PERSEUS

POLICY-ORIENTED MARINE ENVIRONMENTAL RESEARCH IN THE SOUTHERN EUROPEAN SEAS

# Preliminary identification of pressures of the coastal seas in socio-economic terms

# Gap Analysis on data and knowledge

## Deliverable Nr. 2.2

SEVENTH FRAMEWORK PROGRAMME

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**CONTENTS**

**FIGURES**

## TABLES

# Executive summary / Abstract

This deliverable presents the results of the economic and social analysis of the human activities which exert pressures on marine coastal ecosystems of the Mediterranean and the 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). Methods have been adapted from guidance issued for the MSFD implementation. The work presents the first economic and social analysis of this kind carried out at regional and sub-regional levels. It also attempted to assess 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 were distinguished as far as possible from those impacting open waters, beyond 200m depth. This approach is in coherence with distinct ecosystems but raised difficulties, due to the lack of data and as it undermines the spatial coherency between economic and social assessment and design of programme of measures, which must be enforced in areas under given jurisdictional responsibilities. 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.

# Scope

The objective of this first deliverable of the Task 2.2 (Analysis of socio economic activities in the coastal areas) is to assess of the environmental impact of human activities, at sub-regional levels in the SES. It is built on existing data, where available, and highlights the gaps in terms of data and knowledge. This assessment complements the analysis carried out by nature scientists in Task 2.1 (Analysis of pressures and processes and their impact on the ecosystems). Methods and, to some extent, data are identical to the assessment of human activities in open sea performed within Task 1.2 (Analysis of socio-economic activities in the open sea areas). Following the DPSIR model, it 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. This preliminary and basin wide economic and social analysis will be followed by the Deliverable 2.3 which will focus on the four Pilot Cases of the Work Package 6 (Adaptive policies and scenarios). These assessments will be part of the contextual background needed for the preparation of future programme of measures and policies aiming to achieve or maintain a good environmental status at Pilot Cases and Basin levels.

# 1 INTRODUCTION

## 1.1 The PERSEUS and MSFD contexts

This deliverable is the first one of the Task 2.2 (Analysis of socio economic activities in the coastal areas) which is included in the Work package 2 (Pressures and Impacts at coastal level) of the PERSEUS project. The relevance of this deliverable is easily justified by referring to the call in response of which the PERSEUS project has been proposed: OCEAN.2011-3: Assessing and predicting the combined effects of natural and human-made pressures in the Mediterranean and the Black Sea in view of their better governance. The call states that one of the main overall objectives of the project shall be to promote sustainable well-coordinated research efforts in order to characterize patterns of pressure in environmental and socio-economic terms on the Mediterranean and the Black Sea, the Southern European Seas (SES). Characterization of pressures is the general objective of work packages of the PERSEUS project, respectively the WP1 for the open sea and WP2 for the coastal areas. Task 2.2 contributes directly to assess the pressures on the SES waters in socio-economic terms. The call provides also indications on the approach to be followed mentioning that "the project shall provide a scientific rationale for a basin-wide promotion of the principles and objectives put forward in the Marine Strategy Framework Directive (MSFD)". The principles of the MSFD are given in the Directive recitals and specifically in n° 8): "By applying an ecosystem-based approach to the management of human activities while enabling a sustainable use of marine goods and services, priority should be given to achieving or maintaining good environmental status…"

References to the "ecosystem-based approach to the management of human activities" and "sustainable use" clearly indicate the need to consider the economic and social aspects in interaction with the environmental concerns.

The MSFD makes several references (COWI, 2010) to the economic and social aspects. It is stipulated in the Directive recital n° 24 that: "As a first step in the preparation of programmes of measures, Member States across a marine region or sub-region should undertake an analysis of the features or characteristics of, and pressures and impacts on, their marine waters, identifying the predominant pressures and impacts on those waters, and an economic and social analysis of their use and of the cost of degradation of the marine environment". This requirement is detailed in Article 8 of the Directive. Article 5 states that Member States (MS) have to report their initial assessment to the Commission before the 15th of July 2012. Some MS were late in the delivery of their report to the Commission and some are still not publicly available at the date of completion of this deliverable.

The MSFD defines waters as marine waters, including the seabed and subsoil, under the MS´s national jurisdictions. However, MS shall, when implementing their obligations under this Directive, take due account of the fact that marine waters covered by their sovereignty or jurisdiction form an integral part of the marine regions such as the Mediterranean Sea and the Baltic Sea. Article 5 details the marine sub-regions to be considered for the Mediterranean Sea: (b) in the Mediterranean Sea: (i) the Western Mediterranean Sea; (ii) the Adriatic Sea; (iii) the Ionian Sea and the Central Mediterranean Sea; (iv) the Aegean-Levantine Sea.

It is worthwhile to note that the Directive makes multiple mentions to the need to consider the regional dimension and the relations with third countries sharing these regions: "Third countries with waters in the same marine region or sub-region as a Member State should be invited to participate in the process laid down in this Directive, thereby facilitating achievement of good environmental status in the marine region or sub-region concerned". This concern is obviously one of the main reasons of the call OCEAN.2011-3 and by consequence of the PERSEUS project, in order to concretize contributions of the scientific research community to this overall objective.

These reminders of the PERSEUS and MSFD contexts are here to justify the objective of the work underlying this deliverable:

- To make 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;
- Carried out at basin scale of the Mediterranean and Black seas, including as far as possible waters beyond the EU regulation,
- Following a methodology in coherence with the one used for the MS initial assessment, results being presented at sub regional scale for the Mediterranean Sea
- Using existing data and in particular the MS initial assessments, when available
- 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 so be focused on the coastal areas.

## 1.2 Focusing on the coastal areas, an ecosystem evidence

A similar work has been made in the framework of the WP1 for the Task 1.2, focused on the open water instead of the coastal areas. In coherence with the European Nature Information System, the PERSEUS DoW has defined the coastal area as the continental shelf, i.e. the marine area from a depth of 0 to 200 m. The reasons of this distinction between the coastal areas and the open sea, unusual in economic and social analysis which normally tends to consider territorial boundaries of human activities and ignore natural habitat limits, lies in the PRESEUS work plan. In its "New knowledge pressure impact process" cluster, the PERSEUS work plan has made an ecologically soundly funded distinction between open sea and coastal areas, thus so, between WP1 and WP2. Moreover, it has been reasonably wished to foster interdisciplinary cooperation between nature and human sciences by putting tasks devoted to nature and human sciences under the same WP.

## 1.3 In contradiction with the jurisdictional responsibility

This ecological distinction raises difficulties when replicated in the economic and social domains. In substance, it has been seen above that the initial economic and social analysis has no reason by itself to contribute to the achievement of the good environmental status. The turnover of fisheries in a given area says nothing of the sustainability of the exploited fish stocks. However, if it is proven by nature sciences that stocks are overexploited, it will be useful to know the socio economic background of the fisheries in order to limit this overexploitation, by limiting overcapacities, restricting some fishing methods or the establishment of fishery restricted areas. In other words, the economic and social analysis is a preliminary step providing a useful context for implementation of programme of measures aiming to solve environmental issues. It is an evidence to say that programmes of measures can only be implemented in areas by authorities having jurisdictional rights on such area. This explains if needed, why the MSFD Initial assessment is requested to be made in areas under the MS jurisdiction. Therefore, introducing ecological limits in the economic and social assessment weakens the links between this assessment and its ultimate objective, the preparation of the programme of measures.

As a consequence, data and statistics required to elaborate economic and social assessments are generally collected by authorities in a perspective of management of human activities within a given territory. For example, the European Commission has implemented the NUTS classification (Nomenclature of territorial units for statistics), a hierarchical system for dividing up the economic territory of the EU for the collection, development and harmonisation of EU regional statistics. So, existing economic and social data are generally not based on ecological areas, even for marine activities. At the same time, collection of original socio economic data by on field survey was completely beyond the capacity of this task, considering the number of activities and the geographical scope. Most States in these regions have poor statistics on marine activities, beyond the mandatory ones requested by United Nation Statistic Division, only because their collection is expensive and resource demanding.

However, since PERSEUS is a research project committed to explore innovative tools and approaches, it is not out of place to experiment new ideas. Regarding innovation, the economic and social assessment of the use of the Mediterranean or Black Sea waters at basin scale has never been attempted to date, as shown in the deliverable D6.8 (Inventory and critical assessment of current economic valuation studies on marine good and services). Segregation between coastal areas and open water has made this first attempt more challenging.

Practically, it has been decided to perform the two works (D1.2 and D2.2) in parallel, following the same methodology and to focus on a gap analysis, in order to prepare argumentation at the attention of riparian states to increase their effort on data collection regarding activities impacting marine ecosystems.

## 1.4 Deliverable content

The report is divided into five chapters. After the Introduction, chapter 2 presents the main concepts and specially the DPSIR approach, details the spatial aspects to be considered, specially the issues raised by the distinction between open waters and coastal areas and defines the scope of the economic and social analysis of the drivers and pressures impacting the marine waters and. The following chapter 3 provides views on the data used to perform the socio economic assessment and introduces the data gap analysis. Chapter 4 and chapter 5 present respectively the socioeconomic analysis of marine activities and the cost of degradation as far as possible at sub-regional levels. Final chapter 6 presents the conclusions of the study in terms of findings and next steps.

# 2 METHODOLOGY

## 2.1 Main concepts

The evident increase in pressure on natural marine resources (Ban and Alder, 2008; Halpern et al., 2008; Stelzenmüller et al., 2010) and the demand for marine ecological services are often too high and the Community needs to reduce its impact on marine waters regardless of where the effects occur. Furthermore, the marine environment is a precious heritage that must be protected, preserved and, where practicable, restored with the ultimate aim of maintaining biodiversity and providing diverse and dynamic oceans and seas which are clean, healthy and productive (MSFD, 2008/56/EC).

It is within this basis that the Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 emerged, establishing a framework for community action in the field of marine environmental policy. This Directive, also known as the Marine Strategy Framework Directive (hereafter MSFD), establishes a framework within which MS shall take the necessary measures to achieve or maintain Good Environmental Status (GES) in the marine environment by the year 2020 at the latest. GES is defined by the MSFD as "the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive" (MSFD, 2008 -Article 3).

In 2009, in order to assist the development of criteria and methodological standards for GES and address issues of their application by EU MS, a Working Group (WG) was established with the aim of initiating the development of a common understanding of the meaning of the MSFD's normative definitions in the context of making an initial assessment, determining GES and establishing environmental targets. In December 2011, this WG wrote a final document entitled "Common Implementation Strategy activities for the MSFD: Finalization of common understanding document on Good Environmental Status" where it was established that GES means: (a) the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas that are clean, healthy and productive within their intrinsic conditions, and (b) the use of the marine environment at a level that is suitable, thus safeguarding the potential for uses and activities by current and future generations.

In order to attain this GES some deadlines have been established: an initial assessment, to be completed by 15 July 2012 of the current environmental status of the waters concerned and the environmental impact of human activities thereon; a determination, to be established by 15 July 2012 of GES for the waters concerned; establishment, by 15 July 2012, of a series of environmental targets and associated indicators; establishment and implementation, by 15 July 2014 of a monitoring programme for ongoing assessment and regular updating of targets; development, by 2015 at the latest, of a programme of measures designed to achieve or maintain GES; and entry into operation of the programme by 2016 at the latest.

A methodological approach to assess the current environmental status of the waters concerned and the environmental impact of human activities would be through the DPSIR (Drivers–Pressures–State–Impact–Response) framework, which has developed as a systems-based approach which captures key relationships between society and the environment, and is regarded as an approach for structuring and communicating policy-relevant research about the environment. In essence, after being developed from an OECD approach which aimed to link pressures (created by human demands of the system) with the state changes and impacts, the systemic DPSIR framework encompasses Drivers, which are the key demands by society and which create Pressures. Furthermore it recognizes that State changes and Impacts require a Response by society. Fundamental to the DPSIR framework is the definition of the boundary of the system it describes, the demarcation of which depends on the particular issue of interest and its conceptualization (Atkins et al., 2011; Svarstad et al., 2008) (Figure 1).

On the same hand, the DPSWR (Driver-Pressure-State-Welfare-Response) conceptual model is a useful starting point for analysing coupled social and ecological systems, as shown in Figure 1.

DPSWR framework encompasses drivers, which are largely economic and socio-political (e.g. industrial or agricultural development, trade, regulations, subsidies, etc.) and often reflect the way benefits are derived from ecosystem goods and services. Pressures are the ways these drivers burden the environment (e.g. agricultural run-off of nutrients, pollution discharges, bottom trawling, introduction of alien species etc.). State change is a measure (or proxy) of the consequences of pressures on species or ecosystems. Welfare is a measure of changes (the “costs”) to human welfare as a result of state changes. Response is the way society attempts to reduce impact or compensate for it.

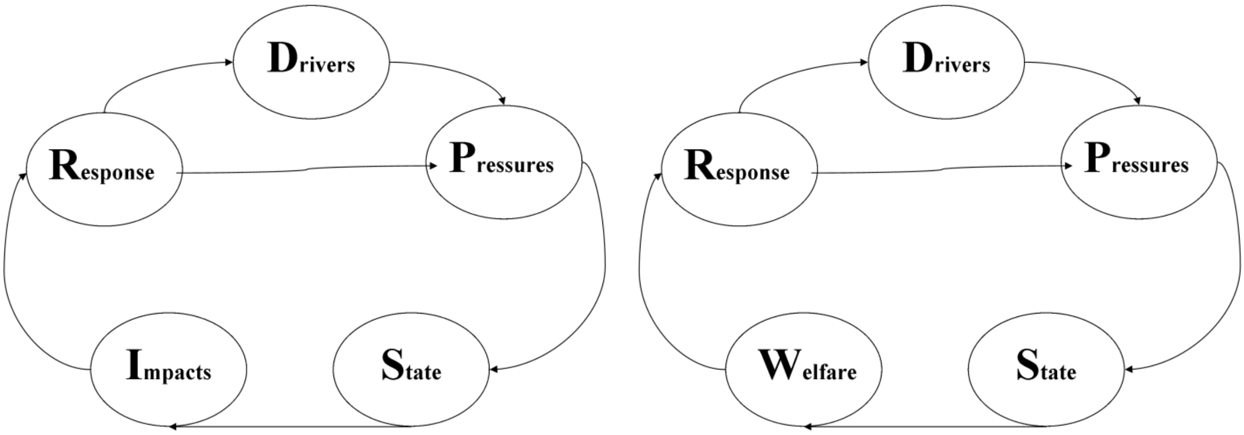



**Figure 1. DPSIR and DPSWR diagrams.**

On the same hand, effectively reducing cumulative impacts on marine ecosystems requires co-evolution between science, policy and practice (Österblom et al., 2010). Furthermore, the development and implementation of the MSFD should be aimed at the conservation of the marine ecosystems (Borja et al., 2011). Such an approach should include protected areas and should address all human activities that have an impact on the marine environment, throughout an integrated ecosystem-based approach (EBA). The EBA has an holistic view on the management and protection of marine ecosystems, focusing upon ensuring the sustainable use of the seas, and providing safe, clean, healthy and productive marine waters (Browman et al., 2004; Jennings, 2005; Borja et al., 2008). Understanding the EBA conceptually and how it is to be implemented practically is, therefore, critical for marine managers (Farmer et al., 2012).

Currently, the concepts of the Ecosystem Based Approach (EBA) and Ecosystem-based management (EBM) are often not fully differentiated, which may be viewed as a reflection of the absence of a clearly defined framework for implementation (Sardá et al., 2011).

Furthermore, many definitions for the Ecosystem-based management (EBM) exist (see Box 2. of Farmer et al., 2012). However, EBM is defined by ICES (2003), as the comprehensive integrated management of human activities based upon the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of goods and services and maintenance of ecosystem integrity (Borja et al., 2011). Its adaptive management recognizes that long-term management decisions based upon conceptual modelling or knowledge of only a limited part of the system is unwise due to high levels of scientific uncertainty in natural systems (Holling, 1978; Mee, 2005). Therefore, taking a flexible and pragmatic approach to marine management is necessary and the correct way since it actually treats a system as a management 'experiment', adapting management policies and goals based upon knowledge gained (Farmer et al., 2012).

Furthermore, oceans ecosystems have been recognized for long as one of the most important natural resources (Costanza, 1999), as they provide an array of ecosystem services that directly or indirectly translate into economic services and values to humans (Figure 2) (Eggert and Olsson, 2009; Granek et al., 2010; Hanley et al., 2003; MEA, 2003; Remoundou et al., 2009). The utilisation of this goods and services approach has the capacity to play a fundamental role in the ecosystem-approach (MEA, 2003; Beaumont et al., 2007), as the EBM of marine ecosystems requires integrating the pressures and demands of society, economy and environment (Granek et al., 2010).

The Millennium Ecosystem Assessment (MA) establishes a conceptual framework for documenting, analysing and understanding the effects of environmental change on ecosystems and human well-being. It views ecosystems through the lens of the services that they provide to society, how these services in turn benefit humanity and how human actions alter ecosystems and the services they provide (Carpenter et al., 2009). Figure 2 presents the MA approach to ecosystem services.

The MEA classifies ecosystem services in four types: provisioning, regulating, supporting and cultural services. For marine ecosystems, provisioning services include: food (inshore or offshore fisheries, algae, aquaculture and wild sources); fibre and fuel (referring to vegetation in coastal systems); water supply (industrial or domestic uses); medicines and others (chemicals and species with medical applications); the provisioning of energy (renewable); raw materials (salt); and the provisioning of transport and navigation. Regulating services are: biological regulation (regulation of pest outsets); freshwater storage and retention in coastal systems; hydrological balance; atmospheric & climate regulation due to ocean air interchange and coastal vegetation; human disease control; waste processing or bioremediation of waste; natural hazard protection and erosion control. Cultural services include: cultural and amenity benefits; leisure and recreation; aesthetic benefits; education and research knowledge; future unknown or speculative values (option values); feel good or warm glows (related to the welfare associated with the conservation of marine environments); cognitive values (those related to the existence or bequest values); and cultural heritage and identity values. And finally, provisioning services include: biologically mediated habitat (the potential of habitats to provide biological assets); nutrient cycling and fertility; and physical habitat for species.


**Figure 2. Conceptual Framework of the Millennium Ecosystem Assessment (MA, 2003)**

The concept of ecosystem services has shifted our paradigm of how nature matters to human societies. Instead of viewing the preservation of nature as something for which we have to sacrifice our well-being, we now perceive the environment as natural capital, one of society's important assets (Liu et al., 2010). Society needs to start acknowledging the value of natural capital (Daily et al., 2009) and Ecosystem Services Valuation (ESV) could be the approach to tackle such a challenge. ESV is the process of assessing the contributions of ecosystem services to sustainable scale, fair distribution, and efficient allocation (Liu et al., 2010). However, challenges still remain for the ESV as ESV research has to become more problem-driven rather than tool-driven. Ultimately the success of ESV will be judged on how well it facilitates real-world decision making and the conservation of natural capital (Liu et al., 2010).

ESV methods can be either monetary or non-monetary. Nevertheless, the economic approach of measuring benefits has limitations. First, data on the benefits of ecosystem services to specific groups (versus society as a whole) may be lacking. Second, many ecosystem services cannot be easily reduced to monetary values. Disputes among groups may require extensive dialogue and explicit discussion of trade-offs that will likely be multifaceted rather than measured in a common currency (Granek et al., 2010).

Recently, The Economics of Ecosystem Services and biodiversity (TEEB) has mainstreamed the economic approach to ecosystem services. The TEEB initiative is rooted on the MA and post-MA assessments and scientific publications to establish an updated framework for ecosystem services assessments.

Non-monetary indicators of ecosystem benefits can be useful in some situations and may be less expensive and take less time to apply. Such approaches may be better suited to address spiritual, cultural, or aesthetic values that are quite difficult to capture in monetary terms. Extensive in-person interviews, quantitative surveys, and other analyses by social scientists can generate evidence about deeply held beliefs of individuals and groups and the benefits they derive from ecosystems.

Few ES assessment analyses of the use of waters have been applied so far, and, when performed, they have mostly looked at assessing the ecosystem services affected by certain marine uses such as fisheries, offshore renewable energy, tourism and conservation measures. Furthermore, opposition is growing from coastal residents and marine user groups who fear substantial impacts of human pressures on marine ecosystems (Halpern et al., 2008) and, thus, onto the services these ecosystems provide. We need to quantify explicitly the impacts of sectors onto the marine ecosystems as well as onto other sectors, in order to be able to assess the possible affections, trade-offs and costs which may occur in a near future if the use of our waters is increased.

The non-legally binding document written by the working group on Economic and Social Assessment, entitled as "Economic and Social analysis for the initial assessment for the Marine Strategy Framework Directive: a guidance document", describes three approaches to the analysis of the cost of degradation. These approaches are: the Ecosystem Services Approach; the Thematic Approach; and the Cost-based Approach. The document further explains what valuation methods could be applicable for each of the approaches and provides guidance on which of the approaches to follow and when. As such, the Ecosystem Services Approach may set your ambition, the Thematic Approach may provide a useful example of how to present your own framework, and the Cost-based Approach may appear to be useful when resources are scarce. The analysis of the cost of degradation can usefully constitute a basis for later analyses in the Directive, for example as a base for the cost-benefit analyses of measures (Art. 13 MSFD) and/or as a foundation for the discussion of potential exemptions (Art. 14 MSFD).

## 2.2 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 level 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, distinction between coastal sea and open sea and their relationships with the marine waters under the jurisdiction of the 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 study should prepare the work to be done in the WP6 sub regional Pilot Cases, which should also be considered.

### 2.2.1 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.

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:

- 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 3.).

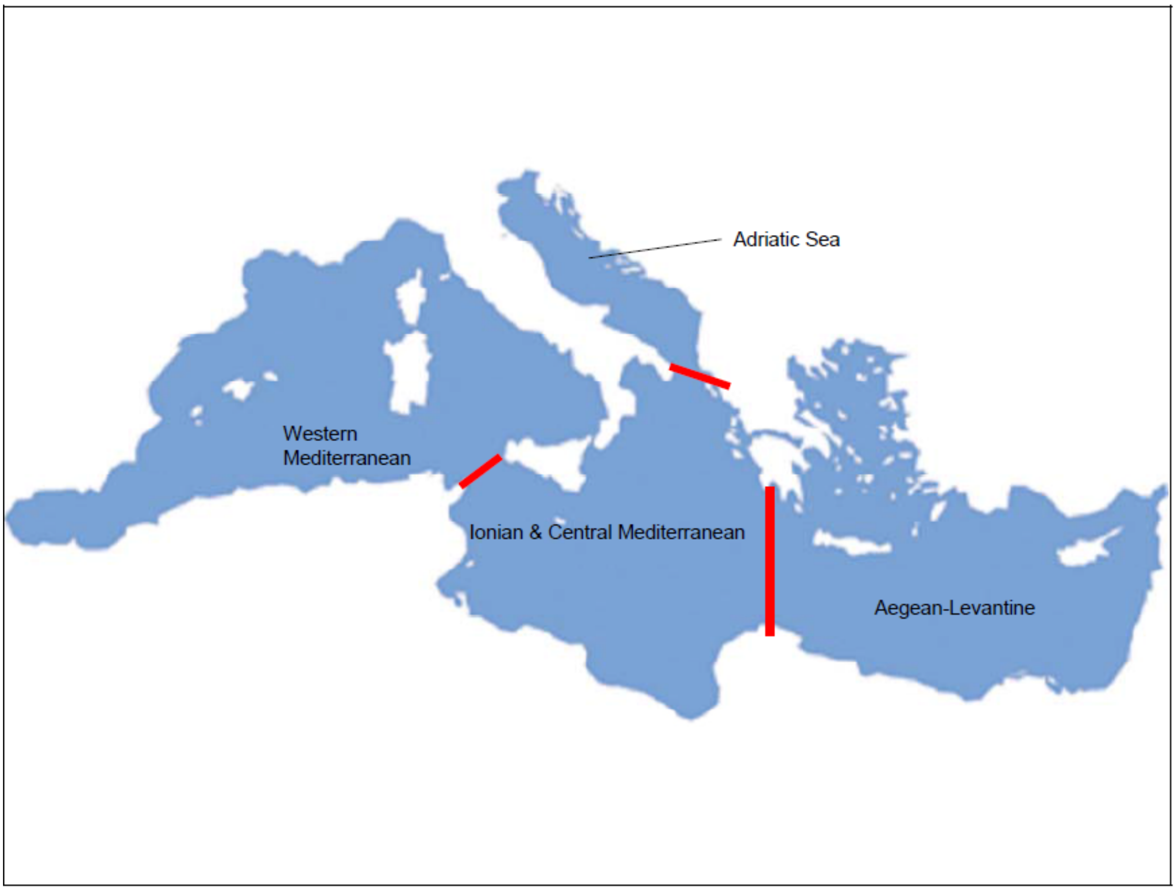



**Figure 3. MSFD and MAP Mediterranean sub-regions Source: UNEP/MAP, 2011.**

The correspondences between PERSEUS sub-regions, MSFD sub-regions and coastal states (Member and Non EU Members) can be summarized in Table 1.

**Table 1. Definition of the PERSEUS sub-regions.** * indicates Countries owning to multiples sub-regions (including outside Mediterranean Sea and Black Sea)

| PERSEUS sub regions | MSFD and RSC sub regions | Member States | Third Countries (non-EU Members) |
|---|---|---|---|
| West Mediterranean | Western Mediterranean | Spain*, France* Italy* | Monaco, Tunisia*, Algeria, Morocco* |
| Central Mediterranean | Adriatic Sea | Italy*, Slovenia | Croatia, Bosnia-Herzegovina, Montenegro, Albania |

| PERSEUS sub regions | MSFD and RSC sub regions | Member States | Third Countries (non-EU Members) |
|---|---|---|---|
| | The Ionian Sea and the Central Mediterranean Sea | Greece*, Italy*, Malta | Libya*, Tunisia* |
| East Mediterranean | Aegean-Levantine Sea | Greece*, Cyprus | Turkey*, Syria, Lebanon, Israel, Palestinian territories, Egypt*, Libya* |
| Black Sea | Black Sea | Bulgaria, Romania | Ukraine, Russia, Georgia, Turkey* |

### 2.2.2 Coastal and open waters

Distinction between coastal and open waters is embedded in the PERSEUS cluster "New Knowledge" which comprises two interactive work packages dealing with pressures and impacts, WP1 at basin and sub-basin scales and WP2 for coastal 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. This contradiction has already been presented in the introduction section.

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) where EEZ have been established. 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.

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.

A pragmatic examination of the marine activities shows that most of them are mainly impacting coastal areas (see Table 2).

Practically, it has been decided that most of the assessments will be presented in the D2.2 deliverable dealing with coastal waters, the open sea deliverable (D1.2) being mostly devoted to qualitative considerations about the impacts of some marine activities in open sea.

**Table 2. 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 | Whole | Focus on some high sea species. |
| Aquaculture | Whole | |
| Port operations | Whole | |
| Maritime transport | Coastal shipping | High sea shipping (Quantitative considerations when possible) |
| Recreational activities and coastal tourism | Whole | |
| 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 | Whole | |
| Population, Urban areas and WWTPs | Whole, considering that impacts are mostly coastal | |

### 2.2.3 The WP6 Pilot Cases

This assessment should also serve to 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. For example, Article 8(c) of the MSFD provides an economic and social analysis of the use of the water and 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.

Within the PERSEUS workflow, this knowledge is supplied from the results displayed by this deliverable. In consequence, the socio economic assessments are reported taking into account as far as possible the Pilot Cases.

The four pilot cases concern areas in each PERSEUS sub-regions are illustrated in Figure 4.


**Figure 4. The four WP6 Pilot Cases.**

## 2.3 Scope of the Analysis

Article 2 of the MSFD defines its spatial scope as: “all marine waters as defined in Article 3(1), and […] the trans-boundary effects on the quality of the marine environment of third States in the same marine region or sub region”. Referring to its content, the MSFD does not restrict MS to analysing specific economic sectors and uses of the marine environment. Though Annex III of the Marine Directive provides an indicative list of pressures and impacts, MS will have to carry out an analysis of "the predominant (our emphasis) pressures and impacts, including the human activity" [Article 8(1)b].

The scope of the socio economic analysis of pressures on the open waters in the present report follows accordingly the results of 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 marine waters, in coherence with Table 2.

- Fisheries
- Aquaculture
- Maritime transport and cruises
- Recreational activities, coastal tourism
- Submarine cable and pipeline operations
- Marine hydrocarbon (oil and gas) extraction
- Desalinisation
- 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 a non-issue to continue.

A consistent, economic and social analysis of the use 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 scope of the cost-of-degradation analysis is to provide a first quantitative assessment of the gap between present status and GES for marine environments in SES. 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. 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.

# 3 DATA

## 3.1 Data sources

Data on marine water uses and economic sectors are scattered in a variety of soures: EU publications, official statistical compendia of MS, ad hoc databases within specific International Agencies and Conventions, private sector associations, marine NGOs, etc. GW 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.

## 3.2 National initial assessment of Member States

### 3.2.1 Progress of the MSFD initial assessments

As regards the Mediterranean Sea Member States, the Initial Assessment reports are publicly available only for Cyprus, Greece and Spain. The Italian Initial Assessment report, although submitted, is not available. France, Malta and Slovenia have not fulfilled their reporting requirements. Nevertheless, France has released relative documents (available at: http://wwz.ifremer.fr/dcsmm/Le-Plan-d-Action-pour-le-Milieu-Marin/Evaluation-initiale/Documents-techniques).

With respect to the Black Sea region, there is no information available yet. The Romanian Initial Assessment report has been submitted but it is not publicly available and Bulgaria has not fulfilled its reporting requirements. It should be also mentioned that Table 3 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.

References of the data source for the various will be detailed, in order to allow checking or gap analysis.

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

**Table 3. The Marine Strategy Framework Directive Scoreboard. Source: The Marine Strategy Framework Directive Scoreboard** (retrieved from: http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/ scoreboard_en.htm – Accessed: December 31st, 2012)

| Country | Art. 26 Transposition Due 15/07/2010 | Art. 7 Competent authorities Due 15/01/2011 | Art. 8 Initial assessment Art. 9 Determination of GES Art. 10 Environmental targets & indicators Due 15/10/2012 |
|---|---|---|---|
| **Belgium** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Bulgaria** | Report or information submitted | Report or information submitted | *Report or information not submitted* |
| **Cyprus** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Denmark** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Estonia** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Finland** | Report or information submitted | Report or information submitted | Report or information submitted |
| **France** | Report or information submitted | Report or information submitted | *Report or information not submitted* |
| **Germany** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Greece** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Ireland** | Report or information submitted | Report or information submitted | *Report or information not submitted* |
| **Italy** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Latvia** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Lithuania** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Malta** | Report or information submitted | Report or information submitted | *Report or information not submitted* |
| **Netherlands** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Poland** | Report or information not submitted | Report or information not submitted | *Report or information not submitted* |
| **Portugal** | Report or information submitted | Report or information submitted | *Report or information only partially submitted* |
| **Romania** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Slovenia** | Report or information submitted | Report or information submitted | *Report or information not submitted* |
| **Spain** | Report or information submitted | Report or information submitted | Report or information submitted |
| **Sweden** | Report or information submitted | Report or information submitted | Report or information submitted |
| **United Kingdom** | Report or information submitted | Report or information submitted | *Report or information only partially submitted* |

### 3.2.2 Case of Greece

The case of Greece is given her as an illustration of national initial assessment performed by MS.

Data on the socioeconomic profile of marine sectors and uses in the Aegean, Ionian and Adriatic Seas can be found in the recent 'initial assessment report' of Greece submitted to the EU as part of its national reporting obligations. The report was made available in September 2012 on the website for public deliberation set up by the Greek Ministry of Environment and Climatic Change (see http://marinestrategy.opengov.gr/ ). Section 4.3 of the Greek initial assessment report contains information on the economic and social analysis of Greek territorial waters (Aegean Sea, Ionian / Adriatic Sea). The approach of Water National Accounts was chosen in order to assess the economic significance of the following sectors:

- Fisheries
- Aquaculture
- Secondary treatment and trade of marine food
- Tourism
- Ports

Parameter used included value of production, value added and employment. The importance of the above Greek marine market sectors was estimated at €6.9 billion or 3.84% of GDP. The report estimates also the importance of Greek non-market marine uses and benefits applying qualitative indices and proxy measures. The following non-market uses were assessed:

- Recreation
- Education and research
- Oil abstraction
- Carbon sequestration

The cost of degradation due to the exertion of the above pressures during 2008-2012 is calculated in terms of production value in the range 0.83% - 1.29% of GDP. In terms of value added the cost of degradation ranges between 0.12% and 0.21% of GDP.

## 3.3 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)

## 3.4 Gap analysis on data

The MSFD requires that MS maintain or achieve GES in their waters. It requires an Initial assessment of the current environmental state (Article 8.1), a determination of what GES means for each country (Article 9) and the establishment of targets and indicators designed to show whether GES is being achieved (Article10) (EU, 2010). Gap analysis is essential to determining the last requirement. Within PERSEUS, there are two essential aspects to the gap analysis: (1) establishing indicators that reflect the GES and can be feasibly measured and compared over countries in the two basins[3]; (2) identifying missing data and information needed to assess gaps between GES targets and the current state in individual countries and over the two basins in a comprehensive and comparable manner; and (3) projecting over time and space future patterns of gaps with reference to difference scenarios (e.g. Business as Usual vs. policy change).

The gap analysis must be informed by quantitative (and possibly qualitative) spatial-temporal descriptions of state variables such as ecosystem functions and ecosystem services. Collaboration between natural and social scientists is essential since the interaction between anthropogenic pressure and changing states and the feedback among them is fundamental to the inter-temporal assessment. Moreover, indicators of environmental status can be measured using a variety of metrics (e.g. ecological, physical and socio-economical). For example, water quality can be assessed in terms of its chemical composition, turbidity or by its relation to human activities such as recreation, fishing or shipping. Thus, the overall quality assessment may be skewed depending on the indicators chosen. For example, despite turbid water generally indicates high primary productivity and/or suspension and is considered less desirable than clearer waters by ecologists and recreational users, they may or may not have negative implications for fishermen, and are irrelevant for the shipping industry. However, turbidity is caused by a combination of natural process and human activities which will probably need to be the targeted for modification in order to achieve the GES. Incorporating all of these factors in the gap analysis is essential to achieving an understanding of the meaning of GES and deviations from it.

In order to achieve PERSEUS goal of integrating the economic and other human aspects with the natural element in an assessment that facilitates basin-wide and sector-wide comparisons, the gap analysis must also need to address information needs. County reporting tends to be inconsistent (mostly missing data) and even when variables are comprehensively reported, ensuring that they are comparable may be challenging and time consuming. Addressing these information issues is essential if PERSEUS is to achieve the dual goals of identifying current gaps as well as scenarios for change.

[3] This is somewhat different that the requirement of the MSFD since region-wide comparison is not an explicit objective.

# 4 RESULTS

## 4.1 Fisheries

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

### 4.1.1 Introduction

#### 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 Black Sea, Western Mediterranean, Aegean-Levantine Sea, Adriatic Sea and Ionian Sea and Central Mediterranean, 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.

### Coastal areas 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 this report, it has been considered that all fisheries statistics unless otherwise stated are for coastal areas. Coastal water fishing activities includes all other fishes caught for commercial, industrial, recreational and subsistence purposes.

However, deliverable D1.2 provides insights on open sea fisheries activities, defined within the PERSEUS Task 1.2 as those targeting some specific species selected according to expert judgment (Pantazi M., HCMR, 2013, Pers. Com.)

Pelagic fishes:

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

Demersal fishes:

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

### 4.1.2 Sector and socio-economic analysis

This section provides information on the sector and its economic and social characteristics. The analysis is made for the Black Sea and the Meditarranean Sea by subregions (Western Mediterranean Sea (WMed), Adriatic Sea (AdS), Ionian Sea and the Central Mediterranean Sea (CentMed) and Aegean-Levantine Sea (AegSea)). However, because data is only available on a National basis, the statistics presented here are according to National fleet. When possible, future projections are provided.

#### Black Sea

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 during 1996-2008 (Shlyakhov and Daskalov, 2008). Anchovy and sprat account for the bulk of the catch and in 2008 these two species alone formed over 90% of the total annual catch of 370000 tons. The remaining catch for 2001-2008 consisted of commercially less important fishes such as the Mediterranean horse mackerel (6600 -15300 tons), whiting (7300-11100 tons), Atlantic bonito (5000-20000 tons) and molluscs. Researchers consider that the important commercial stocks are shared between the coastal countries.

During the past 50 years fisheries have been one of the drivers of environmental changes in the Black Sea ecosystems. Simultaneously they have been radically affected by changes caused by other factors, such as the introduction of invasive species. The past few decades can be divided into three main periods (Eremeev and Zuyev, 2007):

- Fishery development, 1970-1988: a gradual catch increase with total landings, reaching a maximum of almost 800 000 tons;
- Fishery crash, 1989-1991: a drastic catch decrease over three years down to 200000 tons, the lowest point since the 1970s. The decrease was observed in all stocks, but particularly in anchovy and other small pelagic fish with landings reaching

levels of approximately 100000 tons, which is comparable only to those preceding the development period;

- Fishery recovery, 1992- 2004: partial growth of fish landings.

More recent data shows that this recovery period was interrupted in 2005 with landings shrinking to about 270 000 tons, followed by a subsequent growth in 2006-2007. The total mean annual catch of Black Sea fisheries was at a level of around 400000 tons over the period 1992-2010, varying annually from 270 000 to 530 000 tons.

The fluctuations in catch were accompanied by a major change in the species composition from the 1960-70s to the end of the 1980s. A gradual reduction of large-sized, food-valuable fishes such as turbot, bluefish, mackerel, Atlantic bonito, sturgeons and shad has occurred since the 1960s. They have been replaced by several small-sized species such as anchovy, sprat, whiting, horse mackerel and others (GFCM, 2012).

### Sector analysis

**Landings**

The Food and Agriculture Organization of the United Nations (FAO) defines the Black Sea fishing subarea (Subarea 37.4), as consisting of the Sea of Marmara (Division 37.4.1), Black Sea proper (Division 37.4.2), and the Sea of Azov (Division 37.4.3). While the three basins form a common fishing subarea, it is misleading for scientific analysis to mix fauna of the Sea of Marmara with the Black Sea, as the species found in the Sea of Marmara are not found in the Black Sea proper.

The Black Sea is surrounded by six countries: Bulgaria, Georgia, Romania, Russia, Ukraine and Turkey. The Sea of Azov is shared between the Russian Federation and Ukraine, while the living resources of the Sea of Marmara are exploited by Turkey. The capture production, i.e. catches expressed as live weight equivalent of landings for the Black Sea region for the years 2006-2010 is as follows:

**Table 4. Black Sea, Sea of Azov Sea of Marmara landings, tons**

Black Sea landings

| Country \ Year | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Bulgaria | 5 620 | 7 807 | 7 651 | 7 385 | 9 668 |
| Georgia | 9 659 | 18 147 | 26 462 | 25 000 | 25 000 |
| Romania | 614 | 518 | 444 | 331 | 231 |
| Russian Federation | 15 225 | 13 433 | 17 437 | 19 875 | 18 574 |
| Turkey | 313 877 | 468 707 | 350 740 | 309 136 | 332 505 |
| Ukraine | 30 537 | 24 869 | 27 741 | 35 967 | 41 151 |
| **Total** | **375 532** | **533 481** | **430 475** | **397 694** | **427 129** |

Sea of Azov landings

| Country \ Year | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Russian Federation | 16 625 | 13 190 | 12 833 | 12 592 | 11 830 |
| Ukraine | 26 766 | 28 201 | 30 380 | 29 896 | 28 626 |
| **Total** | **43 391** | **41 391** | **43 213** | **42 488** | **40 456** |

Sea of Marmara landings

| Year | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Total | 74 252 | 45 857 | 39 477 | 34 222 | 38 196 |

*Source: FAO Fisheries and Aquaculture Information and Statistics Service, 2010.; GFCM capture production 1970-2008.*

The Turkish fishing fleet has caught on average 81% of the total catch from the Black Sea proper during the first decade of the 21st century, as is also evident from the above tables. The most important fishing activity takes place in the Turkish Eastern Black Sea region, which is responsible for about 60% of the landings of the Black Sea proper or roughly half the catch from the whole fishing subarea 37.4 in 2010.

The reported landings form the Sea of Azov are in the range of 40 000 tons per year. Fishing in the Sea of Marmara has suffered a decline from a peak of 74 thousand tons in 2006, preceded by a period of comparable levels of catch in 2001-2004, to around 39 thousand tons in 2010 and 2011 according to Turkish fishery statistics (Turkstat 2011, 2012).

**Fleet**

The combined fishing fleet in the Black Sea and the Sea of Azov around the year 2010 consists of roughly 11 500 vessels. Over 85% of them could be described as small vessels of overall length up to 12 metres. Another 10% formed the length class from 12 to 24 m, and probably less than 5% were larger than 24 m. Most of the vessels, especially the smaller ones are multipurpose, while among the larger vessel the most important segments are trawlers and purse seiners. There are substantial data gaps due the application of different national criteria in collecting and publishing data on the fishery sector that do not allow to form a complete picture of the tonnage and power of these vessels. For Bulgaria and Romania at least, it is evident that only about 40% of all fishing vessels are active.

<u>Bulgaria</u>

The Bulgarian fleet consists of 2336 registered vessels with a total tonnage of 7 373 GT and combined power of 61 307 kW at the end of 2011. Only 1009 vessels have been active during the year. Nearly 96 % of all the vessels (2237) have overall length of less than 12 m and this group is responsible for 32 % of the Bulgarian catch. The average age of the Bulgarian fishing fleet is 19 years. The number of vessels has decreased by 8 % since 2007, bringing down the gross tonnage by 10% and the motor power by 6%. The days at sea for the same period have nearly doubled to 18 thousand, pointing at increased fishing activity. (NAFA, 2012)

**Table 5. Bulgarian fishing fleet, 2011**

| Length class, m | Number of vessels | Tonnage, GT | Power, kW |
|---|---|---|---|
| under 6 | 773 | 554 | 5 987 |
| 6 -12 | 1 464 | 3 164 | 39 730 |
| 12 - 18 | 62 | 1 200 | 8 403 |
| 18 - 24 | 25 | 1 104 | 4 119 |
| 24 - 40 | 12 | 1 351 | 3 069 |
| **Total** | **2 336** | **7 373** | **61 307** |

*Source: NAFA, 2012.*

Romania

The Romanian fishing fleet consists of 510 registered vessels, with a combined gross tonnage of 920 GT and total power of 7 080 kW, and an average age of 17.4 years in 2012. The size of the Romanian fishing fleet has increased between 2008 and 2010. The number of vessels increased by 16% while the total tonnage and power of the fleet declined by 55% and 38%, respectively during the same period.

In 2011 the Romanian fishing fleet spent a total of around 6 500 thousand days at sea, 57% of which were actual fishing days. The total number of days at sea increased by around 75% between 2008 and 2010, while the total fishing days remained stable during the same period. (STECF, 2012)

**Table 6. Romanian fishing fleet, active vessels, 2010**

| Length class, m | Number of vessels | Tonnage, GT | Power, kW |
|---|---|---|---|
| under 6 | 36 | 29 | 433 |
| 6 -12 | 169 | 172 | 1 295 |
| 24 - 40 | 1 | 136 | 331 |
| **Total** | **206** | **337** | **2 059** |

*Source: STECF, 2012*

Georgia

The Georgian fleet was composed of 26 seiners and 11 motorized wooden vessels equipped with purse nets locally called “motofelugas” in 2009. Georgian companies used to rent also 19 Turkish vessels that operate in Georgian waters. Along with the medium-sized seiners, there were 324 small-scale fishing boats involved in coastal capture fisheries in 2005 (FAO 2006).

The applied fishing effort for the season 2007-2008 is estimated at about 860 days at sea (Castilla-Espino et al., 2012).

**Table 7. Georgian fishing fleet, 2009**

| Type of vessel | Number of vessels | Tonnage, GT | Power, kW |
|---|---|---|---|
| Motofeluga (purse seiner) LOA 10-15 m (av. 12 m) | 11 | 144 | 990 |
| Seiner, Georgian registration LOA 11-32 m (av. 25 m) | 26 | 2 414 | 4 512 |
| Seiner, Turkish registration LOA 27-57 m (av. 40 m) | 19 | 2 179 | 4 282 |
| **Total** | **56** | **4 737** | **9 784** |

*Source: Castilla-Espino et al., 2012*

Ukraine

The fishing fleet of Ukraine operating in the Black Sea and the Sea of Azov in 2008 incorporated 123 vessels with overall length of more than 12 m. This marked a decrease of about 13% in the number of fishing vessels between 2006 and 2008. Most of the vessels use polyvalent gear and are capable of fishing with trawls, purse seines, nets or long-lines (Commission on the Protection of the Black Sea Against Pollution, 2010). It is estimated that less than 10% of all vessels are younger than 10 years. Ukrainian fishermen are allowed to seasonally fish anchovy in Georgian waters on the basis of a bilateral agreement (GFCM, 2012). The statistical data from 2011 points at a larger number of vessels in the length classes over 24 m compared to 2008, yet it is difficult to establish a recent development trend due to diverging approaches of data representation among the various sources.

**Table 8. Ukrainian fishing fleet operating in the Black Sea and Sea of Azov, 2011**

| Vessel type | Number of vessels |
|---|---|
| less than 80 GT and power less than 55 kW | 1045 |
| less than 24 m or less than 300 GT | 106 |
| 24-45 m or 300-3000 GT | 54 |
| over 45 m or over 3000 GT | 23 |
| Total | 1228 |

*Source: Ukrstat, 2011.*

Russia

In 2005 the whole Russian fishing fleet (incl. Arctic, Pacific, etc.) consisted of 2 977 larger units, of which 2 522 capture fishing vessels, 39 processing vessels, 369 freezer vessels and others, including research, fish protection and educational vessels, 47 (Eurofish, 2005). About 17% of the fishing vessels were large vessels (over 64 m length overall, LOA), half (51%) were medium sized (34–65 m) and 32% were small vessels (24–34 m LOA). The fishing fleet is characterized be a substantial number of physically worn-out and obsolete vessels. It has been estimated that about two thirds of all vessels are older than 20 years (OECD, 2009).

By 2010 the size of the fishing fleet has declined to 2 824 units, of which 2 023 fishing vessels. The remaining 800 vessels include service fleet, freezer, processing and other vessels. This confirms a steady downward trend since 2002. The share of the Azov and Black Sea fishing fleet in 2010 is 11% of the total number of vessels, resulting in around 220 fishing vessels with length over 24 m (Belyaev, 2011).

In addition there are small-size fishing vessels with overall length of up to 20 m that until 2012 were registered under a different regime. In the Azov and Black Sea basins there are about 300 such vessels in 2012, owned by 69 companies and individuals (Ministry of Agriculture, 2012).

Turkey

The Turkish Black Sea fleet is by far the largest compared to the fishing capacity of the other coastal countries. It comprised a total of 6 700 units, of which 4 106 in the Eastern Black Sea region and 2 594 vessels in the western part. In 2007 there were 137 trawlers, 164 purse seiners, 309 purse seiners-trawlers, 117 carrier vessels and the rest were small-scale vessels operating in the Black Sea. The number of vessels over 20 m length were 404 with an average gross tonnage and power of 160±16.2 GT and 495±23.0 kW respectively. Some of the bigger purse seiners (approximately 85 vessels) targeting pelagic species like anchovy, pilchards, sprat, bonito and blue fish often move from May to June in the Mediterranean to catch blue fin tuna. (Saglam and Duzgunes, 2010)

For comparison, the Marmara fishing fleet numbered 2982 vessels in 2007, 80% of which with overall length of less than 12 m.

According to 2008 data the total fleet in the Black Sea is made up by 5 884 vessels of which 4 681 are small-scale vessels of less than 12 m length, 1 240 are dredgers over 6 m length, 500 and 460 are respectively purse seiners and trawlers over 12 m. The polyvalent vessels are 223 (GFCM, 2012). Most probably there are discrepancies between the data submitted to the GFCM and the data published by the Turkish Statistical Institute, explaining the substantial difference in the number of vessels between 2007 and 2008.

**Table 9. Turkish Black Sea fishing fleet, 2007**

| Length class, m | Number of vessels |
|---|---|
| under 5 | 196 |

| Vessel tonnage, GT | Number of vessels |
|---|---|
| 1 - 4 | 5222 |

| Vessel power, kW | Number of vessels |
|---|---|
| 1 - 9.9 | 2264 |

| | |
|---|---|
| 5 -11.9 | 5658 |
| 12 – 19.9 | 442 |
| 20 – 29.9 | 262 |
| over 30 | 142 |
| **Total** | **6700** |

| | |
|---|---|
| 5 - 9 | 570 |
| 10 - 29 | 384 |
| 30 - 49 | 165 |
| 50 - 99 | 156 |
| 100 - 199 | 128 |
| 200 - 499 | 63 |
| over 500 | 12 |

| | |
|---|---|
| 10 - 19.9 | 1327 |
| 20 - 49.9 | 1202 |
| 50 - 99.9 | 841 |
| 100 - 199.9 | 541 |
| 200 - 499.9 | 285 |
| over 500 | 240 |

*Source: Turkstat, 2008*

## Economic analysis

Bulgaria

The total amount of income generated by the Bulgarian national 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. The total income of the Bulgarian fleet increased by around 50% between 2009 and 2010. However, total fleet operating costs in 2010 amounted to €8.03 million, almost 173% of total income. Operating costs have increased more than two-fold since 2008, augmenting 68% between 2009 and 2010 only. The largest expenditure items were crew wages (€1.99 million) and fuel costs (€1.77 million). Crew wages have increased significantly (150%) since 2008, whereas fuel costs increased by 28% relative to 2008.

