finished (E & P Forum / UNEP, 1997).

Offshore activities are supported by services activities, such as supply of offshore platforms (various materials, food), personnel transport, security of platforms, anti-pollution but also towing, installation and maintenance of platforms. In this study, these support activities are not taken into account in the calculation of turnover and value added, but they could have been included in the employment data issued by some sources. Some riparian countries of the Pilot cases are also hosting offshore related activities as management, consultancy, research & development, classification or construction and repair of offshore fleet units which are not generally taking place in the Pilot case waters. They are mentioned in the text but not quantified in the activity indicators.

4.6.2 Sector and socio-economic analysis per Pilot Case

Methods, data and assumptions

Data on offshore production in the Mediterranean and in the Black sea are scarce. One reason is due to the fact that oil and gas offshore production is not an economic sector by itself, but a subsector of the oil and gas production in general. The produced commodities (crude oil, natural gas) are identical to those produced on land, the only difference being on the means of exploration and production. Moreover, the PERSEUS Pilot cases are not by far large offshore producing regions, and are not significant in the world production. Data scarcity is developed in the gap analysis for this sector.

The used data and the developed assumptions to address the Pilot Case economic and social analysis for this sector are presented here.

Production figures

- Crude oil and gas production are segregated. Oil and gas productions (generally in barrels per day) have both been converted in TOE (tons of oil equivalent) to be aggregatable.
- 2011 as selected as the reference year, considering available data.
- For Italy, National statistical data (DG RME, 2013) provides a detailed overview of the Italian offshore production.
- National productions (offshore and onshore aggregated) of oil and gas are given by Eurostat.
- Clarkson Research Services provide offshore oil production figures (quantities, number of fields, platforms…) regarding some countries. The December 2010 issue has been used.
- When offshore production figures were not available, assumption was made that approx. 50% of the primary production of crude oil or natural gas is produced offshore. This assumption was employed by the EU Offshore Authorities group to present the offshore oil and gas production in Europe by countries.

Economic analysis

Value of the production

It has been considered that all identified productions have been sold at the average price of the OPEC Reference Basket (ORB) value for the reference year (2011): US$ 107.46 for one barrel or 787.83 for one ton.

Conversion US$ / € has been made using the yearly average conversion rate: one US$ for € 0.78. So, one TOE was valued at € 614.51

Added value

Offshore and onshore productions are generally aggregated in macro-economic statistics and few studies specific to offshore are currently available. None have been found regarding specifically Mediterranean or Black Sea countries. Thus it has been used figures for the UK Offshore industry. According (Pugh, D., 2008), the average added value/ production value ratio is 69%.

Regarding indirect value added, it was found in the study "Economic Impact of the Maritime Industries in Europe" (Policy Research Corporation, 2001), which focused on the economic analysis of the traditional maritime sectors in 15 Member States and Norway (cited in Policy Research Corporation, 2008) that for every euro direct added value, € 0.59 indirect added value was realised after correction for double counting and cross-border effects. However by convention, indirect added value has not been taken into account in this analysis.

Social analysis

Similarly, specific studies on the employment induced by the oil and gas offshore industry within Mediterranean or Black Sea countries have not been found freely available. Figures transferred from the UK offshore industry has been used, (UK Offshore industry, 2013) considering for Mediterranean countries that each TOE generate the same ratio of employment as the one of the UK industry. Considering the large difference in national importance between the UK offshore industry and the one of the Mediterranean and Black sea countries under study, this assumption probably under estimate the direct employment but also overestimate the indirect employment. Thus it provides an order de magnitude on the whole.

In 2012, the UK oil and gas production was about 100,000 kTOE. The same year, exploration for and extraction of oil and gas from the UK continental shelf accounts for around 440,000 employments, comprising:

- Direct: 32,000 directly employed by oil and gas companies and their major contractors (ratio: 0.32 employment/TOE)
- Indirect: 207,000 within the wider supply chain (ratio: 2.07)
- Induced: 100,000 jobs supported by the economic activity induced by employees' spending, plus 100,000 jobs in the exports business, or 200,000 (ratio: 2.00).

Gulf of Lion/ Catalan Sea Pilot Case

By convention, this area contains parts of the Mediterranean coasts and waters of Spain (Levantine Balearic Area) and France (Mediterranean façade) included in the Western Mediterranean MSFD subregion.

Considering this area, there is only is a small production zone in Spain, mostly located in south of the Ebro delta. According Clarkson (2010) 6 fields are in production in Spain, a figure stable from 2006 to 2010, while the production slowly is decreasing. 2009 production of crude oil was estimated to 100 kTOE.

However exploration licences on large and deep to ultra-deep areas have been granted both in France and in Spain. In France, south of the Provencal coasts, Rhône Maritime, in the French EPZ, a very large exploration licence (25,000km^2) going as deep as 2600m was granted in 2002, renewed in 2006 for 125,00km^2 and dropped in 2012. This licence has triggered anger of ecologist movements, as it was located near the Pelagos cetacean sanctuary. Spain has recently granted a very large exploration licence in the slope of the gulf of Lion shelf named Nordeste. It should be noted that a large part of this licence is located in an area claimed both by the recent French (2012) and Spanish (2013) EEZs.

<u>Sector analysis</u>

Coastal areas

- Production tonnage in oil and gas: 123 kTOE (in Spain, the French production being nil)
- Number of installations: 6

Open sea

Production is deemed to be only coastal to date.

<u>Economic analysis</u>

Coastal areas

- Value: € 76 million
- Added value: € 52 million

Open sea

- Value: € 0

<u>Social analysis</u>

Coastal areas

- Current permanent employment for the coastal sea operation in the Pilot case area (in Spain) has been estimated to:
    - 39 Direct employments:

- 255 Indirect employments
- 246 Induced employments
- 540 Total employments

Open sea

- Current permanent employment for open sea operations is probably nil (occasional explorations).

Projections

- Exploration activities in Member State waters are facing strong environmental opposition in these areas, due to their recognized ecological sensitivity, their seismic instability and their ultra-depth, making difficult implementation of control operations in case of problems. This opposition has been strengthened since the BP Deepwater Horizon accident in the Gulf of Mexico. Moreover, production in these areas would be very expensive. For these reasons, production would be probably delayed after 2030, if not dropped out.

Northern Adriatic Sea

This area contains parts of the coasts and waters of Italia, Slovenia and Croatia include in the Adriatic MSFD sub-region. This area is only “coastal”, as the depth does not exceed 200m.

The Italian west coast of Adriatic Sea has been for long subject to permanent production activities. Approximately hundred platforms at sea, which extract mainly gas, are distributed along the Northern and Central Adriatic coast, on depth between 10 to 120m.

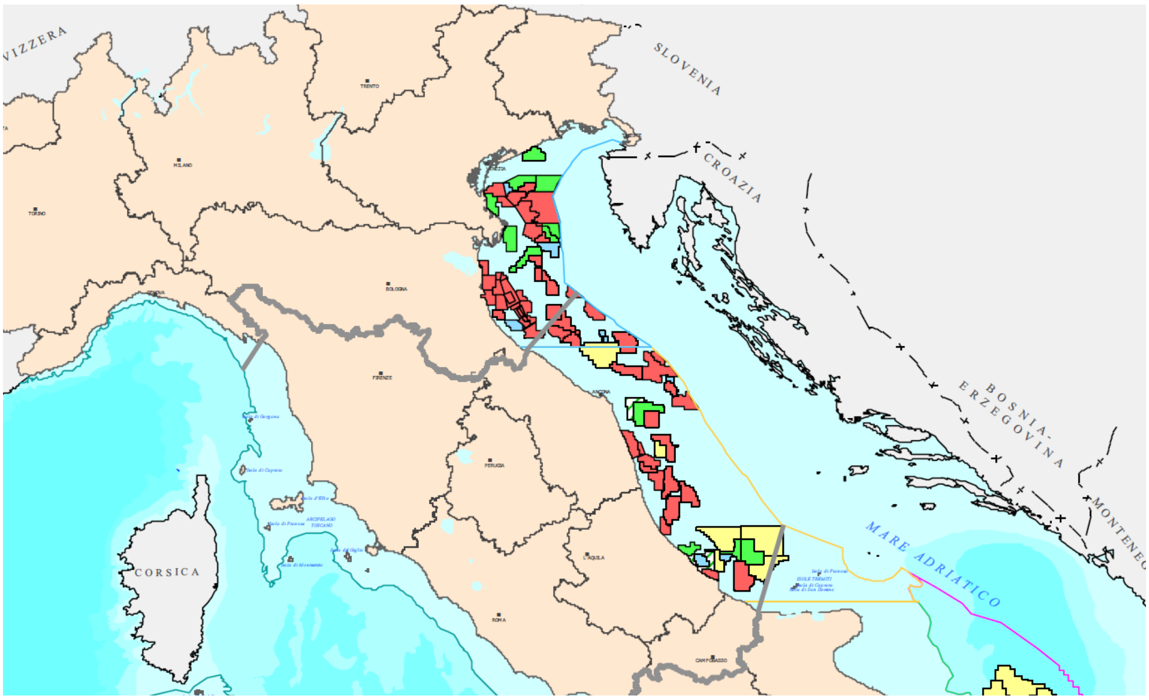

Figure 28. Map of Italian offshore licences in Adriatic

Note: Italian offshores licences are grouped in zones, here Zone A (upper, blue limit) and Zone B (lower, yellow limit) Source: DG RME, 2013

Regarding Italy, the Pilot Case area concerns Zone A and B. These areas concentrate most of the Italian oil extraction (Figure 29) and the whole of the gas production (Figure 30). These productions are declining despite implementation of modern technologies.

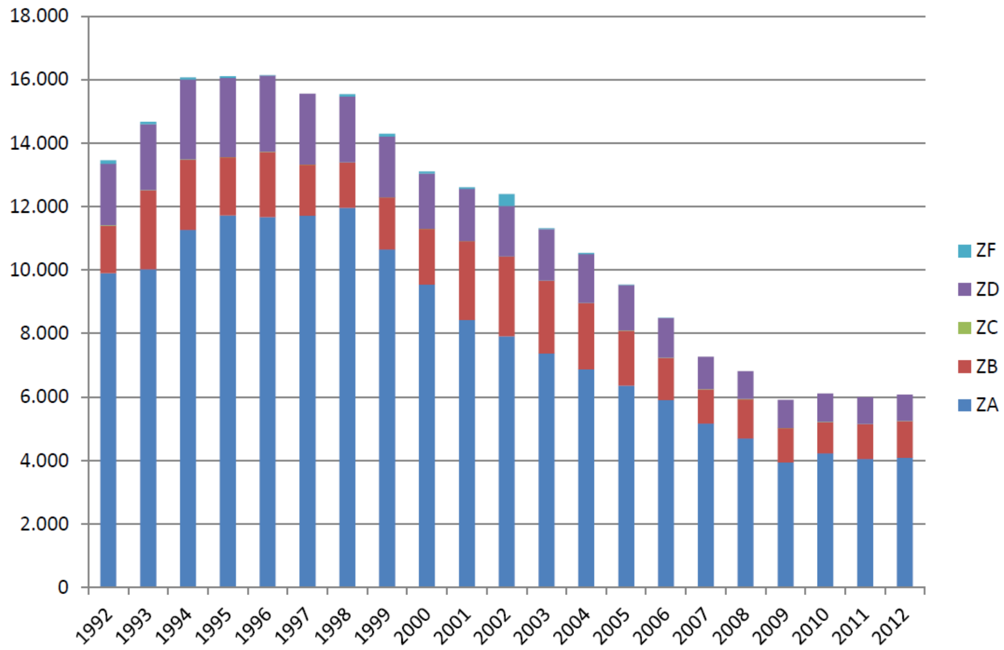

Figure 29. Offshore gas production in the Italian area, years 1992-2012, in million of m³

Note: Northern Adriatic Seas concerned by Zone A (ZA) and zone B (ZB). Source: DG RME, 2013

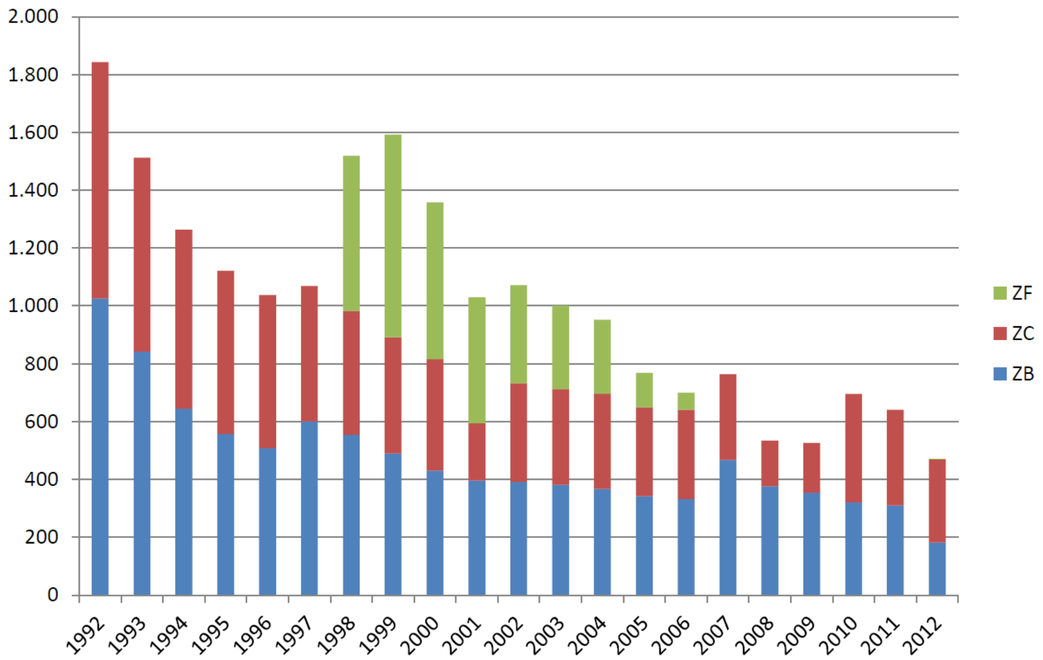

Figure 30. Offshore oil production in the Italian area, year 1992-2012, in million of m³

Note: Northern Adriatic Seas concerned by zone B (ZB). Source: DG RME, 2013

A great number of wells are active in the Italian part (Table 53), productions of which are collected in approx. hundred marine platforms and 8 collection and treatment onshore centres. Using the same ratio between production and number of platforms, it may be considered that approximately 30 to 50 platforms are installed off the Croatian coasts.

Table 53. Number of wells type of activity, end of year 2012

Number	Zone A	Zone B	Pilot case area (A+B)	Total Italy
Productive	252	86	338	396
Potentially productive	227	63	290	312
Other utilisations	13	1	14	14
Total	492	150	642	722

Source: DG RME, 2013

<u>Sector analysis</u>

Coastal areas

By comparison to other northern Mediterranean countries, Italy and to a lesser extent Croatia have an important offshore production (see Table 54). However this production is minor compared to those of some countries of the south of the Mediterranean sea.

Table 54. Production of crude oil and natural gas in the countries concerned by the area,)

Year 2011, in kTOE	Italy	Slovenia	Croatia	Total
Oil	310	0	342	652
Gas	4,218	1	1,004	5,223
Total	4,528	1	1,346	5,875

For Italy offshore production data have been taken from UNMIG (Ministry for Economic Development). For Slovenia and Croatia, assumption was made that approx. 50% of the primary production is produced offshore.

