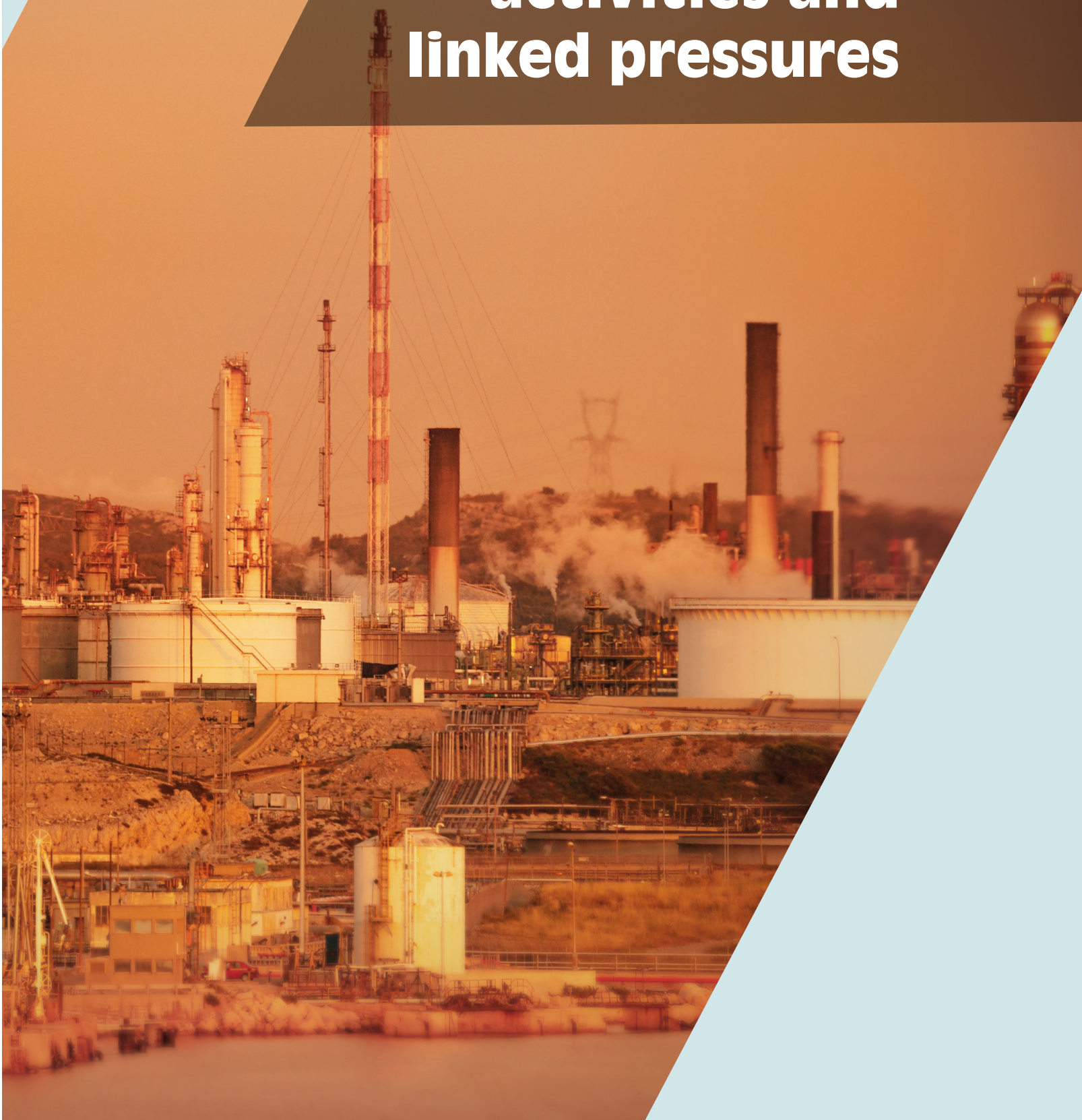
4. Economic activities and linked pressures



Current consumption and production patterns, characterized by high resource consumption combined with low recycling rates and unsatisfactory waste management, are unsustainable overall and lead to considerable environmental degradation in the Mediterranean region, including land take and degradation, water scarcity, noise, water and air pollution, biodiversity loss and climate change.

Pressures resulting from agriculture, fisheries and aquaculture, energy, tourism, transport and industries have the potential to be mitigated to a certain extent. To reach sustainability, they need to be accompanied by more environmentally responsible overall consumer behaviour as well as by the circular, local and resource-efficient production of goods and services. The transition to sustainable economic sectors will both reduce pressures on the environment and increase the resilience of economic activities that depend on quality natural environments, while increasing overall human well-being. Mediterranean countries have initiated many efforts and innovations to foster a green and blue economy. Still, the dominant pattern of economic activities in the Mediterranean remains resource-intense (including carbon), linear (not circular), and generates numerous types of pollution, which are characteristic of market failures inherent to common goods such as the environment. Transitioning to sustainable economic activities requires urgent and coordinated efforts both on production and consumption. On the production side, economic activities must be further regulated to correct the mentioned market failures through targeted policy mixes, including market-based instruments that favour environmentally friendly activities and disadvantage polluting ones. On the demand side, decision makers need enhanced support from the social and behavioural sciences to design measures that will lead to needed radical changes in consumer behaviour.

4.1 Introduction: current consumption and production patterns are not sustainable

4.1.1 Resource consumption patterns and pressures on natural ecosystems

Multiple sociocultural, economic and demographic factors need to be taken into account when looking at the current trends of resource consumption patterns in the Mediterranean region. First, since the start of the 20th century, food consumption patterns in the Mediterranean have been placing increasing pressure on natural resources (Hachem et al. 2016). The gradual shift away from traditional diets, which use local products, has evolved into a common phenomenon in all Mediterranean countries (Hachem et al. 2016). With the acceleration of modernization, globalization and urbanization, along with changes in demography and lifestyles, environmental impacts on natural ecosystems and biodiversity are considerable (Hachem et al. 2016). These trends are further exacerbated by food loss and waste, implying the massive losses of scarce resources, such as water, land and energy, and inputs, such as fertilizers (Lacirignola et al. 2014).

Secondly, this change in lifestyle also concerns the consumption of services. With the increase of living standards and globalized mobility patterns, certain recreational activities previously considered as luxurious have become increasingly accessible within Mediterranean countries, or have a direct effect on them as destination countries. For instance, coastal and maritime tourism has evolved from leisure activities reserved to the wealthiest to more 'democratic' activities, with the spread of the concepts of paid vacations and all-inclusive resorts as well as the growth of affordable means of transportation (Honey & Krantz, 2007). Such activities involve a high intensity of resource use (Lacirignola et al. 2014).

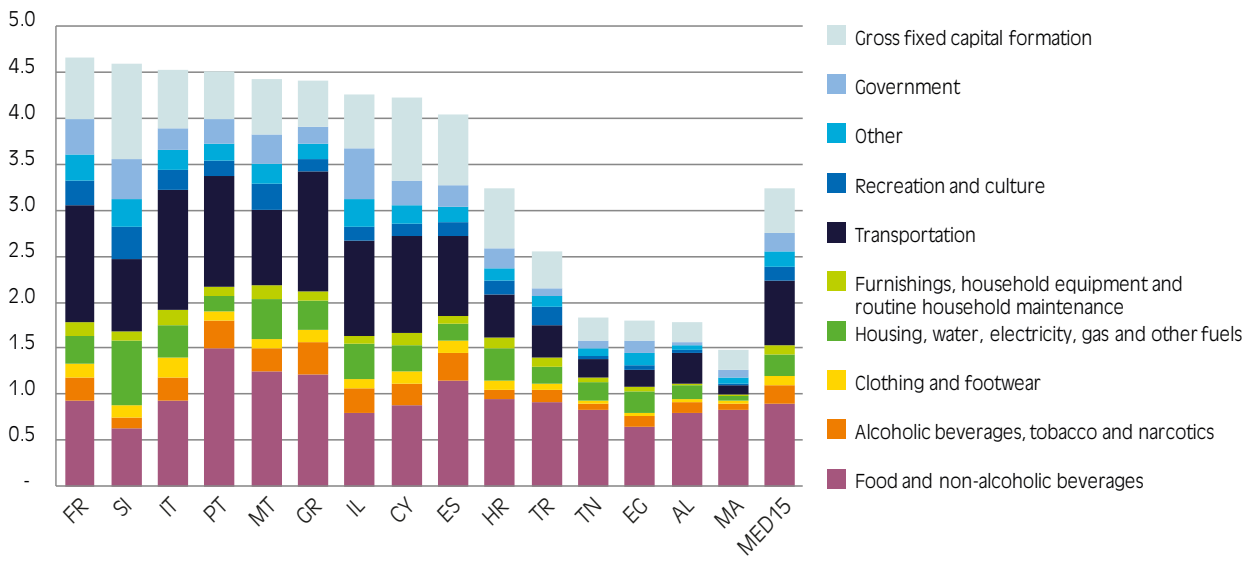


Figure 65 - Ecological Footprint of consumption for 15 Mediterranean countries in 2010[44]
(Source: Galli et al. 2017)

[44] Note: categories with a low contribution to national Ecological Footprint values, such as "Health", "Communication", "Education", "Restaurants and hotels", and "Miscellaneous good and services", have been grouped here under the category "Other".

The Mediterranean region is in a situation of severe ecological deficit, consuming, on average, around 40% more renewable natural resources and other ecosystem services than it provides (Galli et al. 2017). A large proportion of the pollution and intensive use of resources in the Mediterranean is also caused by inefficient industrial processes and unsustainable waste management in current production patterns (Galli et al. 2017). Mediterranean residents and tourists place multiple pressures on ecosystems within and outside their region due to food production, distribution and trade patterns, on top of final consumption patterns. Most Mediterranean countries, first of all Malta and Greece, have a daily food supply that is 20 to 40% higher than the average FAO-determined minimum daily dietary energy requirement.

Overall, current consumption and production patterns in the Mediterranean region lead to considerable environmental degradation (Lacirignola et al. 2014). The environmental footprints of these patterns show a precarious and unsustainable natural resource-consumption nexus in the region that largely causes the many environmental challenges facing the region, such as land degradation, water scarcity, noise, water and air pollution, biodiversity loss as well as climate change (Lacirignola et al. 2014). Unsustainable consumption and production patterns, combined with low recycling rates and inefficient waste treatment, increase pressures on biological and social systems, implying high ecological, carbon, and water footprints (MedReg, 2016) and marine litter. To address such trends, green/blue practices have been expanding in the region, tackling both the behaviour of consumers and producers, and the adaptation actions required.

4.1.2 The current contribution of the green and blue economy to the regional economy

According to the United Nations Environment Programme (UNEP), the green economy aims "to improve human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (Fosse et al. 2016). The blue economy can be considered a "green economy in a blue world" and is an approach promoted by the UNEP flagship report on the subject. It recognizes the crucial contribution of the seas and oceans to food, water and energy provision, especially with the growing number of people living in coastal areas and islands. This is particularly true in the Mediterranean, which is home to a coastal population of 150 million people, which doubles during the tourist season (UfM, 2016). The Mediterranean accounts for 20% of the "Global Marine Product" in an area which makes up only 1% of the world's ocean surface (Randone et al. 2017). The Mediterranean region is also the world's second-largest destination for cruises. The Mediterranean Sea is considered as a "superhighway of transport, trade and cultural exchange". The region boasts 450 ports and terminals and represents one of the busiest traffic lanes in the world, especially for oil traffic. Furthermore, the potential of marine areas for the economic development of Mediterranean countries is considerable. In the EU area alone, the blue economy is expected to unlock an additional two million jobs by 2020 (Randone et al. 2017).
The contribution of the blue economy to the regional economy is mostly due to coastal and maritime tourism. Compared to other sectors of the blue economy, tourism in coastal areas has the highest Gross Value Added (GVA), representing around 83% of the total blue economy's GVA (EUR 169 billion), and also the highest employment, representing around 79% of the total blue economy jobs (4.2 million jobs) (UfM, 2017). On the contrary, fishery and aquaculture, unlike common perception, is a relatively small sector in the Mediterranean blue economy, both in terms of GVA (less than 5%) and job creation (less than 10%) (UfM, 2017).

The purpose of this chapter is to provide an overview of the main macroeconomic features and indicators of key economic sectors in the Mediterranean region with significant interactions with the environment, highlighting their key challenges, opportunities, trends, as well as their potential for a sustainable transition towards a green, blue and circular economy.

Although this chapter dedicates a separate section to each sector, there are many relevant interlinkages between them (tourism in sea areas requires maritime transport, etc.), which highlights the importance of integration between them and a cross-sectoral approach to deal with the assessment of development strategies (UfM, 2017). In the following sections, each key sector of the Mediterranean region's economy is assessed, presenting an overview of its contributions to the economy, its impact on the environment and natural resource use, and potential improvements towards a sustainable economy.

4.2 Agriculture, fisheries and aquaculture

Agriculture (i.e. agriculture, fisheries and aquaculture) represents a key sector within the framework of the United Nations Environment Programme/Mediterranean Action Plan (UNEP/MAP). The socioeconomic aspects of its activities, including its importance in the Mediterranean culture, as well as the considerable pressures generated by this sector on natural resources and its environmental impacts on coastal zones, make agriculture an extremely relevant area of collaboration for Mediterranean countries. This sector reveals potentialities for a sustainable blue economy in the region, thereby reinforcing its role in achieving the objectives of the Barcelona Convention.

4.2.1 Agriculture

4.2.1.1 Overview of the sector

The share of agriculture[45] in GDP and employment has been steadily decreasing over time in almost all Mediterranean countries, due to the tertiarization of national economies (see Chapter 1). This downward trend, accompanied by an

[45] As defined by the FAO, the term "agriculture" and its derivatives include forestry, fisheries and aquaculture.

Countries	Agricultural GDP (%)	Employment in agriculture (%)			Productivity per worker (constant US dollars)		
	2017	1995	2005	2016	1995	2005	2016
Albania	18.9	70.3	54.0	40.7	2,013	3,015	5,442
Algeria	12.3	22.5	20.0	12.7	4,995	5,935	14,369
Bosnia and Herzegovina	5.8	48.1	24.5	19.2	-	4,591	6,037
Croatia	3.3	20.6	17.3	7.6	5,481	8,230	16,470
Cyprus	1.8*	5.3	4.7	3.6	35,709	30,592	21,655
Egypt	11.5	34.0	30.9	25.6	3,290	3,777	5,100
France	1.5	4.6	3.6	2.9	30,695	41,301	52,472
Greece	3.5	20.4	12.2	12.4	11,983	18,856	18,026
Israel	2.1*	2.9	2.0	1.1	31,743	63,695	84,612
Italy	1.9	6.6	4.2	3.9	27,020	40,027	44,242
Lebanon	3.5	3.3	3.4	3.2	45,846	33,478	23,681
Libya	1.2*	9.1	8.7	16.8	-	-	-
Malta	1.1*	2.6	2.1	1.3	-	-	-
Monaco	-	-	-	-	-	-	-
Montenegro	7.2	14.0	8.6	7.6		20,516	24,232
Morocco	13.1	42.0	45.5	37.7	1,677	1,929	3,150
State of Palestine	3.1*	-	-	-	-	-	-
Slovenia	1.8	10.4	9.1	5.0	8,814	9,872	20,790
Spain	2.0	9	5.3	4.2	21,333	30,065	47,281
Syrian Arab Republic	19.5**	28.4	21.2	22.8	-	-	-
Tunisia	9.2*	25.8	20.8	13.7	3,024	4,931	8,526
Turkey	6.1	43.4	25.7	19.5	6,058	12,188	15,108

*In 2016; ** In 2007

Table 19 - Agricultural GDP, employment and productivity of agricultural labour
(Source: FAO, 2018a)

increase in productivity per agricultural worker, is a relatively old phenomenon in northern countries and more recent in southern countries.

With the exception of Albania, where gross agricultural production amounts to 18.9% of total GDP, in non-EU Balkan countries, this rate is around 7.2% (Montenegro) and less than 2% in Mediterranean EU countries (Malta, Cyprus, Slovenia, France, Italy, Spain). A second group of countries, in particular those with low natural potential in land or water, show low rates, comparable to those of European countries: State of Palestine (3.1%), Libya (1%), Lebanon (3.5%) and Israel (2.1%). Agriculture contributes to around 10% of wealth creation in Tunisia, around 12% in Algeria and Egypt, and more than 13% in Morocco. These rates are well below those of the 1960s, when they amounted to nearly three-quarters of GDP. This decline in the contribution of agriculture to national (rural) economies can also be seen in the evolution of agricultural employment.
Between 1995 and 2016, the share of agricultural employment declined in North Africa, whether in Algeria (from 22.5% to 12.7%), Tunisia (from 25.8% to 13.7%) or a little more modestly in Morocco and Egypt. It fell more drastically in the Mediterranean countries of Eastern Europe (from 10.4% to 5% in Slovenia, and even in Albania where the share of agricultural employment has decreased from 70.3% to 40.7%). Turkey has seen its agriculture labour force participation fall by half in relative terms from 43.4% in 1995 to 19.5% in 2016. A group of countries with low agricultural potential (Malta, Cyprus, Israel, Lebanon and the State of Palestine) has also been affected by this downward trend in agricultural employment. In the North, the share of agricultural workers decreased in Spain from 30% in 1970 to just over 4% in 2016, in France from 14% to 2.8% and in Italy from more than 15% to less than 4%. This downward trend, which is currently continuing at a rate of around 2% per year, is parallel to that of the number of farms. Eurostat data (2017) indicates that Italy, which counted more than 2.6 million farms in 1975, had just over 1 million in 2013. In the case of France, the number of farms fell from 1.3 million in 1975 to 472,000 in 2013.

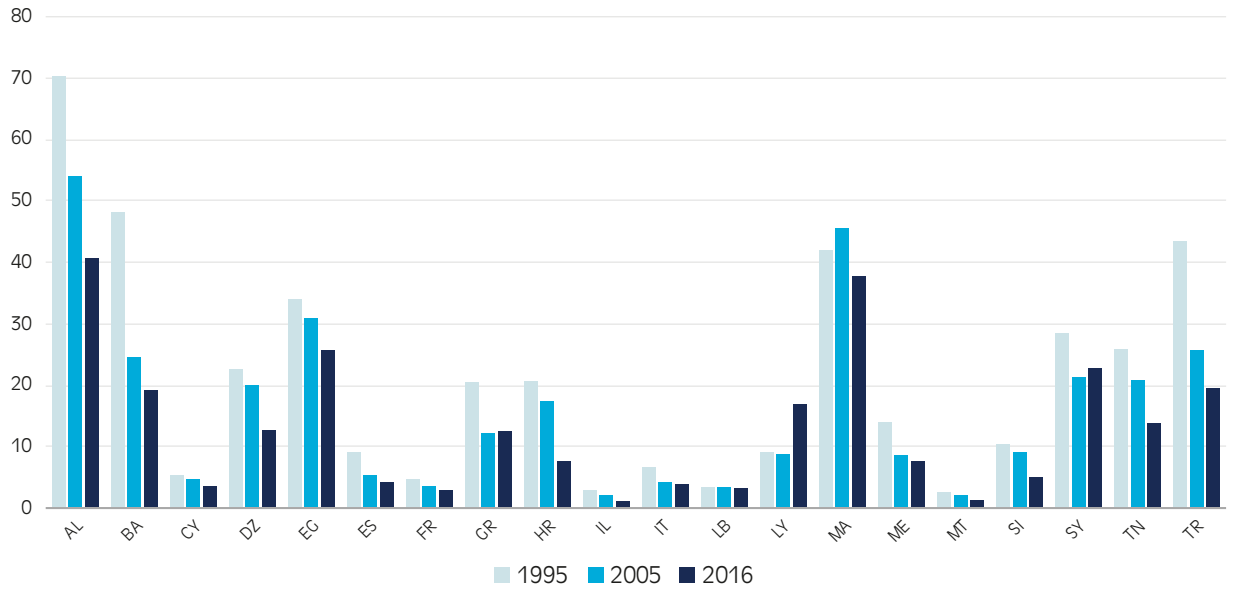


Figure 66 - Employment in agriculture, in % of total employment
(Source: FAO, 2018a)

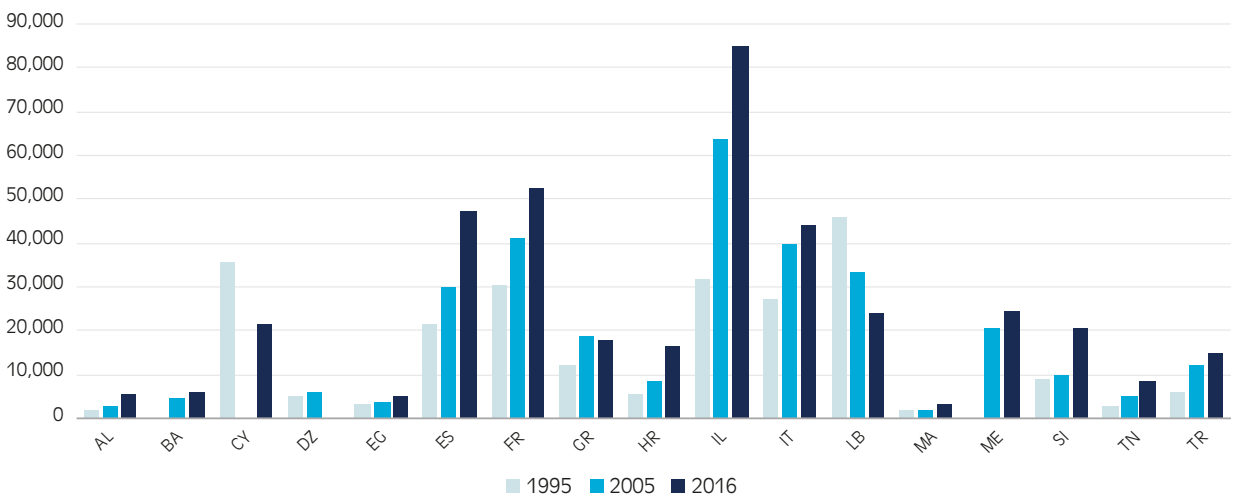


Figure 67 - Productivity per worker, in constant US dollars
(Source: FAO, 2018a)

Especially in Northern Mediterranean Countries (NMCs), the economic and social transformations brought about by agricultural modernization policies, conducted in the context of a structural transition of economies (see Chapter 1), have resulted in significant progress in labour productivity. The productivity of labour in agriculture today shows extreme differences between countries. The productivity of labour is USD 52,472 per worker in France and USD 47,281 per worker in Spain, while reaching only USD 3,150 per worker in Morocco and USD 5,100 per worker in Egypt. Technical and scientific innovations, as well as the mobilization of scarce water resources, make Israel the country where the productivity of land per worker is the highest in the region, at USD 84,612 per worker, more than 15 times that of Egypt and more than 25 times that of Morocco.

4.2.1.2 Pressures on the environment

The most common pressure of agriculture on the marine and coastal environment is the runoff of agricultural substances, described in more detail below. Other agricultural pressures are greenhouse gas emissions, land-use change, and water use, as illustrated by *Figure 75* and analysed in more detail in Chapter 6 "Water and Food Security".

Agricultural runoff: The main impacts of agriculture on the marine environment are due to the runoff of nutrients and agro-chemicals into the sea. Around 80% of marine pollution comes from land-based sources, mainly agriculture, industry, and municipal waste (Hildering,

Coastal agriculture in the Mediterranean: the case of France, Spain and Italy

The majority of the coastline in Spain, France and Italy is urbanized and the area granted to agriculture is decreasing considerably due to demographic pressures and the growth of competing coastal activities such as coastal and maritime tourism (Blanco, 2011). Data on coastal agriculture is extremely scarce - the latest data is from the 2000s - but the trends seem to have been similar over the last two decades (Blanco, 2011).

Countries	Share of useful agricultural land in the total surface area of coastal municipalities	National average share of useful agricultural land in the total surface area	Size of Mediterranean coastal farms
France	21%	51%	Much smaller than the national average with useful agricultural land in coastal municipalities representing only 0.6% of the national useful agricultural land while hosting 1.2% of the total national exploitations.
Italy	41%	41%	Extremely small, employ mostly family members.
Spain	< 40%		85% of coastal farms < 5 hectares

Table 20 - Coastal agriculture in France, Italy, Spain, 2000
(Source: Adapted from Blanco, 2011)

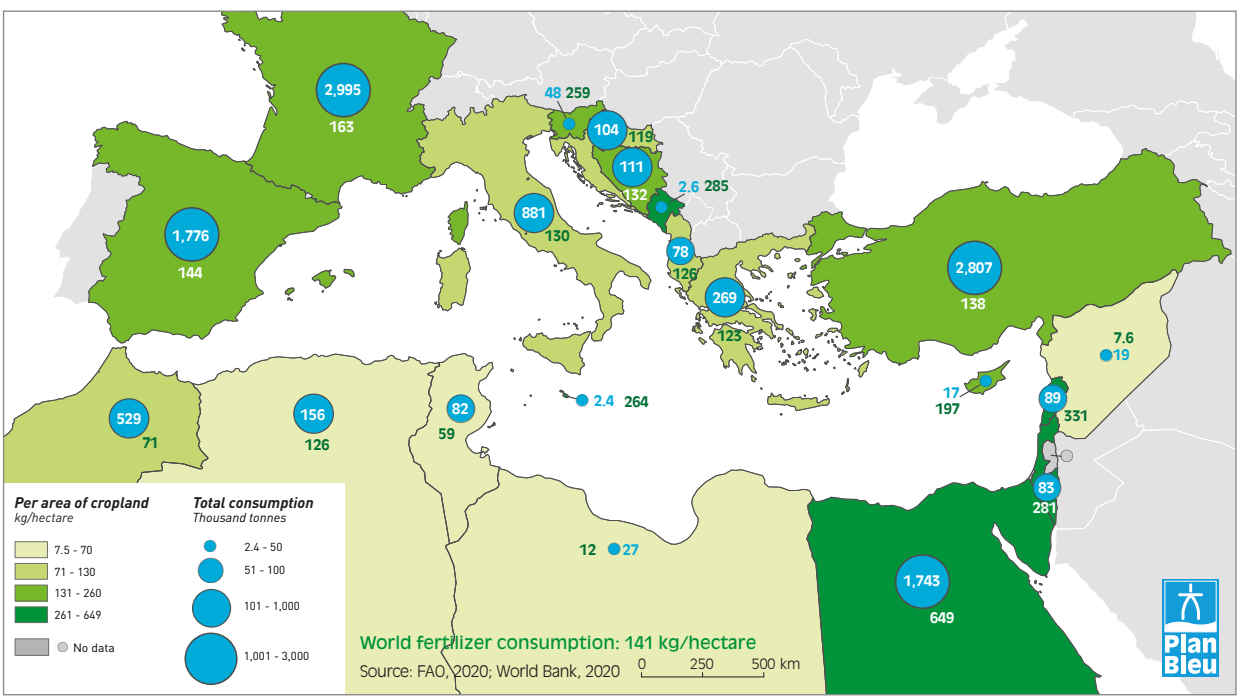


Figure 68 - Agricultural use of fertilizers in Mediterranean countries, 2016
(Source: FAOSTAT, 2020; World Bank, 2020)

Keessen & van Rijswick, 2009). As disaggregation of the impact from different sources of land-based pollution is difficult, there is no quantitative data concerning the effect of agriculture on the environment of the Mediterranean Sea. The runoff of inorganic nitrogen and phosphorus fertilizers leads to eutrophication, which in turn negatively impacts marine ecosystems. The toxins from algal blooms can also deplete local fish stocks. The runoff and infiltration of pesticides into the sea affects the marine environment at a slower pace by bioaccumulation higher up the food chain.

The average consumption of fertilizers[46] of countries in the Mediterranean basin increased by 10% between 2002 and 2016, from 160 kg per hectare to 174 kg per hectare of

[46] Fertilizers include nitrogen fertilizers, potash and phosphate (including natural lime phosphate fertilizers). Traditional nutrients, such as animal and plant manure, are not included in this indicator.

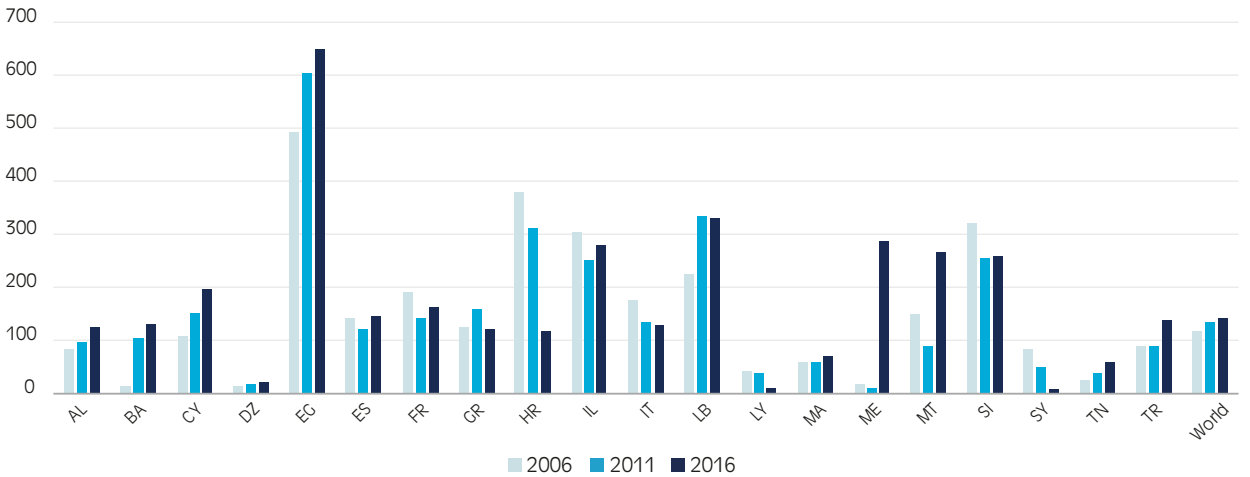


Figure 69 - Fertilizer consumption in the Mediterranean, in kilogram per hectare of arable land, compared to the global average
(Source: World Bank, 2020)

arable land (World Bank, 2020). This average is subject to significant differences, ranging from 8 kg per hectare in the Syrian Arab Republic to 649 kg per hectare in Egypt (World Bank, 2020). Around one third of Mediterranean countries show national consumptions of fertilizers above the global average of 141 kg per hectare of arable land (World Bank, 2020).

The main Mediterranean coastal areas historically affected by the inputs of nutrients are the Gulf of Lion, the Gulf of Gabès, the Adriatic, the Northern Aegean and the South-East Mediterranean (UNEP/MAP, 2017a). Maps showing the concentration of nitrate in the Mediterranean Sea and nitrogen and phosphorus emissions by agricultural areas illustrate coastal and marine areas potentially affected by runoffs of agricultural emissions.

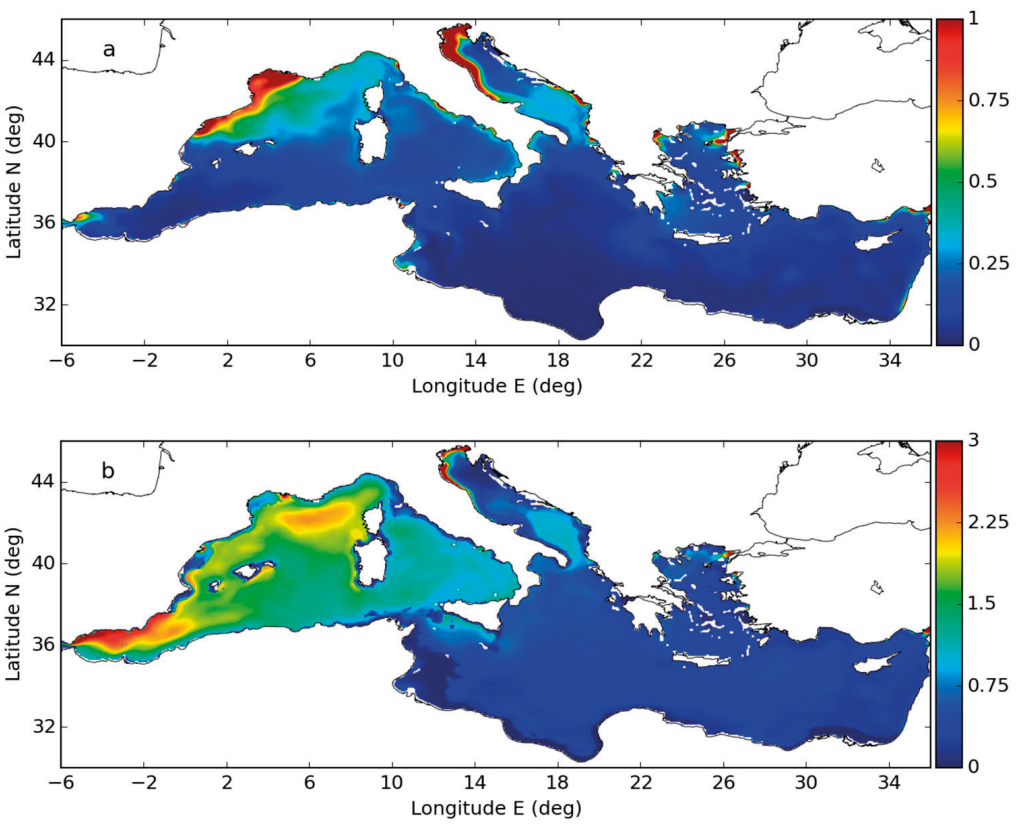


Figure 70 - Surface (a) and sub-surface (b, 0-150 m) maps of nitrate (mmol/m³) over the 2002-2014 period
(Source: Schuckmann et al. 2018)

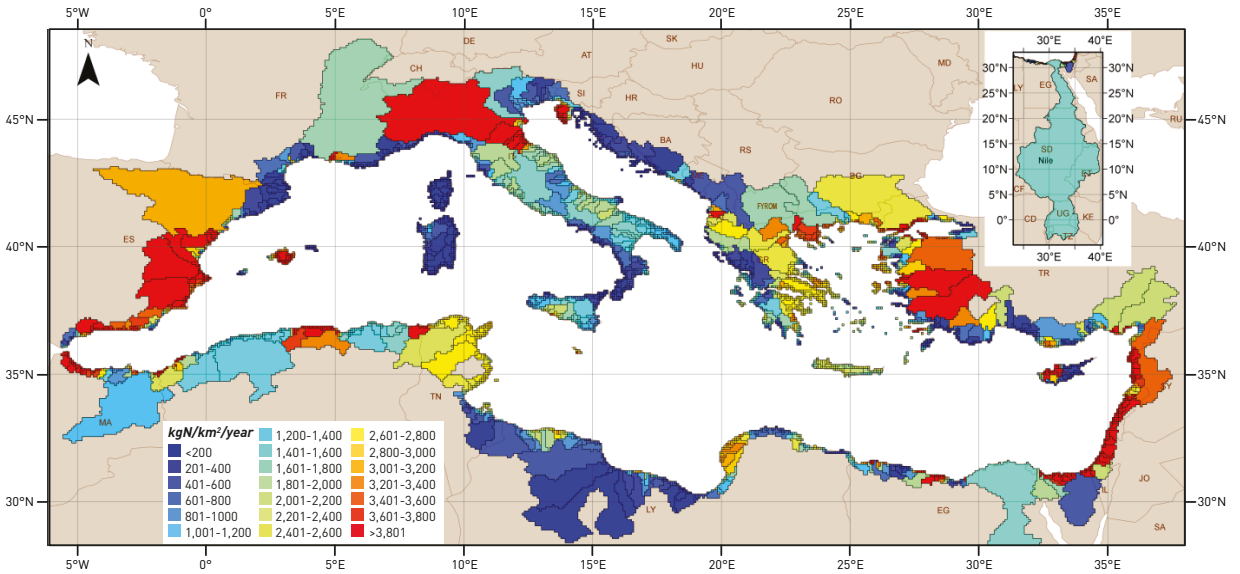


Figure 71 - Nitrogen emissions by agriculture area 2000-2010
(Source: Perseus, 2015)

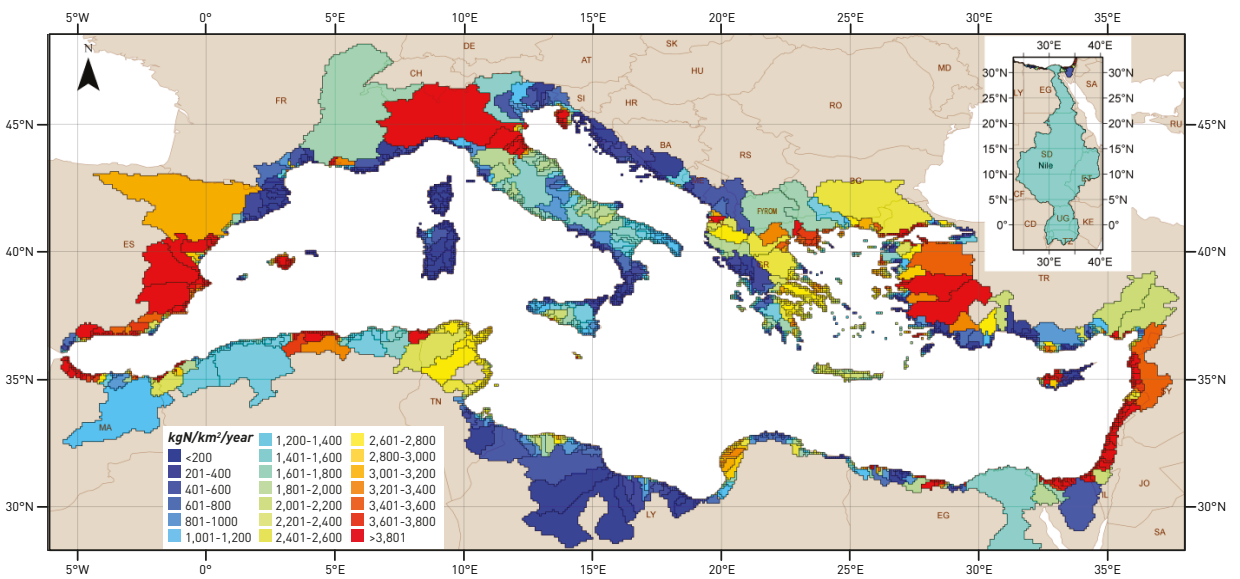


Figure 72 - Phosphorus emissions by agricultural areas in 2000s
(Source: Perseus, 2015)

The consumption of pesticides[47] in the Mediterranean basin varies largely between countries. In 2016, the average use of pesticides in kilogram per hectare of cropland was below or around the world average in most SEMCs except for Israel, Lebanon and the State of Palestine, and generally above the world average in NMCs.