In terms of profitability, and according to the data, the Bulgarian national fleet performed negatively in 2010, generating an overall GVA of -€1.7 million. The Bulgarian fleet suffered a gross loss of € 4.2 million and 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; not surprising considering that income from landings has decreased while total operating costs have increased significantly over the time period analysed. The Bulgarian fleet had an estimated depreciated replacement value of €16.5 million in 2010 and investments in the range of €3.4 million in the same year. (STECF, 2012)

Romania

The total amount of income generated by the Romanian national fleet in 2010 was €0.49 million. This consisted of total landings values, without any fishing rights sales, non-fishing income, and direct subsidies. The total income of the Romanian fleet decreased 33% between 2008 and 259 2010. Total expenditure by the Romanian national fleet in 2010 was €0.45 million, amounting to 92% of total income. The largest expenditure items were fuel costs (€0.21 million) and wages (€0.19 million).

Between 2008 and 2010, the total expenditure of the Romanian fleet decreased by 41%, fluctuating between €0.76 million and €.45 million, largely due to wages and salary. In terms of profitability, the total amount of GVA, gross profit and net profit generated by the Romanian national fleet in 2010 was €0.24 million, €0.05 million and €0.03 million, respectively. (STECF, 2012)

Russia

The available economic data on Russia is aggregated at the level of fishery and aquaculture sector for Krasnodar Krai, thus including the Black Sea fishery and most of the Sea of Azov.

**Table 10. Net financial result of the turnover year for the fishery and aquaculture sector, Krasnodar Krai, Russia**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Net financial result of the turnover year, million euro | 25.3 | 14.6 | 23.7 | -6.6 | 25.7 |

*Source: Krasnodarstat, 2013.*

Turkey

The global value of sea capture production in Turkey was about €669 million in 2007, large part of which is generated by the Black Sea fisheries. Export of sea products generated over €153 million during the same year. (Turkstat, 2008)

Government financial transfers to marine fishery sector in Turkey reached USD 92 million (€73 m) in 2006. Almost half of them were devoted to construction and maintenance of fish ports, as well as monitoring, control and surveillance of fisheries activities and research. The remaining half was spent for various programmes. There are no direct payments to the fishing industry. (OECD 2010)

## Social analysis

It is hard to come up with an estimate of the employment in the fishing sector in the Black Sea region. Difficulties arise from varying reporting practices, different levels of data aggregation and gaps in the data. A very rough estimate of the number of employed in the region is in the range of 25-30 thousand jobs. This is the sum of the reported jobs in the six coastal countries for the period 2007-2011, and it also agrees with the average crew number per vessel in the existing fishery statistics. About two thirds of this employment is created in Turkey with a particular emphasis on the eastern part of its coast.

Bulgaria

The total employment in the Bulgarian fishing sector was estimated at around 3933 jobs and 2889 full time equivalents (FTEs) in 2010 (STECF, 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. At the same other studies support the higher number of employed in the marine fisheries sector, indicating 3 430 jobs on average for the period 2006-2009. The processing sector provides about 2 230 jobs, nearly 90% 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. (European Commission, 2011)

Romania

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 employed increasing by 53% and the number of FTEs increasing by 65% over the time period according to STECF (2012).

Georgia

The Georgian fishing fleet has employed about 750 people for its larger vessels in 2009. (Castilla-Espino et al., 2012)

Russia

The Russian fishing enterprises in the Black Sea and Azov area have employed from 2591 to 2185 workers between 2007 and 2011, respectively. The number of jobs in the sector has fluctuated during the period within the above interval. (Krasnodarstat, 2013)

Ukraine

The employment in the sector of fishing and aquaculture according to the Ukrainian labour statistics was about 7.1 thousand jobs in 2011, corresponding to 6.5 thousand FTEs. This marked a continuous decline by 15% compared to the previous year and the total employment has shrunk to less than a quarter of the level in 2000 (31 thousand) (Ukrstat, 2012). This pronounced negative trend can be linked to the decline of the fishing fleet, but also to the low level of payment in the sector, which is about 52% of the average monthly salary in the country. Assuming that the level of employment is proportional to the contribution of the Black Sea and the Sea of Azov to the total catch (incl. freshwater basins, catch in the EEZ of other countries and high seas), then 32% of the employment in the sector is generated by fishing in the Azov-Black Sea basin. This results in 2.3 thousand jobs, which is equivalent to 2 thousand FTEs.

Turkey

The Turkish fleet has employed 17 637 workers on a full time basis and 1 748 part time in 2007. (Turkstat, 2008)

## Western Mediterranean Sea

The Western Mediterranean Sea is surrounded by Algeria, France, Italy, Morocco, Tunisia and Spain. Data for the Italian fleet is included in the following section on the Adriatic Sea. Data for the Tunisian fleet is included in the section on the Ionian Sea and the Central Mediterranean.

In the Western Mediterranean Sea, coastal waters are the primary source of fish landings representing about 244 731 tons, where open sea waters contribute 10 132 tons of landings.

### Sector Analysis

**Table 11. Landing statistics for the Western Mediterranean Sea**

| | Coastal waters | Open sea |
|---|---|---|
| | **2010** | **2010** |
| Landings (1000t) | 244.73 | 10.13 |

*Source: FAO STAT, 2012*

*Notes: Fishing areas in the Balearic, Gulf of Lion and Sardinia. Data is for Algeria, France, Morocco, Tunisia and Spain. No data is available for Monaco. Open sea data includes Algeria (Blue and Red Shrimp, European Hake and Norway Lobster), France (European Hake and Norway Lobster), Morocco (European Hake and Norway Lobster), and Spain (Blue and Red Shrimp, European Hake, Giant Red Shrimp, and Norway Lobster).*

**Table 12. Sector statistics for the Western Mediterranean Sea**

| | Spain | France | Algeria | Morocco | Tunisia |
|---|---|---|---|---|---|
| | **2010** | **2010** | **2008** | **2008** | **2008** |
| *Fleet* | | | | | |
| Vessels (nr) | n.a. | 6 100 | 4 441 | 3 358 | 11 326 |
| GT (1000) | n.a. | 163.9 | n.a. | n.a. | n.a. |
| kW (1000) | n.a. | 885.1 | 330 | 140 | n.a. |
| *Effort* | | | | | |
| Days at sea (1000) | n.a. | 507.1 | n.a. | n.a. | n.a. |

*Source: EC, 2012; Sacchi, 2011. Note : No data available for Monaco*

### Economic Analysis

**Table 13. Economic statistics for the Western Mediterranean Sea (Million Euros)**

| | Spain | France | Algeria | Morocco | Tunisia |
|---|---|---|---|---|---|
| | **2010** | **2010** | **2008** | **2008** | **2008** |
| Landings value | n.a. | 924.3 | n.a. | n.a. | n.a. |
| Gross value added [a] | 752.6 | 502.7 | 418.8 | 16.2 | 115.1 |
| Gross profit | 120.7 | 116.5 | n.a. | n.a. | n.a. |
| Net profit excluding subsidies | -11.8 | 38.9 | n.a. | n.a. | n.a. |

*Source: EC, 2012; Sacchi, 2011*

*Notes: a, Values for Algeria and Morocco are converted from US Dollars based on January 2013 rates. No data available for Monaco*

### Social Analysis

**Table 14. Social statistics for the Western Mediterranean Sea**

| | Spain | France | Algeria | Morocco | Tunisia |
|---|---|---|---|---|---|
| | 2010 | 2010 | 2008 | 2008 | 2008 |
| Total employed | 38 045 | 10 871 | 39 000 | 16 250 | 4900 |
| Full Time Equivalent (FTE) | 33 678 | 8 410 | n.a. | n.a. | n.a. |

*Source: EC, 2012; Sacchi, 2011. Note: no data available for Monaco*

## Adriatic Sea

In the following section, data on fishing activities in the Adriatic Sea focus on fishing activities of Italy and Slovenia as they are main fleets active in the Adriatic. Little information was found for Croatia, Bosnia-Herzegovina, Montenegro and Albania. 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. But whereas Italian and Slovenian landings show an overall decreasing trend, Croatian landings are increasing. 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 Adriatic Sea coastal waters provided about 143,880 tons in landings where open sea waters provided about 4,270 tons.

**Table 15. Landing statistics for the Adriatic Sea**

| | Coastal waters | Open sea |
|---|---|---|
| | 2010 | 2010 |
| Landings (1000t) | 143.88 | 4.27 |

*Source: FAO STAT, 2012*

*Notes: Fishing areas includes the Adriatic Sea. Coastal water includes data for Croatia, Italy, Montenegro and Slovenia; no data available for Albania and Bosnia-Herzegovina. Open sea includes data for Croatia (European Hake and Norway Lobster), Italy (European Hake and Norway Lobster), and Montenegro (European Hake).*

Regarding the fleets capacity, data is only available for the Italian and Slovenian total fleet. This data also extends beyond the Adriatic Sea. In 2011, 14 715 vessels were registered in Italy and 186 in Slovenia, see Table 16. 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).

**Table 16. Sector statistics for the Adriatic Sea**

| | Italy | Slovenia | Albania | Croatia | Montenegro |
|---|---|---|---|---|---|
| | **2011** | **2011** | **2008** | **2008** | **2008** |
| *Fleet* | | | | | |
| Vessels (nr) | 14 715 | 186 | 269 | 3,823 | 218 |
| GT (1000) | 185 | 1.0 | n.a. | n.a. | n.a. |
| kW (1000) | 1 236,5 | 10.9 | 60 | 580 | 14 |
| *Effort* [a] | | | | | |
| Days at sea (1000) | 1 66,7 | 7.7 | n.a. | n.a. | n.a. |

*Source: FAO STAT, 2012; EC 2012; Sacchi, 2011. No data available for Bosnia-Herzegovina*
*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 1 115 million Euros. This consisted of €1 115 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 17. 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.

**Table 17. Economic statistics for the for the Adriatic Sea (Million Euros)**

| | Italy | Slovenia | Albania | Croatia | Montenegro |
|---|---|---|---|---|---|
| | **2010** | **2010** | **2008** | **2008** | **2008** |
| Landings value [a] | 1 115 | 2 | n.a. | n.a. | n.a. |
| Gross value added [b] | 653 | 0.46 | 10.55 | 320.5 | 4.5 |
| Gross profit [c] | 335 | -0.8 | n.a. | n.a. | n.a. |
| Net profit excluding subsidies [d] | 114 | -1.1 | n.a. | n.a. | n.a. |

*Source: EC, 2012; Sacchi, 2011.*

*Notes: a: Data for landings value in 2011 is only available for Slovenia; b: Data for gross value added is not available for Slovenia for 2008 and 2009. Values for Albania, Croatia and Montenegro are converted from US Dollars based on January 2013 rates; c Data for gross profit is not available for Slovenia for 2008 and 2009; for d: Data for net profit excluding subsidies is not available for Slovenia for 2008 and 2009. No data available for Bosnia-Herzegovina*

The Slovenian fisheries sector is still affected by the small size of its sea fishing area. The existence of two marine reserves where all fishing activities are banned (Portorož and Strunjan fishery reserves) to a large extent limit the Slovenian fishing opportunities. This negatively impacts the sector, in particular, sea fishermen who are engaged only in small-scale coastal fishing (EC 2012).

The fuel price has a high influence in the fisheries sector as well. High fuel prices lead to reduced fuel consumption, shorter fishing trips and consequently lower landings lead to a negative impact on the profitability and employment of the sector. In Slovenia reduced fuel consumption was observed in 2010, relatively to previous years. It is regarded as one reason for low landings and a decrease in full-time jobs (EC 2010). In Italy as well, the energy costs in 2010 showed an increase of 17% compared to 2009, due to increases in fuel prices.

### Social analysis

In Italy the total employment was around 28,982 jobs in 2010, equalling to 22002 full-time equivalents (FTEs) (EC 2012). The level of employment shows trend between 2008 and 2010. The total number of employed decreased by 1% while the number of FTEs increased by 3%. In 2010 9 789 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, 36.6% of them owned two to five fishing vessels. There existed only one fishing enterprise that owned six or more fishing vessels.
Table 18 below provides the combined statistics for the Italian and Slovenian fleets.

**Table 18 Social statistics for the for the Adriatic Sea**

| | Italy | Slovenia | Albania | Croatia | Montenegro |
|---|---|---|---|---|---|
| | **2010** | **2010** | **2008** | **2008** | **2008** |
| Total employed | 28 982 | 116 | 990 | 15 000 | 510 |
| Full Time Equivalent (FTE) | 22 002 | 82 | n.a. | n.a. | n.a. |

*Source: EC, 2012; Sacchi, 2011. No data available for Bosnia-Herzegovina*

### 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).

## Ionian Sea and the Central Mediterranean

Italy (Sicily), Greece, Libya, Malta and Tunisia all border the Ionian Sea and Central Mediterranean.

Data on the Italian fleet is included in the previous section on the Adriatic Sea, while Fleet data for Greece and Libya are covered in the following section on the Aegean-Levantine Sea. Information for the Tunisian fleet is provided in the section on the Western Mediterranean.

In 2010 landing statistics for the Ionian Sea and the Central Mediterranean Sea show that coastal waters provided 189 537 tons, while 10 384 tons were provided by open sea waters.

**Table 19. Landing statistics for the Ionian and Central Mediterranean**

| | Coastal waters | Open sea |
|---|---|---|
| | **2010** | **2010** |
| Landings (1000t) | 189.54 | 10.38 |

**Source: FAO STAT, 2012**

Notes: Fishing areas includes the Ionian Sea. Coastal water includes data for Malta. Open sea includes data for Malta (Blue and Red Shrimp, European Hake).

**Table 20. Sector statistics for the Ionian Sea (Malta)**

| | Malta |
|---|---|
| | **2010** |
| *Fleet* | |
| Vessels (nr) | 1 112 |
| GT (1000) | 12.3 |
| kW (1000) | 85.5 |
| *Effort* | |
| Days at sea (1000) | 65.4 |

*Source: EC, 2012*

### Economic Analysis

**Table 21. Economic statistics for the Ionian Sea (Million Euros) (Malta)**

| | Malta |
|---|---|
| | **2010** |
| Landings value | 8.8 |
| Gross value added [a] | 1.32 |
| Gross profit | -8.77 |
| Net profit excluding subsidies | -22.32 |

*Source: EC, 2012*

### Social Analysis

**Table 22. Social statistics for the Ionian Sea (Malta)**

| | Malta |
|---|---|
| | **2010** |
| Total employed | 360.71 |
| Full Time Equivalent (FTE) | 256 |

*Source: EC, 2012*

## Aegean-Levantine Sea

The Aegean-Levantine Sea area is bordered by Greece, Turkey, Cyprus, Syria, Lebanon, Israel, Palestinian Territories, Egypt and Libya. In this report, data on fishing activities in the Aegean Sea focuses on Greek fisheries. For the Levanine area data on Cyprus is in focus.

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'.

The Cypriot fleet fishes primarily in the Mediterranean Sea. Its fleet has decreased significantly in recent years. Limited data is available for Cyprus after 2010, although some information is provided up to 2012, and reported in the 'The 2012 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 24, 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%, totals GT by 49%, and total kW by almost 44%.

In 2010 in the Aegean-Levantine Sea 212 746 tons of fisheries landings came from coastal waters and 4600 tons from open sea waters.

**Table 23. Landing statistics for the Aegean-Levantine Sea**

| | Coastal waters | Open sea |
|---|---|---|
| | **2010** | **2010** |
| Landings (1000 tonne) | 212.75 | 4.6 |

**Source: FAO STAT, 2012**

*Notes: Fishing areas includes the Aegean-Levantine Sea. Coastal water includes data for Cyprus, Egypt, Greece, Israel, Lebanon, Palestinian Territories, Syria, and Turkey. No data for Libya. Open sea includes data for Cyprus (European Hake), Greece (European Hake and Norway Lobster), Israel (European Hake), Syria (European Hake), and Turkey (Norway Lobster).*

**Table 24. Sector statistics for the Aegean-Levantine Sea**

| | Greece | Cyprus | Egypt (Med) | Lebanon | Libya | Palestinian Territory | Israel | Syria | Turkey (Med) |
|---|---|---|---|---|---|---|---|---|---|
| | **2008** | **2010** | **2008** | **2008** | **2008** | **2008** | **2008** | **2008** | **2008** |
| *Landings (1000t)* | | | | | | | | | |
| *Fleet* | | | | | | | | | |
| Vessels (nr) | 17 657 | 1768 | 3124 | 2660 | 5029 | 717 | 438 | 1213 | 7992 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| GT (1000) | 84.4 | 4.7 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| kW (1000) | 506.1 | 45.5 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| *Effort* | | | | | | | | | |
| Days at sea (1000) | 2 721.4 | 75.6 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |

Sources: FAO, 2012; EC, 2011; EC, 2012; Sacchi, 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.

The Cypriot fleet obtained the highest value of landings from bogue (1.66 million Euros), followed by surmullet and parrotfish. Similarly, bogue also makes the most common species landed in terms of volume by the Cypriot fleet, although this is followed by albacore and picarels.

### 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 25). In 2006 the Gross Value Added (GVA) of the Greek fishing fleet was 591 million Euros, and the Economic profit 477.1 million Euros (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 Euros.

**Table 25. Economic statistics for the Aegean-Levantine Sea (Million Euros)**

| | **Greece** | **Cyprus** | **Egypt (Med)** | **Lebanon** | **Libya** | **Palestinian Territory** | **Israel** | **Syria** | **Turkey (Med)** |
|---|---|---|---|---|---|---|---|---|---|
| | **2008** | **2010** | **2008** | **2008** | **2008** | **2008** | **2008** | **2008** | **2008** |
| Landings value | 544 | 10.2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Gross value added | n.a. | -5.7 | 270.5 | n.a. | 104.6 | n.a. | 12.7 | 184.9 | 16.2 |
| Economic profit | n.a. | -7.12 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |

Source: EC, 2011; EC, 2012; Sacchi, 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 (<12m) which predominantly fishes in coastal areas and large-scale fleet (>12m) 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

**Table 26. Social statistics for the Aegean-Levantine Sea**

| | Greece | Cyprus | Egypt (Med) | Lebanon | Libya | Palestinian Territory | Israel | Syria | Turkey (Med) |
|---|---|---|---|---|---|---|---|---|---|
| | **2008** | **2010** | **2008** | **2008** | **2008** | **2008** | **2008** | **2008** | **2008** |
| Total employed | 23 862 | 1 421 | 18 000 | 8 500 | 7 700 | 3 300 | 1 500 | 4 000 | 19 000 |
| Full time equivalents | n.a. | 910.0 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |

Source: EC, 2011; EC, 2012; Sacchi, 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).

Total fisheries employment in Cyprus was 1421 and 910 FTEs in 2010. This suggests an increase in employment of 43% and FTEs by 10% between 2008 and 2010 (EC, 2012).

### 4.1.3 Links to environmental pressures

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).

### 4.1.4 Gap analysis

Data issues remain a major challenge to assessing the fisheries sector in the Mediterranean and Black Seas, especially for open waters. The assessment conducted here suggests that data is predominantly available for European fleets, with less information available for non-European fleets.

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.

### 4.1.5 Inventory of data sources

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

**Table 27 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 |
| Sacchi, 2011, Analysis of economic activities in the Mediterranean: Fishery and Aquaculture sectors | n.a. |

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

## 4.2 Aquaculture

Prepared by Shirra Freeman, University of Haifa, based on analysis of FAO, FishStat 2012 data and supplemented by multiple published sources

### 4.2.1 Introduction

#### General context

Marine aquaculture (mariculture) takes place in most, if not all of the countries bordering the Mediterranean and Black Seas. In a number of countries, there is a long history of artisanal cultivation, especially in brackish and saltwater lagoons in the Mediterranean. The advent of modern, commercial production began in the 1970s and is currently most developed in EU member countries with Mediterranean coasts, in particular, Spain, Greece and Turkey (finfish) and Italy (bivalves ). In countries such as Egypt, one of the region's largest producers, industrial organization of the sector is rapidly overtaking subsistence farming. International trade in the products of mariculture is complex and highly competitive and while many of the producers in countries bordering the Mediterranean and Black Seas export large proportions of their production, many of these same countries are net importers of cultured fish and seafood.

The rapid pace of mariculture development in the region outstripped governance frameworks and scientific knowledge, especially regarding environmental impacts and this led to considerable uncertainty within the industry and frequent stakeholder conflicts, especially in more congested coastal zones. This situation has been changing, especially since 2007 when a number of initiatives were taken to assess policies, develop guidelines for sustainable mariculture and to promote research.

#### Activity Description

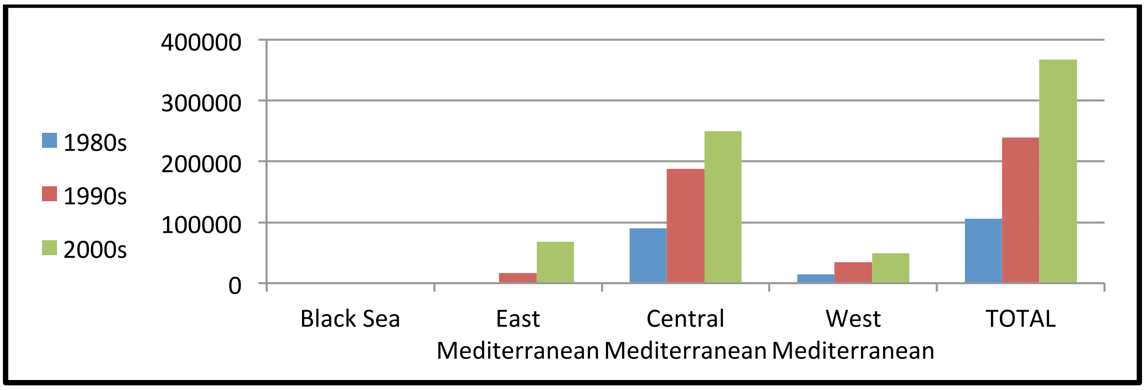
The two main types of mariculture in the Mediterranean and Black Seas are carnivorous finfish and planktivorous bivalves, mainly oysters and mussels. A smaller amount of omnivorous and detritivorous finfish are cultured as are crustaceans. Carnivorous finfish are farmed mainly in intensive net cages located within 2 km of the shore, often in relatively protected areas. Smaller quantities are grown in benthic pens or extensively in estuarine enclosures (Cardia and Lovatelli, 2007). As pressures for space have increased, more and more farms are locating offshore or in less sheltered coastal areas at depths of between 15-30 meters. The higher cost and technical sophistication of such facilities is increasing the trend toward more industrial production (Freeman and Angel, 2009). Cages with diameters of 19-22 metres are the norm for industrial level production with the exception of tuna fattening, for which cage diameters are between 50-60 metres (Barazi-Yeroulanos, 2010). Bivalves are raised on longlines, curtains or rafts which are seeded and harvested when they reach a marketable size. Hatcheries are an important segment of the industry, especially in the case of finfish and many firms are vertically integrated – including hatchery and grow-out facilities as well as processing and marketing activities. In this section, these value-added activities are not calculated as part of production quantities or values.

### 4.2.2 Sector and socioeconomic analysis

The focus is aquaculture activities taking place in or affecting the coastal and marine zones of the Mediterranean and Black Sea Basins. Production areas include coastal and offshore aquaculture as well as brackish water culture in areas closely linked to the sea. The main data source is FAO FishStat 2012, from which entries for Mediterranean and Black Sea marine and brackish water culture have been extracted. Land-based, freshwater and marine aquaculture in the Atlantic (Spain and France) and Pacific (Russia) have been excluded. For completeness, other sources (quantitative and qualitative) have been used as well.

#### Production

Long-term growth patterns in Mediterranean and Black Sea mariculture have largely followed global trends. From under 10% of global fish landings in the 1970s, aquaculture now accounts for over 50% of marketed aquatic products worldwide. Currently, in the Mediterranean area, aquaculture (freshwater, marine and brackish water) accounts for 30% of all landings (fisheries and aquaculture). Mariculture alone accounts for 20% of marine landings (fisheries and mariculture) (Malvaroso and de Young, 2010). Mariculture in the Mediterranean and Black Sea accounts for approximately 25% of all aquaculture production in countries bordering the two basins[4] and approximately 3% of global mariculture production. Figure 5 provides a decadal production summary. Overall, average[5] production has tripled since the 1980's. The proportion of production attributed to the different subregions has been fairly stable, with the central Mediterranean leading and the Black Sea having the smallest amount of production.




[4] Total production includes marine aquaculture in Mediterranean, Black Sea and Northeastern Atlantic waters as well as inland freshwater and brackish water.

[5] For the 1990s and 2000s, the averages are based on 10 years. The 1980s is reported for seven years (1984-1990). Prior to 1984 the consistency of reporting for both production and values declines and is therefore not reported here. In addition, prior to 1975, commercial aquaculture was small compared to artisanal practice.

**Figure 5 Mariculture production history (tonnes) by region per decade**
*Source: FAO FishStat 2012*

In 2010, total production of finfish and seafood in both basins was 392 080 tonnes (FAO FishStat 2012). The Mediterranean subregions together account for nearly all of the mariculture production in the two basins as Table 25 and Figure 6 show. According to the data extracted from FishStat, Turkey, Greece, Egypt, Spain and Italy are the largest four producers; however, data for the Black Sea, Spain and Egypt from FishStat may under-represent actual production. In the case of Spain, FishStat incorrectly misallocates a proportion of Spanish sea bream production to the Atlantic area. A recent GFCM (2013) report indicates that most, if not all Spanish sea bream and sea bass is farmed along the Mediterranean coast as are most of the mussels. Most of Egyptian aquaculture occurs in the Nile Delta. There is a comparatively small amount of cage aquaculture along the Mediterranean coast; however, brackish-water production in the northern part of the Delta is considerable and notwithstanding the FishStat classification as "inland", we consider it in this survey because there is considerable interaction between the marine and estuarian ecosystems in this area (S.Sadek 2013, pers.corrs). The Black Sea and southern Mediterranean countries (excepting Egypt) account for less than 1% of total production.

**Table 28 Mariculture production quantities by subregion in 2010**

| Subregion | Quantity ( tonnes) |
|---|---|
| West Mediterranean | 52 819 |
| Central Mediterranean | 244 039 |
| East Mediterranean | 94 273 |
| Black Sea | 949 |
| TOTAL | 392 080 |

*Source: FAO FishStat 2012*

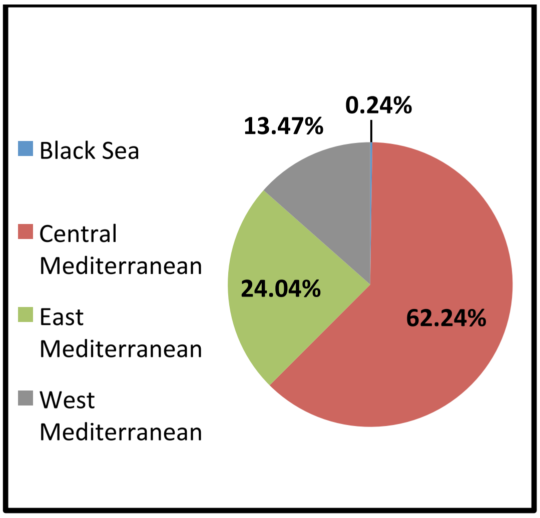



**Figure 6 Allocation of mariculture production quantities to subregions in 2010**

*Source: FAO FishStat 2012*

Historical production trends reflect a shift towards industrial-scale production from a sector previously dominated by artisanal and small-scale, largely family owned enterprises. During the 1970's, the Mediterranean mussel dominated production and was the basis of the sector's expansion until the 1980's when the cultivation of finfish and other shellfish began to grow. Finfish culture increased exponentially until 2006 when growth slowed somewhat. Currently, finfish account for about one third of total production by weight. Gilthead sea bream and European sea bass are the two species cultivated in the highest volumes throughout the Mediterranean (See Figure 7). The production growth for these species (200 000 tonnes in 20 years) is the third highest globally after Norwegian Salmon (600 000 tonnes in 20 years) and Vietnamese pangasius (1 million tonnes in 10 years) (FOESA 2011). The production of mussels, oysters and other shellfish increased linearly until the early 2000's and has been relatively stable since. Mediterranean mussels are the main cultured species, accounting for 68.8% of bivalve production in the Mediterranean, mainly in Italy, Greece, France and Spain. Italy is the largest producer in the region. Carpet shells account for 23.3% of bivalve production in the Mediterranean. The situation is similar to that of finfish with two species making up the bulk of production. Figure 8 provides an overview of production in the Mediterranean basin.

A growing area in aquaculture is hatcheries. These are seen as an additional source of investment, employment and profit as well as environmental sustainability because they reduce reliance on wild stocks for fry. Comprehensive figures on hatchery and nursery operations are not easily obtained and therefore not reported here.

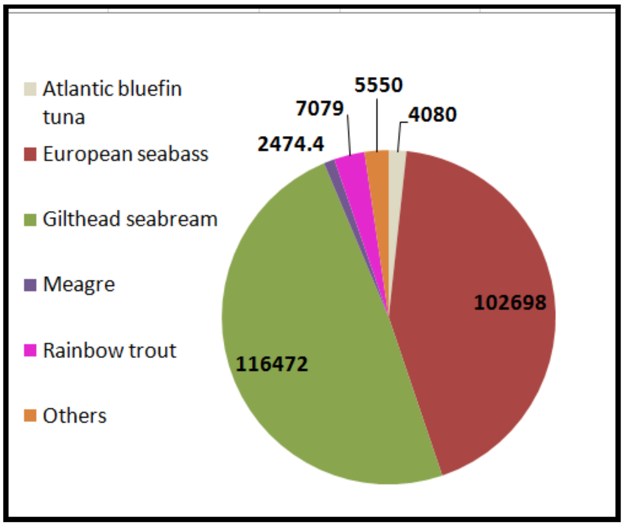



**Figure 7 Allocation of finfish mariculture by species**
Source: FAO FishStat (2012)

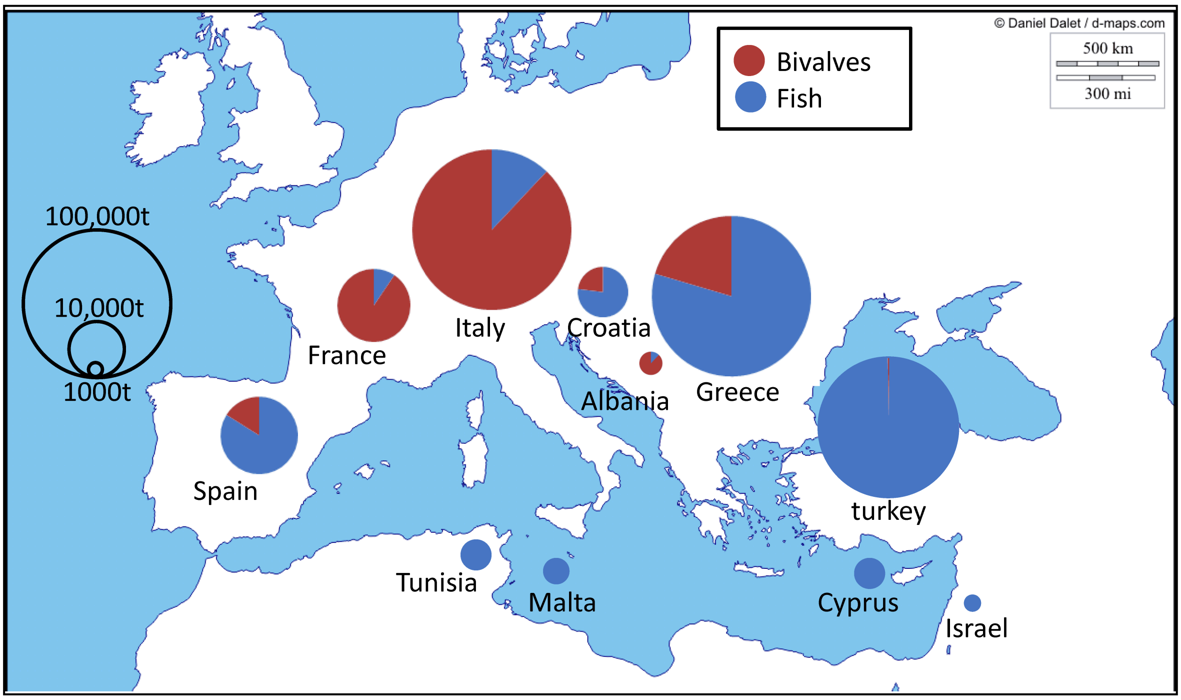



**Figure 8 Mediterranean aquaculture production by main producing countries and taxa. Circle size represents Mediterranean portion of 2010 harvest of cultured species in tonnes.**
Source: FAO FishStat (2012)

#### 4.2.2.1 Socio-economic data

The total value of mariculture production in 2010 recorded by FishStat was 1.67 billion € or approximately 4.27 €/kg (unprocessed) (See Table 26 Mariculture production values by subregion in 2010). Finfish account for about 80% of total value of marketed products. In large part this is due to the high inedible:edible ratio in bivalves. The relatively higher prices of finfish reflect the larger edible portion by weight. The averages do not reflect considerable variability across the different marketed species and sizes. For example, small sea bream and sea bass (200-400 grams) fetch prices of between 3.5 and 6 €/kg. The price for the same species weighing 800 grams or more is between 10 and 14 €/kg (French Ministry of Agriculture and Fisheries, FEAP and Aquamed quoted in Barazi-Yeroulanos, 2010). Fattened tuna are considerably more expensive, often by orders of magnitude and shellfish, whose weight includes shells generally sell for under 3 €/kg (FishStat 2012).

**Table 29 Mariculture production values by subregion in 2010**

| Subregion | Value (€ thousands[6]) |
|---|---|
| West Mediterranean | 245 798 |
| Central Mediterranean | 526 386 |
| East Mediterranean | 901 134 |
| Black Sea | 1 348 |
| TOTAL | 1 674 666 |

Source: FAO FishStat 2012

The viability of Mediterranean finfish mariculture has been especially vulnerable because of its heavy reliance on two species, sea bass and sea bream and pressure from inexpensive imported species such as pangasius (University of Stirling 2004; Barazi-Yeroulanos 2010). In 2002, worldwide oversupply accompanied by low market prices for both species caused a major crisis for Mediterranean producers. The value of harvests in this year dropped precipitously forcing closures of many smaller producers and a degree of consolidation in the sector. At the time Turkish capacity was growing rapidly and the aggregate data for production volumes do not fully reflect the impact in many countries (University of Stirling 2004).

While the need for diversification was recognized early in the 1990's (CIHEAM 1995), there has been limited success in achieving it. Notwithstanding the introduction of many new species over the years, finfish production remains dominated by sea bream and sea bass. Increased efficiency in production has offset somewhat some of the vulnerability by lowering operating costs.

The industry structure has consolidated with more firms with capacity in excess of 1 000 tonnes per year responsible for larger and larger proportions production and value. This is especially true in Turkey, Greece, Spain and Egypt (Barazi-Yeroulanos, 2010). The cost structure for production is dominated by feed and fry in the case of finfish and by fry or seed in the case of bivalve cultivation. Over the last 10 years, the development of hatcheries has become a target of investment by many companies seeking to control costs and ensure a reliable source of juveniles. The hatchery segment recently underwent a major restructuring following a crisis spurred by

[6] Currency conversion as needed : 0.77 €/US$.

oversupply in 2007-8. One fifth of Greek hatcheries and 1/3 of Italian hatcheries ceased operating and many others reduced production due to falling prices. Nevertheless, hatcheries and nurseries remain an integral part of the sector and an important source of employment, especially skilled and semi-skilled workers (Barazi-Yeroulanos, 2010).

Assessing employment generated by the mariculture industry requires consideration of direct job creation (in animal protein production) and indirect job creation (in government, R&D, hatchery, processing, distribution and marketing. In general on-farm employment is low compared to indirect employment sources and these can be considerable (FOESA 2011). In fact, the indirect aspect has been shown to rejuvenate rural coastal communities previously dependent on fisheries (CIHEAM, 1999). Direct employment in aquaculture and fisheries combined is less than 0.5% of total employment in the Mediterranean (Sacchi 2011) and it is reasonable to assume that the contribution of mariculture is small fraction of this value. Summary statistics for direct employment for all aquaculture types and for a mariculture are provided in Table 27. The presentation highlights the challenges in obtaining data specific to mariculture in the PERSEUS regions. For example, in Spain, most aquaculture is marine based; however, there is large production in both the Atlantic and Mediterranean. It is probably reasonable assume that total employment in Mediterranean mariculture is in the range of 3 000 full time job equivalents. In France, with two marine areas and both freshwater and marine culture, the partition is more difficult. In Italy, where there is both aquaculture and mariculture, 1 521 full time job equivalents is probably an accurate reflection of employment in mariculture. On basin and subregional levels, the proportion of employment attributable to mariculture will vary according to the relative distribution of aquaculture types in each country. A very rough approximation for the Mediterranean would be 25% of 123 000 or 30 000.

In the case of indirect employment in processing activities in Table 27 Farms and total number of permanent job equivalents in the Mediterranean aquaculture Table 27 are for the entire aquaculture sector and demonstrate that off-farm sources of employment related to aquaculture generally exceed direct job creation.

**Table 30 Farms and total number of permanent job equivalents in the Mediterranean aquaculture**

| COUNTRY | Number of Farms | Total number of full-time job equivalents | | | Year |
|---|---|---|---|---|---|
| | | Aquaculture all types | Mariculture | Processing | |
| **Albania** | *50* | 2 500 | 225 | n/a | 2009 |
| **Algeria** | 10 | 100 | n/a | n/a | 2006 |
| **Cyprus** | 20 | 260 | 243 | 43 | 2009 |
| **Croatia** | 335 | 1 670 | n/a | n/a | 2010 |
| **Egypt** | 6 000 | 68 000 | n/a | n/a | 2009 |
| **Spain MED** | 200 | (Med Only) 3 060 | (All Spain) 6 231 | 19 430 | 2008-9 |
| **France MED** | 620 | 1 660 | (All France) 3 690 | 14 983 | 2008-9 |
| **Greece** | 1 500 | 9 880 | 5 947 | 1 193 | 2008-9 |

| COUNTRY | Number of Farms | Total number of full-time job equivalents | | | Year |
|---|---|---|---|---|---|
| | | Aquaculture all types | Mariculture | Processing | |
| **Israel** | 60 | 600 | n/a | n/a | 2006 |
| **Italy** | 907 | 7 770 | 1 521 | 5 343 | 2006 |
| **Lebanon** | 200 | 800 | n/a | n/a | 2005 |
| **Libya** | 10 | 140 | n/a | n/a | 2006 |
| **Malta** | 9 | 964 | 145 | n/a | 2009 |
| **Morocco MED** | 2 | 40 | n/a | n/a | 2005 |
| **Montenegro** | 42 | 170 | n/a | n/a | 2009 |
| **Slovenia** | 277 | 230 | 32 | n/a | 2009 |
| **Syria** | 2 060 | 12 000 | n/a | n/a | 2006 |
| **Tunisia** | 54 | 1 000 | n/a | n/a | 2006 |
| **Turkey** | 356 | 12 000 | n/a | n/a | 2010 |
| **TOTAL (rounded values)** | 12 700 | 123 000 | | | |

Sources: *For all aquaculture*: Sacchi 2011 and references quoted therein; *For mariculture and processing*: European Commission 2012)

The value added of aquaculture to GDP is a fraction of the <1% contribution for all types of aquaculture; however, the contribution varies by country. Table 28 provides a breakdown of gross value added of marine finfish and shellfish culture in absolute terms and as a percentage of gross value added in the agricultural sector for selected countries in which such information is available. Countries with the highest value added are Malta, Cyprus and Greece.

**Table 31 Gross value added from mariculture in selected countries**

| Country | Gross Value Added (in € million) | | Ratio with agriculture (%) | |
|---|---|---|---|---|
| | Marine | Shellfish | Marine | Shellfish |
| Bulgaria | -- | 0.3 | -- | 0.018 |
| Cyprus | 4.7 | -- | 1.287 | -- |
| France* | 9.9 | 284.4 | 0.033 | 0.828 |
| Greece | 81.2 | 5.5 | 1.226 | 0.082 |
| Italy | 21.4 | 70.1 | 0.081 | 0.266 |
| Malta | 5.6 | -- | 5.408 | -- |
| Romania | -- | -- | -- | -- |

| Country | Gross Value Added (in € million) | | Ratio with agriculture (%) | |
|---|---|---|---|---|
| | Marine | Shellfish | Marine | Shellfish |
| Slovenia | -- | -- | -- | -- |
| Spain* | 62.2 | 67.8 | 0.239 | 0.260 |

Source: Hoffherr et al. 2010

*May include Atlantic production

Another consideration is the contribution to the export sector and this is especially high in Greece, Turkey and Cyprus.

### Geographical Distribution

Marine and brackish water aquaculture takes place in virtually every country in the two basins. Countries with long coastlines, a high proportion of protected bays and large estuarian ecosystems tend to have a long history of artisanal practice and many of these countries, such as Italy were early leaders in the development of large-scale production.

Currently, with the exception of Egypt, culture in marine areas is the source of highest value (See

Figure 9). In Egypt, production in the northern part of the Nile Delta considered here is larger than marine production. The largest finfish producers are Egypt (mullet and meagre), Turkey, Greece and Spain (sea bass and sea bream) while Italy and France are the largest shellfish producers (See Figure 8).

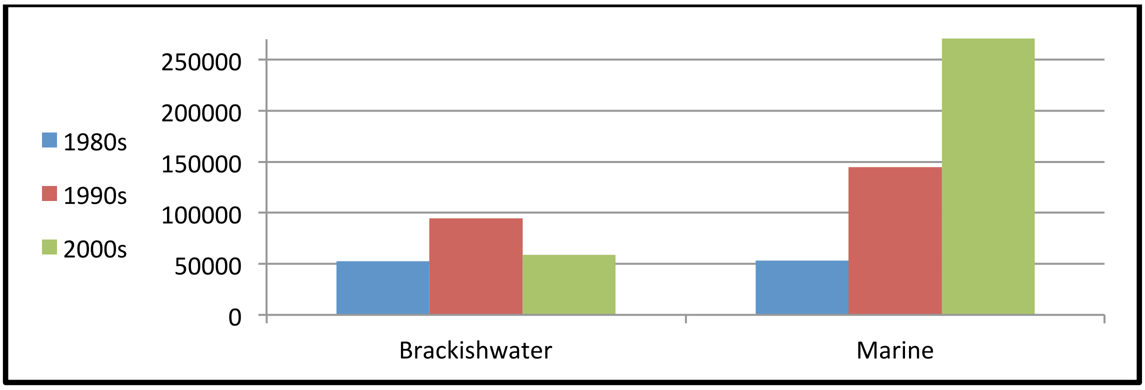



Figure 9 Value history by ecosytem type (in € thousands)

Although most cage aquaculture still takes place in sheltered areas, competition for space, changes in regulation and technological advances have led to increasing numbers of cage farms in deepwater, offshore sites.

## Future trends

Aquaculture remains a sector viewed as having high development potential in the Mediterranean and Black Sea regions. In general, the global demand for fish and seafood is expected to continue to rise and this is the key to future success of mariculture.. For many countries, the development of aquaculture is also regarded strategically as a important element for domestic food security and export earnings. Egypt and Tunisia are two cases in which government policy has specifically targeted development of the sector to meet these two objectives (Sadek, 2012; Barazo-Yeroulanos, 2010).

The sector is currently undergoing a restructuring and according to Barazi-Yeroulanos (2010) and must also go through a further maturation process. Key aspects needed to ensure the sector's future include:

At the enterprise level:

- Improved access to financing. The global financial crisis since 2008-9 and price crisis of 2007-9 severely constrained development in many places.
- Better matching of production to market demand with reference to quantities, market pricing, species and size as well as strategic financing and risk management practices.
- Investment in systems to better control production costs, improve information flow and on production variables such as biomass accumulation and feed conversion. The overall objective is to encourage companies to understand their cost structure and become better positioned to plan their production in anticipation of and in response to changing market conditions. These provisions will include information gathering systems and analysis of market conditions (e.g.: customer buying trends, niche markets).

At the regional sectoral level:

- Collective efforts in marketing and the development of value-added products.
- Promotion of diversity in production, in particular in finfish.
- Consideration of regional strategies to promote markets for products of the Mediterranean and Black Sea areas.

At the governance level:

- simplification existing laws and regulations, in particular those dealing with site licensing.
- unifying the role of various local authorities, departments and ministries to reduce overlap and fragmentation and increase efficiencies in compliance and reporting by firms and oversight by authorities.
- incentivising data gathering, communication and marketing at the company and collective levels.

For countries with relatively young or small industries, a key to development is the ensuring a strong domestic market, especially if access to European and global markets is limited in the near term. This will be especially important for countries of the southern Mediterranean (except Egypt and Tunisia which are more well-established) and the Black Sea which are producing well below their potential. If fish consumption per capita is low (<5kg/year), the challenge may be considerable.

This strategic consideration is most relevant for Romania, Bulgaria, Syria, Lebanon and Libya (Hofherr et al. 2012; Barazi-Yeroulanos 2010).

### 4.2.3 Sector and socio-economic analysis by subregions

The main references for this section come from: FAO-NASO, Sacchi 2011, GFMC 2013 and FEAP 2013.

#### Western Mediterranean Sea

This subregion includes the coasts and estuaries of Spain, France, Morocco, Malta, and Algeria. Spain is the largest producer in this subregion and among the top five in both basins. Spanish marine aquaculture has grown steadily over the past ten years despite fluctuations. By weight, the Mediterranean mussel accounts for 80% of total Spanish marine production. Sea bream and Sea Bass are the two main finfish products accounting for about 75% of finfish output. Cage aquaculture is conducted mainly along the coast but a number of deepwater installations exist. Other species include: turbot, mullet, meagre, sole, blackspot seabream, pollak, eel, octoput, clams, shrimps and cockles. France and Malta also have strong, relatively mature mariculture sectors, the former focused on shellfish and the latter in finfish. Both countries export a large proportion of production. Morocco and Algeria have small mariculture sectors that are considered as having strong potential for development. Both produce in lagoons as well as coastal cages (up to 20-30 m depth). The main intensive cage production is in Aqua M'diq is on the Bay of M'diq and employs 40 people. Gilthead seabream, European seabass, meagre are the main farmed species. Others include Atlantic bluefin tuna (fattening), cupped oyster (Portugese, Gasar and Pacific), flat European oyster, grooved carpet shell, and Kuruma prawn . Hatcheries and nurseries for finfish and bivalve sprat spawning have been developed in all countries in the subregion.

#### Central Mediterranean

This subregion consists of Italy, Slovenia, Croatia, Bosnia Herzegovina, Montenegro, Albania, Greece and Tunisia. The two largest producers in this region are Italy and Greece.

Greece produces mainly Gilthead seabream (57%) and European Seabass (38%) with smaller amounts of common seabream, sharpnout seabream, white seabream, red porgy and common dentex, common pandora, and Atlantic bluefin tuna (fattening). Production is mainly intensive and the proportion of farms with capacity greater than 300 tonnes per year is high. Extensive culture is still carried out in some areas, especially, brackish water lagoon polyculture. About 3% of total value comes from bivalve culture. Over 80% of Greek mariculture is exported, mainly to Spain and Italy and fish is the country's second largest export after olive oil.

Approximately 600 farms are scattered throughout the Italian territory, mainly in the southern regions of the Adriatic Sea. Bivalve culture is responsible for most of Italian marine production with three dominant species (Mediterranean mussel, Japanese and grooved carpet shells). The main finfish species are sea bass and European sea bream and the key to growth in the culture of these species is improved seed production techniques and the application of advanced farming technologies including offshore aquaculture. Fourteen other marine fish species and 11 shellfish species are also cultured. Northern bluefin tuna, fattened in coastal cages has been actively pursued since 2003. Brackish water lagoon polyculture remains common as well. The Italian hatchery is one of the best developed in Europe and is split between the larval and weaning specialities. Production is in high densities (30-150 per litre) and supplies local and export markets.

Tunisia is the second largest of the southern Mediterranean producers after Egypt. The main production zone is in the Governorate of Sousse, in the northeast of the country, producing in the range of 1 000 tonnes of European seabream. A second marine aquaculture production zone is in the southwest (Gouvernorate of Médenine) where an average of 150 tonnes of European seabass and gilthead seabream are produced. Most shellfish production (Mediterranean mussel, Pacific cupped oyster) comes from northern Tunisia, mainly from the Governorate of Bizerte. Production is variable a ten-year average of 100 tonnes per annum.

The remaining countries in this subregion have smaller industries at various levels of development and all are considered as having potential for expansion. In Albania, farming takes place along both the Adriatic and Ionian coasts and the primary constraint on the development of finfish mariculture has been the cost of imported larvae and fingerlings. Bosnia and Herzegovina produce small amounts of sea bream and sea bass (about 150 tonnes per annum) in 2 cage farms. Croatia's production is dominated by sea bass, sea bream and Atlantic bluefish tuna (fattening). The sector has 30 companies farming in 47 locations, 63 farms and three registered hatcheries. Most focus on sea bream and bass but five companies with ten facilities are involved in tuna fattening totalling 3-4 000 tonnes per annum all of which is exported to Japan. An additional 60 tonnes of oysters and 3-4 000 tonnes of mussels are produced mostly in small (<200 tonnes per year), traditional farms. All production, except for tuna is for the domestic market and the main constraint to expanding exports is the high ratio of operating cost to market price.

### Eastern Mediterranean Sea

This subregion consists of Turkey, Cyprus, Syria, Lebanon, Israel, Egypt and Libya. Egypt and Turkey are the two largest producers in the subregion and the Mediterranean as a whole. Aquaculture accounts for 65% of fish produced in Egypt. Marine cage culture of sea bream and sea bass is a tiny proportion; however, large production in the northern reaches of the Nile Delta are also relevant for PERSEUS since this area has substantial interaction with the sea. Most of the culture in the Nile Delta is in semi-intensive earthen ponds (1.5-2.5 tonnes per ha). Increasingly, semi-intensive systems are being replaced by more technically sophisticated intensive ones (14-25 tonnes per ha) as part of a government strategy targeting aquaculture as an important food production sector. The main species are mullet (30%), tilapia

(55%) and carp (11%) as well as meagre. Egyptian production is labour intensive. Employment figures vary between 37 000 and 68 000 full time equivalents. A further 25 000 are employed in indirect activities and 1 000 government employees are involved in aquaculture related activities.

