Projet cofinancé par le Fonds Européen de Développement Régional (FEDER)
Project cofinanced by the European Regional Development Fund (ERDF)

MED MARITIME INTEGRATED PROJECTS
Med-IAMER

Western Mediterranean ecoregion (WME)

Fisheries and aquaculture

Definition

Generally, a fishing activity is linked with the harvesting of fish. It may involve capture of wild fish or rearing of fish through aquaculture (FAO definition). On a broad level, capture fisheries can be classified as industrial, artisanal or recreational. Industrial fisheries involve capital-intensive fisheries using relatively large vessels with a high degree of mechanization and advanced fish finding and navigational equipment. Traditional fisheries could be defined as those involving fishing households, using relatively small amount of capital, relatively small fishing vessels, making short fishing trips (close to shore) and mainly for local consumption. In general, recreational fisheries can be defined as a non-commercial (i.e. not for sale, barter, or trade) subset of capture/harvest fisheries; motivated by catching fish for fun, pleasure, or sport.

Regional context

Landed catches in the WME represent around 35% of overall catches landing in the Mediterranean fishing areas[1]. Small pelagic fishes such as sardine and anchovy are among the main targeted species in the Western Mediterranean representing around half of total landed catches. Bottom species are the second most fished group in the sub-region (28%). Fisheries activities in the WME tend to take place close to the coast. Moreover, they are mainly carried out by a large number of small-scale fishing vessels. Spain – historically an important fishing country – is still highly dependent on fisheries as a source of income.

The table below shows landed catches in the overall Mediterranean fishing areas in

[1] Med-IAMER adopts FAO definition of fish production statistics « the volume of fish catches landed by country or territory of capture ». We refer to them as "landed catches" taking into account that illegal catches or by-catch are not registered in the official statistics.

tons (Black sea, Azov Sea and Sea of Marmara excluded).

Landed catches in the Balearic Islands, the Gulf of Lion and Sardinia amounted to 310,019 tons in 2011. The table above shows a permanent decrease in landed catches in the region between 1995 and 2011. Nevertheless, total catches landed in the WME still accounted for around 35% of total catches landed in the Mediterranean.

Statistical division	1995	2000	2005	2011
Balearic Islands	277 625	268 755	262 535	
Gulf of Lions	308 483	310 484	287 571	236 986
Sardinia	393 020	388 286	373 692	310 019
Adriatic	144 314	154 380	147 169	151 841
Ionian	273 874	211 113	214 112	182 283
Aegean	172 700	114 368	114	88 309
Levant	83 392	79 867	83 824	112 943
Not known (GFCM area)	24		5 879	
Tunas (GFCM area)	75 743	72 665	128 902	51 658
Total	**1 142 912**	**1 020 680**	**1 067 795**	**897 054**
Total West Med	**393 020**	**388 286**	**373 692**	**310 019**
% West Med	**34.4**	**38**	**34,5**	**35**

*** Landed catches of Tuna are not allocated according to GFCM statistical divisions and are grouped together into a division named 'Tunas'; another division, named 'not known' contains all the landed catches for which the statistical division is not known.**

A total of 80 fishing ports are present in the Spanish Western Mediterranean (i.e. Cataluña, Valencia, Murcia and Baleares). In addition, a total fleet of 4,148 vessels representing a total gross tonnage of 124,336 is active in the region. Large differences in gross tonnage (GT) per vessel can be found between the different regions. Nevertheless, commercial fishing in Spain has declined during the last years, and Spain has reduced its deep-sea fleet. However, aquaculture activities showed an increasing trend for the same period in the WME.

France has a rich history of fishing activity as well. The French fisheries sector is also dominated by small-scale fishing using a large number of different fishing techniques. With regard to aquaculture, France is mostly active in oyster cultivation being the largest producer of oysters in the European Union (e.g. Languedoc-Roussillon marine area) as well as mussel culture, though to a lesser extent.

The Italian fishing fleet consists of around 10,159 vessels of which the majority operates in waters around the Italian peninsula. The aquaculture sector has been developing considerably since the 1970s. The current trend in aquaculture is to reduce onshore/coastal sites and develop offshore sites.

Most assessed fish stocks in the WME are in a critical situation. The pressure seems to be particularly strong in the Balearic area and on high value species such as Bluefin Tuna and Swordfish (Source: ICCAT, GFCM, FAO).

The publicly available information on fishing activities, i.e. landed catches, number and tonnage of vessels, type of fishing technique as well as fishing effort cover FAO or GFCM regions and are related to ports, respectively. These indicators do not provide information about the potential pressure exerted on specific areas where fishing activities are developed as the GFCM fishing areas are very broad.

The mandatory Vessel Monitoring System (VMS) on the other hand is a data collection with a vast number of data that consist in geographical positions (GPS) recorded at a more or less regular time step by each vessel. It has led to massive acquisition of fishing vessel movement data which offers new means of studying the spatio-temporal dynamics of fishermen (e.g. Gloaguen et al 2014). Due to the restriction in data access and the fact that models are needed to interpret the data, they could not be used in the present assessment of Med-IAMER.