Coastal areas

- Production tonnage in oil and gas: 5,875 kTOE
- Number of platforms: approx. 150

Open sea

No open sea within this area.

<u>Economic analysis</u>

Coastal areas

- Value: € 3,610 million
- Added value: € 2,491 million

Open sea

No open sea within this area.

<u>Social analysis</u>

Coastal areas

- Current permanent employment for the coastal sea operation in the Pilot case area has been estimated to:
  - 1,880 Direct employments
  - 12,160 Indirect employments
  - 11,749 Induced employments
  - 25,798 Total employments

Open sea

No open sea within this area.

Projections

The Adriatic offshore fields are mature and will be declining in the coming years (Figure 29 and Figure 30). In an optimistic scenario, the Italian RIE (2012) foresees a marginal increase of 0.75 TOE/year for 2020 (+ 10%) if a large revamping program for the offshore platforms is rapidly implemented. Croatian production is stable and should decline.

Aegean Sea/ Saronikos Gulf

This area contains parts of the coasts and waters of Greece included in the Aegean sea MSFD subregion.

Offshore production in the area is very confidential. According Clarkson (2010), 3 fields are said to be in production in 2010, against 71 for Italy to give an idea. Exploration of is relatively recent and oil reserves has discovered in 1973 only at Prinos and South Kavala sites in Thasos offshore field, in the north of the Agean Sea. More promising discoveries are located in the Katakolo field in Western Peloponnese, outside the Pilot case area.

Discovery of proven reserve in the eastern part of the Mediterranean Sea in deep sea, offshore Israel, Malta and Cyprus made up hope of equivalent discoveries in the southern Aegean Sea. Exploration campaigns are on-going. Discoveries could have enormous political, geopolitical as well as economic consequences. Recent declarations of Greek Prime Minister (august 2013) substantiate the opinion that Greece has huge gas reserve, mainly offshore.

Nowadays greek production is mainly offshore, national production and other parameters have been shared equally between the Thasos (inside the area) and the Katakolo (outside the area) fields, in absence of more precise data.

Sector analysis

Coastal areas

- Production tonnage in oil and gas: 103 kTOE

Open sea

Production is deemed to be only coastal to date.

Economic analysis

Coastal areas

- Value: € 63 million
- Added value: € 44 million

Open sea

- Value: € 0

Social analysis

Coastal areas

- Current permanent employment for the coastal sea operation in the Pilot case area has been estimated to:
    - 33 Direct employments:
    - 213 Indirect employments
    - 206 Induced employments
    - 452 Total employments

Open sea

- Current permanent employment for the open sea operation is probably weak (exploration only).

Projections

If offshore reserves are proven, current financial situation of Greece will sweep off environmental opposition and exploitation will start as soon as possible. However, Greece has ratified the Prevention and Emergency Protocol, 2002 associated to the Barcelona convention in 2006. Moreover, the European Union has adopted recently (published 28 June 2013) a new Directive on the safety of offshore oil and gas operations which should provide some guaranties regarding deep sea operation safety.

Western Black Sea

Production

Shows of oil and gas have been observed on the shores of the Black Sea since antiquity, with the first commercial (onshore) production beginning in the 1850's in Romania. Romanian offshore fields are located in the central part of its continental shelf. On-going exploration campaigns show that the whole area could host huge gas reserve. Recent discoveries are located in a disputed zone between Romania and Bulgaria.

Sector analysis

Coastal areas

- Production tonnage in oil and gas: 4,920 kTOE

Open sea

Production is deemed to be only coastal (<200m) to date. Moreover, the Romanian coastal shelf is very large.

Economic analysis

Coastal areas

Production is mostly coming from Romania

- Value: € 3,023 million
- Added value: € 2,086 million

Open sea

- Value: € 0

Social analysis

Coastal areas

- Current permanent employment for the coastal sea operation in the Pilot case area has been estimated to:
    - 1,574 Direct employments
    - 10,184 Indirect employments
    - 9,840 Induced employments
    - 21,599 Total employments

Open sea

- Current permanent employment for the open sea operation is probably weak (exploration only).

Future trends

Most of the Black Sea, both the shelf and the deeper areas, is believed to be prospective for oil and gas. Indeed, numerous discoveries have been made on the shelf of Ukraine, Romania, and Bulgaria. Until recently, however, exploration beyond the shelf on the continental slope and in the deep sea has been sporadic and inconclusive. Among the reasons for this lack of interest are the facts that the littoral countries have traditionally been well supplied with reasonably priced oil and gas by major producers. Also, the lack of technology in the littoral countries and the low incentive conditions offered to private investors of the upstream petroleum industry have limited the scope of exploration for oil and gas in the Black Sea.

However, this context is changing, especially for the two EU countries. In Romania, future pipe line connecting the Ana and Doina fields to the shore will boost exploration and production in the area (Figure 31)

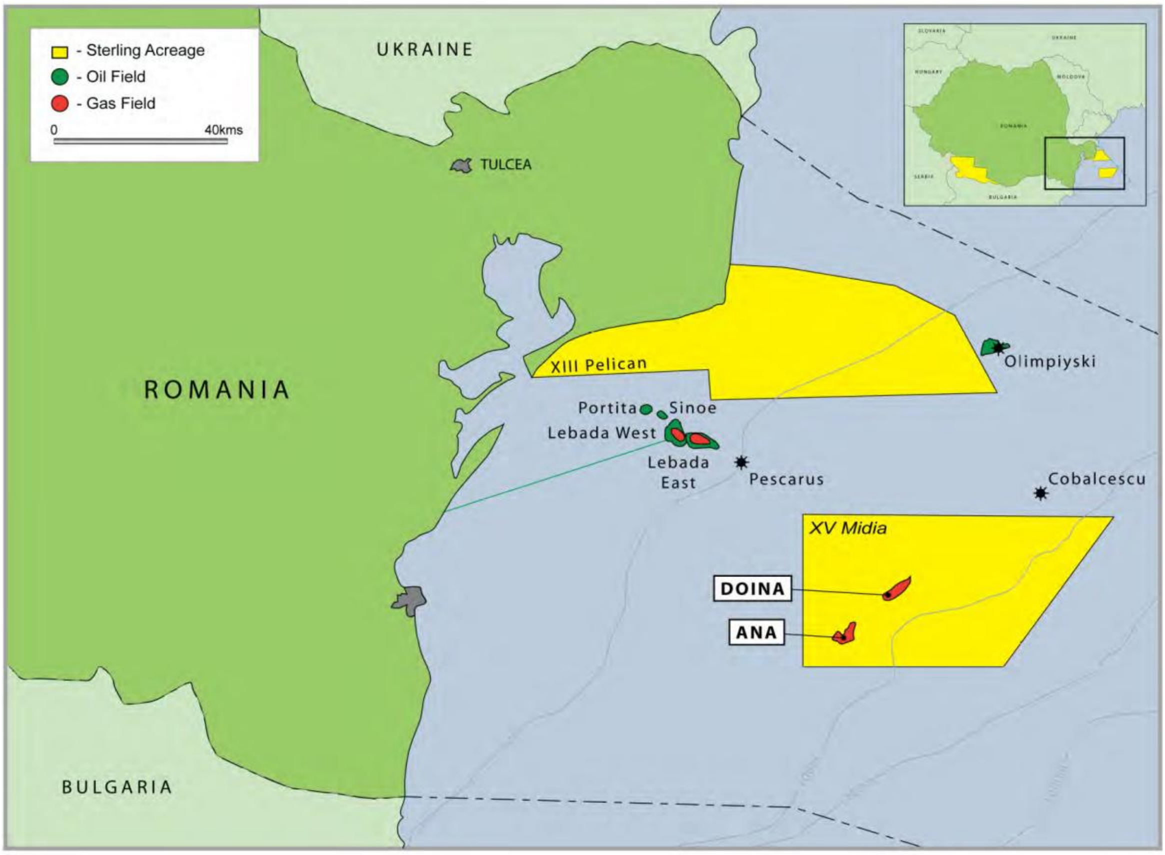

Figure 31. Map of the Romanian offshore production fields

Source : Sterling resources Company, Romania gas forum, 2011

4.6.3 Links to environmental pressures

General considerations

Oil and gas exploration and production operations have the potential for a variety of impact on the environment, depending upon the stage of the process, the nature and sensitivity of the surrounding environment, pollution prevention, mitigation and control techniques (Trabbucco, 2012).

Impact can be roughly classed into two categories; the first is related to ecosystem disturbance by the presence and operation of structures in the water column and on the bottom. The second is related to marine pollution due to oils spills, whether accidental or not.

With regards to the aquatic environment, the principal problems are linked to the presence of the offshore structures and then to waste streams. Presence implies disturbance by noises and vibrations of the marine fauna such as fish and marine mammals in the operating area, as well as possible invasions of exotic species carried by ships' ballast water assistance / support and oil (Kloff and Wicks, 2004).

As for the wastes, produced water consist mainly of water extracted from the reservoir, relatively warm, containing dissolved and dispersed oil, polycyclic aromatic hydrocarbons (PAHs), heavy metals, high salt concentrations, and no oxygen, sometimes even radioactive materials (Steiner, 2003; Wills, 2000; Patin, 1999). Volumes vary considerably throughout the life of a reservoir. Environmental impacts of offshore chronic pollution are not yet well known. However, the current research reveals the existence of cumulative and long-term impacts.

Regarding marine pollution, it should be noted that globally, only 9% of marine pollution from oil is attributable to offshore production, the majority of this pollution being from maritime traffic (68%) and onshore facilities (23%) (Lentz and Felleman, 2003). However, in regions where offshore oil production is intensive, as in the North Sea, the marine pollution by oil due to offshore production rises to 32%. Local environmental impacts can be significant depending on the intensity of the activity. In addition, marine pollution related to petroleum may originate from several sources and it can be chronic or acute and more or less toxic. A relatively small but sudden amount of oil can have fatal acute effects on all marine life, while larger quantities of oil discharged for long periods may have chronic and sub-lethal effect on the marine life.

Small oil spills typically occur during routine operations when oil is loaded and unloaded by tankers. This usually happens in ports, oil terminals such or offshore production platforms. The amount of oil spilled during operations on the terminals is three times greater than the total amount of oil spilled as a result of accidents involving oil tankers (ITOPF[4]). However, there are several examples of best practice globally regarding port management and control systems of tanker traffic, in which the problem can be reduced to very low levels through the use of advanced technology and careful management.

Accidental pollutions are often severe and can be caused by both tankers and offshore oil facilities. If a large spill occurs, pollution reaches almost immediately levels lethal to plants, fish, birds and mammals. The consequences are particularly disastrous if the oil spills happens on the coast and accumulates in sediments of shallow coastal areas. Accidents caused by large oil spills involving offshore oil installations can be caused by various factors. Well blowout or pipeline ruptures are the most common. A recent example for a catastrophic accident is the major explosion of *Deep Water Horizon* platform in the Gulf of Mexico in April 2010, having rejected three months between two and four million barrels of oil into the sea.

Policy context evolution in European waters and the Mediterranean Sea

The European Commission has considered that the scale and characteristics of recent offshore oil and gas accidents demand action. They expose the disparity between the increasing complexity of operations and the inadequacies in the current risk-management practices. In Europe, most oil and gas is produced offshore and the likelihood of a major accident in Union waters needs to be reduced. It has been considered that the existing regulatory framework and operating arrangements do not provide for the most effective emergency response to accidents wherever they

[4] The International Tanker Owners Pollution Federation (ITOPF) http://www.itopf.com/information-services/data-and-statistics/statistics

occur in Union waters, and the liabilities for clean-up and conventional damages are not fully clear.

In this context, the European Commission has proposed end 2011 a regulation of the European parliament and of the Council on safety of offshore oil and gas prospection, exploration and production activities[5]. On 28 June 2013, the European Union published a new Directive on the safety of offshore oil and gas operations in its Official Journal.

The objective of this Directive is to reduce as far as possible the occurrence of major accidents relating to offshore oil and gas operations and to limit their consequences, thus increasing the protection of the marine environment and coastal economies against pollution, establishing minimum conditions for safe offshore exploration and exploitation of oil and gas and limiting possible disruptions to Union indigenous energy production, and to improve the response mechanisms in case of an accident.

In September 2012, IUCN's Members Assembly has adopted a recommendation aimed at strictly regulating the development of offshore oil exploitation policies and projects in the Mediterranean. Through this motion, the World Conservation Congress asks the Mediterranean coastal States to regulate the development of offshore oil exploitation policies and projects in several ways including:

- to apply the precautionary principle to offshore development projects for remarkable and sensitive natural environments as well as protected areas;
- refuse to allow gas, oil or any other kind of exploration or exploitation permits for areas near natural sites which have national or international importance should any impacts be identified; and
- reinforce prior scientific studies on the study of coastal and marine environments.

Main pressures caused by the offshore hydrocarbon extraction

The main pressures considered are those listed in the Table 2 of the MSFD.

By order of importance:

- Oil spills: Contamination by hazardous substance, here oil, impacting marine life. This impact could local in case of operational oil spill or relatively large in case of accidental oil spill. Impacted ecosystem components are Seabirds, fishes (including exploited) shellfishes (including exploited), marine mammals, benthic fauna
- Operational waste: systematic introduction of solid and liquid wastes, specially produced waters, with a local impact
- Physical disturbance of marine life due to noise, especially during the seismic surveys required by the exploration phase.
- Biological disturbance due to potential introduction of introduction of non-indigenous species and translocation caused by associated shipping operations.

[5] Ref. COM/2011/0688 final - 2011/0309 (COD)

Main risks to be considered for each Pilot Cases

Within the tasks T1.1 and T2.1, respectively Analysis of pressures and process and their impact on the ecosystems, respectively in open sea areas and in coastal waters, main risks of non-achievement or maintenance of GES have been identified for the Mediterranean sub regions and the Black Sea. Specific risks for each WP6 Pilot cases have been also selected and presented in paragraph 2.4, Environmental risks analysis. For offshore oil and gas activities, these risks are presented in

Table 55. Potential risks induced or exacerbated by offshore extraction activities

WP6 Pilot cases	Coastal areas	Open Sea
Gulf of Lyon / Balearic Sea	Chemical Pollution (D8, D9), Marine litters (D10)	Physical damages and losses of habitats (D6)
Northern Adriatic Sea	Chemical Pollution (D8, D9)	-
Aegean Sea/Saronikos Gulf	Marine litters (D10)	Physical damages and losses of habitats (D6)
Western Black Sea	Chemical Pollution (D8, D9), Marine litters (D10)	

Gulf of Lyon / Balearic Sea

As seen in the above analysis, offshore extractions activities are nowadays minor compared to other Mediterranean areas. Excepted in the Ebro delta fields, contribution of these activities to increase risk regarding Chemical pollution and Marine litters is negligible.

In open sea, exploration permits have been granted by Spain. However, regarding uncertainties before to installations of production wells, risk of physical damages and losses of habitats will be negligible for long. Moreover these wells would probably not be drilled in the continental shelf slope and canyons, where are located ecosystem hot spots for this area.

Northern Adriatic Sea

More than 700 wells and 150 platforms are in activity in this area. Contribution of this activity to the chemical pollution of the area is certainly significant. In the future, this risk will probably tend to be stable or even decrease as the production is mature and decreasing. Moreover, regulations will be stricter regarding environmental safety of offshore installations.