Pesticides, especially if used irrationally, can lead to animal and human health problems such as the inability to reproduce normally in certain animal species, or cancer, neurological effects, diabetes, respiratory diseases, foetal diseases, and genetic disorders in humans who have been directly or indirectly exposed to certain pesticides (Andersson, Tago & Treich, 2014). Managing this type of pollution is particularly difficult because of its diffuse nature and largely unknown combined effects of multiple types of pesticides and their life cycles in the environment.

4.2.1.3 Are we moving towards a green economy?

The future sustainability of Mediterranean agriculture highly depends on its capacity to adapt to climate change and related impacts, including increased water scarcity,

[47] Pesticides are composed of insecticides, herbicides, fungicides and a number of other products (such as growth regulators).

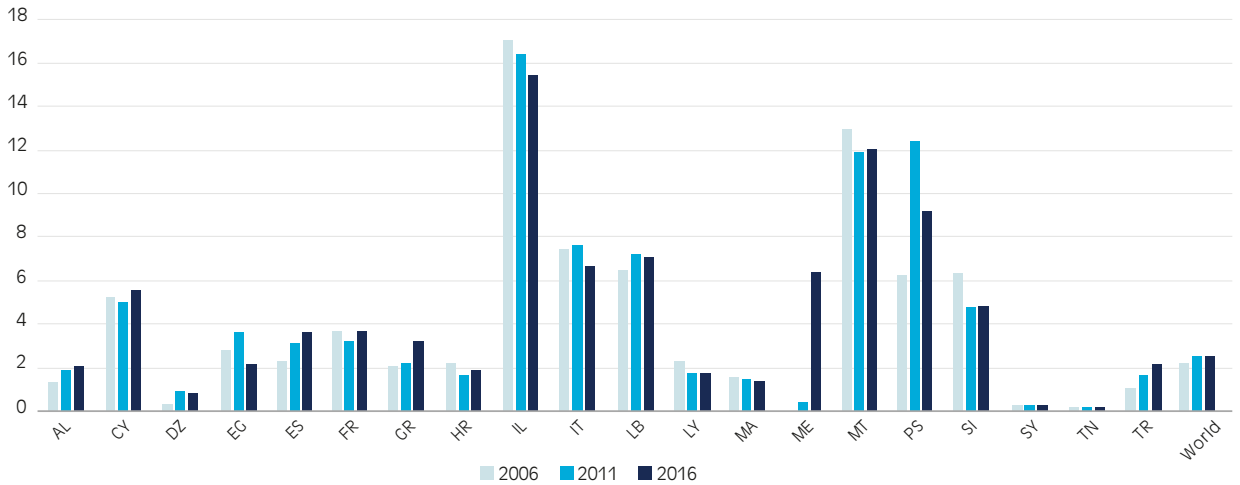


Figure 73 - Pesticide use per area of cropland in Mediterranean countries, in kg/hectare, 2006, 2011 and 2016
(Source: FAOSTAT, 2020)

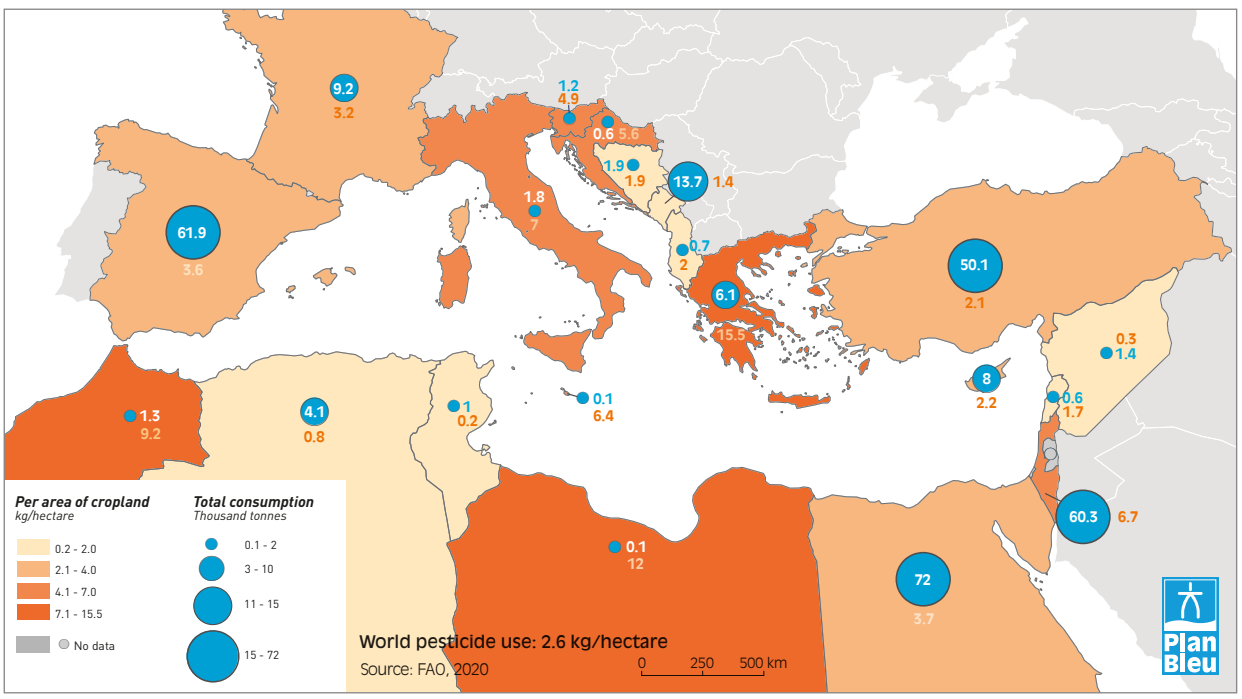


Figure 74 - Agricultural use of pesticides in Mediterranean countries, 2016
(Source: FAOSTAT, 2020)

aridity and soil degradation. Given the crucial role inherent to agriculture in providing food and - indirectly by being the highest water consuming sector - water security, which are particularly challenging in the region (see Chapter 6), the agricultural sector and the people it employs are in urgent need of solutions that provide more resilience. The implementation of integrated approaches considering the water-food-energy nexus as an interlinked system, and Integrated Water Resources Management (IWRM) could contribute to a more efficient use of resources (see Chapters 2 and 6). Responses should also include the robust management of river runoffs, and lead to a gradual reduction in the use of fertilizers and pesticides, thus preventing the release of nutrients and pollutants into the watersheds and reaching the coast. Organic farming can provide a contribution to this transition. Data from the International Center for Advanced Mediterranean Agronomic Studies (CIHEAM) shows that in non-EU CIHEAM countries (Algeria, Egypt, Lebanon, Malta, Morocco, Tunisia, Turkey, and Albania) land used in organic agriculture increased from over 174,000 hectares to over 744,000 hectares (CIHEAM, 2017). Other sustainable agricultural practices, such as agro-ecology, also have a significant potential to prevent negative impacts on the environment, or even contribute to restoring soil and store carbon.

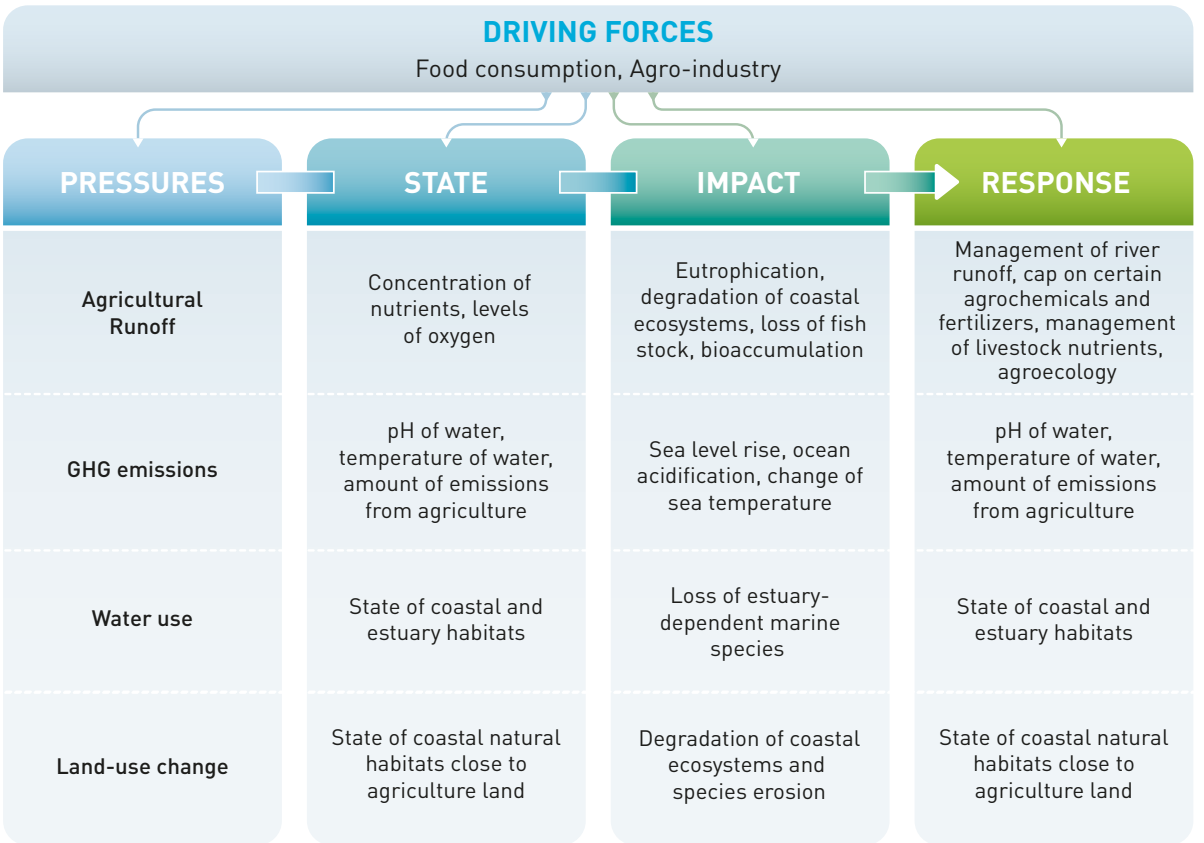


Figure 75 - Pressures exerted by agriculture on the marine and coastal environment

4.2.2 Fisheries and aquaculture

The Mediterranean has sustained important fisheries activities, including the capture of wild fish and shellfish as well as different ways of farming marine species, since ancient times. Today, industrial, semi-industrial and small-scale capture fisheries, as well as industrial and small-scale farming coexist in the region, using a large variety of techniques, fishing gear and farming mechanisms. In contrast with other major fishing areas, Mediterranean capture fisheries generally lack large mono-specific stocks, and instead exploit a variety of benthic and pelagic stocks of fish, as well as molluscs and crustaceans. Aquaculture production in the Mediterranean includes different systems and technologies, ranging from traditional activities, such as extensive aquaculture in pond or lagoon areas and small family farms cultivating mussels, to more intensive offshore finfish cage farms. Both capture fisheries and aquaculture depend on natural ecosystems; capture fisheries, in particular, depend on the status of fisheries resources, while aquaculture depends on water quality and the appropriate spatial conditions to carry out these activities. Since the Mediterranean is a semi-enclosed sea, with reduced space for marine and maritime activities, and is more susceptible to human impacts than the open oceans, both capture fisheries and aquaculture activities are particularly affected by anthropogenic impacts and are limited by space. Impacts include fishing itself, but also pollution, as well as indirect effects such as climate change and the appearance and expansion of non-indigenous species (refer to section 3.3.6)[48].

4.2.2.1 Overview of capture fisheries and aquaculture production and trends

Total production of fish and shellfish in recent years in the Mediterranean from fisheries and aquaculture amounts to approximately 2.4 million tonnes. Combined, fisheries and aquaculture provide an economic output close to USD 12 billion, including both the value at first sale and the wider economic impact along the value chain.

The sector is estimated to provide direct and indirect employment for at least one million people, including at

[48] This section summarizes information regularly provided by the General Fisheries Commission for the Mediterranean (GFCM). For capture fisheries, information is based on the report on the State of Mediterranean and Black Sea Fisheries (FAO, 2018b), while information on aquaculture comes from FishStat and the Information System for the Promotion of Aquaculture in the Mediterranean (SIPAM). Aquaculture information refers to marine species and is compiled at the level of Mediterranean countries, therefore implying that land-based production of marine species, including from other marine areas (such as the Black Sea in the case of Turkey), are included.

least a quarter of a million people directly employed on board capture fishing vessels.
This production is achieved by nearly 100,000 vessels, including official statistics and the estimated number of small boats, of which at least 83% are considered to be small-scale, and more than 30,900 fish farms, almost all of which are small- to medium-sized enterprises and family-owned farms.

Landings from capture fisheries in the Mediterranean reached their height in the 1990s and in the first decade of the 2000s, with peaks of more than one million tonnes. After that, landings started to drop, reaching a minimum of 760,000 tonnes in 2015, slightly increasing to 780,000 tonnes in 2017 *(Figure 76)*.

Italy is the main contributor in terms of landings (22%), followed by Tunisia, Algeria and Spain, respectively. Nine countries contribute to at least 5% of the total catches, together reaching nearly 90% of landings in the area *(Figure 77)*.

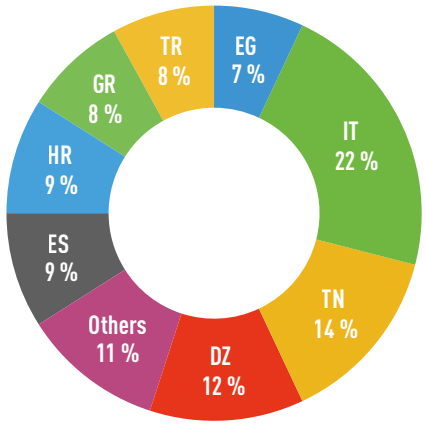


Figure 77 - Main wild capture producers (accounting for at least 5% of catches) in the Mediterranean Sea, average landings in 2014 - 2016
(Source: FAO, 2018b)

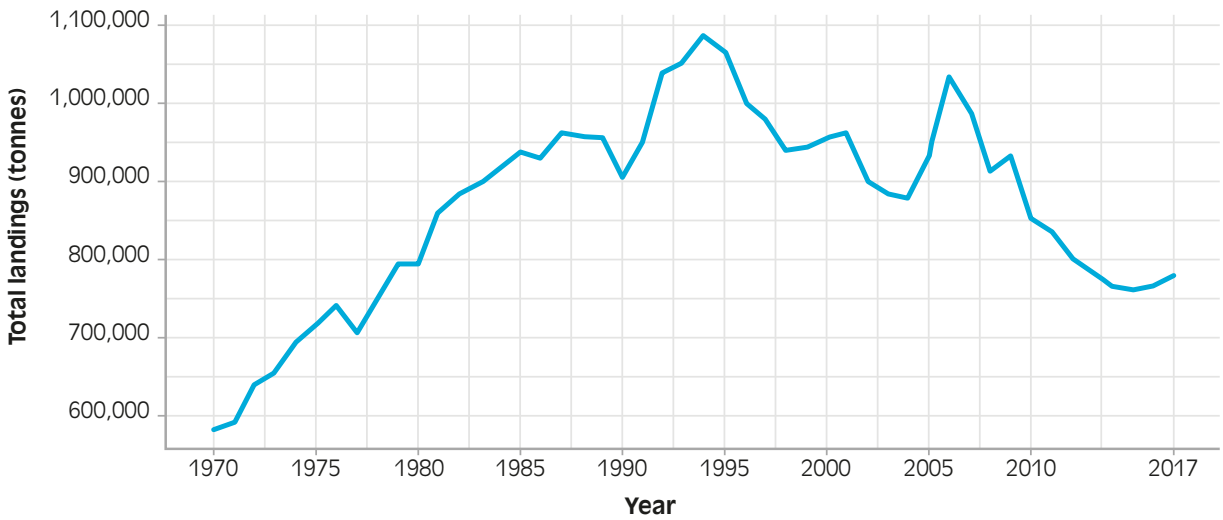


Figure 76 - Landings in the Mediterranean Sea
(Source: updated from FAO, 2018b)

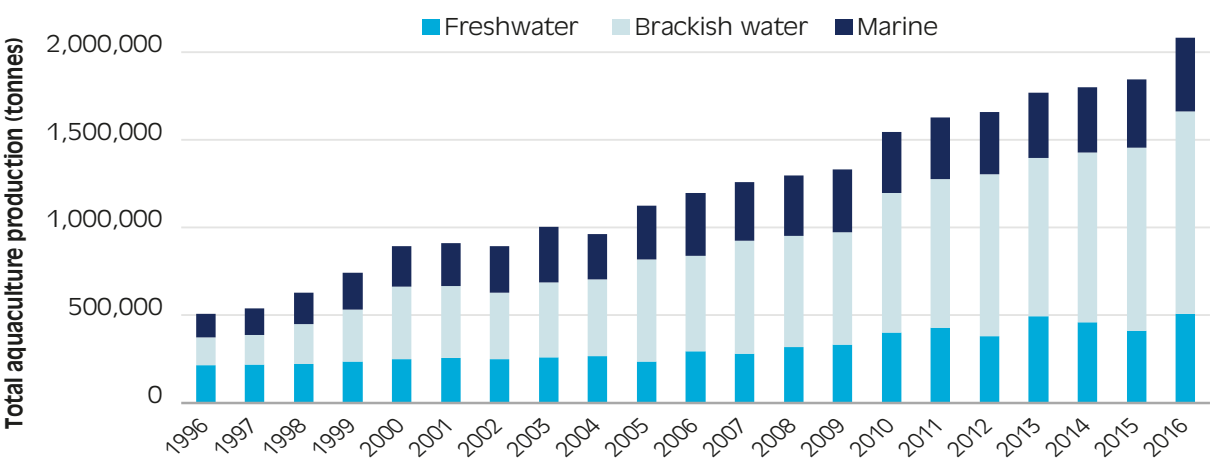


Figure 78 - Aquaculture production in Mediterranean countries, by environment
(All species and environments are included. Atlantic statistical area is excluded)
(Source: produced by GFCM based on Fishstat and SIPAM, 2019)

BOX 25 Recreational and small-scale fisheries in the Mediterranean

In Europe there are almost 9 million practitioners of recreational fishing, who generate around EUR 6 billion annually for regional economies. There are several environmental impacts associated with recreational fishing: impact on vulnerable species, disruption of trophic chains, fish welfare linked to catch-and-release, potential introduction of exotic species used as bait, potential environmental impacts of fishing gear lost or abandoned at sea, damage to sensitive habitats, etc. (Font & Lloret, 2014). Coastal, small-scale fisheries (SSFs), whether artisanal, recreational, subsistence or a combination thereof, play an important socioeconomic role across the Mediterranean countries (Lloret et al. 2018. In the EU, artisanal SSF fishers provide direct employment for around 100,000 people (around 70,000 or 84% of the 25 EU Member State fleets can be considered SSFs). Because of the small-scale nature of SSFs (smaller catches, lower impact on habitats, less annual fuel oil consumption, fewer bycatches and discards and less catch reduced to fishmeal and oil), they are often considered to have a lower ecological impact than large-scale fisheries (Lloret et al. 2018). Coastal fisheries are currently undergoing a number of changes that have been far less studied and managed than those affecting semi-industrial and industrial fisheries. The use of fishing gear that actively selects certain species, sizes and sexes, the deployment of fishing gear on certain fragile habitats, the loss of fishing gear and the use of non-native species as bait are examples of how coastal fisheries can threaten the sustainability of vulnerable coastal species and habitats in the Mediterranean (Lloret et al. 2018).

On the other hand, total aquaculture production in Mediterranean States, considering all species and all environments, has increased substantially during the last 20 years *(Figure 78)*. Production in 1996 was estimated at 509,678 tonnes, while in the last ten years production has increased from more than 1,198,000 tonnes in 2006 to more than 2,082,800 tonnes in 2016 (an increase of 73.8%, with an annual growth rate of approximately 7.4%). Considering only the production of marine species in Mediterranean countries, the production in 2016 was estimated at 1,616,041 tonnes.

This upward trend in aquaculture production has been driven primarily by increased production in Egypt and Turkey. Egypt, with a production of 1,133,439 tonnes in 2016, accounted for more than 71% of the total production of marine species (all environments included). Egypt is followed by Turkey (production of 148,730 tonnes[49]; 9.3% of total production), Greece (production of 121,154 tonnes; 7.6% of total production), Italy (production of 108,360 tonnes; 6.8% of total production), Spain (production of 17,902 tonnes; 1.1% of total production), France (production of 16,400 tonnes; 1% of total production) and Tunisia (production of 15,354 tonnes; 0.96% of total production) *(Figure 79)*.

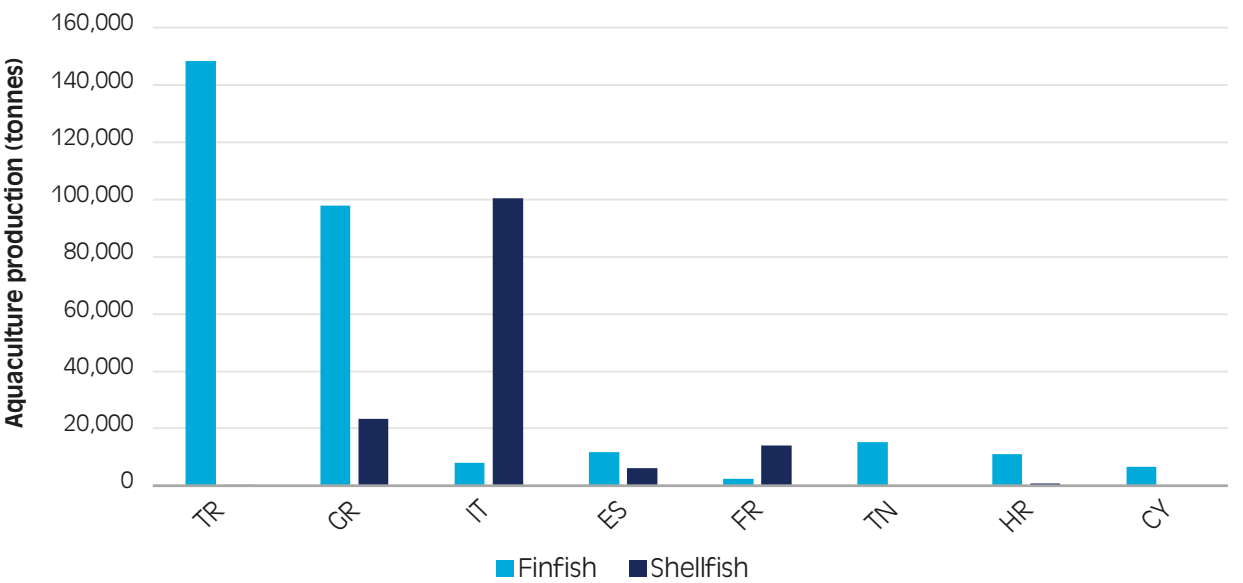


Figure 79 - Main aquaculture producers in the Mediterranean Sea in 2016, excluding Egypt
(Only marine species are included. Egypt, with a production of 1,133,439 tonnes is not shown in this graph for better readability. Black Sea and Atlantic statistical areas are excluded.[50])
(Source: produced by GFCM based on Fishstat and SIPAM, 2019)

[49-50] In 2019, Turkey registered a production of 172,492 tonnes (Turkish Ministry of Agriculture and Forestry, Fisheries Statistics 2019).

4.2.2.2 Status of resources

Eleven species each contribute to at least 1% of the total Mediterranean capture fisheries production, but all together these species only represent around 60% of catches, with a large number of other species representing the remaining 40%. Small pelagic species, in particular the sardine and the anchovy (22 and 12% respectively) are the most dominant species *(Figure 80)*.

Today, around 50% of catches in the Mediterranean and Black Sea are assessed. A considerable majority of the stocks assessed - 78%, including stocks of all priority species - are regarded as overexploited, which means that more fish are being caught than the population can naturally replace. As high as this percentage is, it has slightly decreased since 2014, when the figure was 88%. This reflects the difference made by recent management measures put in place, although it underlines the need to also make further progress.

The most seriously overexploited priority species in the Mediterranean is the European hake, which - due to its presence in most trawl fisheries - shows an average overexploitation rate 5.8 times higher than the target. Conversely, stocks which are fished within biologically sustainable limits mostly include small pelagic species (the sardine and the anchovy) and some stocks of the red mullet and the deep-water rose shrimp. Almost half (47%) of stocks in the Mediterranean show a low biomass, which may reflect the long timeframe over which they have been subject to overexploitation, diminishing their capacity to replenish.

In relation to aquaculture, more than 100 species (finfish, shellfish, crustaceans and algae) are currently cultivated within a wide range of environments and farming systems. Eight species contribute to more than 90% of overall production. Within shellfish production, the main farmed species is the European mussel *(Mytilus galloprovincialis)*, followed by the Japanese carpet shell *(Ruditapes philippinarum)* and the European oyster *(Ostrea edulis)*. Marine finfish aquaculture production is dominated by the European seabass *(Dicentrarchus labrax)* and the gilt-head seabream *(Sparus aurata)*. The production of meagre *(Argyrosomus regius)* is noteworthy among emerging marine farmed species *(Figure 81)*.

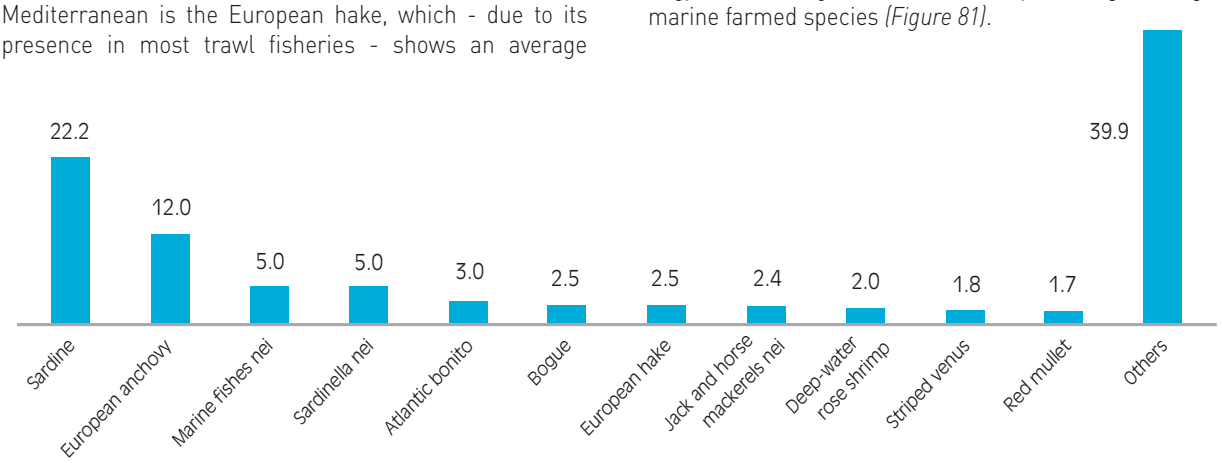


Figure 80 - Annual landings in the Mediterranean Sea by species, average values (in %) in 2014 - 2016
(Source: FAO, 2018b)

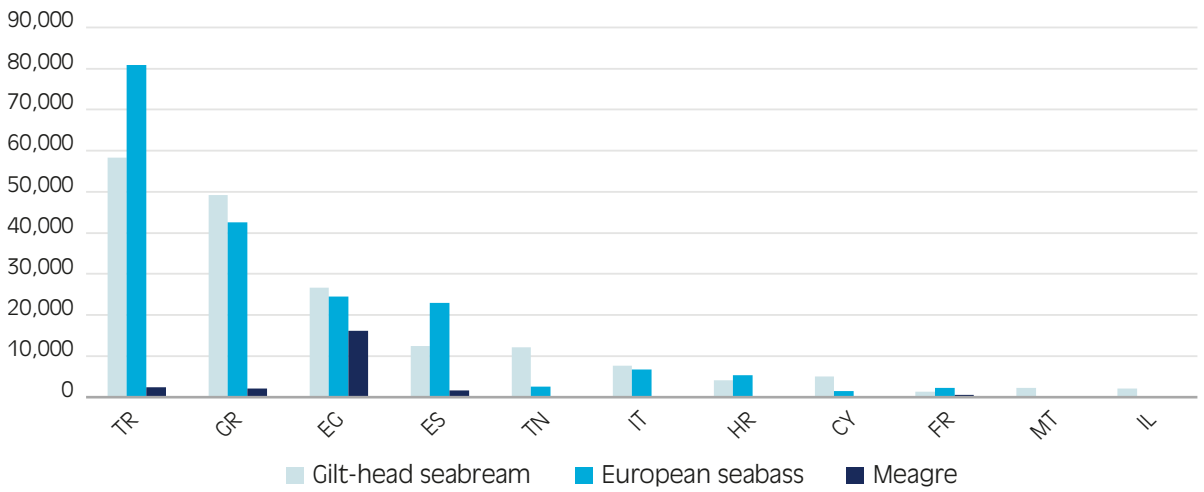


Figure 81 - Annual aquaculture production of the main marine fish species in the Mediterranean Sea, by species and country in 2016
(Source: produced by GFCM based on Fishstat and SIPAM, 2019)

4.2.2.3 Are we moving towards a green and blue economy?

Overall, the main challenge for capture fisheries and aquaculture in the Mediterranean is to provide fish for an increasing population that is also increasingly demanding fish in their diet. In fact, certain Mediterranean States are among the countries globally with a higher demand for fish protein per capita (e.g. Spain, France, Italy, Libya and Egypt; FAO, 2018b). In order to meet this demand, the fisheries and aquaculture sectors have to address different intrinsic challenges, such as the overexploitation of wild stocks and the identification of suitable places to develop aquaculture facilities, but also extrinsic challenges, such as other direct or indirect anthropogenic impacts (different kinds of pollution, habitat degradation, non-indigenous species, climate change, etc.) on the state of Mediterranean ecosystems and the environment.

Overfishing is also fuelled by unsustainable fishing techniques such as bottom trawling and discarding of unwanted fish. Bottom trawling is the least selective fishing practice and is an extensively-used practice in the Mediterranean, which leads to the destruction of benthic communities. Around 18% of the total catch may be discarded, potentially leading to overexploitation, as well as to disruptions in food webs. Non-selective fishing techniques are the main source of fish discards.
The main pressures of aquaculture are the use of wild fish for feed, which can lead to the overexploitation of the fish used for feed (Le Gouvello & Simard, 2017) and the transfer of non-indigenous species (NIS) due to the escape of fish (Sanchez-Jerez, 2013) which potentially leads to disease transfer, competition with local species or predation. These interactions of pressures are indicated in *Figure 83*.

4.3 Energy

The pollution caused by energy generation, distribution and consumption constitutes a significant challenge in the achievement of environmental objectives in the Mediterranean region. The energy mix of the region is dominated by fossil fuels, while renewable energies play a minor role. Hence, the transition to renewable energy sources is a crucial process to reduce environmental issues and threats in the Mediterranean environment.

4.3.1 Overview of the sector

Energy consumption

Mediterranean countries accounted for 7% of the world's primary energy demand in 2015, which represented 955 million tonnes of oil equivalent (Mtoe).

North Mediterranean countries account for nearly two thirds of total Mediterranean energy demand, while the South and East consume about the same, with 19% and 18%, respectively.

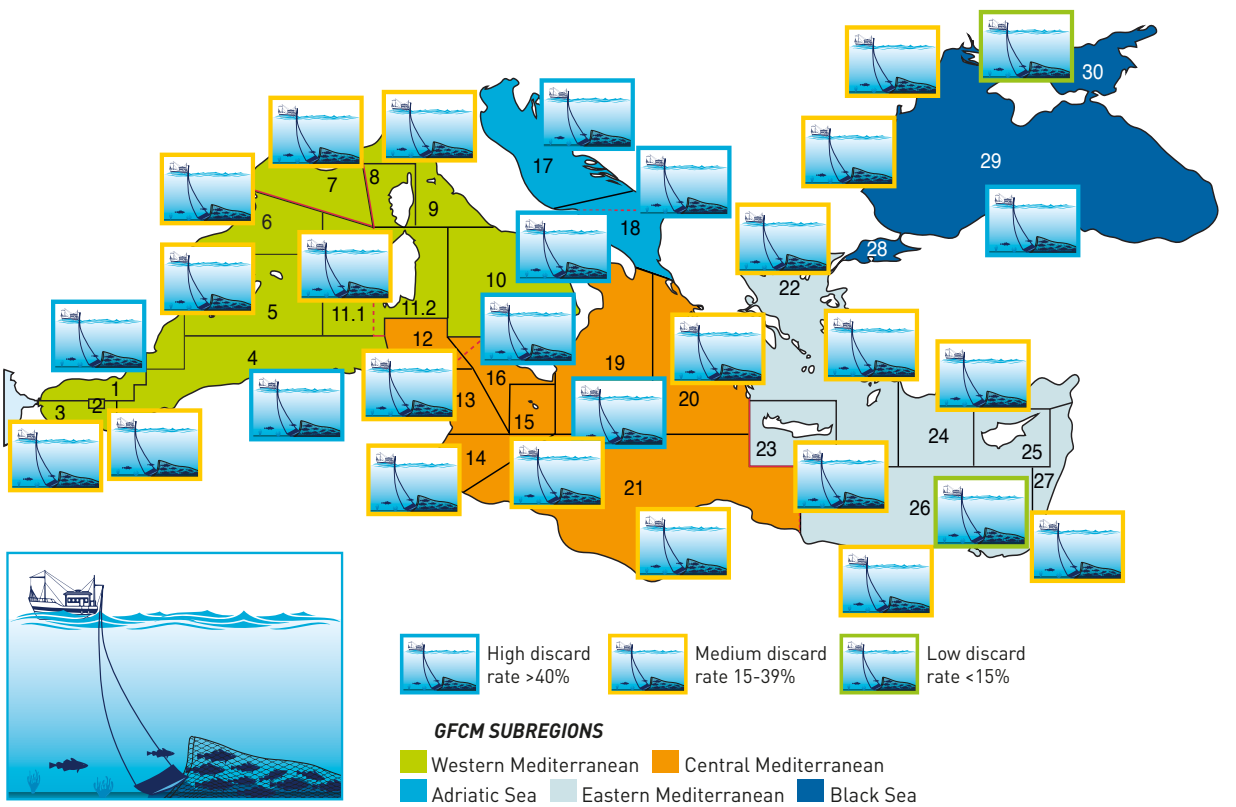


Figure 82 - Bottom trawling: discard behaviour
(Source: FAO, 2018b)

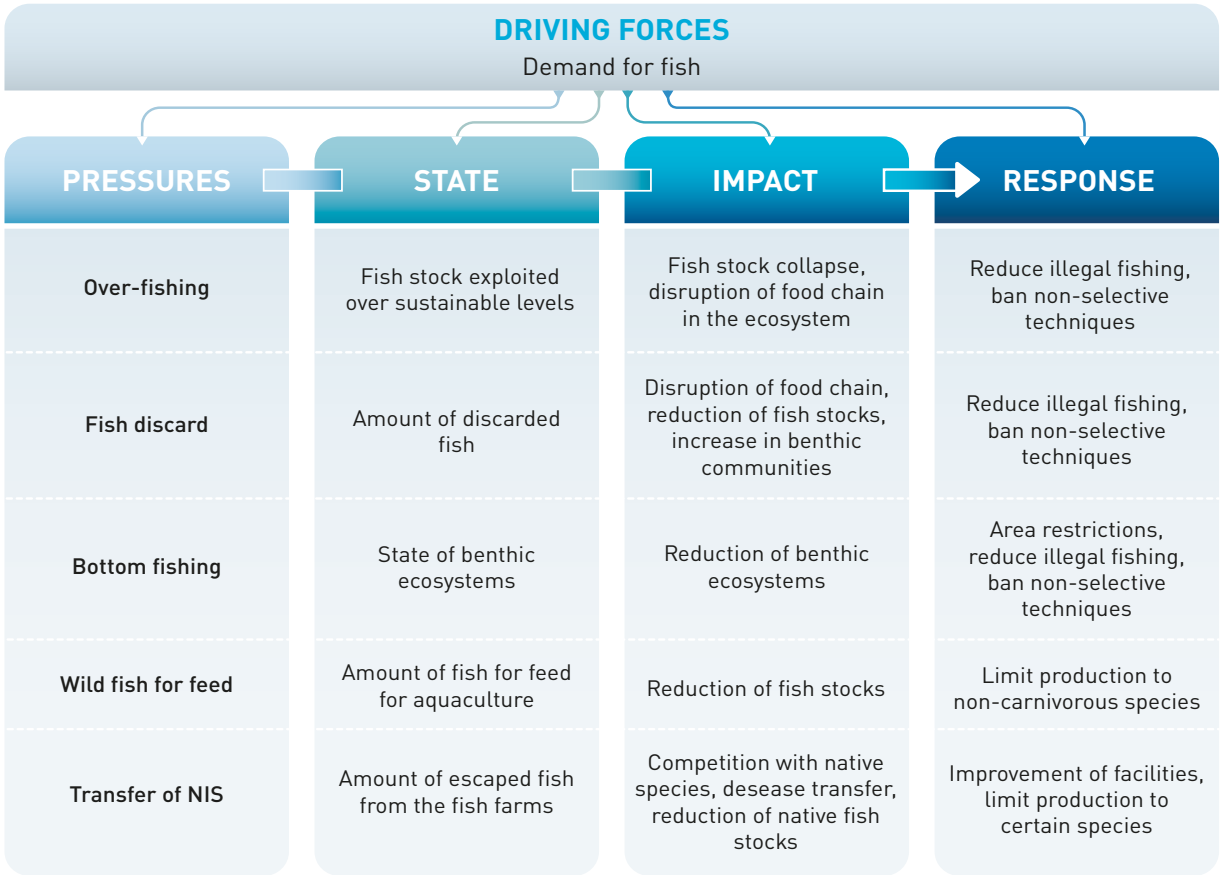


Figure 83 - Pressures exerted by fisheries and aquaculture on the marine environment

According to past trends and the unconditional commitments in the countries' Nationally Determined Contributions (NDCs) to the Paris Agreement (Reference Scenario), the overall energy demand in the region will increase by around 40% by 2040 (Reference Scenario). On the other hand, if the countries meet all the commitments in their NDCs (Proactive Scenario), energy demand will increase by 17% (OME, 2018) *(Figure 85)*.