Turkish mariculture is dominated by finfish production and Turkey is the largest producer of trout, sea bream and sea bass in the region. Ninety five percent of total bass and bream farms are located in the Aegean region which is also responsible for 47 percent of total Turkish production. The Mugla region provides 39 percent of the total production and is is also a major trout growing region. Shellfish culture is in the range of 90 tonnes/year, mostly mussels. Tuna fattening is a growth area with 100% of production for export. Eighty percent of sea bass and sea bream produced is exported to Italy, Spain, France and Germany. Approximately, half of the farms have an annual capacity of less than 10 tonnes with the remainder producing 10-50 tonnes. Approximately 80% of farms are family-owned. Over 50 percent are vertically integrated with hatcheries. Support services (feed plants, equipment providers/distributors and consultants) is a large sector in Turkey and includes 15 fish feed manufacturers that produce over 40 000 tonnes annually.

Since 2006, regulatory changes have required many marine farms to relocate to more exposed areas or secondary bays and thus, types and sizes of the cage systems used are changing. The shift to open water aquaculture has also biased the size of the enterprise towards larger companies that can afford the more technically sophisticated needs of open water farming.

Cyprus is the third major producer in this subregion and mariculture makes a larger contribution to GDP than in most countries, accounting for approximately 80% of all fish harvests by weight and 78% by value, and 0.25% of GDP. It supplies both domestic and export markets. Most of Cyprus' approximately 4 700 tonne aquaculture production is along the southern coast in intensive marine sea cages located at a distance of 1-3 kilometres from shore at water depths ranging from 20-75 meters. The major species cultured are gilthead seabream (approximately 67%, 3 100 tonnes) and European seabass (approximately 32%, 1 500 tonnes). Smaller amounts of meagre, marbled spinefoot, common Pandora, Japanese and sharpsnout seabream and the Indian white prawn are also produced. In 2011, there were nine marine open sea cage farms licensed and operating. Three marine hatcheries (seabream and seabass) produce about 23 million fry annually for the local market.

The total direct employment in the Cypriot aquaculture sector in 2011 was 260 full time equivalents. It is estimated that the aquaculture sector also provides indirect employment for 1 000 people in ancillary professions such as boat building, technical maintenance and importing fishing gear and equipment, processing and packaging as well as traditional marketing and retailing networks that are responsible for 61% of domestic sales.

Of the remaining four countries in the region, Syria has no mariculture to speak of, Lebanon has one small shrimp farming firm, though there are plans for establishing pilot production of marine species. In Libya, about 250-300 tonnes of sea bass and sea bream are produced annually. The main constraints to marine aquaculture are the limited availability of suitable sites along the coast and very small local demand for fish and seafood. Israeli aquaculture is focused on sea bass and sea bream in several farms. Production is intensive and the main constraint to expansion is the lack of appropriate sites.

Black Sea

The countries in this subregion are Romania, Bulgaria, Turkey, Georgia, Russia, and Ukraine. With the exception of Turkey, production in each is small and accurate statistics are sparse. Twenty-four percent of Turkish finfish production takes place in the Sea of Marmara. Marine aquaculture in Romania is limited to molluscs and four coastal areas have been approved for culture. In the Ukraine, attempts have been made to develop mariculture of mussels, oysters, seaweed and other species; however, a limiting factor is the lack of deep bays which do not freeze.

### 4.2.4 Environmental Impacts

The major direct environmental impacts of aquaculture on the environment are related to the effect of fish waste, uneaten food and chemicals (eg: anti-foulants, pharmaceuticals and other treatments) on the water column and benthos. There are also concerns related to indirect effects, in particular on wild fish stocks and biodiversity. These include the potential genetic contamination of native stocks from escapes of non-native species, pathogen spread and in the case of carnivorous finfish, the contribution to overfishing caused by the heavy reliance on fishmeal and fish oils in manufactured fishfeed. In this regard, the increase (absolute and proportional) in the culture of higher trophic species in the Mediterranean has been cited as problematic. (Pullin et al. 2012) Two other issues related to biodiversity are the reliance on wildstocks for certain species of juveniles, in particular Atlantic Bluefin Tuna and grouper and the effect of fish cages as fish attracting devices.

In the case of direct impacts, fish cage effluent is regulated within EU member states under several directives. In non-EU member states comprehensive regulation is lacking. Comprehensive reporting on the costs of compliance (eg: environmental monitoring, fines, etc.) for the two basins is not available. Mitigation of the indirect impacts of fish escapes and pathogen transfer are often as much in the interest of the farmer as the environment; however, the associated costs are difficult to isolate from the costs of standard management practice.

Most marine aquaculture takes place in proximity to other users of the coastal zone and so alternate measures of degradation would include costs to other users. These include the costs of water and benthic impacts attributable to aquaculture measured in terms of clean-up expenditures and/or lost benefits to other users. Again we were unable to find comprehensive basin wide measures. Other measures could include the cost of non-compliance (eg: fines and other penalties) to the farmers and the cost of licensing and permitting as a proxy.

Its reliance on the natural environment makes aquaculture sensitive to degradation and competition for space. The main direct effect of degradation of concern to fish farmers is the impact on harvests (i.e. crop losses and quality). Data on these variables is difficult to obtain. Competition for space is also a challenge and numerous cases of stakeholder conflicts have been observed. The findings from the spatial analysis of existing sites show that the problem of lack of space, often indicated as hindering factor for aquaculture development, seems to be overrated and should be rather reformulated in the need for identifying through integrated marine spatial planning the most suitable sites. This is particularly important for a relatively small and new sector like aquaculture which struggles in competing with larger and more established economic activities in the coastal areas (Hofherr et al. 2012).

#### 4.2.5 Gap Analysis

The major gaps for the mariculture sector stem from inconsistencies in reporting on production, value and environmental monitoring. FAO FishStat is the most comprehensive source; however, there are several cases of mis- or under-reporting. Spain is particularly problematic since a large portion of sea bream and sea bass production appears to have been mis-allocated to the Atlantic region. Reporting for the Black Sea subregion probably underestimates production (GFCM 2013). For the purposes of PERSEUS, there is an additional challenge since all brackish water aquaculture is classified as inland by FAO FishStat, when in fact, activity in many lagoons and estuaries is relevant for the research.

It was possible to partially resolve some of these gaps. First, both brackish water and marine aquaculture data were extracted from the FishStat data base. In the case of Spain and Egypt, secondary sources were also used. Further efforts are needed to resolve data issues for the Black Sea. This will include consulting on a country-by-country basis with relevant sources as well as with organizations such as the Federation of European Aquaculture Producers (FEAP) and professional organizations at the subregion level.

Environmental monitoring over the two regions is variable. Differences arise due to inconsistent quality of monitoring and reporting. In addition, there are different reporting requirement for EU member states and others. These issues may be partially resolvable with further investigation at the country level; however a larger issue, that quantifying the environmental impacts associated with aquaculture will be more difficult to resolve as will differentiating those impact that can be attributed to aquaculture and those that should be attributed to other causes. Currently, the most feasible approach to dealing with impacts is to use a number of guides for achieving sustainable mariculture that include performance indicators.

#### 4.2.6 Inventory of data sources

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

**Table 32 Overview of main data sources**

| Name | Link |
|---|---|
| FAO Stat, 2012 | http://www.fao.org/fishery/statistics/gfcm-capture-production/en |
| Federation of European Aquaculture Producers (FEAP) | http://www.feap.info/default.asp?SHORTCUT=573 |
| French Ministry of Agriculture (MAAPA) | http://agriculture.gouv.fr/ |

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

## 4.3 Maritime transport & ports, Cruises

Prepared by:

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### 4.3.1 Introduction

This introduction presents the content of this chapter, the data sources, and an overview of the sector.

#### Content

This chapter aims at analysing the socio-economic impact of the maritime transport and ports of the Mediterranean and Black Seas and identifying and describing the pressures caused on the environment by these activities.

This first section introduces the report, its structure and the data gathering process. Section two presents the importance of the shipping industry and ports and provides information and data on several indicators related specifically to the maritime transport and ports, namely the gross weight of goods handled in ports, the number of passengers embarked and disembarked, the number of vessels' calls, the turnover of the main Mediterranean and Black Sea ports and the employment generated by the maritime sector. The results in this section are presented according to the four regions identified in PERSEUS. Section three analyses the main pressures on the marine ecosystems and terrestrial habitats derived from ports and ships' activities. Section four presents a case study on the small and medium ports of the Catalan coast. Finally, section five examines and discusses the limitations and weaknesses found doing this study in term of gap analysis in data and knowledge and some conclusions are drawn.

#### Data

Most of the data presented in this report have been obtained from the Eurostat (Eurostat, 2012c), the body responsible to provide statistical information about the European Union (EU) and to promote the harmonisation of statistical methods across its member states. This means that it has not been possible to include data in this report from ports that do not belong to the EU, such as Western Asian and North African countries.

### Overview of the sector

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).

Major commodities transported by the maritime transport are classified into the following categories:

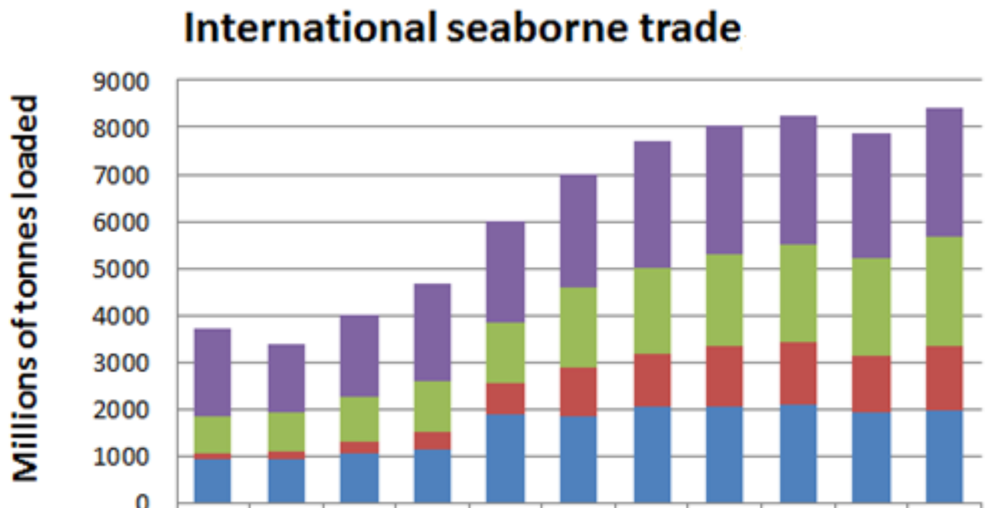
- **General cargo** includes a mix of cargoes and packaged items, such as forest products, heavy equipment, manufactured goods, machinery, furniture, steel, and food products, among others, that are handled in any other method different than containers, such as boxes, barrels, packages, and pallets.
- **Freight containers** are a reusable transport and storage unit for moving products and raw materials between locations or countries. There are approximately seventeen million intermodal containers in the world; a large proportion of the world's long-distance freight generated by international trade is transported in shipping containers. Its capacity is measured in twenty-foot equivalent unit (TEUs).
- **Liquid bulk traffic** is the transport of liquid and gaseous products in bulk by tankers. Liquids may be categorised as non-edible and dangerous such as chemicals, crude oil and petroleum products; and edibles and non-dangerous liquids such as cooking oil, fruit juices, milk, and wine.
- **Dry bulk cargo** is simply cargo that is transported unpacked in large quantities (British Shipping, 2012), including raw materials and manufactured products. The United Nations Conference on Trade and Development (UNCTAD) (United Nations, 2011) considers that the major dry bulk substances are iron ore, grain, coal, phosphates, and bauxite. However, this category also covers many other commodities, namely bulk minerals (e.g. sand & gravel), chemicals (e.g. fertilizer), dry edibles (e.g. flour or sugar), ferrous & non-ferrous metal ores, cement, gypsum, forest products and wood chips.
- **Ro-ro** stands for 'Roll-on/Roll-off' and it focuses on the transport of wheeled equipment for carrying cargo, such as automobiles, trucks, trailers or semi-trailers. Vehicles are driven on and off the ship on their own wheels, which allow the cargo to be efficiently 'rolled on' and 'rolled off'. Although ferries usually perform short journeys for a mix of passengers, cars and commercial vehicles, the term ro-ro is generally reserved for larger ocean-going vessels.
- **Cruise** passengers make sea journeys on cruise ships. A cruise ship is intended to provide passengers with a full tourist experience, calling at ports of cities with tourist attractions. Modern cruise ships are fully equipped with facilities for entertainment aboard such as theatres, cinemas, luxury dining halls, shopping malls and leisure facilities including swimming pools, gyms and even climbing walls (British Shipping, 2012). Ferries carry passengers, cargo and vehicles, operating usually on a regular return service.

### 4.3.2 Sector and socioeconomic analysis

This section presents facts and figures on the performance of the port sector and the maritime industry, classified into three levels: worldwide, European Union, and Mediterranean and Black Sea. Simultaneously, the Mediterranean and Black Sea are divided into four sub-regions according to PERSEUS project: West, Central and East Mediterranean and Black Sea. These data provide the reader with information on the current status of the sector and its trends year over year.

## Worldwide

According to the United Nations Conference on Trade and Development (UNCTAD) (United Nations, 2011), due to the global financial crisis of late 2008, the year 2009 recorded the largest drop in the global seaborne trade since the 1930s, falling by nearly 5%. In 2009, international total goods loaded amounted to 7.8 billion tonnes, below the 8.2 billion tonnes recorded in 2008. In 2010, international shipping experienced a growth reaching an estimated 8.4 billion tonnes of goods loaded (see Figure 10).




| | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude oil and products | 1871 | 1459 | 1755 | 2049 | 2163 | 2422 | 2698 | 2747 | 2742 | 2642 | 2752 |
| Five major bulks | 796 | 857 | 968 | 1082 | 1288 | 1701 | 1836 | 1957 | 2059 | 2094 | 2333 |
| Container | 102 | 160 | 246 | 389 | 628 | 1020 | 1134 | 1264 | 1319 | 1201 | 1347 |
| Other Dry | 935 | 918 | 1039 | 1131 | 1905 | 1852 | 2032 | 2066 | 2109 | 1921 | 1976 |

**Figure 10: International seaborne trade, selected years. Source: Adapted from United Nations, 2011**

As shown, this increase was particularly significant in the loading of dry bulks (with an increase of 11.4%) and containers (12.1%). The trade of crude oil and products (representing the main liquid bulk components) accounted for about one third of the total tonnage loaded internationally in 2010. The five major bulks, namely iron ore, grain, coal, phosphates, and bauxite, were reported as the second type of cargo mostly traded with a share of 28% (United Nations, 2011).

## European Union

The indicators on the maritime transport and ports activity in the European level are discussed under three major groups, namely gross weight of goods handled, passenger traffic and vessel traffic.

According to the European Commission Statistics (Eurostat, 2012a), in 2010, the total weight of goods handled in ports of the 22 European Union maritime Member States was estimated at 3.6 billion tonnes, a rise of 5.7% compared with 2009 (see Figure 11). Although the overall port activity is still under the data recorded in 2007 and 2008, this demonstrates the progressive recovery of the European economy after the downturn experimented in 2009. In 2010, activity grew in most European countries, particularly in Poland (+32%), Estonia (+19.5%), Finland (+17.3%), Belgium (+12.2%), the Netherlands (+11.5%), Sweden (+11%) and Lithuania (+10.3). Only four countries documented negative trends of their port activity, namely Greece (-8.2%), Denmark (-3.9 %), Latvia (-2.3 %) and France (-0.6 %).

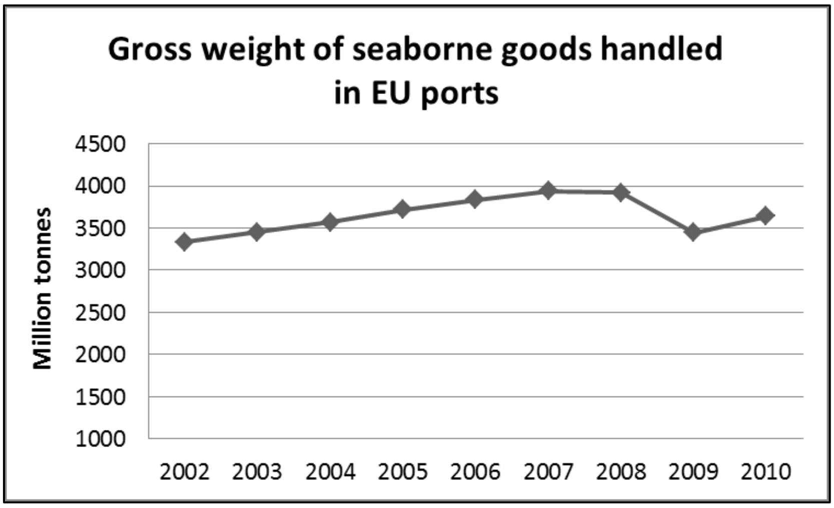



**Figure 11: Gross weight of seaborne goods handled in EU ports (in million tonnes). Source: Eurostat, 2012a.**

Three ports located on the North Sea coast, Rotterdam (the Netherlands), Antwerp (Belgium) and Hamburg (Germany), maintained their positions as the three largest EU ports in terms of both the gross weight of goods and the volume of containers handled. By countries, the Netherlands, with 539 million tonnes, emerged as the largest maritime freight transport country, handling almost a 15 % of the total tonnage handled in EU ports in 2010. It was followed by British ports with 14.1 % and Italian ports with 13.6 % (Eurostat, 2012a).

By type of goods, liquid bulk (which include petroleum products) accounted in 2010 for 41% of the total cargo handled, followed by dry bulk (23%) and containers (19%). Dutch ports handled the largest amount of liquid bulk in Europe (265 million tonnes) and Spain handled the largest volume of containers with 112 million tonnes (Eurostat, 2012a).

The number of passengers passing through EU ports in 2010 was estimated at 396 million people (including inwards movements plus outwards movements), decreasing a 2% compared to 2009, and falling year-by-year the total number of passengers since 2007 (see Figure 12).

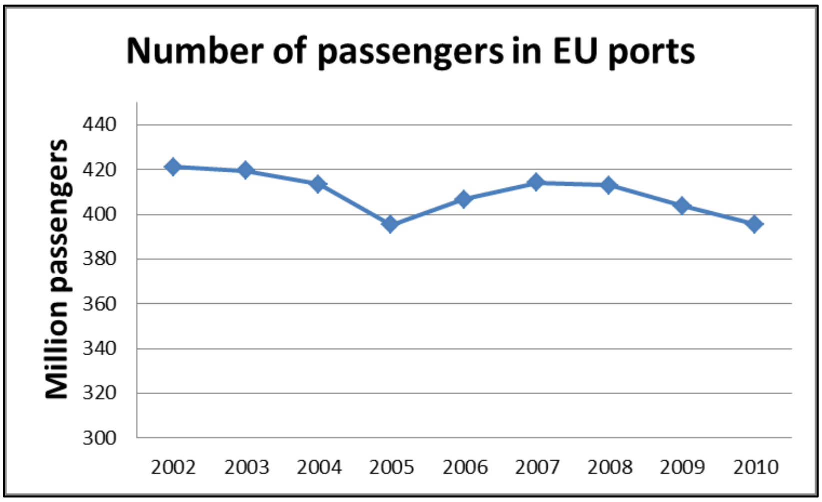



**Figure 12: Number of passengers embarked and disembarked in EU ports. Source: Eurostat, 2012a**

This continued drop may be explained with the rapid growth of low cost flights, the construction of new bridge connections and the resulting reduction in ferry lines. Italy (22%), Greece (21%) and Denmark (11%) are the three leading sea passenger transport countries in Europe. The Port of Dover (United Kingdom) remained as the largest passenger port in Europe, with more than 13 million passengers embarking and disembarking in 2010 despite the competition from the Channel Tunnel.

The European Commission Statistics (Eurostat, 2012a), also specifies that the number of vessels calling at European ports has increased by 4.4% in 2010, compared to 2009 levels. Italy became the country that recorded both the highest number of port calls and the largest gross tonnage of vessels, followed by Greece and Denmark in terms of highest number of port calls and United Kingdom and Spain in terms of gross tonnage of vessels. Concerning the type of vessels, the highest number of calls was made by vessels of general cargo followed by passenger vessels, liquid bulk vessels and container vessels.

### Mediterranean and Black Sea

Figure 13 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.

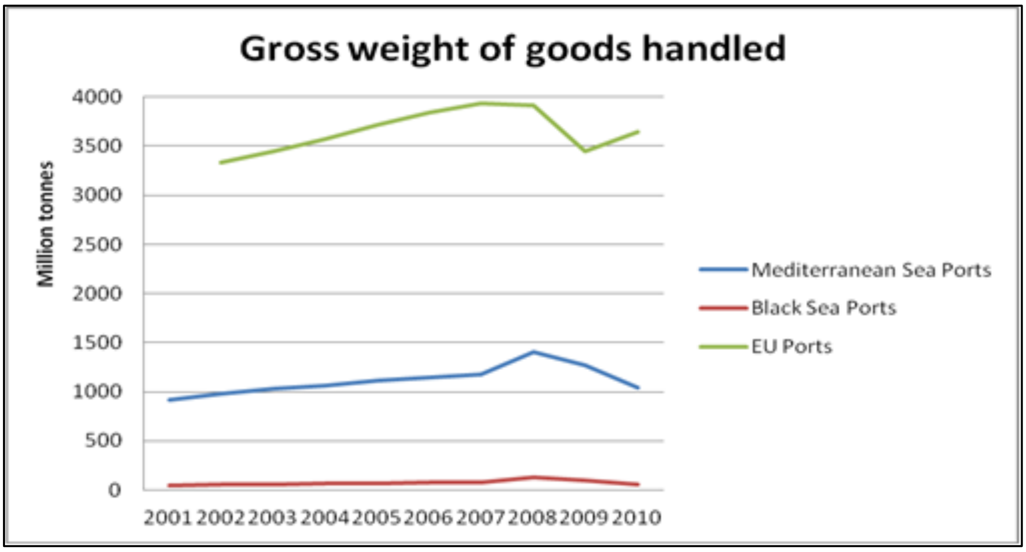



**Figure 13: Gross weight of goods handled in Mediterranean, Black Sea and EU ports from 2001 to 2010. Source: Eurostat, 2012b.**

According to the Figure 13, 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 Figure 13), 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.

In the PERSEUS project, it was agreed to divide the Mediterranean Sea in three regions for a deeper study. Therefore, the results are presented accordingly: West, Central and East Mediterranean and the Black Sea. In each sub-region the traffic statistics are presented in terms of gross weight, liquid bulk, dry bulk, containers, ro/ro, general cargo, passengers and number of vessels.

### West Mediterranean

The West Mediterranean sub-region comprises of the coastal Member States of Spain and France and the non-EU members of Monaco, Tunisia, Algeria, and Morocco. The statistics of this region for EU ports are provided in Table 33.

**Table 33: 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 given in Table 33 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.

### Central Mediterranean

The Central Mediterranean includes Italy, Slovenia and Malta and the non-EU countries of Croatia, Bosnia- Herzegovina, Montenegro, and Albania, and the North African countries of Egypt, Libya, and Tunisia. Table 34 provides the performance of this area for EU countries:

**Table 34: Traffic statistics of the Central Mediterranean sub-region (Italy, Slovenia and Malta)**

| Central Med | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gross weight | 473006 | 490837 | 513351 | 527596 | 553055 | 567443 | 588531 | 577497 | 512119 | 539015 |
| Liquid bulk | 203586 | 203303 | 207542 | 202005 | 217922 | 217254 | 219072 | 214067 | 190021 | 198152 |
| Dry bulk | 88196 | 85150 | 91757 | 96268 | 109653 | 114009 | 113039 | 115568 | 112424 | 77489 |
| Containers | 6378 | 7267 | 8121 | 8226 | 8175 | 8266 | 9103 | 8604 | 7811 | 9199 |
| Ro-ro | 23699 | 27149 | 31019 | 32745 | 33337 | 34336 | 42616 | 38999 | 30893 | 53630 |
| General cargo | 20407 | 24376 | 26880 | 26371 | 27221 | 30732 | 32158 | 41681 | 22411 | 32698 |
| Passengers | 16867 | 25241 | 26472 | 28811 | 29320 | 30419 | 32464 | 34226 | 33892 | 33226 |
| Vessels | 527578 | 511204 | 519089 | 524985 | 630388 | 677691 | 659527 | 683686 | 681949 | 738997 |

*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, Malta 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 539 million tonnes of gross weight.

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 Malta is the only one maritime country in the Mediterranean that has not seen its port operations decrease as a result of the global economic crisis. On the contrary, it increased by 0.1% (Eurostat, 2012e). The third 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%), both included in this sub-region.

Concerning the ro-ro traffic, in these countries there has been an overall increase of 126.3% since 2001, from 23 to 53 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).

### East Mediterranean

The East Mediterranean sub-region only includes two EU coastal countries: Greece and Cyprus. The other countries included in this geographical area are Turkey, Syria, Lebanon, Israel, and Palestinian territories. However, the statistics displayed in Table 35 are only for the EU countries of the East Mediterranean:

**Table 35 Traffic statistics of the East Mediterranean sub-region (Greece and Cyprus)**

| East Med | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gross weight | 122171 | 154912 | 169792 | 164729 | 158555 | 167101 | 171816 | 160460 | 142238 | 131341 |
| Liquid bulk | 34634 | 40373 | 39613 | 39075 | 39504 | 43370 | 43309 | 48688 | 46740 | 44592 |
| Dry bulk | 24591 | 26054 | 28868 | 29786 | 30341 | 29229 | 30174 | 28416 | 23897 | 22584 |
| Containers | 1395 | 1907 | 2162 | 2192 | 2093 | 2121 | 1713 | 1247 | 1355 | 1465 |
| Ro-ro | 7078 | 12984 | 23379 | 19278 | 16270 | 17054 | 18341 | 17674 | 16126 | 11323 |
| General cargo | 6874 | 7253 | 6253 | 6256 | 6393 | 6158 | 6204 | 6135 | 4752 | 4596 |
| Passengers | 50149 | 101549 | 103047 | 96991 | 86262 | 90630 | 92597 | 91251 | 88447 | 84100 |
| Vessels | 194362 | 336584 | 374689 | 465799 | 475063 | 498396 | 522609 | 492924 | 482644 | 491841 |

*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).

The gross weight of goods entering the Mediterranean ports is greater than the gross weight of goods exiting them, since there are a percentage of imports of 66% (Eurostat, 2012e). Cyprus, located in the East Mediterranean, is the country with higher imports, with 87% of its products being brought in. This makes sense because it is a small and an island country.

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 although Cyprus faced the largest drop in the number of vessels (from 4,691 vessels reported in 2002 to 2,741 reported in 2010) (Eurostat, 2012d), the number of vessels in the East Mediterranean region has increased the most compared to the rest of the regions, by 153.1% since 2001. This rise was caused by the Greek increase in the number of vessels, a 151.6% in the period 2001-10 (Eurostat, 2012d).

### Black Sea

In the Black Sea there are two EU countries, Bulgaria and Romania. The rest of the counties that border this sea are Ukraine, Russia, Georgia, and Turkey.

**Table 36: Traffic statistics of the Black Sea sub-region (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 36). 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 37 a compilation as an example.

The shipping industry contributed an estimated EUR 26 billion added value to the economy of the EU 27[7] in 2010, which equated to about 26% of the value added generated by maritime activities (Policy Research Corporation, 2010).

**Table 37: Turnover of selected ports Source: website of port authorities.**

| Country | Port | Year | Amount |
|---|---|---|---|
| Spain | Barcelona | 2010 | 167 million € |
| | | 2011 | 158 million € |
| | Valencia | 2008 | 112 million € |
| | Algeciras | 2010 | 100.8 million € |
| France | Marseille | 2002 | 151.3 million € |
| | | 2003 | 154 million € |
| | | 2004 | 164.9 million € |
| Greece | Piraeus | 2010 | 122 million € |
| | Thessaloniki | 2007 | 66.2 million € |
| Italy | Genoa | 2012 | 71.6 million € |
| Slovenia | Koper | 2010 | 128 million € |
| Bulgaria | Burgas | 2011 | 16.9million € |
| | Varna | 2010 | 19.7 million € |
| Romania | Constanta | 2011 | 63.5 million € |

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.

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).

[7] Excluding Bulgaria

**Table 38: 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 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 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 and wildlife. 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), 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

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).

### 4.3.4 Case study: small and medium ports of the Catalan coast

One of the main characteristics of Mediterranean countries is the presence of marinas[8] and small & medium ports providing services to different sectors: tourism, fisheries, commerce, industry and transport. In addition to the contribution to the local economy, the construction of these installations represents a direct (and indirect) pressure on the coastal zone which produces different types of impacts (Petrosillo et al., 2010).

[8] A **marina** is a harbour for yachts and small boats mainly for recreational purposes.

Although the highest pressures exerted by ports on the Catalan coast are expected to be associated with the largest harbours (Barcelona and Tarragona), the existence of a large number of ports and marinas along the Catalan coast make these 'secondary' installations an important source of pressures on coastal ecosystems which is distributed along the entire territory. Along the Catalan coast, there are 45 small and medium harbours with an average distance between them of 11.2 km (the average distance between harbours in the Spanish Mediterranean coast is 15 km). Due to this, they can be described as a continuous impact source on the coast covering all types of geomorphologies, from rocky/cliffy to sandy coastlines.

When associating the impact induced by these installations on the coastal environment to a specific economic sector, tourism and recreation emerges as the dominant driver. Thus, about the 50% of the existing ports along the Catalan coast are solely dedicated to yachts. The remaining ones, with the exception of 2 industrial harbours (dedicated to cement carriers) are mixed, combining yachting with other sectors such as fishing and/or commercial. Nearly 32,000 yacht moorings are offered along the coast by these installations, being complemented with about 16,700 additional moorings in summer, when temporary anchorage areas in some beaches and bays are offered.

These installations generate a significant pressure on the coastal ecosystem, inducing a series of direct impacts, such as the modification of the littoral dynamics and the stability of the adjacent coast (Hsu et al., 1993), and the alteration of coastal habitats (Di Franco et al. 2011). Moreover, indirect impacts are also produced by ships using the installations, such as pollution (Piehlet et al. 2002) or physical impacts of boats on habitats (e.g. anchoring) (Lloret et al., 2008). Additionally, the daily operations of these installations also generate an environmental impact associated to factors such as waste generation and energy consumption (Darbra et al. 2005; 2009). Their impact is distributed along the entire territory instead of being considered as a single impact source.

One of the most direct indicators of this impact is the coastal surface occupied by the harbour. This implies a direct destruction of the original habitat since it is physically occupied by the installation. In order to take into account the potential affectation to coastal habitats placed at land and at sea, this surface can be divided into two values: surface on land and surface at sea.

Figure 14 shows the relative impact of existing installations along the Catalan coast. In total, small and medium harbours occupy a total surface of 8.2 million $m^2$ from which about 5 million $m^2$ are at the sea and 3.2 million $m^2$ are on land. The average total surface occupied per installation is about 18.2 ha, with average surface values of 11.5 ha and 7 ha at sea and on land respectively.

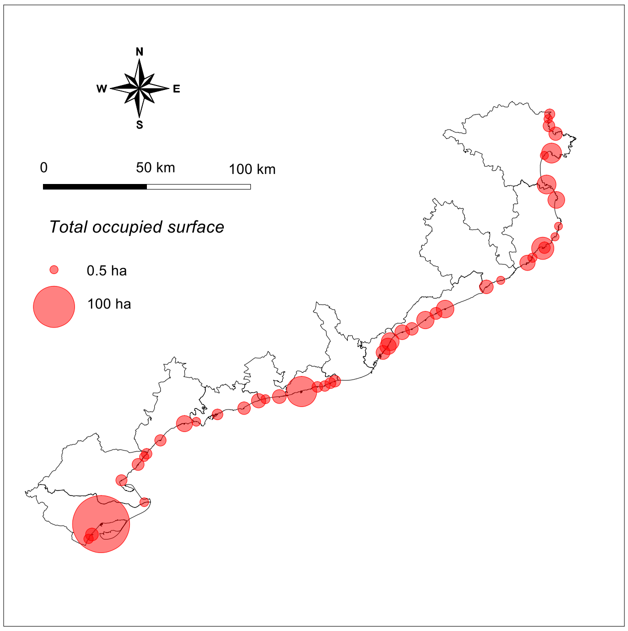



**Figure 14: Relative magnitude of the impact of small and medium harbours along the Catalan coast measured as total occupied surface.**

In addition to this, an idea of the magnitude order of other expected impacts, such as induced pollution and those due to ships' activities (anchoring), could be obtained from a measure of the intensity of the activity along the coast, which is here modelled by using the number of moorings (Figure 15).

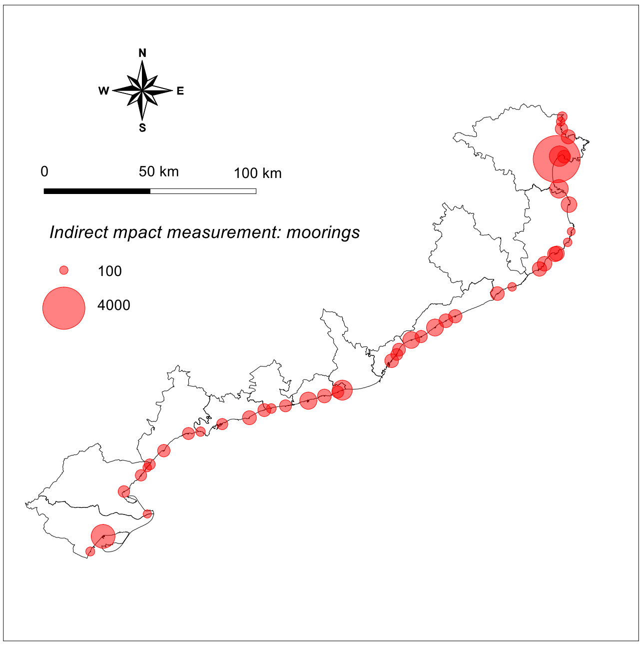



**Figure 15: Number of moorings along the Catalan coast, an indirect measurement of induced impact by harbour operations.**

Finally, another important physical induced impact is the marina's potential to modify the littoral dynamics and, therefore to alter coastal evolution in the adjacent areas. This impact will induce a sediment accumulation usually up coast of installations in coastal stretches where wave-induced long shore sediment transport dominates (or in sheltered areas where wave diffraction plays a significant role) and erosion with the consequent beach disappearance downcast the harbour.

To measure this, installations are classified into 3 types, which, in decreasing order of expected magnitude of the impact, are: (i) barrier ports in open sandy coastlines where they block or alter the long shore sediment transport, inducing erosion downcast; (ii) harbours in sedimentary bays where they alter locally the littoral dynamics and beach stability and (iii) harbours in rocky coasts where their impact on sediment dynamics is minimal. The largest impacts are concentrated, as expected, in those coastal stretches characterized by the existence of long and rectilinear sandy beaches dominated by relatively large sediment transport rates. These are the areas showing the largest shoreline retreat rates and where largest beach nourishment operations have been done.

### 4.3.5 Gap analysis

The research conducted for this review shows significant gaps in the data available for the Mediterranean and Black seas shipping and port sector. Generally, industry data are available for the EU regions in terms of tonnes of cargo, vessels and passenger traffic. However, as mentioned previously, the analysis showed that unfortunately no open data are available for North African and Asian countries since most of the data presented in this report have been obtained from the Eurostat (Eurostat, 2012c),which provides statistical information at a European Union (EU) level.

Furthermore, the analysis also showed that little or no specific economic and social data are available for the Mediterranean and Black seas in regard to the shipping and port sector, such as employment and turnover. Data for these indicators were either not available or not aggregated to the specific seas. Although data on economic indicators (such as gross domestic product or unemployment) were found, they included the whole coastal regions activities, and not exclusively the shipping and ports' activities. It could be possible that further data on economic indicators particularly for ports would exist, although at the moment they are not available. However, some data on the turnover of different Mediterranean and Black Sea ports are provided in this report, which have been obtained from the ports' website.

The results of the industry, economic and social indicators introduced in chapter three 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.

The growing capacity of this industry leads to increasing environmental pressures which challenge fragile and valuable marine ecosystems surrounding the ports. These pressures result in significant impacts on the environment and can lead to further impacts across the maritime economy (e.g. fishing and tourism) and to human well-being (e.g. health). For this reason, in chapter four the major environmental impacts of the shipping and port activities are presented according to the classification of the Marine Strategy Framework Directive (MSFD). The above-mentioned environmental pressures are intensified not only with these raise in the number of shipping vessels but also with the growth in the speed and in the size of the ships.

Policy makers are facing the complex challenge of integrating environmental and economic goals into maritime transport. Moreover, maritime transport of goods and passengers is often a cross-border activity which involves two or more countries or regions, and therefore it is even more difficult to integrate common policies between countries.

The role of port authorities in the protection of the environment is very important. Ports are moving forward to become greener by introducing new technological initiatives, implementing environmental programmes and carrying out projects to promote the sustainable development in the port. The European Sea Ports Organisation (ESPO) has just published in October 2012 the 'ESPO Green Guide; towards excellence in port environmental management and sustainability' aiming at promoting port authorities to be proactive and to commit themselves to sustainable development and the continuous improvement of their environmental performance. The guide also includes best practice examples that evidence the good work that is being done by European port authorities in five selected environmental issues.

With reference to the specific case study of the Catalan coast, the harbours of Barcelona and Tarragona are the two most important port installations in terms of dimension, economic importance and exerted pressure on the coastal environment. However, the existence of a dense network of small and medium harbours along this coast represents a significant land-based pressure source on the coastal zone. The main identified driver for this pressure is the tourism since most of the installations mainly provide mooring and services for yachting. Their impact is distributed along the entire territory covering all types of coasts, from rocky / cliffy to sandy coastlines.

Taking into account that the Catalan coastal zone can be considered representative of other areas along the Mediterranean coast, it is expected that these types of pressures and associated impacts may also be produced in other developed coasts, such as

France and Italy. Moreover, considering the importance of tourism along the Mediterranean coasts, it could be also representative of future conditions in other coastal stretches actually undeveloped.

## 4.4 Recreational activities, coastal tourism

Prepared by Eduard Ariza and Jose A. Jiménez (UPC LIM)

### 4.4.1 Introduction

The importance of tourism for the economic development of coastal areas has been quantified 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. Figure 16 shows the spatial distribution of tourism in Mediterranean coastal regions where a clear concentration in 2 countries in the W basin (Spain and France), one country in the central basin (Italy) and one in the E (Greece) is observed.

As an example of the importance of this economic sector in the region, Spain is the first recreational tourism destination in the world and second in number of arrivals and revenues (this position in revenues and visitors is usually alternated with France and USA). Thus, in 2009, 52.2 million international tourists visited the country (Ministerio de Agricultura, Alimentación y Medio Ambiente 2012). In 2011, the total contribution of the travel and tourism sector (including direct and indirect effects) to the Spanish GNP amounted to 14.9%, with the 80% of this being concentrated in 4 coastal Autonomous Communities in the Mediterranean (Catalunya, Comunitat Valenciana, Balears and Murcia).


**Figure 16. Estimation of tourism during summer season in the Mediterranean. Source: European Environment Agency, 2002)** [dark colours indicate a highest density].

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 mostly "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.

Within this context, the main aim of this report is to characterize the importance of the tourism sector in the Mediterranean area in socio-economic terms as well as to provide some indication about the pressure and impacts originated on the marine environment. Finally, gaps on existing information are identified.

### 4.4.2 Sector and socioeconomic analysis

In order to measure the importance of tourism in the Mediterranean basin we have used some indicators that have been selected based on their relevance and, in practical terms, taking into account the availability of data and/or statistics for Mediterranean countries. In order to value trends, series of chronological data have been collected and compared.

The selected indicators are: (i) *number of tourists* which is a measure of the intensity of the activity (Table 39 and Table 40); (ii) *tourism receipts* (Expenditures by international visitors including payments to carriers for international transport. They also include any other prepayment for goods and services received in the destination country) (Table 41); (iii) *capital investment* spending by all sectors directly involved in Travel & Tourism industry (Table 42); (iv) *contribution to the national GDP* (Table 43) and (v) *number of jobs* which serves to indicate the economic importance in social terms since it takes into account its influence on the employment (Table 44).

| Country | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Albania** | 354 | 470 | 557 | 645 | 748 | 937 | 1,127 | 1,420 | 1,856 | 2,417 |
| **Algeria** | 901 | 988 | 1,166 | 1,234 | 1,443 | 1,638 | 1,743 | 1,772 | 1,912 | -- |
| **Croatia** | 6,544 | 6,944 | 7,409 | 7,912 | 7,743 | 7,988 | 8,559 | 8,665 | 8,694 | 9,111 |
| **Cyprus** | 2,697 | 2,418 | 2,303 | 2,349 | 2,470 | 2,401 | 2,416 | 2,404 | 2,141 | 2,173 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Egypt** | 4,357 | 4,906 | 5,746 | 7,795 | 8,244 | 8,646 | 1,0610 | 12,296 | 11,914 | 14,051 |
| **France** | 75,202 | 77,012 | 75,048 | 74,433 | 74,988 | 77,916 | 80,853 | 79,218 | 76,764 | 77,148 |
| **Greece** | 14,057 | 14,180 | 13,969 | 13,313 | 14,765 | 16,039 | 16,165 | 15,939 | 14,915 | 15,007 |
| **Israel** | 1,196 | 862 | 1,063 | 1,506 | 1,903 | 1,825 | 2,067 | 2,572 | 2,321 | 2,803 |
| **Italy** | 39,563 | 39,799 | 39,604 | 37,071 | 36,513 | 41,058 | 43,654 | 42,734 | 43,239 | 43,626 |
| **Jordan** | 1,672 | 2,384 | 2,353 | 2,853 | 2,987 | 3,225 | 3,431 | 3,729 | 3,789 | 4,557 |
| **Lebanon** | 837 | 956 | 1,016 | 1,278 | 1,140 | 1,063 | 1,017 | 1,333 | 1,844 | 2,168 |
| **Libya** | -- | -- | -- | 43 | 81 | 42 | 38 | 34 | -- | -- |
| **Malta** | 1,180 | 1,134 | 1,127 | 1,156 | 1,171 | 1,124 | 1,244 | 1,291 | 1,182 | 1,332 |
| **Montenegro** | | 136 | 142 | 188 | 272 | 378 | 984 | 1,031 | 1,044 | 1,088 |
| **Morocco** | 4,380 | 4,453 | 4,761 | 5,477 | 5,843 | 6,558 | 7,408 | 7,879 | 8,341 | 9,288 |
| **Palestine** | 43 | 33 | 37 | 56 | 88 | 123 | 264 | 387 | 396 | 522 |
| **Slovenia** | 1,219 | 1,302 | 1,373 | 1,499 | 1,555 | 1,617 | 1,751 | 1,958 | 1,824 | 1,869 |
| **Spain** | 48,565 | 50,331 | 50,854 | 52,430 | 55,914 | 58,004 | 58,666 | 57,192 | 52,178 | 52,677 |
| **Syria** | 2,192 | 2,661 | 2,598 | 3,399 | 3,571 | 4,231 | 4,158 | 5,430 | 6,092 | 8,546 |
| **Tunisia** | 5,387 | 5,064 | 5,114 | 5,998 | 6,378 | 6,550 | 6,762 | 7,050 | 6,901 | 6,903 |
| **Turkey** | 10,783 | 12,790 | 13,341 | 16,826 | 20,273 | 18,916 | 22,248 | 24,994 | 25,506 | 27,000 |

**Table 39. Arrival of international tourists to Mediterranean countries (in thousands)** (World Bank 2012).

| **Country** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Albania** | 955 | 1,303 | 1,350 | 1,694 | 2,097 | 2,616 | 2,979 | 3,716 | 3,404 | 3,443 |
| **Algeria** | 1,190 | 1,257 | 1,254 | 1,417 | 1,513 | 1,349 | 1,499 | 1,539 | 1,677 | -- |
| **Croatia** | -- | -- | -- | -- | -- | -- | -- | 2,357 | 2,497 | 1,873 |
| **Cyprus** | 589 | 645 | 615 | 728 | 766 | 772 | 919 | 1,030 | 1,019 | 1,067 |
| **Egypt** | 3,074 | 3,330 | 3,644 | 5,210 | 5,307 | 4,531 | -- | -- | -- | -- |
| **France** | 19,265 | 18,315 | 18,576 | 21,131 | 22,480 | 22,240 | 22,226 | 21,080 | 21,281 | 21,609 |
| **Greece** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Israel** | 3,561 | 3,273 | 3,299 | 3,614 | 3,687 | 3,713 | 4,147 | 4,207 | 4,007 | 4,269 |
| **Italy** | 22,421 | 25,126 | 26,817 | 23,349 | 24,796 | 25,697 | 27,734 | 28,284 | 29,060 | 29,823 |
| **Jordan** | 1,755 | 1,276 | 1,229 | 1,420 | 1,523 | 2,139 | 2,094 | 1,972 | 2,054 | 2,917 |
| **Lebanon** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Libya** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Malta** | 179 | 157 | 174 | 203 | 225 | 257 | 280 | 301 | 302 | 294 |
| **Montenegro** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Morocco** | 1,701 | 1,533 | 1,612 | 1,603 | 2,247 | 2,135 | 2,669 | 3,058 | 2,293 | -- |
| **Palestine** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Slovenia** | 2,055 | 2,127 | 2,114 | 2,800 | 2,660 | 2,680 | 2,496 | 2,459 | 2,586 | 2,874 |
| **Spain** | 4,139 | 3,871 | 4,094 | 5,121 | 10,464 | 10,678 | 11,276 | 11,229 | 12,844 | 0 |
| **Syria** | 3,492 | 3, 299 | 3,997 | 4,309 | 4,564 | 4,042 | 4,196 | 5,253 | 5,215 | 6,259 |
| **Turkey** | 4,856 | 5,131 | 5,928 | 7,299 | 8,246 | 8,275 | 8,938 | 9,873 | 10,495 | 11,002 |
| **Tunisia** | 1,669 | 1,939 | 2,274 | 2,312 | 2,241 | 2,302 | 2,743 | 3,118 | 2,623 | 2,250 |

**Table 40. Departure of international tourists to Mediterranean countries (in thousands)** (World Bank 2012).

Figure 17 shows the evolution of intensity indicators (number of international arrivals and departures) in West Mediterranean countries (Spain ES, France FR, Tunisia TN, Algeria DZ and Morocco MA), where it can be clearly seen the dominant role played by France and Spain as main receptors and sources of international tourists. In total, the average number of international arrivals during the last 5 years at these West Med countries is about 150 million (146.1 million at 2009) whereas the average number of departures is about 39.8 million (40.7 million at 2009).

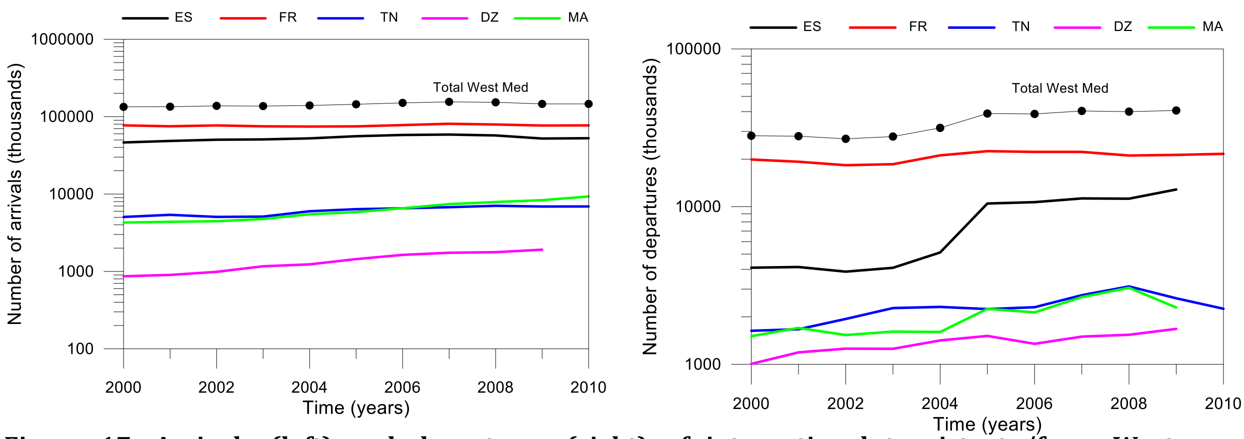



**Figure 17. Arrivals (left) and departures (right) of international tourists to/from West Mediterranean countries (in thousands).**

Figure 18 shows the evolution of intensity indicators (number of international arrivals and departures) in Central Mediterranean countries (Italy IT, Slovenia SI, Croatia HR, Montenegro ME, Albania AL, Malta MT, Greece GR, Egypt EG, Libya LY and Tunisia TN), where Italy emerges as the main contributor in terms of receptor and source of international tourists. In total, the average number of international arrivals during the last 5 years at these Central Med countries is about 93.7 million (99 million at 2010) whereas the average number of departures is about 35.9 million (37.1 million at 2010). It has to be noted that in the departure statistics some countries as Greece are not reported.