Aegean Sea/Saronikos Gulf

Offshore extractions activities are nowadays minor compared to other Mediterranean areas. Excepted in the Thasos offshore fields, contribution of these activities to increase risk regarding Marine litters is negligible.

It has been seen that expectations are high to discover large gas fields in the Aegean Sea deep waters. If it becomes true in the coming years, these fields will be exploited and a great attention should be paid to the impact on the deep sea habitats, as there are biodiversity hotspots on seamounts in this area.

Western Black Sea

While less important than the Adriatic, western Black sea hosts a significant offshore activity, contribution to the chemical pollution of the area, especially in the production field areas. This pressure will probably increase in the future, if some of the offshore extension projects are concretized.

To a lesser extent, offshore production also contributes to the generation of marine litters. It is hoped that stricter regulation will limit these risks in the future.

4.6.4 Gap Analysis

Oil and gas activities are very strategic. They are the subject of plethoric factual information, aggregated in multiple business intelligence surveys at various scales, mostly made by specialized private companies who are generally selling at high price their production to professionals of the sector (typically 1000 € to 2 000 € for a country report or a regional map). Except for specialised reviews on offshore activities, reports are usually not setting apart offshore activities from onshore ones, as they produce the same commodities (crude oil and natural gas). Published scientific publications are generally dealing with issues upstream production, as geological studies, or downstream, as impact of activities or intelligence surveys on the energy resources or needs in the region. For these reasons, this part of the deliverable has been built on few available references, from which data have extrapolated by the authors in view to provide orders of magnitude and some general perspectives. These references have been presented in the methodology and data section of the analysis.

Except some field specific data, available data does not separate coastal areas activities from those in open sea, here defined as beyond the 200m bathyline. It can be considered that most of the oil and gas extraction in the PERSEUS Pilot cases is nowadays in the coastal area. However projections show that these activities could be developed in open sea in the next decades (W Black Sea, Aegean)

4.7 Population, Urban areas and WWTPs

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4.7.1 Introduction

In most of Mediterranean coastal areas the process of urbanization started during the second half of the second century. Presently, two thirds of the Mediterranean inhabitants live in urban areas and over half of the urban population lives in small cities (less than 300.000 inhabitants) (Plan Blue 2009). In view of the current dynamics observed, it is expected that by 2050, the urban population would stabilize in the North Mediterranean Countries (NMCs) reaching around 170 million (140 million in 2005), while in the Southern and Eastern Mediterranean Countries (SEMCs), it would double up, thus about 300 million inhabitants (151 million in 2005)(Plan Blue 2009).

Urbanization expands from metropolitan areas and it originates fragmentation and specialization (endangering social cohesion). In terms of coastal artificialization, about 40 % of the total length of the coastal area is already occupied (Pan Blue 2009). This occupation of the coast has been produced by demographic growth (coupled with internal redistribution, inter-urban migration and rural migration) and tourism sector development. The establishment of human settlements on coastal areas have transformed the coastal ecosystem and disrupted the processes that provide ecosystem services. The process of coastal development has occurred, frequently, without proper planning and consideration of the needs of the socio-ecological systems. Along the Northern Mediterranean coast, the metropolitan areas are characterized by a scattering of the population and of employment, as well as by a twofold movement of sub-urbanization and of metropolisation over increasingly extended territory (with problems of access to housing). On the Southern and Eastern coasts, the extension of cities is particularly driven by "informal" housing (with problems of access to water, sanitation and other basic urban services)(Plan Blue 2009).

Within this context, the main aim of this section is to characterize the magnitude of urbanization in the PERSEUS pilot areas and to provide information on pressure and impacts originated on the marine environment. Finally, gaps on existing information are identified. A similar section but providing data for the entire Mediterranean basin was presented in deliverable D2.2.

4.7.2 Population

Figure 32 shows the distribution of population in regions along the Mediterranean Sea and Black Sea, where a clear concentration of population along the coastal zone is observed. Population statistics in coastal regions of the different PERSEUS pilot sites are shown in Table 56. Population statistics in coastal regions in the PERSEUS pilot sites (Eurostat, 2013). Integrating all people living in the pilot sites, the W Mediterranean is the most populated area with more than 22 million inhabitants followed by the N Adriatic with about 20 million. On the other side, areas in the E Mediterranean and Black Sea are the less populated with 8.5 million and 4.8 million respectively.

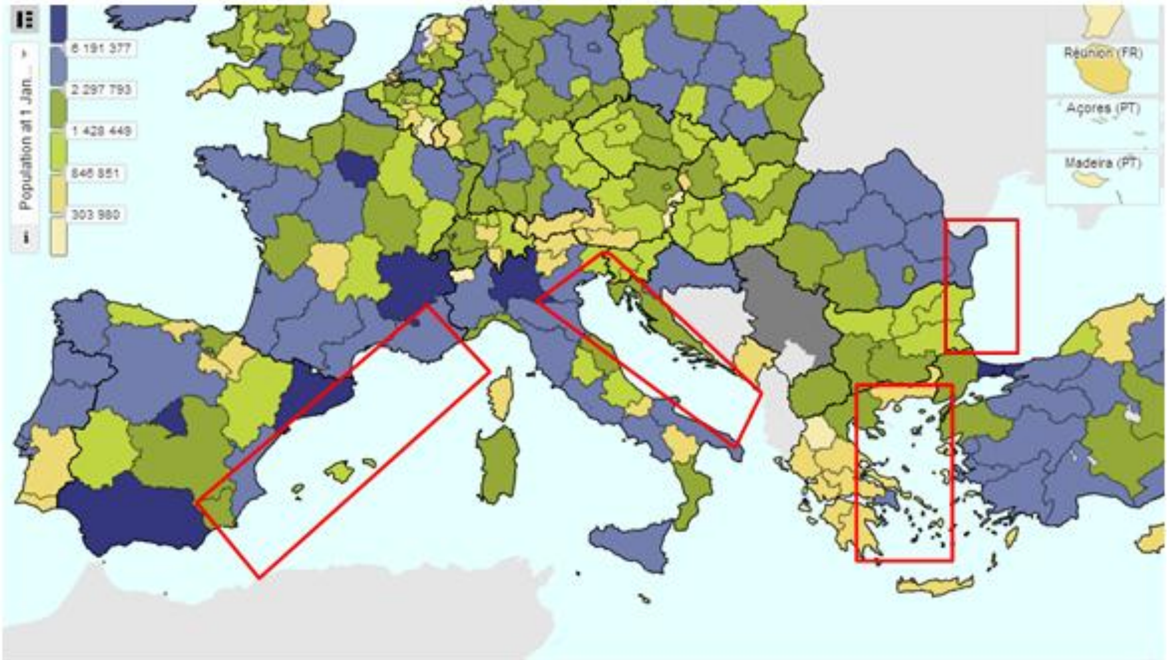


Figure 32. Population in NUTS 2 regions (Eurostat, 2013)

Table 56 shows the crude rate of population growth in regions of the different PERSEUS pilot sites, which is the ratio of the total population growth during the year (2011) to the average population in the area in question in that year and it includes the natural rate of change and net migration. As it can be seen, negative rates of change dominate in the E Mediterranean and Black Sea, whereas in the W Mediterranean and N Adriatic, although variable, the increase of population is the dominant type of change.

These areas also present the highest population density values (Table 56), although the largest values of the pilot areas are found in the regions of Veneto (N Adriatic) and Attiki (E Med) (Figure 33).

Table 56. Population statistics in coastal regions in the PERSEUS pilot sites (Eurostat, 2013)

Perseus pilot site	Country	Region	Population 2011 (inhabitants)	Population 2011 (thousands)	Population density (people/km2)	Crude rates of population change (o/oo)
W Med	Spain	Catalonia	7,333,532	22,467	229	-2.1
		Valencia	5,004,474		217.3	1.4
		Murcia	1,468,130		130.4	5.6
		Baleares	1,088,513		218.6	5.3
	France	PACA	4,911,811		156.6	2.6
		Lang-Rouss	2,660,946		97.7	9.4
N Adriatic	Italy	Veneto	4,937,854	20,358	268.9	3.9
		Friuli	1,235,808		157.3	0.2
		Emilia-Romagna	4,432,418		198.1	6
		Marche	1,565,335		167.3	2.4
		Abruzzo	1,342,366		124.8	1.9
		Molise	319,780		72	-2.1
		Puglia	4,091,259		211.3	-0.6
	Slovenja	Zahodna Slovenija	966,546		120.8	4.8
	Croatia	Jadranska Hrvatska	1,466,689		59.3	-2
E Med	Greece	Anat Maked, Thraki	606,004	8,556	43.1	-1.7
		Kent Maked	1,956,233		103.5	-1.2
		Thessalia	735,410		52.5	-1.7
		Sterea Ellada	554,609		35.9	-1.6
		Peloponnisos	589,790		38	-3.7
		Attiki	4,113,979		1 080.3	-1.2
Black Sea	Romania	Sud-Est	2,802,532	4,847	89.6	-4.1
	Bulgaria	Severoiztochen	966,328		66.7	-4.5
		Yugoiztochen	1,078,597		55.5	-5.3

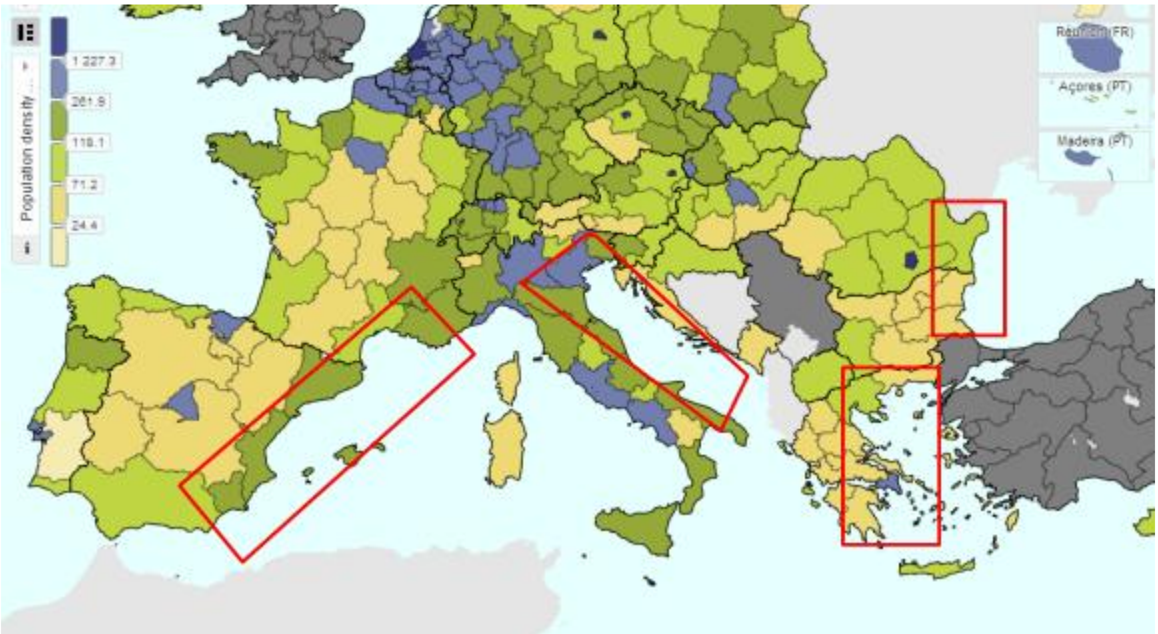


Figure 33. Population density (people/km²) in NUTS 2 regions (Eurostat, 2013)

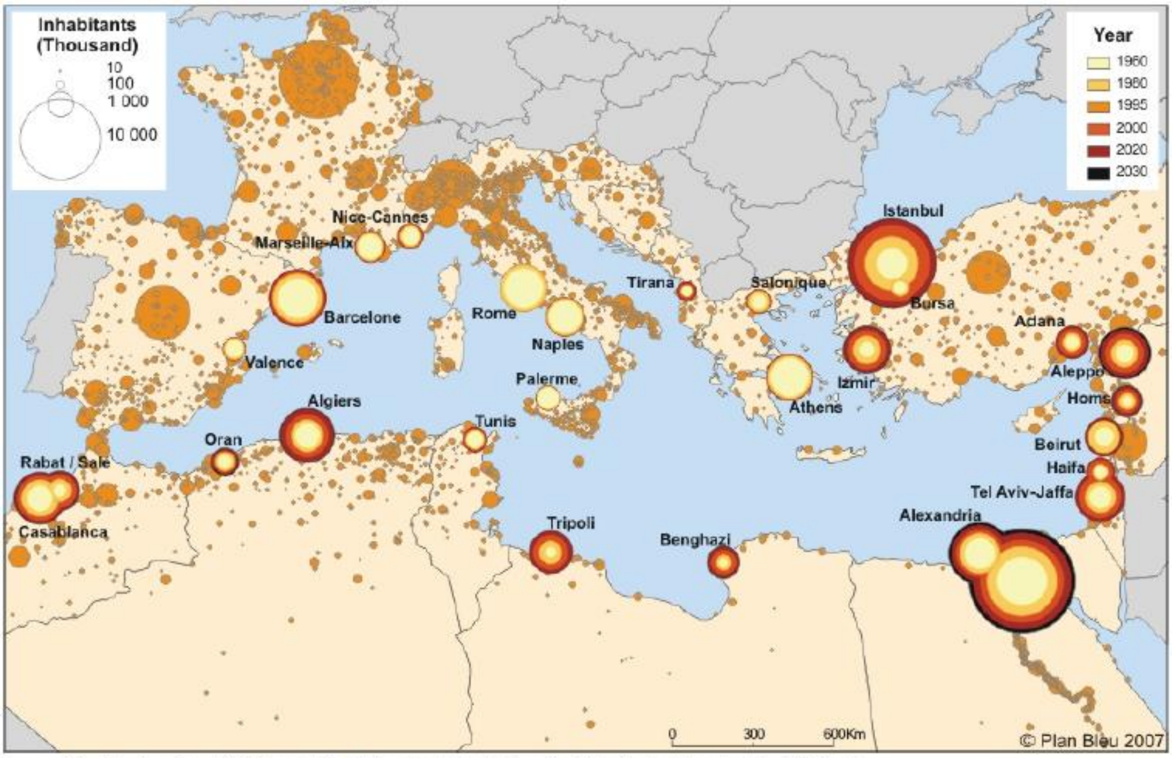
4.7.3 Urban Development

One of the main common characteristics of the demography worldwide is the trend to concentrate in urban areas. Thus, in overall, the percentage of urban population in the Mediterranean countries has evolved from 63 % in 2000, to 65.3 % in 2005 and to 66.73 % in 2010. Table 57 shows the evolution of the percentage of urban population for the different countries composing the Perseus pilot sites during the period 2000-2010.

Table 57. Urban population (% of the total) in countries of the Perseus pilot sites (World Bank 2012).