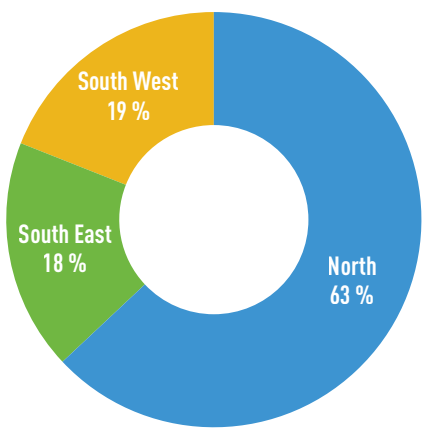


Figure 84 - Mediterranean primary energy demand by subregion, 2015
(Source: Observatoire Méditerranéen de l'Energie - OME, 2018)

The increase in energy demand is expected to be driven by Southern and Eastern Mediterranean Countries (SEMCs), which would double demand in a Reference Scenario. On the other hand, the North is expected to decrease its energy demand.

When looking at the type of fuel to be consumed in the coming decades, fossil fuels are expected to continue to clearly dominate the energy demand in both the Reference Scenario (77%) and the Proactive Scenario (67%) (OME, 2018). Most energy demand will come from transport and electricity.

Power generation trends

Total energy production has been increasing since 1990, reaching 549 Mtoe in 2015. This increase was driven mainly by the North (0.6% annual increase), followed by the South West (0.3%). On the other hand, the South East has experienced a decline in its share of production from 10% to 8% since 1990 (OME, 2018).

Regardless of the scenario, fossil fuels remain the dominant energy source in the region's primary energy mix and oil will continue to be the dominant fuel, as the region's oil demand will continue to rise, in particular for transport fuels. The production of **offshore oil and gas** was estimated at 87 Mtoe in 2011, of which 19 Mtoe were from crude oil

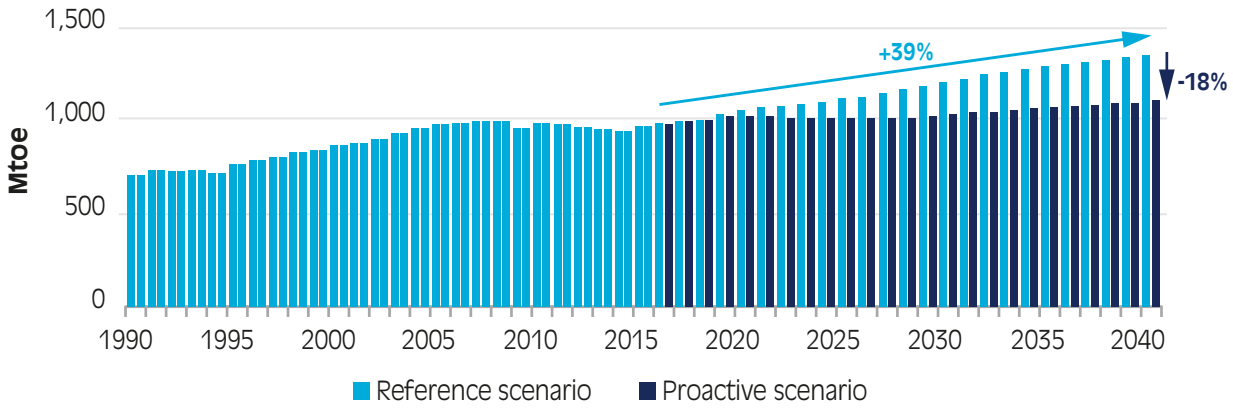


Figure 85 - Mediterranean primary energy demand by scenario, 1990-2040
(Source: OME, 2018)

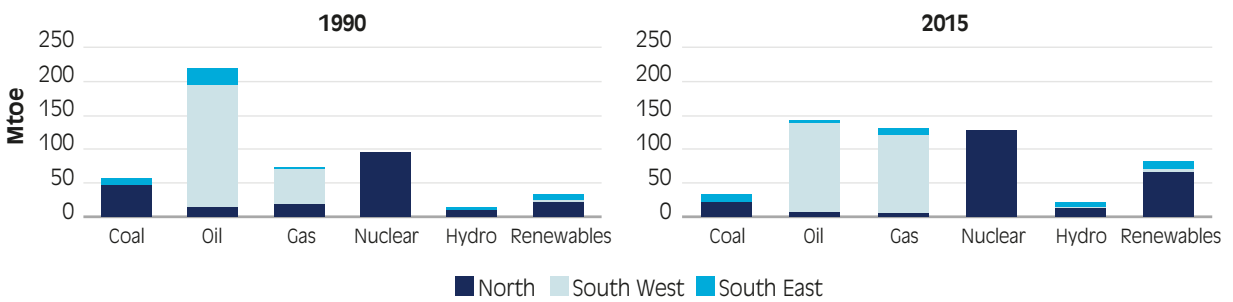


Figure 86 - Mediterranean primary energy production in 1990 and 2015
(Source: OME, 2018)

and 68 Mtoe from natural gas produced on the more than two hundred active offshore platforms in the Mediterranean. Mediterranean oil reserves represent 4.6% of global oil reserves, which are almost entirely located off the coast of Algeria, Libya, and Egypt (Piante & Ody, 2015). There are also many production areas off the coast of Greece and Turkey, and recent discoveries of major gas reserves in the Eastern Mediterranean Basin. Ongoing offshore exploration in the Eastern Mediterranean, as well as in the Nile Delta Basin and the Aegean Basin could uncover significant reserves of oil and gas that could transform the Eastern Mediterranean ecosystems and economies.

From 1990 to 2015, Northern countries decreased their share in total electricity generation in the Mediterranean from 84% to 65%. The South West and South East have both almost doubled their share to 17% and 19% respectively. In both the Mediterranean Observatory for Energy (OME) Reference Scenario and the Proactive Scenario, by 2040, the North region will produce around 50% of total electricity, while the South West and South East will both produce around 25% (OME, 2018). Currently, the North region has a varied generation mix, while the Southern Mediterranean mainly relies on natural gas, except for Turkey and Morocco, which significantly rely on coal for their electricity production (OME, 2018).

The share of non-hydro renewables is expected to grow in the energy mix, with the current policies. In the Reference Scenario, the share of renewables will expand approximately by 2.3% per year to contribute to 24% of the energy supply by 2040. In the Proactive Scenario, renewable supply would rise by 3.4% per year, accounting for 40% of energy supplied. These trends in non-hydro renewables are sustained in both Northern and Southern and Eastern Mediterranean countries *(Figure 88)* (OME, 2018).

4.3.2 Pressures on the environment

The main pressures from the energy sector on the marine and coastal environment are the release of **greenhouse gas emissions,** which derive from the production and use of energy, and from **underwater noise** and **accidental discharges,** which derive from offshore oil and gas production and the transportation of fossil fuels. See *Figure 90* for an illustrative summary of the interaction of pressures with the marine and coastal environment.

Emissions: The main greenhouse gas emitted by the energy sector is CO_2. Mediterranean countries are responsible for around 6% of the world's CO_2 emissions. Mediterranean energy-related CO_2 emissions increased from 1.575 $MtCO_2$ in 1990 to 2.013 $MtCO_2$ in 2015, of which 45% came from

BOX 26

Fossil fuels continue to be subsidized in Mediterranean countries

(Source: OECD & IEA, 2019)

Fossil-fuel subsidies undermine efforts to mitigate climate change and aggravate local pollution problems. They also represent a considerable strain on public budgets and distort the prices that inform the decisions of many producers, investors, and consumers, thereby perpetuating older technologies and energy-intensive modes of production.

Fossil fuel subsidies do not currently show a clear downward trend in Mediterranean countries. Of the ten countries for which data on fossil fuel subsidies are available, only one (France) has experienced a steady phasing-out of these subsidies over the last ten years. Most of the countries studied show an increase in fossil fuel subsidies over the same period.

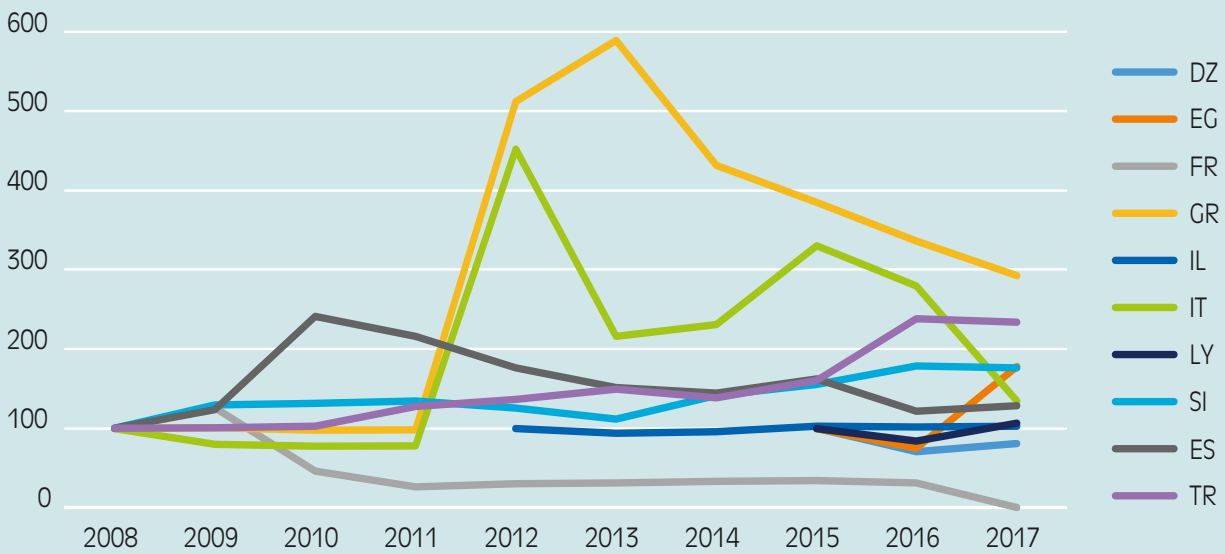


Figure 87 - Indexed evolution of government support for fossil fuels in Mediterranean countries, 2008=100

(Source: based on OECD & IEA, 2019) Notes: (i) Data available from 2015-2017 only with 2015=100 for Algeria, Egypt, Libya; (ii) Government support for fossil fuels in Israel = 0 from 2008 to 2011

In Israel, between 2008 and 2012, fossil-fuel subsidies were non-existent. They soared in 2012 upon the discovery of the Tamar Natural Gas field in the Eastern Mediterranean Basin and have been around 480 million Israeli shekels, equivalent to around Euro 120 million per year since then. Fossil-fuel support granted since 2012 is exclusively related to natural gas, including grants for the conversion of factories to natural gas and the gas agreement between the Israel Electric Corporation and Tamar Gas Field.

In Greece, fossil-fuel support rose after the 2011 Greek government-debt crisis, with a package of measures taken by the government including variable cost-recovery mechanisms for fuel expenditure. The most significant measure in terms of budget spent was a subsidy for petroleum-based small and off-grid power generators on remote Greek islands. Another measure in place is a tax refund provided for fuels used in boats for tourism in Greece.

In Italy, support for fossil-fuel consumption seems to have risen sharply since 2009, which is mainly due to a lack of data on the value of certain measures prior to 2009. Since 2012, a nominal increase in diesel tax credits for trucks and VAT reductions on electricity for domestic use can be noted. Other contributing measures that have also seen increases since 2012 are related to support for fuels in the agriculture sector as well as in air transportation and marine navigation within EU waters. Examples of measures leading to fossil-fuel support in Italy include lower rates of royalties applying to offshore production and the first 20,000 tonnes of oil produced onshore every year. A similar provision applies to natural gas for the first 25 million cubic metres extracted.

In Turkey, the 2012 new Investment Incentive Regime provides higher levels of support to coal and oil investments than to renewable-energy projects. The 2015 - 2019 Strategic Plan of the Ministry of Energy and Natural Resources identifies increased oil and gas exploration activities as a priority goal to reduce import dependency in coal, oil and gas, and to increase the use of domestic coal. Another measure in place in Turkey provides coal in kind to poor families for heating, with more than 2 million families receiving coal aid in 2017, distributed by local governments.

The weight of fossil-fuel subsidies compared to the national economy varies considerably between the surveyed countries. While they can represent up to more than 13% in Libya, around 8% in Egypt and close to 7% in Algeria, fossil-fuel subsidies represent less than 1% of national GDP in all other studied countries.

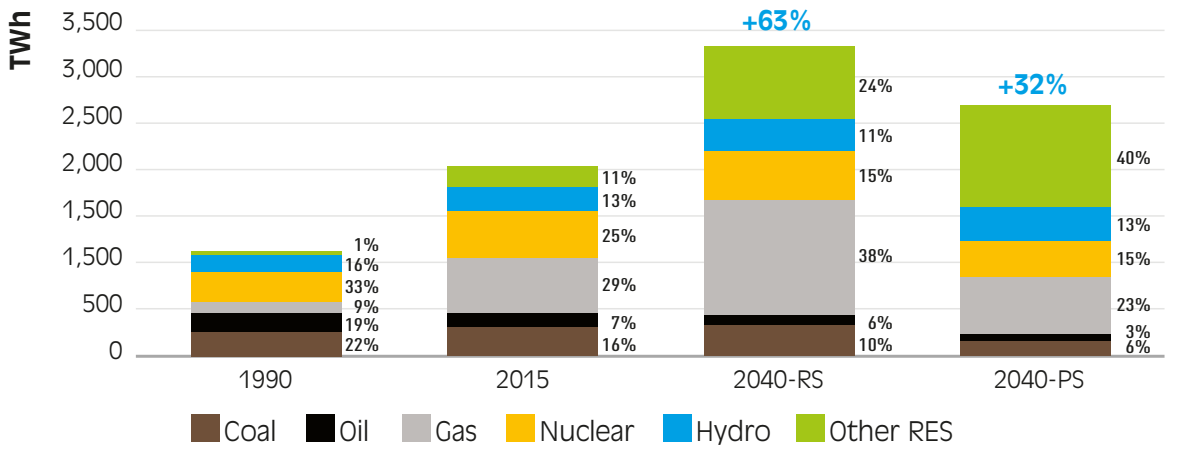


Figure 88 - Mediterranean power generation by type in 1990-2040
(Source: OME, 2018)

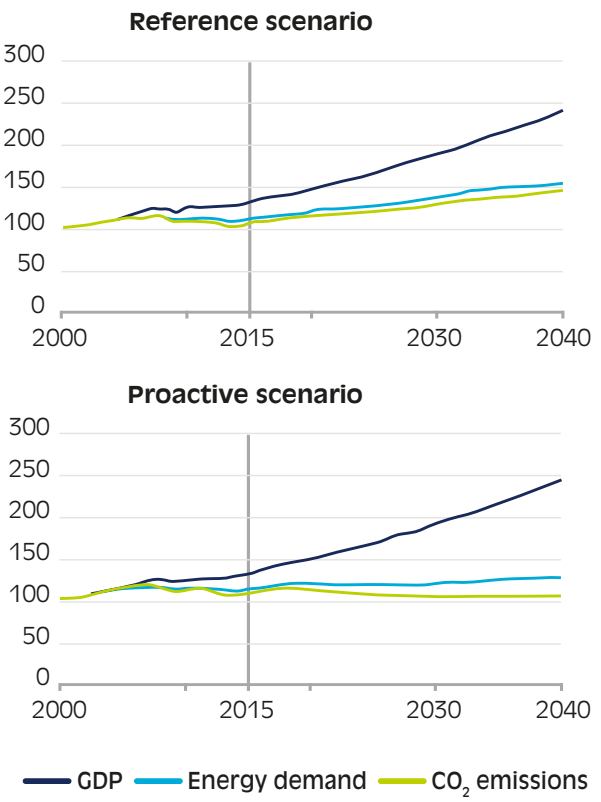


Figure 89 - CO_2 emissions in the Mediterranean region for each scenario
(Source: OME, 2018)

Northern Mediterranean countries, and 55% from Southern Mediterranean countries (OME, 2018). In the assessed scenarios for 2040, the share of CO_2 emissions from the North is expected to decrease by 9 to 13% and to increase in the South, also by 9% to 13% (OME, 2018). The energy sector is also a significant source of sulphur dioxide emissions, which exacerbates ocean acidification.
Both the current trend of CO_2 emissions from energy use and the national pledges are not in line with the temperature targets of the Paris Agreement, and emissions will greatly impact the Mediterranean environment through climate change and related impacts.

Mediterranean countries can respond by increasing the ambition of their NDCs, to fall into line with the 1.5°C target, which would significantly reduce the impacts of climate change. This would entail a rapid transformation of the energy sector towards renewable energies. Additional measures that could contribute to the reduction of greenhouse gas emissions are the adoption of an ambitious tax on greenhouse gas emissions, establishing a cap on greenhouse gas emissions, and the phasing out of fossil-fuel subsidies.

Underwater noise: The most relevant impacts of underwater noise are species' behavioural changes, such as feeding and mating, that lead to population decrease; as well as physical damage, such as the rupture of tissues and organs that can lead to the death of fish and marine mammals (Hawkins & Popper, 2016). The main responses should focus on designating restricted areas, developing more silent technology, and prohibiting noisy technologies and techniques.

Accidental discharges: The majority of spills (oil and other substances) from offshore drilling and exploration activities have been a minor source of marine pollution compared to the transport industry. The transport of oil is also part of the energy sector. From 1970 to 2009, Italy hosted most of the accidents (16), followed by Greece (5) and Spain (3) (Piante & Ody, 2015). Notably, 44% of the Mediterranean area is either contracted or designated for oil & gas exploration. Oil spills lead to the reduction of plankton, physical damage of fish stocks, marine mammals, and birds, resulting in general population decline[51]. The spillage of other chemical substances exacerbates the impacts of pollution, such as bioaccumulation and the biomagnification of ma-

[51] www.oilspillresponseproject.org/wp-content/uploads/2017/01/Impacts_on_marine_ecology_2016.pdf, pp.15, 16 and 30.

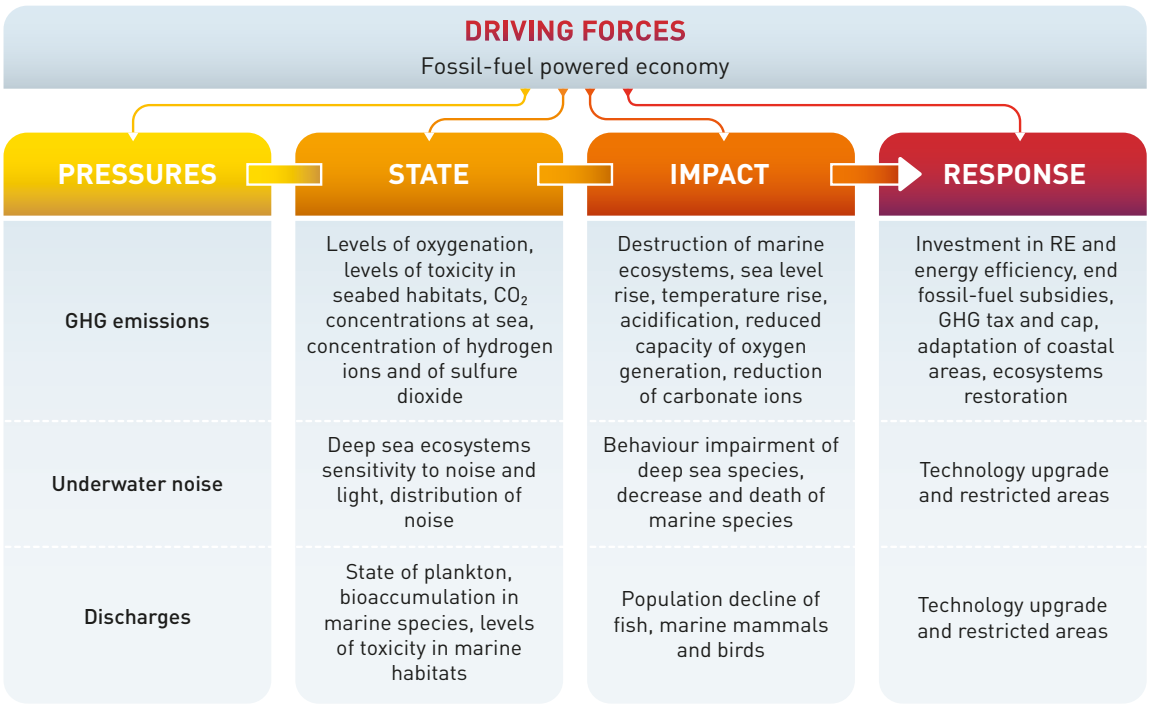


Figure 90 - Pressures exerted by the energy sector on the marine environment

rine organisms. The main regional instrument addressing offshore spillage is the Offshore Protocol of the Barcelona Convention, which entered into force in 2013. The main responses should focus on improving technology, designating restricted areas, and ensuring effective onboard pollution control facilities.

4.3.3 Dependency on the availability of natural resources and the quality of ecosystems

The Mediterranean region is overall highly dependent on the importation of fossil fuels. In 2015, the region imported 430 Mtoe of fossil fuels, which represented a 44% energy import dependency ratio. Northern Mediterranean countries import 90% of their fossil fuels, while Southern Mediterranean countries only import about 20%.

Under the Reference Scenario, where countries only achieve their unconditional NDC, countries that export fossil fuels, such as Algeria and Egypt, will have to reduce their exports to meet their domestic energy demands. In turn, importing countries, especially in the South, will have to improve their energy efficiency and increase their share of renewable energy sources. Nevertheless, in a Proactive scenario, where countries fully achieve their NDCs, in 2040 fossil fuel imports will have been reduced by more than half, reducing the fossil fuel import dependency rate to about 23% (OME, 2018).

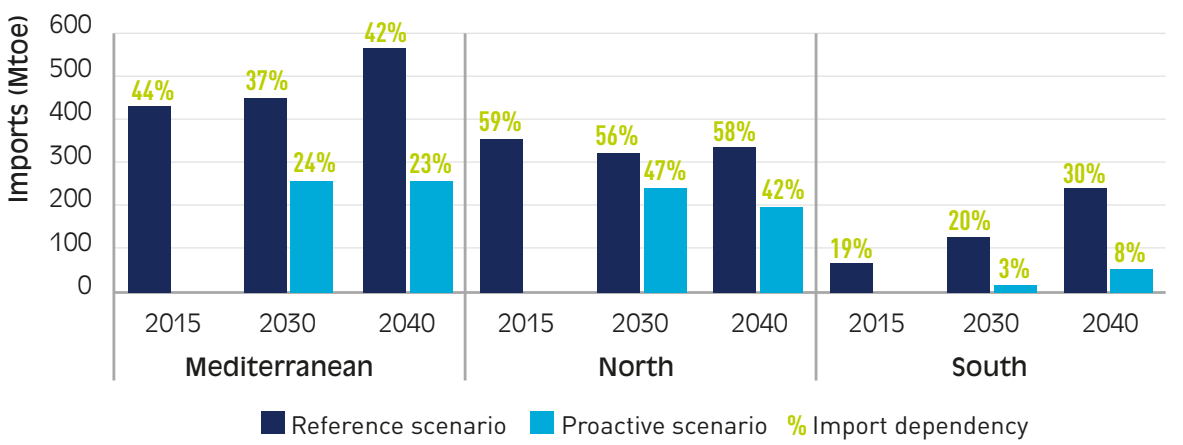


Figure 91 - Fossil fuel net trade volumes and import dependency
(Source: OME, 2018)

4.3.4 Are we moving towards a green and blue economy?

Until the early 2000s, renewable energy technologies were almost non-existent in the Mediterranean region, apart from hydropower, biomass and geothermal. Between 2000 and 2015, non-hydro renewables have more than doubled their output. Today, renewable energy technologies are mostly present in the electricity sector and the capacity is increasing faster than natural gas. Renewables currently reach 107 Mtoe, accounting for 11% of the total Mediterranean energy supply. About 80% of the region's renewable energy supply is located in the Northern countries (84 Mtoe), while the remaining 23 Mtoe are mostly in Turkey (15 Mtoe) (OME, 2018).

Therefore, there is an important margin of progress for an energy transition towards a green and blue economy is SEMCs. Indeed, the highest potential for renewable energy, especially solar power, lies in the South.

In 2040, the OME Reference Scenario would result in a renewable energy share of 34% of total energy production and the Proactive Scenario in a 52%, with NMCs clearly leading in both scenarios (OME, 2018).

Region	2015	2040	
		Reference scenario	Proactive scenario
North West	28%	52%	76%
North East	36%	36%	48%
South West	6%	15%	30%
South East	23%	23%	36%
Total Mediterranean	25%	34%	52%

Figure 92 - Renewable electricity production shares by scenario, 2015 and 2040
(Source: OME, 2018)

In any case, both scenarios fail to decarbonize Mediterranean energy consumption and to meet the goal of the Paris Agreement. For the Mediterranean to be moving towards a sustainable economy, countries would have to adopt the necessary regulatory measures to achieve ambitious targets regarding renewable energy deployment and energy efficiency that would result in meeting the goals of the Paris Agreement.

Furthermore, the decentralization and the digitalization of energy systems are crucial to boost the potential of renewable energy systems, with countries relying on a diversity of renewable energy sources that are best suited to their national environment.

Ultimately, reaching a sustainable economy greatly depends on the level of investment in the energy transition. In order to reach the OME Proactive Scenario (which still falls short of meeting the Paris Agreement), the region would have to invest over 3.3 trillion Euros in the energy system, 40% of which would go to energy efficiency measures, and 34% to power generation (OME, 2018).

BOX 27

The 2020 Renewable energy investment programme in Morocco

(Source: Moroccan Agency for Solar Energy (MASEN))

Development prospects for renewable energy in Morocco are very favourable:
- An estimated wind potential of 25,000 MW, of which nearly 6,000 MW are achievable by 2030;
- A solar potential illustrated by 3,000 hours of sunshine per year and 5 kWh/m²/day of irradiation;
- A significant hydraulic potential for micro-hydropower plants: more than 200 sites that can be exploited;
- A significant biomass potential;
- Highly-developed transit energy infrastructures;
- A legislative and institutional framework to accelerate the implementation of renewable energy development projects.

The Moroccan energy investment programme for 2020 is estimated at around USD 19 billion, which would generate some 50,000 jobs. The programme forecasts that the share of installed electrical power in renewable energy (wind, solar, and hydro) would reach 42% of the energy mix by 2020 (52% by 2030), and would also save 2.5 million tonnes of oil equivalent (toe) in fuel, representing nearly USD 1.25 billion, and avoid 9 million tonnes of CO_2 emissions per year.

4.4 Tourism

Tourism has been gradually recognized as a key economic sector within the UNEP/MAP - Barcelona Convention system with the 1980 Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities identifying tourism as an economic activity to consider when setting priorities for action plans, and the 2015 Sustainable Consumption and Production (SCP) action plan setting a goal-oriented framework to promote sustainable tourism in marine and coastal protected areas in Southern Mediterranean countries, namely Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, the State of Palestine, and Tunisia.

4.4.1 Overview of the sector

Over time, the Mediterranean region has developed a unique blend of maritime and coastal tourism, offering significant employment and economic wealth. The economic growth induced by tourism activities has often been to the detriment of environmental integrity and social equity. Sea-Sand-Sun (3S) dependency, cultural alteration, environmental pollution, resource depletion, climate change vulnerability,

geopolitical insecurity, social instability, job precarity, are the upcoming issues that threaten the long-term sustainability of the tourism sector - and in general of the coastal communities' well-being - in the Mediterranean region. Tourism, as one of the major economic activities in Mediterranean countries, can contribute positively to local development, environmental protection and social cohesion only if it is correctly managed, monitored and supervised. Long-term strategies, multi-stakeholder collaborations and sound public policies are essential tools to promote truly sustainable tourism in the Mediterranean.

With its unique combination of mild climate, rich history and cultural heritage, exceptional natural resources and proximity to major source markets, the Mediterranean region has become the world's leading tourism destination, with around 360 million international tourist arrivals (ITAs) in Mediterranean countries, representing around 27% of total world tourists for 2017 (UNWTO, 2019). ITAs grew from 58 million in 1970 and are forecast to reach 500 million by 2030 (UNWTO, 2019). Approximately half of the 2017 arrivals -170 million - are in Mediterranean coastal areas,

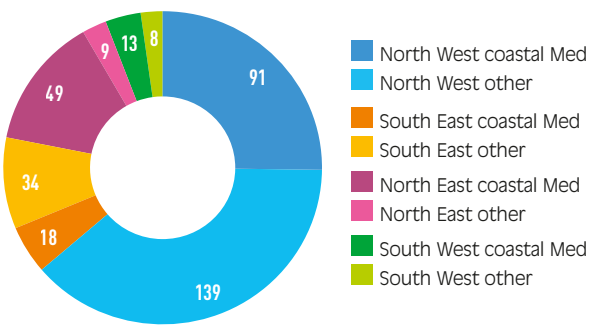


Figure 93 - Coastal Mediterranean international tourist arrivals (ITAs) and non-coastal ITAs in Mediterranean subregions, in millions of ITAs, 2017
(Source: eco-Union estimates, based on Eurostat, WTO and national sources, 2019)

aggravating the concentration of human-made pressures in coastal zones, particularly during the summer season.

The top five destinations in Mediterranean countries, receiving most of the Mediterranean countries' international tourist arrivals are France (86.9 million ITAs), Spain (81.8 million), Italy (58.3 million), Turkey (37.6 million) and Greece (27.2 million) - represented more than 82% of the region's total ITAs in 2017. The highest ten-year growth rates of ITAs have been registered in Albania (1.2 million in 2008 to 4.6 million in 2017) and Bosnia and Herzegovina (from 322,000 in 2008 to 922,000 in 2017).

Tourism is one of the most important economic sectors in the Mediterranean region, bringing high economic value, particularly for countries (or regions within countries) with limited industrial or agricultural development. As shown in *Figure 95*, the tourism sector contributes to 11.3% of total GDP[52], 11.5% of employment, 11.5% of exports and 6.4% of capital investments in the region (WTTC, 2015).

The tourism sector remains volatile and sensitive to external and internal turbulences: social conflicts and political turmoil; terrorist attacks and insecurity; economic slowdown and unemployment; and climate change and environmental degradation. Such shocks have recently led to the so-called "connected vessels effect", i.e. the fact that part of tourist flows towards destinations of Southern Mediterranean countries (seaside but also historical centres and archaeological sites) are diverted towards similar destinations in the Northern Mediterranean, considered as safer or more attractive.

Since the Arab Springs, especially in 2011, the number of international tourist arrivals decreased drastically in the countries concerned. In Egypt, this number decreased by almost 46% in 2011 and increased only slightly after 2013. In Tunisia, international arrivals dropped by more than 20% after the 2011 revolution, reversing the previous upward

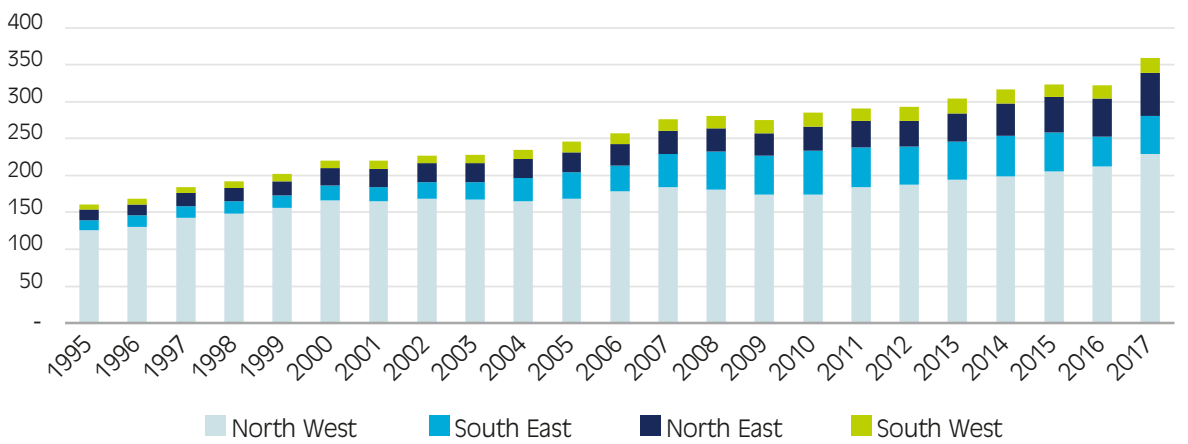


Figure 94 - Mediterranean international tourist arrivals (ITA), in millions, 1995-2017
(Source: based on UNWTO data, 2019)

[52] Taking into account direct and indirect impacts.

trend. In Turkey, the terrorist attacks and putsch attempt in 2015 and 2016 have led to a significant downturn of international tourist arrivals. In the case of Egypt, Tunisia and Turkey, previous levels of international tourism have been reached once again only just recently in 2018[53]. This change in trends might have benefited Northern countries that saw their arrivals rise in this period. For instance, in France, while the growth rate of international tourist arrivals was at - 1.2% between 2009 and 2010, the rate jumped to 38.5% the following year. Similarly, in Italy, this rate was at 3.9% between 2009 and 2010 and 24.9% between 2010 and 2011.

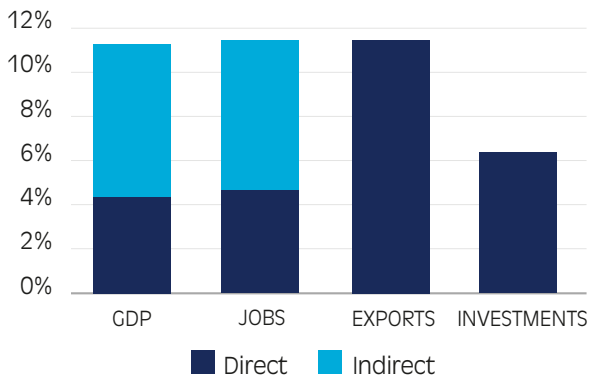


Figure 95 - Economic impact of Mediterranean tourism
(Source: Plan Bleu, 2016, based on data from WTTC, 2015)

4.4.2 Pressures on the environment

Tourism is a major consumer of natural resources: water - an extremely scarce resource in many coastal areas; food - sometimes causing pressure on the local production, leading to overfishing; electricity and cooling/heating facilities - making tourism a massive consumer of energy. Coastal tourism generates serious environmental impacts by causing marine and freshwater pollution through the discharge of sewage and the disposal of solid waste.

Tourism in the Mediterranean strongly depends on the region's natural assets, with related ecosystem services accounting for more than two thirds of the total value of ecosystem services in the Mediterranean (UNEP/MAP, 2012). This denotes that the majority of services provided by coastal and marine ecosystems are exploited for tourism purposes (BleuTourMed, 2018). Tourism supply and demand tend to be concentrated in coastal areas, which results in territorial disparities between densely-occupied coastal areas (collecting most of the economic benefits) and hinterlands where tourism activities are less developed. Climate change could create redeployments of tourist flows in space and time, thus challenging the profitability of heavy investments in coastal areas (seaside and summer tourism).

From the current state of play of tourism in the Mediterranean (Plan Bleu, 2016), it is indisputable that human-made pressures are dramatically threatening both the environmental and social sustainability of destinations as well as the economic viability of the sector. In particular, the benefits of mass tourism to local communities is highly questionable: large international operators, providing both demand (groups of international tourists) and offer (resorts, cruises, etc.), are able to extract most of the economic value generated (so-called economic leakage). Despite increasing awareness of the societal risks linked to tourism development, sustainability principles are not yet widely applied in the facilities and destination management. The key issues affecting the main pillars of sustainability related to the tourism sector, are summarized in *Figure 96*.

The main pressures of the tourism sector on the marine environment are marine litter, coastal land take, habitat degradation, air emissions, water consumption and sewage generation, and proximity to natural sensitive areas. *Figure 98* illustrates the interaction of pressures with the marine and coastal environment.

Figure 96 - Main issues of Mediterranean tourism
(Source: Plan Bleu, 2016)

[53] According to announcements by the UNWTO, but pending official reports.

BOX 28 Pressures from leisure boating

Coastal Mediterranean areas are very attractive for leisure boating. The recreational boating sector is undergoing structural changes with a general slight downturn of new boat orders at the global level and at the same time the doubling of total orders of megayachts (>60 m) between 2007 and 2014 (Boat International, 2019), of which approximately 50% sail in the Mediterranean. Recreational boating, especially the rapid growth of yachting (ships >24 m), is creating significant environmental and socioeconomic challenges, since yachts and their associated infrastructure (ports, marinas, etc.) can threaten marine fauna and habitats and cause conflicts with other sectors from recreational users to professional fishers. Increasing attention is being paid to the environmental impacts of recreational boating, raising the question of the management of boating and yachting. Of particular concern is the destructive impact of anchoring on *Posidonia* meadows, which increases with the size of the boat.

BOX 30 Tourism severely threatens the Mediterranean monk seal

The critically endangered Mediterranean monk seal needs cave and beach habitats to breed successfully. Many of such areas are exploited for tourism which has played a major role in the drastic decline and extinction of the Mediterranean monk seal in France and Corsica, Spain and the Balearic Islands, Croatia, Italy and Sardinia, and Tunisia. Without dramatic changes, the current tourism pressure will likely drive the species to extinction (WWF, 2001).