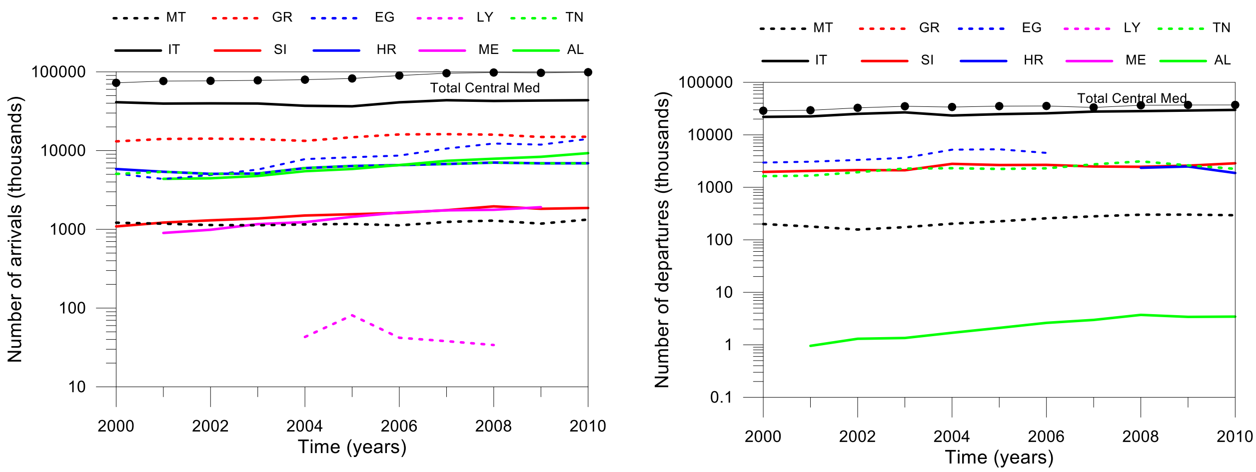



**Figure 18. Arrivals (left) and departures (right) of international tourists to/from Central Mediterranean countries (in thousands).**

The evolution of intensity indicators (number of international arrivals and departures) in East Mediterranean countries (Greece GR, Cyprus CY, Turkey TR, Syria SY, Lebanon LB, Israel IL, West Bank at Gaza WBG, Egypt EG and Lybia LY) is shown in Figure 19. Main receptors of international tourism are Turkey and Greece, whereas Turkey is the largest source of international tourism (no data from Greece). In total, the average number of international arrivals during the last 5 years at these East Med countries is about 63 million (72.3 million at 2010) whereas the average number of departures is about 20.6 million (22.6 million at 2010). It has to be noted that in the departure statistics some countries as Greece are not reported.

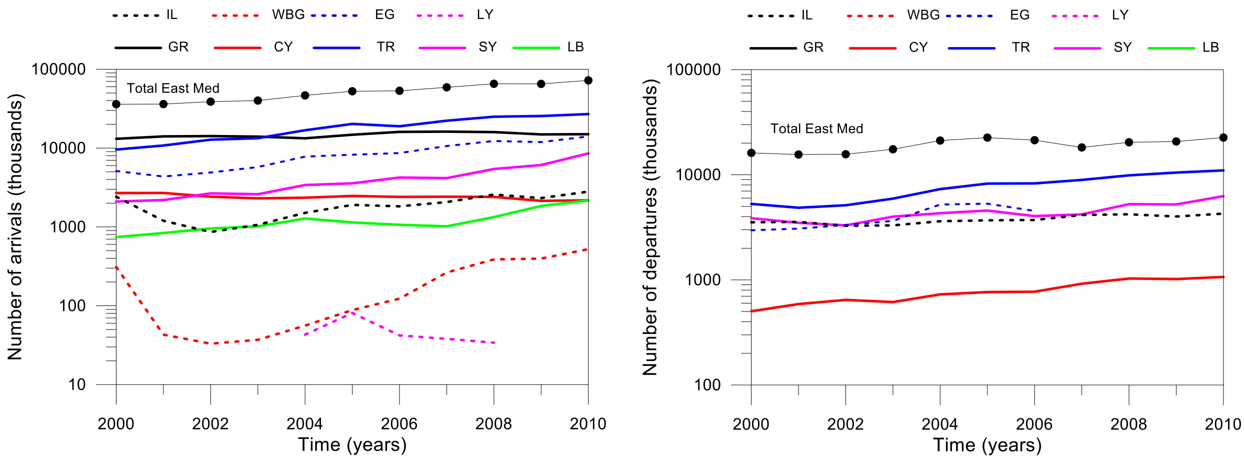



**Figure 19. Arrivals (left) and departures (right) of international tourists to/from East Mediterranean countries (in thousands).**

Tourism and Travel is one of the most important economic activities in Mediterranean countries. This sector has significant direct and indirect/induced economic impacts. The World Travel & Tourism Council (WTTC) quantifies its total contribution by capturing its indirect and induced economic impacts (Figure 20).


**Figure 20. Direct and indirect components to calculate the tourism and travel total contribution to GDP and employment** (World Travel & Tourism Council 2012).

Figure 21 shows the evolution of International tourism receipt and Capital investment in tourism in West Mediterranean countries (Spain ES, France FR, Tunisia TN, Algeria DZ and Morocco MA) where, as expected according to the already observed pattern in number of tourists, it can be clearly seen the extremely dominant role played by France and Spain in economic terms (one order of magnitude higher than Tunisia and Morocco and, two orders higher than Algeria). In total, the average international tourism receipt during the last 5 years at these West Med countries is about 101.3 billion € (99 billion € at 2010) whereas the average capital investment in tourism is about 41.4 billion € (36.9 billion € at 2010).

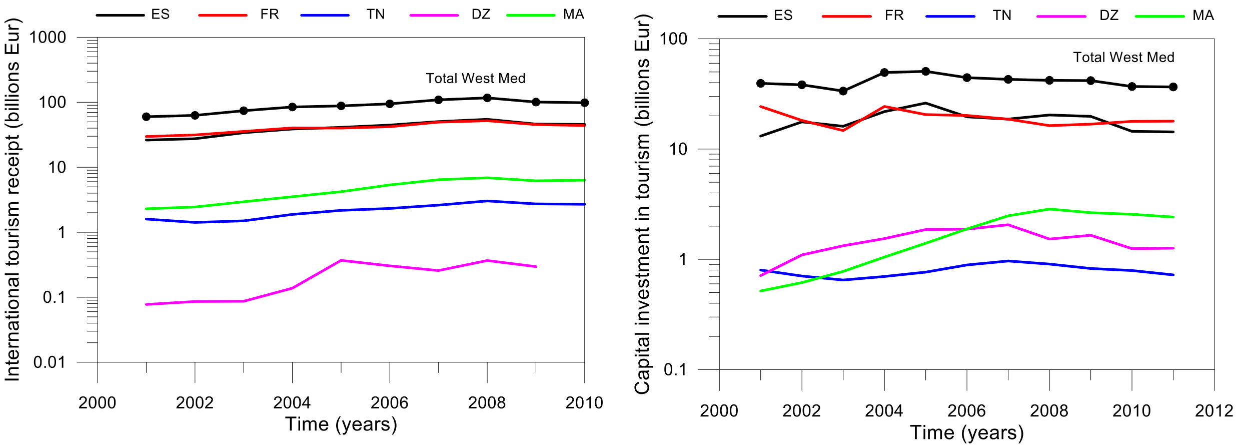



**Figure 21. International tourism receipt (left) and capital investment in tourism (right) in West Mediterranean countries (in billion Euros).**

Figure 22 shows the evolution of International tourism receipt and Capital investment in tourism in Central Mediterranean countries (Italy IT, Slovenia SI, Croatia HR, Montenegro ME, Albania AL, Malta MT, Greece GR, Egypt EG, Libya LY and Tunisia TN), where following the observed pattern in number of tourists, Italy plays the dominant role in the area. In total, the average international tourism receipt during the last 5 years at these Central Med countries is about 68.9 billion € (65.6 billion € at 2010) whereas the average capital investment in tourism is about 28.9 billion € (25.8 billion € at 2009).

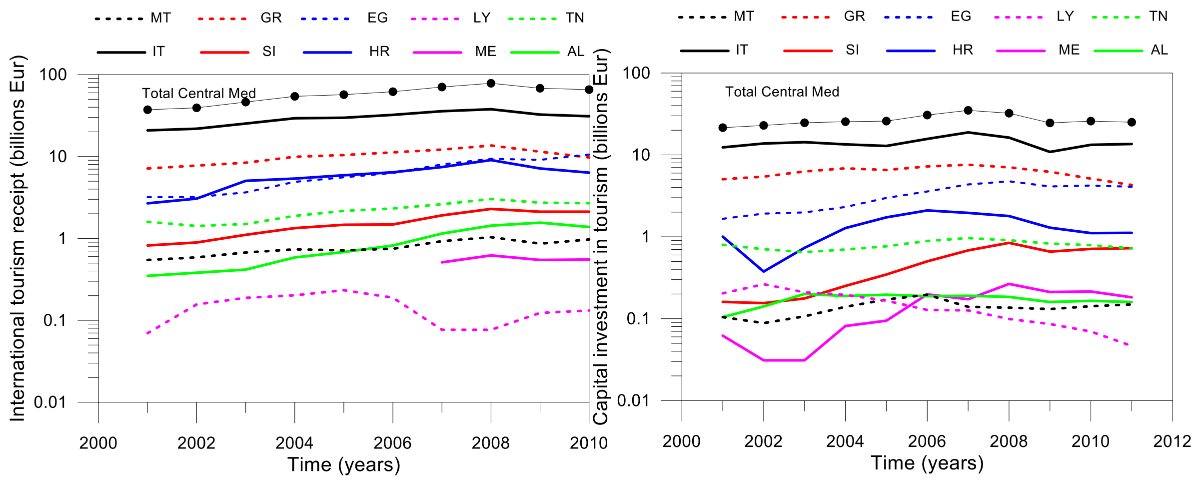



**Figure 22. International tourism receipt (left) and capital investment in tourism (right) in Central Mediterranean countries (in billion Euros).**

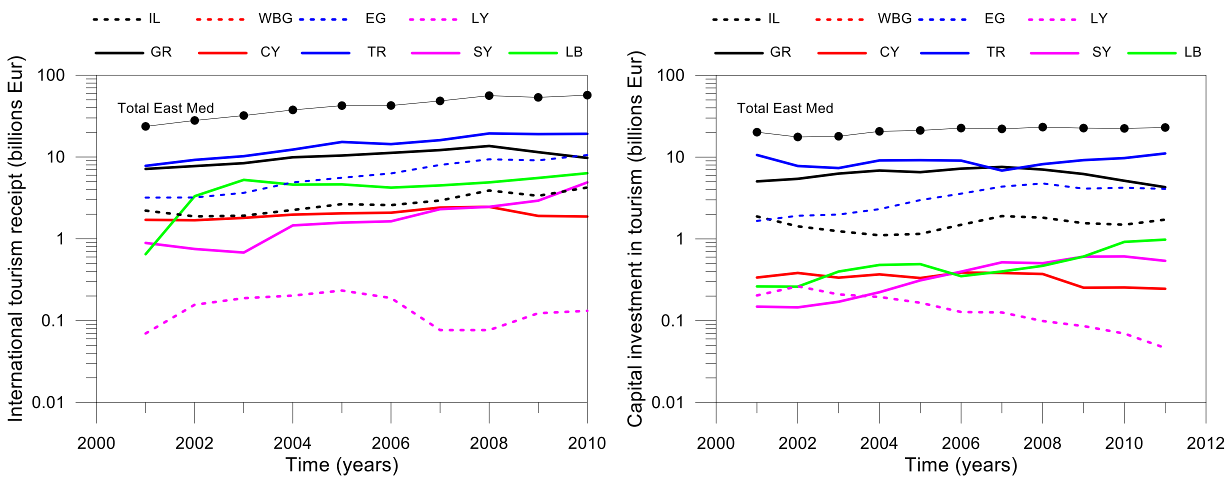



**Figure 23. International tourism receipt (left) and capital investment in tourism (right) in East Mediterranean countries (in billion Euros).**

The evolution International tourism receipt and Capital investment in tourism in East Mediterranean countries (Greece GR, Cyprus CY, Turkey TR, Syria SY, Lebanon LB, Israel IL, Egypt EG and Lybia LY) is shown in Figure 23. Consistently with number of tourists, Turkey and Greece are the countries where the economic indicators of tourism are highest during most of the time, although figures for Egypt converge to the Greece ones at 2010. In total, the average international tourism receipt during the last 5 years at these East Med countries is about 51.5 billion € (57 billion € at 2010) whereas the average capital investment in tourism is about 22.7 billion € (22.4 billion € at 2010).

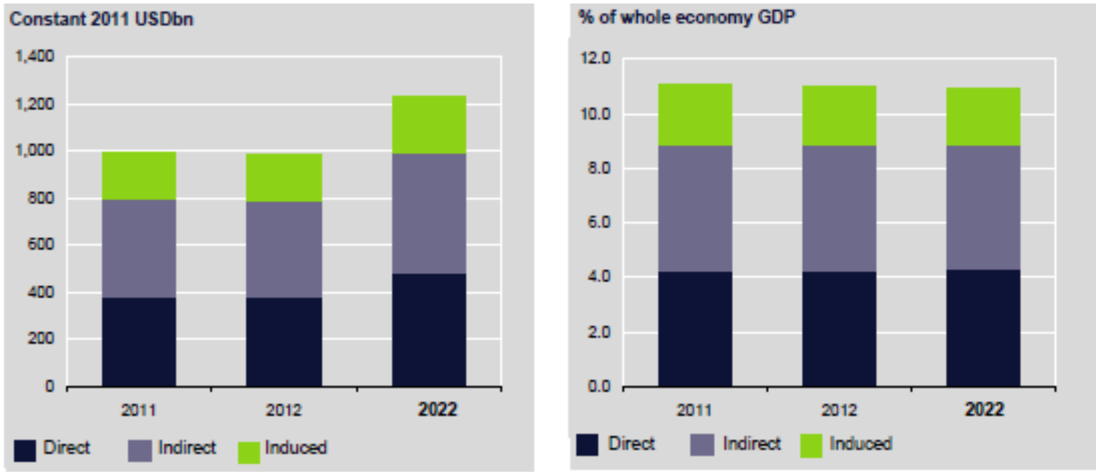
| Country | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Albania** | 0.35 | 0.38 | 0.42 | 0.59 | 0.68 | 0.82 | 1.15 | 1.43 | 1.56 | 1.38 |
| **Algeria** | 0.08 | 0.09 | 0.09 | 0.14 | 0.37 | 0.30 | 0.26 | 0.37 | 0.30 | |
| **Croatia** | 2.68 | 3.06 | 5.05 | 5.38 | 5.91 | 6.43 | 7.44 | 9.05 | 7.15 | 6.36 |
| **Cyprus** | 1.71 | 1.69 | 1.80 | 1.98 | 2.05 | 2.09 | 2.41 | 2.46 | 1.91 | 1.87 |
| **Egypt** | 3.19 | 3.20 | 3.65 | 4.90 | 5.58 | 6.30 | 8.00 | 9.38 | 9.11 | 10.57 |
| **France** | 29.75 | 31.42 | 35.64 | 40.38 | 40.06 | 42.07 | 49.42 | 52.01 | 45.37 | 43.91 |
| **Greece** | 7.14 | 7.75 | 8.40 | 9.93 | 10.43 | 11.23 | 12.16 | 13.63 | 11.47 | 9.75 |
| **Israel** | 2.21 | 1.88 | 1.92 | 2.25 | 2.66 | 2.58 | 2.94 | 3.90 | 3.36 | 4.24 |
| **Italy** | 20.86 | 21.85 | 25.26 | 29.35 | 29.74 | 32.27 | 35.76 | 37.79 | 32.50 | 31.04 |
| **Jordan** | 0.69 | 0.97 | 0.98 | 1.26 | 1.36 | 1.88 | 2.13 | 2.74 | 2.69 | 3.11 |
| **Lebanon** | 0.65 | 3.32 | 5.26 | 4.60 | 4.63 | 4.23 | 4.49 | 4.90 | 5.55 | 6.33 |
| **Libya** | 0.07 | 0.16 | 0.19 | 0.20 | 0.23 | 0.19 | 0.08 | 0.08 | 0.12 | 0.13 |
| **Malta** | 0.55 | 0.59 | 0.67 | 0.74 | 0.72 | 0.75 | 0.93 | 1.04 | 0.86 | 0.97 |
| **Montenegro** | | | | | | | 0.51 | 0.62 | 0.55 | 0.55 |
| **Morocco** | 2.30 | 2.45 | 2.95 | 3.52 | 4.21 | 5.35 | 6.44 | 6.89 | 6.18 | 6.34 |
| **Palestine** | 0.03 | 0.03 | 0.12 | 0.09 | 0.09 | 0.07 | 0.16 | 0.21 | 0.32 | |
| **Slovenia** | 0.82 | 0.89 | 1.11 | 1.34 | 1.47 | 1.48 | 1.91 | 2.29 | 2.12 | 2.12 |
| **Spain** | 26.22 | 27.49 | 33.99 | 38.75 | 41.13 | 44.60 | 50.39 | 54.59 | 46.14 | 45.58 |
| **Syria** | 0.89 | 0.75 | 0.68 | 1.46 | 1.58 | 1.64 | 2.30 | 2.46 | 2.93 | 4.89 |
| **Tunisia** | 1.60 | 1.42 | 1.50 | 1.88 | 2.17 | 2.32 | 2.61 | 3.03 | 2.73 | 2.69 |
| **Turkey** | 7.80 | 9.22 | 10.23 | 12.31 | 15.28 | 14.36 | 16.06 | 19.40 | 19.07 | 19.21 |

**Table 41. International tourism receipts in Mediterranean countries (billion €)** (World Bank 2012) [Note.- Original data in US$; employed conversion rate 1 US$ = 0.775 €]

| Country | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Albania** | 0.10 | 0.14 | 0.20 | 0.19 | 0.20 | 0.19 | 0.19 | 0.18 | 0.16 | 0.17 | 0.16 |
| **Algeria** | 0.71 | 1.10 | 1.33 | 1.54 | 1.86 | 1.88 | 2.06 | 1.53 | 1.65 | 1.25 | 1.26 |
| **Croatia** | 1.00 | 0.38 | 0.73 | 1.28 | 1.73 | 2.10 | 1.96 | 1.79 | 1.29 | 1.11 | 1.12 |
| **Cyprus** | 0.34 | 0.38 | 0.34 | 0.37 | 0.33 | 0.39 | 0.38 | 0.37 | 0.25 | 0.25 | 0.25 |
| **Egypt** | 1.66 | 1.92 | 1.98 | 2.31 | 2.98 | 3.57 | 4.36 | 4.77 | 4.12 | 4.23 | 4.08 |
| **France** | 24.28 | 18.17 | 14.72 | 24.31 | 20.53 | 20.17 | 18.66 | 16.31 | 16.83 | 17.82 | 17.90 |
| **Greece** | 5.05 | 5.43 | 6.29 | 6.85 | 6.55 | 7.23 | 7.59 | 7.04 | 6.22 | 5.14 | 4.29 |
| **Israel** | 1.88 | 1.43 | 1.24 | 1.11 | 1.15 | 1.49 | 1.90 | 1.82 | 1.56 | 1.49 | 1.72 |
| **Italy** | 12.36 | 13.79 | 14.30 | 13.45 | 12.86 | 15.68 | 18.81 | 16.27 | 10.88 | 13.29 | 13.60 |
| **Jordan** | 0.37 | 0.39 | 0.40 | 0.48 | 0.53 | 0.46 | 0.48 | 0.47 | 0.45 | 0.35 | 0.32 |
| **Lebanon** | 0.26 | 0.26 | 0.40 | 0.48 | 0.49 | 0.35 | 0.40 | 0.47 | 0.61 | 0.92 | 0.98 |
| **Libya** | 0.20 | 0.26 | 0.21 | 0.20 | 0.17 | 0.13 | 0.13 | 0.10 | 0.09 | 0.07 | 0.05 |
| **Malta** | 0.10 | 0.09 | 0.11 | 0.14 | 0.17 | 0.20 | 0.14 | 0.14 | 0.13 | 0.14 | 0.15 |
| **Montenegro** | 0.06 | 0.03 | 0.03 | 0.08 | 0.09 | 0.20 | 0.17 | 0.27 | 0.21 | 0.21 | 0.18 |
| **Morocco** | 0.52 | 0.62 | 0.78 | 1.05 | 1.40 | 1.88 | 2.48 | 2.86 | 2.65 | 2.56 | 2.42 |
| **Slovenia** | 0.16 | 0.16 | 0.18 | 0.25 | 0.35 | 0.50 | 0.68 | 0.84 | 0.66 | 0.71 | 0.73 |
| **Spain** | 13.11 | 17.64 | 16.08 | 21.86 | 26.11 | 19.58 | 18.69 | 20.37 | 19.79 | 14.47 | 14.31 |
| **Syria** | 0.15 | 0.15 | 0.17 | 0.22 | 0.31 | 0.40 | 0.52 | 0.51 | 0.61 | 0.61 | 0.54 |
| **Tunisia** | 0.80 | 0.71 | 0.65 | 0.70 | 0.77 | 0.89 | 0.97 | 0.91 | 0.83 | 0.79 | 0.72 |
| **Turkey** | 10.62 | 7.79 | 7.35 | 9.10 | 9.18 | 9.06 | 6.84 | 8.20 | 9.18 | 9.73 | 11.09 |

**Table 42. Capital investment in tourism in Mediterranean countries (billion €)** (World Travel & Tourism Council 2012). [Note.- Original data in US$; conversion rate 1 US$ = 0.775 €].

Figure 24 shows the estimations of the *total contribution of Tourism & Travel sector to GDP* in the Mediterranean for 2011 and 2012 and the forecasting for 2022. WTTC (2012) estimated that the induced income impacts was 774.5 bn € in 2011 (11.1% of GDP) which is expected to be 766.2 bn € (11.0% of GDP) in 2012. This contribution is forecasted to rise by 2.2% to reach a value of 952.4 bn € (10.8 % of the GDP).




[1] All values are in constant 2011 prices & exchange rates

**Figure 24. Tourism and Travel Total contribution to GDP in the Mediterranean** (World Travel & Tourism Council 2012).

| Country | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 16.8 | 19.2 | 18.2 | 17.9 | 19.8 | 21 | 23 | 22.4 | 25.3 | 23 | 21.7 |
| Algeria | 6.9 | 7.4 | 7.8 | 8.9 | 8.5 | 9.2 | 8.6 | 7.8 | 8.8 | 7.9 | 7.7 |
| Croatia | 17.8 | 18.1 | 26.7 | 26.1 | 27.9 | 28.5 | 27.7 | 29.1 | 25.3 | 26.2 | 26.4 |
| Cyprus | 33.1 | 30.1 | 26.8 | 25 | 24.1 | 22.5 | 22.3 | 19.2 | 17 | 17.4 | 17.7 |
| Egypt | 14.1 | 14.6 | 16.5 | 19.1 | 19 | 19 | 19.5 | 19 | 17.9 | 17.5 | 14.8 |
| France | 12.6 | 12 | 11.3 | 11.6 | 11 | 10.7 | 10.4 | 9.9 | 9.8 | 9.4 | 9.2 |
| Greece | 16.9 | 16.4 | 15.7 | 16.1 | 17.4 | 17.7 | 17.5 | 16.7 | 15.7 | 15.4 | 16.5 |
| Israel | 7.7 | 7.5 | 7.6 | 7.6 | 8 | 7.9 | 7.8 | 8.3 | 7.8 | 8.2 | 8 |
| Italy | 10.6 | 10 | 9.5 | 9.4 | 9.1 | 9.3 | 9.3 | 8.7 | 8.3 | 8.5 | 8.6 |
| Jordan | 18 | 21.3 | 20.2 | 22.7 | 21.9 | 23.4 | 23.2 | 23.1 | 21.3 | 21.9 | 18.8 |
| Lebanon | 15.4 | 33.2 | 46.1 | 40.1 | 39.4 | 36.8 | 34.8 | 31.3 | 31.8 | 33.9 | 35.1 |
| Libya | 5.6 | 6.3 | 5.6 | 5.9 | 6.4 | 4.1 | 3.7 | 3.5 | 4.1 | 3.3 | 3.2 |
| Malta | 27.4 | 27.2 | 27.1 | 25.9 | 26.6 | 26.9 | 26.5 | 26.5 | 24.4 | 26.2 | 27.7 |
| Montenegro | 10.2 | 9.1 | 10.2 | 12.8 | 14.9 | 21.5 | 23.6 | 26.4 | 17.9 | 17.6 | 15.4 |
| Morocco | 14.8 | 14.7 | 14.6 | 16.3 | 18.5 | 20.8 | 22.4 | 21 | 19.2 | 19.4 | 18.9 |
| Slovenia | 11.5 | 11.4 | 10.9 | 11 | 11.5 | 11 | 11 | 11.4 | 12.4 | 12.5 | 12.8 |
| Spain | 16.9 | 16.8 | 16 | 16.5 | 16.8 | 15.7 | 15.5 | 15.5 | 15.2 | 14.6 | 14.8 |
| Syria | 13.3 | 12.3 | 12.1 | 14.9 | 14.3 | 13.4 | 14.7 | 12.6 | 14.4 | 15.3 | 13.1 |
| Tunisia | 19.8 | 17.6 | 16.7 | 17.8 | 19.4 | 19.9 | 19.5 | 18.9 | 18.5 | 17.8 | 14.2 |
| Turkey | 14.5 | 12.6 | 13.1 | 12.5 | 12 | 10.7 | 10.1 | 10.3 | 11.8 | 10.6 | 10.9 |

**Table 43. Tourism and Travel Total contribution to GDP (%) in Mediterranean countries** (World Travel & Tourism Council 2012).

Tourism and travel contribution to GDP in Mediterranean countries during the first decade of the 21st century is shown in Table 43, whereas the corresponding contribution for each Mediterranean region can be seen in Figure 25.

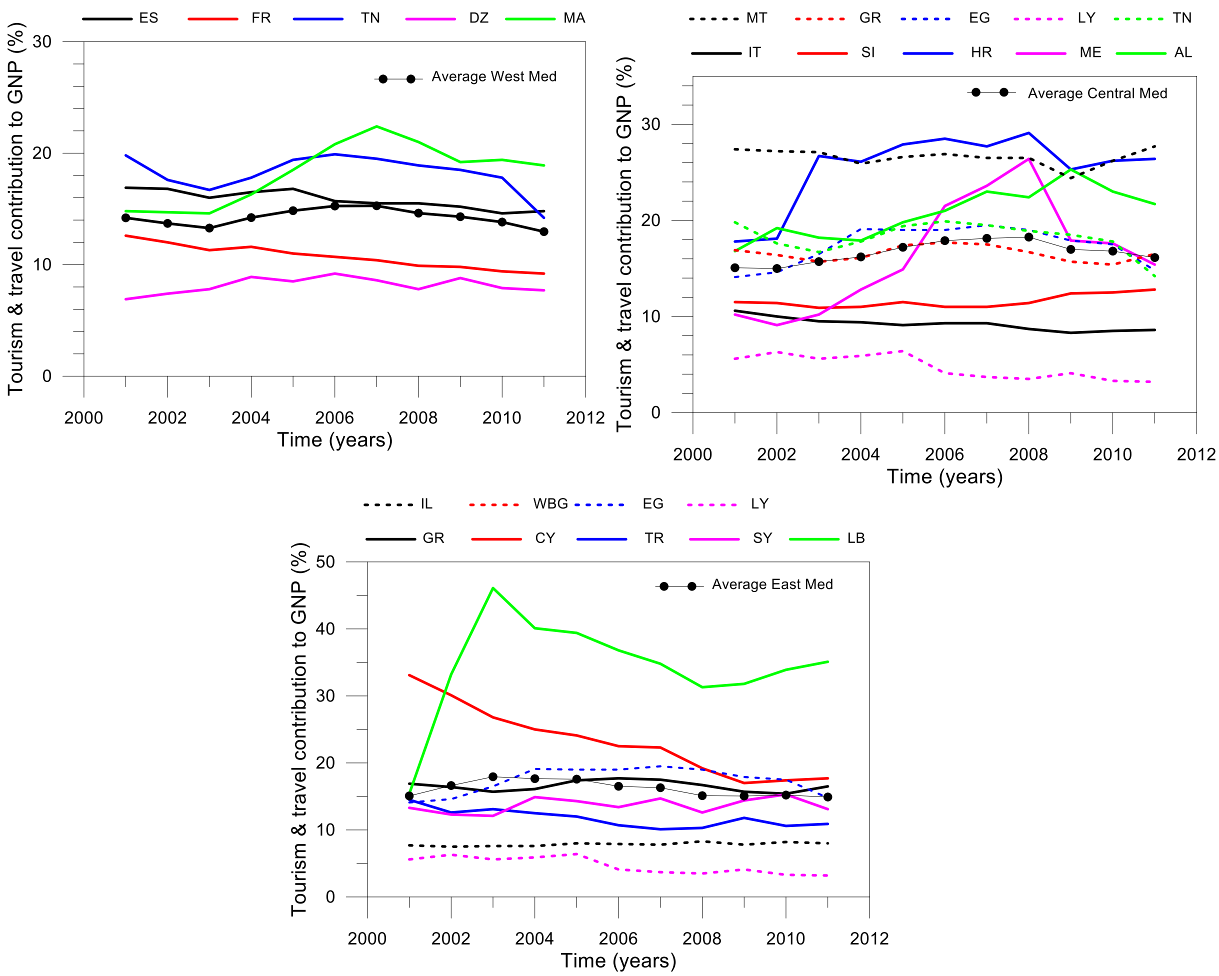



**Figure 25. Tourism and Travel Total contribution to GDP (%) in countries in different Mediterranean Regions: West Med (top left); Central Med (top right); East Med (bottom).**

Finally, Table 44 shows an indication of the economic importance of Tourism in social terms in Mediterranean countries 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. The evolution of these values for countries located in each Mediterranean Region is shown in Figure 26 to Figure 28.

In overall, Tourism & Travel sector has contributed to employment in the Mediterranean countries in average between a minimum of 14.7 % and a maximum of 16.9 % during the period 2001-2011 (Figure 29), being the peak being attained at 2007 whereas the present (2011) contribution is 15.2 %. In relative terms, the largest contributions of this sector to national employment rates occur in Lebanon, Malta and Croatia with more than 25 %.

When this percentages are converted in number of jobs, the total number of generated jobs in Mediterranean countries varies between a minimum of 17 million and a maximum of 20.3 million during the period 2001-2011 (Figure 29), being the peak being attained at 2007 whereas the present (2011) number of related jobs is 18.5 million. In absolute terms, the country where this sector generates the highest number of jobs is Egypt with more than 3 million, followed by France, Spain and Italy with more than 2 million.

| Country | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Albania** | % | 14.9 | 17.1 | 16.2 | 16 | 17.8 | 18.8 | 20.7 | 20.2 | 22.9 | 20.8 | 19.7 |
| | 1000 | 138 | 157.5 | 150.8 | 148.1 | 165.6 | 175.8 | 194 | 194.9 | 219.1 | 189.6 | 183.3 |
| **Algeria** | % | 6.1 | 6.6 | 7 | 8 | 7.7 | 8.2 | 7.8 | 7.1 | 7.9 | 7.1 | 7 |
| | 1000 | 408.8 | 458.4 | 474.4 | 629.8 | 629.7 | 734.9 | 670.5 | 650.3 | 750.6 | 697.8 | 699.9 |
| **Croatia** | % | 22.7 | 22.4 | 32.2 | 30.9 | 32.4 | 32.7 | 31.4 | 32.7 | 28.1 | 28.9 | 28.2 |
| | 1000 | 235.5 | 235.2 | 346.1 | 338.8 | 361.9 | 372 | 362.8 | 383.3 | 324.1 | 314.4 | 311.1 |
| **Cyprus** | % | 35.6 | 32.3 | 28.6 | 26.8 | 25.9 | 24.2 | 24.1 | 20.8 | 18.3 | 18.7 | 19 |
| | 1000 | 110.4 | 102.1 | 93.8 | 90.6 | 90.3 | 86.6 | 91.1 | 79.7 | 69.8 | 72.8 | 74.3 |
| **Egypt** | % | 12.4 | 12.8 | 14.5 | 16.8 | 16.7 | 16.7 | 17.2 | 16.7 | 15.8 | 15.4 | 13.1 |
| | 1000 | 2194.1 | 2306.6 | 2641.2 | 3149.5 | 3240.7 | 3418.6 | 3735.7 | 3770.4 | 3654.2 | 3682.9 | 3079.4 |
| **France** | % | 13.9 | 13.2 | 12.5 | 12.8 | 12.2 | 12.1 | 11.6 | 11.2 | 11.2 | 10.6 | 10.4 |
| | 1000 | 3586.2 | 3429.6 | 3250.7 | 3345.3 | 3201 | 3205.8 | 3130.3 | 3037.5 | 2991.9 | 2841.7 | 2793.4 |
| **Greece** | % | 19.3 | 18.8 | 17.9 | 17.9 | 19.3 | 19.7 | 19.4 | 18.6 | 17.4 | 17.1 | 18.4 |
| | 1000 | 789.7 | 789.1 | 766.7 | 775.8 | 844.8 | 877.7 | 877.5 | 847.4 | 787.6 | 754.4 | 758.3 |
| **Israel** | % | 7.9 | 7.8 | 7.9 | 8 | 8.5 | 8.3 | 8.2 | 8.8 | 8.3 | 8.8 | 8.5 |
| | 1000 | 180.8 | 178.9 | 184.4 | 193.2 | 212.8 | 214.9 | 222.3 | 244.6 | 235.8 | 258.5 | 258.4 |
| **Italy** | % | 11.3 | 10.8 | 10.4 | 10.3 | 10.1 | 10.4 | 10.4 | 9.7 | 9.3 | 9.6 | 9.7 |
| | 1000 | 2491.4 | 2415.9 | 2321.5 | 2323.3 | 2288.6 | 2396.1 | 2429.8 | 2286.9 | 2156.4 | 2200.4 | 2231.3 |
| **Jordan** | % | 15.9 | 18.8 | 17.8 | 20.1 | 19.4 | 20.7 | 20.6 | 20.5 | 19 | 19.6 | 16.8 |
| | 1000 | 198.1 | 239.8 | 237.7 | 286.4 | 283.6 | 311 | 316.8 | 323.6 | 301.6 | 320.7 | 282.1 |
| **Lebanon** | % | 14.2 | 30.9 | 42.9 | 37.5 | 36.7 | 34.3 | 32.6 | 29.4 | 30.1 | 32.2 | 33.4 |
| | 1000 | 155.2 | 348.2 | 497.6 | 445 | 446.6 | 425.4 | 412.4 | 375.7 | 398.2 | 425.6 | 448.3 |
| **Libya** | % | 5.2 | 5.9 | 5.3 | 5.6 | 6.1 | 4 | 3.5 | 3.3 | 3.9 | 3.2 | 3 |
| | 1000 | 70.3 | 81.9 | 77.1 | 83 | 93.4 | 61.9 | 56 | 53.7 | 64.5 | 51.2 | 36 |
| **Malta** | % | 28 | 27.8 | 27.7 | 26.4 | 27 | 27.2 | 27.2 | 27.3 | 25 | 26.9 | 28.5 |
| | 1000 | 40.8 | 41.2 | 40.9 | 38.9 | 40.6 | 41.4 | 42.4 | 43.9 | 40.2 | 43.2 | 46 |
| **Montenegro** | % | 11.4 | 11.3 | 12.9 | 13.5 | 14.8 | 19 | 20 | 21.7 | 15.9 | 15.7 | 13.7 |
| | 1000 | 16.4 | 16.3 | 18.4 | 19.4 | 21.3 | 28.7 | 31.3 | 36.1 | 27.8 | 25.4 | 23.1 |
| **Morocco** | % | 13.2 | 13 | 13 | 14.5 | 16.4 | 18.5 | 19.8 | 18.6 | 17.1 | 17.3 | 16.8 |
| | 1000 | 1172.5 | 1191.9 | 1239.2 | 1390 | 1578.1 | 1843.8 | 2007.2 | 1905.1 | 1761.5 | 1805.8 | 1798.4 |
| **Slovenia** | % | 11.8 | 11.7 | 11.1 | 11.3 | 11.8 | 11.3 | 11.3 | 11.7 | 12.6 | 12.7 | 13.1 |
| | 1000 | 91.9 | 91.9 | 87 | 88.8 | 96.5 | 93.8 | 97.1 | 103.2 | 108.6 | 106.8 | 110.8 |
| **Spain** | % | 14.2 | 14.3 | 13.6 | 14.2 | 14.6 | 13.6 | 13.4 | 13.5 | 13.4 | 12.7 | 12.6 |
| | 1000 | 2308 | 2391.3 | 2361.8 | 2558.5 | 2776 | 2691.9 | 2734.5 | 2747.9 | 2546.5 | 2346.8 | 2304.6 |
| **Syria** | % | 11.7 | 10.9 | 10.7 | 13.2 | 12.6 | 11.9 | 13 | 11.2 | 12.7 | 13.4 | 11.4 |
| | 1000 | 513.9 | 488 | 497.5 | 622.6 | 619.2 | 602.1 | 679.6 | 606.3 | 708.1 | 771.7 | 684 |
| **Tunisia** | % | 17.7 | 15.8 | 15 | 16 | 17.5 | 17.9 | 17.6 | 17.1 | 16.7 | 16.1 | 12.8 |
| | 1000 | 466.8 | 426.4 | 418.8 | 461.1 | 512.6 | 540.4 | 543.3 | 540.9 | 536.4 | 530.9 | 415.5 |
| **Turkey** | % | 8.3 | 8.2 | 8.7 | 8.5 | 8.6 | 8.3 | 8.2 | 8.2 | 8.7 | 8.1 | 8 |
| | 1000 | 1798.9 | 1763.2 | 1856 | 1856.7 | 1744.2 | 1715.4 | 1713.5 | 1758.7 | 1862.2 | 1840.1 | 1938.7 |

**Table 44 Tourism and Travel Total contribution to employment (%) and number of jobs of the sector (in thousands) in Mediterranean countries** (World Travel & Tourism Council 2012).

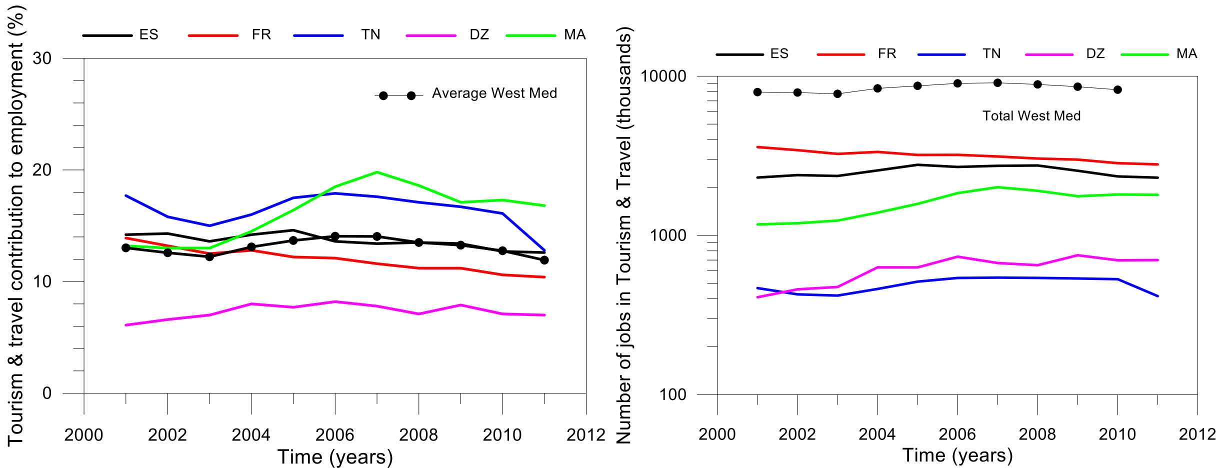



**Figure 26. Tourism and Travel Total contribution to employment (%) (left) and number of jobs of the sector (right) in West Med countries.**

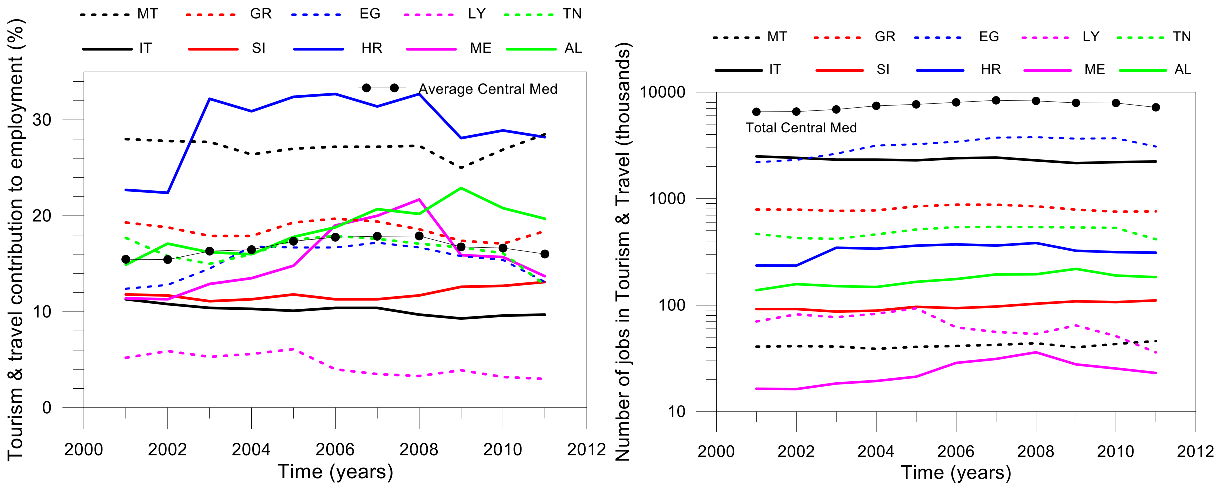



**Figure 27. Tourism and Travel Total contribution to employment (%) (left) and number of jobs of the sector (right) in Central Med countries.**

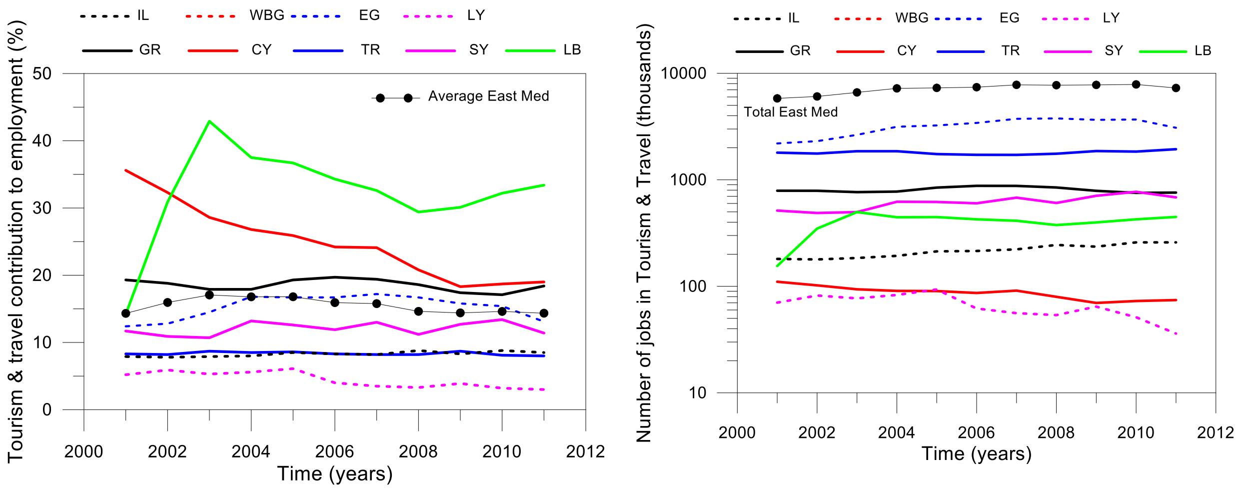



**Figure 28. Tourism and Travel Total contribution to employment (%) (left) and number of jobs of the sector (right) in East Med countries.**

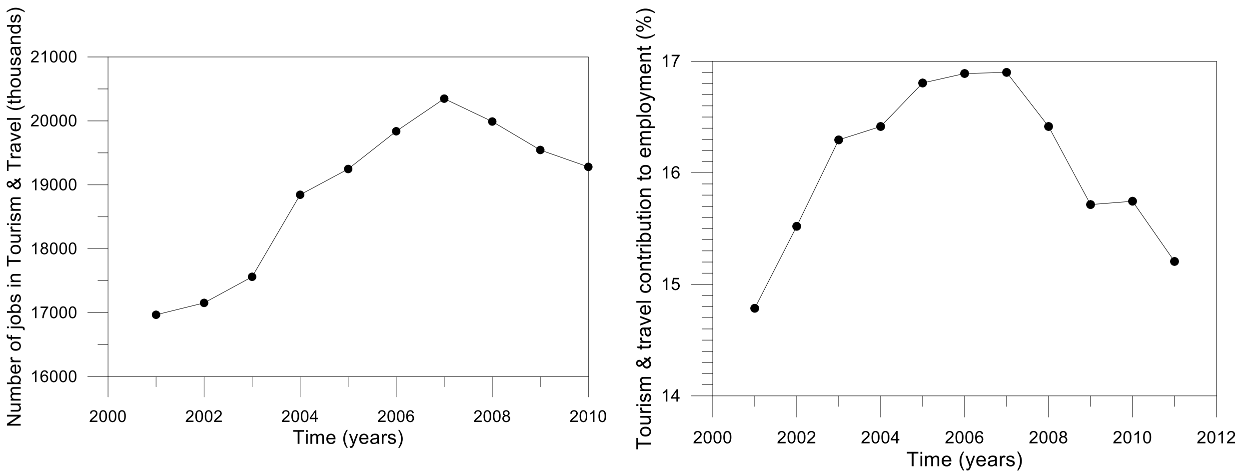



**Figure 29. Tourism and Travel Total contribution to employment (%) (left) and number of jobs of the sector (right) in Mediterranean countries.**

It has to be mentioned that there is a number of countries such as Spain, France, Turkey and Egypt where tourism is not only performed in the Mediterranean and, in consequence, it should be desirable to assess which percentage of the presented figures can be really labelled as representative of the Mediterranean part.

In the case of Spain, the Mediterranean coast account for about the 53 % of the total number of international tourists and, the percentage of jobs in the tourism sector with respect to the total of Spain is 34.7 % (MAGRAMA, 2012).

In the case of France, the Mediterranean coast account for about the 36 % of the total number of international tourists and, the percentage of jobs in the tourism sector with respect to the total of France is 40 % (Ministère de l'écologie, du développement durable et de l'énergie, 2012).

### 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).

To give an idea about of the magnitude of this pressure and associated potential impacts, in what follow main figures about this sector in the Mediterranean are given. First, it has to be mentioned that cruise is a type of tourism which is widespread across the entire Mediterranean basin (Figure 30). The evolution of *total number of cruise passengers* in main Mediterranean ports from 2007 to 2009 is shown in Table 45. As it can be seen, there is a continuous increase in the total number of passengers from one year to the next one, with the largest increase occurring from 2007 to 2008 (about 3.8 millions). In total, Mediterranean ports handled about 26 million passengers in 2009 (Torbianelli, 2011).

Table 45. Number of cruise passengers in main Mediterranean ports in 2007, 2008 and 2009 (Plan Bleu 2011).Table 45 shows the evolution total number of cruisers in main Mediterranean ports which are grouped under the Association of Mediterranean cruise ports Figure 31), which also include ports in the Black Sea. Although there is a variation in the number of associates during the first years, once they stabilized (since 2005), a more or less continuous growth is detected. These tourists were travelling along this area in more than 12,000 ship movements - cruise calls (Figure 31) with a clear seasonality (Figure 32), being the period between May and October the busiest one.

One of the characteristics of this specific sector is that although each cruise will have their own base in a specific port (Figure 30 and Table 45), its activity and environmental impact are developed in a larger geographical area which in many cases can cover different Mediterranean regions (Figure 33).


**Figure 30. MedCruise member ports (MedCruise, 2012).**

| Ports | Country | 2007 | 2008 | 2009 |
|---|---|---|---|---|
| **Barcelona** | Spain | 1,765,838 | 2,069,651 | 2,151,465 |
| **Civitavecchia** | Italy | 1,586,101 | 1,818,616 | 1,802,938 |
| **Palma Mallorca** | Spain | 1,048,906 | 1,131,147 | 1,056,215 |
| **Naples** | Italy | 1,151,345 | 1,237,078 | 1,265,000 |
| **Venice** | Italy | 1,003,529 | 1,215,088 | 1,420,980 |
| **Piraeus (Athens)** | Greece | 1,000,000 | 1,290,000 | 1,500,000 |
| **Savona** | Italy | 761,000 | 772,000 | 712,681 |
| **Genoa** | Italy | 520,197 | 547,905 | 671,468 |
| **Livorno** | Italy | 713,144 | 849,050 | 795,313 |
| **Nice/Villefranche/Cannes** | France | 559,411 | 708,785 | 742,668 |
| **Limassol/Larnaka** | Cyprus | 427,408 | 376,296 | 320,467 |
| **Marseille** | France | 434,087 | 540,000 | 622,300 |
| **Valetta** | Malta | 487,817 | 556,861 | 441,913 |
| **Palermo** | Italy | 471,395 | 537,721 | 478,900 |
| **Bari** | Italy | 351,897 | 465,739 | 567,885 |
| **Messina** | Italy | 291,296 | 337,117 | 253,200 |
| **Malaga** | Spain | 290,558 | 352,875 | 487,955 |
| **Monte Carlo** | Monaco | 184,117 | 231,639 | 35,904 |
| **Gibraltar** | Gibraltar - UK | 275,993 | 308,989 | 348,199 |
| **Ajaccio** | France | 191,548 | 197,571 | 229,882 |
| **Valencia** | Spain | 179,209 | 199,335 | 184,909 |

**Table 45. Number of cruise passengers in main Mediterranean ports in 2007, 2008 and 2009** (Plan Bleu 2011).

| Year | No. Members | Total Pax Movements | % variat. on prev. Year | Cruise Calls | % variat. on prev. Year |
|---|---|---|---|---|---|
| 2000 | **44** | 6.920.045 | - | 8.304 | - |
| 2001 | **44** | 7.634.181 | 10,3% | 8.847 | 6,5% |
| 2002 | **50** | 8.455.704 | 10,8% | 9.220 | 4,2% |
| 2003 | **55** | 10.582.077 | 25,1% | 10.475 | 13,6% |
| 2004 | **55** | 10.528.906 | -0,5% | 9.985 | -4,7% |
| 2005 | **59** | 12.431.283 | 18,1% | 10.937 | 9,5% |
| 2006 | **60** | 14.480.010 | 16,5% | 11.309 | 3,4% |
| 2007 | **60** | 17.293.157 | 19,4% | 12.791 | 13,1% |
| 2008 | **63** | 20.198.750 | 16,8% | 14.144 | 10,6% |
| 2009 | **64** | 20.728.847 | 2,6% | 12.757 | -9,8% |
| 2010 | **65** | 22.463.629 | 8,4% | 12.991 | 1,8% |

NOTE: 2010 shows just 65 ports data because 4 ports data are was not provided or showed 0 passengers (with this sum we get to 69 members ports).