Region	Country	2000	2005	2010
West Med	Spain	76.2	76.7	77.3
	France	76.9	81.6	85.2
N Adriatic	Italy	67.2	67.6	68.2
	Slovenia	50.7	50.5	50.0
	Croatia	55.6	56.4	57.5
E Med	Greece	59.7	60.3	61.2
Black Sea	Bulgaria	68.9	70.2	72.5
	Romania	53.0	52.8	52.8

A s it can be seen, countries with largest percentage of urban population compose the W Mediterranean pilot site which were also the ones most populated, i.e. France and Spain. On the other hand, countries with the lowest percentage were Slovenia (N Adriatic) and Romania (Black Sea). Although these are overall percentages (corresponding to the entire country), if we assume that they are also representative of the regional conditions, they will be indicating that the absolute importance of urban agglomerations in the pilot sites (and thus their associated pressures and impacts) is, in decreasing order: W Mediterranean, N Adriatic, E Mediterranean and Black Sea.



Source : Blue Plan from Geopolis 1998 and United Nations Population Division, World Urbanization Prospects: The 2005 Revision

Figure 34. Evolution of population in urban agglomerations in the Mediterranean countries, 2004 (Plan Blue 2009)

Figure 34 shows the distribution of main urban centres in the Mediterranean countries. As it can be seen, with the exception of Spain, France and Morocco which also have an Atlantic coastline and having the largest urban agglomerations out of the Mediterranean coast (Madrid, Paris and Casablanca respectively), the largest urban agglomerations in each country are located along the Mediterranean coastline. This concentration along the coastal zone is especially evident in the South coast, where most of the territory lacks of significant urban agglomerations.

In place like Spain, the potential revenues generated by tourism and real estate development have influenced the political process allowing the massive urbanization of areas and the degradation of their natural resources and in many cases local economies (Suárez de Vivero and Rodríguez Mateos 2005). Another factor that has contributed to the degradation of the coastal landscape is the existing institutional setting. Coordination among the different levels of management has not traditionally worked very well (Barragán 2003). The structural changes experienced by the cities around the Mediterranean call for methods of governance that are tailored to their new operating scales. As an example, in the Catalan coast the response to the coastal development dynamics has been the establishment of the PDUSC (Plan for the urban development of the coastal system). Under this plan, a protection 500 m coastal strip has been established to avoid the full excessive urbanization of the coast.

Table 58. Major coastal urban areas (> 500,000 people) in the Pilot study sites.

Pilot area	Country	City	Total rank	Population (1000^3)	Density (people/km^2)	Land area (km^2)
W Med	Spain	Barcelona	85	4223	5300	803
		Valencia	544	810	3000	272
		Palma	807	500	3000	168
	France	Marseille	286	1,582	1300	1,204
		Nice	473	962	1300	743
		Toulon	737	559	700	764
N Adriatic	Italy	Bologna	792	510	3300	155
		Venezia		271	653	415
	Croatia	Zagreb	615	700	4400	158
	Slovenia*	Ljubljana		225	4100	54
E Med	Greece	Athens	119	3,269	4800	684
		Thessaloniki	534	840	4300	194
W Black Sea	Romania	Constanta		300		
	Bulgaria	Varna		396	1931	205
		Burgas		310		

Notes: * indicates the largest city of the region when no urban area exceeding the threshold does exist. Rank refers to the position with respect to global list of populated urban areas (only when population > 500,000).

Table 58 shows the basic dimensions of major urban areas (> 500,000 people) in regions composing the Perseus pilot study sites as well as their position in the rank of most populated cities of the world. Again, with the exception of Athens (E Mediterranean) which is the capital of Greece, the W Mediterranean is the area that concentrates the largest urban agglomerations in absolute terms (population) and relative terms (density).

In the Black Sea site, in Romania the total population in the Sud-Eest region is about 2.8 million people, from which 1.5 million people live in urban agglomerations larger than 150,000 people and, about 1.3 million people live in very small agglomerations

(2,000-10,000 people) (Ministry of Environmental and Sustainable Development, 2007). In Bulgaria, of a total of about 2,025 million people living in the regions included in the pilot sites, around the 72.4 % live in urban areas.

4.7.4 Wastewater Treatment Plants

The high rate of population growth along the Mediterranean coastal zone previously as well as the development of coastal urban agglomerations have originated an increase in the quantity and quality of wastes produced. Besides this, it has to be considered that these areas also experience a seasonal increase in coastal population due to tourism.

Within this context, wastewater treatment plants (WWTP) become one of the key infrastructures to preserve the ecological health of coastal waters. Although the factors controlling the deterioration of coastal water quality (and the marine environment in general) are various and most of them are interconnected, land-based pollution sources become dominant. Within this, we can include pollution loads from (i) human agglomerations in coastal areas and (ii) discharges from "inland" municipal, industrial and agricultural areas, which are partially treated or even untreated ones, which reach the sea through the hydrographic river networks (UNEP, 2004).

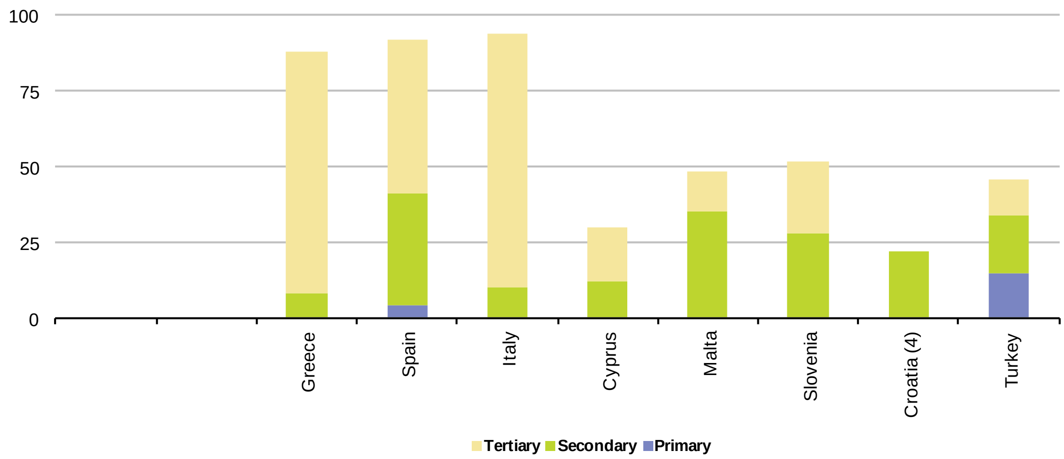


Figure 35. Population connected to wastewater treatment (Eurostat, 2009).

Municipal wastewater is discharged directly into the coastal zone through outfall structures of variable length and reaching also variable depths. In cities and large cities, it usually contains a variety of chemical wastes both from households and from industries discharging directly into the public sewerage system (UNEP, 2004). Wastewater discharge into the sea is regulated in EU through the Urban Waste Water Directive (91/271/EC), whose main objective is to protect the environment from the adverse effects of urban waste water discharges and discharges from certain industrial sectors. This directive prescribes as a minimum the secondary treatment for urban areas with a population larger than 10,000 people. Figure 63 shows the percentage of population connected to wastewater treatment in different European countries as well as the type of treatment (Eurostat, 2009).

Table 59 shows the percentage of population connected to wastewater collecting systems and wastewater treatment plants in Mediterranean and Black sea countries comprising the Perseus pilot sites. With respect to the coastal urban agglomerations along the Mediterranean, Figure 36 shows the distribution of WWTPs, where it can be seen that whereas main urban areas along the European coast have WWTP, a large part of coastal cities in the south and east coasts do not have such infrastructure. The percentage of coastal municipalities in the Mediterranean with a given WWTP status for small (between 2,000 and 10,000 people) and medium and large cities (> 10,000 people) is shown in Table 59. Thus, about 41 of % small cities and 29 % of medium and large cities are not served by WWTPs.

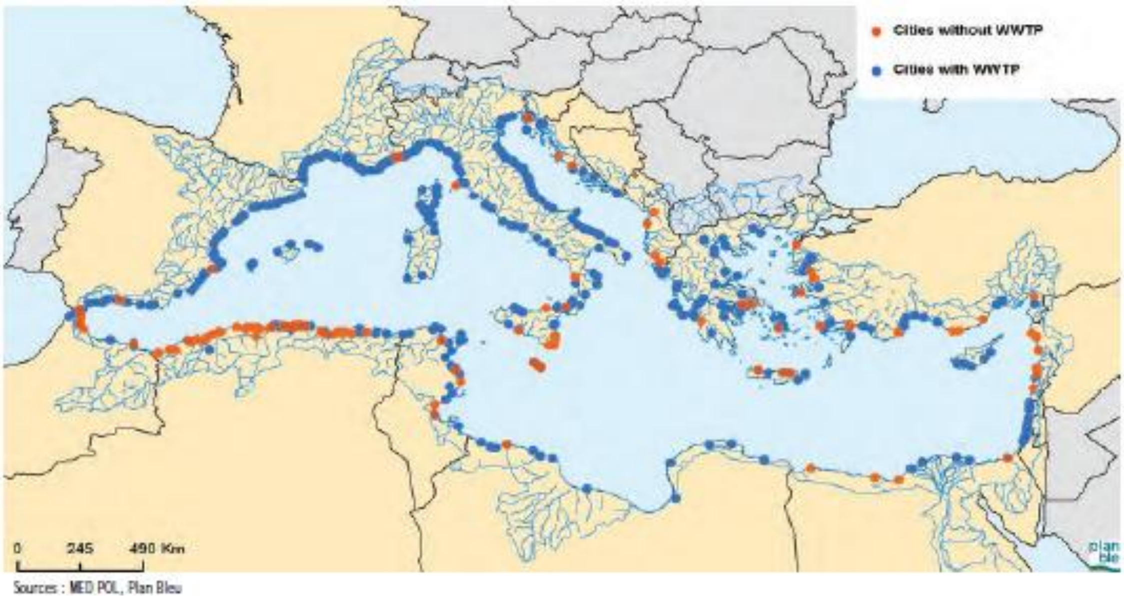


Figure 36. WWTPs along the Mediterranean coast (Plan Bleu, 2009).

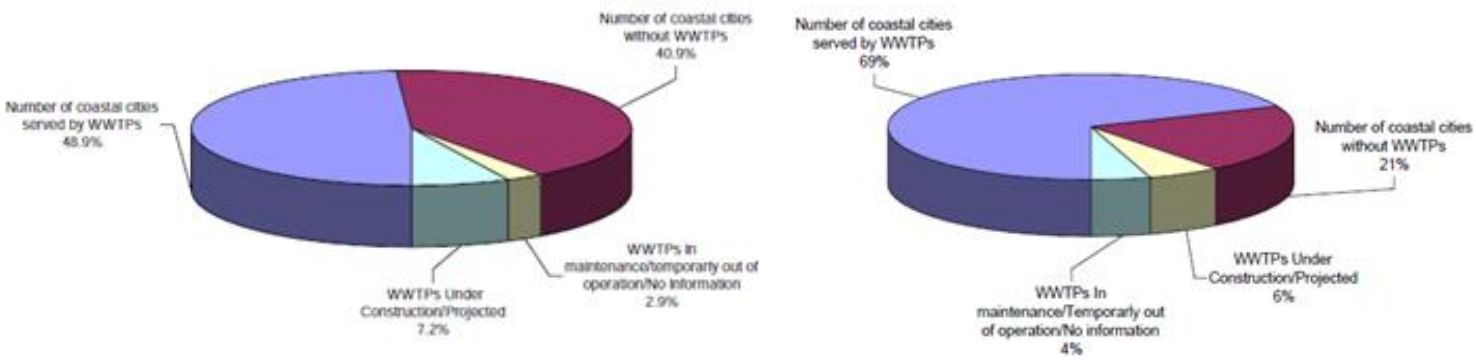


Figure 37. Availability of Wastewater treatment plants in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004).

The degree of treatment for wastewater of small and medium and large coastal cities in the Mediterranean basin is shown in Figure 38, where it can be seen that secondary treatment dominate, especially for medium and large cities. This result is in agreement with the fact that European coastal cities are the largest contributor to WWTPs and that they are regulated by EU norms which, as it was mentioned before, require secondary treatment in urban areas larger than 10,000 people.

The discharge of treated wastewater of small and medium and large coastal cities in the Mediterranean is shown in Figure 39. Discharge of treated wastewater in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004). As it can be seen, the most frequent situation is the lack of information about the destiny of the water, with 56 % and 39 % of the cases for small and medium/large cities respectively. Without this class, there is a difference in the way of discharge for small and medium/large cities. In the first case, the dominant type is the direct discharge into the sea, whereas in the second case, the dominant type of discharge is through submarine outfalls.

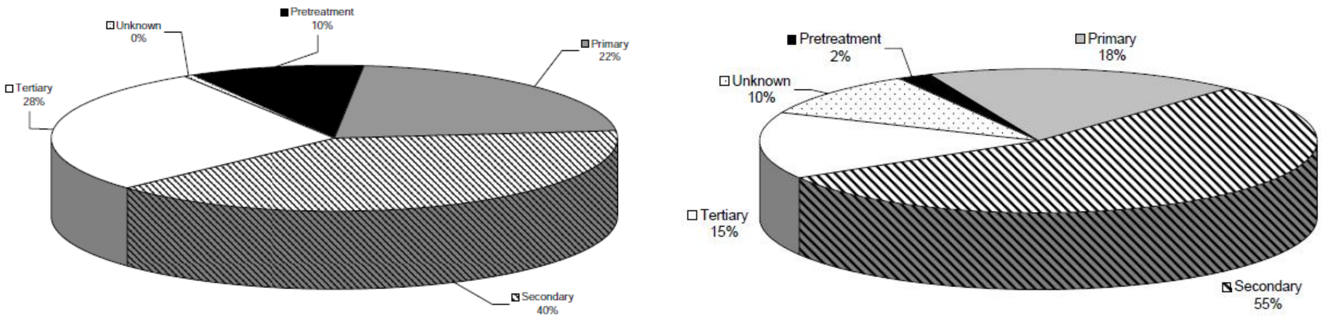


Figure 38. Degree of treatment in WWTPs in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004).

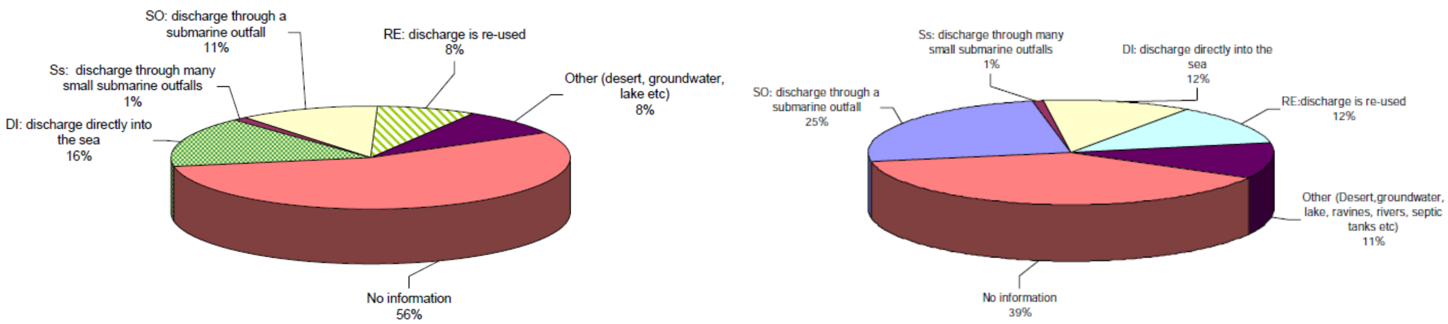


Figure 39. Discharge of treated wastewater in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004).