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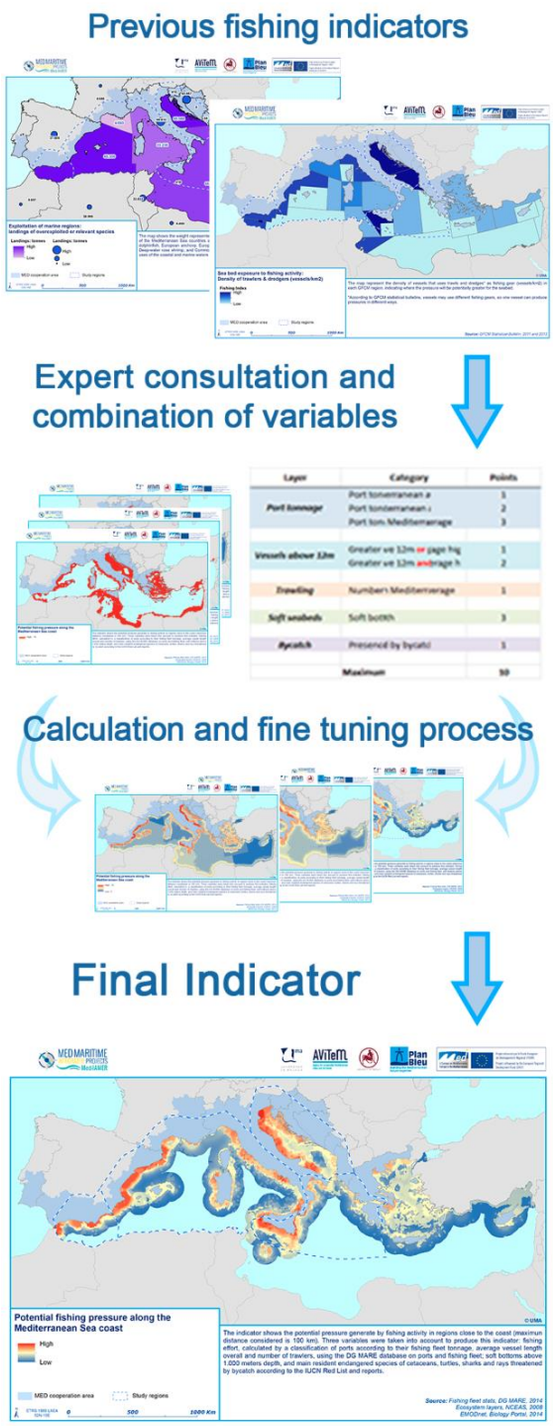
Improvement of indicator

After a consultation with stakeholders from both the fishing and conservation sectors where the first preliminary (area- and port- related indicators) were presented (see first step in the workflow diagram), the need for a spatially explicit mapping of fishing activities was expressed.



Consequently, Med-IAMER developed an expert-based approach to estimate the spatial distribution of fishing activities and the related pressure of harmful fishing techniques on marine environments. This approach resulted in the Cumulative Fishing Indicator, that aims at provide a spatial explicit estimation of main pressures exerted from fishing related activities, particularly trawling and dredging, taking into account the variables (listed in the table below) for which spatial data are available and that had a specific influence on marine ecosystem. Based on the intensity of each activity, a scoring has been assigned based on expert judgment. The main activities, ranges of categories and scoring systems datasets are described below.

Layer	Category	Points
Port tonnage	Port tonnage lower than Mediterranean average	1
	Port tonnage higher than Mediterranean average	2
	Port tonnage much higher than Mediterranean average	3
Vessels above 12m	Greater number of vessels above 12m **or** port average higher than 12m	1
	Greater number of vessels above 12m **and** port average higher than 12m	2
Trawling	Number of trawlers higher than Mediterranean average	1
Soft seabeds	Soft bottoms above 1000m depth	3
Bycatch	Presence of species threatened by bycatch	1
	Maximum sum	**10**

Highlighted features

The map shows the composite indicator, developed by Med-IAMER, on the spatial distribution of potential pressures

generated by fishing activities in coastal regions of the Mediterranean Sea. It is clearly visible that the coastal water along the Spanish Mediterranean coast is highly exposed to this pressure in the WME. Additionally Italian coastal waters in the areas around Naples are affected by high pressures. The fishing activities around the WME islands exert lesser pressures due, mainly to the smaller fishing fleet in the region.