Marine litter: The pronounced seasonality of marine litter on beaches indicates that tourism is a significant source of marine litter (UNEP/MAP, 2017a) (see section below on marine litter). Tourist destinations can adopt many actions to tackle marine litter. For instance, local authorities can improve waste management systems, upgrade sewage systems, and develop guidelines for the management of their coastal litter. Regional governments can introduce dissuasive taxes, such as the Balearic Islands Sustainable Tourism Tax, which applies to all tourist accommodation facilities and invests revenue into protecting, preserving and restoring the Balearic environment (Sustainable Balearic Islands website, 2019).

BOX 29 Marine litter in coastal destinations

The results of the 2016 Blue Islands Project, an assessment of marine litter in Mallorca, Sicily, Malta, Rab, Crete, Rhodes, Mykonos and Cyprus showed a pronounced seasonality of marine litter. The study showed that July is the month with the most litter on beaches, with an average of 450,000 litter items per km^2 per day at tourist beaches, and 200,000 litter items per km^2 per day at remote beaches. The majority of litter found on beaches is formed of plastics (36.8%) and cigarette butts (30.6%). Microplastics represent 9.3% of total waste, mesoplastics (from 0.5 to 2.5 cm) account for 19.8% of the total, and macroplastics, 7.7%. The beach with the greatest amount of marine litter is Marsaxlolk beach in Malta, followed by the beaches of Torà in Mallorca, Golden Bay in Malta, Es Caragol in Mallorca, Gnejna Bay in Malta and Sunrise Beach in Cyprus (Universitat Autònoma de Barcelona, 2018).

gas emissions contribute to ocean acidification, while greenhouse gas emissions also lead to other global warming impacts on the sea, such as temperature rise and sea level rise, all of which degrade marine ecosystems. Between 2009 and 2013, tourism's global carbon footprint increased from 3.9 to 4.5 $GtCO_2$, four times more than previously estimated, accounting for around 8% of global greenhouse gas emissions (Lenzen et al. 2018). As the Mediterranean is the leading destination in the world, it therefore accounts for a significant amount of emissions. No study has estimated the amount of emissions generated by Mediterranean coastal and marine tourism. One significant source of emissions is cruise ships. For instance, in Greece, cruise ship emissions are close to non-existent in winter and peak to 800 tonnes of total emissions in August *(Figure 97)* (Papaefthimiou, Maragkogianni & Andriosopoulos, 2016).

The authorities can respond by heavily investing in (research and development for) clean transportation, promoting sustainable tourism, improving efficiency standards in the sector, as well as implementing a carbon cap and a robust carbon tax.

Water consumption: Tourism, agriculture and industry place a significant stress on freshwater resources in the Mediterranean basin (UNEP/MAP, 2017a). A tourist staying in a hotel uses, on average, one third more water per day than a local inhabitant. Water parks, golf clubs, and other tourist and recreational facilities are significant consumers of water, especially during the dry season (WWF, 2004). In consequence, the tourism sector's intensive demand for water contributes to the building of dams and reservoirs that reduce the amount of river flows to the sea. While the impacts of reduced river flows on the marine environment are not fully known, it surely has adverse impacts on marine species, which are dependent on brackish habitats. Reduced riverine flow can also lead to saltwater intrusion in estuaries and lower river systems, resulting in negative

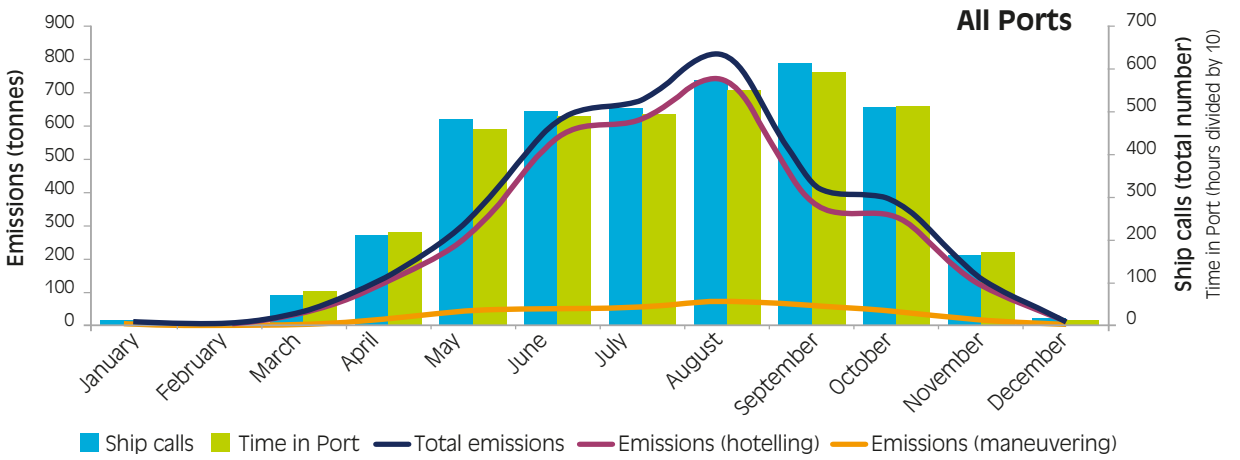


Figure 97 - Seasonal variation of cruise ships' emissions in Greek ports
(Source: Papaefthimiou, Maragkogianni & Andriosopoulos, 2016)

consequences on estuarine-dependent species and marine species dependent on reduced salinity conditions for part of their life history (FAO, 1995).
Authorities can respond by promoting sustainable tourism, restricting water-intensive practices, and implementing plans to conserve water.

Proximity to natural sensitive areas: Coastal manmade infrastructure causes irreversible damage to landscapes, habitats and biodiversity, and shoreline configuration by disrupting sediment transport (UNEP/MAP, 2017a), as well as pollution and beach erosion. Special attention should be paid to the degradation of transitional areas, including deltas, estuaries and coastal lagoons, which serve as critical nursery areas for commercial fisheries and support unique assemblages of species, but also to the broader coastal zone (UNEP/MAP, 2012). Authorities can respond by implementing coastal management plans,

DRIVING FORCES
Demand for sand, sea and sun - Extension of seasonality of coastal tourism - Demographic changes - Affordability of travel and lodging expenses

PRESSURES	STATE	IMPACT	RESPONSE
Marine litter	Amount of marine litter	Fish stock collapse, disruption of food chain in the ecosystem	Improvement of municipal waste, management of coastal areas, restriction on plastic and smoking on beaches
Coastal development	Disruption of coastal ecosystems, erosion	Disruption of coastal ecosystems, erosion	Coastal management
Air emissions	pH of water, temperature of water	Sea level rise, ocean acidification, change of sea temperature	Cap on emissions, carbon tax, clean transport, sustainable tourism, improve efficiency
Water consumption	State of coastal and estuary habitats	Loss of estuary-dependent marine species	Sustainable tourism, restrictions on water-intensive facilities
Proximity to natural sensitive areas	State of sensitive habitats close to tourism hotspots	Loss of habitat of keystone species	Coastal management

Figure 98 - Pressures exerted by tourism on the marine environment

setting minimum standards, requiring certification systems concerning water use, and developing guidelines.

4.4.3 Are we moving towards a green and blue economy?

The call for better governance
Coastal, urban and cultural tourism has increased exponentially in the past decades all over the Mediterranean region. Low-cost airlines and all-in-one packages make a short trip to sunny islands or historical sites accessible to a large number of middle-class consumers. Unfortunately, this massification comes at a cost, in particular for the local communities who feel that they are losing control of their neighbourhoods and suffering irreversible cultural or environmental damage. Recently, voters in tourist cities and regions (such as Barcelona, Paris, Rome, etc.) have elected politicians who propose to regulate tourism activities more stringently and enhance transparency and governance processes in order to increase local benefits and reduce negative environmental and social externalities.

Drawing benefit from international commitments
Mediterranean countries have recently approved global sustainability objectives, such as the Sustainable Development Goals (SDGs), the Paris Agreement on climate change (UNFCCC COP21), the Convention on Biological Diversity (CBD), as well as, under the Barcelona Convention, the Mediterranean Strategy for Sustainable Development (MSSD 2016-2025), the Regional Action Plan on Sustainable Consumption and Production in the Mediterranean (SCP AP), and the Protocol on Integrated Coastal Zone Management in the Mediterranean (ICZM Protocol). These institutional commitments strongly contribute to tackling some of the issues identified previously, but inherent societal characteristics and exponential development of the tourism sector create the need for a dedicated set of actions that could be embedded in a possible Mediterranean Strategy for Sustainable Tourism (MSST) to be approved by regional and national stakeholders including countries, the private sector, civil society and NGOs, and scientists.

Defining a shared vision and building a common strategy
Until now, each Mediterranean country has developed its own tourism strategy and set of policies to regulate and encourage the development of tourism activities. However, environmental degradation, social inequalities, lack of economic competitiveness, cultural alteration and poor governance go beyond national borders and therefore require a regional strategy shared by all neighbourhood countries. A common vision has to be shaped by all national and regional stakeholders to *"promote sustainable Mediterranean tourism in which visitors and hosts enjoy balanced, respectful and fruitful relationships and value the unique Mediterranean environmental, human and cultural heritage, while ensuring inclusive socioeconomic development, taking into account the carrying capacity of healthy natural ecosystems, and developing complementarity between various economic activities at the tourist destination level"* (Fosse & Le Tellier, 2017).

Engaging with regional stakeholders
In order to successfully implement the proposed MSST, relevant international institutions have to be involved to coordinate specific objectives, directions or actions, in particular: UNEP/MAP and its Regional Activity Centres (technical coordination), the World Tourism Organization (UNWTO) and UNESCO (thematic expertise), the Organisation for Economic Cooperation and Development (OECD) (policy knowledge), the European Union (financing mechanisms), and the Union for the Mediterranean (political support). A comprehensive, transparent and reliable monitoring system with relevant indicators also has to be built to support the implementation and follow-up of the Strategy, which should be fully integrated within the Mediterranean Strategy for Sustainable Development (MSSD 2016-2025). As the budget to implement the Strategy may be significant, it requires innovative financial instruments to attract private and alternative investments financing concrete actions, projects and activities.

4.5 Transport

Transport is an important sector in the framework of the Barcelona Convention as it facilitates mobility, trade and Mediterranean regional integration. With the continued economic development of Southern and Eastern Mediterranean countries, expanding and strengthening transport infrastructure within and between Mediterranean partner countries becomes essential, entailing the need to comply with the Barcelona Convention to regulate pollution caused by the transport sector.

4.5.1 Terrestrial transport

4.5.1.1 Overview of the sector

Transport represents the biggest share of energy use (31% in NMCs and 38% in SEMCs). Road transport accounts for more than 70% of the transport sector's energy use in Mediterranean countries, with private vehicles accounting for the highest share (Medener, 2013). Total transport energy use has increased considerably in the last decade within SEMCs compared to NMCs. However, NMCs consume more energy in transport than SEMCs. While the efficiency of transportation has improved, especially in NMCs, energy consumption remains high in this sector. In SEMCs, there is an almost total dependency on combustible fuels for transport energy. In NMCs, a mix of combustible fossil fuels, electricity and gas sources is used for transport.

Modal Share in Land Transport
Private vehicles are still the primary means of transport at the national level with a modal share exceeding 75% in NMCs. Western NMCs have the most diversified public transport systems. Buses and coaches are still predominant as public transport in most countries.

In Northern Mediterranean cities, public transport and soft modes of transport (walking, biking) are the predominant transport modes over motorized alternatives (EEA, 2013a).

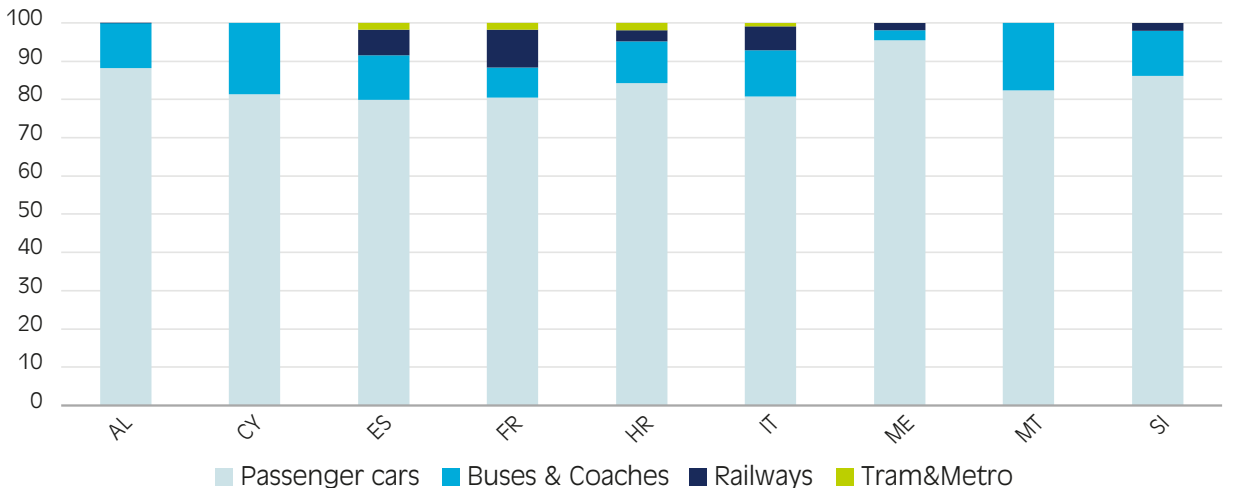


Figure 99 - Modal split of passenger transport on land in NMCs in 2015
(Source: European Commission, 2017)

While data availability on transport modes in SMCs is challenging, modal split data is provided for motorized mobility in the cities of Algiers, Beirut, Cairo and Tunis. Public transport is more developed in NMCs than in SMCs, and its further development is an important lever for reducing air pollution, traffic congestion and transport poverty. Providing incentives and better regulation to take the most-polluting vehicles out of circulation is another way to improve air quality and energy efficiency. The relevance of urban cycling as an alternative to walking, public transport and private cars is unknown.

Train Passengers and Freight

National train systems are more developed in western NMCs. In the last decade, neither the development of railways, nor the number of train passengers have changed in eastern NMCs and SEMCs. Railway transport is key for the decarbonization of transport and for reducing

BOX 31 Barcelona Mobility Strategy

In Barcelona, Spain, the modal share for public transport, walking and biking is 74%. In the last five years, the use of motorized transport has decreased and bike mobility has increased.

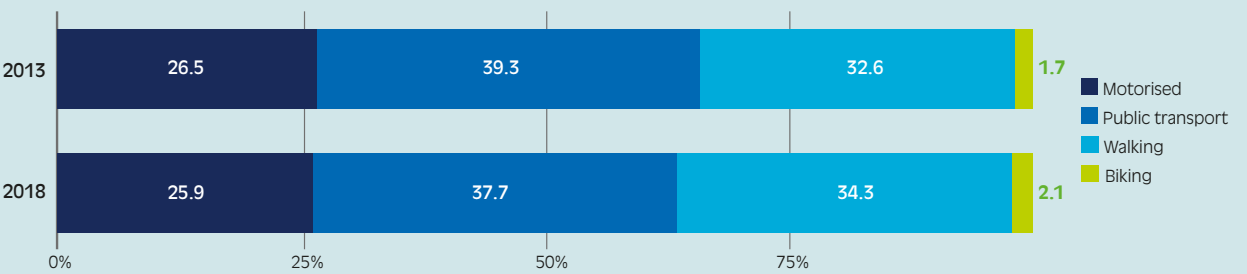


Figure 100 - Barcelona City Transport Modal Share 2013-2018
(Source: Barcelona Urban Mobility Plan 2013-2018)

The new Urban Mobility Plan (PMU 2019-2030) intends to significantly reduce motorized private vehicles, increase public space and low-emission zones, reduce private car space and increase the number of pedestrianized streets and bike lanes. In 2019, the metropolitan area will introduce an integrated public transport card, facilitating accessibility and flexible pricing. This identifies a certain number of basic traffic roads and places inside each network a wider pedestrian priority zone, where only bikes, pedestrians, residents' vehicles and urban services and emergency vehicles are allowed. It aims to establish priority areas and access controls under the UN Habitat Design for Sustainable Urban Mobility, such as to limit the transit of private vehicles. The identification of pedestrian priority zones corresponds to the routes of public transport networks.

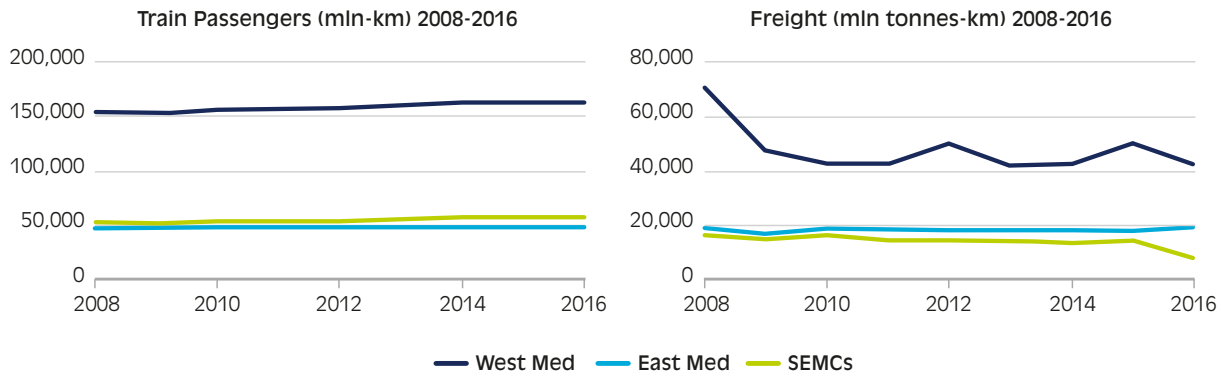


Figure 101 - Train passengers in min-km in 2008-2016 and freight in min tonne-km in 2008-2016
(Source: World Bank, 2020)

disparities between regions and within the countries. In terms of railway freight, goods transportation decreased in the North-West Mediterranean after the economic crisis and pre-crisis levels have not been recovered. In SMCs, train freight volumes declined in 2015.

Energy Use and Transport
Gasoline/Diesel are still predominant sources of energy for transport, with an increasing share of gas products, especially in NMCs. Biofuels are the second source in NMCs. Electricity, mainly used in public transport and private vehicles, is still not significant.

4.5.1.2 Environmental impacts

Motor traffic exposes people not only to physical hazards related to accidents, but also to hazardous emissions of air pollution, noise and anthropogenic heat (Mueller et al. 2017) (see Chapter 7, Health and Environment).

4.5.1.3 Are we moving towards a green economy?

In order to achieve a green land transport sector in the Mediterranean, current trends of stagnating, or even worsening, air quality, particularly in cities, need to be curbed. Major efforts are required in terms of decarbonization, depollution and energy efficiency, and need to go hand-in-hand, aiming at both meeting emission targets and health requirements.

BOX 32

Electro-mobility in Mediterranean countries

All Mediterranean countries are dependent on combustible fuels for their transportation sector. Electrical sources of energy represent a small share of energy use in transport. The share of electric transportation in NMCs is bigger and growing faster than in SEMCs (IEA, 2016). In NMCs, public transport, such as the underground and trams, are increasingly turning towards electrical sources of energy in order to reduce carbon and greenhouse gas emissions in urban areas (IEA, 2016). This shift towards electricity needs to be done carefully because shifting towards electrical sources of energy in the transport sector allows only partial decoupling. It may reduce emissions from the means of transport, but it generally generates indirect emissions due to the low share of electricity generation based on renewable energy. Although electricity generation in the Mediterranean region depends increasingly on renewable resources (hydro, wind and solar), the share of these resources in electricity generation remains low with around 25% (OME, 2018). In 2018, **EnerNETMob** (EnerNETMob, 2018), an Interreg MED-funded project, was launched in parallel to the "Sustainable Electromobility Plans" with the purpose of enabling a Mediterranean-wide network that connects cities in coastal and maritime areas with land transport. By implementing several pilot networks of Electric Vehicle Supply Equipment (EVSE), co-powered by renewable energy, EnerNETMob aims to test interurban and interregional mobility plans and land-sea intermodality using electric transport systems. It also seeks to coordinate future investments in electric transport in the Euro-Mediterranean region.

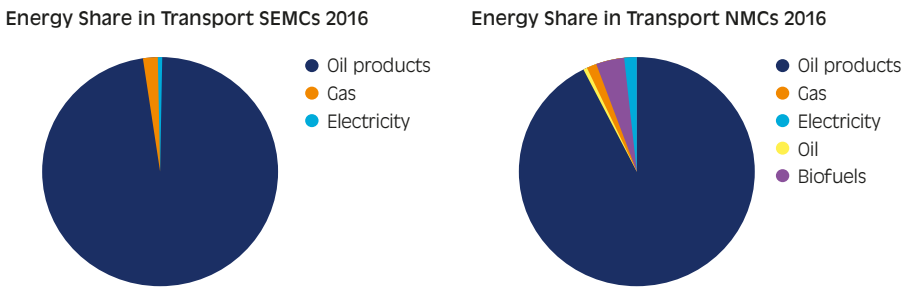


Figure 102 - Energy use and transport in 2016
(Source: IEA, 2016)

BOX 33 Social inclusiveness of public transportation in the Mediterranean

Access to transport is often subject to implicit obstacles that impede certain groups from obtaining full inclusion, especially women and young people, and particularly in rural areas. In many areas, especially in Southern Mediterranean countries, the lack of affordable, safe and reliable transportation is an impediment to women's inclusion in the labour market, making the combination of work, commuting to work and spending time on chores and childcare more difficult. These problems are amplified in rural areas, where even though transport links have been improved, the lack of transport infrastructure is still a problem, increasing the distance to market and, therefore, the isolation of some social groups. Adequate infrastructure and, in particular, access to transport and the ability to travel, are identified as essential in order to access employment and develop social relationships in remote rural areas. More particularly, in rural regions, the dispersal of a high number of small villages make traditional public transport services difficult and very expensive. In order to facilitate commuting to cities for rural inhabitants, Italy and France have created a type of territory to make sure that villages are not marginalized and can access public transport. Transportation challenges are one of the most significant barriers to youth participation in the workforce, especially for females (International Youth Foundation, 2014). The barriers to finding employment among young people depend on the relationship between transport, employment and housing, and are accentuated in rural areas, partly due to the marginality of many regions and the costs associated with spatial exclusion, such as access to education and training facilities (International Youth Foundation, 2014).

Significant levers of action in urban areas include integrated urban planning with measures to reduce traffic and avoid busy roads around schools and playgrounds, including low emission zones, more green areas, bike lanes and pedestrianization in city centres and the most congested areas, as well as public investment in (electric) public transport that is accessible to all, and the promotion of active mobility (cycling and walking). Establishing rail freight corridors, promoting the electrification of vehicles and trucks powered by renewable energy sources and the support of measures enhancing energy efficiency (potentially 15% energy savings in the Mediterranean transport sector by 2030 with a proactive scenario, OME, 2018) are other environmentally friendly solutions to decouple economic development from a high-carbon, high-pollution land transport system.

4.5.2 Aerial transport

4.5.2.1 Overview of the sector

Mediterranean Air Passenger Traffic: Disparities concerning connectivity

Commercial aviation in the Mediterranean region experienced an almost 50% increase in air passengers between 2005 and 2018, crossing the threshold of 350 million passengers. The increase in SEMCs (from 37 million passengers in 2005 to 158 million in 2018) and particularly in Turkey (from 17 million passengers in 2005 to close to 116 million in 2018) has been much stronger than in NMCs (from 155 million passengers in 2005 to 201 million in 2018). Airport infrastructure is more developed in NMCs, generating around close to 60% of air passenger traffic. Air passenger traffic within NMCs and SEMCs, especially Morocco, will keep growing over the coming years (Eurocontrol, 2017).

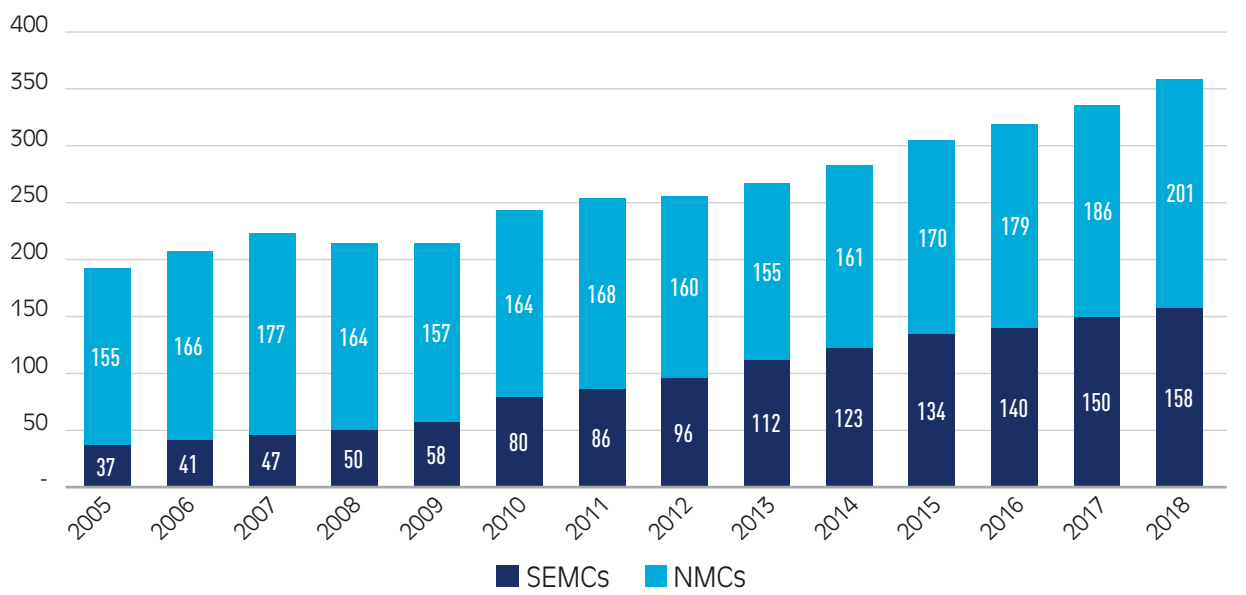


Figure 103 - Air Traffic Passengers in Mediterranean Countries 2005-2018, in million passengers
(Source: World Bank, 2019)

Figure 104 shows the striking difference between NMCs and SEMCs in terms of air passenger traffic and connectivity by key coastal airports in the Mediterranean Region. NMCs rely on an extensive network of international airports, compared to SEMCs. The Connectivity Index (Arvis & Shepherd, 2011)[54] shows that NMCs are better connected than SEMCs. The Western Mediterranean region is the most connected, followed by the Adriatic-Ionian region. Algeria, Tunisia and Turkey have the best-connected airports among SEMCs.

4.5.2.2 Environmental impacts

Aviation is responsible for an estimated 4.9% of anthropogenic global warming (Cames et al. 2013). In this context, if international aviation greenhouse gas emissions are not properly regulated, they are expected to increase by 17% (Cames et al. 2013). While aviation is not the major source of air pollution, Mediterranean cities that have a port and / or airport nearby register higher levels of greenhouse gas emissions (Dayan et al. 2017).

4.5.2.3 Are we moving towards a green economy?

Electrofuels and biofuels are potential technological solutions to decarbonize aviation, but significant electrification will probably not be possible in the coming decades, as it is too heavy and costly at this stage. To fuel 50% of European aviation in 2050 with electrofuels would require 8 million

BOX 34

Air quality near ports and airports in Spain

The air quality in coastal Mediterranean Spanish cities is considerably affected by the presence of ports and airports that can represent very large concentrations of emissions of pollutants such as NO_2, SO_2 or volatile hydrocarbons, emissions that are generally produced in metropolitan areas, although sometimes in non-urban areas.

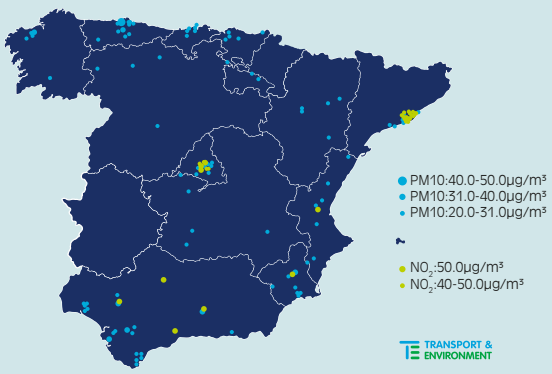


Figure 105 - PM_{10} and NO_2 emissions in Spain
(Source: Transport & Environment, 2018a, based on EEA 2015 data)

The concentration of NO_2 and PM_{10} (airborne particles) generation along Spain's Mediterranean coast corresponds to the cities where there are the biggest and busiest airports (Barcelona, Alicante, etc.).

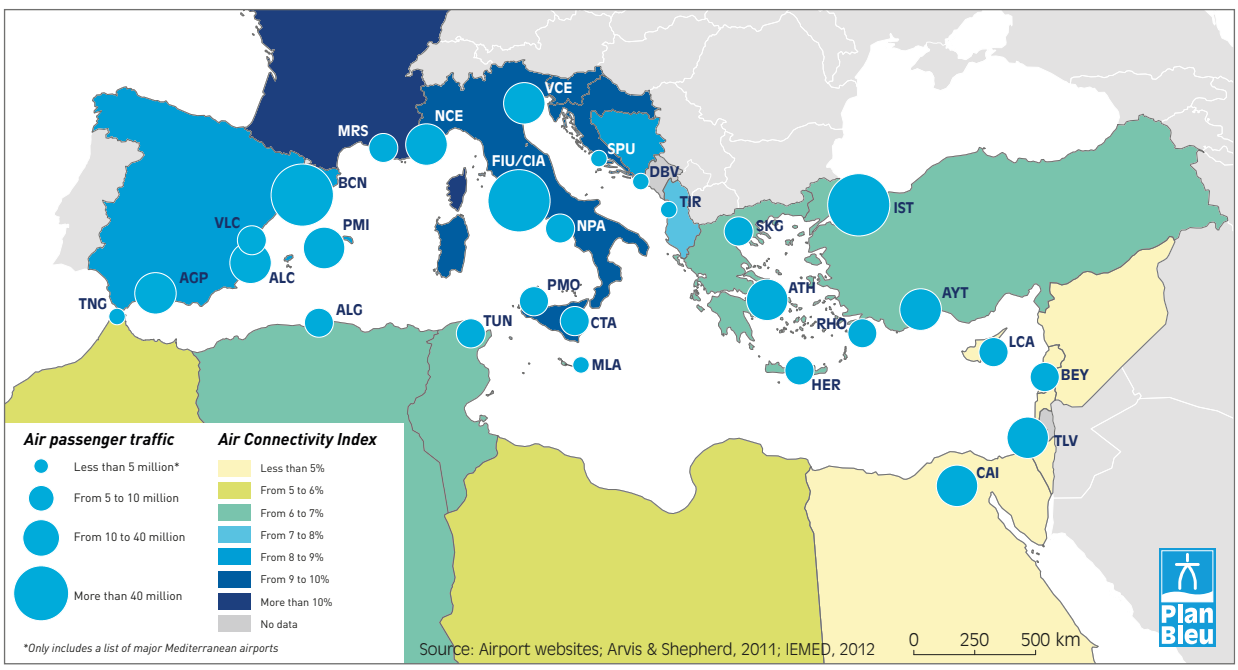


Figure 104 - Air Passenger Traffic in the Mediterranean Coast, 2017, and the national Air Connectivity Index, 2012
(Source: Airport websites; Arvis & Shepherd, 2011; IEMED, 2012)

[54] The Air Connectivity Index (ACI) measures the overall level of air service: frequency of flights, reliability, and diversity of destinations. It defines connectivity as "the importance of a country as a node within the global air transport system. A country is considered to be better connected the stronger is the overall "pull" it exerts on the rest of the network. A country's connectivity score is higher if the cost of moving to other countries in the network is relatively low. It is considered to be less well connected if the dispersion of those costs is high" (Arvis & Shepherd, 2011).

hectares of land and 33 million hectares of farmland, along with a renewable energy generation equivalent to 25% of total electricity supply in the European Union (Transport & Environment, 2018b). Its use for aviation must be considered under a conservative assessment of sustainable levels of electrification.

4.5.3 Maritime transport

4.5.3.1 Overview of the Sector

Maritime transport is the backbone of trade and economic development (80% of goods are shipped by maritime transport). Global seaborne trade volumes and demand for shipping services have been in constant - although moderate - growth since the 2008-2009 economic crisis. In 2015, for the first time, the world seaborne trade volumes exceeded 10 billion tonnes (UNCTAD, 2016). In 2017, the world fleet continued to grow (+ 3.15% in deadweight tonnage (dwt) or + 2.47% in the number of vessels) compared to 2016, but growth has been decelerating since 2011 (UNCTAD, 2017a).

The Mediterranean Sea is located at the crossroads of three major maritime crossings, namely the Strait of Gibraltar, opening into the Atlantic Ocean and the Americas; the Suez Canal, a major shipping gateway which connects to Southeast Asia via the Red Sea; and the Bosporus Strait, leading to the Black Sea and Eastern Europe / Central Asia. With its strategic location, the Mediterranean hosts an important transit lane and trans-shipment activities[56] for

BOX 35

Euro-Mediterranean Common Aviation Area (EMCAA), fuel taxation and climate mitigation

The EU is actively pursuing its policy of promoting the Euro-Mediterranean Common Aviation Area (EMCAA), based on the principle of a gradual market opening and regulatory convergence (UfM, 2013). The finalization of this agreement will enhance connectivity between Europe and South and Eastern Mediterranean countries. The NGO, Transport and Environment (T&E)[55], along with other stakeholders, such as the International Coalition for Sustainable Aviation (ICSA), to achieve ambitious targets for reduced emissions within the aviation sector, especially by removing exemptions on fuel taxation and Value Added Tax (VAT) for airlines in the EU. It builds on the 2008 agreement to include emissions from international aviation - to and from Europe - in the EU Emissions Trading System (EU ETS). The EU ETS needs to be reformed to be made more effective, especially when it comes to aviation. Increasing the rate at which the cap falls and removing the surplus which has built up are two key reforms that are being negotiated. These reforms are essential for aviation, as aircraft operators purchase allowances from this overall EU ETS. At present, the aviation sector receives 85% of its allowances for free. The T&E initiative encourages the EU to ensure that reductions in emissions from the aviation sector make a fair contribution to achieving the EU's overall 2030 climate target. This implies ending tax exemptions and subsidies and investing in low-carbon alternatives. All international flights and fuel are currently VAT-exempt based on the 1944 Chicago Convention.

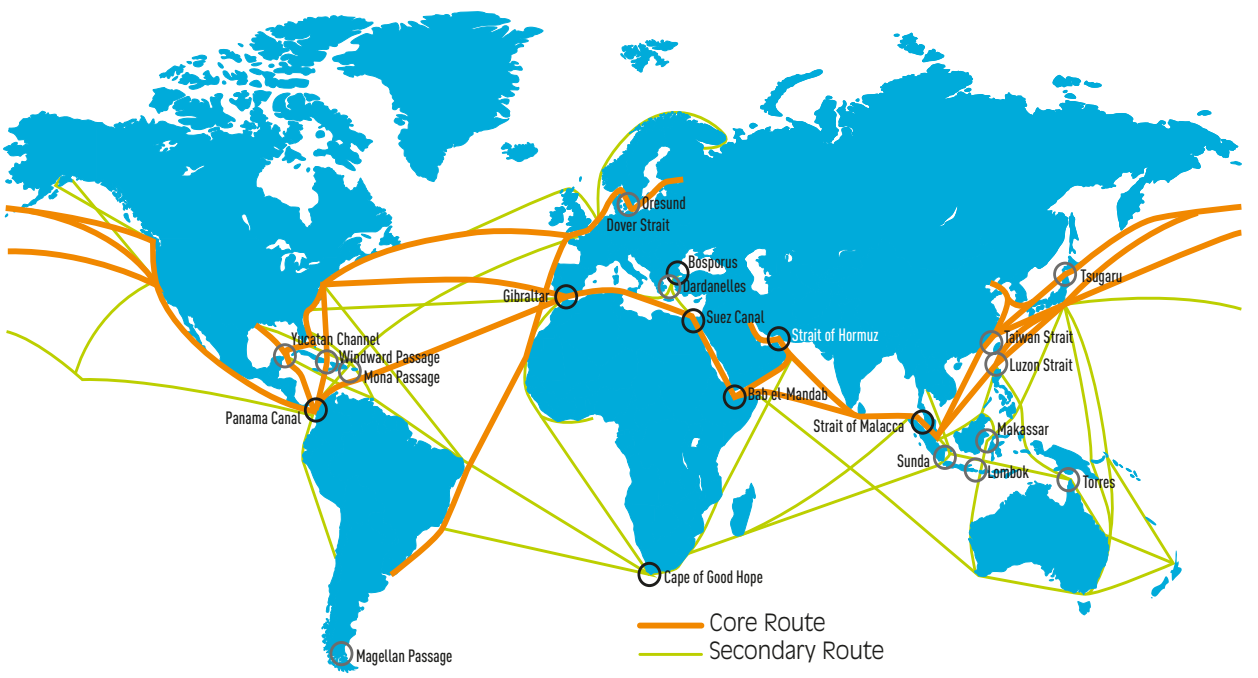


Figure 106 - Main Maritime Shipping Routes
(Source: Rodrigue, 2017)

[55] https://www.transportenvironment.org/what-we-do/aviation
[56] Trans-shipment is the transfer of goods (containers) from one carrier to another or from one mode to another.