Table 59. Population connected to wastewater collecting system and wastewater treatment in the Mediterranean countries

Region	Country	Latest year available	Population connected to wastewater collecting system (%)	Latest year available	Population connected to wastewater treatment (%)
W Med	Spain	2007	100.0	2008	92.0
	France	2004	82.0	2004	80.0
N Adriatic	Italy	2005	94.0	1999	69.0
	Slovenia	2009	63.0	2009	52.0
	Croatia	2008	44.2	2008	27.3
E Med	Greece	2009	87.0	2009	87.0
Black Sea	Romania	2007	41.0	2007	25
	Bulgaria	2011	74	2011	55.7

Source: UNSD/UNEP; Eurostat; OECD.

4.7.5 Links to environmental pressures

Figure 40 shows a sketch of the main environmental pressures due to human land use on the coastal zone.

The main impacts associated to coastal development are (Plan Blue 2009):

- Natural resources degradation.
- Scarcity of arable land.
- Degradation of cultural heritage sites.
- Pressure on water resources.
- Erosion.

In the specific case of large cities, the main potential impacts are:

- Degradation of seawater and sediment quality
- Saltwater intrusion.
- Coastal pollution.
- Atmospheric pollution.
- Mobility problems.
- Excessive energy consumption.

Finally, the specific impact associated with WWTPs is:

- Degradation of seawater and sediment quality.

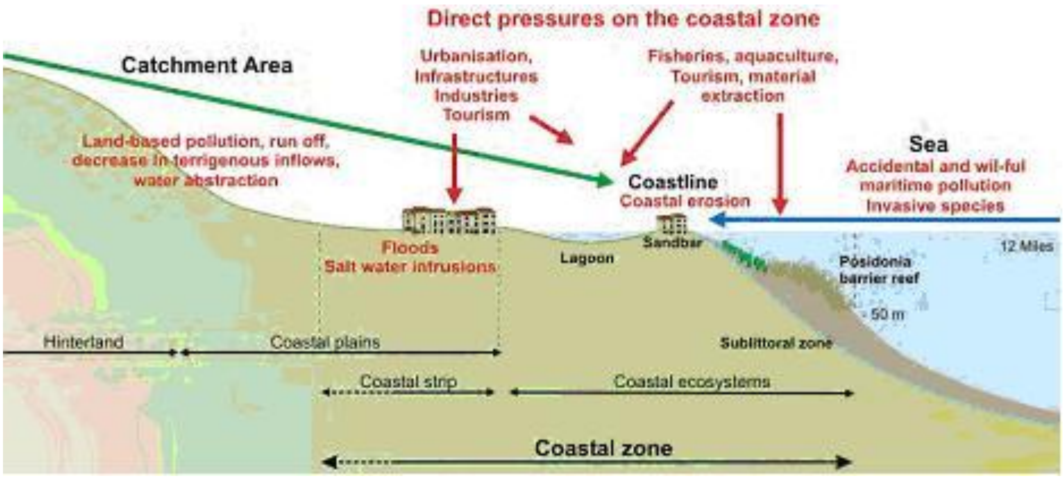


Figure 40.Main land-based pressures on the coastal zone affecting coastal and marine ecosystems (Plan Bleu, 2009).

An example of environmental pressure associated to the covered activities is the presence of point pollution sources or polluted coastal areas which may affect human health, ecosystems and/or economy, i.e. pollution hotspots. Figure 41 shows the distribution of pollution hotspots along the Mediterranean coast, where 131 points have been identified. According to UNEP/MAP (2003) about of 26 % are urban, 18 % industrial and 56 % mixed (urban and industrial). In the Black Sea about 53 municipal sources of pollution (hot spots) from which 12 are in Bulgaria and 4 in Romania (Black Sea Commission, 2011).

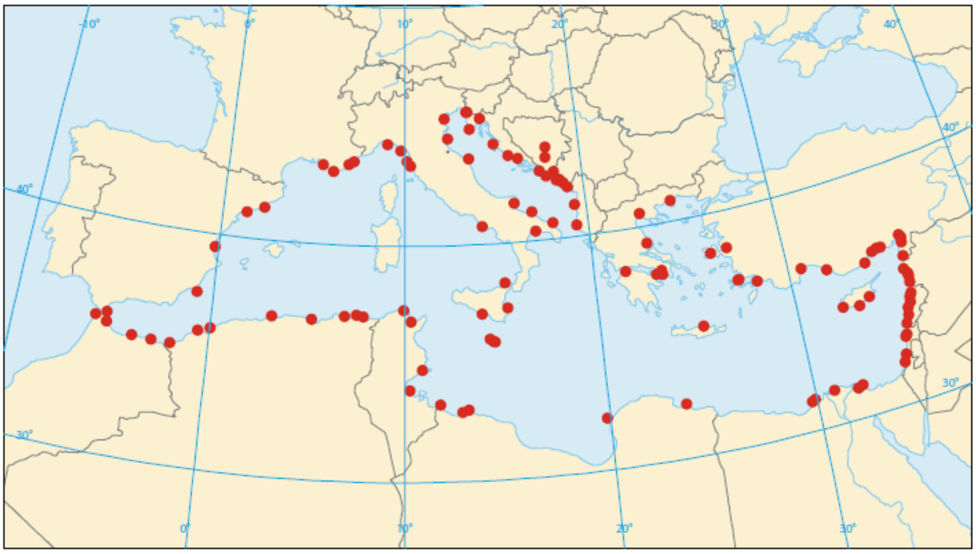


Figure 41. Pollution hot spots along the Mediterranean coast (EEA. 2006).

4.7.6 Gap Analysis

There is a need of updated and detailed data on extension of coastal urban areas for the different countries.

Population statistics are usually obtained from big census data. In order to obtain detailed figures about coastal population, disaggregated data or well spatially described ones are required. Due to the large tourism development of the area, it is necessary to incorporate seasonal fluctuations of population during summer to obtain realistic coastal population figures.

With respect to wastewater treatment plants, updated statistics are required since in some countries (especially in the south and east borders) there is a lack of data availability. As already identified in other existing studies, the most important constraints are related to: (i) insufficient data to characterize seasonal increases of population (mainly related to tourism); (ii) incomplete information on the quantities of wastewater treated and ways of disposal; and (iii) incomplete information concerning the details for the services being provided to the population.

Regarding environmental pressures and impacts, existing studies are essentially local ones with few data at the basin scale mainly related to pollution.

5 RESULTS OF THE COST OF DEGRADATION

5.1 Introduction, methodological considerations

In the context of PERSUES four Pilot Cases are examined, namely: the Balearic Sea and Gulf of Lyon; the Northern Adriatic Sea; the Aegean Sea/Saronikos Gulf and the Western Black Sea.

These areas are presented in section The WP6 Pilot Cases2.3.2, in terms of geographic features, in particular their surface, which has been used in some cases to assess the cost of degradation per Pilot case, as a proportion of the Cost of degradation assessed in similar areas, generally in the framework of the MSFD economic and social assessment (ESA) carried out by Member States.

General methods to assess cost of degradation are presented in the Guidance document elaborated by an ad'hoc working group at European level.

Three approaches were suggested in the WG ESA guideline to undertake the Cost of Degradation of marine waters:

- The Ecosystem Service Approach
- The Thematic Approach
- The Cost-based Approach

Each of these approaches is briefly presented and analysed in terms of strengths and limitation.

The Ecosystem Service Approach

Definition of "Cost of Degradation": The cost of degradation is associated to the value of (lost) ecosystem services, calculated as the potential difference between Good Environmental Status and a "Business As Usual" (BAU) Scenario.

Objectives: Capture the potential difference between the reference condition (attaining GES scenario) and the scenario that may originate in the absence of policy, by identifying and inventorying the ecosystem services and associated benefits that might be lost if the marine environment is negatively affected.

The Ecosystem Service Approach involves 4 main steps:

I. Defining GES for each component of the marine environment

II. Assessing the environmental status in a BAU Scenario

- Projections: forecast of drivers and pressures or simple extensions of historic trends in the state of the environment.

III. Describing in a qualitative and, if possible, quantitative manner, the difference between GES and the environmental status under the BAU Scenario (environmental degradation).

IV. Describing consequences of environmental degradation to human welfare in a qualitative, quantitative or monetary manner.

Strengths:

- Very detailed and exhaustive.
- It considers both qualitative and quantitative data.

Limitations to the Ecosystem Service Approach:

- Dealing with uncertainty: two or more future scenarios need to be assessed (e.g. the "BAU Scenario" and the "GES - MSFD scenario"), as well as monetary valuation of all ecosystem goods and services.
- Indicators able to compare different scenarios should be established.
- Risk of double counting when estimating the costs of losing ecosystem services.
- Dealing with reality: a significant amount of resources (time and data) are needed for a quantified and monetized assessment of the full cost of degradation.
- Taking into account the former aspects, a qualitative assessment might be the result of adopting this approach.

The Thematic Approach

Definition of "Cost of Degradation": The socio-economic impacts of current environmental degradation with regard to the reference situation.

Objectives:

- Providing a comparison between the current costs of implementing measures aiming to protect the marine environment and prevent its degradation, and the costs of implementing such measures in a reference – GES- situation.
- Assessing the current cost of degradation, reflecting the present costs, expenses and losses of benefits related to the anthropogenic degradation of the marine environment.
- Assessing the financing structure for the protection of the marine environments, that is, providing an overview of the economic actors that are involved in the implementation of these measures.
- Providing useful qualitative and quantitative information characterizing the benefits of implemented measures.

The Thematic Approach involves 4 main steps:

I. Defining degradation themes (e.g. chemical compounds, marine litter, oil spills, microbial pathogens, eutrophication, invasive species, degradation of natural resources etc.).

II. Defining the reference condition, where GES targets are achieved.

III. Describing in a qualitative and, if possible, quantitative manner, the difference between the reference condition (GES) and the present environmental status for all themes.

IV. Describing consequences of environmental degradation of marine environments to human welfare in a qualitative, quantitative or monetary manner. It may include 4 types of costs:

- Expenditures on current measures for environmental protection and prevention
- Mitigation costs: expenses for avoiding impacts linked to the loss of ecosystem services.
- Transaction costs: linked to monitoring and dissemination.
- Opportunity costs: loss of benefits of activities suffering from environmental degradation or lack of biodiversity resources.

Strengths:

- It considers both qualitative and quantitative data.
- Since no BAU Scenario to be forecast, this approach results less contentious from the analytical perspective.

Limitations to the Thematic Approach:

- The reference situation (GES) needs to be determined and explained for each cost type and degradation theme.
- Limitations on data availability, leading to an assessment rather qualitative.

The Cost-based Approach

Definition of "Cost of Degradation": Cost of avoiding today's environmental degradation, according to relevant legislation put in place for the protection of the marine environment.

Objectives: This approach assesses the current cost of degradation, and quantifies the present costs, expenses and loss of benefits related to the anthropogenic degradation of the marine environment.

The Cost-based Approach involves 4 main steps:

I. Identifying current legislation intended to improve the status of the marine environment. This step involves the following tasks:

- Considering all individual measures that have been put in place and have a significant effect upon the marine environment.
- Considering whether measures are on land or sea; whether they are paid by public or private sectors; and the time scale they are paid over.

II. Assessing the costs of this legislation to the public and private sectors.

- E.g. costs to public sector: subsidies, personnel costs, carrying out measures for land-based activities, etc.

III. Assessing the proportion of this legislation that can be justified on the basis on its effect on the marine environment.

IV. Adding together costs attributable to protecting the marine environment from the review of the different legislation

Strengths:

- It refers to the present situation, consequently data and information might be available.
- It delivers useful information for assessing benefits of measures currently put in place.
- There is no need for developing neither a reference condition nor future scenario.
- It provides with an overview of the financing structure for the protection of the marine environment by detailing which are the economic sectors implementing measures (and assuming costs).
- It can also consider measures resulting from concerns in areas other than marine environments (i.e. agricultural sectors, wastewater treatment plants, etc.) but having an effect on them.

Limitations to the Cost-based Approach:

- This approach considers only quantitative data on already implemented measures for preventing marine degradation.
- It does not include a reference condition (since it does not aim to present benefits of improving marine environmental status or achieving GES).
- Cost of total degradation is not quantified, since current measures are not able to prevent total degradation of marine environments.
- The inventory of land-based measures might be challenging: to what extent do they need to be considered.

Analysis of the Cost of degradation assessment made by EU MS riparian of the PERSEUS Pilot cases shows diversity in the methods chosen by MS, some MS combining methods. Greece has used a simplified Ecosystem Service approach, as Slovenia which combined this method with a valuation of the current goods and services provided by marine ecosystems. Italy and Spain used the Cost based approach while France developed an original method combining the Cost based approach with the Thematic approach. This diversity shows the novelty of the subject and has made more difficult to assess the Cost of degradation in the PERSEUS Pilot Cases.

5.2 Cost of degradation per Pilot Case

The environmental risks affect a number of the ecosystem services of the marine areas, both final and intermediate. In order to provide detailed estimates of the cost of degradation for each Pilot Case, it would be necessary to have a plethora of quantitative information regarding:

(a) the ecosystem status

(b) the pressures and impacts affecting the provisioning (e.g. food, genetic resources, renewable resources and non-renewable resources, maritime transportation routes), the regulating (e.g. air quality regulation, climatic regulation, storm and flood protection, erosion control, water purification), the cultural (e.g. recreation and leisure, aesthetics, cultural heritage) and the supportive services (e.g. nutrient cycling, ecosystem stability and resilience, habitats, biodiversity) of the marine ecosystem

(c) the characteristics of the population affected (i.e. number of affected inhabitants, tourists, recreationists, etc.)

(d) the affected population's willingness to pay for measures aiming to protect the marine ecosystem (per impacted service) by means of methods capable of capturing both use and non-use values of these services.

Although in the context of PERSEUS existing data were gathered and synthesized and new knowledge was developed, there are still significant gaps in information relating mainly to the abovementioned issues (b) and (d). For instance, as proved during the process of constructing the *V-MESSES* database, the number of monetary estimates for specific marine ecosystem services is limited, if not absent, in Mediterranean and Black Sea regions. In addition, the disparity in the monetary estimates is quite large. For example, for the Mediterranean Sea, the economic value of marine ecosystem benefits ranges between 125 € (2012) per ha and year (Mangos et al. 2010) and 161,000 € (2012) per ha and year (Brenner et al. 2010). This is attributed to the different 'assets' valued and the different area of interest (e.g. an entire sea region vs. a coastal area) and it coincides with the conclusions drawn by TEEB (2010), i.e. that the monetary value of the potential use of all services of coastal ecosystems varies between 248 and 79,580 USD per ha per year (App. 3, Tables A3.1 & A3.3).