**Figure 31. Total passenger movements and cruise calls 2000-2010 in MedCruise member ports** (MedCruise, 2012).

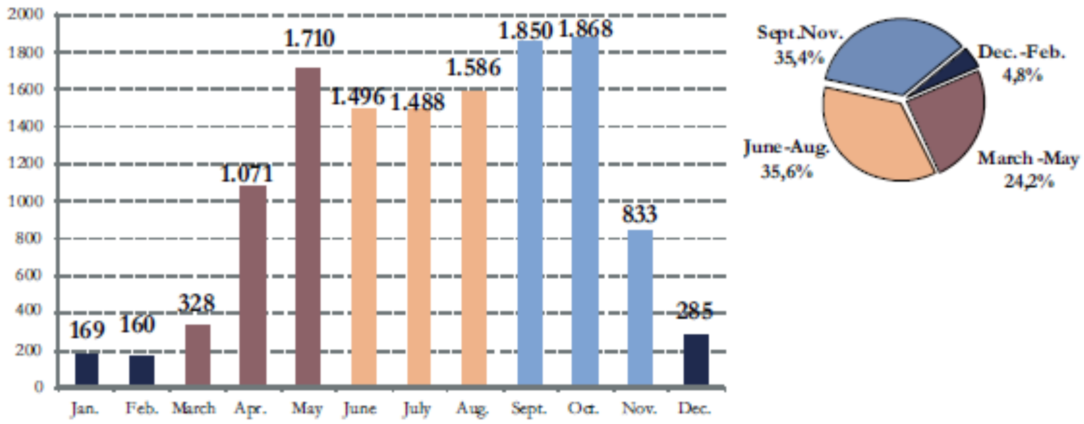



**Figure 32. Total cruise calls per month and trimester shares in MedCruise member ports** (MedCruise, 2012).


**Figure 33. Examples of cruises crossing different med regions. Left: Disney Cruise Line Barcelona-Venice 2014. Right: Princess Cruise Rome-Venice 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 number of tourist beds. Table 46 shows the evolution of total beds in hotels and similar establishments in Mediterranean countries.

Table 46 shows the evolution of this pressure indicator (number of beds) in the different Mediterranean regions, where the observed pattern in number of tourists (Figure 34) is reproduced. Countries with the highest number of arrivals in each region are also the ones with the highest number of beds and, thus, with the highest potential impact (Spain and France in the W Med, Italy in Central Med and, Greece and Turkey in East Med).

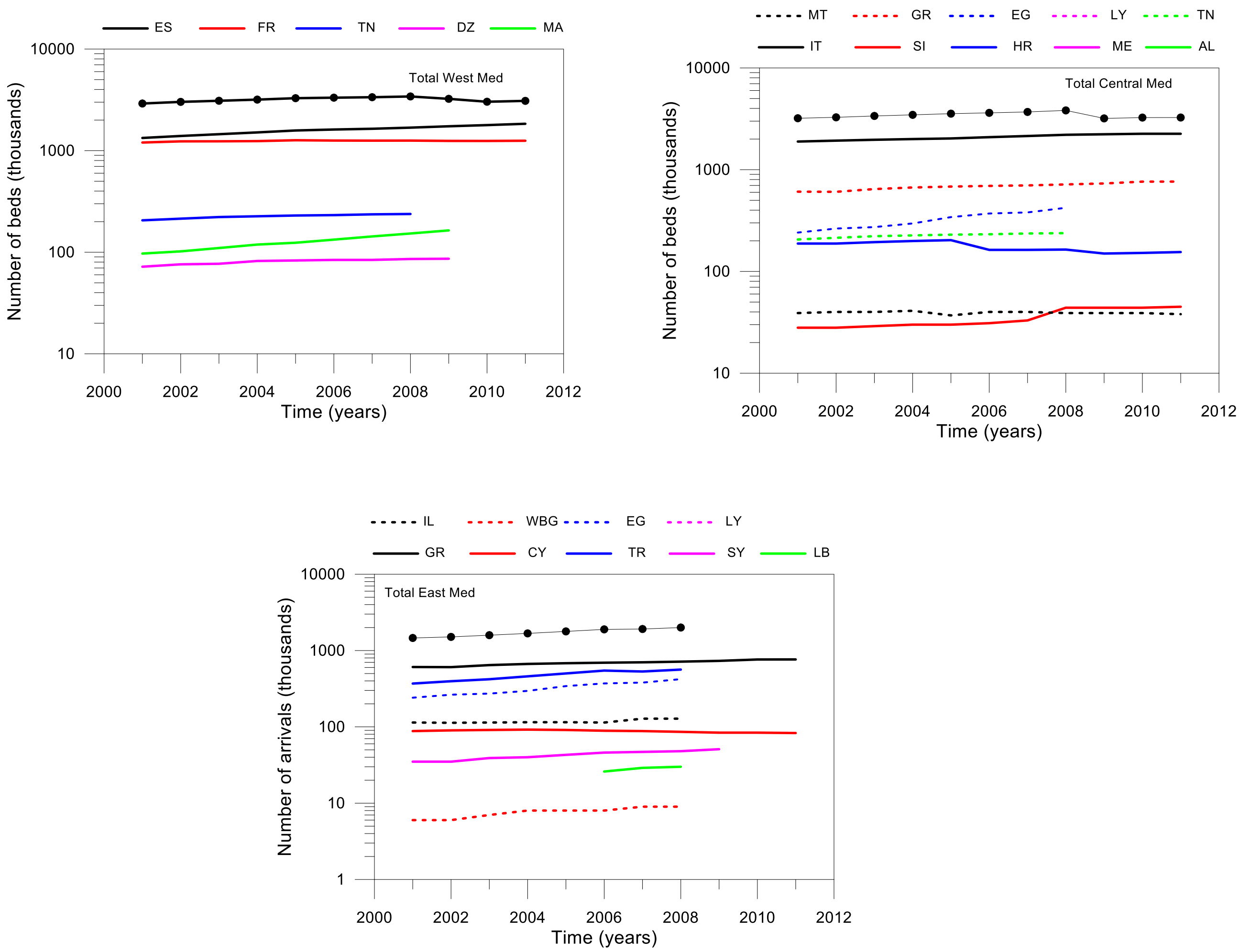



**Figure 34. Number of bed places in hotels and similar establishments in Mediterranean Regions: West Med (top left); Central Med (top right); East Med (bottom).**

| Country | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Algeria | 72 | 76 | 77 | 82 | 83 | 84 | 84 | 85.8 | 86.3 | | |
| Croatia | 188 | 188 | 194 | 199 | 203 | 163 | 163 | 164 | 150 | 152 | 155 |
| Cyprus | 88 | 90 | 91 | 92 | 91 | 89 | 88 | 86 | 84 | 84 | 83 |
| Egypt | 241 | 264 | 273 | 296 | 342 | 371 | 380 | 422 | -- | | |
| France | 1,202 | 1,235 | 1,236 | 1,241 | 1,266 | 1,258 | 1,254 | 1,256 | 1,248 | 1,246 | 1,252 |
| Greece | 608 | 606 | 645 | 668 | 682 | 693 | 701 | 716 | 732 | 763 | 764 |
| Israel | 114 | 113 | 114 | 115 | 115 | 114 | 128 | 128 | -- | | |
| Italy | 1,891 | 1,930 | 1,969 | 2,000 | 2,028 | 2,087 | 2,143 | 2,202 | 2,228 | 2,253 | 2,253 |
| Jordan | 37 | 37 | 38 | 39 | 40 | 42 | 42 | 44 | 44 | | |
| Lebanon | -- | -- | -- | -- | -- | 26 | 29 | 30 | -- | | |
| Malta | 39 | 40 | 40 | 41 | 37 | 40 | 40 | 39 | 39 | 39 | 38 |
| Morocco | 97 | 102 | 110 | 119 | 124 | 133 | 143 | 153 | 164 | | |
| Palestine | 6 | 6 | 7 | 8 | 8 | 8 | 9 | 9 | -- | | |
| Slovenia | 28 | 28 | 29 | 30 | 30 | 31 | 33 | 44 | 44 | 44 | 45 |
| Spain | 1,333 | 1,394 | 1,452 | 1,512 | 1,580 | 1,615 | 1,642 | 1,685 | 1,737 | 1,785 | 1,838 |
| Syria | 35 | 35 | 39 | 40 | 43 | 46 | 47 | 48 | 51 | | |
| Tunisia | 206 | 214 | 222 | 226 | 230 | 232 | 236 | 238 | -- | | |
| Turkey | 369 | 396 | 421 | 459 | 501 | 546 | 531 | 563 | -- | | |

**Table 46. Number of bed places in hotels and similar establishments in Mediterranean countries (in thousands).**

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 Mediterranean countries as well as its density along the coast (measured by the average distance between installations per country). As it can be seen the most affected areas (in terms of existing number of infrastructures) are West and Central Med, whereas the area with the highest density (shortest distance between marinas) is the West Med, with a minimum average distance of 14 km between marinas in Spain and France.

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 Mediterranean countries as 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. Figure 35 shows the different types of structures that can be found along the Spanish Mediterranean coastline.

| Country | Distance (km) | Number of marinas |
|---|---|---|
| Albania | 38 | 11 |
| Algeria | 50 | 24 |
| Croatia | 72 | 81 |
| Cyprus | 261 | 3 |
| Egypt | 159 | 6 |
| France | 14 | 124 |
| Greece | 111 | 135 |
| Israel | 22 | 8 |
| Italy | 29 | 253 |
| Lebanon | 75 | 3 |
| Libya | 118 | 15 |
| Malta | 30 | 6 |
| Montenegro | 147 | 2 |
| Morocco | 57 | 9 |
| Slovenia | 16 | 3 |
| Spain | 14 | 191 |
| Syria | 61 | 3 |
| Tunisia | 45 | 29 |
| Turkey | 140 | 37 |

**Table 47. Mean distance between navigational ports and number of marinas in Mediterranean Countries (**Plan Bleu 2011).

| Country | Total lenght of the coastline (km) | Eroding coastline (km) | Artificial coast (% of total coastline) |
|---|---|---|---|
| Cyprus* | 66 | 25 | 20 |
| France | 8,245 | 2,055 | 15 |
| Greece | 13,780 | 3,945 | 4 |
| Italy | 7,468 | 1,704 | 8 |
| Malta | 173 | 7 | 7 |
| Slovenia | 46 | 14 | 18 |
| Spain | 6,584 | 757 | 10 |

**Table 48. 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 (Eurosion 2004).[*: only accounting the 20% of Cyprus coastline].**

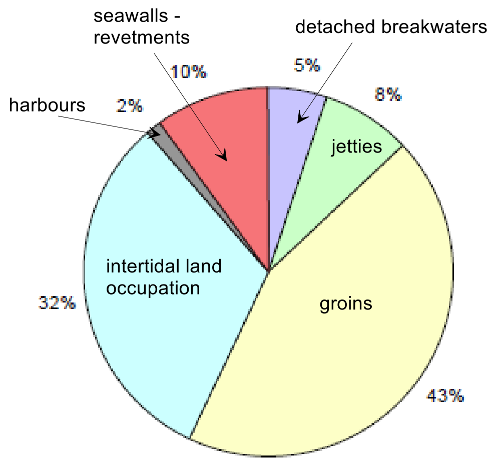



**Figure 35. Percentage of coastal infrastructures along the Spanish Mediterranean coast** (MAGRAMA, 2012).

As mentioned in previous chapters, **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 49 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 | Land | | | Underwater | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | People | kg | km | People | kg | km | People | kg | km |
| Croatia | 42 | 377 | 8 | 14 | 100 | 1 | 56 | 477 | 9 |
| Cyprus | 3,095 | 6,975 | 275 | 295 | 1,729 | 1,359 | 3,390 | 8,704 | 1,634 |
| Egypt | 5,014 | 51,402 | 282 | 1,595 | 11,384 | 140 | 6,609 | 62,786 | 422 |
| France | 315 | 3,761 | 20 | 160 | 4,215 | 38 | 475 | 7,976 | 58 |
| Greece | 6,052 | 26,402 | 208 | 465 | 23,614 | 47 | 6,517 | 50,016 | 255 |
| Israel | 4,471 | 22,517 | 34 | 205 | 2,123 | 7 | 4,676 | 24,640 | 41 |
| Italy | 2,905 | 19,835 | 111 | 371 | 2,510 | 90 | 3,276 | 22,345 | 201 |
| Jordan | 3,930 | 2,761 | 12 | 318 | 1,571 | 4 | 4,248 | 4,332 | 16 |
| Lebanon | 50 | 82 | 1 | 70 | 273 | n/d | 120 | 355 | 1 |
| Malta | 135 | 873 | 24 | 256 | 3,831 | 7 | 391 | 4,704 | 31 |
| Palestine | 11 | 34 | 3 | 54 | 112 | 1 | 65 | 146 | 4 |
| Spain | 1,424 | 20,090 | 79 | 340 | 3,051 | 56 | 1,764 | 23,141 | 135 |
| Tunisia | 7 | 136 | 1 | 12 | 762 | 1 | 19 | 898 | 1 |
| Turkey | 24,747 | 77,422 | 1,079 | 517 | 3,730 | 97 | 25,264 | 81,152 | 1,175 |

**Table 49. Data from Mediterranean beach & underwater cleanups. ICC campaigns 2002-2006** (UNEP/MAP 2011).

As it was previously mentioned, the marine litter has different origins and not only will be due to recreational activities. To illustrate the importance of this sector in Mediterranean coast, Figure 36 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.

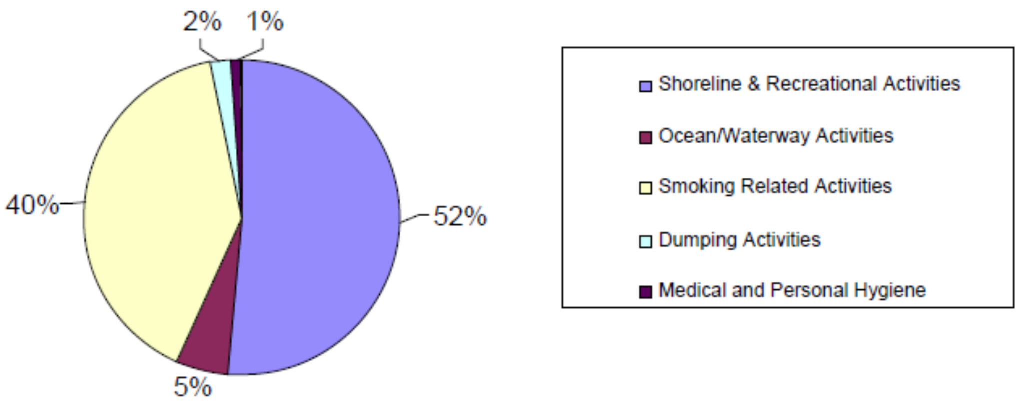



**Figure 36. Sources of marine litter (2002 - 2006)** (UNEP/MAP, 2011).

### 4.4.4 Gap analysis

Domestic tourism: Although some statistics are available for national tourism in Mediterranean countries, they cannot be directly used for comparison due to the different methods used. It has to be taken into account that internal tourism is a very important part of the total tourism activity in Mediterranean countries. Therefore, it is important to obtain comparable data so that the analysis of the whole sector could be performed.

There is a lack of information for the indicators of coastal artificialization, beach works and km of erosion for Israel, Malta, Tunisia, Algeria, Morocco, Syria, Croatia, Lebanon, Libya, Turkey and Egypt.

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

Statistics have been presented in country scale tables. In the case of the southern Mediterranean countries, tourism activity is located mainly at the coast, so the country scale approach describes appropriately coastal tourism. In other cases, such as Spain, France, Turkey and Egypt where tourism activity is disseminated around the country and, even is developed in other coastal areas, local statistics are required.

## 4.5 Submarine cable and pipeline operations

Prepared by Marta Pascual (BC3) and Didier Sauzade (Plan Bleu).

### 4.5.1 Introduction

#### Context

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

Oil and Gas Pipelines:

International trade and sea transport of hydrocarbons represent a vital link in the chain of oil and oil services, since the centers of production of oil and gas are generally far from the centers of consumption. The distances are very important and international transportation of crude oil is mainly done by sea. Hydrocarbons can be liquid or gaseous, hazardous and likely to be polluted and polluting. These characteristics give importance to their transport characteristics. Indeed, it should be transported in special containers: oil tankers ("tankers") and pipelines for crude oil, and pipelines for natural gas. To distinguish the transportation of oil from other shipping, we have mainly focused on the transport of oil through shipping. However, some specific infrastructure maritime transport of oil from pipelines will also be identified even thought their socio-economics will not be considered to avoid double counting.

Submarine cables:

Economic activities related to submarine cables are considered separately from transport activities (although it is a kind of transportation including information and power). They include the installation and operation of:

- Telecommunication submarine cables
- Electricity submarine cables

### 4.5.2 Sector and socioeconomic analysis for the Mediterranean

#### General

Oil and Gas Pipelines:

The Mediterranean region is a transit zone of more than 22% of the trade of oil in the world, which makes its potential impacts and risks at sea to be increased. About 336 millions of tons of oil are transported across the Mediterranean Sea most of which is transported mainly by tankers and partly due to some international pipelines However, if compared to the ship-transport, the transport of oil through pipelines crossing the Mediterranean can be considered as marginal.

In addition, also crossing the Mediterranean Sea, over 105 billion $m^3$ of gas are exchanged through some of the major international gas pipelines. In 2010, those pipelines carried approximately 41 billion $m^3$ of gas.

**Table 50. Gas transport at the Mediterranean Sea (El Andaloussi, El Habib, 2011; BP, 2011)**

| Characteristics | Figures | Reference year |
|---|---|---|
| Number of the gas pipelines | 5 (+2 projets) | 2011 |
| Undewater gas pipelines (Km) | 943 km (+502 km projets) | 2011 |
| Trade volume of gas transported through the Mediterranean Sea | 105 millions $m^3$ | 2010 |
| Trade volume of gas transported via pipelines from the Mediterranean Sea. | 41 millions $m^3$ | 2010 |

Submarine cables:

We have considered a cable as being from the Mediterranean if the cable is tied to one or more Mediterranean countries or if it ties two destinations under the condition that the cables run through the Mediterranean. Therefore, the Mediterranean parts of long-distance worldwide cables will also be taken into consideration. In the context of the socio-economic activities related to submarine cables, this study takes into account:

- - The installation, operation and maintenance of electrical cables
- - The installation of telecommunications cables

Due to lack of data, we are not able to calculate the costs of operation and maintenance of telecommunication cables or even the turnover generated by the rental units of the frequency telecommunication cables. Furthermore, due to reasons of no data availability, the evaluation of jobs related to the electrical cables in the Mediterranean could also not be performed.

**Telecommunications cables**

Since the appearance of the first telecommunication submarine cable of optic fiber in the 1980s, submarine cables have become the primary pathways of telecommunication, even more important than satellites. The dimensions of a submarine telecommunication cable are 28-50 mm in diameter with a weight of less than 10 kg / m. Figure 35 shows the number and lengths of submarine telecommunication cables which have been settled in the Mediterranean through time. The graph rises particularly rapidly between 1988 and 2002, due to the development of optic fiber cables.

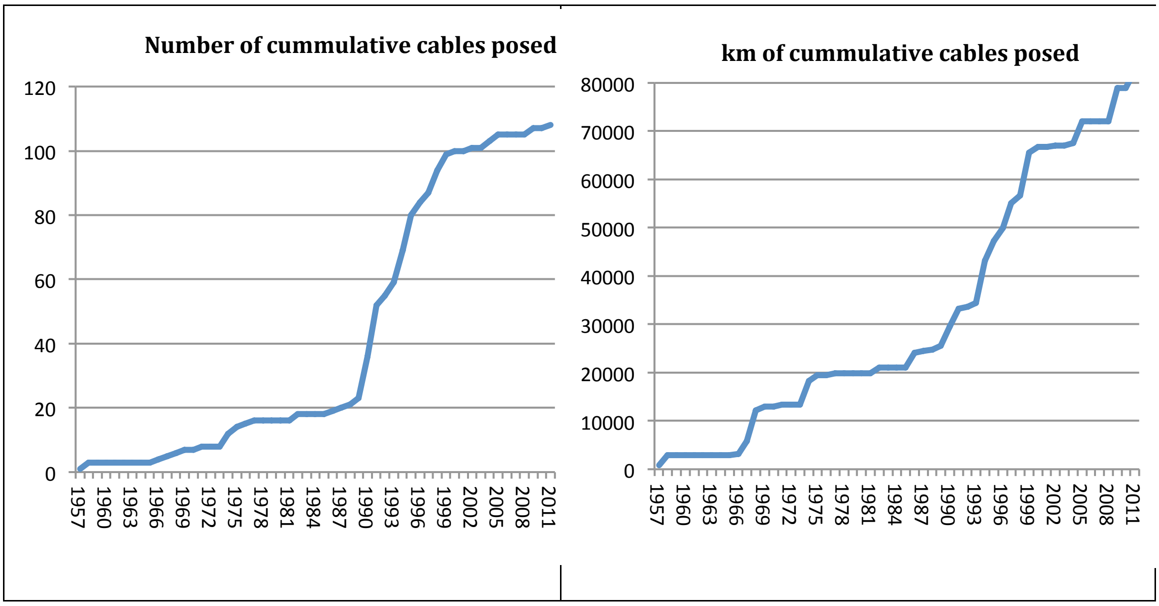



**Figure 37. Cumulative number of km of submarine telecommunication cables posed in the Mediterranean, 1957-2011 (ICPC, 2010; Telecom Egypt, 2011).**

Nowadays cables carry more than 95% of transmissions of telephone, fax, internet and e-mail and television programs (Drew and Hopper, 2009). A very detailed study on the evolution of submarine cables in the world was established by the ICPC in cooperation with UNEP-WCMC (UNEP-WCMW and ICPC, 2009).

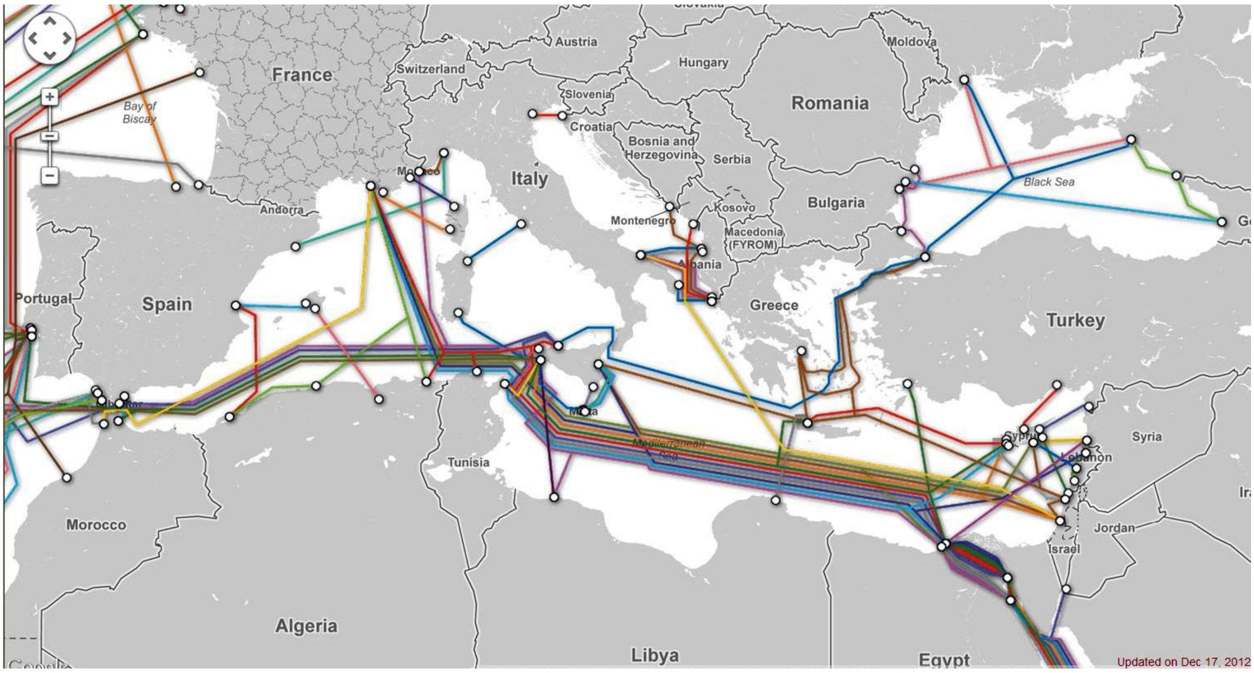



**Figure 38. Submarine cables map taken from TeleGeography (Available at: [http://www.submarinecablemap.com/](http://www.submarinecablemap.com/); accessed 07/01/2013).**

From those cables we must highlight:

- - The FLAG Europe-Asia (FEA) cable of 28,000 km length which goes from Porthcurno (UK) to Miura (Japan) stopping at Estepona (Spain) and then crossing all the Mediterranean Sea, The Red Sea, The Indic Ocean and the Sea of China
- - The Atlas Offshore cable (transferring 320 gigabits) which goes from Asilah (Marocco) to Marseile (France)
- - The SEA-ME-WE 4 cable (transferring 1280 gigabits) which goes from Marseille (France) to Asia (trough all the Mediterranean, red and Indic Ocean).
- - The I-ME-WE cable (transferring 3840 gigabits) which goes from Marseille (France) to Mumbai (India) through all the Mediterranean, Red Sea and Indic Ocean.

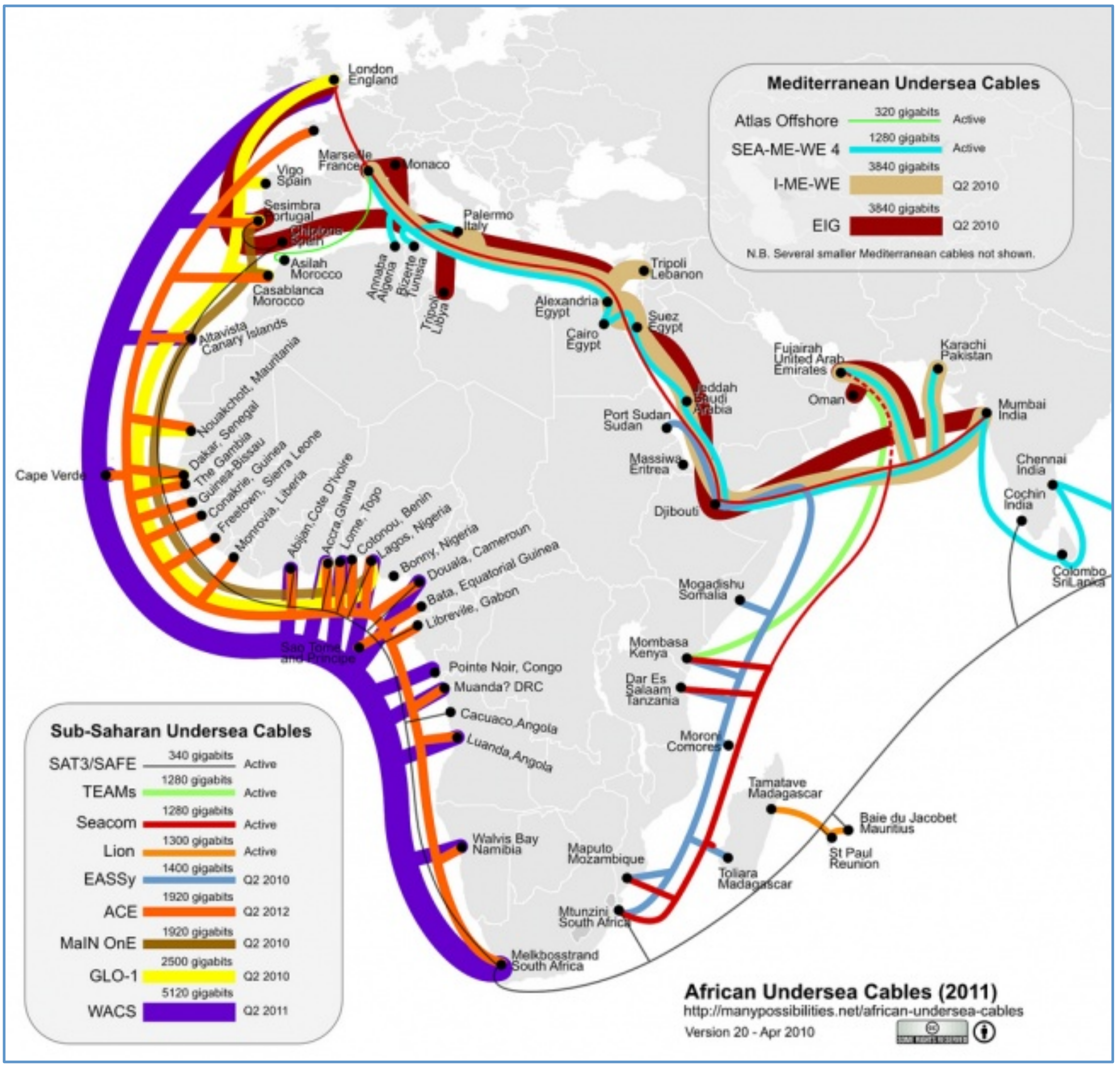



**Figure 39. Mediterranean and African Undersea Cables (info from [http://wikitel.info/wiki/Cable_submarino](http://wikitel.info/wiki/Cable_submarino)).**

## Electrical cables

Regarding electrical submarine cables, three are settled in the Mediterranean at the moment, but several projects are underway. The dimensions of an electric cable are significantly greater than those of a telecommunications cable. An underwater electric cable reaches a diameter of about 235 mm and a weight of 100 kg / m.

The total length of electrical and telecommunication cables along the bottoms of the Mediterranean is about 82 845 km, including the 202 km of 29 telecommunication cables which are settled also outside of the Mediterranean. However, several ongoing projects could rise up this total cable length to over 88 000 km in a very few years. There are seven cable ships operating in the Mediterranean (with usual ports in the Mediterranean) at the moment (see Table 46). However, there are several other cable ships in the world that operate globally and can also appear in the Mediterranean.

**Table 51. Cable ships with their usual port in the Mediterranean, 2010 (ICPC, 2010).**

| | Name | Main Port | Registration Country | Operator/Owner | Capacity |
|---|---|---|---|---|---|
| 1 | Raymond Croze | La Seyne sur Mer, France | Kerguelen | France Telecom Marine | 1300 tonnes |
| 2 | René Descartes | La Seyne sur Mer, France | Kerguelen | France Telecom Marine | 5800 tonnes |
| 3 | Certamen | Catania, Italy | Italy | Elettra Tlc S.p.A. | 1200 tonnes |
| 4 | Pertinacia | Naples, Italy | Italy | Elettra Tlc S.p.A. | 6000 tonnes |
| 5 | Teliri | Catania, Italy | Italy | Elettra Tlc S.p.A. | 2500 tonnes |
| 6 | Giulio Verne | Castellamare Di Stabia, Naples, Italy | Italy | Pirelli | 8000 tonnes |
| 7 | Teneo | Valencia,Spain | Spain | Tyco Telecommunications | 1000 tonnes |

These are some of the names of the submarine cables which we can find at the Mediterranean: ALETAR; ALPAL-2; Aphrodite 2; BERYTAR; Bezeq International Optical System; CADMOS; CIOS (cable system); Columbus II; Columbus III; Eastern Mediterranean Optical System 1; Europe India Gateway; GO-1; I-ME-WE; KINYRAS; LEV (cable system); MedNautilus; MENA (cable system); Minerva (cable system); Pentaskhinos; SEA-ME-WE 3; SEA-ME-WE 4; TE North; TEFKROS; UGARIT.

## Socio-economic data

### Oil and Gas Pipelines:

In 2010, the turnover of gas transportation via pipeline in the Mediterranean Sea was approximately €1 billion, excluding €100 million from transit charges levied by third countries through which the pipelines pass.

However, there is an important lack of data according to the number of jobs related to oil transportation activities which cannot yet be estimated. Since most oil present in the Mediterranean region is located on the ground and the majority of oil transport is carried by tankers, the socio-economic impacts associated with oil in the Mediterranean Sea are estimated to be marginal.

**Table 52. Turnover and added value of the gas transmission pipelines in the Mediterranean Sea, 2010 (Communications with El Habib El Andaloussi, 2011; BP 2011; Factor value based on Pugh, 2008).**

| | |
|---|---|
| **Turnover gas transmission via pipelines** | €1 billion + €100 million from transit charges |
| **Added value of gas transportation via pipeline** | €700 millions + €100 million from transit charges |

### Submarine cables:

Observing the investment costs related to submarine cables, we see a very large difference in cost between telecommunication cables and electrical cables as the average investment cost per kilometer is a little more than 40000 € for telecommunication cables and about € 2 million for electric cables.

**Table 53. Estimates of investment costs of cables through the Mediterranean, 2011 (MED-IMP, 2010; ICPC, 2010; UCTE, 2008).**

| | | |
|---|---|---|
| Telecomunication cables | Investment cost of telecommunication cables located in the Mediterranean | 3,2 billion € (whose 1,2 billion € out of service) |
| | Cost of investment projects of telecommunication cables located in the Mediterranean | 272 million € |
| | Average annual investment cost (installation of telecommunication cables) | 61,2 million € |
| Electrical cables | Investment cost of electrical cables located in the Mediterranean | 674 million € |
| | Cost of investment projects of electrical cables located in the Mediterranean | 4,7 billion € |
| | Average annual investment cost (installation of electrical cables)) | 700,000 € |
| | Average annual investment cost for the next 10 years (laying cables) | 200 – 500 million € |
| Cable Ships | Direct jobs on seven ships in the Mediterranean | 460 |

Regarding jobs related to the installation and operation of submarine cables, an estimate of the order of magnitude is currently not possible. Indeed, the available data on economic activities cables are aggregated at both corporate and national levels. Given that the cost structures and labor of submarine cables differ significantly from those of terrestrial cables, it is not possible to use aggregate data to estimate an order of magnitude for cables submarines. However, 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.

## Geographical distribution

### Oil and Gas Pipelines:

In the Mediterranean, the oil production is concentrated in the South of the Mediterranean, while the load centers are located in the countries of the northern shore of the sea. This structure is also reflected in transport patterns of hydrocarbons. Indeed, the exchange of intra-Mediterranean hydrocarbons are mainly in the South-North direction, which makes the Mediterranean Sea almost an obligatory passage by sea between the centers of production and consumption centers.

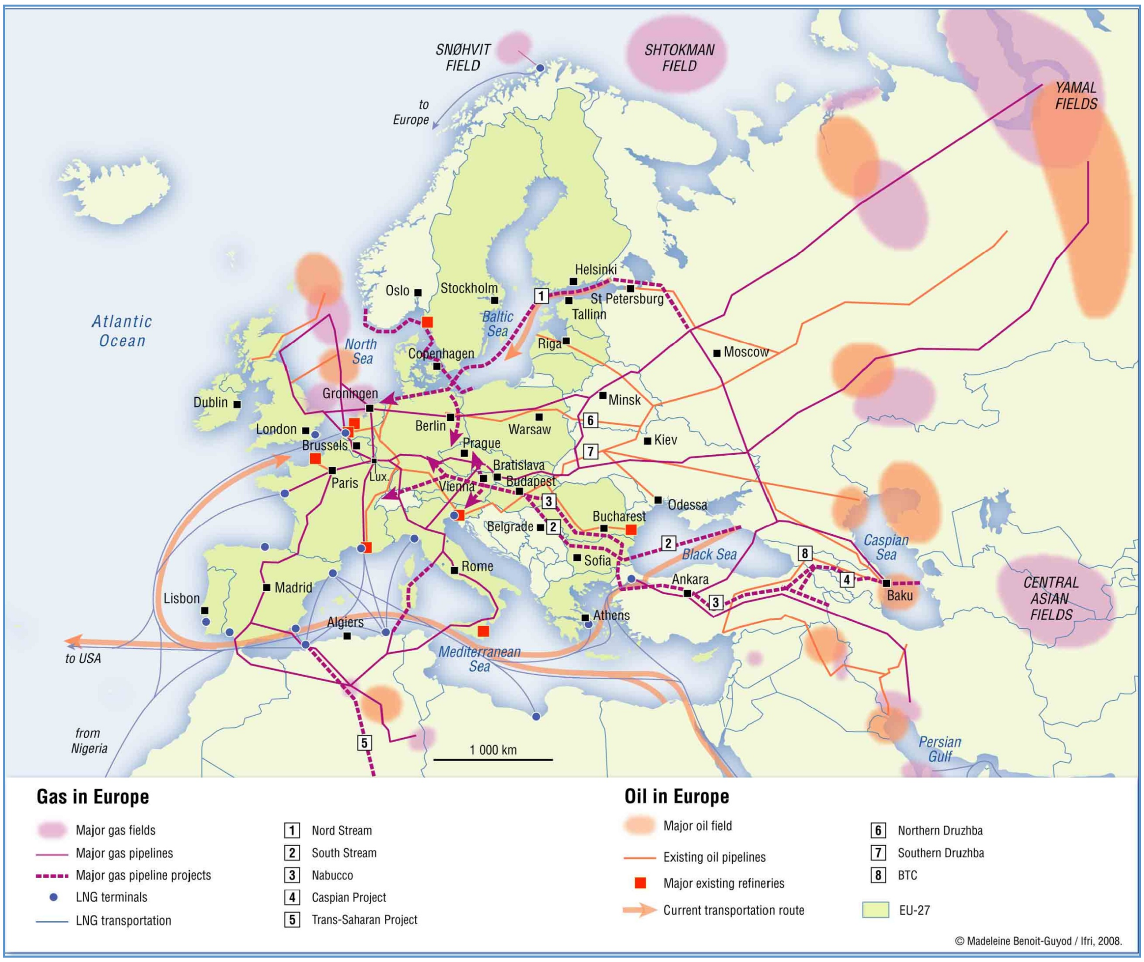



**Figure 40. Oil and Gas transport in Europe (Nies, 2011).**

**Table 54. Gas pipelines at the Mediterranean (Eurogas; EGM; Cedigaz).**

| **Linking** | **Gas pipeline name** | **Capacity Gm³/yr** | **In service since** | **Km underwater** |
|---|---|---|---|---|
| Algeria – Italy (via Tunis) | Enrico Mattei –EMG (ex-Transmed) | 27 | 1983 &1994 | 155 |
| Algeria – Spain (via Marocco) | Pedro Duran Farell –PDFG- (ex-GME Maghreb-Europe) | 13 | 1997 & 2004 | 45 |
| Libia - Italy | Greenstream | 8 | 2004 | 516 |
| Turkey - Greece | ITG | 11 | 2007 | 17 |
| Algeria - Spain | Medgaz | 8-10 | March 2011 | 210 |
| Greece - Italy | IGI | 8-10 | Planned 2011 | 217 |

| | | | | |
|---|---|---|---|---|
| Algeria - Italy (Sardinia) | Galsi | 8-10 | Planned 2011 | 285 |

In order to trade oil internationally, exchange of hydrocarbons in the Mediterranean are dominated by exchanges between the Mediterranean countries (22%), followed by trades with Russia (15%) and the Middle East (14%).

### Submarine cables:

See figure of cables geographical distribution above at Figure 36.

## Future trends

### Oil and Gas Pipelines:

Faced with the growing demand for energy in the Mediterranean countries, exports and total imports, from or to the Mediterranean countries, will continue to grow and increase between 20-25% by traded volume in 2025. Therefore, the Mediterranean Sea will continue to play the role of a transit region for nearly a quarter of world trade for oil, with ever-increasing the potential risks of impacts to sea.

### Submarine cables:

In the Mediterranean region, several projects of lying electrical and telecommunications submarine cables have been announced or are already under construction, with an investment cost of approximately € 270 million for telecommunication cables and approximately € 4.7 billion for electric cables.

Regarding the installation of telecommunication cables, recent years have shown a clear trend towards the installation of long-distance cables which are managed by consortia of national telecommunications companies. Indeed, it seems that the market for "small" telecommunication cables (less than 500 km) is relatively saturated leading to those companies to rely on the replacement of existing cables as work. Therefore, the trend for future years would mainly be the placement of international long distance cables or the replacement of obsolete or irreparable cables.

What it is for sure is that the market for submarine cables is booming and, in recent years, the cumulative length of submarine cables in the Mediterranean could reach eight times its current length. These prospects are based on the MEDRING (Mediterranean electricity ring = loop electrical Mediterranean) draft, an initiative that emerged in the 2000s, which has grown considerably in the last three years. The project's objective is to link Europe and the countries of the southern Mediterranean with electrical interconnections to ensure energy security in the region. This is to allow the exchange of electricity between the countries of the southern Mediterranean, which have significant potential energy and electricity demand with relatively small countries of the European Union that they are characterized by significant energy demand and energy resources much less abundant. According to the European Commission, the electrical loop is particularly essential for developing the potential of solar and wind energy in the region. In addition, the potential development of offshore wind energy will require underwater cables that carry electricity produced at sea to land.

### 4.5.3 Sector and socioeconomic analysis for the Black Sea

#### General

Oil and Gas Pipelines:

The Black Sea region is a contested neighbourhood and the subject of intense debate. This reflects the changing dynamics of the region, its complex realities, the interests of outsiders and the region's relations with the rest of the world. Its strategic position, linking north to south and east to west, as well as its oil, gas, transport and trade routes are all important reasons for its increasing relevance (BSC).

In 1995 it was created by the EU the Interstate Oil and Gas Transportation to Europe (INOGATE), which is a regional structure which covers the energy transport in the Black Sea (BSC). It involves countries like: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkey, Turkmenistan, Ukraine, and Uzbekistan, and it aims to support the development of energy cooperation between the European Union, the littoral states of the Black and Caspian Seas and their neighboring countries.

Submarine cables:

International service is provided by three submarine fiber-optic cables in the Mediterranean and Black Seas, linking Turkey with Italy, Greece, Israel, Bulgaria, Romania, and Russia; also by 12 Intelsat earth stations, and by 328 mobile satellite terminals in the Inmarsat and Eutelsat systems (2002)

#### Socio-economic data

Oil and Gas Pipelines:

The energy dispute between Russia and Ukraine in the winter of 2008-09 was a clear indication of the importance of energy security for the region and for its customers. In the context of the Black Sea, the principal transport and pipeline routes for oil and gas from the Caspian basin and Russia to the West have become a key test of several types of relationship: Firstly, those between the producers; Russia, Azerbaijan, Turkmenistan and Kazakhstan, secondly, between the transit countries; Russia, Georgia, Turkey and Ukraine and finally between the consumers; EU countries, Turkey and others. The ability to strike a rational balance between the respective interests of all players, meaning security of supply for consumers, security of demand for producers and security of steady revenue for transit countries, will be a make-or-break issue for the development of successful models of cooperation between the Black Sea states (BSC).

**Table 55. Oil in 2009.**

| | Armenia | Azerbaijan | Bulgaria | Georgia | Greece | Moldova | Romania | Russia | Turkey | Ukraine |
|---|---|---|---|---|---|---|---|---|---|---|
| Reserves (thousand millions barrels-2009) | 0 | 7 | 0.0015 | 0.035 | 0.010 | 0 | 0.60 | 60 | 0.30 | 0.395 |
| Production (thousand barrels daily-2008) | 0 | 875.15 | 3.35 | 0.97 | 4.89 | 0 | 115.24 | 9789.78 | 46.11 | 101.27 |
| Consumption (thousand barrels daily-2008) | 47 | 121 | 120 | 17 | 433.98 | 15.80 | 255 | 2916 | 675.54 | 370 |
| Imports (thousand barrels daily-2008) | 0 | 0 | 144 | 0.30 | 386.67 | 0 | 48 | 174 | 437.28 | 230 |
| | N/A | N/A | N/A | N/A | 134.24 | N/A | N/A | N/A | 297.27 | N/A |
| Exports (thousand barrels daily-2008) | 0 | 730 | 0 | 0 | 21.40 | 0 | 5120 | 0 | 0 | 0 |
| | N/A | N/A | N/A | N/A | 131.58 | N/A | N/A | N/A | 133.05 | N/A |

[1]International Energy Statistics

**Table 56. Gas in 2009 (International Energy Statistics).**

| | Armenia | Azerbaijan | Bulgaria | Georgia | Greece | Moldova | Romania | Russia | Turkey | Ukraine |
|---|---|---|---|---|---|---|---|---|---|---|
| Reserves (trillion cubic meters - 2009) | 0 | 0.84 | 0.005 | 0.008 | 0.001 | 0 | 0.063 | 47.57 | 0.008 | 1.10 |
| Production (billion cubic meters-2008) | 0 | 16.19 | 0.31 | <0.02 | <0.02 | 0 | 11.41 | 662.21 | 1.01 | 19.79 |
| Consumption (billion cubic meters-2008) | 1.92 | 10.64 | 3.39 | 1.72 | 4.21 | 2.52 | 16.93 | 475.69 | 37.18 | 80.78 |
| Imports (trillion cubic meters) | 1.92 | 0 | 3.08 | 1.72 | 4.19 | 2.52 | 5.49 | 56.88 | 36.72 | 64.19 |
| Exports (billion cubic meters) | 0 | 5.55 | 0 | 0 | 0 | 0 | 0 | 243.41 | 0.42 | 3.19 |

**Table 57. Major pipelines (Global Insight).**

| Name | Capacity | Source | Route | Notes |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| The Baku-Tblisi Ceyhan Pipeline (BTC) | 1 million bb/d | Azeri Light crude | Azxerbaijan-Georgia-Turkey | Began operations in 2006. It is the only major export route for Caspian oil that does not pass through Russian territory or the crowded Turkish Straits. |
| Kirkuk-Ceyhan | 1,65 million bb/d | | Iraq-Turkey | Frequent sabotage attacks on the pipeline and feeder lines regularly disrupt operations.However, throughput has increased gradually and supplies have become more stable as violence in Iraq has declined |
| Samsun-Ceyhan (proposed) | 1 million to 1,4 million bb/d | | | In May 2006 the Turkish government approved plans for the Samsun-Ceyhan pipeline. Initial construction began in 2007 |

## Submarine cables:

**Table 58. Telecommunication cables at the Black Sea (from www.cytaglobal.com ).**

| Cable name (Acronym) | Name | Linking | Length | Capacity | Start Operation Year | Cost | Other |
|---|---|---|---|---|---|---|---|
| BSFOCS | Black Sea Fibre Optic Cable System | Bulgaria, Ukraine and Russia | 1300 km | 20 Gbit/s | September 2001 | €55 millions | http://www.bsfocs.com/bsfocs-profile.pdf |
| KAFOS | Karadeniz Fiber Optik Sistemi - Black Sea Fibre Optic System | Romania, Bulgaria, and Turkey | 527 km | 622 Mbit/s | 13 June 1997. | | Is integrated with other systems such as TBL, TAE and ITUR |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ITUR | Italian-Turkish-Ukrainian-Russian Submarine Fiber Optic Cable System | Italy; Turkey; Ukraine; Russia | 3500 km | 565 Mbit/s | August 1994 | | Thanks to the integration of the ITUR system with EMOS-1, KAFOS and SEA-ME-WE 3 systems, Türk Telekom has come into strategic prominence in handling the international communication traffic |

## Geographical distribution

### Oil and Gas Pipelines:

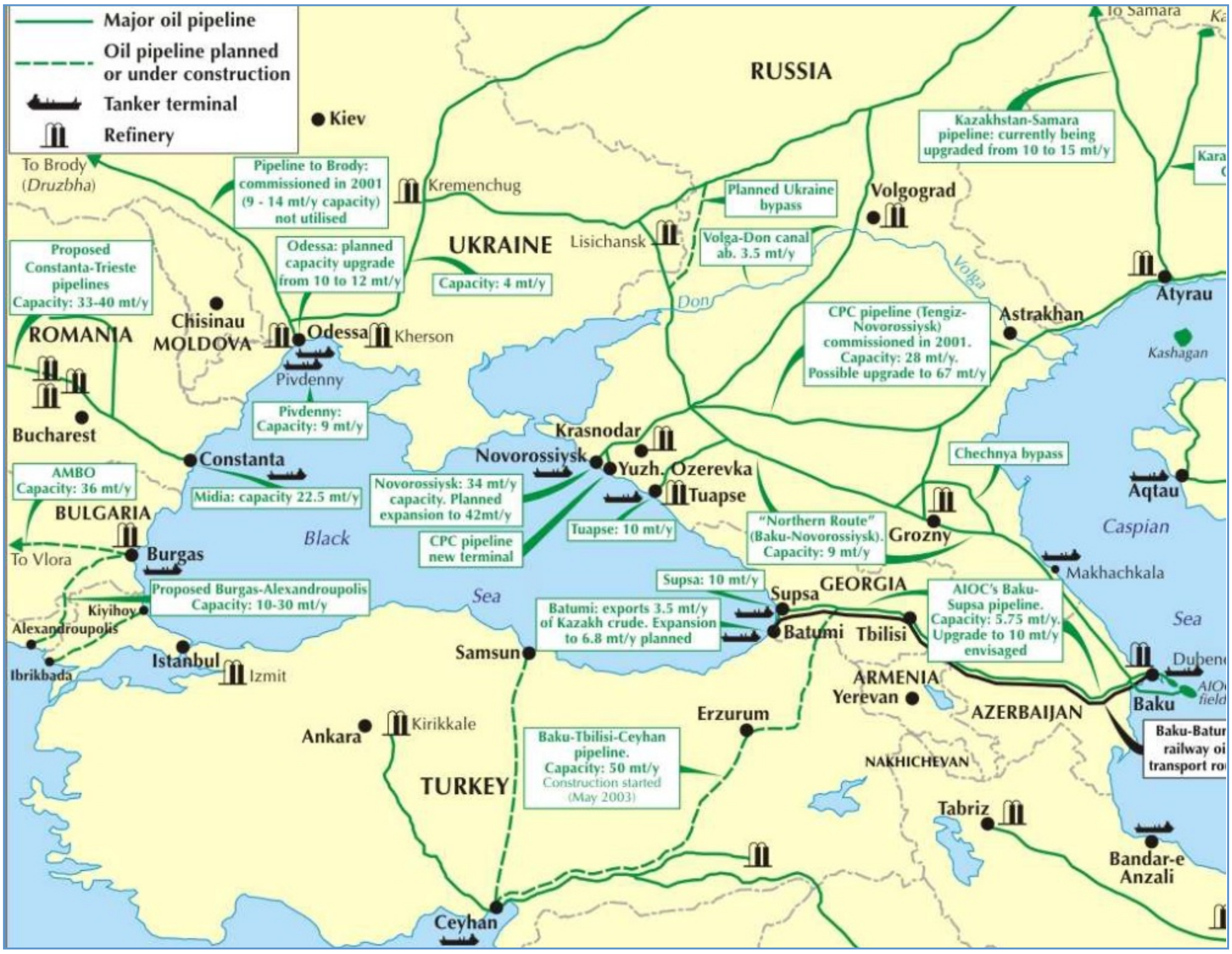



**Figure 41. Schematic Map of the Black Sea Oil Transit Routes (IEA, 2005).**

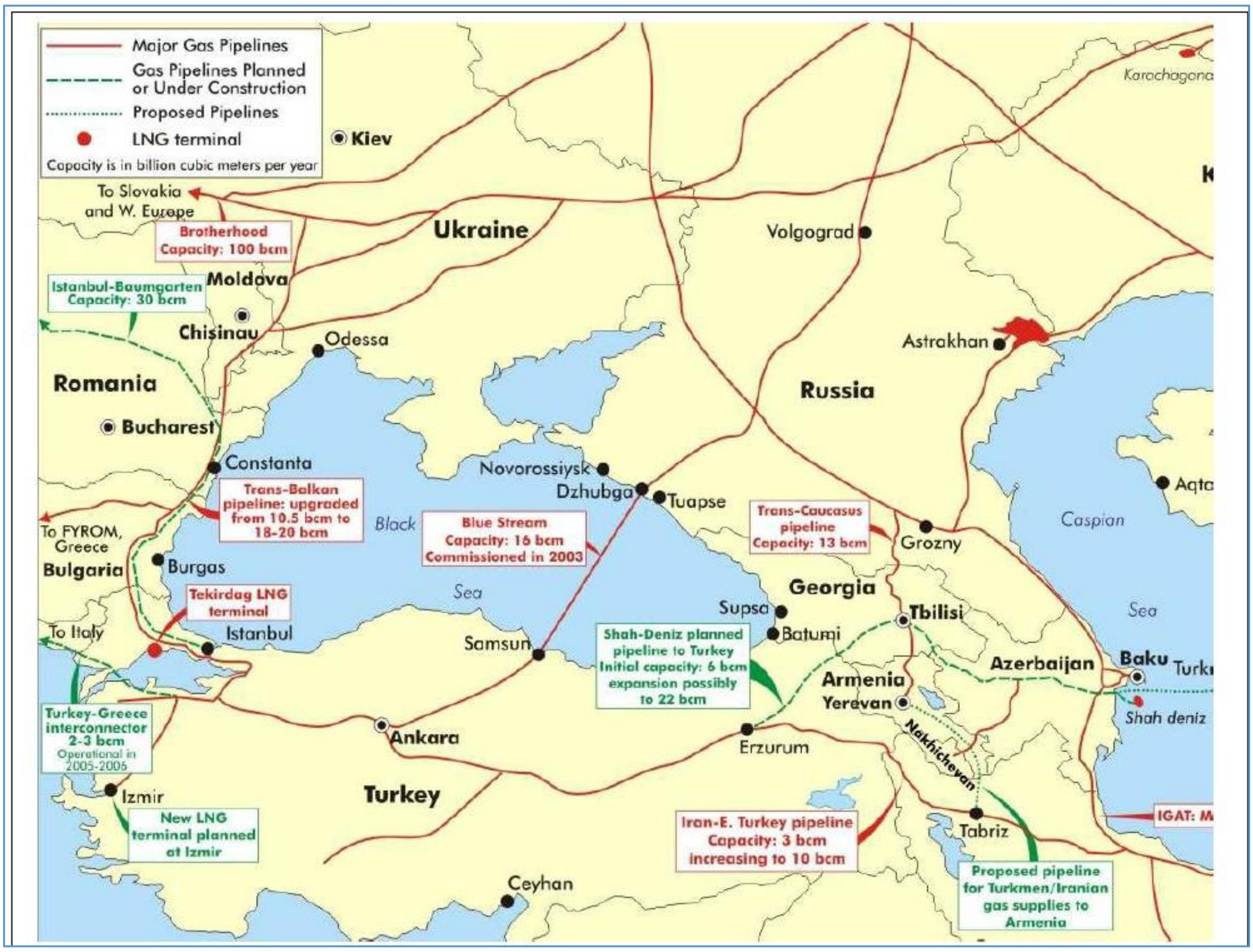



**Figure 42. Schematic Map of Black Sea Natural-Gas-Transit Routes (IEA, 2005).**

### Submarine cables:

Telecommunications cables:


**Figure 43. Schematic Map of the Black Sea telecommunication cables.**

## Future trends

### Oil and Gas Pipelines:

There are various prospective oil explorations forthcoming at the Black Sea such as the one between Turkey-Shell and another one between Russia-ExxonMobil.