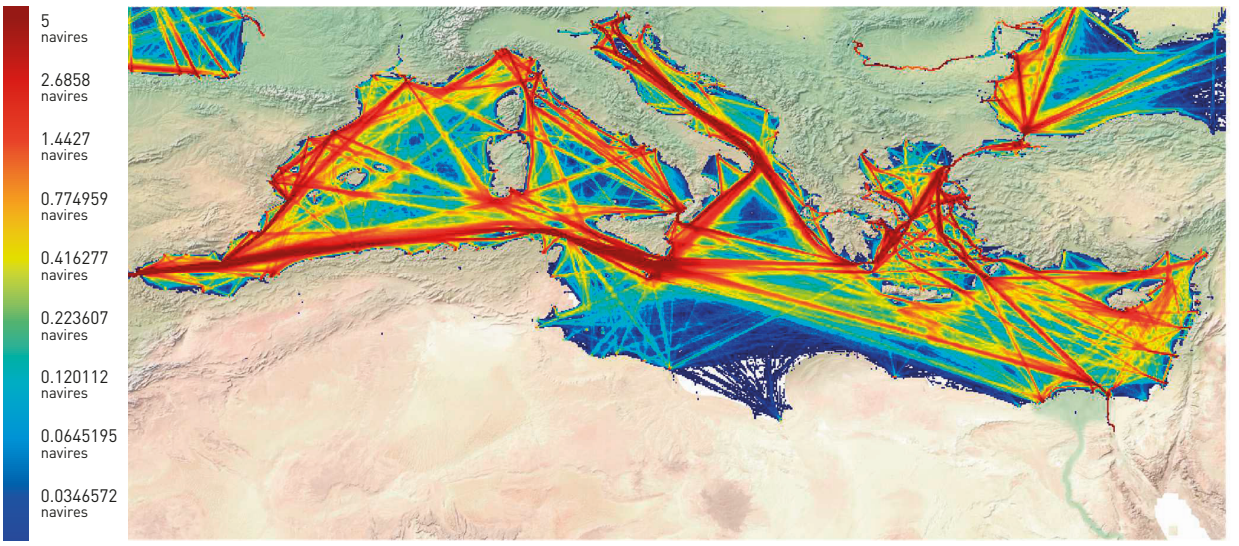


Figure 107 -Traffic density in the Mediterranean Sea Area
(Source: INERIS, 2019)

international shipping. It is also a busy traffic area due to Mediterranean seaborne traffic (movement between a Mediterranean port and a port outside the Mediterranean), and short sea shipping activities (connecting two Mediterranean ports).
In terms of connections with the rest of the world, Europe (European port calls) is by far the main shipping connection for the Mediterranean, receiving around 40-50% of total extra-Mediterranean traffic (from ports outside the Mediterranean) (Arvis et al. 2019), as shown in the *Figure 108*.

The proportion of intra-Mediterranean traffic in total Mediterranean traffic rose from 49% in 2009 to around 58% in 2016. This increase was attributable to the growth of either trans-shipment or coastal or short sea shipping (Arvis et al. 2019).

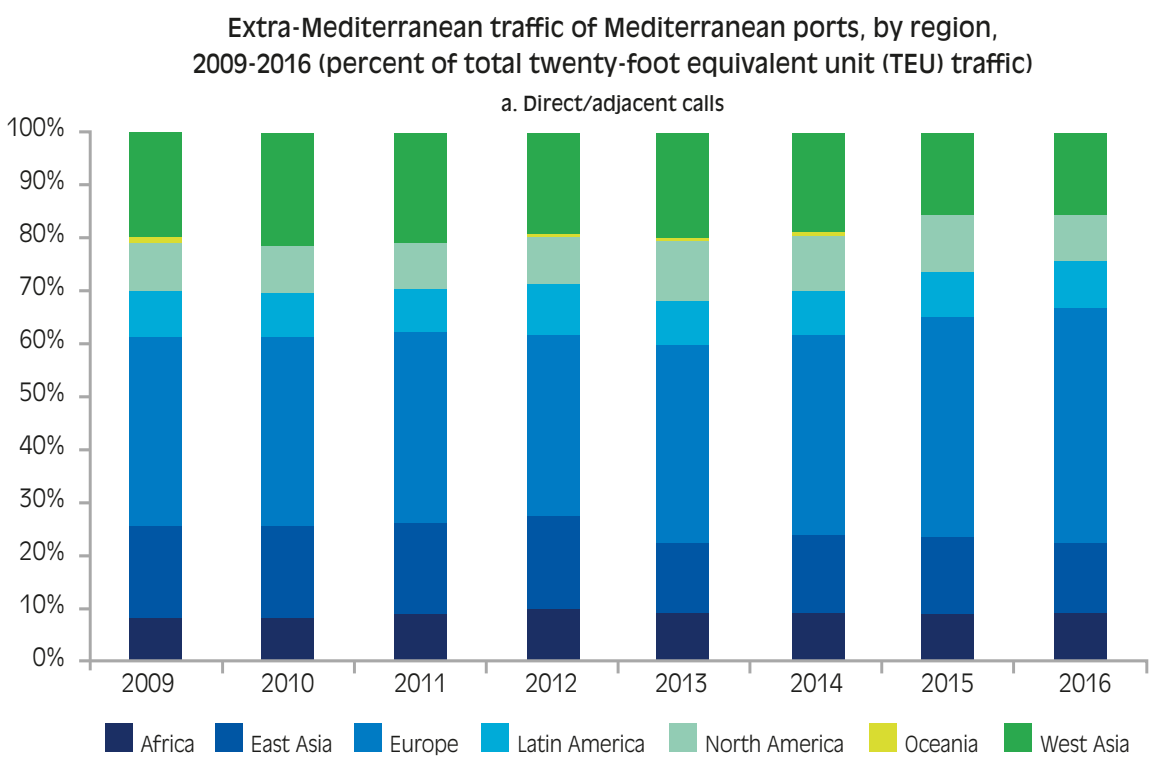


Figure 108 - Traffic density in the Mediterranean Sea Area
(Source: Arvis et al. 2019)

Oil transport: The Mediterranean is host to major oil transportation lanes, notably with oil shipments through 2 of the 6 major oil chokepoints worldwide. These are (i) the Suez Canal / SUMED Pipeline with 5.4 million barrels per day of crude oil and petroleum in 2015, equivalent to approximately 9% of the world's seaborne oil trade, and (ii) the Turkish Bosporus and Dardanelles straits with 2.4 million barrels per day of crude oil and petroleum products in 2016 (US Energy Information Administration, 2017). Together, the Suez Canal / SUMED Pipeline and the Turkish straits accounted for 13.24% of the world's seaborne oil trade in 2015.

A fast-emerging cruise industry: The Mediterranean region has seen a significant and rapid rise in cruise ship movements over the past two decades: the number of individual cruise passengers in 2017 was almost 26 million, more than double compared to 2006, with 12 million cruise passengers (MedCruise Association, 2018). Today, the region stands as the second biggest cruising region in the world (15.8% of global cruise fleet deployment in 2017 (MedCruise Association, 2018)), after the Caribbean. Because of this continuous growth, ports are facing the challenge of providing proper infrastructure to accommodate large cruise ships and upgraded facilities to be able to accommodate an ever-growing number of cruise passengers as well as to collect and dispose of related waste.

Ports accommodating more than 120,000 cruise passengers each year are considered major ports. 36 ports in the Mediterranean fall under this category, 25 of which are located in the Western Mediterranean area, 7 ports in the Adriatic and 4 ports in the Eastern Mediterranean area. Ports with fewer than 120,000 cruise passengers in 2017 include 15 Western Mediterranean ports, 11 Eastern Mediterranean ports and 6 ports located in the Adriatic (MedCruise Association, 2018).

For three years in a row, Mediterranean cruise ports hosted, on average, more than 2,000 cruise passengers per cruise call *(Figure 110)*. The increase from previous years is an indication of the continuous increase in the cruise shipping business in the Mediterranean region, but also of the increase in size of cruise vessels sailing in the Mediterranean (MedCruise Association, 2018).

BOX 36

Mediterranean countries' fleet by main ship types

(Source: UNCTAD, 2017b)

Capacity of Mediterranean coastal States' fleet (2017, in dwt)	Capacity in dwt	Mediterranean / World (~%)
Total capacity	248,304	13%
Oil tankers	92,771	17%
Bulk carriers	103,764	13%
General cargo ships	7,688	10%
Container ships	25,923	11%

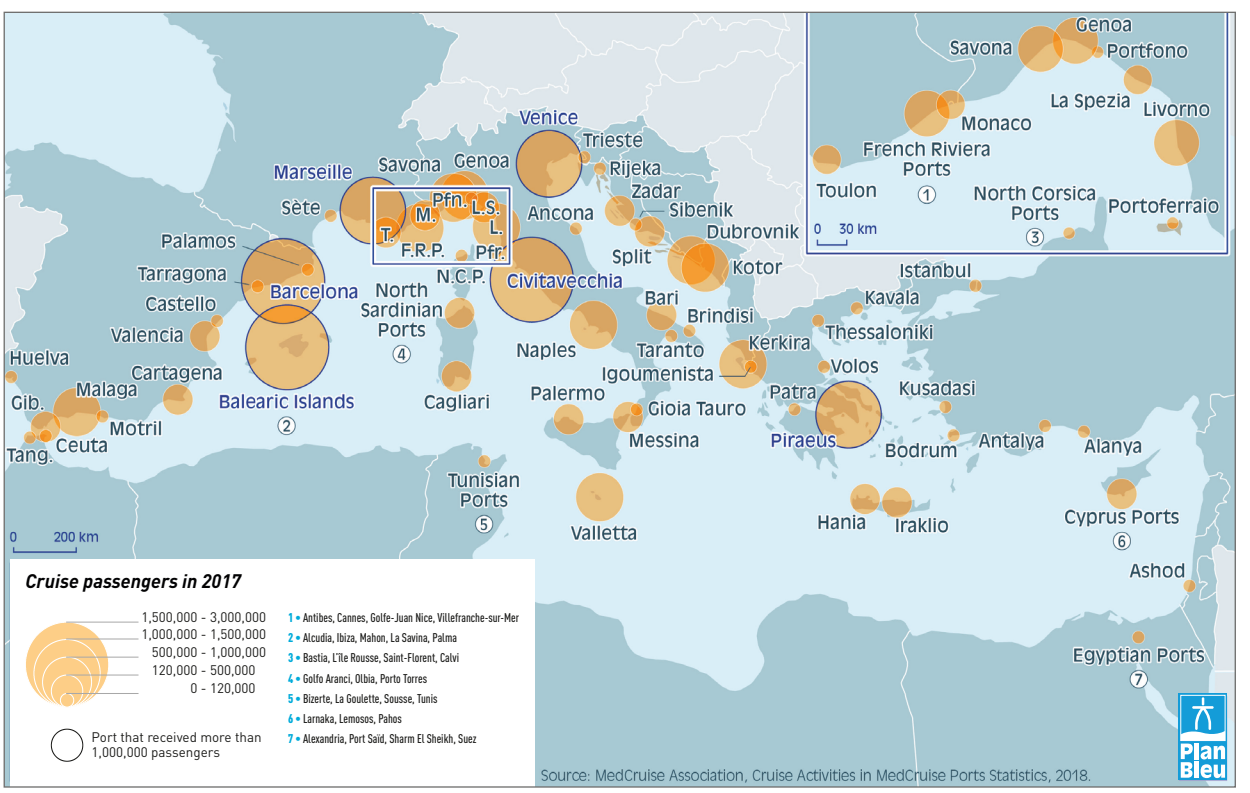


Figure 109 - Cruise passengers per cruise call in the Mediterranean, 2017
(Source: MedCruise Association, 2018)

4.5.3.2 Pressures on the environment

Increasing shipping and maritime activities are significant drivers for anthropogenic pressure on the marine environment in the Mediterranean Sea. Pressures from maritime transport essentially include: potential **accidental and illicit discharges** of oil and hazardous and noxious substances (HNS); **marine litter; water discharge and hull fouling; air emissions** from ships; **underwater noise; collisions** with marine mammals; **land take** through port infrastructure; and **anchoring.** While accidental pollution and operational oil discharges have historically been the focus and appear to be under control due to a series of technical and regulatory measures implemented over the past two decades, marine bio-invasions, air pollution from ships and marine litter are today emerging as the three more pressing environmental challenges. Recently, underwater noise and marine mammal disturbance have been the subject of increasing international attention and action. See *Figure 114* for an illustrative summary of the interaction of pressures with the marine and coastal environment.

61% resulted in a spillage of less than 1 tonne (REMPEC, 2014). In the Mediterranean, the quantities of HNS accidentally spilled considerably decreased during the 1994 - 2013 period. Since 2003, the release of HNS has become insignificant compared to the 1994 - 2002 period. According to the findings of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), shown in *Figure 111*, the majority of incidents occurred in the Eastern Mediterranean area (REMPEC, 2014).

Oil spills and other hazardous substances lead to the reduction of plankton and physical damage to fish stocks, marine mammals and birds, resulting in general population decline[57].

For an effective response to accidental discharges, countries should agree to adopt the recommendations set forth by the International Council on Clean Transportation (ICCT), UNEP/MAP and the EEA concerning the design of new engines and vessels as well as the use of cleaner fuels and onboard pollution control facilities (Abdulla & Linden, 2008).

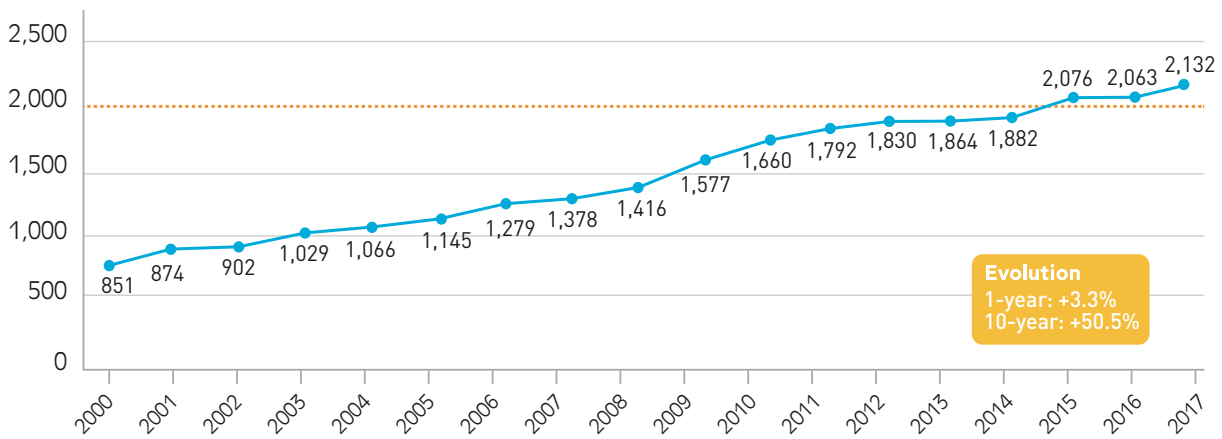


Figure 110 - Average number of cruise passengers per cruise call in the Mediterranean, 2000-2017
(Source: MedCruise Association, 2018)

Accidental and illicit discharges: Incident rates, especially incidents involving oil, have decreased globally, including in the Mediterranean, despite a steady increase in oil and other cargo volumes transported by ship. This can be attributed to the adoption and implementation of international maritime conventions addressing the safety of transportation as well as preparedness and response to accidents, following the Torrey Canyon oil pollution disaster in 1967. Between 1 January 1994 and 31 December 2013, approximately 32,000 tonnes of oil were released into the Mediterranean Sea as a result of incidents. The number of incidents involving oil spills as a proportion of the total number of incidents dropped from 56% for the 1977 - 1993 period to 40% for the 1994 - 2013 period. Of these incidents,

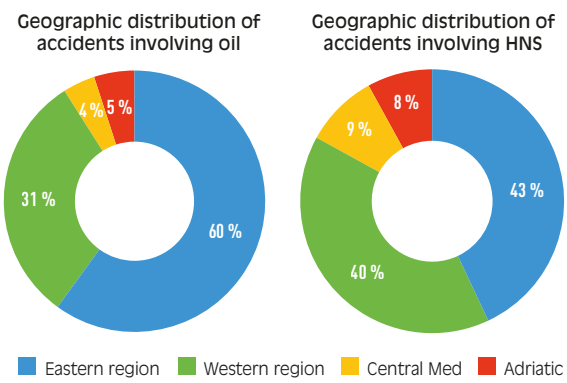


Figure 111 - Geographical distribution of accidents
(Source: REMPEC, 2014)

[57] www.oilspillresponseproject.org/wp-content/uploads/2017/01/Impacts_on_marine_ecology_2016.pdf, pp.15, 16 & 30

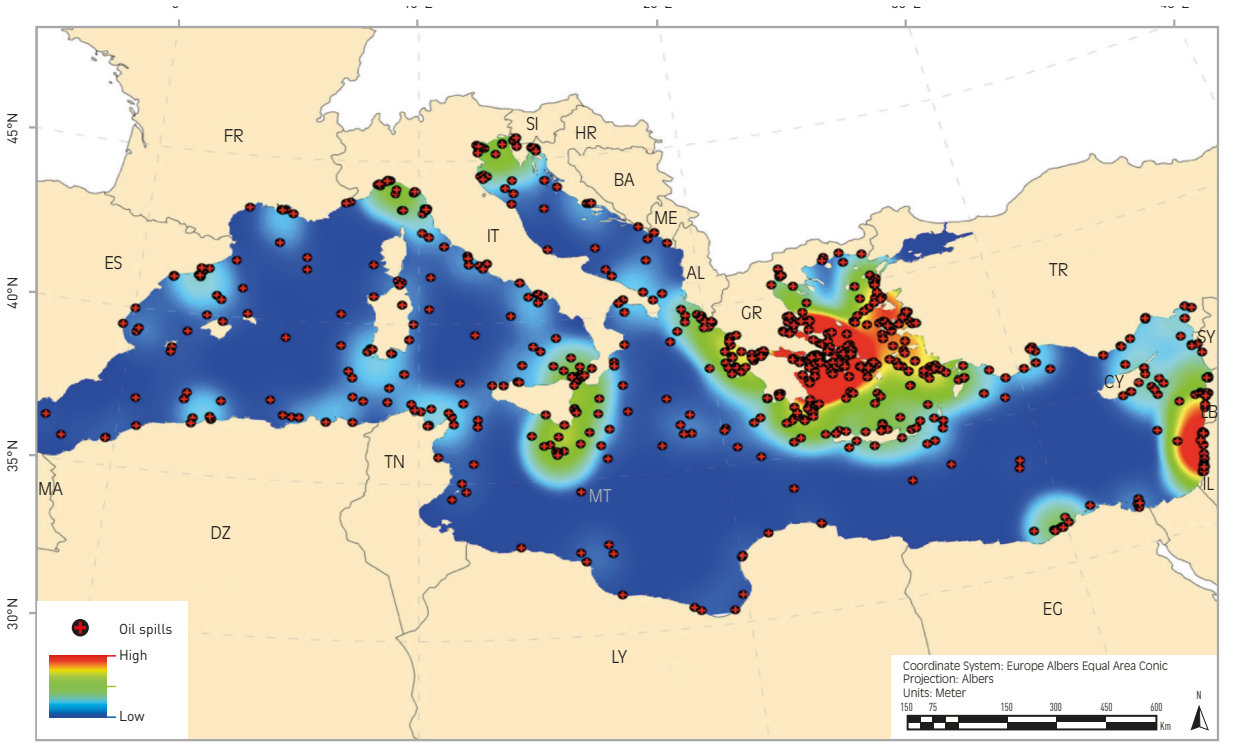


Figure 112 - Main oil spills in the Mediterranean Sea 1977-2017
(Source: Polinov, 2018 from REMPEC data)

Furthermore, sustained efforts to control illicit oil pollution discharges from ships are needed. Strict discharge regulations as well as the introduction of mandatory equipment and management procedures (required under MARPOL) have addressed operational discharges from ships, such as sewage, garbage and cargo residues. However, illicit ship pollution discharges of oily water remain an issue, although increased regional cooperation for ship surveillance, data sharing, prosecution and Port State Control have proven effective. It is expected that sustained efforts and cooperation among Mediterranean States to promote better enforcement will help minimize the occurrence of illicit ship pollution discharges.

Marine litter: Although most marine litter in the Mediterranean originates from land-based sources, commercial fishing has been recognized as a sea-based source of litter, particularly fishing gear (UNEP/MAP, 2015). Litter from fisheries, such as nets, depletes fish stocks by continuously capturing fish (ghost fishing), and can also result in the transfer of NIS. Responses should focus on introducing mandatory measures concerning onboard litter management.

Ballast water released at sea and hull fouling facilitate the transportation and proliferation of NIS, over 1,000 of which are established in the Mediterranean, with the greatest impact felt in the Eastern Mediterranean (UNEP/MAP, 2017a). NIS negatively impact the environment through predation and competition upon native species (Chapter 3). The primary responses to tackle NIS from ballast water is the 2017 IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention). On the other hand, the most relevant international response to reduce biofouling is the IMO voluntary GloFouling Partnerships project. Overall, responses focus on the adequate management of ballast water and the periodic maintenance of hulls.

Air emissions from ships: Shipping activities have increased significantly over the last century and, as such, are a known contributor to the global emissions of air pollutants and greenhouse gases. Ship emissions contain toxic gases and particulates like sulphur oxides (SOx) and nitrogen oxides (NOx). When released into the atmosphere, these have adverse effects on human health and cause acidification of soil and the aquatic environment, impairing the life of fauna and flora. Greenhouse gas emissions lead to ocean acidification, sea level rise and temperature rise. Greenhouse gas emissions from ships, particularly carbon dioxide (CO_2), contribute to climate change. According to the third greenhouse gas study published by the IMO in 2014, shipping accounted for 2.2% of global CO_2 emissions in 2012 (IMO, 2015). A recent study published by the International Council on Clean Transportation (ICCT) shows that shipping's contribution to global CO_2 emissions has increased slightly (2.6% in 2015) (Olmer et al. 2017). Predictions indicate that by 2050, these emissions could grow by 50 to 250%, depending on economic growth and energy developments (IMO, 2015). The ecosystems of the Mediterranean Sea are specifically vulnerable to climate change and require urgent emissions reductions. The forthcoming application of IMO global regulations establishing a sulphur cap in 2020 is expected to curb air emissions by promoting low-sulphur and alternative fuels and energy. Further responses should

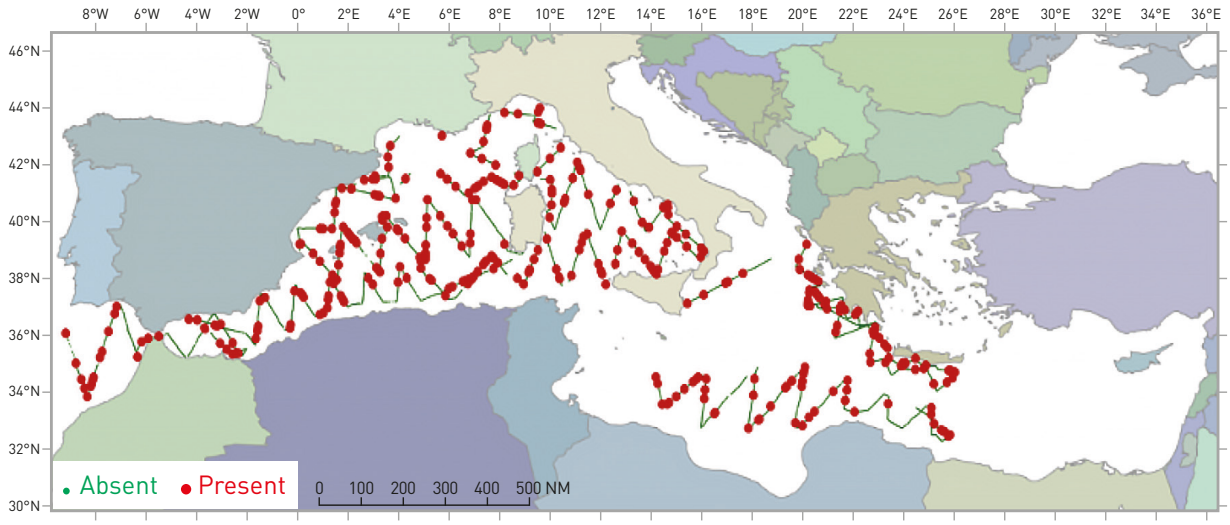


Figure 113 - Passive acoustic surveying - anthropogenic noise: shipping
(Source: ACCOBAMS, 2018)

include the adoption of ambitious emission reductions with the upscale of transport powered by renewable energies and robust carbon taxes.

Underwater noise: As sound travels four times faster in water than in air, it affects the communication, behaviour and overall health of marine species that are reliant on sound to survive, most notably cetaceans. Shipping is a significant source of underwater noise, which is mainly generated by propeller cavitation and on-board machinery (Nolet, 2017). The Mediterranean Sea is one of the world's busiest waterways and is deeply affected by underwater noise. Given the significance of shipping traffic in the Mediterranean Sea, several attempts have been made to predict or assess noise levels from vessels in the region. A recent study published by ACCOBAMS[58] has identified and mapped several areas of high anthropogenic pressure in the Mediterranean region (noise hotspots)[59], including noise from shipping and port activities (Maglio, Pavan & Castellote, 2016). Initial data from the ACCOBAMS survey illustrates that underwater noise from shipping is considerably more abundant in the Western Mediterranean, although the coast of Greece is also a significant hotspot (ACCOBAMS, 2018).

The most relevant impacts of underwater noise are behavioural changes, such as feeding and mating, which lead to population decrease; as well as physical damage, such as the rupture of tissues and organs that can lead to death (Hawkins & Popper, 2016).

Despite the fact that many agreements acknowledge the issue of underwater noise, such as the Barcelona Convention, the GFCM, and ACCOBAMS, no relevant response has led to the effective adoption of minimum standards for quieting technologies nor speed limits to reduce underwater noise.

Collisions with marine mammals: Around 220,000 vessels of over 100 tonnes cross the Mediterranean Sea every year, often navigating on autopilot day and night. Such vessels pose a significant risk of collision to marine mammals, specifically cetaceans that spend long periods of time at the surface (Panigada et al. 2006). A collision between a ship and a marine mammal can be caused directly by a ship crossing paths with a mammal in motion, but it

BOX 37

Potential impacts of underwater noise on marine animals

(Source: Hawkins & Popper, 2016)

Impact	Effects on animal
Mortality	Death due to damage from sustained noise
Injury to tissues	Injury of gas-filled organs, such as the swim bladder; internal haemorrhaging, etc.
Damage to the auditory system	Rupture of hearing organs
Masking	Masking of sounds essential for species survival
Behavioural	Interruption of feeding, schooling, spawning, migration, etc.

[58] Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS).
[59] Activities considered: commercial and recreational marine traffic, harbour activities, commercial and scientific seismic surveys, oil and gas drilling activities, wind farm projects, military exercises.

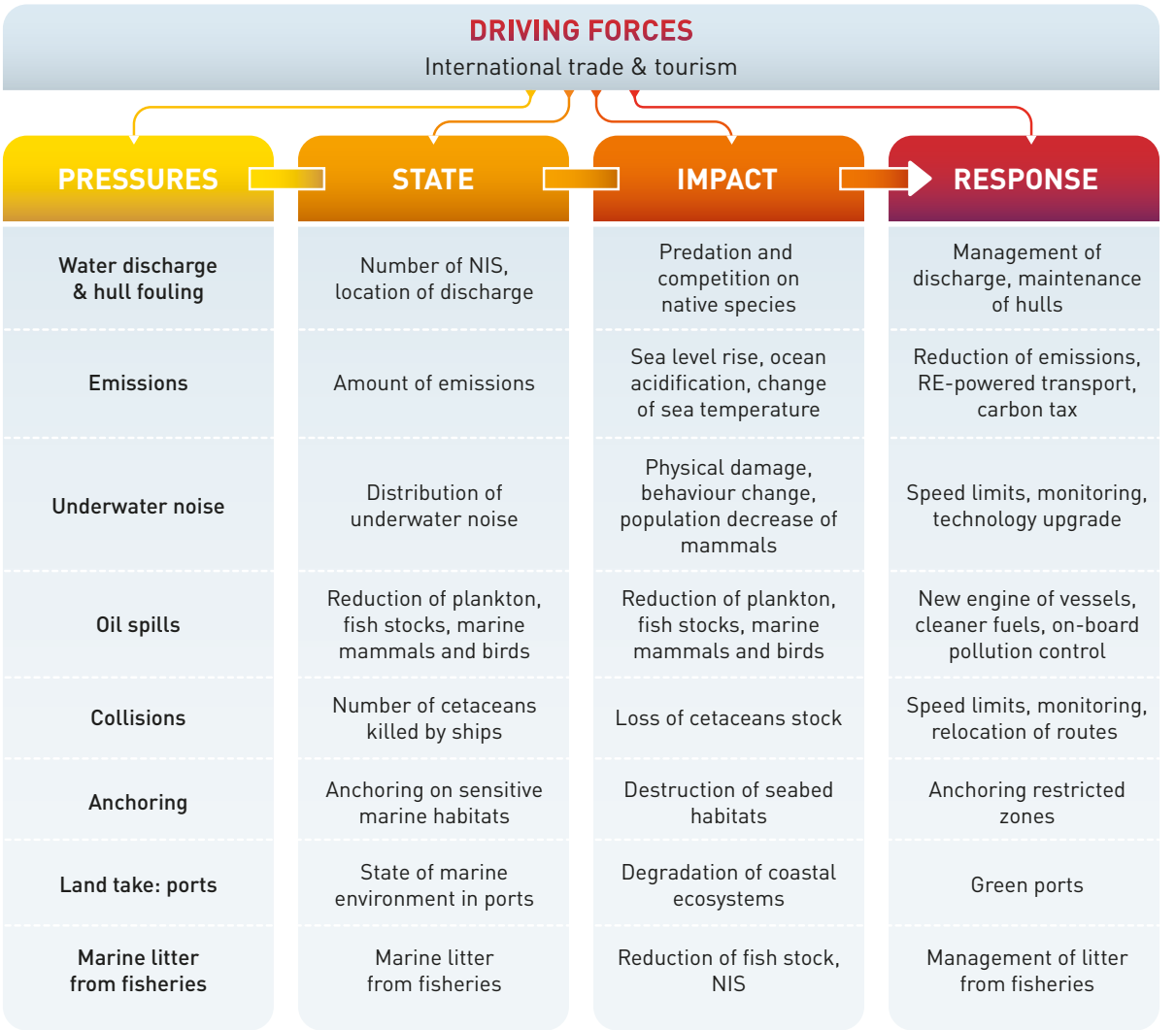


Figure 114 - Pressures exerted by maritime transport on the marine environment

can also be caused by underwater noise from shipping activities, acting as sound masking, which interferes with mammals' communication and echolocation (Gerstein, Blue & Forsythe, 2006; Nolet, 2017). The risk of collision between ships and marine mammals is high in some parts of the Mediterranean Sea where there is intense shipping traffic (IUCN, 2012). Areas of particular risk for collision with cetaceans are the central part of the Ligurian Sea, areas off the Provencal coasts (Alleaume & Guinet, 2011) and the southern area of the Pelagos Sanctuary, the only pelagic Marine Protected Area (MPA) for marine mammals in the Mediterranean Sea (Pennino et al. 2017). The quantitative data available shows that ship strikes killed 16% of carcasses found between 1971 and 2000 (Panigada et al. 2006). Studies also suggest that most strikes are unreported, and some indicate that ship strikes in Greece are responsible for 60% of whale deaths.[60] Hence, collisions with cetaceans can lead to a significant reduction of the cetacean population. Responses should focus on a basin-wide conservation strategy, including real-time monitoring of cetacean presence, the relocation of ferry routes, and reducing ship speed in high-density cetacean areas.

Land take due to port infrastructure: Depending on the location, construction and operation of a port, it will imply modifications to water quality, coastal hydrology, and marine and coastal ecology, leading to the degradation of coastal ecosystems due to bottom-sediment contamination. Authorities should minimize the impacts of the land-use change caused by port infrastructure by turning existing ports into green ports and building new port infrastructure based on environmental impact assessments.

Anchoring has a significant impact on keystone species present on the sea floor, such as Posidonia oceanica, and can therefore lead to the destruction of seabed habitats. As a response, some local authorities, such as Port Cros, France, have introduced anchoring restriction areas, especially in zones designated as environmentally sensitive (Abdulla & Linden, 2008).

[60] https://www.theguardian.com/environment/2018/may/27/shipping-routes-move-save-whales-greek-seas-dying-agony

4.5.3.3 Are we moving towards a green and blue economy?

Shipping and the UN Sustainable Development Goals (SDGs): Compared to road, rail and aerial modes of transportation, shipping is a low-cost, energy-efficient and safe mode of transport. As such, it has an essential role to play in achieving sustainable development and reaching the UN Sustainable Development Goals (SDGs) and targets to promote economic prosperity, while protecting the planet. IMO has established clear links between its work and the SDGs. The shipping industry has also embraced sustainable development by participating in the UN Global Compact initiative, a UN-led corporate sustainability movement in support of achieving the SDGs by 2030, and mapping opportunities in the sector to contribute to the SDGs (DNV-GL, 2017).

Ocean management: Marine Spatial Planning (MSP) provides a framework for arbitrating between competing marine human activities, including shipping, and managing their impact on the marine environment. The work achieved for the ongoing conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction (BBNJ) through the development of a new legally-binding instrument under the United Nations Convention on the Law of the Sea (UNCLOS) is certainly relevant to fill in the gaps in the management and use of biodiversity beyond national jurisdiction. This work is expected to conclude in 2020.

Port reception Facilities: In the Mediterranean, ahead of the adoption of the IMO action plan to address marine plastic litter from ships in 2018, sustained work has been carried out over the past decade to address ship-generated waste. First, by prohibiting any discharge of garbage - under the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V special-status and oily waste, in accordance with MARPOL Annex I, into the Mediterranean Sea. Second, by promoting the availability of port reception facilities so that ships can dispose of their waste on shore for subsequent collection, processing, if needed, and final disposal. Third, following the adoption in 2013 of the Regional Plan on Marine Litter Management in the Mediterranean, by promoting, within the framework of the EU-funded "Marine Litter-MED" Project, the application of charges at reasonable costs or, where applicable, a No-Special-Fee system for the use of port reception facilities by ships calling at Mediterranean ports - whether or not they use port reception facilities. This is in line with the EU Directive 2000/59/EC (Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues) applicable to EU ports. As shown in the *Figure* below, some EU ports in Mediterranean countries use a cost recovery system, either based on administrative fees (ADM) that are partly established based on the amount of waste delivered, or a Non-System Fee that is charged to ships irrespective of their use of facilities, or direct fees that are only established based on the volumes of waste discharged.

Operational cooperation to address illicit discharges from ships in the Mediterranean: Cooperation among Mediterranean countries is key to coherently and effectively address illicit discharges from ships in the region. In recent years, joint work has included coordinated aerial surveillance operations and reporting, as well as agreeing on common methods for collecting, recording and documenting evidence. A Mediterranean Network of Law Enforcement Officials (MENELAS), relating to MARPOL within the framework of the Barcelona Convention was established in 2015 and an information system made available (http://www.menelas.org/). The challenge is to engage all Mediterranean countries in operational cooperation, which is subject to the availability of expertise and funding.

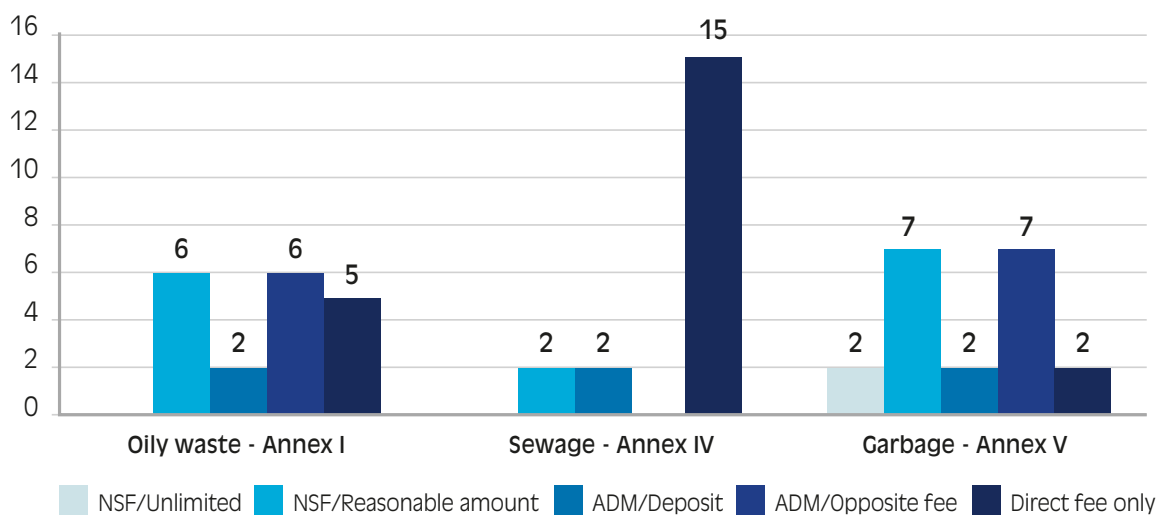


Figure 115 - Types of fee systems used in EU ports located in the Mediterranean region
(Source: UNEP/MAP, 2018)

Alternative fuel type	Potential CO_2 emission reductions
Advanced biofuels	25-100%
LNG	0-20%
Hydrogen	0-100%
Ammonia	0-100%
Fuel Cells	2-20%
Electricity	0-100%
Wind	1-32%
Solar	0-12%

Table 21 - Alternative fuels and potential energy and corresponding CO_2 emission reductions
(Source: OECD/ITF, 2018a)

Alternative fuels and energy: There are emerging promising alternative fuel and energy options for potential greenhouse gas emission reductions *(Table 21)*. Although not all of these alternatives are mature or readily available on the market, ships are increasingly looking at these, especially for new builds or retrofitting. The 2020 sulphur cap, which will reduce the permitted sulphur content in ship fuel from 3.50% to 0.50%, will increase maritime transport costs. This, in turn, will increase the attractiveness of lower-carbon ships and alternative fuel types such as LNG-powered ships.