Bearing in mind the above remarks, the cost of degradation, at this stage, was based on the information provided from the MSFD Initial Assessment reports of the EU MS. More explicitly, first, the total national or regional cost of degradation of the marine environment from the MSFD Initial Assessment reports of the MS was scaled on a per square kilometre basis. Then, the cost of degradation attributed to each of the four Pilot Cases was estimated according to their geographic area (see section 2.3.2), taking into consideration the following activities:

- fisheries
- aquaculture
- maritime transport
- recreational activities and tourism (ferries, cruise ships)
- underwater pipelines and cables (power and communication)
- "offshore" industry (oil, renewable marine energy)

The methodology adopted follows a ‘top-down’ approach and it is not capable of providing a detailed breakdown of the cost of degradation per ecosystem service and activity because of the lack of appropriate input data. As a result, its ability towards selecting targeted measures is reduced. In addition, it may underestimate the cost of degradation related particularly to non-use values. On the other hand, the methodology is simple, transparent, straightforward and consistent with the approaches adopted by EU MS. Consequently, the estimates of the cost of degradation for each Pilot Case are comparable and at least as reliable and accurate as those of the MSFD Initial Assessment reports of the EU MS. It is finally noted that those issues will be addressed by means of a more detailed quantitative description and mapping of economic sectors that will be made in the Barcelona/Catalan coast, which is known to have adequate information and data in both environmental and socio-economic issues related to pressures from human activities.

5.2.1 Balearic Sea and Gulf of Lyon

Based on economic data published by the Spanish General Office of Analysis, Forecasting and Coordination, Department of Agriculture, Food and Environment, the cost of degradation was estimated at 139.99 million Euros and 83.10 million Euros for the years 2009 and 2010, respectively (i.e. 111.5 million Euros per year, on average), through investments attributed to the protection of the eastern provinces of Spain - Balearic Sea marine sub-region. In addition to that cost, the Autonomous Communities of Catalonia, Valencia and Balearic Islands spent, on average, around 256.5 million Euros per year, in 2009-2011 (i.e. Catalonia: 65 million Euros; Valencia: 125 million Euros; and Balearic Islands: 67 million Euros) for the protection of the marine environment (details are provided in deliverable D2.2).

The French Mediterranean coast comprises the Gulf of Lion and the Cộte d’Azur. The Gulf of Lion is broad and shallow and reaches, in the south, from the border with Spain to Toulon, in the west. The Cộte d’Azur is narrow and drops steeply to depths of 2000 meters and more (Lambeck and Bard, 2000). Bearing in mind the characteristics of this area and the fact that the economic figures which are available from the French Initial Assessment report (Mediterranean region) refer mainly to marine activities in coastal waters, the cost of degradation for the Gulf of Lyon was considered equal to the estimates provided for the French Mediterranean region. Based on this assumption, the cost of degradation is around 748 million Euros per year (details are provided in deliverable D2.2).

5.2.2 Northern Adriatic Sea

According to the Italian report, the total cost of degradation of the Italian marine environment is estimated at about 1,543 million Euros (ISPRA, 2013). The total exclusive economic zone of Italy is 551,369 square kilometers (de Vivero, unknown). Given that the total area of the Northern Adriatic Sea is, as mentioned, 18,900 square kilometers, the cost of degradation attributed to the specific pilot case is 52.85 million Euros.

5.2.3 Aegean Sea/Saronikos Gulf

According to the Greek report, the cost of degradation was considered to be equal to the Present Value of lost Gross Value Added in specific sectors. Using the results of the basic scenario (i.e. a discount rate of 2.38%), the total cost of degradation of the Greek marine territory is around 557.5 million Euros. The total exclusive economic zone of Greece is 504,452 square kilometers (de Vivero, unknown). The area covered by the Aegean Sea and the Saronikos Gulf is 217,600 square kilometers. Based on these figures, the total cost of degradation for the policy case is around 240.5 million Euros in Net Present Value terms.

5.2.4 Western Black Sea

The Romanian Initial Assessment employs a cost based approach, which includes monetary values of measures related to the coastal zone and the marine area in four main fields:

1) Investments in wastewater treatment facilities and construction of sewerage systems under the Urban Wastewater Treatment Directive. The total investment for rehabilitation of wastewater treatment plants sums up to € 24 million, while the extension and upgrade of the sewerage system along the coast is estimated at about € 50 million.

2) Nutrient abatement costs in the Romanian part of the Danube basin. The estimates for achieving reduction in nutrient loads until 2015 according to a baseline scenario (12% decrease in nitrogen and 20% in phosphorus compared to the level of 2005-06) are the staggering € 46,700 million or about one third of Romania's GDP in 2011.

3) The annual costs for removing algae from the beaches during the summer season are in the range of € 0.5-0.6 million.

4) The total costs for protection and rehabilitation of the southern part of the coast are estimated at € 40.3 million.

The total cost of degradation of the Romanian zone adds up to around € 115 million, not taking into account the nutrient abatement costs part of the Danube Basin Management Plan.

As far as Bulgaria is concerned, according to the Initial Assessment report that was recently released, the potential damages to fisheries and the tourism sector, in permanent damage to the marine environment, range between € 0.575-0.890 and 39 -58 million, respectively. The cost of degradation was calculated as the net present value of lost production value in the two sectors under a baseline scenario with a discount rate of 2.53%. This cost of degradation is used as a preliminary assessment of the cost of degradation of the specific policy case.

5.2.5 Results on cost of degradation and gap analysis

The cost of degradation for the four policy cases is summarized in the following table (Table 60). As mentioned, the estimates were based on existing information gathered by the Initial Assessment reports of the Member States after appropriate scaling. The estimates will be updated as new data becomes available.

Table 60. Cost of degradation for the PERSEUS policy cases

Policy case	**Cost of degradation** (millions of EURO)
Balearic Sea and Gulf of Lyon	1,116*
Northern Adriatic Sea	53*
Aegean Sea/Saronikos Gulf	240**
Western Black Sea	155 - 175**

*Note: *Annual estimates; **Total estimates*

The reader should note the relatively very low cost of degradation in Northern Adriatic Sea. This is due to the fact that the Italian Initial Assessment of the cost of degradation (ISPRA 2013, p. 6) is performed on a national scale. This imposes the proportioning of the total cost of degradation to the total area of Italian national waters and then to the relatively small area of Northern Adriatic Sea. As a consequence, all economic information pertaining to local marine ecosystem services and uses is lost.

Data issues remain a major challenge to assessing the cost of degradation for the pilot cases. The lack of information is attributed to not having:

(a) detailed surveys regarding the connection between the ecosystem status, the pressures and impacts and the ecosystem services of the marine areas;
(b) valuation studies and data-points regarding the main environmental risks and the services affected in each pilot case.

In order to cope with these issues, first, a detailed analysis of the ecosystem status and of the pressures and impacts affecting the ecosystem services of the marine areas would be necessary, considering both the final (e.g. food provisioning, raw materials and energy, recreation, maritime transport) and intermediate services (e.g. habitat, climate regulation, eutrophication mitigation, and resilience). In addition, anthropogenic pressures on marine ecosystems derived from land-based activities, namely the effects of large cities, ports, coastal development, pollution from industry and their interference with hydrology, nutrient and organic matter enrichment, biological disturbance or contamination effects in the pilot cases should be considered. Except some specific data, available information does not detail the interconnections between ecosystem status, pressures and impacts and ecosystem services, neither separates coastal areas activities from those in open sea, here defined as beyond the 200m bathyline.

Regarding market and non-market valuation studies, the *V-MESSES* database contains, so far, over 100 value estimates for four categories and 20 subcategories of marine services extending to regions of SES. Thus, the database enables, so far, the estimation of the aggregated value of all ecosystem services, as well as the economic value of: (a) provision of food, raw materials and genetic resources/medicine; (b) gas and climate regulation, erosion control, bioremediation of waste and water purification; (c) recreation and leisure, aesthetics, cultural heritage, spiritual values and science and education; (d) primary production, biochemical cycling, ecosystem stability, habitats and biodiversity.

Nevertheless, it should be noted that there are gaps of information that need to be filled. For instance, the Black Sea and the Central Mediterranean areas appear to have monetary estimates relating only to cultural values. Focusing on specific countries, Italy and Bulgaria have estimates only for cultural services, while no such data are available for France. Furthermore, not all ecosystem categories are covered with respect to the services offered within the area of interest. For example, there are limited or even no records for specific provisioning services.

In addition to availability of data or credible information, the selection and implementation of values is another restriction, since several conditions should be met in order to conduct effective and efficient value transfers (e.g. similar characteristics in terms of the environmental good or service valued, similar population sizes and characteristics in the study and policy sites, similar distributions of property rights, etc.). Finally, besides those issues, there are additional difficulties in applying value transfers in the context of marine and coastal ecosystem services, e.g. care must be taken not to use values derived in the context of incremental changes to value the ecosystem as a whole, not to add estimates of individual components of value when benefits from ecosystems are non-complementary to avoid overestimation of total economic value, etc.

6 CONCLUSIONS

Following the DPSIR model, this study provides an overview of the socio economic drivers (D) exerting pressures (P) on the coastal areas ecosystems whose knowledge is required to prepare the responses (R) aiming to reduce the impacts (I) to an acceptable level. More specifically, the objective of this deliverable D2.3 of the Task 2.2 (Analysis of socio economic activities in coastal areas) is to assess in socioeconomic terms the environmental impact of human activities using the coastal and marine areas, at the scale of the PERSEUS WP6 (Adaptive policies and scenarios) Pilot Cases, where will be implemented and tested the Adaptive Policy Frame Work (APF) Tool Box. This Tool Box is a kind of Decision support system for the construction of adaptive policies aiming to achieve or maintain the Good Environmental Status at Pilot Cases and Basin levels. Its logic follows a policy cycle in five steps, each steps calling for tools and knowledge base. The economic and social assessment (ESA) presented in this deliverable is an important part of the knowledge required to build policies, in the same way as the ESA included in Initial assessment is needed for further steps of the MSFD implementation by EU Member States (MS).

In this context, the PERSEUS four Pilot Cases have been examined, namely:

- the Balearic Sea and Gulf of Lyon (abbr. W. Med)
- the Northern Adriatic Sea (abbr. N. Adriatic)
- the Aegean Sea/Saronikos Gulf (abbr. Aegean)
- the Western Black Sea (abbr. W. Black Sea)

This study on the four PERSEUS Pilot cases has been preceded by the D2.2, which was focused on the four subregions of PERSEUS.

A similar work (D1.4) has been made in the framework of the Task 1.2, focused on the open water, here defined as waters including the seabed and subsoil beyond the 200m bathyline. This approach is in coherence with distinct ecosystems studied within the PERSEUS project but raised difficulties in practice due to the lack of data as well as in theory as it undermines the spatial coherency between the economic and social assessment and the design of programme of measures, which must take place in areas under given jurisdictional responsibilities. However, it has been considered as innovative to make a focus on the open seas.

As for the D2.2, this analysis has been focused on the following main sectors: i) fisheries, ii) aquaculture, iii) maritime transport and ports, iv) recreational activities and coastal tourism, v) submarine cable and pipeline operations, vi) marine hydrocarbon (oil and gas) extraction and vii) Population urban areas and wastewater treatment plants

The distinction between coastal areas and open seas proved to be more difficult than expected.

- For fisheries, distinction between coastal areas and open seas has been made on the basis of species known to be mostly fished in high sea, such as some pelagic Bluefin tuna and swordfish and some demersal fishes (Hake, Norway lobster, Blue and red shrimp and Giant red shrimp).

- For Maritime transport, it turned out difficult to segregate open sea from coastal area operations and it has been considered that all the maritime transport was taking place in open sea.
- Regarding submarine pipelines and cables, it was also difficult to segregate open sea from coastal area operations. In general for practical and then economic reasons, submarines pipes lines are nowadays rather installed in coastal seas whereas electrical and mostly data cables are laid in open seas. However, some submarine pipe lines have been installed in open seas and this trend will increase in the coming years.
- In the Mediterranean and Black Seas, offshore marine hydrocarbon operations take place mostly in coastal areas. However there are several projects of installation in open seas, and even in deep areas.
- Aquaculture, recreational activities and coastal tourism, desalination, urban development and wastewater treatment plants are deemed to be mainly coastal activities.

In consequence, it has been chosen to present in this deliverable both coastal and open sea activities, as for the D 2.2, in order to give a complete picture of the maritime stressors on the marine environment and to focus the D1.4 deliverable on the open sea activities.

For all these sectors a consistent, economic and social analysis of the use of waters and an assessment of the Cost of degradation has been made. Effort has been undertaken to quantify as fully as possible the parameters describing the socio-economic importance of the sectors examined but wherever this is not possible - within the time and resource constraints of the present research - analysis takes a more qualitative aspect. Parameters studied include production means, production values, and employment.

The statistical data used for these assessments were collected from various sources, mainly Eurostat, as the Pilot Cases areas are surrounded by EU MS only and the Initial Assessments of the MS, when available. However, it is striking to note that professional data bases have also been used, as FAO fish stat for the fisheries or World Travel & Tourism Council for tourism as well multiple specific studies.

Cost of Degradation assessment has mostly based on Initial Assessments of the MS and economic values extracted from the V-MESSE data base developed in the Frame Work of the PERSEUS D6.8.

The gap analysis has shown that a significant part of required data to perform these assessments are missing or not publicly available, especially those needed to assess value added and employment wages as well as cost of degradation. Impacts on the marine ecosystems have been characterized in qualitative terms. For some sectors, it has been attempted to make projection, for the next decade in a qualitative way.

The results obtained in the socioeconomic analysis are summarized in the Table 61, which makes possible a rough comparison between Pilot Cases.

Table 61 Synthetic overlook of the main drivers in the four WP6 Pilot Cases

Drivers/Activities (unit) in the Pilot case areas	W. Med	N. Adriatic	Aegean	W. Black Sea
Populations (1000)	22,467	20,358	8,556	4,847
Urbanization (% inh. in coastal large cities)[1]	38%	8%	48%	21%
Fisheries (Landings, T)	99,904	90,784	65,266	9,900
Maritime Transports				
Gross Weight (1000T /y)	376	539	131	61
Passengers (million/y)	27	33	84	0.001
Nb. Of Vessels (1000)	123	739	492	5
Tourism, bed places (1000)	2,784	2,455	1,111	323
Marinas (Nb.)	297	330	13	17
Submarine cables / pipelines (Nb. of landings)[2]	0/11	1/6	1/6	1/8
Offshore (oil and gas production, kTOE/y)	123	5,875	103	4,920

[1] Ratio: Inhabitants in coastal cities > 500,000 inh./ total inh. in NUTS 2 ,

[2] Existing and in project

In terms of population counted in the NUTS 2 regions bordering the Pilot cases, W. Med and N. Adriatic are equivalent, Aegean representing less than the half and W. Black sea about a quarter. Coastal urbanization may be measured in different ways; here we evaluated the percentage between populations in cities of more than 500,000 inhab. and the residents in the corresponding NUTS 2. W. Med and Aegean appear to be much more urbanized, mainly due to the city of Athens for the latter.

Fisheries are equivalent in W. Med and N. Adriatic, Aegean being a little behind and W. Black Sea far below. Note that this indicator shows the importance of fisheries for the local economy but says nothing of the stocks exploitation. Maritime transport is described through three indicators, transported gross weight, number of transported passengers and number of vessels using the pilot case ports. Again W. Med and N. Adriatic are relatively close for the goods, but with much more vessels in N. Adriatic, which reflects the intense cabotage in the area, Aegean is characterized by a number of very important number of passengers, which reflects the importance of the maritime passengers traffic between the islands in the Aegean Sea, W. Black sea is far behind. Regarding tourism and considering the number of beds, W. Med and N. Adriatic are in the same order of magnitude, with an advantage W. Med, especially if the filling rate is considered (not shown here), Aegean is about at half, W. Black Sea being an order of magnitude lower. For the number of marinas, W. Med and N. Adriatic arrive well ahead. In all Pilot cases, the number of submarine pipelines is low, by contrast with the numbers of telecommunication cables landings, especially in W. Med and W. Black Sea. Offshore production is almost nil in W. Med and Aegean, historically relatively important in N. Adriatic and W. Black Sea. However Aegean may reveal important potentialities.