Shell has signed an agreement with Turkey's state-owned energy company TPAO on oil exploration in the western Black Sea region, envisaging drilling at least one well under the deal with a total drilling cost of around $150 million to $200 million. With this initiative Turkey has stepped up exploration efforts in the Black Sea and Mediterranean in co-operation with foreign companies as it tries to reduce its import dependence, but has yet to find oil in the Black Sea.

On the same hand ExxonMobil has signed an agreement with the Russian state oil company Rosneft to jointly explore and develop oil and gas resources in the Black Sea's Tuapse Trough. The area, covering 11,200 square kilometers, lies in deep waters in the northeast section of the Black Sea, offshore the Krasnodar region in Southern Russia, and is near to the major Russian oil export terminal at Novorossiysk. This is ExxonMobil's second largest venture in Russia after the path-breaking Sakhalin-I project (also in collaboration with Rosneft) about a decade ago. Rosneft estimates that the area could contain 7.3 billion barrels of oil equivalent of untapped oil and gas resources - about the same as the total proved reserves of Norway. The deal requires ExxonMobil to invest $1bn in the exploration stage, during which, the venture would stand at 50%:50%. The venture split would then be revised to 66%:33% in favor of Rosneft at the development stage. The agreement also gives the two companies an option to extend the partnership at a later stage, namely in the development of regional transportation infrastructure, possible exports from Novorossiysk, and/or crude oil sales to Rosneft's nearby Tuapse refinery. There is also the possibility of further collaboration in research and development for deepwater exploration.

Therefore, Russia's offshore production is expected to increase to about 15% of total oil production by 2020 from less than 5% today, and Russian companies may look to engage in many more such mutually beneficial partnerships in the future. Although this could signal the start of a new optimistic era, observers will always be wary due to the history of changes to the regulatory framework and sometimes bitter legal wrangles.

Submarine cables:

If we look at TRACECA EU project, which is open for all the initiatives promoting the development of regional transport dialogue and ensuring the efficient and reliable Euro-Asian transport links, promoting the regional economy on the whole, we observe that the traffic volume is increasing between Europe and Asia. As an example: by 2008 traffic amounted 20.1 Tbps (TeraBytes Per Second), and forecast by 2012 is that traffic volume would surplus 81.1 Tbps.

From year to year the demand on bandwidths is increasing. For instance, traffic volume in 2008 amounted 20.1 Tbps, while for the year 2012 the traffic volume is assumed surplus of 81.1 Tbps.

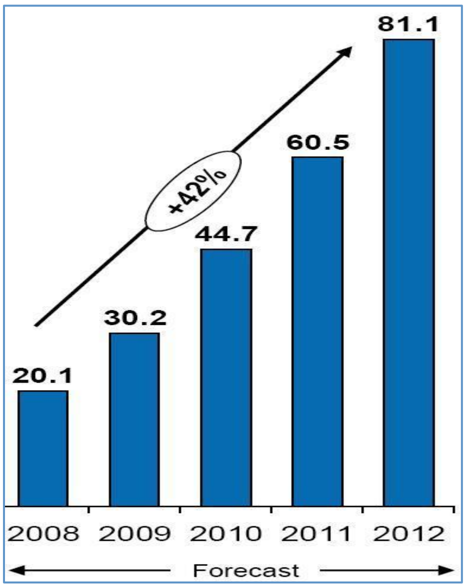



**Figure 44. Increased traffic volume trend since 2008.**

Furthermore, 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 45). The Poti-Constantsa route would have an estimated length of 1200 km and its costs are estimated to be around € 22 million. While the Poti-Istanbul route´s estimated length is 1059 km and its cost is estimated to be of € 20 million. The maximum term of construction is of 2 years and its construction turnover term -6-7years.

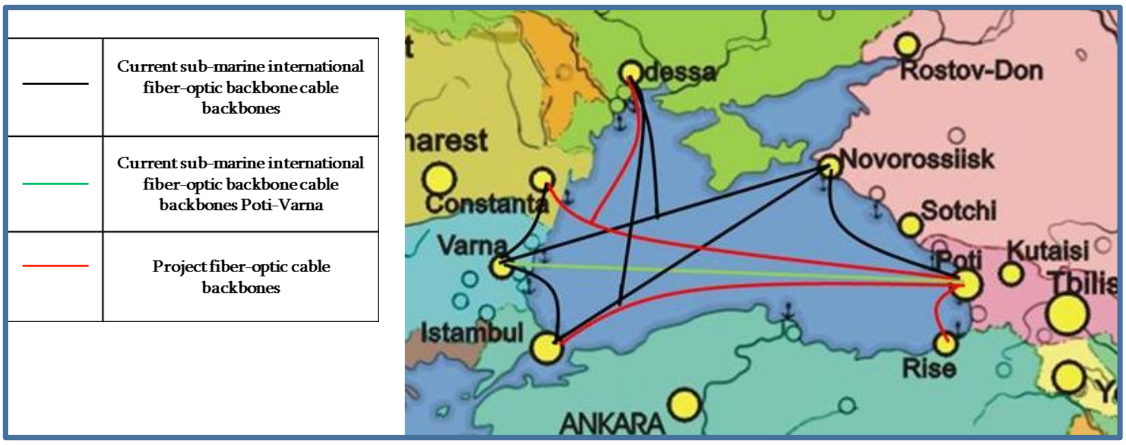



**Figure 45 : Schematic Map of the Poti-Constantsa fiber-optic submarine cable route**

### 4.5.4 Links to environmental pressures

There is a common misconception that nowadays most international communications are routed via satellites, when in fact well over 95 per cent of this traffic is actually routed via submarine fibre-optic cables. Data and voice transfer via these cables is not only cheaper, but also much quicker than via satellite (Carter *et al.*, 2009). Thus, there is a need to control and determine the best practices to settle these submarine cables. The International Cable Protection Committee has established a set of environmental criteria which we will summarize below:

The total length of fibre-optic cables in the world's oceans is c.1 million km (Carter *et al*., 2009). In terms of physical size, a modern cable is small. The deep-ocean type has a diameter of 17–20 mm and its counterpart on the continental shelf and adjacent upper slope is typically 28–50 mm diameter because of the addition of protective armouring. Despite this small footprint, fibre-optic cables may still interact with the benthic environment. Thus Environmental Impacts Assessments need to be carried out in order to assess and ensure that any environmental effects of cable laying and maintenance are taken into account before authorization is provided to lay a cable on the seabed.

**Physical damage**

Modern cables are usually buried into the seabed at water depths down to c.1500 m as a protective measure against human activities. However, some shallow-water cables may be placed on the seabed in areas unsuitable for burial, e.g. rock or highly mobile sand. For water depths greater than c.1500 m, deployment on the seabed is the preferred option (Carter et al., 2009). Thus, surface-laid cables may physically interact with the seabed under natural or human influences, creating the abrasion of rocks.

**Biological disturbance**

Over benthic biota: Overall, studies have demonstrated that cables have no or minimal impact on the resident biota. On the basis of 42 hours of video footage, the comprehensive study of Kogan et al. (2003, 2006) showed no statistical difference in the abundance and distribution of 17 animal groups living on the seabed within 1 m and 100 m of a surface-laid coaxial scientific cable. Likewise, 138 sediment cores with an infauna of mainly polychaete worms, nematodes and amphipods showed that the infauna was statistically indistinguishable whether near or distant from the cable. The main difference associated with the cable was that it provided a hard substrate for the attachment of anemones (Actiniaria). These organisms were abundant where the cable traversed soft sediment that normally would be unsuitable for such animals. Fishes, especially flat fishes, were more common close to the cable at two observational sites where small patches of shell-rich sediment had formed, probably in response to localized turbulence produced by current flow over the cable (Carter *et al*., 2009).

Over marine mammals and fish: Records extending from 1877 to 1955 reveal that 16 faults in submarine telegraph cables were caused by whales (Heezen, 1957; Heezen and Johnson, 1969). Thirteen of the faults were attributed to sperm whales, which were identified from their remains entwined in the cables. The remaining faults were caused by a humpback, killer and an unknown whale species. In most instances, entanglements occurred at sites where cables had been repaired at the edge of the continental shelf or on the adjacent continental slope in water depths down to 1135 m. However, whale entanglements have nowadays ceased completely. In a recent review of 5740 cable faults recorded for the period 1959 to 2006 (Wood and Carter, 2008), not one whale entanglement was noted. This cessation occurred in the mid-1950s during the transition from telegraph to coaxial cables, which was followed in the 1980s by the change to fibre-optic systems.

**Other physical disturbance** (underwater noise, marine litter)

Given our incomplete knowledge of the different responses of marine animals to different sources of noise (National Research Council, 2003), cable survey equipment is regarded as posing only a minor risk to the environment (SCAR, 2002) compared to prolonged high-energy midrange sonar systems, which may be associated with standings of some whale species (Fernandez *et al*., 2005) and are the subject of ongoing research (Claridge, 2007).

### 4.5.5 Gap Analysis

There is a clear evidence that both, the Mediterranean and the Black Sea are being highly used in terms of submarine cables and pipelines. However, a gap of information has been found when looking at the specificities these uses require in terms of legislation, potential conflicts with other marine uses, etc. According to the Convention on the High Seas of 1958-Freedom of the high seas, include freedom to lay submarine cables and pipelines. Thus, although coastal states have sovereign rights and jurisdiction in their exclusive economic zone, other states have the right to lay submarine cables and pipelines, and other uses associated with the operation of submarine cables and pipelines. This entails major troubles in terms of potential conflicts which may occur with other uses in the area and potential accidents which could also occur.

Furthermore, our incomplete knowledge of the different responses of marine animals to different sources of noise makes it even harder to determine their potential impacts onto the Mediterranean and Black Sea marine environments.

This highlights a major gap in submarine cables and pipelines legislations which should be shortly addressed for a correct management of our environments.

## 4.6 Marine hydrocarbon (oil and gas) extraction

Prepared by D. Sauzade, Plan Bleu, on the basis of former Plan Bleu grey literature.

### 4.6.1 Introduction

#### a) General context

Production in the Mediterranean is concentrated in waters of Egypt, Libya, Tunisia and Adriatic in Italy, but other areas are promising as offshore of the Levantine (Israel, Palestine and Lebanon) and Western Mediterranean (Catalonia and France). Production on the Black Sea shores has known several peaks in the past especially in Romania, followed by complete breaks for various political reasons. Nowadays, the Black Sea region can be considered as complex but hugely important area for hydrocarbon development. Recent offshore exploratory drilling activities are promising in most of the Black Sea, both for the shelf and the deeper areas.

However, the development of the offshore oil and gas production in the east part of the Mediterranean and in the Black sea is heavily conditioned by the evolution of the regional territorial conflicts, especially the Palestinian-Israeli and the Cyprus-Greek-Turkish ones.

#### b) 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.

### 4.6.2 Sector and socioeconomic analysis for the Mediterranean

The data used for the socioeconomic assessments and the assumptions made in case of extrapolation and value transfers are presented in Table 61. Gap Analysis.

#### Production

At the international level, the Mediterranean countries are relatively small producers of oil and gas, with 5.8% of global oil production and 5.7% of global production of natural gas in 2010. Considering the offshore production only, about 0.8% of oil production and 1.9% of global gas production come from the 250 or so of offshore oil and gas platforms (Court, 2011). After an initial phase of growth and decline between 1965 and 1973, offshore oil production in the Mediterranean took off after the first oil shock in 1974, reaching its peak in 1993 and decline slightly thereafter. During the last 10 years, oil production in the Mediterranean has remained relatively stable with an output of 34.6 million of tons of oil equivalent (TOE) in 2000 and 33.7 MTOE in 2010.

However, the production of offshore gas has increased steadily since the 1970s and more than doubled between 2000 and 2009 (see Table 54). It was only in 2010 that the gas production decreased slightly from 56.1 MTOE in 2009 to 55.1 MTOE in 2010.

**Table 59. Volume of offshore oil and gas in the Mediterranean, 2000-2010.**

| Years | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Past trends |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oil production (MTOE / year) | 34.6 | 33.4 | 33.6 | 33.6 | 33.0 | 32.7 | 32.7 | 33.8 | 33.9 | 33.8 | 33.7 | → |
| Gas production (MTOE / year) | 22.8 | 25.6 | 26.8 | 28.4 | 31.7 | 40.1 | 49.6 | 51.1 | 53.7 | 56.1 | 55.1 | ↗ |
| % Production offshore Med / total oil worldwide | 0.93% | 0,90 | 0,90 | 0.88% | 0.82% | 0.81% | 0.80% | 0.83% | 0.83% | 0.85% | 0.83% | → |
| % Production offshore Med /total gas worldwide | 1.05% | 1.14% | 1.18% | 1.20% | 1.30% | 1,60 | 1.91% | 1.92% | 1.94% | 2.09% | 1.91% | ↗ |

Sources: BP (2011), The Petroleum Economist (2004) and author estimate for the offshore share

These data are illustrated by the following graphs (see Figure 46 and Figure 47).

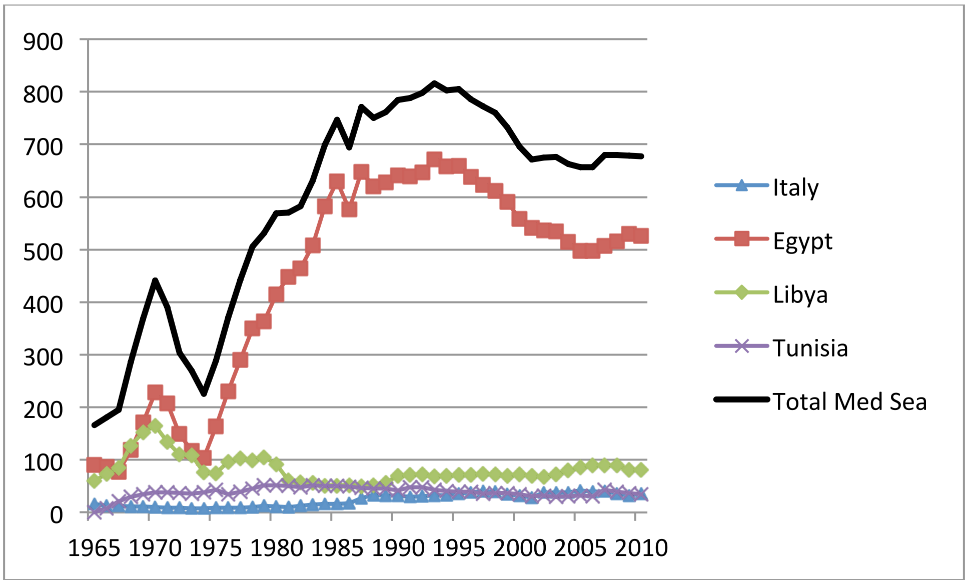



**Figure 46. Evolution of offshore oil production in the Mediterranean, thousands of barrels /day, 1970-2010.**

Sources: BP (2011), The Petroleum Economist (2004) and author estimate for the offshore share

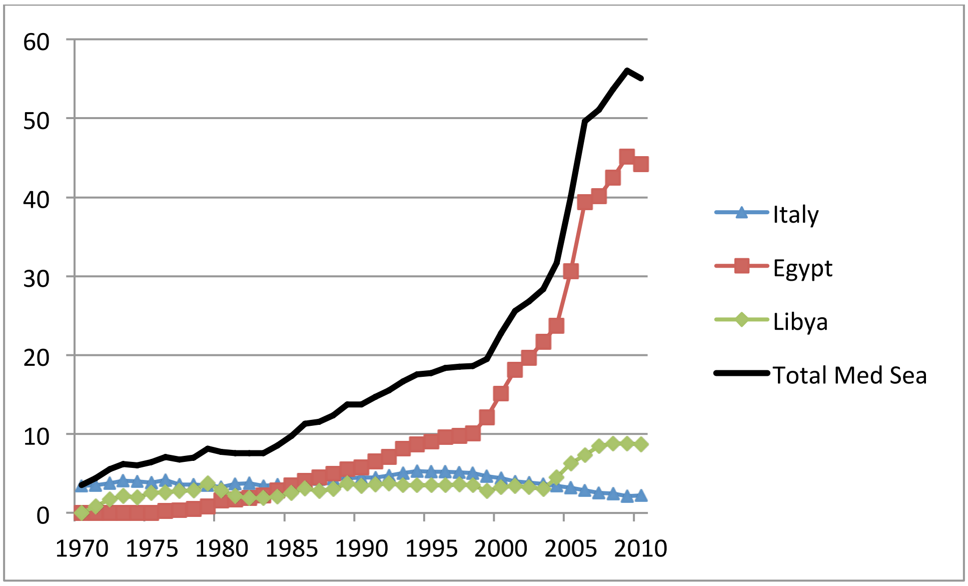



**Figure 47. Evolution of gas production offshore in the Mediterranean, Mtoe / year, 1970-2010.**

Sources: BP (2011), The Petroleum Economist (2004) and author estimate for the offshore share

## Socio-economic data

Turnover of oil and gas are heavily dependent on oil and gas prices and often very volatile. This volatility explains the turnover increase in 2008: compared to 2007, the production volume increased by only 0.3% for oil and 5.1% for gas, while revenues rose by 21.1% for oil and 40% for gas.

In terms of employment, the numbers of direct jobs and total jobs have been estimated to have increased by about 55% between 2000 and 2010 for all oil and gas activities, a development that is closely linked to the rapid evolution of gas operations at sea

**Table 60. Socio-economic figures related to offshore oil and gas production in the Mediterranean Sea, estimates 2000-2010.**

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Oil production turnover (In Giga €) | 9.6 | 7.95 | 7.65 | 7.21 | 8.31 | 11.33 | 13.01 | 13.33 | 16.14 | 10.79 | 14.83 |
| Gas production turnover (In Giga €) | 2.86 | 4.18 | 3.67 | 4.08 | 4 | 7.57 | 12.41 | 11.99 | 16.97 | 13.74 | 10.82 |
| Added value oil and gas (direct contribution to GDP) (In billion €) | 8.62 | 8.39 | 7.83 | 7.81 | 8.79 | 13.08 | 17.58 | 17.51 | 22.9 | 16.97 | 17.74 |
| Direct jobs (In thousands, oil and gas | 15.6 | 16.0 | 16.4 | 16.8 | 17.5 | 19.7 | 22.3 | 23.0 | 23.7 | 24.4 | 24.1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| combined) | | | | | | | | | | | |
| Total jobs (direct + indirect) (In thousands, oil and gas) | 116.3 | 119.5 | 122.3 | 125.7 | 131.0 | 147.3 | 166.7 | 172.0 | 177.4 | 182.0 | 179.9 |

Sources: BP (2011); Oil and Gas UK (2011); The Petroleum Economist (2004) and author estimate for the offshore share

## Geographical distribution

The global oil and gas reserves are distributed very heterogeneously. Figure 46 shows the distribution of world oil reserves by region. It highlights that the majority of oil reserves are located onshore and especially in the Middle East.

In the Mediterranean, about 14% of oil production and 35% of gas production comes from offshore operations. The offshore production is concentrated in the waters of the Tunisia, Italy in the Adriatic, Libya and Egypt, as shown in Figure 47. In the Mediterranean, Egypt is the largest producer of oil and gas offshore, with 80% of gas production and oil production in the region. Tunisia produces mostly oil with 5% of offshore oil production of the region.

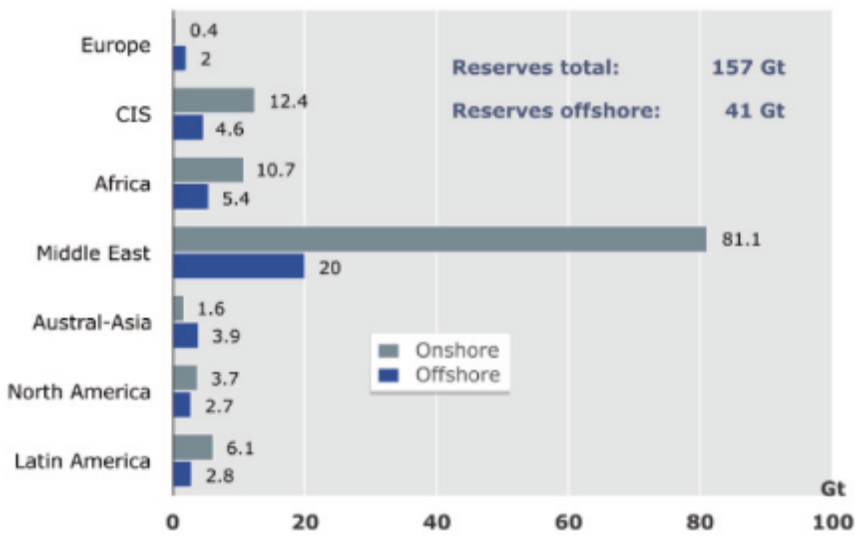



**Figure 48. Oil reserves in the world, by region.**
Source: BGR (2010)

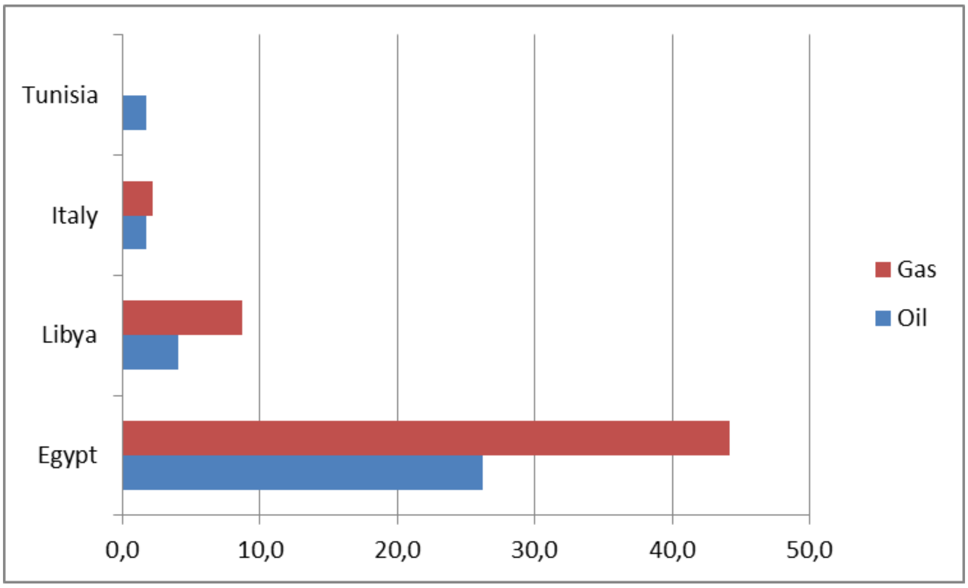



**Figure 49. Current Oil and gas production offshore in the Mediterranean, 2010, Mtoe / year.**
Sources: BP (2011); The Petroleum Economist (2004) and author estimate for the offshore share

## Future trends 2020

With the current level of production, the reserve life of Mediterranean oil is thirty years and those gas fifty years. New exploration operations or production of oil and gas are under study or currently in process on the coasts of Spain, Croatia, Egypt, Israel, Lebanon, Libya, Tunisia, Turkey and in the Maltese and Cypriot waters. Algeria is preparing to expand its exploration program to offshore areas in 2011.

Recent discoveries of large gas fields in the waters of Egypt, Israel and Lebanon or the oil discoveries in the waters of Libya strengthen the some experts' predictions of an increase in oil drilling and gas in the coming years, mainly in the eastern part of the Mediterranean (Court, 2011).

In addition, the Mediterranean is a deep sea; the development of deep offshore operation over 500m depth is a factor favouring the exploitation of oil and gas in the Mediterranean. These are major technological advances in the field of seismic and subsea facilities and an increase in crude oil prices that make profitable investments, even at great depths.

## Sector and socio-economic analysis by subregions

### Western Mediterranean Sea

This area includes parts of the coasts and waters of Spain, France, Italia, Tunisia, Algeria and Morocco.

Algeria is currently the largest producer in the Mediterranean for oil and gas, production being currently only onshore. Algeria's offshore, where recent seismic surveys have been conducted, is considered a promising deep water frontier. To date, however, there are only a few exploration wells drilled and only one in deep water. State-owned company plans to start drilling offshore in 2011-2012. (OME, 2011)

Regarding the north part of the basin, exploration surveys have been conducted offshore the Catalonia shelf of Spain and in the recent French EEZ (formerly EPZ) in a large ultra-deep area (2600 m) south of the Provencal coasts. There is no regular production.

Sector analysis

**Coastal areas**

- Production tonnage in oil and gas: 0
- Number of installation: 0

**Open sea**

- Production tonnage in oil and gas : 0
- Number of installations: 0

Economic analysis

**Coastal areas**

- Value: 0

**Open sea**

- Value: 0

Social analysis

**Coastal areas**

- Current permanent employment for the coastal sea operation is probably nil.

**Open sea**

- Current permanent employment for the open sea operation is probably nil.

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.
- Situation could be different in Algeria where production could be triggered by good results of the on-going explorations, high energy price and policies effectively favourable to foreign investments.

### Adriatic Sea

This area includes parts of the coasts and waters of Italia, Croatia, Bosnia-Herzegovina, Montenegro and Albania.

The Italian west coast of Adriatic Sea is 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.

Sector analysis

**Coastal areas**

- Yearly production quantity in oil and gas
  - Oil: 35 000 BPD (Barrel per day), or 1,8 million TEP year 2010 (estimate)
  - Gas: 5,1 million TOE year 2010 (estimate)
  - Total: 6.9 million TOE year 2010 (estimate)
- Number of offshore installations: 100 (mostly gas)

**Open sea**

- Production figures in oil and gas: 0
- Number of installations: 0

Economic analysis

**Coastal areas**

- Yearly production value (on the basis of international yearly averaged prices):
  - Oil: € 780 million per year, 2010 (estimate)
  - Gas: € 1 010 million per year, 2010 (estimate)
  - Total : € 1 790 million per year, 2010 (estimate)
- Value added coefficient: 70% (estimated from Pugh D., 2008)

**Open sea**

- Yearly production value: 0

Social analysis

**Coastal areas**

- Employment

Employment have been estimated from data transferred from UK surveys (Oil and Gas UK; http://www.oilandgasuk.co.uk/employment.cfm )

For 1 million TOE /year (oil and gas included)

- 270 Direct employments:
- 1 750 Indirect employments
- 850 Induced employments
- 2 870 Total employments

Italy:

- 1 860 Direct employments:
- 12 080 Indirect employments
- 5 870 Induced employments
- 19 810 Total employments

**Open sea**

- Employment: 0

Projections

The Adriatic offshore fields are mature, especially for gas, and will be declining in the coming years. In an optimistic scenario, the Italian RIE (2012) foresees a marginal increase of 0.75TOE year for 2020 (+ 10%) if a large revamping program for the offshore platforms is rapidly implemented. These developments are mostly concerning the coastal areas.

### Aegean-Levantine Sea

This area includes parts of the coasts and waters of Greece, Turkey, Cyprus, Syria, Lebanon, Israel, Palestinian territories, Egypt and Libya.

Production concerns mainly Egypt in coastal waters (<200m), but the area is promising offshore Egypt and all along the Levantine coast in open waters. More natural gas reserve could be located off the South East Mediterranean Shore. In 2009-2010 the world's largest deep water gas discoveries of the last decade have been identified in this area with the fields de Tamar and Leviathan situated offshore Israel in depths around 1500_1700m (OME, 2011)

In Egypt, natural reserves are on the rise and untested areas are still to be explored. A recent assessment identifies potentially extractable resources in the Nile Margin Reservoir, onshore and near-shore, and in the Nile Cone, in deep water (OME, 2011).

Sector analysis

**Coastal areas**

- Yearly production quantity in oil and gas (Egypt)
    - Oil: 526 000 BPD (Barrel per day), or 26 million TOE year, 2010 (estimate)
    - Gas: 44 million TOE year, 2010 (estimate)
    - Total: 70 million TOE year 2010 (estimate)

**Open sea**

- Production figures in oil and gas: nil or marginal
- Number of permanent installations: nil or marginal

Economic analysis

**Coastal areas**

- Yearly production value (on the basis of international yearly averaged prices):
    - Oil: € 11 500 million per year, 2010 (estimate)
    - Gas: € 8 200 million per year, 2010 (estimate)
    - Total : € 19 700 million per year, 2010 (estimate)
- Value added coefficient: 70% (estimated from Pugh D., 2008)

**Open sea**

- Yearly production value: nil or marginal

Social analysis

Employment have been estimated from data transferred from UK surveys (Oil and Gas UK; http://www.oilandgasuk.co.uk/employment.cfm ), to provide an order of magnitude probably greatly underestimated due to the large differences in employment structure between the two countries.

For 1 million TOE /year (oil and gas included)

- 270 Direct employments:
- 1 750 Indirect employments
- 850 Induced employments
- 2 870 Total employments

Egypt:

- 18 900 Direct employments:
- 122 500 Indirect employments
- 59 500 Induced employments
- 200 900 Total employments

**Open sea**

- Employment: nil or marginal

Projections

Current production and large promising reserves, mainly gas, are situated offshore the south and east of the region, not far from large consumption area. The outlook is for a robust growth in gas production, coming from Egypt and Israel, who will become gas exporter. Development of these fields will mainly depend on the political stability of the region.

### Ionian Sea and the Central Mediterranean Sea

This area includes parts of the coasts and waters of Italy (Sicily), Albania, Greece, Libya Tunisia and Malta.

Current offshore production mainly concerns Libya and Tunisia. Libya has the largest proven oil reserves in the Mediterranean region and some observers think that the reserve may be higher based on potential in both onshore and offshore sedimentary basins, of which large parts remains poorly explored. The offshore eastern Tripolitan Basin is mentioned in the list of the areas recognized to have exceptional potential for major undiscovered petroleum resources. (OME, 2011).

Unlike its prolific oil producing neighbour, Algeria, Tunisia's upstream oil industry is modest. Offshore fields are located in the Gulf of Gabes.

It should be noted that Malta is a known flag state for mobile offshore fleet.

Sector analysis

**Coastal areas**

- Yearly production quantity in oil and gas (Libya and Tunisa)
  - Oil: 116 000 BPD (Barrel per day), or 6 million TOE year, 2010 (estimate)
  - Gas: 9 million TOE year, 2010 (estimate)

- Total: 15 million TOE year 2010 (estimate)

**Open sea**

- Production figures in oil and gas: nil or marginal
- Number of permanent installations: nil or marginal

Economic analysis

**Coastal areas**

- Yearly production value (on the basis of international yearly averaged prices):
    - Oil: € 2 550 million per year, 2010 (estimate)
    - Gas: € 1 630 million  per year, 2010 (estimate)
    - Total : € 4 180 million per year, 2010 (estimate)
- Value added coefficient: 70% (estimated from Pugh D., 2008)

**Open sea**

- Yearly production value: nil or marginal

Social analysis

**Coastal areas**

Employment have been estimated from data transferred from UK surveys (Oil and Gas UK; http://www.oilandgasuk.co.uk/employment.cfm ), to provide an order of magnitude, probably greatly underestimated due to the large differences in employment structures between these countries.

For 1 million TOE /year (oil and gas included)

- 270 Direct employments:
- 1 750 Indirect employments
- 850 Induced employments
- 2 870 Total employments

Libya and Tunisia:

- 4 050 Direct employments:
- 26 250 Indirect employments
- 12 750 Induced employments
- 43 050 Total employments

**Open sea**

- Employment: nil or marginal

Projections

It is assumed that the Libyan oil production will reach the pre-crisis level by late 2013 and its contribution to the Mediterranean oil production will increase strongly by 2030, barely offsetting the decline in all other Mediterranean countries. Its gas production will also increase during this period. The Libyan oil and gas reserves concern both onshore and offshore fields. However the offshore part in these future productions is still unknown.

Tunisian offshore production will be progressively depleting.

### 4.6.3 Sector and socioeconomic analysis for the Black Sea

#### Production

Shows of oil and gas have been observed on the shores of the Black Sea since antiquity, with the first commercial production beginning in the 1850's in Romania. Since then, Romania witnessed two peaks of oil production, one of gas, and is now a net importer of both. Ukraine, once a net gas exporter is now heavily dependent on imports from Russia. Other countries, believed to be poorly endowed with petroleum, also went through boom and bust cycles of their own – Georgia during the 1980's, Bulgaria during the 1970's, and Moldova as well – but production there was and remains marginal. (Nitzov, 2010)

While all of the littoral countries around the Black Sea except Russia are today net oil and gas importers, the case of Ukraine stands out. Its proven oil reserves are small, only 0.4 billion barrels at the end of 2007, smaller than those of Romania (0.5 billion barrels) and about the same as Turkey (0.3 billion barrels). However, Ukraine boasts about a trillion cubic meters of gas reserves, a resource base that would generally be adequate enough to make the country self-sufficient in natural gas, since the reserves are equivalent to some 15 years of consumption at current levels. However, Ukraine imports up to two-thirds of the consumable gas at prices that it can hardly afford. (Nitzov, 2010)

#### 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 the general 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. In 2009, Turkey's state-owned petroleum company, TPAO, and Brazil's Petrobras signed an agreement for the exploration of oil in the Black Sea. The estimated oil reserves that could be discovered by the exploration program at 10 billion barrels or more, which may be sufficient to support all of Turkey's oil demand. Similar opportunities may exist offshore of Georgia, Ukraine, and Bulgaria. (Nitzov, 2010)

#### Sector and socio-economic analysis

The data used for the socioeconomic assessments and the assumptions made in case of extrapolation and value transfers are presented in Table 32. Gap Analysis.

Sector analysis

**Coastal areas**

- The collected information leads to think that if several exploration programs are running in the selves of Ukraine, Romania, Bulgaria and Turkey, production is still marginal. It has not been possible to collect data on production and number of installation in at sea. It should be noted that exploration program are punctual operations, generally limited to few months for a given area, involving one main vessel.

**Open sea**

- For now, these exploration programs are focussed on the Coastal areas (< 200m depth)

Economic analysis

**Coastal areas**

- It has not been possible to collect data on the main economic figures of this activity. Value can be estimated in the range of 100 million – 1 000 million € per year.

**Open sea**

- Nowadays, value for the open sea is probably marginal or nil.

Projections

There is evidence of large oil and mostly gas reserves in the shelves of the Black Sea. However the development of the production will greatly depends on the world energy market and of the regional political context. Production will be boosted by cheaper and safer conditions than elsewhere.

### 4.6.4 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[9]). 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

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

[9] 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[10].

More recently, 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 in the marine environment 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.

### 4.6.5 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 500€ to 2 000 € for a

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

country report or a regional map). Free reports generally concern largely outdated studies. Moreover offshore activities are usually not set apart from the onshore one, as they produce the same commodities. 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 needed in view to provide orders of magnitude and some general perspectives.

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 Mediterranean and Black sea is nowadays in the coastal area. However projections show that these activities will be developed in open sea in the next decades.

**Table 61. Inventory of the various data used for each assessment and assumptions made in case of extrapolation or value transfer.**

| Theme | Indicators: | Sources | Assumptions | Comments |
|---|---|---|---|---|
| Segregation offshore / onshore | Production from offshore oil / gas | The Petroleum Economist Ltd.., 2004, World Energy Atlas 2004, Schlumberger | This source provides a map of the onshore and offshore oil and gas wells. For a given country, it is possible to calculate the ratio offshore wells on total wells. This ratio is a proxy to calculate the offshore fraction. | 2004 World Energy Atlas is outdated. Assumption is not necessarily valid and provides only an order of magnitude.<br>This ratio has been used for all countries excepted for Italy, for which a ratio given by (Trabucco, 2012 – quoting ENI) has been used. |
| Economic data | Turnover | BP, 2011, BP Statistical Review of World Energy June 2011;<br>German Federal Office of Economics and Export Control (BAFA). | Production (and sale) of oil and gas is averaged throughout the year. | To calculate the turnover, we used data on the annual production of oil and gas and we have multiplied with the respective average annual price in U.S. $. Then, this figure has been converted into € using annual average exchange rate. |
| Economic data | Value | D. Pugh, 2008 | The ratio of value added / turnover is the same as the one in UK and in all Mediterranean countries. | The value added was calculated using an estimated value factor was applied to the turnover. This rate was estimated by D. Pugh for oil and gas activities in the UK. |
| Social Data | Employment | Oil & Gas UK, 2011, BP, 2011; | The ratio jobs / total output of oil and gas (toe) is the same in the Mediterranean and in the UK. | The combination of data from BP and Oil & Gas UK has been used to calculate the ratio jobs / Mtoe in 2010.This rate has been reported on the Mediterranean production to assess employments. |

## 4.7 Desalinisation

Prepared by Jose A. Jiménez and Eduard Ariza, UPC-LIM

### 4.7.1 Introduction

Water resources suffer important pressures in many Mediterranean countries (Boyé 2008). In some countries (Libya, Cyprus, Malta), water abstractions are close to the threshold of renewable resources (Boyé 2008) (Figure 50). Freshwater needs, in particular those related to drinking water, are increasing due to both demographic growth and economic development.

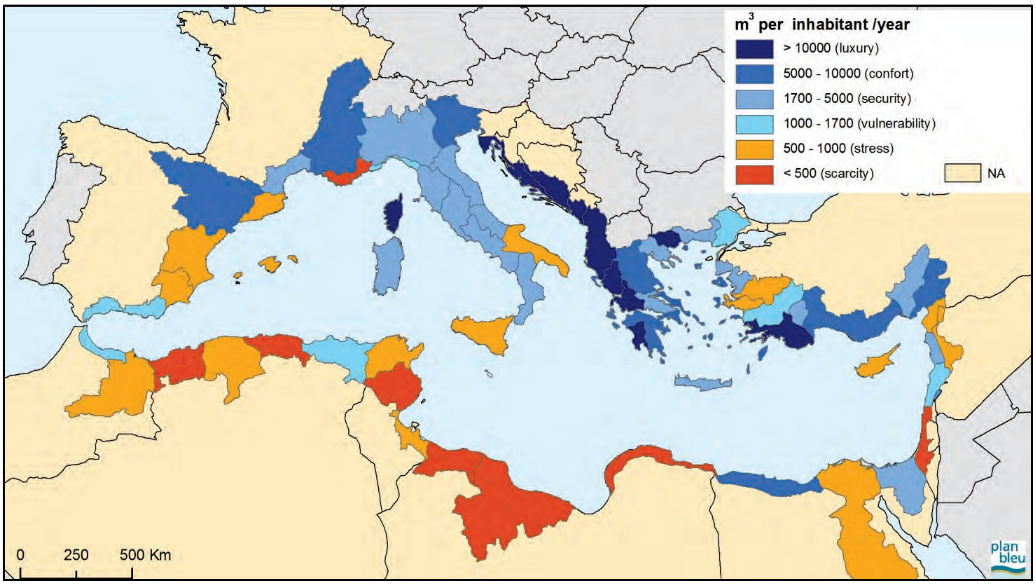



**Figure 50. Renewable Fresh Water resources per inhabitant in Mediterranean elementary river basins (between 1995-2005) (Plan Bleu 2009)**

In order to manage freshwater scarcity, water management public policies must integrate (i) the management of the demand and (ii) the development of non-conventional alternative resources. The production of freshwater by desalination is a basic component of the later.

The worldwide installed desalination capacity has been continuously increasing, especially after the 80's when the desalination industry can be considered fully developed (Figure 51). According to data from the International Desalination Association, the production capacity of all desalination plants worldwide was around 44.1 $Mm^3$/day by the end of 2006 including all facilities which were either in construction, online, or presumed online (Lattemann et al 2010). According to these authors, the projected installed capacity will presumably reach 64 $Mm^3$/day by 2010 and 98 $Mm^3$/day by 2015 (Figure 51).

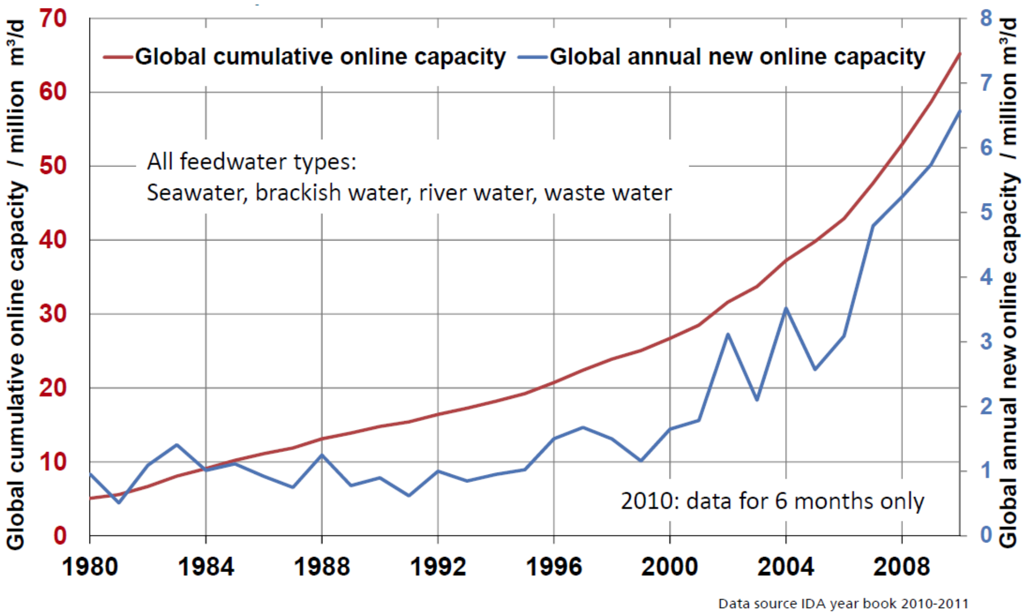



**Figure 51. Global desalination capacity (Koschikowski, 2011).**

Water desalination can be done by means of 2 different processes: (i) thermal processes and (ii) membrane based technologies (Boyé 2008). Thermal techniques used to be, until few years ago, the main technology employed in the world. These techniques have been mainly developed in the gas and oil producing countries of the Arab-Persian Gulf. In the group of membrane based technologies, reverse osmosis has progressively become more important (Figure 52). This fact is due to two factors (i) reduction of energy consumption (in best performance plants consumption is in the order 3kWh/$m^3$ (Boye 2008) and (ii) reduction of membrane cost.

Nowadays, reverse osmosis processes have lower costs of production of desalinated $m^3$ of water than thermal processes. On the other hand, a disadvantage of membrane based technologies is the potential environmental impacts induced by the disposal of chemical products into the water (descaling, preliminary treatment). In spite of the efficiency progress achieved, the costs associated with desalination are still high: 1) Energy consumption; 2) Investment costs and 3) Operation costs (Koschikowski, 2011). These costs are limiting factors for the establishment of more desalination plants. Energy needs for water are set to double up within 10 years and will exceed, by 2025, 20% of the total demand on electricity for the SEMC (Southern and Eastern Mediterranean Countries) (10%, all Mediterranean riparian countries considered) (Plan Blue 2010). A good overview on the different aspects related to desalination processes at global scale can be seen in Latteman et al (2010).

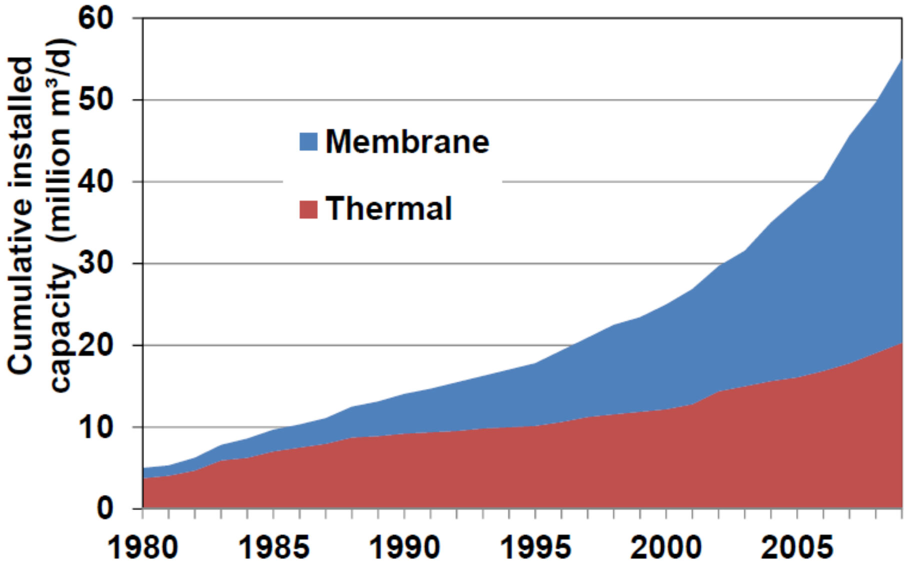



**Figure 52. Development of desalination capacity by membrane and thermal processes** (Koschikowski, 2011)

### 4.7.2 Water production

Desalination began in the Mediterranean countries in situations of insular isolation, located in the coast and/or desert situation, although, today, it is expanding around the basin (Plan Bleu 2009). Thus, nowadays, Mediterranean countries account for about a quarter of global desalination. Figure 53 shows the installed desalination capacity using any feedwater type grouped by region, where it can be seen that seawater desalination is the dominant type in the Med region (Southern Europe and North Africa). By 2030, the region will probably approach reach a desalination capacity of 30 to 40 $Mm^3$/day (Plan Bleu 2009).