Knowledge gaps. Integrated maritime data with a specific focus on the Mediterranean Sea remains scarce. Economic and shipping data (such as UNCTAD data or Eurostat data and other databases and data analysis) often fail to consider the Mediterranean as a whole. In most cases, Mediterranean coastal States are distributed between different geographical groups (Europe; Africa; Middle East) or are classified in groups according to their level of economic development. Another challenge is to keep databases and information systems up to date, given that maritime traffic characteristics (type of cargo transported; number, type and size of ship movements), port infrastructure developments and volumes of goods and passengers calling at ports can vary significantly over the years. There is also a gap in research and studies addressing all sources of pollution from ships and their specific impact on the Mediterranean Sea and coastal ecosystems, as defined in the Barcelona Convention. This lack of knowledge may be a challenge for shaping policy that would adequately address maritime transportation and its interaction with the marine and coastal ecosystems in the region.

4.5.4 Dependency on natural resources and quality of ecosystems

The transport sector is the second largest component in the Mediterranean Ecological Footprint after the food sector, with a share of 22% (Mancini & Galli, 2017). Transportation's footprint in the region is mostly due to the transportation of people (both private vehicles and public transport) in major Mediterranean cities. The higher a city's income level, the higher its ecological footprint, mostly due to the greater use of transportation. This explains why cities such as Tel Aviv, Athens or Barcelona have a larger per capita ecological footprint than their respective countries. In cities with lower per-capita footprints, such as Cairo and Tunis, approximately 14% of the ecological footprints are due to transportation, compared to 25% in cities with the largest values, such as Athens and Barcelona. The transport sector is also strongly dependent on public services and policies as well as personal behaviour. Countries with a well-functioning public transport network can lower the sector's resource requirements, allowing households to depend less on private cars (Mancini & Galli, 2017).

Therefore, two conflicting dynamics are taking place in Mediterranean cities (Mancini & Galli, 2017). Cities concentrating investment are able to maximize resource and energy efficiency, contributing to a lower dependency on natural resource availability and a smaller per-capita footprint. Cities also permit an increase of wealth per capita and lifestyle improvements, which increase the demand for resources, dependency on the quality of ecosystems and pressures on natural resources. In order to understand the dependency of Mediterranean cities on natural resources and the quality of ecosystems it is essential to understand the trade-offs between these two dynamics (Mancini & Galli, 2017).

Since the beginning of the 20th century, the development of different means of transportation in Mediterranean countries required and mobilized an exponential quantity of resources, leading to a growing total energy use (Brun, Blanc & Otto, 2016). As an energy intensive sector, until now, transport has depended mainly on fossil fuels and has required the massive use of natural resources at every stage of production and delivery in order to satisfy human requirements and all three types of transportation (terrestrial, aerial and maritime), with infrastructure building, cars and other transport industries, oil, petrol or gas for transport operation, etc. (Brun, Blanc & Otto, 2016).

According to estimates from the International Energy Agency (2014), by 2040, global energy demand will increase by 37% and be equally divided into four components: oil, gas, charcoal and low-carbon emission energy sources (Brun, Blanc & Otto, 2016). As transport is the second largest driver of the Mediterranean region's ecological footprint and is constantly growing in size and value, its dependency on natural resources is likely to increase if national and regional stakeholders fail to prevent an unsustainable allocation of resources. For instance, total maritime traffic is expected to grow with the future implementation of 'Motorways of the Sea', which is part of the Trans-European Transport Network, implying a considerable increase in the volume of traffic in the Euro-Mediterranean region (Brun, Blanc & Otto, 2016).

4.6 Industries and mining of non-living resources

The Barcelona Convention specifies in its 1995 version of Article 7 that "the Contracting Parties shall take all appropriate measures to prevent, abate, combat and to the fullest possible extent eliminate pollution of the Mediterranean Sea Area resulting from exploration and exploitation of the continental shelf and the seabed and its subsoil" (Amendments to the Barcelona Convention, 1995). This implies that activities by marine biotechnology industries and the mining of non-living resources represent a central challenge to sustainable development if not properly monitored and regulated. This sector also constitutes a major stake in scientific and technological cooperation (Article 11) in the Mediterranean.

4.6.1 Marine biotechnology industries

4.6.1.1 Overview of the sector

Bioprospecting is defined as *"the search for interesting and unique genes, molecules and organisms from the marine environment with features that may be of benefit for society and have value for commercial development"* (UfM, 2017). It has the potential to make a significant contribution to green growth in many industrial sectors through multiple applications in medicine, food, materials, energy and cosmetics. Since many microbial species are still unknown, bioprospecting has a huge potential, and developing this sector could help address major global challenges (UfM, 2017).

There is little statistical data on the global development of marine biotechnology industries, and even less regarding the Mediterranean region specifically (UfM, 2017). It has been estimated by the European Union that the sector may be producing a Gross Value Added (GVA) of EUR 1 billion in European waters, although there are no statistical databases that back up these estimations (UfM, 2017).

On the other hand, a report tried to define the value of bioprospecting, and estimated that the size of the European blue biotechnology sector in 2012 represented approximately EUR 302 - 754 million in revenue (Ecorys, 2014). If market growth of 6-8% per annum is maintained, revenue from this sector in Europe should reach EUR 1 billion by 2020, which would result in the creation of 10,000 jobs (Ecorys, 2014). There is no data on the economic value of the blue biotechnology market (GDP contribution) nor on public funding of R&D (UfM, 2017).

Patent claims regarding marine organisms in the Mediterranean are mainly in European countries, as shown in the following graph. Israel and Turkey are the only non-European Mediterranean countries where patents were registered during the 1991-2009 period.

Over 50% of the European patents are related to health, followed by cosmetics, genetics and food, with fewer patent

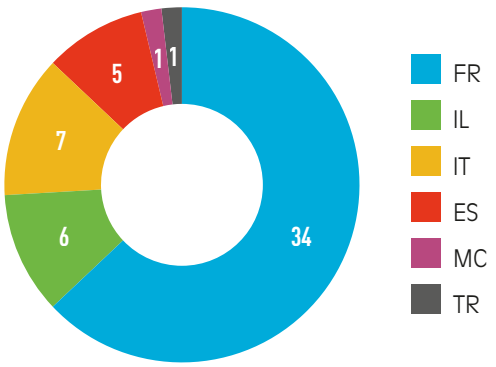


Figure 116 - Number of bioprospecting patent claims on marine organisms in Mediterranean countries
(Source: eco-union & Plan Bleu, 2017b)

claims in energy and aquaculture (Plan Bleu, 2017b). Due to the small number of patent claims, it can be assumed that this sector implies low employment, but the jobs created are probably highly qualified. Ecorys estimated that the number of employees in the Blue Biotechnology sector in Europe could range from 11,355 to 39,750 (Ecorys, 2014). These numbers are expected to grow in the next decade as the Mediterranean region has been identified as a region with high endemic potentialities, especially as the Mediterranean is rich in species with the highest potential for application (sponges, extreme microorganisms) (Ecorys, 2014).

4.6.1.2 Environmental impacts

Since there are very few marine resources currently extracted by the activities of biotechnology industries, the environmental impact of bioprospecting is estimated to be low (UfM, 2017). In the longer term, the potential impacts are rather unclear due to the immaturity of this sector. If bioprospecting undergoes significant development, there could be risks of biological contamination and the overexploitation of organisms in the Mediterranean Sea (UfM, 2017).

4.6.1.3 Are we moving towards a green and blue economy?

The Mediterranean Sea has considerable potentialities for bioprospecting, especially due to its diverse environments shifting from extremes such as thermal or sulphur vents and hypersaline intrusions at depths of 2000 metres or more, which are considered of great value for Blue Biotechnology (UfM, 2017). Nevertheless, the cost of prospecting in such deep environments is extremely high (UfM, 2017). To foster bioprospecting in the Mediterranean area, several channels can be explored (UfM, 2017):

- Increase coordination between academic and industry partners through common projects;
- Facilitate public investment in R&D in order to increase knowledge on the ecology of marine species and organisms;

- Develop a regulatory framework that secures intellectual property rights and monitor social and environmental impacts;
- Elaborate regional policies on marine biotechnology development.

If this sector is to develop, it should implement policies and regulations to control its activities, especially by applying the precautionary principle. This sector, if regulated, could therefore enable the achievement of SDG 14.2 *"By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans".*

4.6.2 Deep-sea mining

4.6.2.1 Overview of the sector

According to the OECD, marine and seabed mining are "the production, extraction and processing of non-living resources in seabed or seawater" (OECD, 2016). Three types of deposits containing minerals, such as copper, zinc, indium or gold, can be found in the deep sea, namely polymetallic nodules, polymetallic sulphides and cobalt-rich crusts (UfM, 2017). This type of extraction could help meet the increasing demand for minerals by capitalizing on basins and alleviating the dependency on imported mineral resources. For example, the European economy is more than 90% dependent on imported metals (UfM, 2017). Despite deep-sea mining representing an opportunity, many potential environmental issues remain unknown questioning the sustainability of such a practice.

Until now, no projects have been granted a mining license in the Mediterranean. Apart from the exploration project submitted and granted in 2007 in the Tyrrhenian Sea in Italy, there is no deep-sea activity in the Mediterranean (UfM, 2017). This slow development of deep-sea exploitation can be partially explained by low technological development in the region and the lacking regulatory system (UfM, 2017).

The Mediterranean region seems to have a rather low resource potential for deep-sea mining, attracting fewer investment projects, particularly when compared to other locations such as the Pacific Ocean (UfM, 2017). Researchers seem to remain divided about the profitability of turning to deep-sea mining in the Mediterranean and launching exploration projects. Although studies show that there is a potential for companies working in the oil & gas supply chain to turn to deep-sea mining in Italy, generating high revenue streams (Keber et al. 2017), these activities are not likely to create many jobs (UfM, 2017).

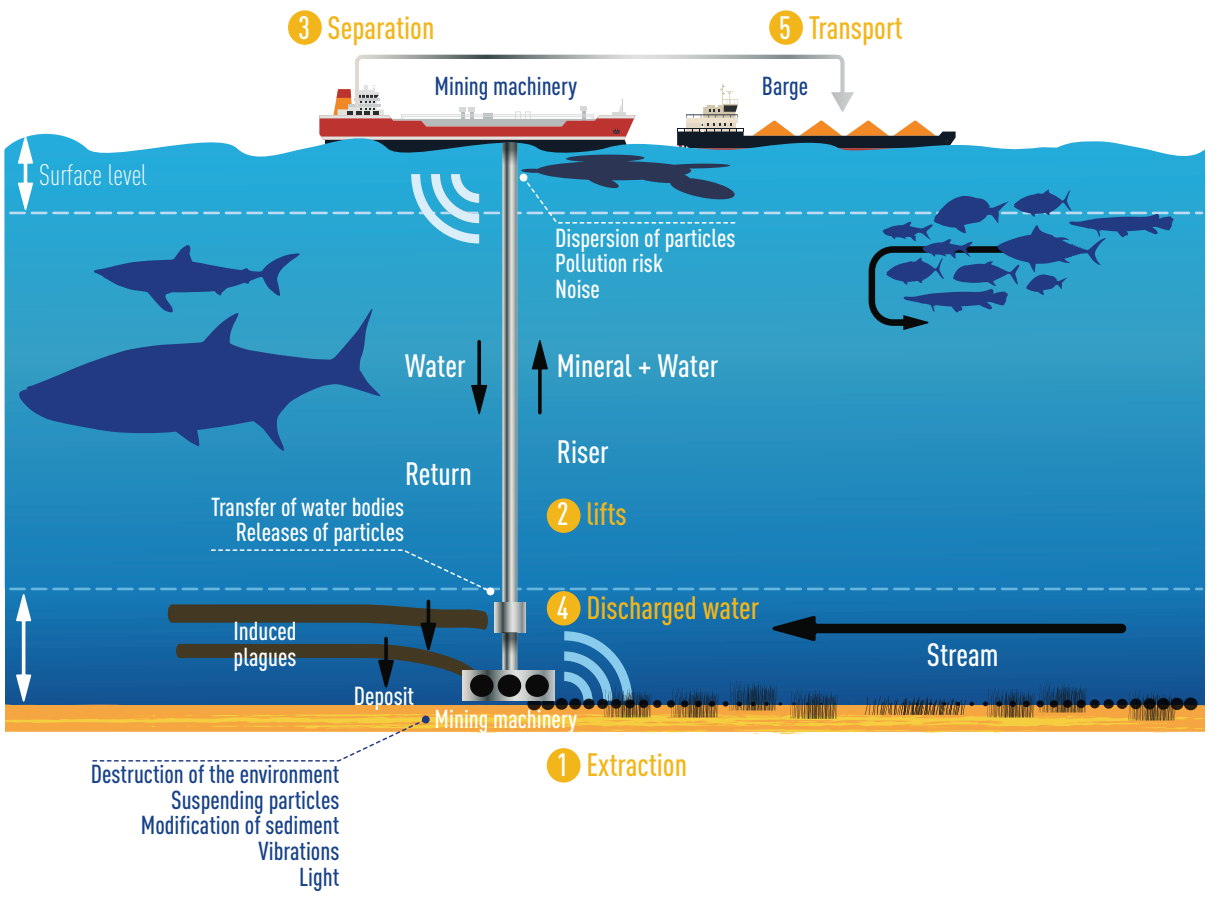


Figure 117 - Environmental impact of deep-sea mining
(Source: Navarre, Lammens & ESG Analysis, 2017)

4.6.2.2 Pressures on the environment

There is little understanding of the potential environmental and social impacts of deep-sea activities given that the state of knowledge regarding deep-water biodiversity remains very low. This is also true for knowledge about the ecosystems' faculty to recover after mining operations and the resulting disruption (UfM, 2017). Deep-sea mining could present similar challenges to offshore oil and gas exploration and production, but is likely to be less damaging to the environment than deep-sea trawling or the consequences of rising temperatures on Mediterranean ecosystems (Plan Bleu, 2017b). According to the UfM report (2017), deep-sea mining could have several harmful environmental consequences, such as *"destroying deep-sea ecosystems, stirring up potentially toxic sediment plumes, impacting species because of the noise, vibration and light induced, or through waste management"*. It could also impact local communities by disturbing fishing or tourism.
These potential harmful environmental consequences are mostly derived from the three main pressures of deep-sea mining on the marine environment: **extractive techniques, underwater noise and light,** and **water discharge.**

Extractive techniques: The different extractive techniques can change the state of seabed habitats by scattering toxic sediment plumes, leading to the destruction of fragile deep-sea ecosystems, which are essential to biogeochemical cycles (Navarre, Lammens & ESG Analysis, 2017).

Underwater noise and light: Deep-sea species have evolved in silence and complete darkness, and are therefore sensitive to noise and light. Consequently, the noise and light from deep-sea mining may result in behavioural changes in seabed species, such as the impairment of sensing food fall (the fall of organic matter that is an essential food source for deep-sea species) (Navarre, Lammens & ESG Analysis, 2017).

Water discharge: Deep-sea mining can affect the environmental state at different depths by releasing water extracted from the seabed. The pollution can thus affect species and degrade the habitats at all depths of the mining area.
Regulations for the emerging deep-sea mining activities should respond by tackling all pressures at once, for example, by designating restricted zones, best practices, as well as minimum standards of noise, light and extractive techniques.
The following *Figure* illustrates the relationship between the pressures of deep-sea mining with its driving forces, impacts, and potential responses, as described above.

4.6.2.3 Are we moving towards a green and blue economy?

From 2013 to 2016, the European Union partly funded the MIDAS[61] (Managing Impacts of Deep-seA reSource exploitation) project to explore the potentialities of deep-sea activities. Its aim was to better identify the potential environmental impacts entailed by deep-sea mining in the Mediterranean and other regions, focusing on the direct impacts caused by mining on the ecosystems on the ocean floor, as well as the impacts of sediment plumes and toxic chemicals released by mining activities (UfM, 2017).

Via this project, more information has been collected on the potential capacity of recovery of ecosystems, including species. Researchers were able to draw up a set of recommendations and essential best practices for ensuring the relative sustainability of the deep-sea mining industry (UfM, 2017). One of the main recommendations suggested the creation of conservation zones where mining activities would be prohibited. Recommendations are being translated into regulations within each European Union Member State for areas located in their Exclusive Economic Zone (UfM, 2017). These recommendations are

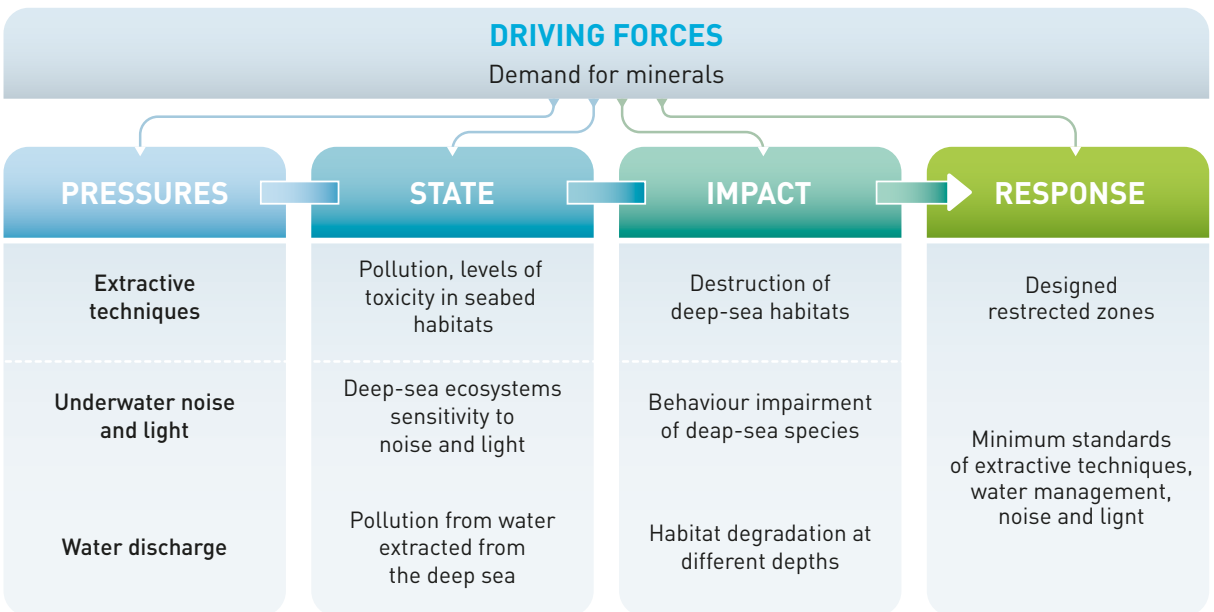


Figure 118 - Pressures exerted by deep-sea mining on the marine environment

being integrated within the regulations of the International Seabed Authority (for international waters located more than 200 miles from a State's baseline) (UfM, 2017).

4.7 Pollution

The main types of pollutants in the Mediterranean are oxygen-depleting substances, heavy metals, persistent organic pollutants (POPs), hydrocarbons, microorganisms, nutrients introduced by human activities and marine litter. The latter source of pollution is discussed in section 4.9. *Figure 119* shows pollution hot spot areas (in red) and areas of major environmental concern (in yellow) (UNEP/MAP, 2012).

Pollutants enter the Mediterranean Sea as land-based sources either via discharge points and dumping grounds (point source pollution) or from surface fluvial run-off (nonpoint source pollution). Pollutants also enter the marine and coastal environment through atmospheric deposition. Other pollutants are derived directly from marine activities such as shipping, mining, and oil and gas exploration. In recent years, emerging pollutants are raising cause for concern.

4.7.1 Eutrophication status

The offshore waters of the Mediterranean have been characterized as extremely oligotrophic with a clear gradient eastward (Turley, 1999). The highly populated coastal zone in the Mediterranean and the riverine input from a draining area of 1.5 10^6 km² (Ludwig et al. 2009) induce eutrophic trends in coastal areas. The main coastal areas in the Mediterranean which are historically known to be influenced by natural and anthropogenic inputs of nutrients are the Gulf of Lion, the Gulf of Gabès, the Adriatic, the North Aegean and the South-East Mediterranean. The coastal area of the South-East Mediterranean is facing eutrophic conditions, mainly caused by sewage effluents from the cities of Cairo and Alexandria. The North Aegean shows mesotrophic to eutrophic conditions that are explained by the river inputs from Northern Greece and inflow from the nutrient-rich Black Sea.

The available data shows that in areas where assessment is currently possible, key nutrient concentrations in the water column fall within ranges that are characteristic of coastal areas and in line with the main processes occurring in the specific area. The assessment based on chlorophyll a concentration in the water column showed that, with only a limited set of data for France, in the Western Mediterranean all stations in the Gulf of Lion were in a less than moderate state. Slovenia, Croatia and Montenegro were assessed in the Adriatic, with all stations showing good environmental status. Cyprus, Israel and the Mersin area in Turkey were also assessed, showing that stations in Cyprus have a good status while Israel and the Mersin area in Turkey have a moderate status (UNEP/MAP, 2017a).

Based on remote sensing, chlorophyll *a* concentrations in the Mediterranean Sea have been modelled by the European Commission's Copernicus Marine Environment and Monitoring Service. The *Figure 120* illustrates the results of this exercise, showing a remarkable East-West difference (decrease in the West and increase in the East) in the Mediterranean and an overall increasing trend of chlorophyll *a* concentrations in the Mediterranean Sea over the past twenty years.
An improvement of data availability would be required in order to establish time series of data capable of determining significant trends. Criteria for reference conditions and boundaries for key nutrients in the water column should be

Figure 119 - Pollution hot spots and areas of environmental concern on the Mediterranean coast
(Source: UNEP/MAP, 2012)

[61] MIDAS project: http://www.eu-midas.net/

determined and harmonized throughout the Mediterranean region, as well as reference conditions for coastal water type and boundaries for chlorophyll *a* concentration in the water column for the Southern Mediterranean region (UNEP/MAP, 2017a).

4.7.2 Contaminants status

The trends and levels of so-called legacy pollutants (e.g. heavy metals, persistent organic pollutants and pesticides), have decreased significantly in the most impacted areas in the Mediterranean Sea after the implementation of environmental measures, but issues remain as described below.

Assessment of key harmful contaminants measured in the relevant matrix shows that acceptable conditions exist for heavy metals (mercury, cadmium and lead) for biota (mussel and fish) in coastal surface marine waters, which are showing levels below the assessment criteria, except for lead in some mussel monitoring areas. These areas correspond to known coastal sites (hotspots). The sediment assessment for heavy metals shows an impact on the coastal benthic ecosystem, especially for total mercury, which should be further investigated and assessed against the assessment criteria, taking into consideration subregional specificities.

Data on petroleum hydrocarbons and persistent organic pollutants (POPs) from the national coastal monitoring networks reporting to the MED POL database show limited data availability with insufficient geographical coverage and quality assurance to allow for proper regional assessment, and mostly non-detected concentrations. There are still, nevertheless, point and diffuse pollution sources releasing both priority and emerging chemical contaminants into the Mediterranean.

Levels of heavy metals (cadmium, mercury, lead) in coastal waters show a more-or-less acceptable environmental status, assessed from bivalves and fish against Background Assessment Concentrations (BAC) and Environmental Assessment Criteria (EAC). For lead, 10% of stations show levels above the set EC maximum concentrations in foodstuff to protect public health for mussel samples. Concerns with regard to heavy metals are found in the coastal sediment compartment for lead and total mercury, indicating an impact from these chemicals. For total mercury, 53% of the sediment stations assessed are above the Effects Range Low value developed by the US Environmental Protection Agency as sediment quality guidelines, used to protect against potential adverse biological effects on organisms.

BOX 38

Eutrophication

Eutrophication is a process driven by the enrichment of water bodies with chemical nutrients, especially compounds of nitrogen and/or phosphorus, leading to increased growth, primary production and biomass of algae, changes in the ratio of nutrients resulting in changes in the ratio of organisms, changes in species composition, water quality degradation, including decreased transparency and oxygen depletion. The consequences of eutrophication are undesirable if they appreciably degrade ecosystem health and/or the sustainable provision of goods and services. These changes may occur due to natural processes; management becomes a concern when they can be attributed to anthropogenic sources. Water bodies are classified according to their level of nutrient loading and phytoplankton growth. Low nutrient/phytoplankton levels characterize oligotrophic water bodies; water bodies enriched in nutrients are characterized as mesotrophic; and water bodies rich in nutrients and algal biomass are characterized as eutrophic. To assess the status of eutrophication under the ecosystem approach, the UNAP/MAP Integrated Monitoring and Assessment Programme (IMAP) combines information on nutrient levels, direct effects (chlorophyll *a* concentration and water transparency) and indirect effects (oxygen concentration). Reference conditions for coastal water types and boundaries between good and moderate status were agreed and adopted in the IMAP for chlorophyll *a* in the Mediterranean, based on the influence of freshwater inputs as the main nutrient drivers.

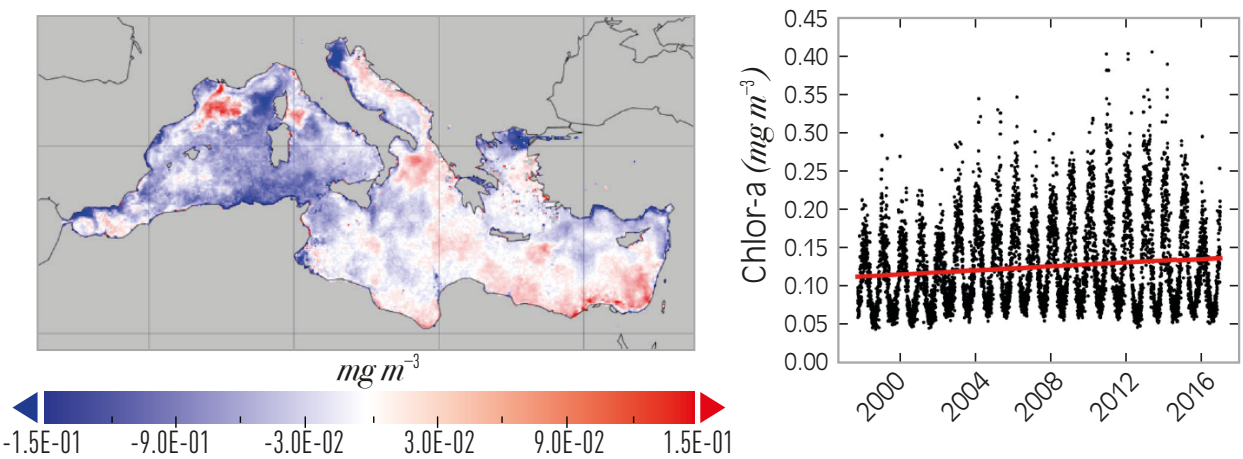


Figure 120 - Chlorophyll anomalies for 2016 compared to the 1997-2014 reference period (left) and regional time series of chlorophyll a in the Mediterranean region, 1997-2016 (right)
(Source: Schuckmann et al. 2018)

Measures and actions should focus on known hotspots associated with urban and industrial areas along the coasts of the Mediterranean Sea, and include sea-based sources, as these are also important inputs. Riverine inputs and coastal diffuse run-off also play an important role (UNEP/MAP, 2017a).

4.7.3 Industrial Pollution

The MED POL National Baseline Budget (NBB) is the reporting tool established by UNEP/MAP to detect changes, including a potential downward trend, in direct and indirect releases of pollutants into the marine environment. The main activities contributing to the emissions of pollutants are wastewater treatment plants, metal production and processing, energy production, pulp and paper processing and production, the chemical industry, intensive livestock production and aquaculture, and other activities (pre-treatment or dyeing of fibres or textiles; tanning of hides and skins; surface treatment of substances, objects or products using organic solvents; production of carbon or electrographite through incineration or graphitization; ship building, painting or paint removal).

Figure 121 shows the total aqueous effluent values per sector for the Mediterranean reported by NBB 2003, 2008, 2013 and the European Pollutant Release and Transfer Register (E-PRTR) 2013. In 2003, the major effluent values reported are from the chemical industry (74% of total industrial releases) and the food and beverage industry (11%). In 2008, the major reported sectors discharging pollutants in their effluents are the paper and wood processing industry (92%) and the chemical industry (74%). In 2013, the major liquid emissions reported are from the chemical industry (66%) and other activities (22%).

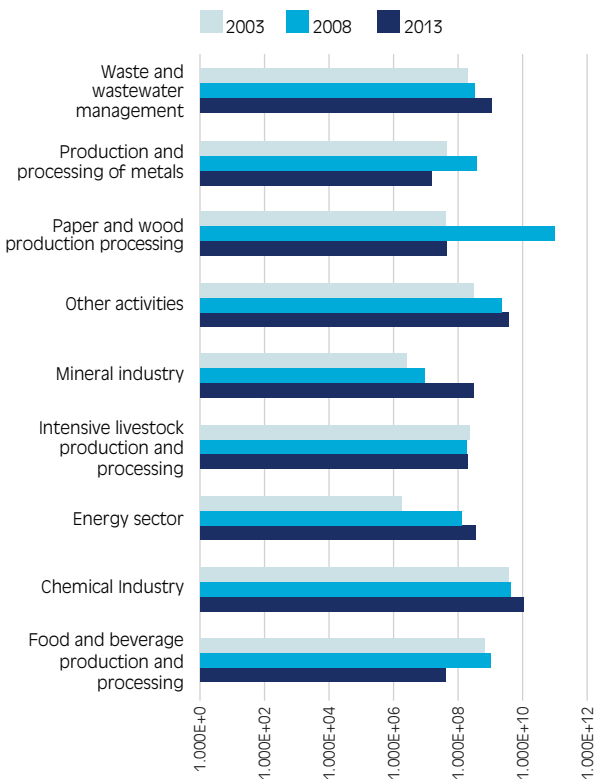


Figure 121 - Total aqueous effluent values per sector *(NBB 2003, 2008 and 2013 & E-PRTR, 2013)*

Figure 121 gives an indication that from 2003 to 2013, aqueous effluent values from waste and wastewater management, the mineral industry, the energy sector, the chemical industry and other activities show increasing trends, indicating a potential for an increasing pollution contribution from these sectors. Effluent values for the production and processing of metals, and the food and beverage sector show decreasing trends from 2003 to 2013, indicating a potential for a decreasing pollution contribution from these sectors. Between 2008 and 2013, there is an indication of a decrease in effluent values from the paper and wood production and processing sector, indicating a potential for a decreasing pollution contribution from this sector. *Figure 121* shows that values for intensive livestock products and processing remained the same between 2003 and 2013.

There are constraints and limitations associated with the National Baseline Budget (NBB) data analysis. The data presents inconsistencies between reporting years, and with other reporting systems (PRTR) methods, where used. Different criteria are used to define the geographic scope when establishing the NBB industrial inventory. While it is generally acknowledged that a large percentage of pollution received by coastal waters stems from land-based sources located in Mediterranean watersheds, which flows into the coastal zone as riverine inputs, whereas NBB data analysis is currently not systematically conducted at the watershed level, but instead by administrative zone. This introduces a significant bias into the analysis, especially where the geographical limits of watersheds do not coincide with administrative boundaries. In these cases, pollution stemming from sources located upstream beyond the administrative limits are not taken into account. Along with the lack of data validation, this somewhat hinders the identification of reliable trends, and therefore the extraction of strong conclusions and recommendations for action.

4.7.4 Emerging Pollutants

The terms "emerging contaminants" or "contaminants of emerging interest" describes a heterogeneous set of thousands of molecules and metabolites whose presence in the environment had not been detected in the past and whose study and monitoring are relatively recent. We find these substances in personal care products (antiseptics, sun lotions, cosmetics, etc.), synthetic musk, flame retardants, additives in plastics, in pesticides and in herbicides, bisphenol A (used in plastic wrap), plasticizers such as phthalates, nanoparticles (measuring less than 100 nanometres, used in food, medicine, construction and textiles), phytoestrogens (plant-derived substances, i.e. isoflavones), perfluorocarbons (PFCs used as protective layers), pharmaceuticals (painkillers, hormones, antibiotics, antidepressants) and non-halogenated substances (carboxylic

BOX 39 Legacy pollution from industrial activities - the case of the Calanques in Marseille, France

(Source: Daumalin & Laffont-Schwob, 2016)

Located on the outskirts of the global port city that is Marseille (France), the Calanques are known as a place of natural picture-postcard beauty and became a national park in 2012, attracting thousands of tourists. The Calanques are much less known for their industrial history: for around two centuries, highly-polluting activities, mainly in the soda and lead industries, were carried out in twelve factories on this site, which continue to impact the environment and people.

The area around the former industrial sites remains contaminated from legacy pollution of the soil and living organisms, as well as marine sediments, affecting terrestrial and marine biodiversity. The contamination can also affect human health, either directly via ingestion or inhalation, or indirectly via the food web. For example, significant concentrations of lead and arsenic are found locally in soil and dust, as well as in aerial parts of edible plants colonizing the area, such as rosemary. While these concentrations are below the threshold of acute intoxication, they could be of concern for chronic exposure and cumulated exposure to a "cocktail" of contaminants. Coherent management of these sources of pollution is required, even long after the industrial activities that caused them have ceased. Local and national governments and environmental institutions therefore continue to work together to reduce legacy pollution.

BOX 40 The importance of riverine inputs of industrial contaminants to the Western Mediterranean Sea

Using the River Rhône as an example, in comparison to port contributions, urban contributions and direct industrial contributions, riverine inputs (watersheds, coastal watercourses), the river Rhône contributes 97% of the main heavy metals, with significant concentrations (Boissery, 2018).

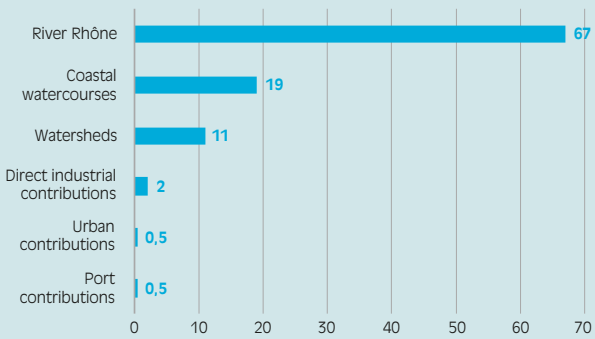


Figure 122 - Origin of heavy metal concentrations in French Mediterranean coastal waters

(Source: Boissery, 2018)

acid, formaldehyde). Few studies have analysed the effects of prolonged exposure to these substances, which can be toxic for marine organisms and humans in minute doses. The effect is not only additive but also synergistic and municipal treatment plants are currently unable to remove these substances. The study of the multitude of emerging contaminants, their interactions with the environment and human health and their treatment is extremely complex and costly, has been insufficient for a number of substances, and does not currently keep up with the pace at which new substances are being created. To date, the European Chemicals Agency has registered more than 22,000 substances (European Chemicals Agency, 2019) under the REACH regulation, compared to more than 142 million in existence worldwide (CAS, 2019).

Although depollution measures, such as wastewater treatment, are improving in their capacity to effectively treat or eliminate certain substances, it is likely that neither the technology nor financial resources will ever be sufficient to treat 100% of pollution. Therefore, pollution prevention must be a priority, involving the following:

- reduction and phasing-out of the use of known harmful substances;
- action to avoid the "creation" of new substances whenever possible and to regulate the emergence of new substances on the market with mandatory and strongly-enforced environmental and social (including health) impact assessments; and
- emergency preparedness and responsiveness for accidental pollution, natural hazards and other emergencies.

BOX 41 A best practice case study of a "switcher", resource efficiency and sustainable waste management in the State of Palestine

(Source: SCP/RAC, 2019)

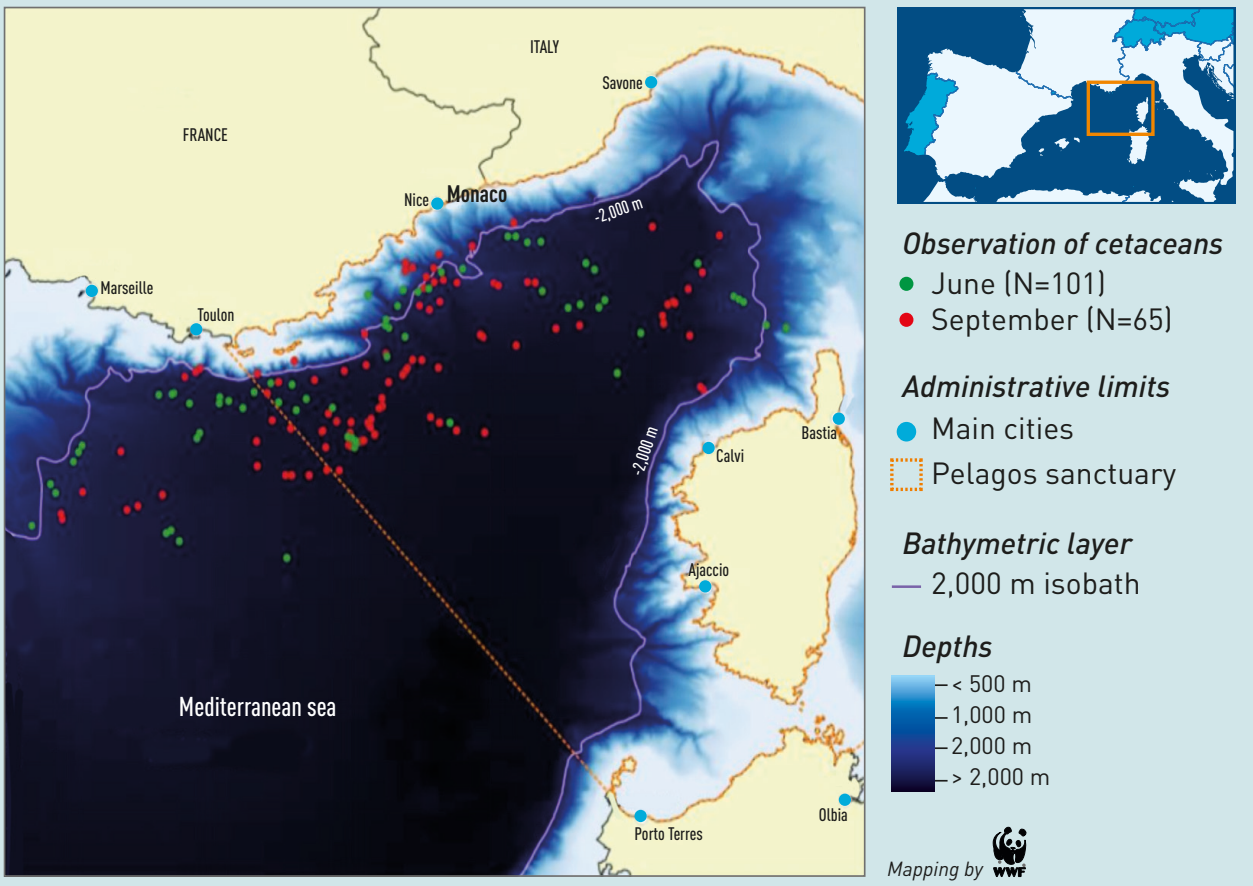
Three female Palestinian environmental engineers have invented an innovative concept of treating waste by using waste to eliminate environmental pollution from both leather tanning wastewater and stone cutting solid waste. This is an integrated treatment system that minimizes the economic losses for both industries and improves public health and the environment.