If we also consider the very distinct morphological characters of the four Pilot Cases, for example between W Med and N. Adriatic, we can say that the four pilot cases WP6 PERSEUS are really diverse which will allow to test efficiently the PERSEUS Adaptive Policy Framework during the next phase of the PERSEUS project.

REFERENCES

Angel, D.L. 2012. Sustainable marine aquaculture in the Mediterranean. In: Robert A. Meyers (ed.), Encyclopedia of Sustainability Science and Technology, Springer Science+Business Media LLC, 18 p.

Astiaso Garcia, D., Bruschi, D., Cumo, F., Gugliermetti, F., 2013. The Oil Spill Hazard Index (OSHI) elaboration. An oil spill hazard assessment concerning Italian hydrocarbons maritime traffic. Ocean and Coastal Management 80, 1-11.

Barragán JM. 2003. Coastal zone management in Spain (1975-2000). Journal of Coastal Research 19(2): 314-25

Benet-Perelberg, A. (2013) Ministry of Agriculture, Fisheries Branch, personal communication.

Black Sea Commission (BSC), 2009. Black Sea fish check-list, compiled by Yankova M. Black Sea Commission Publications. (http://81.8.63.74/Downloads/Black_Sea_Fishes_Check_List.pdf)

Bowen, R.E., Riley, C., 2003. Socio-economic indicators and integrated coastal management. Ocean & Coastal Management, 46: 299-312.

Bowen, Robert E., and Cory Riley. "Socio-economic Indicators and Integrated Coastal Management." Ocean & Coastal Management 46, no. 3–4 (January 2003): 299–312. doi:10.1016/S0964-5691(03)00008-5.

BP, 2012, BP Statistical Review of World Energy June 2012. Available at: http://www.bp.com/content/dam/bp/pdf/Statistical-Review_2012/statistical_review_of_world_energy_2012.pdf

BP, 2013, BP Statistical Review of World Energy June 2013. Available at: http://www.bp.com/content/dam/bp/pdf/statistical_review/statistical_review_of_world_energy_2013.pdf

Brake, J., Davidson, J. And Davis, J., 2004. Field observations on growth, gametogenesis, and sex ratio of triploid Mytilus edulis. Aquaculture, 236: 179-191.

Brenner, Jorge, José A. Jiménez, Rafael Sardá & Alvar Garola (2010), An assessment of the non-market value of the ecosystem services provided by the Catalan coastal zone, Spain, Ocean & Coastal Management 53: 27-38

Britannica (unknown). Aegean Sea. http://www.britannica.com/EBchecked/topic/6988/Aegean-Sea

Cal, R. M., Vidal, S., Martínez, P., Álvarez-Blázquez, B., Gómez, C. and Piferrer, F., 2006, Growth and gonadal development of gynogenetic diploid *Scophthalmus maximus*. Journal of Fish Biology, 68: 401–413. doi: 10.1111/j.0022-1112.2006.00889.x

Caric, H. 2011. Cruising tourism environmental impacts: case study of Dubrovnik, Croatia. J. Coastal Research, SI 61: 104-113.

Clarkson, 2010. Offshore Intelligence Monthly, Pre-launch draft 4. December 2010

Collet I., 2011, The Mediterranean and Black Sea basins - Eurostat : Statistics in focus, http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-11-014/EN/KS-SF-11-014-EN.PDF

DAISIE, 2010, Delivering Alien Invasive Species Inventories Europe, European Summary, http://www.europe-aliens.org/europeSummary.do# accessed 08 January 2013.

Dassenakis M., Scoullos M., Rapti K., Pavlidou A., Tsorova D., Paraskevopolou V., Rozi E., Stamateli A., Siganos M. (2001). The distribution of copper in Saronicos gulf after the operation of the wastewater treatment plant of Psitalia, In CEST2001: pp. 139-146.

De Groot RS, Wilson MA, and Boumans RMJ. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41: 393-408.

de Juan, S. and Lleonart, J., 2010, A conceptual framework for the protection of vulnerable habitats impacted by fishing activities in the Mediterranean high seas. Ocean & Coastal Management 53 (2010) 717-723

De Vivero, J. (unknown). EEZs in Europe. EUROCEAN. http://www.eurocean.org/np4/80.html

Degobbis, D. and Gilmartin, M. (1990). Nitrogen, phosphorus and biogenic silicon budgets for the northern Adriatic Sea, Oceanologia Acta 13, pp. 31-45. http://archimer.ifremer.fr/doc/00103/21404/18989.pdf

DG RME, 2013. IL MARE -Supplemento al Bollettino ufficiale degli idrocarburi e delle georisorse - Anno LVII N. 2 - 28 Febbraio 2013Direzione generale per le risorse minerarie ed energetiche, Italia

E & P Forum / UNEP 1997, "Environmental Management in Oil & Gas Exploration and Production: An overview of management issues and Approaches" http://www.ogp.org.uk/pubs/254.pdf

EC DG ENV, WG ESA, 2010, Economic analysis for the Initial assessment for MSFD, Working Group on economic and social Assessment

EC, 2011 a, Relationship between the initial assessment of marine waters and the criteria for good environmental status, Commission staff working paper, SEC(2011) 1255 final,

EC, 2011 b, The 2011 Annual Economic Report on the European Fishing Fleet, Scientific, Technical and Economic Committee for Fisheries (STECF), accessed 26 October 2012.

EC,2011c. Assessment of the status, development and diversification of fisheries-dependent communities. Region: Black Sea coast, North of Bourgas city. In: Regional social and economic impacts of change in fisheries-dependent communities. (http://ec.europa.eu/fisheries/documentation/studies/regional_social_economic_impacts/bulgaria_en.pdf)

EC, 2012, The 2012 Annual Economic Report on the European Fishing Fleet, Scientific, Technical and Economic Committee for Fisheries (STECF), (http://stecf.jrc.ec.europa.eu/documents/43805/366433/12-08_STECF+12-10+-+AER+EU+Fleet+2012_JRC73332.pdf) accessed 26 October 2012.

EcoPorts Foundation. 2004. Guidelines for Self Diagnosis Method SDM. Version 1.4.

EEA, 2011, Aquaculture production (CSI 033) – Assessment. European Environment Agency. Available at: http://www.eea.europa.eu/data-and-maps/indicators/aquaculture-production-1/aquaculture-production-assessment-published-feb

EEA, 2012, Marine aquaculture production relative to coastline length. European Environment Agency. Available at: http://www.eea.europa.eu/data-and-maps/figures/fig.-5-marine-aquaculture-production

EEA, 2013, Nutrients in transitional, coastal and marine waters (CSI 021) – Assessment. European Environment Agency. Available at: http://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-transitional-coastal-and/nutrients-in-transitional-coastal-and-4

EEA, 2010, The European Environment, State and Outlook 2010, Marine and Coastal Environment, European Environment Agency.

EL.STAT, 2012, Hellenic Statistical Authority, http://www.statistics.gr/portal/page/portal/ESYE/PAGE-themes?p_param=A0201&r_param=SPA03&y_param=2010_00&mytabs=0 accessed 30 October 2012.

EMI (Energy Markets International), 2011.

Eremeev, V.N. and Zuyev, V. 2007. Commercial fishery impact on the modern Black Sea Ecosystem: a review. Turkish Journal of Fisheries and Aquatic Sciences, 7: 75–82.

EU Offshore Authorities Group, 2013, "Offshore oil and gas production in Europe", http://euoag.jrc.ec.europa.eu/node/63, 2013, accessed on the 29/08/13

EU, 2006. Europa Maritime Affairs. Available at: http://ec.europa.eu/maritimeaffairs/pdf/com_2006_0275_en_part2.pdf

European Commission, 2011. Mobility and transport. Maritime Transport. What do we want to achieve? [Online]. Available at: http://ec.europa.eu/transport/maritime/index_en.htm [Accessed: 18 June 2012].

European Sea Ports Organization (ESPO), 2010. European Port Governance. Report of an Enquiry into the Current Governance of European Seaports. The ESPO Fact-Finding Report. Brussels.

Eurosion 2004. Living with coastal erosion in Europe: Sediment and Space for Sustainability. PART II – Maps and statistics. Report 27 p.

Eurostat, 2012a. Maritime ports freight and passenger statistics [Online]. Available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Maritime_ports_freight_and_passenger_statistics#Passenger_traffic [Accessed: 20 June 2012].

Eurostat, 2012b. Mediterranean and Black Sea coastal region statistics. [Online]. Available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Mediterranean_and_Black_Sea_coastal_region_statistics [Accessed: 20 June 2012].

Eurostat, 2012d. Country level - Number and Gross Tonnage of vessels in the main ports (based on inwards declarations), by type of vessel. [Online]. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=mar_mt_am_csvi&lang=en [Accessed: 28 June 2012]

Eurostat, 2012e. Maritime transport - Goods (gross weight) - Annual data - All ports - by direction. [Online]. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=mar_go_aa&lang=en [Accessed: 25 June 2012]

Eurostat, 2012f. Country level - Gross weight of goods handled in all ports. [Online]. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=mar_mg_aa_cwh&lang=en [Accessed: 27 June 2012]

Eurostat, 2012g. Transport > Maritime Transport > Maritime Transport – Goods > Maritime transport - Goods (gross weight) - Annual data - Main ports - One detailed table per each reporting country - by direction, partner entity, type of cargo and nationality of registration of vessels. [Online]. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/transport/data/database [Accessed: 3 July 2012]

Eurostat, 2012h. Transport > Maritime Transport > Maritime Transport – Goods > Maritime transport - Goods (volume) - Quarterly data - Main ports - Cargo: containers only (TEU) - by direction, partner entity, container size and loading status. [Online]. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/transport/data/database [Accessed: 28 June 2012]

Eurostat, 2012i. Maritime transport - Passengers - Annual data - All ports - by direction. [Online]. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=mar_pa_aa&lang=en [Accessed: 28 June 2012]

Faganeli, J., Kovac, N., Leskovsek, H., Pezdic, J., 1995. Sources and fluxes of particulate organic matter in shallow waters characterized by summer macroaggregate formation. Biogeochemistry 29, 71-88.

FAO STAT, 2012, Fishery Statistical Collections, GFCM (Mediterranean and Black Sea) Capture Production, http://www.fao.org/fishery/statistics/gfcm-capture-production/en accessed 01.11.2012 at 12:14:00.

FAO, 2012, Impacts of fisheries activities, http://www.fao.org/fishery/topic/12273/en accessed 08 January 2013.

FAO. 2011. Aquaculture development. 5. Use of wild fish as feed in aquaculture. FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 5.Rome:, FAO. 79p.

FAO. 2012. State of world fisheries and aquaculture (SOFIA) 2012. Rome, FAO. 209p.

Ferreira, J.G., Andersen, J.H., Borjac, A., Brickerd, S., Campe, J., Cardoso da Silva, M., Garcés, E., Heiskaneng, A-S., Humborg, C., Ignatiades, L., Lancelot, C., Menesguehk, A., Tett, P., Hoepffner, N., Claussen, U. (2011) Overview of eutrophication indicators to assess environmental status within the European Marine Strategy Framework Directive. Estuarine, Coastal and Shelf Science 93 (2011) 117-131.

Fezzardi D., Massa F., Àvila-Zaragoza P., Rad F., Yücel-Gier G., Deniz H., Hadj Ali Salem M., Hamza H.A., Ben Salem S. 2013. Indicators for sustainable aquaculture in Mediterranean and Black Sea countries. Guide for the use of indicators to monitor sustainable development of aquaculture. Studies and Reviews. General Fisheries Commission for the Mediterranean. No 93. Rome, FAO. 2013. 60 p.

Freight Transport for Development, 2012. Ports [Online]. Available at: http://www.ppiaf.org/freighttoolkit/knowledge-map/ports [Accessed: 26 June 2012].

Gagnaire, B., Soletchnik, P., Madec, P., Geairon, P., Le Moine, O. and Renault,

GESAMP, 2010, IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection; Bowmer, T. and Kershaw, P.J., 2010 (Eds.), Proceedings of the GESAMP International Workshop on plastic particles as a vector in transporting persistent, bio-accumulating and toxic substances in the oceans. GESAMP Rep. Stud. No. 82, 68pp

GFCM, 2012, Statistical Bulletin 2009

GIIGNL (International Group of Liquefied Natural Gas Importers), 2011. The LNG Industry in 2011. GIIGNL, Paris Cedex. Available at: www.giignl.org/fileadmin/user_upload/pdf/A_PUBLIC_INFORMATION/LNG_Industry/GIIGNL_The_LNG_Industry_2011.pdf. Accessed on 22/07/2013.

GIWA Black Sea graphics . Main crude and dirty product routes in the Black Sea. Available at: http://www.grida.no/graphicslib/detail/main-crude-and-dirty-product-routes-in-the-black-sea_48ad. Accessed on 23/07/2013.

Giziakis, K., Kanellopoulos, N., Gialoutsi, S., 2013. Spatial analysis of oil spills from marine accidents in Greek waters. Proceedings of the 4th International Symposium of Maritime Safety, Security & Environmental Protection. Available at: http://www.massep.gr/content/Massep%202013%20Proccedings.pdf

Guillen, J. and Motova, A. (2013) Summary of the 2013 Economic performance report on the EU aquaculture sector (STECF 13-30), Luxembourg: EU. Available at: http://stecf.jrc.ec.europa.eu/documents/43805/622206/2013-12_STECF+13-30+-+Aquaculture+economics+Summary+report_JRCxxx.pdf

Herr, H., Fock, H.O., Siebert, U., 2009, Spatio-temporal associations between harbour porpoise Phocoena phocoena and specific fisheries in the German Bight. Biological Conservation 142 (2009) 2962–2972

Hoffherr, J., Natale, F, and. Fiore, G. 2012. An Approach Towards European Aquaculture-Performance Indicators. Indicators for Sustainable Aquaculture in the European Union. Ispra, Italy. European Comission, Joint Research Centre. 260p.

Hogan, M. (2013). Balearic Sea, The Encyclopedia of Earth. http://www.eoearth.org/view/article/150390/

Houston, JR. 2008. The economic value of beaches—A 2008 update. *Shore and Beach*, 76(3): 22–26.

ICPC-UNEP -WCMC, The United Nations Environment Programme World Conservation Monitoring Centre. 2009. Submarine cables and the oceans: connecting the world. Available at: http://www.iscpc.org/publications/ICPC-UNEP_Report.pdf.

Indicators for the Seas (unknown). Gulf of Lions - Geographic Area. http://www.indiseas.org/ecosystems/gulf-of-lions/geographic-area

International Organisation for Standardisation (ISO), 1996. ISO 14001:1996 Environmental Management Systems - specification with guidance for use.

ISPRA (2013). Costi del degrado a livello nazionale, p. 6.

IUCN. 2009. Guide for the sustainable development of Mediterranean aquaculture: Aquaculture site selection and management. Gland, Switzerland and Malaga, Spain IUCN.

Karakassis I., Pitta P., and Krom M.D., 2005, Contribution of fish farming to the nutrient loading of the Mediterranean Sea. Sci Mar 69:313–321.