Figure 54 shows an overview of the total water production from seawater in the Mediterranean basin (Lattemann et al 2010). Water desalination capacity per country is shown in Table 62, where it can be seen that from a total capacity of about 4.6 $Mm^3$/day, Spain is the largest contributor with about the 30 % (excluding the production in Canary Islands).

The observed trends in desalination capacity (Figure 51) are expected to maintain in the next years, in such a way that the industry does not forecast any abrupt change in the development of the desalination market.

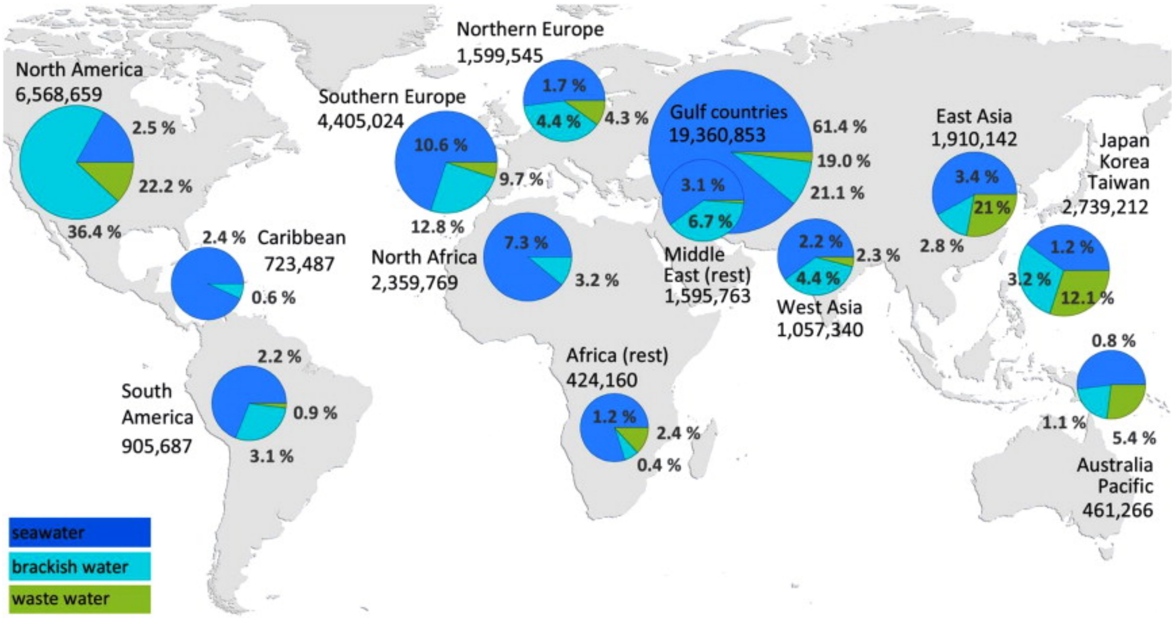



**Figure 53. Global desalination capacities in m3/day** (Latteman et al 2010).

**Table 62. Water desalination capacity in Mediterranean countries** (1: Lattemann et al 2010; 2: Bashitialshaaer et al 2011; 3: Fichtner 2011; 4: Hadadin et al 2010; 5: Drouiche et al 2011; 6: Zachariadis 2010; 7: ).

| Country | Capacity 1000 m³/day | Source | Observations |
|---|---|---|---|
| Albania | | | |
| Algeria | 757 | 1 | |
| Croatia | | | |
| Cyprus | 151 | 1 | |
| Egypt | *379 | 1 | *248 in Red Sea |
| France | | | |
| Greece | 44 | 1 | |
| Israel | *458 | 1 | *8 in Red Sea |
| Italy | 270 | 1 | |
| Jordan | 9 | 4 | |
| Lebanon | 30 | 3 | |
| Libya | 792 | 3 | |
| Malta | 191 | 1 | |
| Montenegro | | | |
| Morocco | 36 | 2 | |
| Slovenia | | | |
| Spain | 1,419 | 1 | excluding Canary Islands |
| Syria | | | |
| Tunisia | 72 | 3 | |
| Turkey | 41 | 1 | |

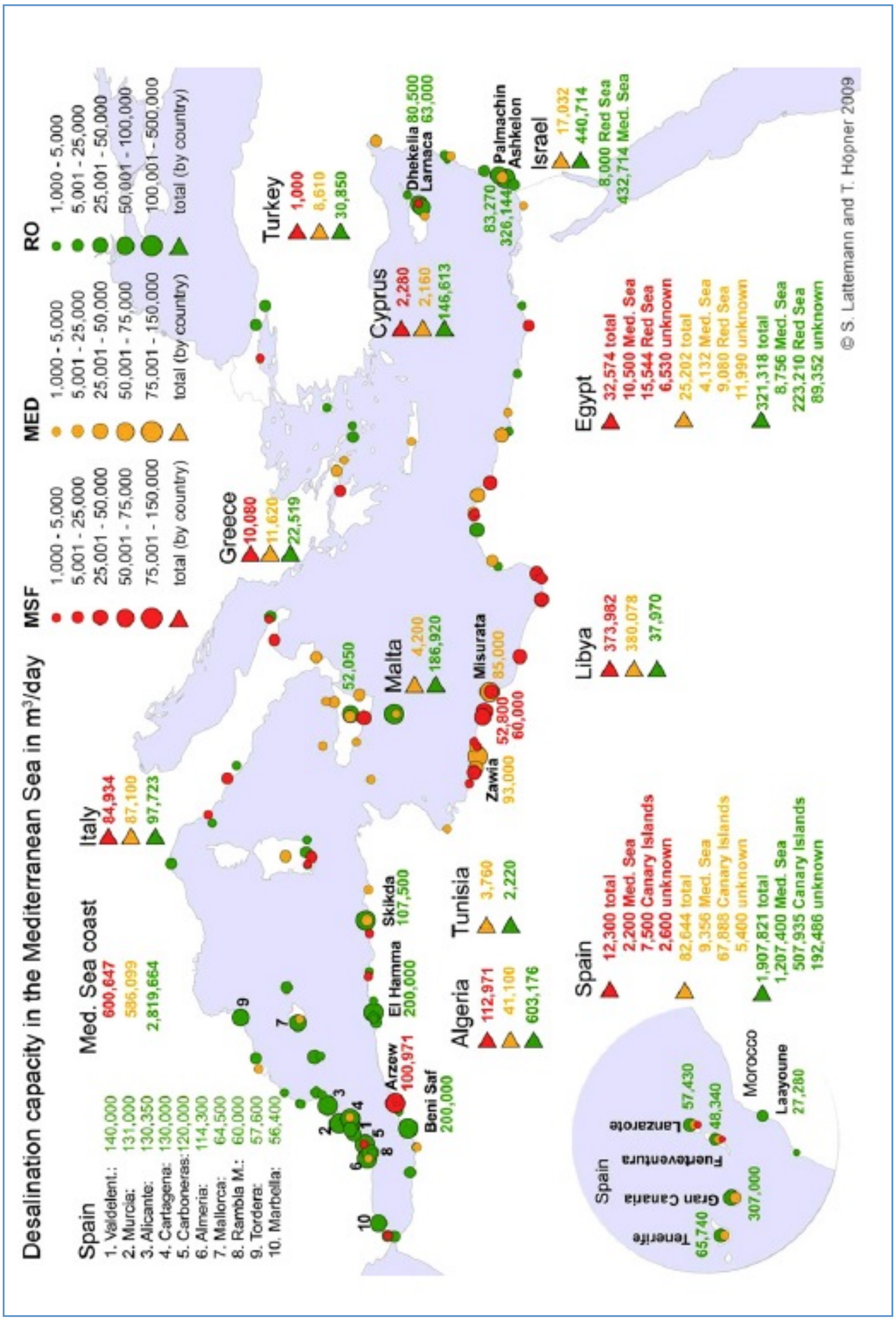



**Figure 54. Cumulative desalinisation capacities in the Mediterranean Sea in cubic meters per day using different techniques**

**Legend:** [multistage flash (MSF), multieffect distillation (MED) and reverse osmosis (RO)] by site location (dots) and by country (triangles). The map shows all sites with an installed capacity ≥1000m3/day and displays sites with a capacity ≥50,000m3/day by name and capacity (Latteman et al 2010).

### 4.7.3 Socio-economic costs of water production

Desalination unit costs have decreased during the last decades (Figure 55), a trend that has been associated with technology improvements (e.g. SWRO membrane performance).

As expected, investment costs depend on the size of the plant, in such a way that they are reduced with increasing production capacity. As an example, Lapuente (2012) analysed the costs in the case of desalination in the Segura basin (Spain) and found that, for a lifetime period of 25 years and annual production capacity of 346 days per year, estimated investment costs vary between 1500 and 1150 €/m³/day for plants with a production capacity between 50,000 and 250,000 m³/day.

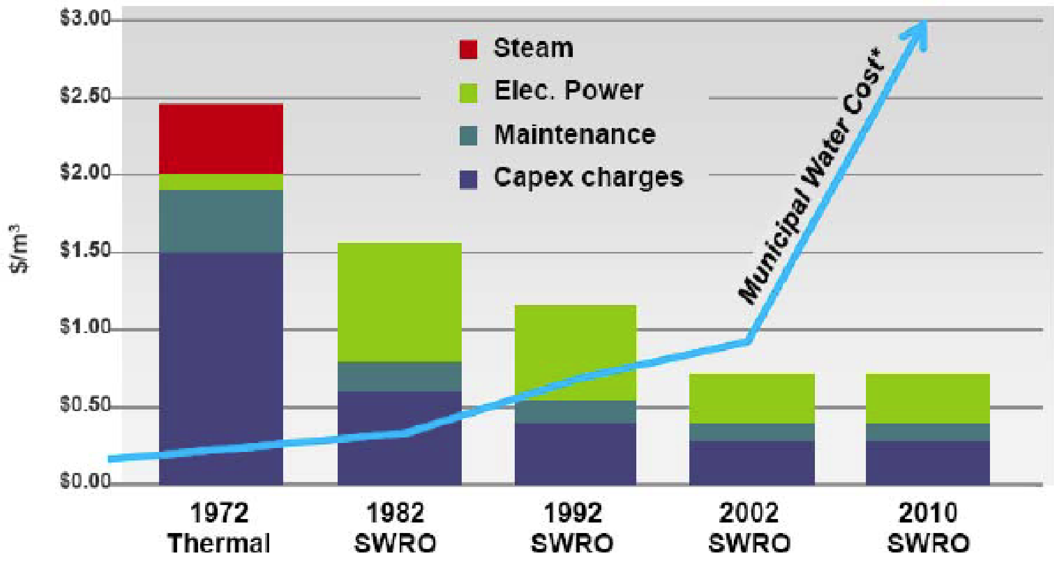



**Figure 55. Unit costs for desalination processes** [SWRO: Seawater Reverse Osmosis] (WaterReuse Association. 2012).

The cost of desalinated water is estimated based on the sum of the two parts: capital costs and operation and maintenance cost. Capital costs include the plant and land costs, civil works and amortization. Operation costs include energy requirements, chemicals, spare parts, maintenance and labor costs (Table 63). Costs breakdown into main categories for different desalination plants of varying capacity are shown in Table 64. In general, operating costs in reverse osmosis plants are dominated by energy consumption. A detailed analysis about socioeconomic costs of water desalination can be seen in Abazza (2012).

Since desalination is an energy intensive process which determines energy supply to be one of the main factors contributing to total cost, the potential of using renewable energies such as solar (especially in an environment such as the Mediterranean region) should be considered (Abazza, 2012). In any case, it has to be considered that capital costs for solar plants are higher, although energy costs will reduce as well as will produce environmental benefits derived from reduced CO2 emissions.

Abazza (2012) identifies that one of the implications of supplying water by desalination is the increase in amount of subsidies paid by governments to maintain the same level of water charges. As an example, the cost of supplying water in Egypt is US$ 0.166/m$^3$ of which US$ 0.133/m$^3$ is the amount of subsidy.

**Table 63. Operation and maintenance parameters for desalination plants (WaterReuse Association. 2012).**

| Cost Association | Parameter | Percentage of Total O&M Costs |
|---|---|---|
| Maintenance | Instruments<br>Pump upkeep<br>Facility upkeep including intake pipeline pigging<br>Minor equipment replacement<br>Video/CCTV intake/wells and associated cleaning | 6% |
| Legal/Permitting | Environmental monitoring<br>Permit compliance | 2% |
| Operations | Labor | 6% |
| | Sludge and solids waste disposal<br>Bar rack and band screen solids waste disposal | 4% |
| | Cartridge Filters and RO Membrane Replacements | 11% |
| | Power (Energy) | 55% |
| | Chemicals | 6% |
| | Other Related | 10% |

**Table 64. Summary of costs of different desalination technologies for varying production capacities** (Abazza, 2012).

| | Capacity (m$^3$/d) | Capital cost (US$×10$^6$) | UPC (US$) |
|---|---|---|---|
| SWRO | 10,000 | 20.1 | 0.95 |
| | 50,000 | 74.0 | 0.70 |
| | 275,000 | 293.0 | 0.50 |
| | 500,000 | 476.7 | 0.45 |
| BWRO | 10,000 | 8.1 | 0.38 |
| | 50,000 | 26.5 | 0.25 |
| Source | 275,000 | 93.5 | 0.16 |
| (Wittholz, 2007) | 500,000 | 145.4 | 0.14 |
| MSF | 10,000 | 48.0 | 1.97 |
| | 50,000 | 149.5 | 1.23 |
| | 275,000 | 498.1 | 0.74 |
| | 500,000 | 759.6 | 0.62 |
| MED | 10,000 | 28.5 | 1.17 |
| | 50,000 | 108.4 | 0.89 |
| | 275,000 | 446.7 | 0.67 |
| | 500,000 | 734.0 | 0.60 |

## 4.7.4 Links to environmental pressures

According to the documents *Annex 4: Indicative list of human activities and their possible pressures on the marine environment* and Boyé (2008), Plan Bleu (2009 and

2010), Koshikowski (2011), Latteman and Höpner (2008), UNEP (2008) main impacts of desalination and its associated pressures (Land requirement, Concreting, Energy consumption, Volume of brine and Volume of effluent) are:

- Change in area of coastal habitat
- Change in landscape characteristics
- Interference with hydrological processes (Thermal and salinity regimes)
- Changes in water quality
- Resources depletion

In addition to these direct impacts on the sea environment, one of the main environmental impacts of desalination is related to the excessive levels of $CO_2$ emissions resulting from the burning of fossil fuels to produce energy. Thus, it is the carbon footprint one of the main environmental concerns related to desalination (Abazza, 2012).

Table 65 shows a qualitative assessment of the main environmental impacts generated in desalination by means of the three main technologies (RO: reverse osmosis; MSF: multistage flash; ED: mutieffect distillation) and where it can be seen that the introduction of reverse osmosis has produced a reduction in the expected environmental impact in comparison with the other technologies.

| Effect/type of plant | RO | MSF | E.D. |
|---|---|---|---|
| Noise | H | M | L |
| Water effluent | M | H | M |
| Microelements | L | H | L |
| Toxic material | M | H | M |
| Air pollution | L | H | M |
| Industrial risk | L | H | M |

*Note:* H = high, M = medium, L = low.

**Table 65. Qualitative overview of environmental impact of desalination.**

Following the allocation of environmental impacts to different elements of the desalination process suggested by Latteman et al (2010): intakes, discharges and energy demand.

With respect to intakes, their construction causes an initial disturbance of the seabed and, once they have been built, they may alter coastal dynamics in their surroundings. Moreover, additional installations such as pumping stations and wells also produce environmental changes mainly associated with occupation of the coastal zone and sealing, in addition to local alterations of the littoral dynamics and degradation of the coastal zone. As an example Figure 56 shows installations associated to a desalination plant in the coastal zone of Blanes (Catalonia, Spain) which have been exposed to wave action due to local coastal erosion process. As a result of this, different coastal actuations have been conducted (rip rap protection of the station and beach nourishment to widen the beach in front of it) which occasioned additional costs (environmental and economic ones).

**Figure 56. Auxiliary installations of a desalination plant in Blanes (Catalonia, Spain) exposed to wave action due to coastal erosion.**

With respect to discharges, desalination produces a series of effluents composed by concentrated brines, chemical products and, in some cases, increased temperature waters. A detailed review of environmental impacts of desalination plants and their discharges with special emphasis on published monitoring studies can be in seen in Roberts et al (2010). According to this review, the critical aspect controlling the extent of the environmental impact is the discharge site selection. Existing studies report variable effects ranging from no significant impacts or only affected at small spatial scale (10s of meters) in well flushed environments to significant alterations in community structure in seagrasses when they are released to poorly flushed ones.

With respect to this, Sánchez-Lizaso et al (2008) have investigated the effects of brine discharges on *Posidonia oceanica*, a key coastal ecosystem in the Mediterranean, and found a significant sensitivity to salinity increases and recommend a series of actions to minimize the expected impact.

In order to give an idea about the magnitude of the potential impact associated to brine discharges, Figure 57 shows an estimation of evolution of brine discharges in the Mediterranean.

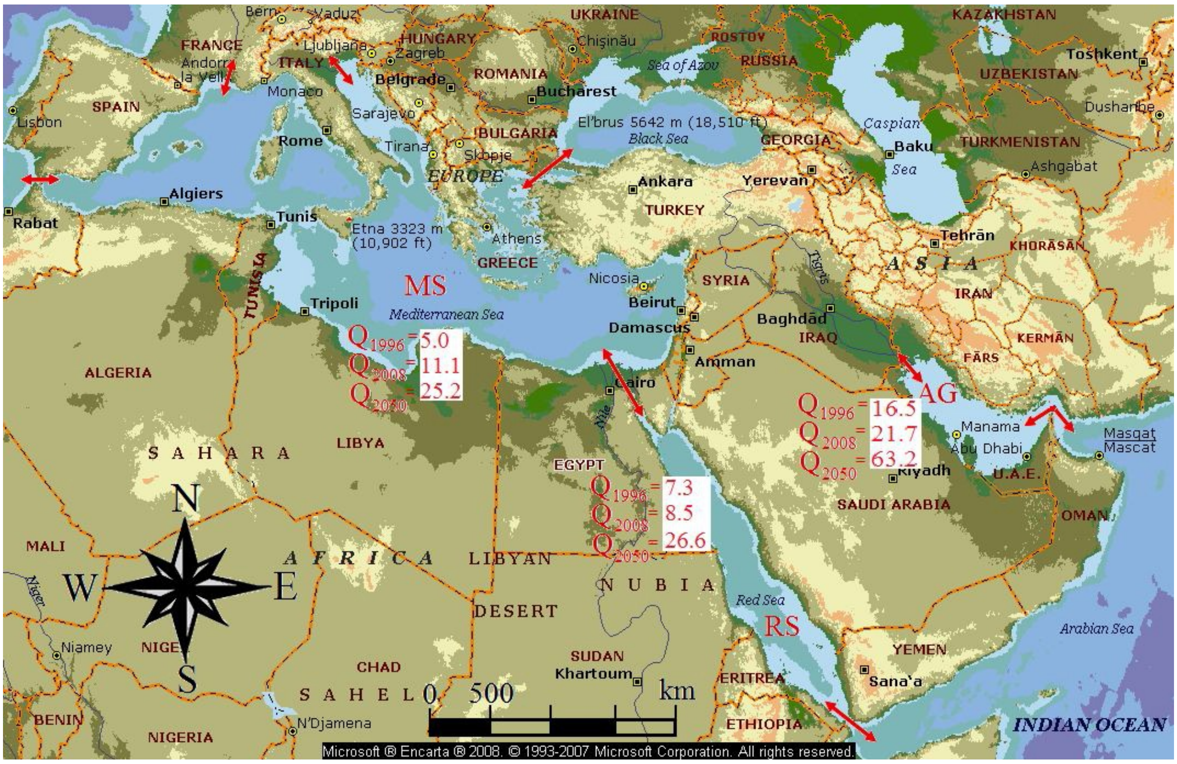



**Figure 57. Estimation of brine water QB (in 106 m3/d) for the Arabian Gulf (AG), Mediterranean Sea (MS), and Red Sea (RS) in 1996, 2008, and 2050** (Bashitialshaaer et al 2011).

Finally, a summary of potential benefits and direct and indirect costs, including socioeconomic and environmental ones, involved in supplying water through desalination are shown in Table 66. In any case, it has to be considered that although desalination is an energy intensive process, there is a high potential of using renewable energy sources such as solar energy. Although in this case, capital cost for may be higher, it results in long term benefits by means of energy cost reduction and environmental benefits through reduced $CO_2$ emissions and impacts on health and the environment (Abazza, 2012).

| | |
|---|---|
| Capital and operating costs | ***Benefits***<br>Increased supply of freshwater to meet domestic demand<br><br>Increased activity in other sector (agriculture, industry, tourism) due to increased availability of water<br><br>Increased contribution to GDP<br><br>Costs<br>Cost of constructing the desalination plant, including cost of land<br><br>Cost of operation, including cost of energy, labour cost, spare parts and maintenance<br><br>Government subsidies |
| Environmental Implications | ***Costs***<br>Increased $CO_2$ emissions with negative impacts on climate<br><br>Impacts on coastal and marine life, including impacts of discharge of brine in the sea<br><br>Impacts on wetlands, mangroves, forests, and biodiversity<br><br>Impacts on desertification<br><br>Noise pollution |
| Social Implications | ***Costs***<br>Increased medical cost due to increased incidence of disease due to increased $CO_2$ emissions resulting from increased economic activities<br><br>***Benefits***<br>Increase in number of jobs created to build and operate the desalination pant<br><br>Increased number of jobs in other productive sectors due to increased water availability in other sectors<br><br>Improved health conditions due to availability of clean freshwater<br><br>Increased productivity of labour force due to better access to water and sanitation |

**Table 66. Cost and benefits of supplying water through desalination (Abazza, 2012).**

### 4.7.5 Gap Analysis

National statistics on water desalination by countries varies very much according to the sources consulted. In some cases, production refers to theoretical or installed capacity and not to real capacity. Apparently, the best statistical data belongs to industry which clearly control the contracted capacity.

Existing (and published) data on energy consumption is usually published in very generic terms, without a detailed accounting of costs of energy per country. This is also extensible to full desalination costs.

Regarding environmental impacts, existing studies are, in most of the cases, generic and mainly based on theoretical and experimental (laboratory) studies. With the exception of impacts on *Posidonia oceanica* which has been studied on the field, there is a need of further studies to monitor the environmental impact of desalination plants. Moreover, monitoring existing effluents in coastal areas of natural interest should be promoted.

## 4.8 Population, Urban areas and WWTPs

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### 4.8.1 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 along the Mediterranean coast and to provide some indication about the pressure and impacts originated on the marine environment. Finally, gaps on existing information are identified.

### 4.8.2 Population

Figure 58 shows the distribution of population in countries of the Mediterranean Sea, whereas the evolution of population per country during the first decade of the 21st century is shown in Table 67. Integrating all people living in coastal countries along the Mediterranean basin, the total population has increased during the first decade of the 21st century from 419.61 million in 2000, to 446.56 million in 2005 to reach a final value of 471.12 million in 2010.In other words, the total population has increased in about 13 % in 10 years.

Figure 59 shows the evolution of the total population of countries composing each of the PERSEUS Mediterranean subregions. As it can be seen, all regions experience an increase in population from 2000 to 2010, with the East region being the most populated area and, at the same time, experiencing the largest increase.

**Table 67. Population (thousands people) in the different Mediterranean countries (World Bank 2012). (*: countries belonging to West and Central Mediterranean regions; **: countries belonging to Central and East Mediterranean regions**

| Region | Country | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| West Med | Spain | 40,263.2 | 43,398.1 | 46,071 |
| | France | 60,910.9 | 63,175.9 | 65,075.6 |
| | Morocco | 28,793.2 | 30,392.5 | 31,951.4 |
| | Tunisia* | 9,563.5 | 10,029 | 10,549.1 |
| | Algeria | 30,533.8 | 32,888.4 | 35,468.2 |
| Central Med | Italy | 56,942.1 | 57,607 | 60,483.4 |
| | Slovenia | 1,988.9 | 2,000.5 | 2,048.6 |
| | Greece** | 10,917.5 | 11,103.9 | 11,315.5 |
| | Malta | 381.4 | 403.8 | 416 |
| | Croatia | 4,426 | 4,442 | 4,418 |
| | Albania | 3,071.9 | 3,141.8 | 3,204.3 |
| | Monten. | 632.6 | 626.7 | 631.5 |
| | Cyprus | 943.3 | 1,032.6 | 1,103.6 |
| | Libya** | 5,231.2 | 5,769.7 | 6,355.1 |
| | Egypt** | 67,648.4 | 74,203.2 | 81,121.1 |
| East Med | Turkey | 63,627.9 | 68,143.2 | 72,752.3 |
| | Israel | 6,289 | 6,930.1 | 7,623.6 |

| | | | | |
|---|---|---|---|---|
| | **Jordan** | 4,797.5 | 5,411.5 | 6,047 |
| | **Lebanon** | 3,742.3 | 4,052.4 | 4,227.6 |
| | **Syria** | 15,988.5 | 18,484.1 | 20,446.6 |
| | **Palestine** | 2,922.2 | 3,320.4 | 3,811.1 |

As it can be seen, most of the population is concentrated in the Northern and Eastern borders of the Mediterranean basin, where countries with the largest population are found (France, Egypt, Turkey, Italy and Spain). Countries along these borders (North and East ones) also present the highest population density values (Table 68) whereas the countries along the Southern border are characterized by having their population mainly concentrated along the coastal zone with most of their territory being uninhabitated (Figure 58).

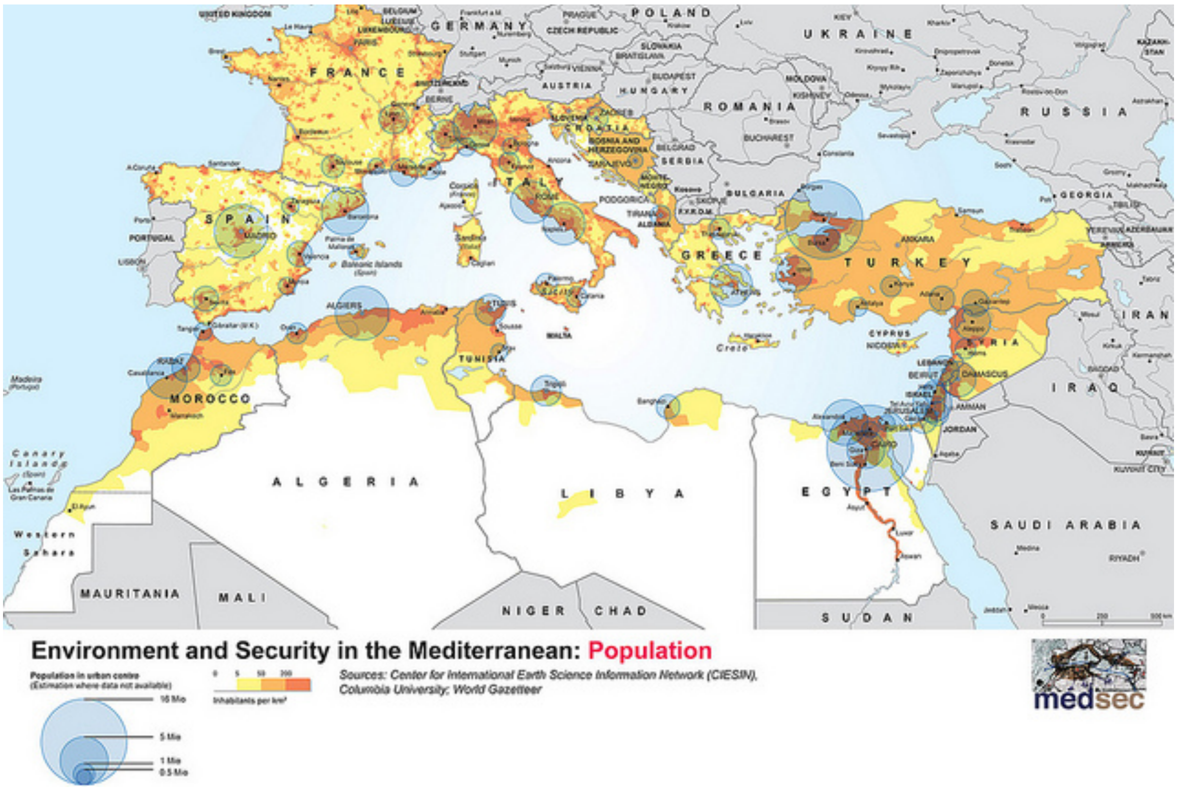



**Figure 58. Population distribution in Mediterranean countries**

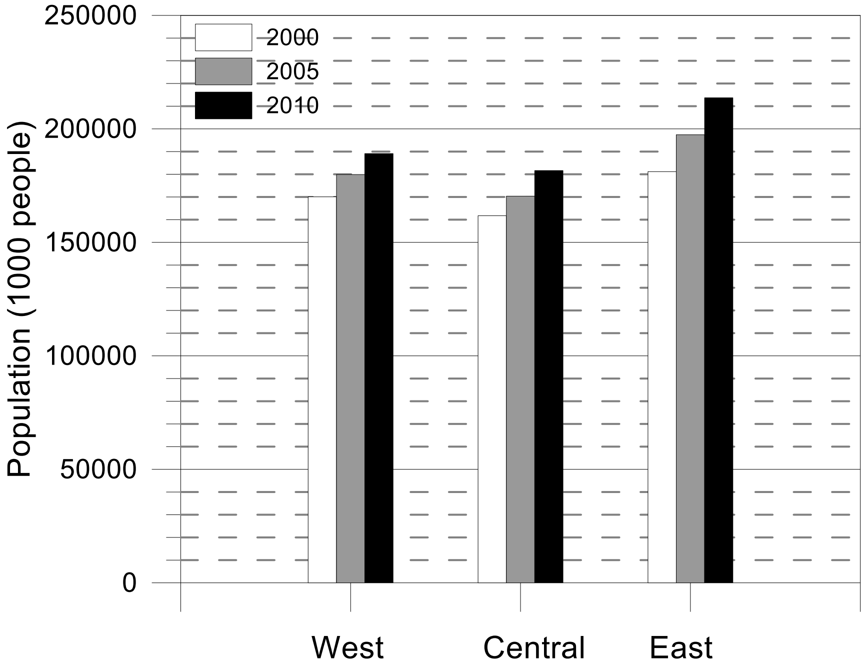



**Figure 59. Evolution of population in the Mediterranean PERSEUS subregions from 2000 to 2010 (data source: World Bank, 2012).**

**Table 68. Population density (people/km2) in the different Mediterranean countries (World Bank 2012). (*: countries belonging to West and Central Mediterranean regions; **: countries belonging to Central and East Mediterranean regions)**

| Region | Country | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| West Med | Spain | 79.9 | 87.0 | 92.4 |
| | France | 111.2 | 115.4 | 118.8 |
| | Morocco | 64.5 | 68.1 | 71.6 |
| | Tunisia* | 61.6 | 64.6 | 67.9 |
| | Algeria | 12.8 | 13.8 | 14.9 |
| Central Med | Italy | 193.6 | 199.2 | 205.6 |
| | Slovenia | 98.7 | 99.3 | 101.7 |
| | Greece** | 84.7 | 86.1 | 87.8 |
| | Malta | 1191.8 | 1262 | 1300. |
| | Croatia | 79.2 | 79.4 | 78.9 |
| | Albania | 112.1 | 114.7 | 116.9 |
| | Monten. | 47 | 46.6 | 47.0 |
| | Cyprus | 102.1 | 111.7 | 119.4 |
| | Libya** | 2.97 | 3.3 | 3.6 |
| | Egypt** | 68 | 74.5 | 81.5 |
| East Med | Turkey | 82.7 | 88.5 | 94.5 |
| | Israel | 290.6 | 320.2 | 352.3 |
| | Jordan | 54.4 | 61.3 | 68.1 |
| | Lebanon | 365.8 | 396.1 | 413.3 |
| | Syria | 87 | 100.7 | 111.3 |
| | Palestine | 485.4 | 593.8 | 648.7 |

### 4.8.3 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 evolve from 63 % in 2000, to 65.3 % in 2005 and to 66.73 % in 2010. Table 69 shows the evolution of the percentage of urban population for the different Mediterranean countries during the period 2000-2010.

The evolution of the urban population for each of the Mediterranean subregions during this period is shown in Figure 60 and as it can be seen, the West Mediterranean is the area with the largest urban population at present, which is mainly controlled by France and Spain due to their large population and their societal structure, with most of the population living in urban agglomerations.

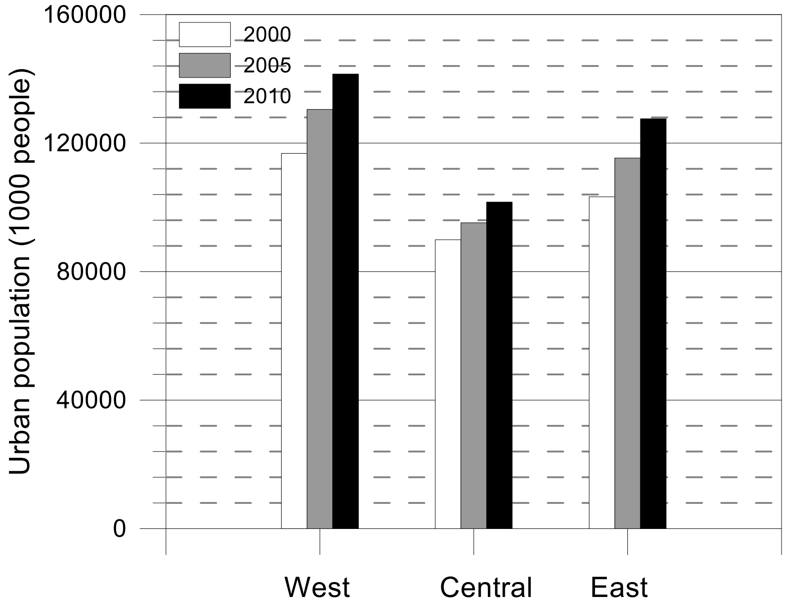



**Figure 60. Evolution of urban population in the Mediterranean PERSEUS subregions from 2000 to 2010 (data source: World Bank, 2012).**

**Table 69. Urban population (% of the total) in the different Mediterranean countries (World Bank 2012). (*: countries belonging to West and Central Mediterranean regions; **: countries belonging to Central and East Mediterranean regions)**

| Region | Country | 2000 | 2005 | 2010 |
|---|---|---|---|---|
| West Med | Spain | 76 | 77 | 77 |
| | France | 76 | 82 | 85 |
| | Morocco | 53 | 55 | 57 |
| | Tunisia* | 63 | 65 | 66 |
| | Algeria | 61 | 67 | 72 |

| | | | | |
|---|---|---|---|---|
| **Central Med** | **Italy** | 67 | 68 | 68 |
| | **Slovenia** | 51 | 50 | 50 |
| | **Greece**** | 60 | 60 | 61 |
| | **Malta** | 92 | 94 | 95 |
| | **Croatia** | 56 | 56 | 58 |
| | **Albania** | 42 | 49 | 52 |
| | **Monten.** | 56 | 62 | 63 |
| | **Cyprus** | 69 | 69 | 70 |
| | **Libya**** | 76 | 77 | 78 |
| | **Egypt**** | 43 | 43 | 43 |
| **East Med** | **Turkey** | 64 | 67 | 70 |
| | **Israel** | 91 | 92 | 92 |
| | **Jordan** | 79 | 81 | 82 |
| | **Lebanon** | 86 | 87 | 87 |
| | **Syria** | 51 | 54 | 56 |
| | **Palestine** | 71 | 73 | 74 |

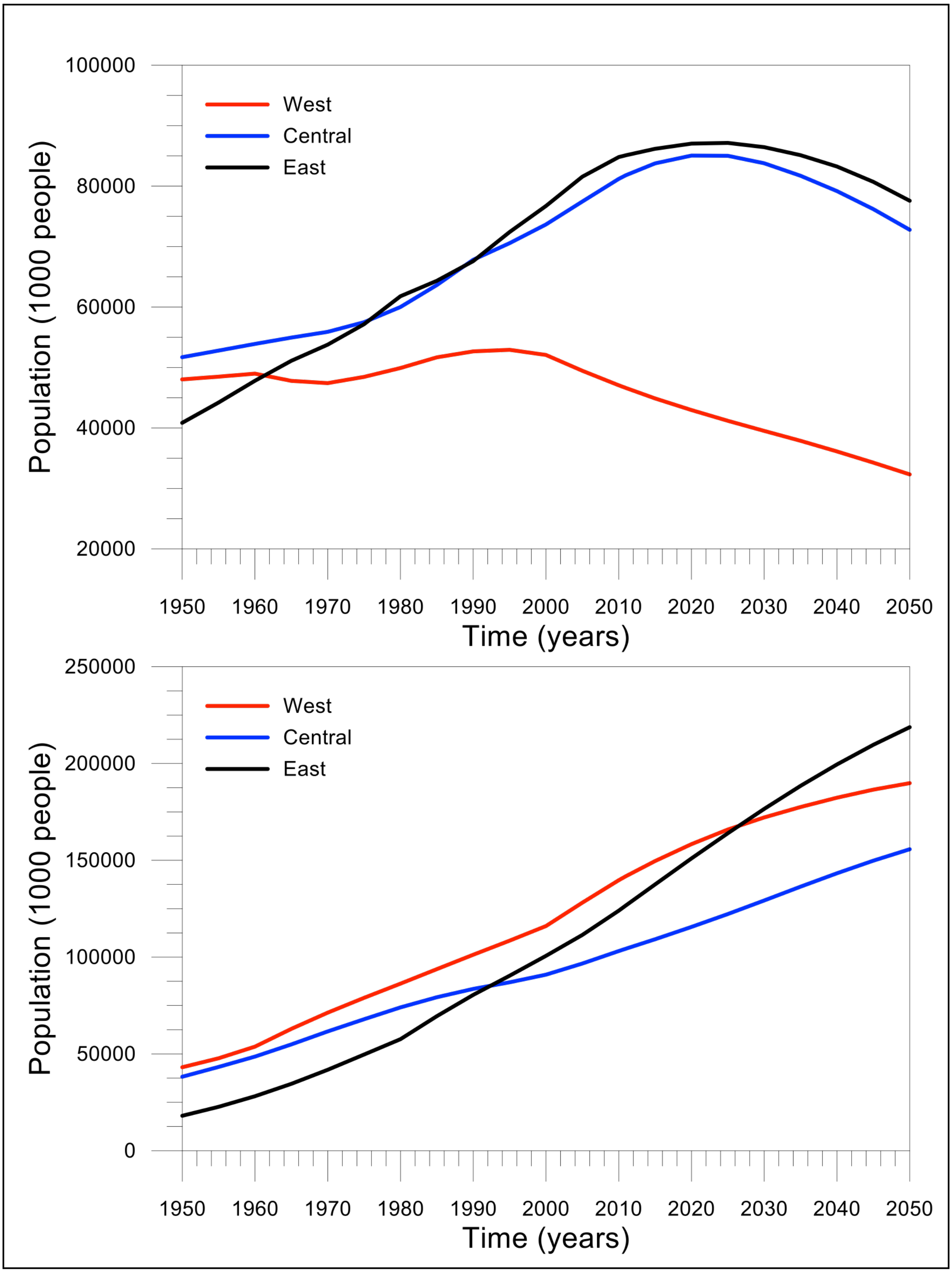
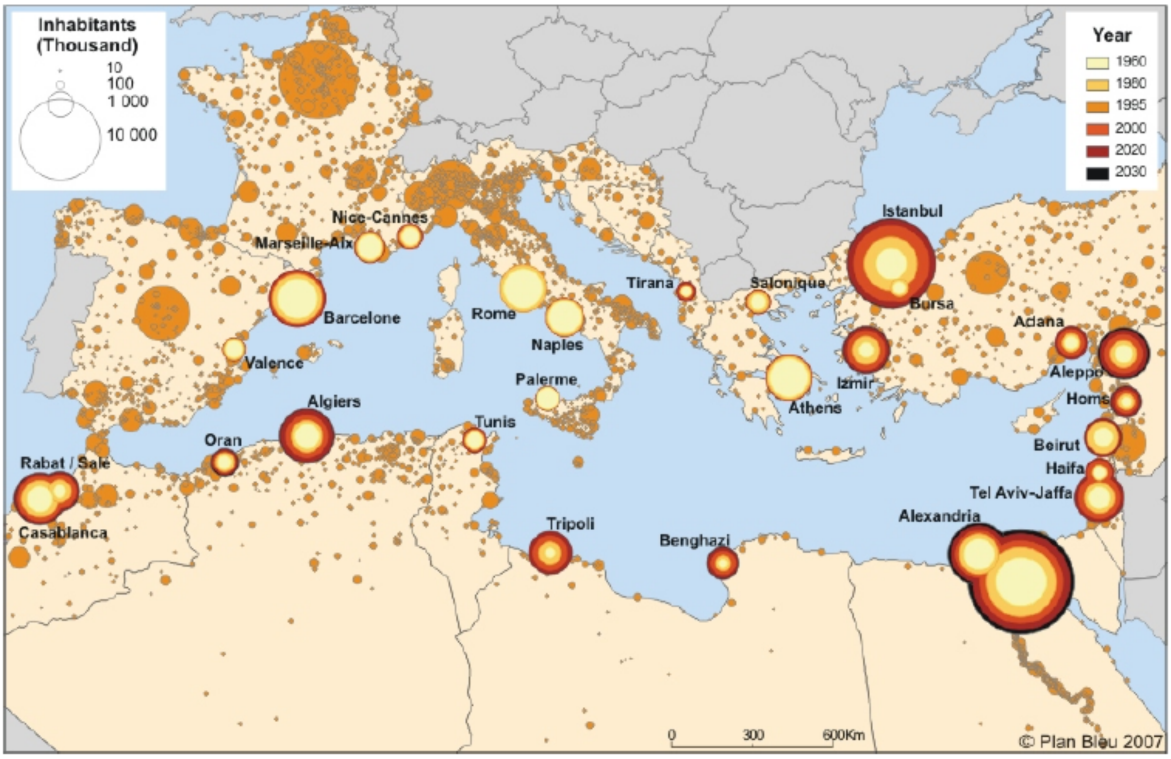



**Figure 61. Evolution of urban (top)and rural(bottom) population in the Mediterranean PERSEUS subregions (data from United Nations, World urbanisation prospects 2011 revision)**

If we analyze urban and rural population projections a different behaviour is observed (Figure 61). Thus, urban population continuously grow in the 3 regions, with the East Mediterranean region presenting the largest (predicted) growth, in such a way that will exceed the population at the West part around year 2027.

On the other hand, rural population in the 3 regions present a peak of maximum development to later decrease. The West region presents an almost constant rural population until year 2000 which linearly decrease after such date until 2050. During almost the entire period, the east region has the lowest rural population. The Central and East regions present a rural population growth until around 2020 when they present the maximum value, which later decrease. Again the East region is the most populated.




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

**Figure 62. Evolution of population in urban agglomerations in the Mediterranean countries, 2004 (Plan Blue 2009)**

Figure 62 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, that present the largest urban agglomerations out of the Mediterranean coast (Madrid, Paris and Casablanca respectively), the Mediterranean Sea is fully bordered by a large number of urban centres. This concentration along the coastal zone is especially evident in the South coast, with the rest of the territory lacking of urban agglomerations.

In places 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 500 hundred meter coastal band has been established and future urbanization of the area limited regarding social. cultural and natural characteristics.

Table 70 to Table 72 show the basic dimensions of major urban areas (> 500,000 people) along the coastal zone in each region of the Mediterranean sea as well as their position in the rank of most populated cities of the world.

**Table 70. Major coastal urban areas (> 500,000 people) in countries of the West Mediterranean region (only along the Med coastline). * indicates the largest city of the country when no urban area exceeding the threshold does exist.**

| Country | City | Total rank | Population ($1000^3$) | Density (people/$km^2$) | Land area ($km^2$) |
|---|---|---|---|---|---|
| Spain | Barcelona | 85 | 4,223 | 5300 | 803 |
| | Valencia | 544 | 810 | 3000 | 272 |
| | Malaga | 683 | 600 | 3600 | 168 |
| | Palma | 807 | 500 | 3000 | 168 |
| | Zaragoza | 807 | 500 | 5700 | 88 |
| France | Marseille | 286 | 1,582 | 1300 | 1,204 |
| | Nice | 473 | 962 | 1300 | 743 |
| | Toulon | 737 | 559 | 700 | 764 |
| | Grenoble | | 495 | 1000 | 513 |
| Morocco | Tanger | 561 | 790 | 16,100 | 49 |
| Algeria | Algiers | 141 | 2,946 | 6,500 | 453 |
| | Wahran | 550 | 805 | 8,600 | 93 |
| | Constantine | 603 | 730 | 7,400 | 98 |

Rank refers to the position with respect to global list of populated urban areas.

**Table 71. Major coastal urban areas (> 500,000 people) in countries of the Central Mediterranean region (only along the Med coastline). * indicates the largest city of the country when no urban area exceeding the threshold does exist**

| Country | City | Total rank | Population ($1000^3$) | Density (people/km$^2$) | Land area (km$^2$) |
|---|---|---|---|---|---|
| Italia | Milan | 65 | 5,232 | 2,800 | 1,891 |
| | Rome | 92 | 3,799 | 3,400 | 1,114 |
| | Naples | 96 | 3,726 | 3,600 | 1,023 |
| | Turin | 307 | 1,499 | 4,000 | 376 |
| | Palermo | 520 | 876 | 6,000 | 145 |
| | Florence | 541 | 821 | 3,700 | 220 |
| | Catania | 609 | 720 | 2,900 | 246 |
| | Genoa | 668 | 625 | 8,000 | 78 |
| | Bologna | 792 | 510 | 3,300 | 155 |
| Greece | Athens | 119 | 3,269 | 4,800 | 684 |
| | Thessaloniki | 534 | 840 | 4,300 | 194 |
| Malta* | Valetta | | 300 | 3,300 | 91 |
| Croatia | Zagreb | 615 | 700 | 4,400 | 158 |
| Albania | Tirana | 733 | 560 | 6,600 | 85 |
| Slovenia* | Ljubljana | | 225 | 4,100 | 54 |
| Bosnia-Herz.* | Sarajevo | | 350 | 5,200 | 67 |
| Montenegro* | Podgorica | | 125 | 4,700 | 233 |
| Tunisia | Tunis | 175 | 2,420 | 6,700 | 363 |
| Libya | Tripoli | 385 | 1,143 | 5,900 | 194 |
| | Benghazi | 503 | 600 | 5,000 | 119 |
| Egypt | Cairo | 18 | 14,718 | 8,900 | 1658 |
| | Alexandria | 78 | 4,526 | 15,500 | 293 |
| | Port Said | 717 | 550 | 15,200 | 36 |
| | Suez | 807 | 500 | 6,900 | 73 |

Rank refers to the position with respect to global list of populated urban areas.

**Table 72. Major coastal urban areas (> 500,000 people) in countries of the East Mediterranean region (only along the Med coastline). * indicates the largest city of the country when no urban area exceeding the threshold does exist**

| Country | City | Total rank | Population ($1000^3$) | Density (people/km$^2$) | Land area (km$^2$) |
|---|---|---|---|---|---|
| Greece | Athens | 119 | 3,269 | 4,800 | 684 |
| | Thessaloniki | 534 | 840 | 4,300 | 194 |
| Turkey | Istambul | 21 | 13,576 | 9,700 | 1399 |
| | Izmir | 145 | 2,910 | 10,700 | 272 |
| | Bursa | 265 | 1,706 | 13,400 | 127 |
| | Antalya | 502 | 901 | 5,800 | 155 |
| | Mersin | 683 | 600 | 8,000 | 75 |
| Israel | Tel Aviv | 113 | 3,387 | 7,100 | 479 |
| | Haifa | 421 | 1,061 | 4,700 | 228 |
| | Jerusalem | 565 | 780 | 3,300 | 233 |
| Cyprus* | Nicosia* | | 230 | 1,900 | 119 |
| Syria | Aleppo | 123 | 3,196 | 12,300 | 259 |
| | Homs | 595 | 741 | 11,400 | 65 |
| Lebanon | Beirut | 221 | 2,016 | 3,000 | 673 |
| Palestine | Gaza | 606 | 725 | 16,500 | 44 |
| Libya | Tripoli | 385 | 1,143 | 5,900 | 194 |
| | Benghazi | 503 | 600 | 5,000 | 119 |
| Egypt | Cairo | 18 | 14,718 | 8,900 | 1658 |
| | Alexandria | 78 | 4,526 | 15,500 | 293 |
| | Port Said | 717 | 550 | 15,200 | 36 |
| | Suez | 807 | 500 | 6,900 | 73 |

Rank refers to the position with respect to global list of populated urban areas.