This environmentally friendly, efficient and integrated wastewater treatment unit removes chromium-containing tannery wastewater by adsorption on stone cutting solid waste particles, thus eliminating pollution from both industries. Laboratory results proved that this treatment system is 99% effective. Chromium is removed within a much shorter time frame (30 minutes) in comparison to conventional methods. This sustainable wastewater treatment solution costs three times less and saves 50% of treated wastewater for the industry, estimated at 6 cubic meters daily. Reusing the treated wastewater minimizes the running cost of the leather tanning factories and makes them more competitive. The process is also applicable in the galvanization industry to remove zinc, the dairy industry to remove organics and the lubricants industry to remove waste lubricants and grease.

The EU "SwitchMed" project provides coaching sessions to improve pitching skills in order to find potential funding and launch the project.

BOX 42 The presence of phthalates and dibromobiphenyl in the "Pelagos" Sanctuary, 2015

(Source: Boissery, 2018)



	Di Ethyl Phthalate (DEP)	Bis (2-Ethylhexyl) Phthalate (DEHP)	Dibutyl Phthalate (DBP)	Diisobutyl Phthalate (DIBP)	Di-n-Hexylphthalate (DNHP) + Benzylbutyl Phathalate (BBP)	Di Methyl Phthalate (DMP)	Bis (2-Methoxyethyl) Phthalate (DMEP)	Di-n-Octyl Phthalate (DNOP)	Di-n-Decyle Phthalate (DNDP)	Total
Order of abundance	1	2	3	4	5	6	7	8	9	
Mean	14,656	1,060	629	409	337	267	184	5	0	17,547
Standard deviation	14,747	1,390	825	497	413	359	480	15	0	15,227

4.7.5 Pollution from noise

As underwater noise is considered a major threat for cetaceans, in the 2015-2016 period, ACCOBAMS conducted a study aimed at identifying noise hotspots and areas of potential conflicts with cetacean conservation. Data was collected from activities using noise sources identified as being of primary concern for cetacean conservation (coastal and offshore activities, geophysical surveys, naval exercises, maritime traffic).

4.8 Waste

The types and amounts of waste generated and the associated management practices vary widely across Mediterranean countries. The total amount of municipal solid waste produced in Mediterranean countries in 2016 was around 184 million tonnes, i.e. an average of 370 kilograms per capita per year (about 1 kg per capita per day). In NMCs, the range of values is from 1.0 to 1.7 kg/cap./day, rising to more than 3 kg/cap./day in Monaco. In SEMCs, the amount generated is from 0.5 kg/cap./day in Morocco to 1.0 in Lebanon (the value for Israel is similar to EU countries with 1.8 kg/cap./day). In NMCs and Israel, the percentage of Food & Organic waste is between 31% and 52%, while this rate in SEMCs is higher still (from 53% in Lebanon to 70% in Libya).

Recycling rates also vary widely. In NMCs, the recycling rate is above 13%, exceeding 40% in Slovenia. Bosnia and

BOX 43 The ACCOBAMS study on underwater noise hot spots

The positions of 1,446 harbours, 228 drilling platforms for hydrocarbon exploitation, 52 wind farm projects, 830 seismic exploration areas, several military areas, and 7 million vessels were recorded in the 2015-2016 ACCOBAMS study on areas of potential conflict with cetacean conservation. The results revealed several noise hotspots overlapping with important cetacean habitats such as the Pelagos Sanctuary, the Strait of Sicily, and the upper portion of the Hellenic Trench. These results provide strong evidence of multiple stressors acting on the marine environment and of the need for urgent management and conservation actions.

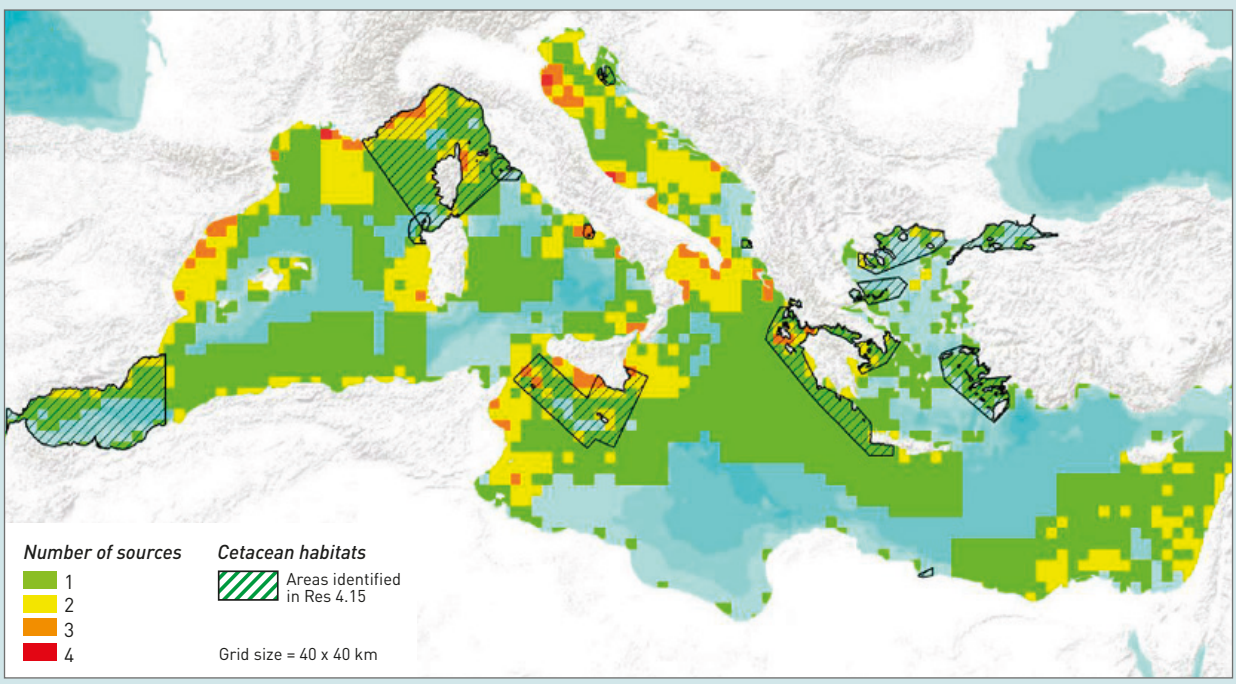


Figure 123 - Overview of the noise hot spots in the ACCOBAMS area

Overview of the noise hot spots in the ACCOBAMS area

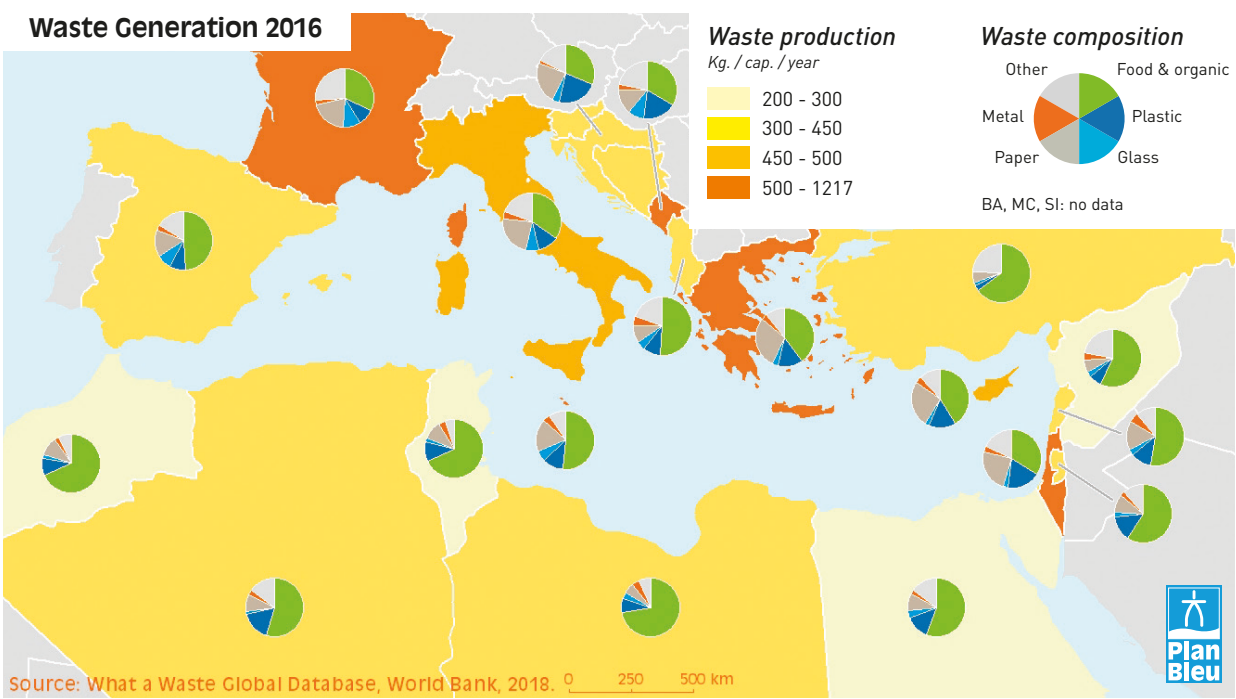


Figure 124 - Waste generation and composition in Mediterranean countries, 2016

(Source: World Bank, 2018)

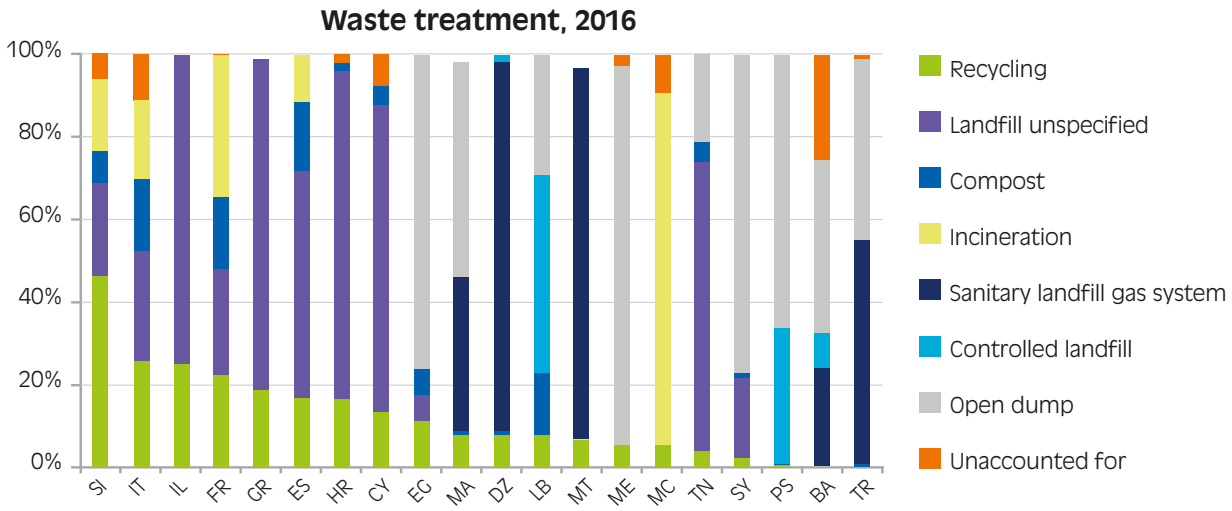


Figure 125 - Waste treatment in Mediterranean countries, 2016
(Source: World Bank, 2018)

BOX 44

Urban waste and recycling in Italy

(Source: ISPRA, 2019)

A recent national report on waste management in Italy (ISPRA, 2019) showed that per-capita waste production in Italy was 449 kilograms in 2017, around 55% of which was collected for recycling. The *Figures* below show that the absolute quantity of urban waste produced has decreased since 2010 and stagnated since 2012. At the same time, the percentage of waste collected for recycling has been growing steadily, from 34% in 2009 to 56% in 2017.

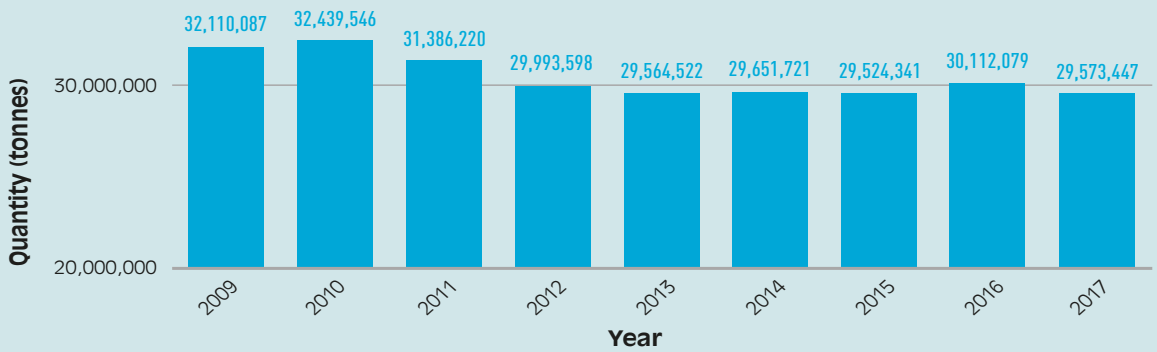


Figure 126 - Total urban waste production in tonnes in Italy, 2009-2017
(Source: ISPRA, 2019)

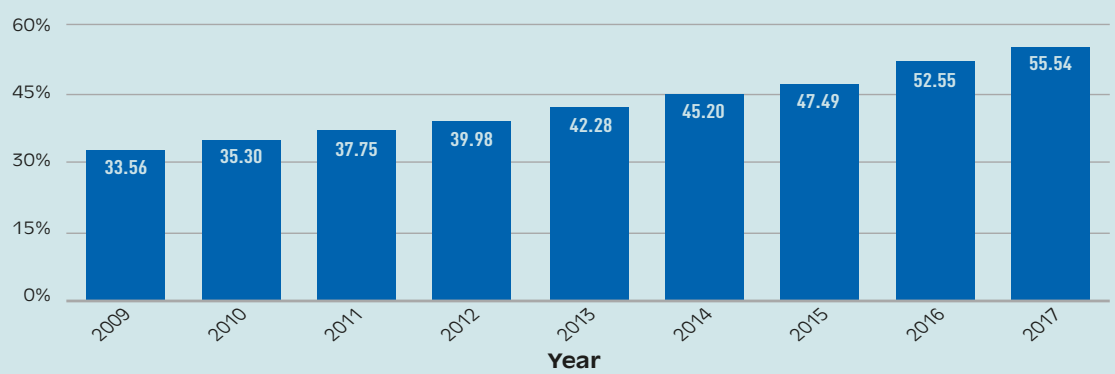


Figure 127 - Percentage of waste collected for recycling in Italy, 2009-2017
(Source: ISPRA, 2019)

Herzegovina (close to 0%) and Malta (7%) are exceptions on the northern shore. In SEMCs, Egypt has the highest recycling rate (12.5%), after Israel (25%), and the recycling rate is especially low in the Syrian Arab Republic and the State of Palestine.

4.9 Marine Litter

4.9.1 Introduction

Marine litter - any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine environment- is globally acknowledged as a major societal challenge of our times due to its significant environmental, economic, social, political and cultural implications. The root causes of marine litter are unsustainable consumption and production patterns, coupled with deficiencies in waste management, resulting in alarming amounts of waste leaking into the oceans every day. For plastic only, the global production of resins and fibres increased from 2 million tonnes in 1950 to 380 million tonnes in 2015, i.e. an annual growth rate of 8.4% (Geyer, Jambeck & Lavender Law, 2018), while the production of resin in Europe reached 64 million tonnes in 2017 (Plastic Europe, 2018).

Global commitments have resulted from the meetings of the United Nations Environment Assembly since 2016, the Convention on Biological Diversity, recent G7 and G20 declarations, and under Target 14.1 of the Sustainable Development Goals (UN Environment, 2018a), while more than 730 tonnes of plastic are entering the Mediterranean Sea every day (UNEP/MAP, 2015). Consequently, the Regional Plan on Marine Litter Management in the Mediterranean (MLRP) was adopted in 2013 by the 18th Conference of the Parties to the Barcelona Convention

BOX 45

Plastic waste exports from EU countries

Global plastic production increased from 2 million tonnes in 1950 to 380 million tonnes in 2015 and is projected to continue to grow rapidly (WWF, 2019). The EU is responsible for 18% of this production (Barra et al. 2018) and around 40% of plastic demand is for packaging (Plastic Europe, 2018). Plastic recycling in EU countries is most successful in the first stage of the recycling value chain, i.e. collection. After collection, much of the plastic waste is exported to non-EU countries in order to deal with insufficient recycling capacities in the EU. Receiving countries use the plastic waste to foster industrial growth, which is, however, potentially linked to negative impacts on social and environmental conditions (OECD, 2018). Waste import restrictions, mainly in China and Hong Kong, have shifted European waste exports to other receiving countries and sharply reduced exported plastic waste. The country that experienced the highest increase in the amount of EU plastic waste received is Turkey. EU-originated plastic waste imported in Turkey in 2018 was 13 times the amount imported in 2015, making Turkey the number two destination for EU plastic waste exports, after Malaysia (D'Amato et al. 2019).

The United Nations Basel Convention has recently prohibited the trade of some types of plastic waste for EU countries. This further narrows prospects for trading plastic waste and requires countries to make decisive progress towards a circular economy for plastic in Europe.

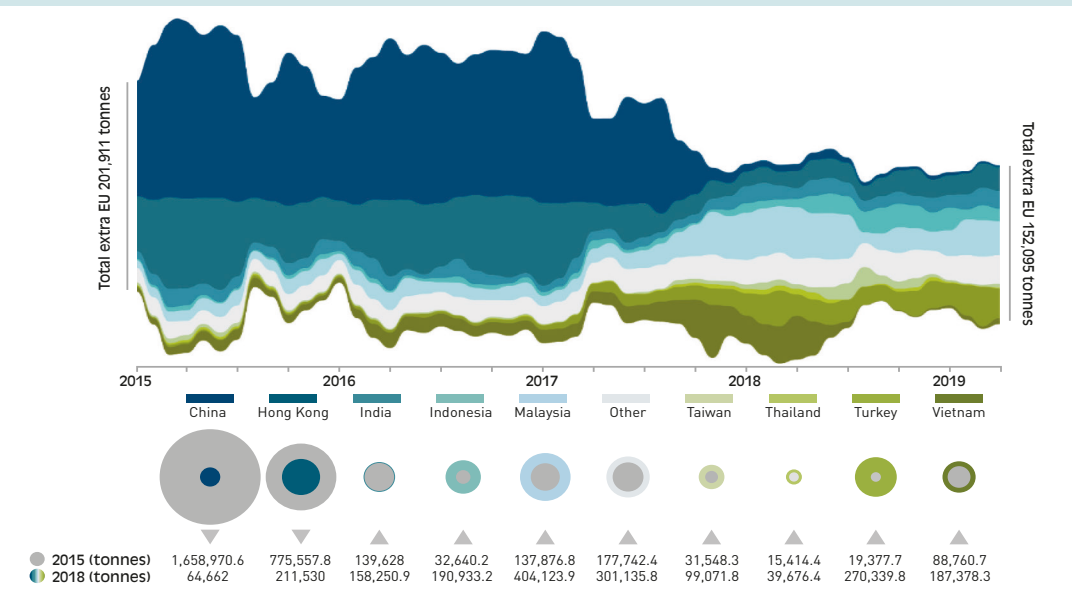


Figure 128 - Extra-EU-28 plastic waste trade by receiving country
(Source: D'Amato et al. 2019)

(COP 18). Among all Regional Seas Conventions, it is the first legally-binding instrument to reduce marine litter, an issue of high concern for the Barcelona Convention since its early years. In addition, European policies such as the EU Plastics Strategy and various directives such as the Marine Strategy Framework Directive (MSFD, 2008), the Directive on Port Reception Facilities (PRF, revised in 2019) and the Single-Use Plastics Directive (2018) provide a driving force to act on marine litter and the related impacts. Coordinated national measures and promising strategies on plastics in the circular economy also address marine litter in the Mediterranean Sea, together with the MLRP and related updated National Action Plans (Markovic & Hema, 2016).

4.9.2 Situation and evolution of marine litter in the Mediterranean

Studies on marine litter in the Mediterranean basin started in the 1990s, but more attention was given to the issue after 2010, when more data became available on the abundance and distribution of marine litter, and when the first attempts to assess trends were made, microplastics entered into the agenda and the mapping of impacts became a priority. There is no comprehensive assessment of the economic impacts of marine litter in the Mediterranean Sea, apart from an assessment of the economic impacts of marine litter in the Adriatic and Ionian Seas within the framework of the EU funded DeFishGear project (Vlachogianni, 2017), as well as limited information deriving from beach clean-up activities, the fishing industry, and research reports. The Mediterranean Sea is a closed basin, with a coastal population of about 210 million inhabitants. Mediterranean countries are the number one tourist destination in the world, with around 360 million visitors every year, and receives waste from coastal zones, as well as from many large rivers flowing through largely urbanized cities such as the Nile River that transports more than 730 tonnes of plastic into the Mediterranean Sea per year (Lebreton et al. 2017). In addition, more than 20% of global maritime traffic passes through the Mediterranean Sea. Consequently, the basin has become one of the most marine litter-affected areas in the world (UNEP/MAP, 2015). Plastics are the prevailing type, accounting for up to 95-100% of total floating marine litter, due also to the high floatability of plastics, and more than 50% of seabed marine litter. The analysis of 80 beaches conducted in 2016 (Addamo, Laroche & Hanke, 2017) indicated that only 10 types of debris, mostly single-use plastics (cutlery/trays/straws, cigarette butts, caps/lids, plastic bottles, shopping bags) represent more than 60% of the total recorded marine litter on beaches. No change was observed in the percentage of the dominant marine litter categories between 2013 and 2018 on the beaches of 8 Mediterranean countries (Ocean Conservancy, 2018). Typically, most of the litter on beaches originates from beach/recreational activities. Glass bottles and metal beverage cans disappeared from the top ten lists in non-tourist areas in recent years because of behavioural changes.

On the sea floor of the north-western basin, plastics and fishing-related items (some of which are also made of plastic) have represented the same percentage of litter for more than 20 years (UNEP/MAP, 2017a), but information still remains scarce, especially on the specific issue of abandoned, lost or otherwise discarded fishing gear (ALDFG), which may account for a large or even the largest part of marine litter items in many areas (UNEP/MAP, 2015). Particular importance is currently being paid to the emerging issues of micro- and nanoplastics and the possible release of associated Persistent Organic Pollutants (POPs) and Endocrine Disrupting Chemicals (EDCs). Concentrations of microplastics at the surface of the Mediterranean Sea are largely above 100,000 items per km² (UNEP/MAP, 2015) and, reach maximums of more than 64 million floating particles per km² (Van Der Hal, Ariel & Angel, 2017).

4.9.3 Sources and driving forces

In most Mediterranean countries, the root causes of plastic pollution are found in the increase of plastic use, unsustainable consumption patterns, ineffective/inefficient waste management and loopholes in plastic waste management. Plastic ranges from 5% (Morocco), to 14% (Israel) of the total waste generated (World Bank in UNEP/MAP, 2015). Inputs of plastics into the sea, as estimated in 2015, are at the level of over 260,000 tonnes per year or 730 tonnes per day *(Table 22)*, depending on the coastal population, which may vary depending on the country, representing more than 2% of the total inputs in the world's oceans.
At the level of Mediterranean watersheds, another study (Weiss et al. 2019) modelled plastic flows into the Mediterranean Sea, as shown in the *Figure 129*.

In some areas, up to 58% of the municipal solid waste collected is still disposed of in open dump sites. Of the millions of tonnes of plastic waste produced every year in Mediterranean countries, less than one third is recycled and plastics recycling is less than 6% (WWF, 2018). Bearing in mind the importance of wastewater as a pathway for waste leaking into the sea, a key challenge is that in the Mediterranean region, 21% of wastewater (25% in Southern Countries) undergoes only basic treatment, and less than 8% (1% in southern countries) undergoes tertiary treatment (UNEP/MAP, 2017a).

Key economic sectors in the Mediterranean, such as professional and recreational fisheries, aquaculture, tourism and shipping, also generate large amounts of litter that end up as marine litter.

4.9.4 A significant socioeconomic and ecological cost

Measuring the full economic cost of marine litter is complex due to the wide range of economic, social and environmental impacts, the range of sectors involved and impacted by marine litter and the geographic spread of those affected. Marine litter creates an economic burden on local authorities through clean-up costs, and potential loss of income and jobs from tourism, residential property values, and recreational activities. From surveys based on public

Countries	Plastic waste littered (kg/person/year)	Plastic waste littered (tonnes/day)
AL	0.5	3.5
BA	1.1	1.7
CY	1.8	4.2
DZ	1.0	47.5
EG	1.3	77.2
ES	2.0	125.6
FR	1.4	66
GR	1.5	39
HR	1.8	8
IL	2.2	39.5
IT	1.0	89.8
LB	0.7	7.3
LY	1.1	11.6
MA	0.5	25
MC	2.4	0.2
ME	1.0	0.7
MT	1.6	1.7
PS	0.5	3.8
SI	1.1	1.0
SY	1.3	12.9
TN	1.0	20.9
TR	1.5	144
Total		731

Note: UNEP/MAP calculations based on World Bank (in Jambeck et al. 2015), and Jambeck et al. 2015. Values for Egypt, France, Morocco, Spain and Turkey were estimated for the Mediterranean coast only.

Table 22 - Estimated total plastic waste littered in the 50 km Mediterranean coastal belt by country
(Adapted from UNEP/MAP, 2015).

perception of the impact of littering, significant differences were found between countries, with important implications for the importance of the estimated social costs across European countries, including from the Mediterranean region (Brouwer et al. 2017). Notwithstanding the uncertainties underlying full damage assessments, and although only addressing a fraction of the damage, financial expenditure linked to beach clean-ups is generally known. In European countries, beach cleaning may reach EUR 3,800 per tonne per year (CleanSea project, 2016), depending on clean-up methods. For floating litter, the same study indicated that removal was equal to a unit cost of EUR 2,200 per tonne per year per km². For the fishing sector, an annual economic loss of EUR 61.7 million has been estimated in European waters (WWF, 2018), with a total cost for all sectors of EUR 263 million (Arcadis, 2014). Extrapolating loss at the Mediterranean level will require more data and studies, but the costs will probably be higher considering the higher litter concentration.

The damage and associated social costs of marine litter also extend to other sectors, such as aquaculture and fishery, where litter damages nets, reduces (ghost fishing) or contaminates catches, and more broadly affects marine ecosystems. Marine litter also creates economic pressures for the shipping sector, including yachting (fouled motors, lost output and repair costs) and risks to human health, via injuries and accidents, or through the potential release of chemical substances.

The main impacts on marine organisms for which scientific certainty exists are linked to entanglement, ingestion, colonization and rafting marine organisms. Costs of damage to marine ecosystems and services, through the introduction of alien invasive species, for example, must also be considered despite a limited understanding of the detrimental impacts on the marine ecosystem structure

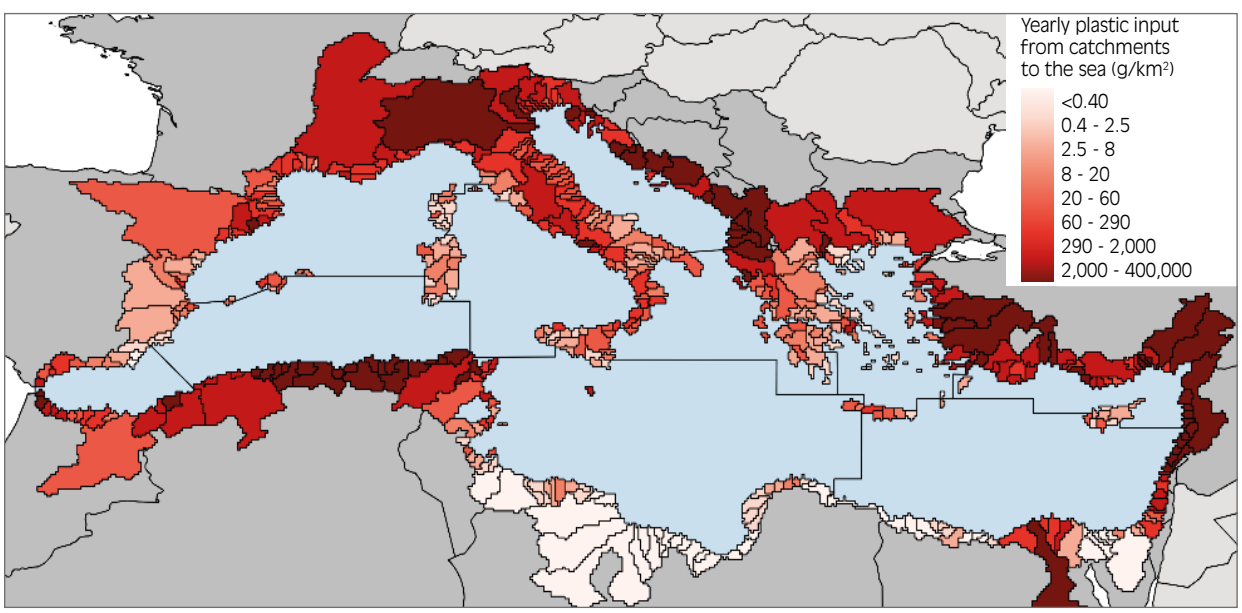


Figure 129 - Estimate of annual specific plastic flows (kg/m³) discharged by watersheds into the Mediterranean Sea
Flows calculated based on Lebreton et al. 2017
(Source: Weiss et al. 2019)

and functioning. Links to human health are not sufficiently addressed and the gaps in knowledge are even bigger when it comes to nanoplastics, which may have even greater impacts on marine ecosystems, with a possible transfer through the trophic chain (GESAMP, 2016).

4.9.5 A regional and circular economy approach as a response to marine litter in the Mediterranean region

In acknowledgement of the importance of prevention and the circular economy rather than clean-up actions, a plan for reduction measures was provided in the Regional Plan on Marine Litter Management in the Mediterranean (UNEP/MAP, 2017b), where governments committed to pass plastic reduction policies, support industry to minimize plastic packaging and redesign products, and change consumer habits. So far, the majority of Mediterranean countries have made progress towards upgrading the regulatory framework for reducing single-use plastic bags, and many of them have adopted, or are making progress towards, adopting an extended producer responsibility (EPR) approach to tackle packaging waste. In order to support such policies, pilot projects promoting alternatives to single-use plastic bags and rewards schemes for the return of packaging have been tested. The countries, supported by UNEP/MAP, have also explored and implemented fishing-for-litter schemes, as well as improved port reception facilities, including the application of charges at reasonable costs and no-special-fee systems. In addition, five Mediterranean countries have joined the #CleanSeas campaign. Policy action by sub-national authorities, industry-based solutions[62] and large-scale green economy initiatives[63] support the transition towards a more sustainable economy, promoting the transfer of environmentally-sound technologies to industry, policy changes and incentives to enable the circular economy, providing innovative and long-term solutions. The action of civil society[64] has been of great importance in this issue, not only in terms of awareness, but also for advocacy and the promotion of concrete solutions to marine litter.

Nevertheless, with only one binding quantitative target to reduce marine litter on beaches by 20% by 2024, and despite a number of pieces of legislation and international agreements, the circular economy concept will not be fully implemented (Eunomia, 2016). Typically, there are insufficient accounting and cost-recovery mechanisms in most of the countries regarding wastewater and solid waste management. Weak enforcement, insufficient waste

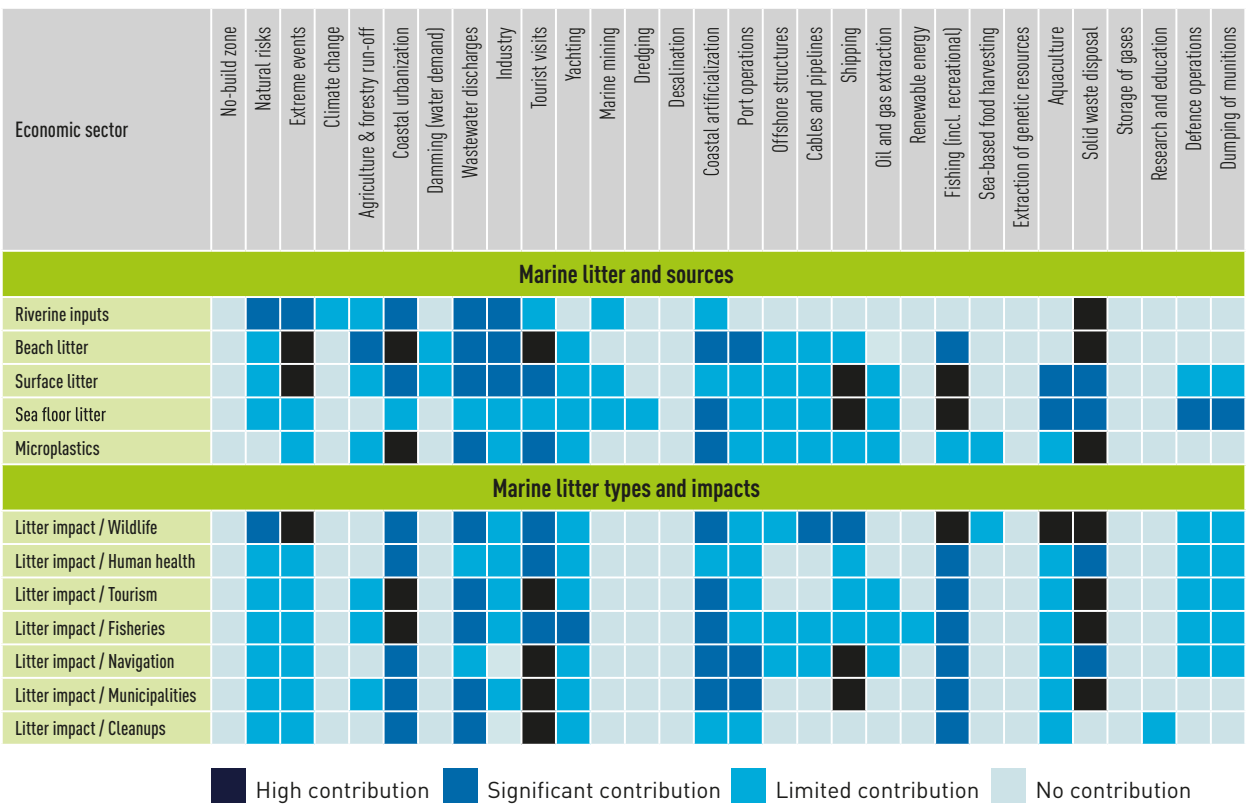


Figure 130 - Marine litter in relation to the economic sectors in the Mediterranean Sea. Sources, amounts and impacts (According to UNEP/MAP, 2015 & UN Environment, 2018a)

[62] https://www.marinelittersolutions.com
[63] https://switchmedconnect.com/en/
[64] i.e. www.breakfreefromplastic.org, mio-ecsde.org

treatment infrastructure and policies, as well as strong regional disparities between urban and rural areas, and poor stormwater management are still gaps that need to be addressed. Despite measures for the establishment of wastewater treatment systems in most agglomerations, there are still many coastal cities without wastewater treatment plants, especially in the Southern and Eastern Mediterranean. The issue of the informal economy, informal recycling networks around the basin, illegal manufacturing and black markets is a reality in some Mediterranean areas and jeopardizes solutions to marine litter, making it even clearer that the waste management schemes at a national level need to become more effective.

Single-use plastic bags have generally been addressed through bans and economic disincentives, as shown in this map. However, they are still persistent along with other iconic items such as cigarette butts.

Ship-generated waste and cargo residues can be managed through port reception facilities. In the Mediterranean, these do not yet operate optimally, especially in small harbours and marinas. Relevant legislation on port reception facilities still requires efforts to be fully implemented and/or enforced. A regional survey (UNEP/MAP, 2015) revealed some important shortcomings in the management of ALDFG, extending to insufficiently-adopted environmentally-responsible fishing practices. The most critical levers to reduce litter are objectives and actions to reduce plastic consumption, support eco-design/innovation, resource efficiency and better waste and water management, long-term efficient and viable recycling targets for municipal waste and packaging/plastic waste, greater use of policy instruments and control measures, such as bans, incentives, taxes, etc., extended producer responsibility schemes and coordination of policy investments in the waste sector (Ten Brink et al. 2018).

Socioeconomic assessments made on/of various measures at the Mediterranean level (Plan Bleu, 2017a) have demonstrated the cost-effectiveness of a Mediterranean plastic bag tax, estimated as levied at the retail level, at a cost of EUR 670 million for a 95% reduction of incremental plastic bag waste during the first year of implementation. "Fishing for litte[65]" initiatives, at a large scale, also lead to an estimated cost-effectiveness of around EUR 900 per tonne of fished litter, with reduced indirect costs to the fishing sector itself. Other measures, such as the use of port reception facilities at a reasonable cost, or the no-special-fee system, where applicable, are recommended because of their positive impacts on employment and tackling chronic pollution from ships.

Finally, in the Mediterranean Sea, adopting ambitious targets for reducing the production and consumption stages of the most important items found in the marine environment, such as single-use plastics, will largely contribute to the reduction of marine litter and its impact.