Karakassis, I,. 2001 Ecological effects of fish farming in the Mediterranean. In : Uriarte A. (ed.), Basurco B. (ed.). *Environmental impact assessment of Mediterranean aquaculture farms*. Zaragoza : CIHEAM, 2001. 15-22. (Cahiers Options Méditerranéennes; n. 55). TECAM Seminar on Environmental Impact Assessment of Mediterranean Aquaculture Farms, 2000/01/17-21, Zaragoza (Spain).http://om.ciheam.org/om/pdf/c55/01600225.pdf

Karakassis, I. and Angel, D.L. 2011a. Aquaculture-environment interactions in the Mediterranean Sea In: Borg, J.A., Crosetti D. and Massa F. (eds). Site selection and carrying capacity in Mediterranean marine aquaculture: key issues (WGSC-SHoCMed) Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 90 Rome, FAO. p 19-41

Karakassis, I. and Angel, D.L. 2011b. Ecological monitoring of aquaculture activities. In: Borg, J.A., Crosetti D. and Massa F. (eds). Site selection and carrying capacity in Mediterranean marine aquaculture: key issues (WGSC-SHoCMed) Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 90 Rome, FAO. p 42-51.

Kloff S. and Wicks C., 2004, Environmental Management of offshore oil exploitation and maritime oil transport, a background document for stakeholders of the West African Marine Eco Region –UICN, http://cmsdata.iucn.org/downloads/offshore_oil_eng.pdf, 02/09/2013

Komiss, W and Huntzinger, L.V., 2011. The Economic Implications of Disruptions to Maritime Oil Chokepoints. CRM D0024669.A1/Final, 88pp. Available at: http://www.cna.org/sites/default/files/research/the%20economic%20implications%20of%20disruptions%20to%20maritime%20oil%20chokepoints%20d0024669%20a1.pdf

Kousta E., 2012 The representativeness of trade unions and employer associations in the sea fisheries sector http://www.eurofound.europa.eu/eiro/studies/TN1105068S/gr1105069q.htm accessed 26 October 2012.

Kovac, N., Cermelj, B., Vrišer, B. and Lojen, S., 2004. The Influence of Fish Farming on Coastal Marine Sediment in Slovenia (Piran Bay, northern Adriatic) – Summary. In: UNEP/MAP/MED POL: Mariculture in the Mediterranean. MAP Technical Reports Series No. 140, UNEP/MAP, Athens, 2004.

Lambeck, K. and Bard, E., 2000. Sea-level change along the French Mediterranean coast for the past 30 000 years. Earth and Planetary Science Letters, 175, pp. 203-222.

Lampert, C. Kroiss, H. and Zessner, M., 2007, Nutrients in Danube River Basin. http://www.undp-drp.org/pdf/Workshops_and_Meetings%20-%20Phase%20II/2007-01-25_Detergent_Workshop/4%20Lampert.pdf

Lentz, SA, Felleman, F., 2003.Oil spill prevention: a proactive approach. In: Proceedings of the 2003 International Oil Spill Conference. Vancouver Canada.

Lloyd's Marine Intelligence Unit, 2007. Lloyd's List Ports of the World 2008. London Informa UK Ltd.

Macfadyen G., Salz P. and Cappell R., 2011, Characteristics Of Small-Scale Coastal Fisheries in Europe http://www.europarl.europa.eu/committees/en/studiesdownload.html?languageDocument=EN&file=49091 accessed 29 October 2012.

Mangos, A., Bassino, J-P., Sauzade, D. (2010). The economic value of sustainable benefits rendered by the Mediterranean marine ecosystems. Plan Bleu, Valbonne. (Plan Bleu paper 8).

MedCruise. 2012. MedCruise 2012/13. Yearbook.

MED-IMP Euro-Mediterranean Energy Market Integration Project. 2010. MEDRING Update Volume IV - Visualizing the Mediterranean Sea Basin for Electric Power Corridors. Available at: http://ec.europa.eu/energy/international/studies/doc/2010_04_medring_vol4.pdf.

Ministerio de Agricultura, Alimentación y Medio Ambiente. 2012. Estrategia marina. Documento marco. Evaluación inicial, buen estado ambiental y objetivos ambientales. IEO & CEDEX, Madrid.

Ministerio de Agricultura, Alimentación y Medio Ambiente. 2012. Estrategia marina. Demarcación marina Levantino-Balear. Evaluación inicial. Parte II: Análisis de presiones e impactos. Madrid.

Ministerio de Agricultura, Alimentación y Medio Ambiente, (MAGRAMA) 2013, Estadisticas Pesqueras, http://www.magrama.gob.es/es/estadistica/temas/estadisticas-pesqueras/Estadisticas_Pesqueras_2013-04_tcm7-277464.pdf

Ministry of Environment and Sustainable Development. 2007. Sectoral Operational Programme Environment 2007-2013. Government of Romania.

NASO 2013. National aquaculture sector overview: France. Fisheries and Aquaculture Department, FAO. Available at:
http://www.fao.org/fishery/countrysector/naso_bulgaria/en
http://www.fao.org/fishery/countrysector/naso_croatia/en
http://www.fao.org/fishery/countrysector/naso_france/en
http://www.fao.org/fishery/countrysector/naso_greece/en
http://www.fao.org/fishery/countrysector/naso_italy/en
http://www.fao.org/fishery/countrysector/naso_slovenia/en

NEF, 2011, Fish dependence – 2011 Update, The increasing reliance of the EU on fish from elsewhere. (http://www.neweconomics.org/sites/neweconomics.org/files/Fish_dependence_2011_Update.pdf).

Nies, S., 2011. Oil and Gas Delivery to Europe. An Overview of Existing and Planned Infrastructures. IFRI (French Institute for International Relations), 150 pp.

Notteboom, T. 2010. Dock labour and port-related employment in the European seaport system. ITMMA University of Antwerp.

Nowacek, D.P., Thorne, L.H., Johnston, D.W., Tyack, P.L., 2007, Responses of cetaceans to anthropogenic noise. Mammal Review 37, 81–115.

Oil and gas UK, 2013. "Knowledge Centre Knowledge centre Employment Key facts" http://www.oilandgasuk.co.uk/employment.cfm, accessed on the 02/09/2013

Olsen, Y. 2011. Resources for fish feed in future mariculture. Aquaculture Environment Interactions. 1, 187-200.

OSPAR, 2010, Quality Status Report 2010, OSPAR Commission, London 2010 ISBN 978-1-907390-38-8, Publication number 497 / 2010) [Accessed 08 February 2012].

Paipai, E. 1999. Guidelines for Port Environmental Management. Report SR 554. HR Wallingford.

Patin, S., (1999).Environmental impact of the offshore oil and gas industry, Publishing EcoMonitor East Northport, NY 425 p.

Policy Research Corporation, 2008. The role of Maritime Clusters to enhance the strength and development of European maritime sectors. Report on results. Study for DG Mare

Policy Research Corporation, 2010. Study on the economic effects of Maritime Spatial Planning, Final Report, DG Maritime Affairs and Fisheries, http://ec.europa.eu/maritimeaffairs/studies/economic_effects_maritime_spatial_planning_en.pdf [Accessed 11 March 2011].

Pugh, D., 2008, Socio-economic indicators of marine-related activities in the UK economy

Pusch, C. and Pedersen, S.A. (Eds.),2010, Environmentally Sound Fisheries Management in Marine Protected Areas (EMPAS) in Germany. Results of the Research and Development (F+E)-Project (FKZ-Nr. 804 85 003) of the Federal Agency for Nature Conservation. Naturschutz und Biologische Vielfalt Heft 92. Bundesamt für Naturschutz, Bonn - Bad Godesberg 2010.

Remoundou, K., Koundouri, P., Kontogianni, A., Nunes, P., Skourtos, M., 2009. Valuation of natural marine ecosystems: an economic perspective. Environmental Science & Policy 12, 1040-1051.

SAFEMED- Euromed Cooperation on Maritime Safety and Prevention of Pollution From Ships, 2008. Study of Maritime Traffic Flow in the Mediterranean Sea. EU-Funded MEDA Regional Project MED 2005/109-573, 40pp.

Sánchez Montañés A., Torrent Bravo F. Aquaculture and environment from the perspective of a Spanish fish farmer. In : Uriarte A. (ed.), Basurco B. (ed.). *Environmental impact assessment of Mediterranean aquaculture farms*. Zaragoza : CIHEAM, 2001. p. 101-107. (Cahiers Options Méditerranéennes; n. 55). TECAM Seminar on Environmental Impact Assessment of Mediterranean Aquaculture Farms, 2000/01/17-21, Zaragoza (Spain).http://om.ciheam.org/om/pdf/c55/01600225.pdf

Sanchez-Jerez P, Fernandez-Jover D, Uglem I, Arechavala P, Bayle-Sempere J, Valle-Perez C, Izquierdo D, Bjørn PA, Nilsen R, Dempster T (2011) Coastal fish farms as

Fish Aggregation Devices (FADs). In: Bortone S (Ed.) Artificial Reefs in Fisheries Management, Taylor and Francis, p187-208.

Sea Around Us Project, University of British Columbia (unknown). Exclusive Economic Zones. http://www.seaaroundus.org/eez/

Sedigas, 2012, Annual report, http://www.sedigas.es/informeanual/2012/index.html

Sheavly, S.B. 2005. Sixth Meeting of the UN Open-ended Informal Consultative Processes on Oceans & the Law of the Sea. Marine debris – an overview of a critical issue for our oceans. June 6-10. [Online]. Available at: http://www.un.org/Depts/los/consultative_process/consultative_process.htm [Accessed: 13 December 2012]

Shipping Facts, 2011. Shipping and World Trade, overview [Online]. Available at: http://www.marisec.org/shippingfacts//worldtrade/index.php. [Accessed: 25 June 2012].

Shlyakhov V., Daskalov G. 2008. The state of marine living resources. In: State of the Environment of the Black Sea (2001-2006/7). Edited by Temel Oguz. Publications of the Commission on the Protection of the Black Sea Against Pollution (BSC) 2008-3, Istanbul

Steiner, R., 2003. Background document on offshore oil for Stakeholders of the Baltic Sea region.

Suárez de Vivero and Rodríguez Mateos. 2005. Coastal Crisis: The Failure of Coastal Management in the Spanish Mediterranean Region. Coastal Management 33: 197–214

Tacon AGJ, Metian M, Turchini GM (2010) Responsible aquaculture and trophic level implications to global fish supply. Rev Fish Sci 18:94–105

Ten Brink, P., Lutchman, I., Bassi, S., Speck, S., Sheavly, S., Register, K., and Woolaway, C., 2009, Guidelines on the Use of Market-based Instruments to Address the Problem of Marine Litter. Institute for European Environmental Policy (IEEP), Brussels, Belgium, and Sheavly Consultants, Virginia Beach, Virginia, USA. 60 pp.

The Economics of Ecosystems and Biodiversity – TEEB (2010). The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Pushman Kumar (ed.), Earthscan, London and Washington.

Torbianelli, V. 2011. Mediterranena cruises as drivers of investments and relations between ports and cities. Territory and Economy, 2011, 261-266.

Trabucco, C. Maggi, L. Manfra, O. Nonnis, R. Di Mento, M. Mannozzi, C. Virno Lamberti, A. M. Cicero and M. Gabellini (2012). Monitoring of Impacts of Offshore Platforms in the Adriatic Sea (Italy), Advances in Natural Gas Technology, Dr. Hamid Al-Megren (Ed.), ISBN: 978-953-51-0507-7, InTech.

Trozzi, C. and Vaccaro, R. 2000. Environmental impact of port activities. In: Brebbia, C.A. and Olivella, J. Eds. Maritime engineering and ports II. Sothampton, Boston: WIT Press, pp. 151 – 161.

Turner, R.K., Hadley, D., Luisetti, T., Lam, V.W.Y., Cheung, W.W.L., 2010. An introduction to socio-economic assessment within a marine strategy framework. DEFRA, CSERGE, UEA, 121pp. Available at:

http://archive.defra.gov.uk/environment/marine/documents/legislation/msf-socioeconomic.pdf. Accessed 25/09/2013.

IUCN, Centre for Mediterranean Cooperation. 2008. Maritime traffic effects on biodiversity in the Mediterranean Sea: Review of impacts, priority areas and mitigation measures. Ameer Abdulla, PhD, Olof Linden, PhD (editors). Malaga, Spain.

UNEP, 2009. Marine Litter: A Global Challenge. Nairobi.

UNEP/MAP - Plan Bleu. 2009. State of the environment and development in the Mediterranean. Report 199 p.

UNEP/MAP. 2004. Municipal wastewater treatment plants in Mediterranean coastal cities (II). MAP Technical Reports Series No. 157

UNEP/MAP. 2008. Municipal wastewater treatment plants in Mediterranean coastal cities: Inventory of treatment plants in cities of between 2.000-10.000 inhabitants. Technical Report Series nº 69 (106 p).

UNEP/MAP. 2011. Assessment of the status of marine litter in the Mediterranean. Report 89 p.

UNEP/MAP. Plan Blue 2011. Cruises and the Recreational Boating in the Mediterranean. Report 78 p.

UNEP/MAP/MED POL (2004) Mariculture in the Mediterranean. MAP Technical Reports Series No. 140, UNEP/MAP, Athens.

Union for the Coordination of Transmission of Electricity (UCTE), 2008. Global Transmission Report, Developing a regional market through interconnectors in SEE. http://www.globaltransmission.info/archive.php?id=815.

United Nations (UN), 1992. Economic and Social Commission for Asia and the Pacific (ESCAP). Assessment of the Environmental Impact of Port Development. A guidebook for EIA Port Development. New York: United Nations

United Nations (UN), 2012. United Nations Conference on Trade and Development (UNCTAD). [Online]. Available at: http://unctad.org/en/pages/PublicationArchive.aspx?publicationid=1734 [Accessed: 22 June 2012].

University of Bristol, 2010, Human noise pollution in ocean can lead fish away from good habitats and off to their death, in ScienceDaily Available at http://www.sciencedaily.com/releases/2010/08/100803212015.htm [Accessed 05 October 2012].

Villasante S., Morato, T., Rodriguez-Gonzalez, D., et al., 2012, Sustainability of deep-sea fish species under the European Union common fisheries Policy. Ocean and Coastal Management. Doi: 10.1016/j.ocecoaman.2012.07.033.

Wills J. , 2000, "Muddied Waters - A survey of Offshore Oilfield Drilling Wastes and Disposal Techniques to Reduce the Ecological Impact of Sea Dumping" http://www.alaskaforum.org/other/muddiedwaters.pdf

World Bank and FAO, 2008, The Sunken Billions: The Economic justification for Fisheries Reform. The World Bank and Food and Agriculture Organization of the United Nations, Washington, DC.

World Travel & Tourism Council. 2013. Travel & Tourism. Economic impact 2013. Mediterranean.

Worm, B., Barbier, E.B., Beaumont, N., et al., 2006, Impacts of biodiversity loss on ocean ecosystem services. Science 314,787-790.

Zenetos, A., Siokou-Frangou, I., Gotsis-Skretas, O., and Groom, S. (2011) Europe's Biodiversity- biogeographical regions and seas, The Mediterranean Sea- blue oxygen-rich, nutrient-poor waters, EEA.

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SEVENTH FRAMEWORK PROGRAMME