### 4.8.4 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).

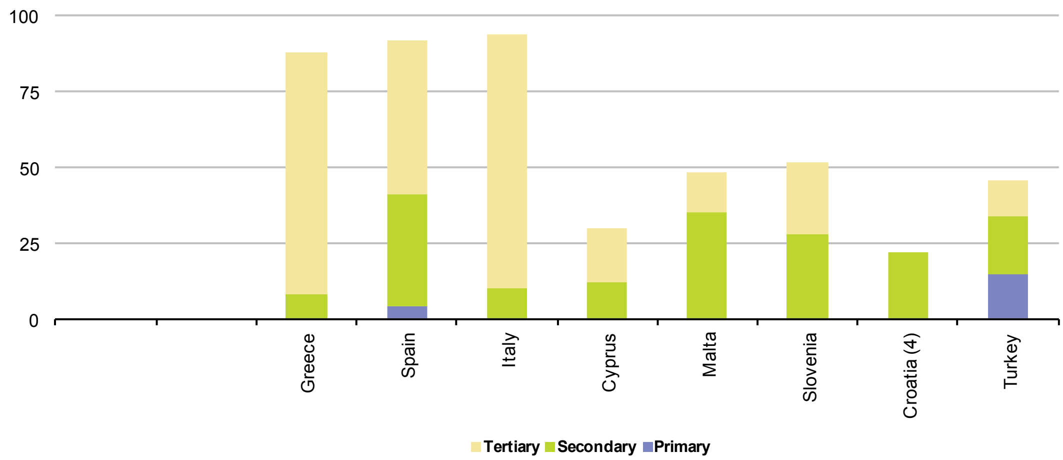



**Figure 63. Population connected to wastewater treatment (Eurostat, 2009).**

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 73 shows the percentage of population connected to wastewater collecting systems and wastewater treatment plants in Mediterranean countries. With respect to the coastal urban agglomerations along the Mediterranean, Figure 64 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 73. Thus, about 41 of % small cities and 29 % of medium and large cities are not served by WWTPs (Figure 65).

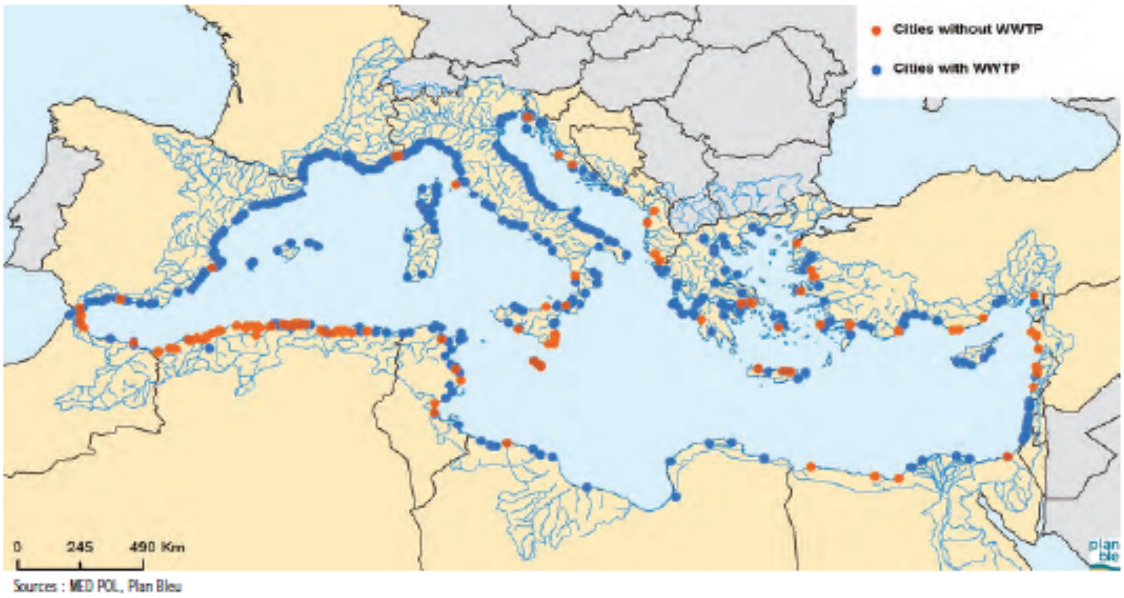



**Figure 64. WWTPs along the Mediterranean coast (Plan Bleu, 2009).**

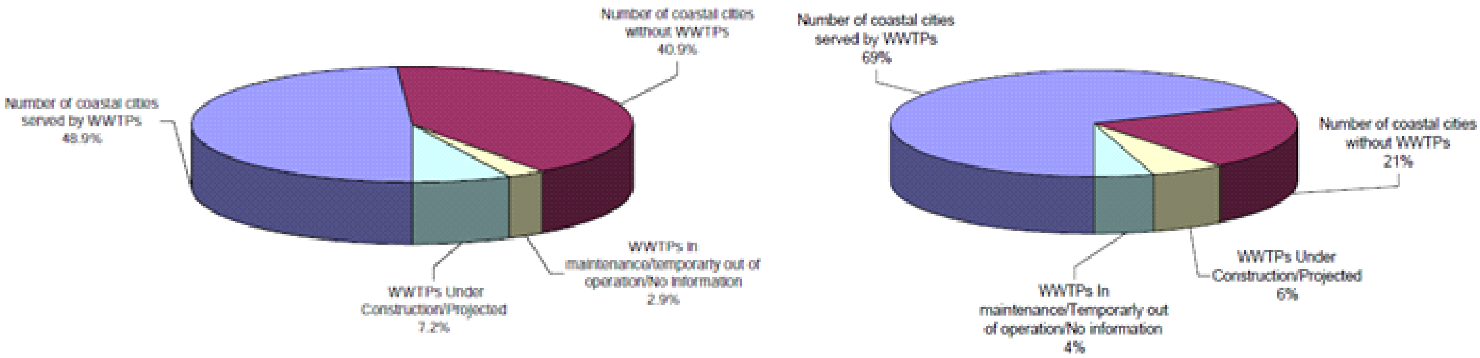



**Figure 65. Availability of Wastewater treatment plants in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004).**

The degree of treatment for wastewater of small and medium and large coastal cities in the Mediterranean basin is shown in Figure 66, where it can be seen that secondary treatment dominate, specially 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 67. 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.

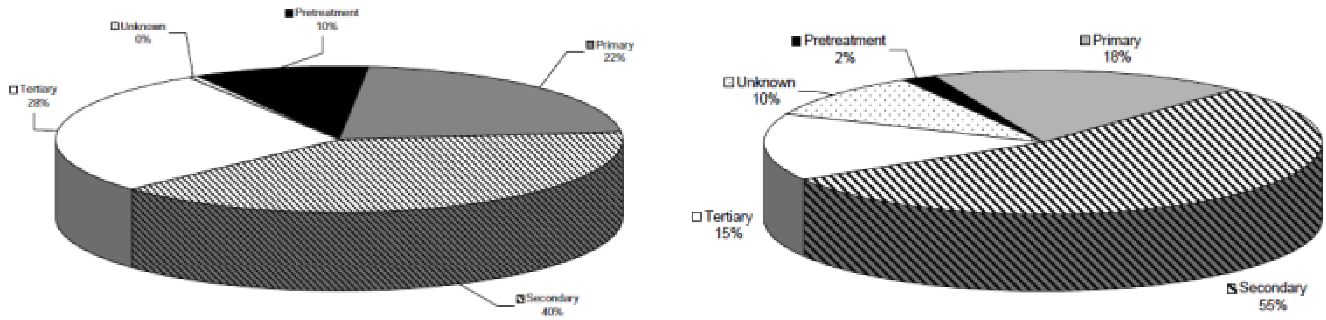



**Figure 66. Degree of treatment in WWTPs in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004).**

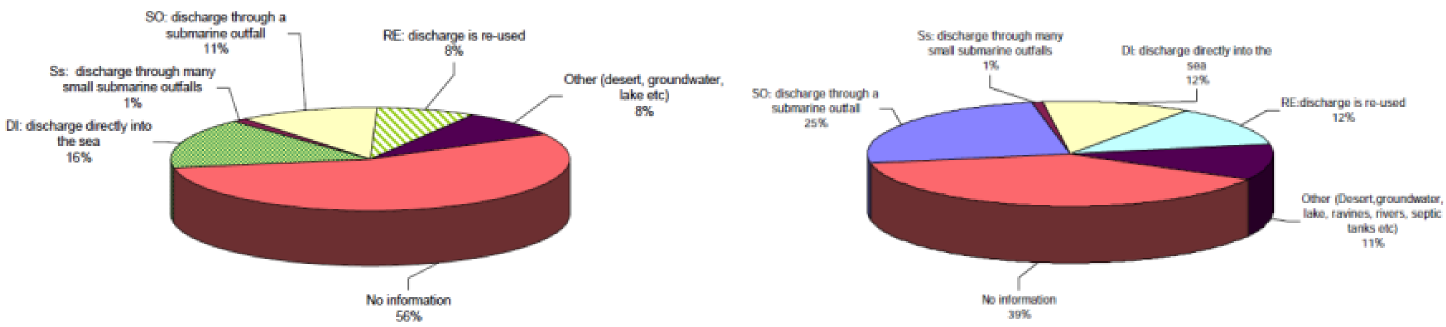



**Figure 67. Discharge of treated wastewater in small coastal cities -left- (UNEP/MAP, 2008) and medium and large coastal cities -right- (UNEP/MAP, 2004).**

**Table 73. Population connected to wastewater collecting system and wastewater treatment in the Mediterranean countries (%) (UNSD/UNEP; Eurostat; OECD).**

| Region | Country | Latest year available | Population connected to wastewater collecting system (%) | Latest year available | Population connected to wastewater treatment (%) |
|---|---|---|---|---|---|
| West Med | Spain | 2007 | 100.0 | 2008 | 92.0 |
| | France | 2004 | 82.0 | 2004 | 80.0 |
| | Morocco | 2005 | 87.2 | 2000 | 80.0 |
| | Tunisia* | 2008 | 55.9 | 2008 | 52.5 |
| | Algeria | 2009 | 86.0 | 2008 | 53.0 |
| Central Med | Italy | 2005 | 94.0 | 1999 | 69.0 |
| | Slovenia | 2009 | 63.0 | 2009 | 52.0 |
| | Greece** | 2009 | 87.0 | 2009 | 87.0 |
| | Malta | 2009 | 98.0 | 2009 | 48.0 |
| | Croatia | 2008 | 44.2 | 2008 | 27.3 |
| | Albania | | | | |
| | Monten. | | | | |
| | Cyprus | 2005 | 30.0 | 2005 | 30.0 |
| | Lybia** | -- | -- | -- | -- |
| | Egypt** | -- | -- | -- | -- |
| East Med | Turkey | 2008 | 73.0 | 2008 | 46.0 |
| | Israel | 2007 | 93.8 | 2007 | 91.0 |
| | Jordan | 2006 | 61.0 | 2006 | 61.0 |
| | Lebanon | 2004 | 67.4 | -- | -- |
| | Syria | -- | -- | -- | -- |
| | Palestine | 2009 | 52.1 | -- | -- |

*(*: countries belonging to West and Central Mediterranean regions; **: countries Central and East Med*

### 4.8.5 Links to environmental pressures

Figure 68shows 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.

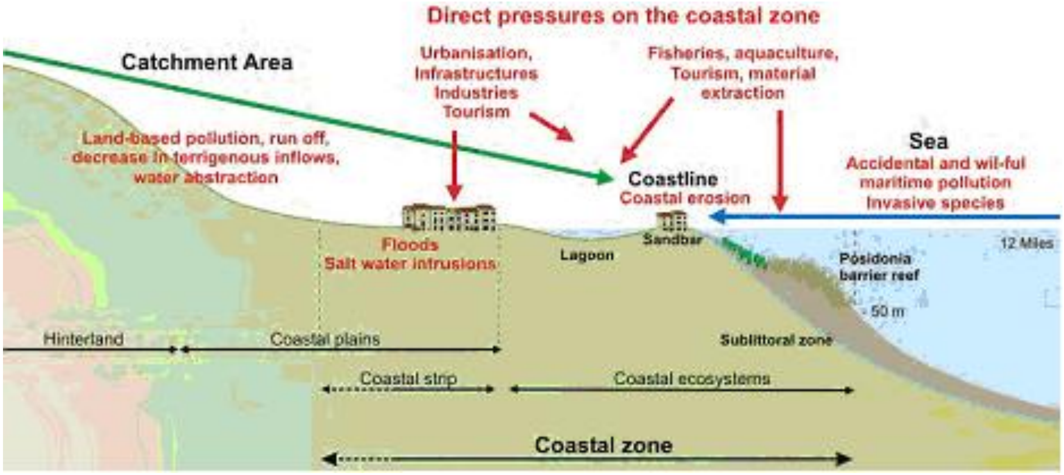



**Figure 68.Main land-based pressures on the coastal zone affecting coastal and marine ecosystems (Plan Bleu, 2009).**

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 69 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).

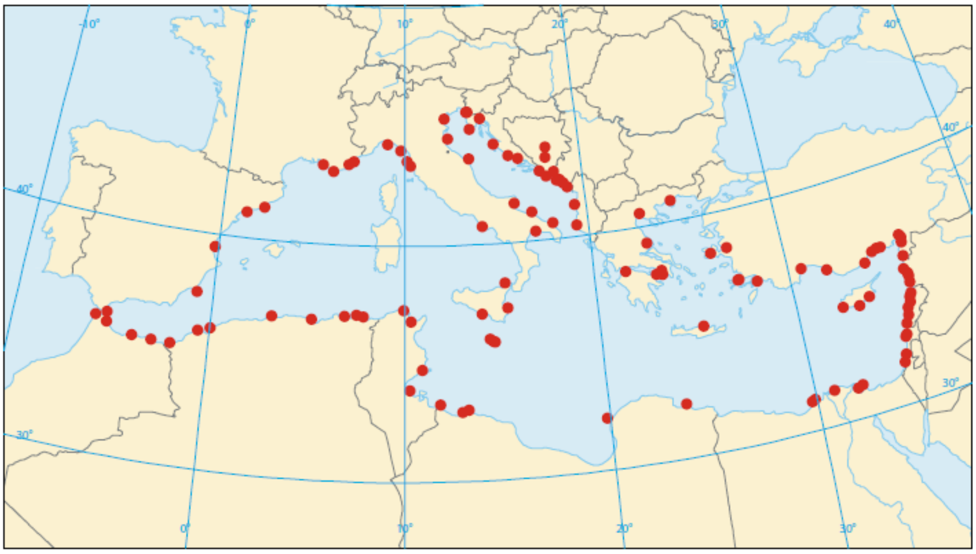


**Figure 69. Pollution hot spots along the Mediterranean coast (EEA. 2006).**

### 4.8.6 Gap Analysis

There is a need of updated and detailed data on extension of coastal urban areas for the different Mediterranean countries. Existing detailed compiled data are only available for few countries obtained in EU research projects such as Eurosion project (measurements of urbanization in 1990 for France, Greece, Italy, Slovenia and Spain).

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 (specially 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 Sources and data

This section aims at providing significant information as regards the estimated Cost of Degradation for both final (e.g. food provisioning, raw materials and energy, recreation, maritime transport) and intermediate services (e.g. habitat, climate regulation, resilience). The following activities will mainly be considered:

- Fisheries
- Aquaculture
- Maritime transport
- Recreational activities and tourism (ferries, cruise ships)
- Underwater pipelines and cables (power and communication)
- Offshore industry (oil, renewable marine energy)

We conduct the analysis for the Black Sea and the Mediterranean Sea by sub-regions [Western Mediterranean Sea (WMed), Adriatic Sea (AdS), Ionian Sea and the Central Mediterranean Sea (CentMed) and Aegean-Levantine Sea (AegSea)].

Given that the analysis is based on compilation of existing data, the sources of information consist of the Initial Assessment reports prepared by Member States in the context of the Marine Strategy Framework Directive (MSFD). For this purpose, the latest state of implementation of the MSFD was taken into consideration (http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/scoreboard_en.htm) shown in Table 3 above.

### 5.1.1 Fisheries

According to Section 2.2.1, the PERSEUS marine sub-regions and coastal states considered are as follows:

- The Black Sea: Bulgaria, Romania Ukraine, Russia, Georgia, and Turkey.
- The West Mediterranean: Spain, France, Monaco, Tunisia, Algeria, and Morocco.
- The Central Mediterranean
    - Adriatic Sea: Italy, Slovenia, Croatia, Bosnia-Herzegovina, Montenegro, and Albania.
    - Ionian Sea and Central Mediterranean Sea: Greece, Italy, Malta Egypt, Lybia, Tunisia, and Albania.
- The Aegean-Levantine Sea (East Mediterranean): Greece, Cyprus, Turkey, Syria, Lebanon, Israel, Palestinian territories, Egypt, and Lybia.

Given that the estimated Cost of Degradation at this stage is based on data gathered from the Initial Assessment reports, only EU Member States are considered.

Furthermore, as referred to Section 2.2.2, it has been decided that the economic and social assessment of fisheries (as well as of the vast majority of other activities) will be included in the coastal domain, i.e. the marine area from a depth of 0 to 200 meters. The open sea deliverable (D1.2) is being mostly devoted to qualitative considerations about the impacts and pressures of fisheries in open sea. However, a distinction will be made for some open sea species, i.e. tuna and red shrimp, wherever possible.

### Black Sea

This area includes the coasts and waters of Bulgaria and Romania. As mentioned, however, the Romanian Initial Assessment report has been submitted but it is not publicly available and Bulgaria has not fulfilled its reporting requirements.

### Western Mediterranean Sea

This area includes parts of the coasts and waters of Spain and France.

#### France

Fishery resources are subject to various factors of degradation, mainly due to direct exploitation, but also due to exogenous pressures caused by changes in the marine environment - alteration of coastal habitats, invasive species, chemical pollution, climate change. The analysis here focuses only on the degradation related to fisheries exploitation, whether professional or recreational.

The sustainable management of fisheries is part of the initial assessment of present policies (and associated costs). The methodological framework used for fishing followed international standards (OECD, 2003). This framework aims at distinguishing different types of expenditure: coordination costs of fisheries management, expenditure on actions to avoid degradation of fisheries resources. It also seeks to identify the costs of mitigating the damage to fishing activities. Finally, it addresses the issue of social cost (i.e. lost profits) related to degradation, but at this stage the IA does not provide a quantitative monetary estimate. These lost profits affect commercial and recreational fishermen and concern upstream and downstream activities in particular in terms of indirect and induced employment in the local economy. As part of this initial economic analysis it was not possible to allocate costs by marine sub-region, with the exception of certain items, especially on fisheries management tools.

*(1) Coordination costs of fisheries management*

Coordination costs of fisheries management include time costs of negotiation, implementation of management measures and the collection of relevant information. Its estimation followed the scientific expertise mobilized in support of the definition of policy of fisheries management. This typology is used by OECD (2003) and aims at introducing the actors involved in the political management of fisheries resources and the costs associated with the implementation of these policies. The assessment of these costs includes: salaries, operating expenses and investment costs.

The costs for coordination, monitoring and reporting of fisheries management in millions Euros (national and Community budgets) are, as follows:

a. Administration and coordination of fisheries management: 22.3
b. Professional structures: 3.6
c. Non-Governmental Organizations: 0.5
d. Monitoring, research & expertise: 23.7

*(2) Costs of positive actions (avoidance and prevention)*

Among the fisheries management measures to regulate the exploitation of fishery resources and thus avoid their degradation, two main types of management measures can be distinguished, namely:

- Conservation measures that aim at improving productive capacity and reproductive stocks. This is the total allowable catches for 33 stocks that represent approximately 50% of the landed value in the Atlantic (sub-marine region Bay of Biscay), limitations of capacity and total effort of fishing fleets, minimum sizes catch, gear regulations, closed areas, etc. Conservation policies are necessary but largely ineffective if they are not accompanied with effective control of access to resources. Their aim is to allocate the limited production capacity of stocks between fishing companies, or more broadly between users and limit incentives to over-investment.
- The second important area for fisheries management is the control and surveillance of fisheries.

Expenses related to management measures are largely confused with coordination costs presented above because these measures are standards and do not generate specific costs clearly identifiable. However, there exist other measures that lead to public spending relating to financial incentives for professional fishermen, i.e. financial aid to exit from the fleet and to change fishing practices attributed particularly in the context of 'blue contracts'. The total spending to reduce the capacity of fishing fleets were ***47.3 million Euros***, in 2008, (including 20% of budget funded Community) and the cost 'blue contracts' amounted to ***12.9 million Euros*** (20% financed by the Community budget).

As regards the control and surveillance of fisheries, the budget of the central government was ***3.9 million Euros***. It relies on the cost of decentralized MEDDTL (DIRM, including within them patrol, patrol boats and regional CROSS), the DDTM (including their ULAM), the Navy, Gendarmerie and Customs. The cost of monitoring fisheries attributable to other jurisdictions was not evaluated (MEDDTL, Ministry of Defense, Ministry of Budget, Public Accounts and Civil Administration). Some regional committees also contribute to the finance of certain monitoring operations. Given the increased control obligations, it was assumed that this amount is probably around ***30 million Euros***.

*(3) Costs of mitigation measures*

This refers to actions and costs associated with mitigation measures for fishermen due to degradation of fisheries resources, e.g. the state funding in the context of temporary stoppages for anchovy and cod in the Bay of Biscay. It is part of a process of rebuilding fish stocks or to better conserve fishery resources and the marine environment. These expenses amounted to ***6.8 million Euros*** in 2008 (national budget) and are integrated as well as the outputs of floating in actions relating to the adjustment of fishing effort. In 2008 for the Western Mediterranean Sea sub-region, no temporary halt was implemented.

*(4) Residual costs: lost profits associated with the degradation of fishery resources*

The economic and social analysis of the use of water provides economic indicators (turnover, value added, and employment) on the situation of the fisheries sector as well as the downstream sector. Revenues generated by operations depend on the production and its market value, cost of production, fishing capacity deployed and the status of biological resources exploited. This type of evaluation requires quantifying the difference between incomes generated by the exploitation of fisheries and the potential revenue generated by the adjustment of fishing capacity and resource exploitation restored, e.g. maximum sustainable yield.

Various studies have attempted to quantify the loss of revenue, specifically resource rent using bio-economic modeling tools. Assuming an unchanged fishing gear selectivity and recruitment, production gains expected from an adjustment of the fishing effort levels to achieve maximum sustainable yield would not be very large (Macher et al. 2011). In contrast, the reduction of fishing effort and/or fishing capacity would result to increasing yields.

### Spain

The calculation of Cost of Degradation in Spain regarding the area of interest involves the Alboran Sea - Strait of Gibraltar sub-region and the eastern provinces of Spain - Balearic Sea sub-region.

**a. The Alboran Sea - Strait of Gibraltar marine sub-region**

In order to estimate the Cost of Degradation in the Alboran Sea - Strait of Gibraltar marine sub-region, an analysis of budgetary programs concerning measures related to the protection of the marine environment, both in the General State Administration and the Autonomous Communities, was taken into consideration. To improve the consistency of the results, the analysis covered a three-year period, i.e. 2009, 2010 and 2011.

The average annual amount of funding provided by the General Administration Programs related to the marine environment is nearly ***1,300 million Euros*** (Table 71).

**Table 74. Budget expenditures of the General Administration Programs related to Marine Environment (in million euros)**

| | | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| **415A** | Protection of fisheries resources and sustainable development | 47.68 | 52.10 | 28.67 |
| **415B** | Improved structures and fish markets | 125.11 | 152.08 | 93.34 |
| **456A** | Water quality | 471.83 | 584.98 | 295.34 |
| **456D** | Coastal measures | 280.83 | 301.20 | 162.40 |
| **456M** | Pollution and climate change prevention measures | 121.19 | 166.57 | 101.51 |
| **467E** | Oceanographic and fisheries research | 65.77 | 61.28 | 60.52 |
| **454M** | Maritime safety and coastal monitoring | 264.41 | 219.10 | 197.17 |
| **Total** | | **1376.82** | **1537.31** | **938.95** |

Source: Estrategia Marina Demarcación Marina Del Estrecho y Alborán, Evaluación Inicial Parte III: Análisis Económico y Social , p. 43

Using economic data published by the General Office of Analysis, Forecasting and Coordination, Department of Agriculture, Food and Environment, the investments attributed to the protection of the Alboran Sea - Strait of Gibraltar marine sub-region were ***56.68 million Euros and 38.35 million Euros for the years 2009 and 2010, respectively***. Nevertheless, with the available information it is not possible to determine which portion of the funds provided for the protection of the marine environment, in general, is directed to fisheries.

In Andalusia two Departments with budget programs related to the marine environment were identified, namely the Department of Environment and the Department of Agriculture and Fisheries (Table 72 and Table 73).

**Table 75. Budget of the Department of Environment of the Autonomous Community of Andalusia (in million euros)**

| Ministry of Environment | 2009 | 2010 | 2011 |
|---|---|---|---|
| **General Secretariat of Environmental Services** | 634.40 | 527.08 | 306.64 |
| **Climate change, prevention and Environmental Quality** | 41.89 | 80.03 | 80.23 |
| **Natural Areas and Citizenship** | 83.36 | 70.37 | 67.17 |
| **Environmental Management** | 370.49 | 334.12 | 334.77 |
| **Sustainable Development and Environmental Information** | 21.44 | 17.12 | 15.99 |

Source: Estrategia Marina Demarcación Marina Del Estrecho y Alborán, Evaluación Inicial Parte III: Análisis Económico y Social , p. 45

**Table 76. Budget of the Department of Agriculture and Fisheries of the Autonomous Community of Andalusia (in million euros)**

| Ministry of Agriculture and Fisheries | 2009 | 2010 | 2011 |
|---|---|---|---|
| **General Secretariat of Agriculture and Fisheries** | 280.67 | 264.22 | 211.09 |
| **Fisheries** | 99.95 | 95.67 | 56.41 |

Source: Estrategia Marina Demarcación Marina Del Estrecho y Alborán, Evaluación Inicial Parte III: Análisis Económico y Social , p. 45

**b. The eastern provinces of Spain - Balearic Sea**

The estimation of the Cost of Degradation of the eastern provinces of Spain - Balearic Sea marine sub-region was based on the analysis of budgetary programs relating to measures and actions for the protection of the marine environment. The information was collected from both the General State Administration and the Autonomous Communities. In order to improve the consistency of the estimates, a three-year period (i.e. 2009, 2010 and 2011) was considered.

Through the economic data published by the General Office of Analysis, Forecasting and Coordination, Department of Agriculture, Food and Environment, the investments attributed to the protection of the eastern provinces of Spain - Balearic Sea marine sub-region were ***139.99 million Euros and 83.10 million Euros for the years 2009 and 2010, respectively***. Nevertheless, with the available information it is not possible to determine which portion of the funds provided, in general, for the protection of the marine environment is directed to fisheries.

In the Autonomous Community of Catalonia, nine budgetary programs related to the marine environment were identified, in 2009-2011 (Table 74). Nevertheless, with the available information it is not possible to determine which portion of the total funds provided for the protection of the marine environment is directed to fisheries.

**Table 77. Budget of the Autonomous Community of Catalonia (in million euros)**

| | 2009 | 2010 | 2011 |
|---|---|---|---|
| **Water Sanitation** | 529.77 | 637.98 | 433.71 |
| **Ports and Maritime Transport** | 27.03 | 25.43 | 23.48 |
| **Coastal projects** | 1.66 | 3.74 | 1.82 |
| **Protection and conservation of the natural environment** | 201.47 | 206.25 | 119.10 |
| **Infrastructure and waste management** | 124.56 | 127.00 | 118.22 |
| **Policy and environmental awareness** | 9.91 | 7.74 | 4.27 |
| **Prevention and Environmental Control** | 8.15 | 8.59 | 5.94 |
| **Support of agriculture and fisheries subsectors** | 38.98 | 41.88 | 26.43 |
| **Modernization of agricultural and fisheries companies** | 62.05 | 63.76 | 70.01 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 49

In Valencia two budgetary programs related to protecting the marine environment were found from the Department of the Environment, Water, Housing and Urban Development and the Department of Agriculture, Fisheries and Food. The expenditure budgets for the period 2009 -2011 are given in the next tables (Table 75 and Table 76).

**Table 78. Budget of the Department of Environment, Water, Housing and Urban Development of the Autonomous Community of Valencia (in million euros)**

| Department of Environment, Water, Housing and Urban Development | 2009 | 2010 | 2011 |
|---|---|---|---|
| **Coastal planning** | 0 | 0.002 | 0.001 |
| **Sanitation and Water Purification** | 0.026 | 0.013 | 0.007 |
| **Conservation of the Natural Environment** | 0.017 | 0.013 | 0.009 |
| **Restoration and Protection of Natural Resources** | 0.058 | 0.043 | 0.032 |
| **Climate Change and Environmental Quality** | 0.007 | 0.006 | 0.005 |
| **Conservation of Natural Areas** | 0.020 | 0.015 | 0.012 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 50

**Table 79. Budget of the Department of Agriculture, Fisheries and Food of the Autonomous Community of Valencia**

| Ministry of Agriculture, Fisheries and Food | 2009 | 2010 | 2011 |
|---|---|---|---|
| Improved Management and Fish Production | 0.033 | 0.026 | 0.022 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 50

In the Region of Murcia two budgetary programs related to protecting the marine environment were found from the Department of Agriculture and Water and the Ministry of Public Works and Territory. The expenditure budgets for the period 2009 -2011 are given in the next tables (Table 77 and Table 78).

**Table 80. Budget of the Department of Agriculture and Water of the Autonomous Community of Murcia (in million euros)**

| Ministry of Agriculture and Water | 2009 | 2010 | 2.011 |
|---|---|---|---|
| Fisheries and Aquaculture | 10.64 | 9.22 | 8.49 |
| Sanitation and Treatment | 53.38 | 38.77 | 31.34 |
| Protection and Nature Conservation | 4.16 | 3.41 | 0.00 |
| Biodiversity, Game and Inland Fisheries | 0.00 | 0.00 | 1.42 |
| Environmental Quality | 4.35 | 4.94 | 2.63 |
| Planning and Protection of Protected Areas and Natural Environment | 11.49 | 12.09 | 11.69 |
| Environmental Monitoring and Auditing | 13.21 | 10.62 | 7.51 |
| Promotion of Environment and Climate Change | 0.99 | 0.84 | 0.38 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 50

**Table 81. Budget of the Department of Public Works and Planning of the Autonomous Community of Murcia (in million euros)**

| Ministry of Public Works and Territory | 2009 | 2010 | 2011 |
|---|---|---|---|
| Ports and Coasts | 9.50 | 8.21 | 4.85 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 51

In the Region of the Balearic Islands two budgetary programs related to protecting the marine environment were found from the Department of Environment and the Department of Agriculture and Fisheries. The expenditure budgets for the period 2009-2010 are given in the next tables (Table 79 and Table 80).

**Table 82. Budget of the Department of Environment of the Autonomous Community of the Balearic Islands (in million euros)**

| Department of Environment | 2009 | 2010 |
|---|---|---|
| Water Treatment and Purification | 35.57 | 36.85 |
| Protection and Control of Water Framework Directive | 1.94 | 4.05 |
| Areas of environmental relevance | 1.34 | 1.38 |
| Conservation and enhancement of the natural environment | 2.44 | 0.52 |
| Protected Natural Areas Management | 8.44 | 11.76 |
| Environmental quality, pollution control | 1.49 | 1.35 |
| Quality of bathing water | 2.81 | 0.24 |
| Monitoring of climate change | 0.88 | 0.86 |
| Environmental Education and Society | 1.77 | 1.71 |
| Training and education in relation to the sea | 0.22 | 1.12 |
| Coastal management | 0.31 | 0.25 |
| Port Facilities Management | 5.26 | 6.31 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 51

**Table 83. . Budget of the Department of Agriculture and Fisheries of the Autonomous Community of the Balearic Islands (in million euros)**

| Ministry of Agriculture and Fisheries | 2009 | 2010 |
|---|---|---|
| Improved productivity and fisheries exploitation | 1.61 | 1.45 |
| Fisheries management | 0.43 | 0.48 |
| European fishing Programmes | 0.96 | 0.59 |

Source: Estrategia Marina Demarcación Marina Levantino – Balear, Evaluación Inicial Parte III: Análisis Económico y Social , p. 51

With the available information it is not possible to determine which portion of the funds provided for the protection of the marine environment in the Autonomous Areas is directed to fisheries.

## Central Mediterranean

### a. Adriatic Sea

This area includes parts of the coasts and waters of Italia, Croatia, Bosnia-Herzegovina, Montenegro and Albania. The only EU Member State is Italy. Nevertheless, the Italian Initial report is not publicly available, so far.

### b. Ionian Sea and Central Mediterranean Sea

This area includes parts of the coasts and waters of Greece, Italy (Sicily), Malta, Egypt, Albania, Libya and Tunisia. Provided that the Italian Initial report is not publicly available and Malta has not fulfilled its reporting requirements, only figures from Greece are reported hereinafter.

### Greece

The calculation of Cost of Degradation was based on a construction of a scenario under the hypothesis of benefit losses. The Cost of Degradation was considered to be equal to the Present Value of lost Gross Value Added. The baseline situation is that of the year 2008. The time horizon for carrying out the Cost of Degradation analysis is the period 2008-2020, as it is suggested by the most of EC working papers, partly due to the fact that 2020 is the year to maintain good environmental status (MSFD article1, no. 1). It is also directly comparable with the analysis of "Programme of measures" of article 13.

A discount rate of 2.38% was used (based on the European Commission's discount rates for September 2012, which was 1.38%, and a margin of 100 basis points). Furthermore two more scenarios were considered with rates 5% and 10%, respectively to deal with risk.

The results for the Cost of Degradation in the fisheries sector in Greece are illustrated in the following tables (Table 81 and Table 82).

**Table 84. Cost of Degradation for the fisheries sector in Greece in NPV terms – Gross Production Value (in million euros)**

| | 2.38% | 5% | 10% |
|---|---|---|---|
| Fisheries | 129.28 | 207.73 | 237.56 |

**Table 85. Cost of Degradation for the fisheries sector in Greece in NPV terms – Gross Added Value (in million euros**

| | 2.38% | 5% | 10% |
|---|---|---|---|
| Fisheries | 26.11 | 41.96 | 47.99 |

In total, the Cost of Degradation equals 0.03% of GDP. Due to data unavailability and inconsistencies it is not possible to separate the Cost of Degradation for the Ionian Sea.

## Aegean-Levantine Sea

This particular area includes parts of the coasts and waters of Cyprus, Greece, Turkey, Syria, Lebanon, Israel, Palestinian territories, Egypt, Libya and Tunisia. For the purposes of this report only Cyprus and Greece (Aegean Sea) are examined.

### Cyprus

Considering the impacts of environmental pressures, it is envisaged that during the next decade Cyprus is not probable to face severe impacts on marine waters degradation. The amount of pressures does not constitute a critical mass altering the environmental status of marine waters in such a degree as to lower the benefits of the sectors profiting from marine waters. Regarding the fishing sector, two areas could produce negative results:

a) The overfishing that is going to have at the end benefit losses for fisheries either due to fish stock collapse or due to deliberate reduction of catches by fisheries in order to avoid fish stocks collapse.

b) The Lessepsian migration (up to now more than 300 species from Red Sea were identified in East Mediterranean).

The calculation of Cost of Degradation was based on a construction of a scenario under well-defined working hypotheses assuming benefit losses and was considered to be equal to the Present Value of lost Gross Value Added. The baseline situation is that of the year 2010. The time horizon for carrying out the cost of degradation analysis is the period 2010-2020, as it is suggested by the most of EC working papers, partly due to the fact that 2020 is the year to maintain good environmental status (MSFD article1, no. 1). It is also directly comparable with the analysis of “Programme of measures” of article 13.

A discount rate of 3% was used based on the European Commission’s base rates for 1/1/2012 (which was 2.07%) and a margin of 100 basis points (as mentioned, for reasons of simplicity 3% was used instead of 3.07%).

Rebuilding the fish stocks requires short-term sacrifices and the difficulties of succeeding reduced catches are well known. The point is to calculate the losses in fishing revenues regardless of the cause (in other words either being the result of monitoring implementation or reduced catches due to reduced stocks). Whatever the cause, loss of revenues is a result of marine water degradation and therefore it constitutes Cost of degradation.

A basic scenario was constructed assuming an annual Gross Value Added loss of 5%. Data for the baseline GVA is jointly available for fisheries and marine aquaculture. In order to get GVA separately for fisheries the relative contribution of each sector to Value of Production was used, for which the data appears separately. So 25% of joint GVA is considered to be the share of fisheries. Though this calculation may not be completely accurate, it is a well proxy.

The basic assumptions were that the starting point accruing losses is the year 2014, and the base line GVA is remaining constant through the whole time period.

The Present Value of benefit losses for fisheries is ***1.8 million Euros***, which corresponds to an insignificant percentage of GDP.

Two alternative scenarios were also constructed to deal with risk. The optimistic one is based on a 3% reduction and the pessimistic one is based on a 7% reduction. In the first case the Present Value of losses is ***0.411 million Euros***, while for the second one the Present Value is ***2.4 million Euros***.

#### Greece

The calculation of Cost of Degradation for the fisheries sector in Greece is described in Section 4.3.2.3.1. As mentioned, the total Cost of Degradation for the fisheries sector, for the Basic scenario, is around ***26 million Euros***. Yet, it was not possible to separate the Cost of Degradation for the Aegean Sea due to data unavailability and inconsistencies.

### 5.1.2 Recreational activities, coastal tourism

#### Black Sea

This area includes the coasts and waters of Bulgaria and Romania. As mentioned, however, the Romanian Initial Assessment report has been submitted but it is not publicly available and Bulgaria has not fulfilled its reporting requirements.

#### Western Mediterranean Sea

#### France

As detailed in Section 4.1, the French Initial Assessment report organized the estimation of the Cost of Degradation by themes, e.g. marine litter, contaminants, oil spills and illegal oil discharges, , impacts of invasive species etc.

According to the reports included in the Thematic Contributions[11], coastal tourism and recreational activities are affected by marine litter, introduction of energy, oil spills and illegal oil discharges, etc. Hereinafter, a brief description of those issues is provided. Wherever possible, monetary estimates related to the Cost of Degradation of coastal tourism and recreational activities are illustrated.

a. Costs of marine litter

The presence of marine litter causes discomfort to the users of the sea and coastline and, thus, beaches should be cleaned. According to a survey conducted by LH2 (2011), 97% of French interviewed were embarrassed to find human waste on the beach, 95% were bothered by traces of oil, 73% of dead animals and 40% by seaweed left by the sea. Furthermore, 85% of French respondents said that they had faced problems of dirt beaches and 17% canceled or modified a holiday or a leisure activity because of this issue. Individuals are aware of the environmental problems posed by marine litter. Indeed, the problem of oil spills and illegal discharges, marine debris are considered one of the most pressing problems by 97% of French respondents and 86% believe that there are not enough companies to fight against the problem of marine litter (LH2, 2011).

[11] Analyse Economique Et Sociale De L'utilisation De Nos Eaux Marines Et Du Cout De La Dégradation Du Milieu Marin - Cout De La Dégradation Du Milieu - Méditerranée occidentale C2.1 to C2.9. Available at : http://wwz.ifremer.fr/dcsmm/Le-Plan-d-Action-pour-le-Milieu-Marin/Evaluation-initiale/Contributions-thematiques

The impacts on tourism motivate coastal municipalities to spend large amounts of money to clean the beaches.

b. Costs associated with the introduction of energy into the environment and changes in the hydrological regime

In terms of cost of residual impacts (damage observed despite the measures taken), the residual erosion of the coastline, and the introduction of constructions to fight against erosion, potentially generate costs and shortfalls in certain economic sectors such as tourism. The loss of tourist attraction (if any) of the resorts of Languedoc Roussillon, due to erosion and / or measures to fight against erosion, however, is almost impossible to quantify.

c. Costs related to the impacts of invasive non-native species

It is acknowledged that invasive non-native species may affect tourism due to the reduction of marine biodiversity that could result in reduced recreational opportunities. Nevertheless, is seems difficult to directly compare the importance of different types of costs due to the lack of quantitative data for certain costs.

d. Costs associated with oil spills and illegal oil discharges

Oil spills in Mediterranean Sea are very significant due to the high vulnerability of the marine sub-region, the importance of coastal tourism and the importance of population and economic activities located in coastal areas. There are no data, however, regarding the impact of the oil spill on recreational activities.

Illegal oil discharges are also significant. Yet, there is no work dealing with the issue of the impact of illegal discharges on the marine environment. Thus, it was not possible to reconstruct the elements and assess the economic impacts of illegal discharges in the Initial Assessment report.

e. Costs associated with microbial pathogens

The presence of microbial pathogens in the marine environment can cause loss of recreational amenities as well as economic losses to tourism through necessary measures, e.g. temporary closures of swimming areas.

The Cost of Degradation attributed to residual impacts of the presence of microbial pathogens in the marine environment could be estimated by the following indicators:

- Classification of beaches, expressed as the percentage of poor quality beaches.
- Percentage of sites with poor quality water sports.
- Occurrence and duration of beach closings.
- Loss of amenity suffered by recreational users.
- Economic loss of tourism industry.
- Loss of amenity suffered by recreational fishermen.

A survey conducted by LH2 (2011) revealed that 33% of those interviewed had decided at least once to modify or cancel their holiday or a leisure activity after being confronted with pollution of marine waters, resulting in a bathing prohibition or warning on risks when swimming.

Due to the complexity of these impacts, no reliable valuation methodology has been established so far. However, there exist some economic data with respect to the cost of degradation attributed to presence of microbial pathogens.

*Information and monitoring costs*

The cost of information and monitoring for the Western Mediterranean sub-region is 237,420 Euros for the REMI network (or 11% of the cost of all marine sub-regions), 1.8 million Euros for the monitoring of bathing waters (50% of the cost on all marine sub-regions) and 115,000 Euros for the Surfrider network (or 80% of the cost of all marine sub-regions). In addition, 21,000 Euros are spent for the preparation of classification studies on microbial pathogens and 715,000 Euros for the program 'ocean health', respectively.

*Costs of prevention and avoidance*

In the Western Mediterranean sub-region, the annual cost of public wastewater treatment plants is 492 million Euros (47% of the cost of all marine sub-regions) and the annual cost of sewerage is 100 million Euros (47% of the cost of all marine sub-regions).

*Mitigation costs*

For the Western Mediterranean sub-region, the cost of remediation is 1.7 million Euros (27% of the cost of all marine sub-regions).

#### Spain

The Cost of Degradation of the marine environment in the Alboran Sea - Strait of Gibraltar and the eastern provinces of Spain - Balearic Sea sub-regions is discussed in Section 4.3.2.2.2. As mentioned, the Spanish Initial Assessment report has estimated the total Cost of Degradation for the region, and with the available information it is not possible to determine which portion of the funds provided for the protection of the marine environment is directed to tourism and recreational activities.

### Central Mediterranean

**a. Adriatic Sea**

This area includes parts of the coasts and waters of Italia, Croatia, Bosnia-Herzegovina, Montenegro and Albania. The only EU Member State is Italy. Nevertheless, the Italian Initial report is not publicly available, so far.

**b. Ionian Sea and Central Mediterranean Sea**

This area includes parts of the coasts and waters of Italy (Sicily), Albania, Greece, Libya and Tunisia. Provided that the Italian Initial report is not publicly available, only figures from Greece are reported hereinafter.

#### Greece

The calculation of Cost of Degradation was based on the approach described in Section 4.3.2.3.1, i.e. a scenario was constructed under the hypothesis of benefit losses and the Cost of Degradation was calculated by the Present Value of lost Gross Value Added. The baseline situation is that of the year 2008. The time horizon for carrying out the cost of degradation analysis is the period 2008-2020.

A discount rate of 2.38% was used based on the European Commission's discount rates for September 2012 (which was 1.38%) and a margin of 100 basis points. Furthermore two more scenarios were considered with rates 5% and 10%, respectively to deal with risk.

The results for the Cost of Degradation in the tourism sector in Greece are illustrated in the following tables (Table 83 and Table 84).

**Table 86. Cost of Degradation for the tourism sector in Greece in NPV terms – Gross Production Value (in million euros)**

| | 2.38% | 5% | 10% |
|---|---|---|---|
| Tourism | 964.78 | 1,276.53 | 1,459.83 |

**Table 87. Cost of Degradation for the tourism sector in Greece in NPV terms – Added Value (in million euros)**

| | 2.38% | 5% | 10% |
|---|---|---|---|
| Tourism | 50.55 | 241.90 | 276.64 |

In total, the Cost of Degradation equals 0.15% of GDP. Due to data unavailability it is not possible to separate the Cost of Degradation for the Ionian Sea.

### Aegean-Levantine Sea

#### Cyprus

In order to estimate the Cost of Degradation for coastal tourism, a basic scenario was constructed assuming an annual loss in Gross Value Added of 3%. The calculation of losses starts from year 2014 allowing for the deterioration of waters quality from the present status of excellent condition.

The Gross Value Added upon which losses are counted is that of the year 2010 and it is taken constant throughout the whole period. This assumption was adopted in order to isolate the clear

The Present Value (PV) of potential losses is ***146.55 million Euros***, which corresponds to 0.8% of GDP.

In order to deal with the risk two alternative scenarios are used allowing for a more optimistic and less optimistic outcome. These two alternative scenarios are based in the assumption that the actual loss is 1% and 5% respectively.

In the first case the PV of losses is ***51.73 million Euros*** or 0.3% of GDP, and in the second case the resulting PV is ***230.80 million Euros*** or 1.3% of GDP, respectively.

Greece

The calculation of Cost of Degradation for coastal tourism and recreational activities for Greece is described in Section 4.3.3.3.1. As mentioned, the Cost of Degradation for Greece according to the Basic scenario is about ***50.5 million Euros***. Due to data unavailability, however, it was not possible to isolate the Cost of Degradation in the Aegean Sea.

## 5.2 Gap analysis of Cost of Degradation data

The analysis of the Cost of Degradation at this stage is based on existing data gathered from the Initial Assessment reports that have been prepared by Member States in the context of the Marine Strategy Framework Directive (MSFD). The research conducted shows significant gaps in data availability and reliability for the Mediterranean Sea and Black Sea regions. There exist no data for the Cost of Degradation for Italy, Malta, Romania and Bulgaria, given that the Italian and Romanian Initial Assessment reports have been submitted but they are not publicly available, while Bulgaria and Malta have not fulfilled their reporting requirements. More specifically:

### 5.2.1 Black Sea

(i) Fisheries

No estimates are made for this region.

(ii) Coastal tourism and recreational activities

No estimates are made for this region.

### 5.2.2 Western Mediterranean Sea

(i) Fisheries

The French Cost of Degradation data for the fisheries sector, which are presented in the Initial report, have not been allocated by marine sub-region. Hence, it was not possible to estimate the French Cost of Degradation for the Western Mediterranean Sea sub-region.

The calculation of Cost of Degradation for the fisheries sector in Spain involves the Alboran Sea - Strait of Gibraltar and the eastern provinces of Spain - Balearic Sea sub-regions. The Spanish report provides an allocation of Cost of Degradation per region.

Nevertheless, with the available information it is not possible to determine which portion of the cost figures is directed to fisheries.

(ii) Coastal tourism and recreational activities

As has already mentioned, the French Initial Assessment report organized the estimation of the Cost of Degradation by themes, e.g. marine litter, contaminants, oil spills and illegal oil discharges, eutrophication, impacts of invasive species etc. Consequently, the Cost of Degradation of coastal tourism and recreational activities is estimated indirectly from the cost caused by marine litter, introduction of energy, oil spills and illegal oil discharges, etc. Nevertheless, the Cost of Degradation of recreational and tourism amenities has been quantified in monetary terms only in association with the presence of microbial pathogens in the marine environment.

The Spanish report provides an allocation of Cost of Degradation for the Western Mediterranean sub-region. However, with the available information it is not possible to determine which portion of the cost figures is directed to the protection of recreational and tourism amenities.

### 5.2.3 Central Mediterranean

#### Adriatic Sea

(i) Fisheries

No estimates are made for this region.

(ii) Coastal tourism and recreational activities

No estimates are made for this region.

#### Ionian Sea and Central Mediterranean Sea

(i) Fisheries

The calculation of Cost of Degradation in the fisheries sector was based only on data presented in the Greek Initial Assessment report. Nevertheless, it was not possible to separate the Cost of Degradation for the Ionian Sea due to data unavailability and inconsistencies.

(ii) Coastal tourism and recreational activities

The calculation of Cost of Degradation in the tourism sector was based only on data presented in the Greek Initial Assessment report. Even so, it was not possible to separate the Cost of Degradation for the Ionian Sea due to data unavailability.

#### Aegean-Levantine Sea

(i) Fisheries

Regarding Greece, it was not possible to separate the Cost of Degradation for the Aegean Sea due to data unavailability and inconsistencies.

(ii) Coastal tourism and recreational activities

Regarding Greece, it was not possible to isolate the Cost of Degradation in the Aegean Sea due to data unavailability.

# 6 CONCLUSIONS

The objective of this first deliverable 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 areas, at sub regional levels in the SES. This assessment complements the analysis carried out by natural scientists in T2.1 (Analysis of pressures and processes and their impact on the ecosystems).

Following the DPSIR model, it 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, this work is in coherence with the economic and social analysis to be carried out in the MFSD Initial assessment. This preliminary and basin wide economic and social analysis will be followed by the D2.3, which will focus on the four Pilot cases of the WP6 (Adaptive policies and scenarios). These assessments will be part of the contextual background needed for the preparation of future programme of measures and policies aiming to achieve or maintain the Good Environmental Status at Pilot Cases and Basin levels.

A similar work has been made in the framework of the WP1 for the Task 1.2, focused on the instead open water of the coastal areas, here defined as waters including the seabed and subsoil within 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, since PERSEUS is a research project committed to explore innovative tools and approaches, it is not out of place to experiment new ideas. Regarding innovation, the economic and social assessment of the use of the Mediterranean or Black sea waters at basin scale has never been attempted to date. Distinction between coastal areas and open waters has made this first attempt more challenging.

The analysis has been focused on the following main sectors: fisheries, aquaculture, maritime transport and cruises, recreational activities and coastal tourism, desalination, urban developments, wastewater treatment plants, submarine cable and pipeline operations, and marine hydrocarbon (oil and gas) extraction.

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, in order to give a complete picture of the maritime stressors on the marine environment and to focus the D1.2 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 performed. 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 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.

This preliminary and basin wide economic and social analysis will be followed by the D2.3, which will focus on the four Pilot cases of the WP6 (Adaptive policies and scenarios). These assessments will be part of the contextual background needed for the preparation of future programme of measures and policies aiming to achieve or maintain the Good Environmental Status at Pilot Cases and Basin levels.

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