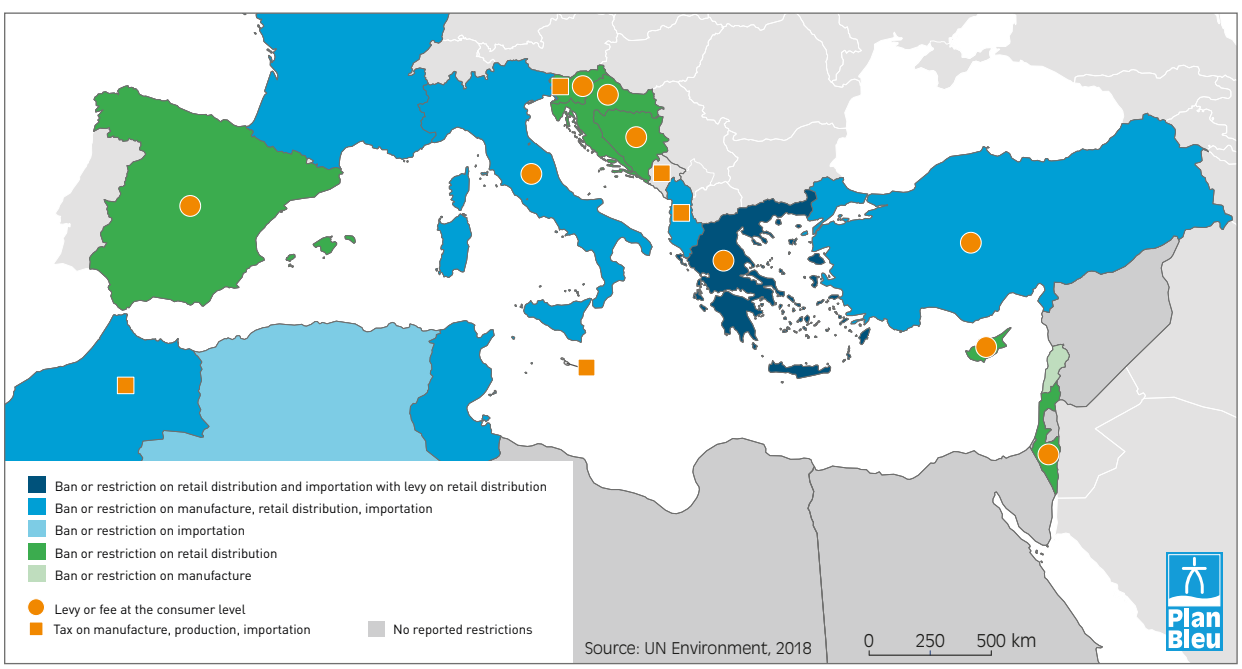


Figure 131 - Total and partial bans and taxes on the manufacture, free distribution, and importation of plastic bags

(Source: UN Environment, 2018b) Note: In Bosnia and Herzegovina, the restriction covers one of the three national administrative divisions, the Federation of Bosnia and Herzegovina (O.G. of FBiH, No. 09/14). In Lebanon, the voluntary agreement with malls has been withdrawn after publication of the source mentioned in the *Figure*. In Egypt, two governorates issued bans on plastic bags: the Red Sea Governorate (Decree no. 167 for 2019) and South Sinai Governorate (Decree no. 172 for 2019).

[65] Fishing for litter: action where participating fishing vessels collect marine litter that is caught in their nets during their normal fishing activities.

Solving the problem of marine litter is a complex task because of the diversity of the stakeholders involved, the sources, the materials, the socioeconomic aspects and the regulatory frameworks. Changes towards a more circular economy have been observed in recent years, but large gaps remain. Prior to the effective implementation of the measures required at the national level, political, environmental and operational targets must be set to drive the necessary actions. The Mediterranean region may have to face new challenges, such as the increase of plastics production, the use of new materials (bioplastics, copolymers, etc.) that may not have been produced to be environmentally relevant and may mislead consumers. The need for better understanding of the links between marine litter flows and the regional economy, as well as for coordination in establishing and implementing national programmes of measures to maximize transboundary benefits, should be continuously addressed at the regional governance level.

4.10 Responses and Priorities for Action

The economic sectors described above are based on dominant linear business models and systematic unsustainable resource consumption, generating detrimental impacts on the environment, including carbon emissions. Economic outputs are coupled with environmental degradation. Each unit of economic value added is linked to incremental resource consumption and environmental degradation, referred to as negative externalities.

Transitioning to a sustainable economy requires urgent and profound changes in both production and consumption patterns, based on environmentally responsible lifestyles and resource consumption within sustainable limits. Targeted policy mixes, including market-based instruments and behavioural insights that favour environmentally-friendly activities and disadvantage polluting ones (including by making producers accountable for the entire life cycle of their products), are needed to mitigate climate change, protect natural ecosystems and biodiversity, and promote circular economy principles within current business models, thus enabling the transition to a blue/green economy[66].

4.10.1 Transforming consumption patterns

Unsustainable consumption patterns, i.e. demand for unsustainably-produced and/or unsustainable quantities of products and services, are a key (if not the main) driver for environmental pressures. Directing demand towards products and services that are produced and consumed within the carrying capacity of ecosystems is one of the most effective levers for avoiding environmental degradation and requires profound modifications in consumers' values and behaviour. Changes in consumers' choices and behaviour require an inclusive approach that pays attention to inequalities and involves civil society in decision-making and action.

The young generations and their demands and potential for action are central to short-term and longer-term progress, including in countries with strong demographic growth. Young generations represent an opportunity to foster transformative change in consumption behaviour and economic sectors, yielding reduced resource consumption and sustainable lifestyles. Women can also play a major role in promoting sustainable household consumption and investment (e.g. in food, energy), and in entrepreneurship and economic development.

Knowledge about the attitudes of Mediterranean citizens towards the environment can guide decision-making and increase public acceptance and the effectiveness of environmental measures and policies.
In the absence of comprehensive studies about environmental attitudes in Mediterranean countries, some elements can be drawn from an EU-wide survey *(Box 46)*.

Obtaining a better understanding of the behavioural mechanisms that contribute to environmental issues, by involving disciplines such as behavioural economics, psychology and neuroscience, represents another important lever for more effective policies aimed at changing consumption patterns. Behavioural insights are a complementary tool alongside other policy instruments, such as pricing and regulation.

4.10.2 Transforming economic sectors and production patterns

Making Mediterranean **fisheries and aquaculture** sustainable requires urgent and coordinated actions. The GFCM recently launched two dedicated strategies for capture fisheries and aquaculture. In 2016, the GFCM launched the "Mid-term strategy (2017-2020) towards the sustainability of Mediterranean and Black Sea fisheries", with the aim of reversing the trend of overexploitation of commercial fish stocks and improving coastal livelihoods. The following year in 2017, the "Strategy for the sustainable development of Mediterranean and Black Sea aquaculture" was also launched, with the aim of achieving a level playing field and promoting the sector to make it more competitive, sustainable, productive, profitable and equitable. Both strategies are designed so as to contribute directly to achieving the United Nations Sustainable Development Goals, particularly Goal 14 to "Conserve and sustainably use the oceans, seas and marine resources for sustainable development"[67].

[65] Fishing for litter: action where participating fishing vessels collect marine litter that is caught in their nets during their normal fishing activities.
[66] The circular economy approach has already proven successful in the EU where, in a few years, it has contributed to the creation of a significant number of jobs and business opportunities (European Commission, 2019).
[67] Important advances in the implementation of both strategies include the publication of the GFCM report on the State of Mediterranean and Black Sea Fisheries (SoMFi) (FAO, 2018b) and the upcoming publication of the report on the State of Mediterranean and Black Sea Aquaculture. In 2018, the GFCM also organized the first Forum on Fisheries Science in the Mediterranean and the Black Sea (Fish Forum 2018), and launched a series of dedicated regional surveys, such as socioeconomic sample surveys, bycatch monitoring surveys and pelagic acoustic and demersal trawl surveys to assess the status of resources (for more detailed information, visit the GFCM webpage at www.fao.org/gfcm).

BOX 46 Environmental attitudes in EU Mediterranean countries

(Source: TNS political & social, 2017)

The Special Eurobarometer "Attitudes of European citizens towards the environment" gives some indications about the declared environmental preferences of European citizens.

- **Environmental protection is important to European citizens.** The study shows that 94% of responding Europeans (ranging from 99% in Cyprus to 87% in Croatia) say that the protection of the environment is important to them personally.
- **Mediterranean-EU countries are more concerned about environmental issues than the EU average.** 81% of EU respondents agree that environmental issues have a direct effect on their daily life and their health. This proportion is higher than the EU average in all surveyed EU Mediterranean countries, with 97% in Cyprus, 96% in Greece, 93% in Malta, 91% in Spain, 90% in Italy, 84% in Slovenia, 83% in France and 82% in Croatia. 74% of Europeans agree that they are worried about the impact on their health of everyday products made of plastic. This proportion is also higher in EU-Mediterranean countries than the EU average, except for France. The five EU countries where citizens worry the most about the impact of plastics on their health are all located on the Mediterranean rim. All Mediterranean-EU countries also show a high proportion (EU average of 87% or above) of respondents indicating they are worried about the impact on the environment of everyday products made of plastic. A similar picture is revealed when asking Europeans if they are worried about the impact of chemicals present in everyday products on their health: Mediterranean-EU countries reply positively more often (96-87%) than the EU average (84%), just as when asked if they are worried about the impact of chemicals present in everyday products on the environment (EU average = 90%, Mediterranean-EU countries above average (98-93%), except for Croatia (89%)).
- **Mediterranean-EU countries are particularly worried about air pollution and think that the EU level is the right scale to address this issue.** In terms of environmental issues, air pollution is considered the most important environmental issue in five Mediterranean-EU countries, followed by climate change (three Med-EU countries) and the increasing amount of waste (one Med-EU country). Mediterranean-EU countries are more numerous than the EU average (47%) to say that they perceive that air quality has deteriorated over the last 10 years: at least six in ten respondents in Cyprus (69%), Spain (68%), France (62%), Italy (61%) and Greece (60%) think that the air quality has worsened in their country. When asked about the most effective ways to address air quality, the most popular option chosen by respondents is applying stricter pollution controls on industrial and energy production activities (41%). Overall, more than six in ten respondents in the EU (62%) say that they have undertaken at least one action to reduce harmful emissions into the air over the past 2 years, and most say that air pollution can be best addressed at the EU level (versus the national or subnational level).
- **EU citizens consider that environmental action taken by all stakeholders is insufficient and that environmental legislation is a main lever to protect the environment.** The majority of respondents agree that the action taken by the different stakeholders to protect the environment is insufficient: 79% say that industries and big companies are not doing enough, 67% say this is the case for their national governments, 66% say that citizens are not doing enough, 62% say the same for the European Union, 53% for their region, and 50% for their city, town or village. When asked about effective ways to tackle environmental problems, EU respondents give strong support to measures linked to environmental legislation (higher fines for breaches, stronger enforcement and more stringent legislation), along with more investment in research and development for technological solutions.

This study is based on stated environmental preferences (what citizens say); it does not survey revealed preferences (what citizens actually do).

Field projects implemented in the region offer lessons learned with respect to crucial issues such as overfishing, as illustrated in *Box 48, Box 49* and *Box 50*. The initiatives emphasize the following: i) effective governance is crucial to conserve marine natural resources while harnessing the potential of fisheries; ii) transnational, multi-stakeholder and cross-sectoral actions, based on the "value chain approach", should be designed for generating alternative sources of income for fishermen (such as marine environment monitoring, environmental education, fishing-tourism, MPA patrolling activities, valorization of local fish products, etc.), while identifying gaps and/or bottlenecks hindering such income diversification; iii) clear mechanisms for the participation of small-scale fishermen in MPA decision-making processes should be established within the existing collaboration schemes between MPAs and fishery-related authorities; iv) technological solutions for sustainable fishing practices should be sustained while supporting auxiliary industries which give value to discards with the aim of promoting job creation and onshore investments.

Moving towards sustainable aquaculture has become an urgent issue considering the fast expansion of the sector in the Mediterranean region. Approaching aquaculture with a systemic view has led to innovative aquaculture processes, as illustrated in the *Box 51*.

Moving towards **energy** efficiency and reliance on low-carbon energy mixes is key. The energy sector too often has considerable fossil-fuel subsidies (including tax exemptions on polluting activities, such as for fuels for aviation and maritime transport), going well beyond those needed for social purposes. Its environmental impacts need to be controlled in energy facilities (at primary production, at power plants and at refining facilities). Supportive policies and adequate investments are needed to support renewable energy sources, such as wind, solar or biomass, including those in prototype form, such as marine energy *(Box 52)*.

Moving towards sustainable **tourism** requires the cooperation of multiple stakeholders and their commitment to value and preserve Mediterranean cultural and environmental heritage while ensuring the well-being of local populations. Effective governance mechanisms can determine the economic, sociocultural and environmental sustainability of tourism developments. This is why the current

BOX 47 Examples of applications of behavioural insights in different policy areas

(Source: OECD, 2017)

A recent OECD study provides a number of examples where insights from behavioural sciences have been used to design and implement measures to tackle environmental issues. Behavioural levers are mainly based on changing default settings, using social comparisons, and framing information in more understandable ways, for example:

- **Encouraging energy conservation and private investment in energy efficiency:** supplementing energy efficiency labels with estimates of lifetime running costs can encourage choosing more efficient household appliances, because consumers are sensitive to the way in which labels are presented. Providing real-time feedback on energy consumption through in-home displays, changing default options to more energy-saving settings and comparing one's own energy consumption against that of one's peers have also proven to lead to changes of behaviour.
- **Promoting the purchase of more fuel-efficient cars:** providing information about expected fuel costs over a period of multiple years, and especially comparing these costs against those of the most fuel-efficient car in the same class, can promote the purchase of more fuel-efficient models.
- **Encouraging water conservation:** statements on the water bill comparing household consumption with the average in the same neighbourhood and guidance on concrete steps to take to save water have been successful. Likewise, placing "save water" stickers next to taps has also proven to induce water savings. Using in-home displays to provide real-time feedback on hot water consumption in the shower has led to both energy and water savings in Switzerland.
- **Incentivizing more sustainable food consumption:** providing clear information about food products, including encouragements to consume imperfect-looking food products, or about the optimal quality guarantee of food products (best-before date vs. production date) can prevent food waste.
- **Promoting environmental compliance:** sending regulated entities timely reminders of their obligations, emphasizing the mandatory nature of these obligations and the consequences of not complying, have proven effective.
- **Encouraging participation in voluntary schemes:** messages underlining the environmental benefits and competitive advantages associated with voluntary environmental certification can be effective.

BOX 48 Fishermen's organizations agreements for the protection of demersal fisheries resources - case study

(Source: Plan Bleu, 2020)

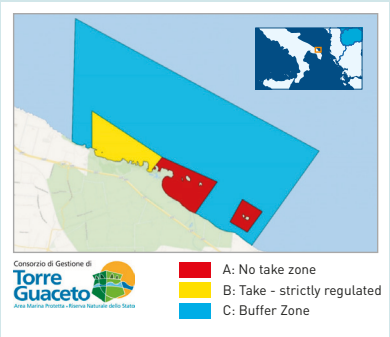
The "Fishermen's Organizations Agreements for the Protection of Demersal Fisheries Resources" is a fishing sector initiative aiming at improving the conditions of demersal resources with the consequent long-term maintenance of the fishing activity that depends on it along the coast of Girona (Spain). The three main species targeted by the project *(Merluccius, Aristeus antennatus, Nephrops norvegicus)* are in different states of overfishing. The general objective is to ensure that fishing activities are environmentally, economically and socially sustainable, ensuring that living marine resources are restored and stocks maintained above levels capable of producing the Maximum Sustainable Yield (MSY). Measures have been introduced to reduce fishing efforts, increase selectivity and control access to resources. These measures were agreed by the fishermen's organizations involved and acknowledged by the competent authorities. The main management measures are: i) rules to reduce and/or restrict fishing efforts: decreasing the number of operations of fishing gear per day or per fishing ground; ii) incorporation of technical measures to improve selectivity and/or reduce environmental impact: more restrictive technical measures (type of gear, mesh size, dimension, type of otter trawl doors); iii) access control regulations: census of authorized fleet); iv) time limitation on fishing activity: temporary closure of areas to protect juveniles and reduction of total fishing time per day; v) adaptive and multi-stakeholder management: active participation of the agents involved in regulating the activity.

These measures aim to reduce fishing pressure to adjust the capacity of fleets to the state of the resource, and balance environmental sustainability of the fishing grounds with the best long-term economic performance. Current results include: i) improved relationships between fishermen; ii) better quality of the product sold (larger sizes, better pre-sale maintenance conditions); iii) reduction of physical impact on the ground; iv) increased biomass of harvested stocks; v) better economic efficiency; vi) involvement of the fishing sector in the decision-making process.

lack of cooperation and common understanding between different stakeholders is an issue to be addressed urgently and at different levels (e.g. through public-private cooperation initiatives). Due to the number of economic activities linked to tourism, only the inclusion and engagement of all stakeholders can reconcile contrasting visions and goals with respect to tourism developments.

BOX 49 Engaging fishing communities in MPA management - Torre Guaceto Marine Protected Area (Italy) - case study

(Source: Plan Bleu, 2020)



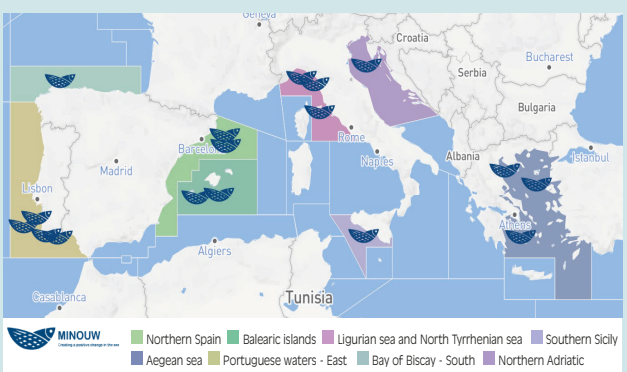
The experience of Torre Guaceto Marine Protected Area (hereafter called TGMPA) is one of the few examples in the Mediterranean of the successful involvement of traditional fisheries within MPA management programmes. TGMPA is a stretch of coast where traditional fishermen have been working for generations. When the MPA was first enforced, fishermen felt that they had been deprived of their rights. Between 2000 and 2001, all fishing activities were banned, causing violent frictions between fishermen, MPA authorities and police bodies (e.g. coastguard). Based on an agreement and a shared vision between fishermen and the TGMPA authority - under the scientific supervision of a research institute - a regulated fishing activity was allowed as of 2005 in part of the buffer zone surrounding the two TGMPA no-take zones.

Fishermen's participation in the adaptive co-management program was proposed on a voluntary basis. Fishermen were invited to share decisions with the MPA authority about the rules to manage fishing activities, while a scientific institute supervised the monitoring programme. Fishermen who adhered to the co-management protocol (initially only seven fishing boats) were authorized to fish. The fishing effort was set up and the gear selected to limit the impact on key fish predators, juvenile stages, and benthic communities and habitats. Fishermen agreed to fish only inside part of the buffer zone using shorter trammel nets (1 kilometre long versus 2-3 kilometres) with a larger mesh (3 vs 2.4 cm), and to haul the nets only once per week. They also agreed to reduce the fishing effort if symptoms of overfishing were detected through scientific monitoring (total and per-species yields, and catch composition). The data collected showed that catches were, on average, 2-4 times higher inside the buffer zones of the TGMPA than outside. More recently, several fishermen who initially did not accept to join the program, asked to be part of it, representing an extraordinary signal of success, but also the increase of the overall fishing effort, which represents a new challenge for the management body.

The main lesson learned is that building trust with fishermen is crucial as well as agreeing collectively on objectives. Tangible results to demonstrate the benefit of the MPA management body for safeguarding local fisheries help to slowly modify the cultural approach to fishing. The continuous exchange with fishermen in TGMPA helped define a shared roadmap for enlarging the MPA and its inclusion in the Natura 2000 Network.

BOX 50 MINOUW project - case study

(Source: Plan Bleu, 2020)



The "Science, Technology and Society Initiative to Minimize Unwanted Catches in European Fisheries" (MINOUW) addresses the implementation of the Landing Obligation from the scientific, technical, economic and societal perspectives. Catches of unwanted species can be large in demersal fisheries. Bottom trawling on fish nursery areas can generate large amounts of unwanted catches that are usually discarded (undersized specimens, untargeted species or over-quota catches).

MINOUW is based on a multi-stakeholder approach, whereby scientists, technicians, fishermen, producers and NGOs work together to provide the scientific and technical basis to gradually eliminate discards. Providing a diagnosis of the problem, partners develop a portfolio of solutions to be tested in the field under commercial conditions. The impact of such solutions is ranked against biological, social and economic criteria, and recommendations are made. The project shows that it is possible to decrease the production of unwanted by-catches by changing fishing procedures or adopting more selective nets in bottom trawl or set nets. New types of sorting grids specifically designed for Mediterranean trawls have proven effective. In small-scale fisheries, a guarding net fitted to the footrope of the trammel net can reduce unwanted by-catches, as well as costs. In surface longline fisheries targeting swordfish, a significant reduction in the catch rates of undersized swordfish was demonstrated. The project has also made progress in developing a Geographic Information System (GIS) tool that can identify areas with high potential of unwanted catches.

MINOUW's main lessons learned/recommendations are: i) fishermen are the stewards of marine resources and they have a direct interest in the sustainability of their activities. While some tend to be adverse to innovation imposed from outside, they are not against innovation as such; ii) fishery managers need to resist the pressure from industry for short-term profit and instead work closely with other stakeholders to ensure the resources needed for monitoring and control, capacity-building and awareness campaigns; iii) scientists and experts play a key role, namely gathering and analysing data to gain understanding of current trends, and develop innovative selective fishing gear and sustainable practices in collaboration with fishermen; iv) valorization of discards by other industries might lead to new jobs and onshore investments; v) means for enforcing the existing regulation are needed; vi) underfunded and understaffed fisheries management agencies cannot promote the implementation of the solutions proposed by MINOUW and other projects addressing the issue of overfishing. Public incentives are required to attract private investments from technological companies considering that the Mediterranean fishing industry is mainly composed of micro-enterprises with a very low investment capacity.

BOX 51 Integrated Multi-Trophic Aquaculture (IMTA)

A new approach to aquaculture attempts to address technical, environmental, market, socioeconomic and governance issues, while exploring innovative solutions, and to provide codes of practice and tools throughout the value chain with the aim of enhancing the performance of the marine fish-farming sector holistically[68]. Integrated Multi-Trophic Aquaculture (IMTA) is acknowledged as a promising, though complex, solution for the sustainable development of aquaculture. Its ecosystem approach is fully in line with the FAO Code of Conduct for Responsible Fisheries.[69] The concept of IMTA, inspired by the trophic dynamics of the natural environment, is based on farming fish together with molluscs and/or crustaceans, algae and/or aquatic plants, with the aim of improving environmental and economic yield.

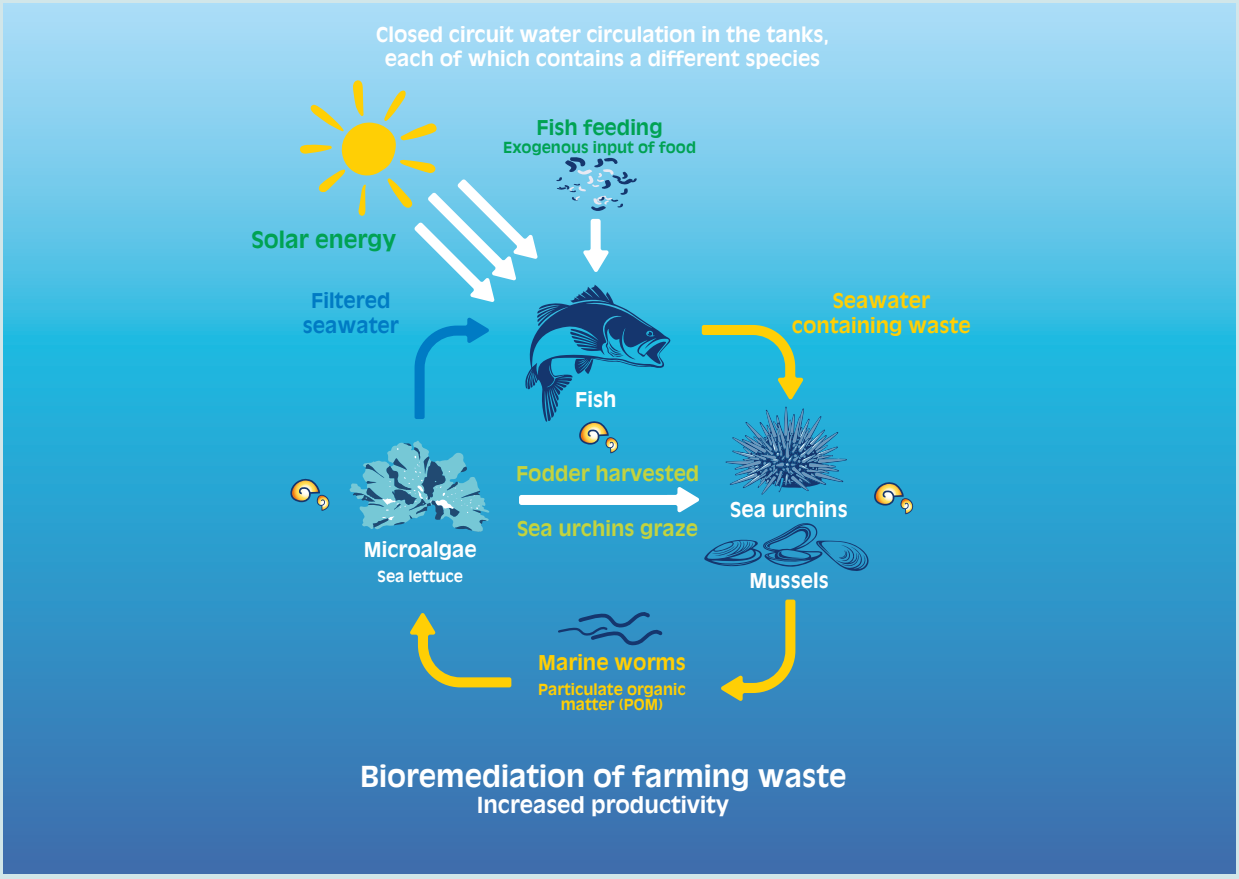


Figure 132 - Integrated Multi-Trophic Aquaculture (IMTA)
(Source: Paul Ricard Oceanographic Institute website, consulted October 2019)

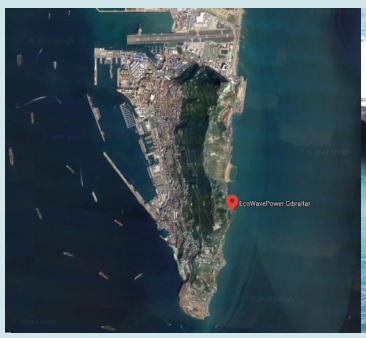
The Sustainable Tourism Community under the Interreg MED programme[70], with support of the BleuTourMed project, showcased how sustainable tourism can contribute to solving crucial environmental and socioeconomic challenges. Shifting to sustainable tourism models would require: i) introducing more stringent monitoring systems when assessing the health of marine and coastal ecosystems to ensure better decision-making when it comes to preserving those ecosystems' services, which are at the foundation of most tourism developments; ii) shifting the focus of tourism policies and practices from competitiveness to sustainability in order to halt environmental and social degradation and unleash the potential of the sector to promote local and regional development through the improvement of infrastructure, the creation of decent jobs, etc.; iii) avoiding a system whereby negative externalities of tourism developments are paid by residents only, and ensuring that environmental, economic, social and cultural

[68] MedAID (Mediterranean Aquaculture Integrated Development), a four-year project, funded by the European Union in the framework of Horizon 2020, http://www.medaid-h2020.eu/
[69] The Code of Conduct for Responsible Fisheries, approved by FAO in 1995, is the framework for national and international efforts to ensure the sustainable exploitation of aquatic living resources in harmony with the environment.
[71] https://sustainable-tourism.interreg-med.eu/

BOX 52 Eco Wave Power - Gibraltar Power Station - case study

(Source: Plan Bleu, 2020)

Since 2016, Eco Wave Power (EWP), a Swedish company founded in Israel in 2011, has been operating a 100 kW wave energy array in Gibraltar. The station is the only grid-connected wave energy array in the world operating through a commercial Power Purchase Agreement (PPA)[71]. It is the initial part of an overall plan which aims to cover 15% of Gibraltar's electricity needs. So far, the results of EWP are promising: the station surpassed 15,000 grid connection hours, a new world record for wave energy, and made significant scientific progress, resulting from the tests and R&D conducted at the power station, which will assist the commercialization of wave energy worldwide.



costs are accounted for in planning and budgetary documents; iv) favouring inclusive, structured and coordinated governance that empowers citizens, strengthens destinations' resilience and reconciles social needs and the legitimate interests of the sector. With regard to the latter, there are very interesting experiences in the region, in particular the establishment of stakeholder/thematic clusters for structured private-public collaboration and cooperation.

Moving towards a **sustainable transport** sector requires paying attention to infrastructure (e.g. investment and maintenance in road, rail, port and airport facilities, and their environmental impacts), vehicles (e.g., pollution control for new and in-use vehicles, and the use of the best available technologies, transition to renewables-based electric and/or hydrogen technologies, reduction of the environmental impacts of civilian and military maritime transport with Mediterranean and non-Mediterranean flags at port and at sea), and traffic management (e.g. urban traffic police, urban public transport optimization, control of straights and canals, legal and illegal maritime transport of freight and humans).

At the Mediterranean level, tackling air pollution from **shipping** is an urgent matter since a high percentage of the air pollution in coastal towns comes from this sector. The emissions of carbon dioxide (CO_2), nitrogen oxides (NOX), sulphur dioxide (SO_2) and particulate matter (PM 2.5) from shipping occurring in European waters contribute up to 10-20% of overall worldwide shipping emissions. When considering all ship traffic from national and international shipping arriving or departing from EU ports, the contribution rises to 30% for CO_2 (EEA, 2013b). A feasibility report looking at implementing a low-emission zone for ships in the region has concluded that the benefits would outweigh the costs threefold (INERIS, 2019). The report highlights that particulate matter can be reduced by up to 20% and nitrogen dioxide (NO_2) levels even by up to 76%, leading to up to EUR 14 billion in reduced health costs and potentially saving more than 6,000 lives every year in the region. The possibility of designating the Mediterranean Sea as an Emission Control Area (ECA)[72] is an important subject of discussion among Mediterranean countries.

Industry and mining need to improve: i) their resource use in the context of a circular economy, with the reduction, reuse and recycling of waste, ii) their attention to the production and use of chemicals, their impacts on humans and the environment, and the presence of chemicals in the environment and products (e.g. traditional pollutants, endocrine disruptors, substances, etc.), and (iii) their use of best available techniques.

Having steadily increased with global production over the past fifty years, the presence and accumulation of **plastic debris** is nowadays recognized as a major environmental problem, with consequences affecting not only nature and biodiversity, but also society and human well-being.

[71] A Power Purchase Agreement (PPA) often refers to a long-term electricity supply agreement between two parties, usually between a power generator and a customer (an electricity consumer or trader). The PPA defines the conditions of the agreement, such as the amount of electricity to be supplied, negotiated prices, accounting, and penalties for non-compliance. Since it is a bilateral agreement, a PPA can take many forms and is usually tailored to the specific application. PPAs can be used to reduce market price risks, which is why they are frequently implemented by large electricity consumers to help reduce investment costs associated with planning or operating renewable energy plants.

[72] International Convention for the Prevention of Pollution from Ships (MARPOL), Protocol, Annex VI *Regulations for the Prevention of Air Pollution from Ships*, 1997.

BOX 53 DestiMED project - case study

(Source: Plan Bleu, 2020)

DestiMED brings together a network of Mediterranean partners and protected areas to collectively develop, manage, monitor and promote ecotourism in Mediterranean protected areas, to inspire transformative nature experiences and cultural exchange. DestiMED aims to: i) assess and monitor the sustainability of ecotourism products developed in Mediterranean protected areas; ii) provide capacity building and reinforce cooperation for sustainable ecotourism product development at the local and regional scales; iii) improve the regional governance of ecotourism in Mediterranean protected areas.

Among other outputs, the project developed:

- a tested methodology for measuring the environmental impacts of tourism products, the "Ecological Footprint Calculator" available online for any Destination Management Organization, and the design of various ecotourism packages tested/assessed in thirteen protected areas in six Mediterranean countries.
- a replicable governance method for ecotourism development (planning, implementing, monitoring, revising), applicable to any destination with significant natural/cultural assets. A Public-Private Partnership is in place in each of the thirteen pilot protected areas, starting from the establishment of a Local Ecotourism Cluster in each area, involving ecotourism stakeholders in the destination and the park management bodies.

BOX 54 Mitigation of impacts from maritime transport in Marine Protected Areas (MPAs)

The impact of the **maritime transport sector** is an issue for the whole Mediterranean Sea, but is particularly critical in Marine Protected Areas (MPAs). In this respect, there are clear recommendations developed within projects that aim to prevent or minimize the impact of the maritime transport sector on MPAs. The PHAROS4MPAs project provides a set of practical recommendations for regional stakeholders, including public authorities, as listed below (Randone et al. 2019).

Maritime Spatial Planning (MSP) Authorities should: i) make use of Particularly Sensitive Sea Areas (PSSAs), Areas To Be Avoided (ATBAs) and Traffic Separation Schemes (TSSs) to protect MPAs from the risks of maritime traffic accidents and reduce the chances of collisions with cetaceans; ii) use MSP processes to prevent anchoring impacts, introduce voluntary no-anchoring zones, adopt zoning plans indicating sensitive areas as well as suitable anchoring areas, include MPA boundaries and anchor-sensitive areas on nautical charts.

Ports Authorities should: i) develop joint solutions with MPAs - including monitoring, modelling and vulnerability assessments - to mitigate the impact of pollution from port operational activities; ii) work with local pilot companies to identify and implement piloting solutions in key marine areas; iii) together with the State, promote cross-border cooperation by defining agreements between national authorities and/or port authorities for navigation safety and pollution response.

States should: i) promote and actively participate in coordinated response and contingency plans for oil spills and other pollution events at the cross-border, subregional and regional levels; ii) ensure implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), particularly through inspections and monitoring activities (Randone et al. 2019).

Public authorities can also play a major role in minimizing the cruise sector's impacts on MPAs by, for example, establishing strict limits and buffer zones regarding the minimum distance at which cruise ships are allowed to navigate, moor or stop from the borders of MPAs. This would minimize existing impacts and counterbalance the growing interest from the industry in visiting these areas. National environmental/marine authorities should also: i) promote the continuous monitoring of cruise activities, with close cooperation between MPA managers and the relevant public authorities (e.g. registration of operational data, emissions and discharges, fuel type); iii) ensure that authorization to navigate in highly sensitive natural areas is a well-informed process, with the close involvement of MPA managers to limit the risks (e.g. grounding, collisions); iv) implement speed restrictions to mitigate the collision risk. In addition, lower speeds reduce potential acoustic impacts and emissions of air pollutants; v) make use of MSP tools such as PSSAs to prevent accidents and the consequential environmental impacts (UNEP/MAP - PAP/RAC, 2019).

While waste prevention measures are likely to be more efficient than curative action, both approaches need to go hand in hand, especially given the amount of marine litter already present today in the Mediterranean Sea. Innovative responses have been put forward in the Mediterranean *(Box 55)*.

At the current stage of knowledge, even if applying all available best practices and technologies, it is not possible to eliminate all environmental impacts stemming from the economic activities described above. Such impacts can and must be mitigated. The most effective way to do so is by applying the mitigation hierarchy, that aims at (i) avoiding negative impacts as much as possible in the first place, (ii) then, if degradations cannot be avoided, to reduce them, and (iii) in a third and last step, if negative externalities can neither be avoided nor reduced, to offset them (Chapter 8, *Figure 199*). Integrating this mitigation hierarchy into the prevailing business models and production patterns will be key to achieving sustainability in the Mediterranean region.

BOX 55

Cleaning Litter by developing and Applying Innovative Methods (CLAIM) - case study

(Source: Plan Bleu, 2020)

CLAIM
CLEANING LITTER BY DEVELOPING & APPLYING INNOVATIVE METHODS IN EUROPEAN SEAS

The CLAIM project targets marine litter through the development of new technologies and approaches to clean our seas. The project will power five innovative marine cleaning technologies, and prevent litter from entering the sea at two main source points: wastewater treatment plants and river mouths. Directly after pre-filtering, a photocatalytic nano-coating device will degrade microplastics in wastewater treatment plants. Mounted on ships, a small-scale thermal treatment device (pyrolyzer) will be used to turn the litter collected into energy to power ships. At river mouths, a floating device will collect and monitor visible litter, while a CLAIM network of FerryBox systems will operate on ships in the Baltic, West & East Mediterranean, mounted with an automated seawater sampling device & passive flow-through filtering system. From a scientific point of view, CLAIM aims to develop innovative modelling tools to assess and create informative maps about visible and invisible marine plastic pollution at the basin and regional scales (Saronic Gulf, Gulf of Lion, Ligurian Sea and Belt Sea). An ecosystem approach will guide the project through the assessment of the potential benefit from proposed litter cleaning methods to ecosystem services and human well-being. New business models will enhance the economic feasibility for upscaling the innovative cleaning technologies, taking into account the existing legal and policy frameworks in the CLAIM countries, as well as acceptance of the new technologies by their end users and relevant stakeholders. The main strengths of the project are to: i) respond to one of the major environmental concerns nowadays through cost-effective, environmentally-friendly and innovative solutions; ii) positively impact society (public health) and the coastal economy (preservation of cultural/historic heritage and biodiversity); iii) introduce new business models to evaluate the cost-efficiency and feasibility of the proposed solutions within existing policy and legal frameworks based on social acceptance; iv) use technologies that are suitable for uptake and upscaling, and eventually commercialization.