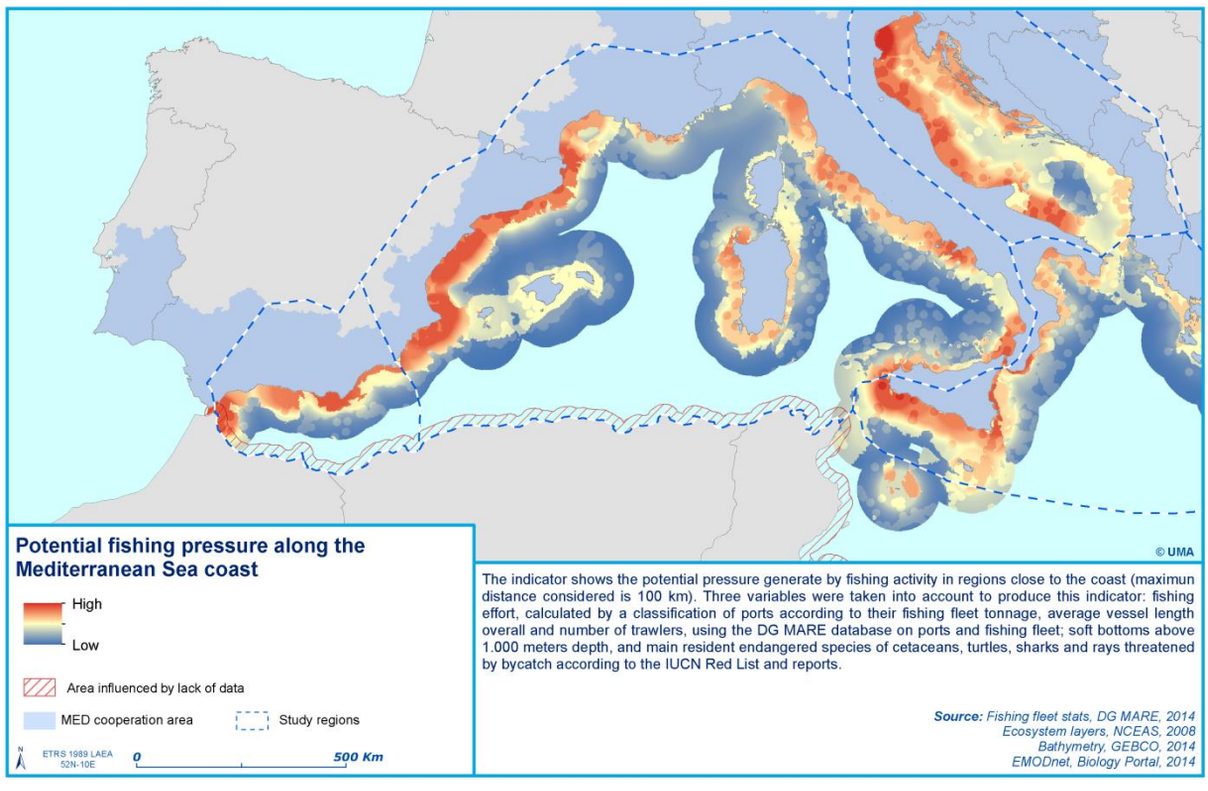
Data/Indicator used

Three variables were taken into account to produce the composite indicator: fishing effort, seabed substrate and biodiversity affected by bycatch.

Fishing effort was calculated by a classification of ports according to their fishing fleet tonnage, the average vessel length overall (vessels larger or smaller than 12 meters) and the number of trawlers. Fuel prices and time play an important role for fishermen. Therefore, based on expert criteria, a distance offshore was determined considering a maximum travel time of 3 hours at regular operating speed for fishing vessels (6-8 knots). The resulting distance is around 24 nautical miles (about 45 km). This area of influence around ports is where the fishing activity is mainly concentrated. From this point (45 km), the probability of finding ships decreases with distance. Exponential distance decay was calculated until 100 km offshore to model this fact.

Marine ecosystems on soft bottoms are vulnerable to trawling. According to expert knowledge, trawling is limited to 1000 meters depth. It is usually practiced between 180-450m. Using bathymetry data (GEBCO 2014), soft bottoms deeper than 1000m were discarded in order to locate seabed that may suffer from trawling pressure.

As data were so far not facilitated from Mediseh project (DG-MARE), information



on biodiversity was produced using EMODnet Biology Portal database. The indicator used considers main resident endangered species of cetaceans, turtles, sharks and rays threatened by bycatch according to the IUCN Red List and reports.

Gaps

Port data used to produce the indicator present gaps for ports in Turkey, North African and Middle Eastern countries. Data for Albania and Montenegro were found in different reports of the European Commission.

Limits of methodology

DG MARE port data do not specify waters where vessels operate. Therefore, the fishing effort indicator may be overestimated because vessels may fish in waters outside the Mediterranean Sea.

Biodiversity data used are field observations and not the actual distribution areas of the species. The principle of absence-presence must be considered: just because it has not been seen, it does not mean it is not there. In addition, the indicator only takes into account what is registered in the EMODnet database.

Seabed information is based on a global dataset. A more regionalized data may provide some more detailed information.

Upcoming improvements will include data from MEDISEH Project (DG MARE). A petition to use specific outcomes from the MEDISEH project for the improvement of this indicator has been sent to DG MARE back in November 2014 and Med-IAMER did not have access to such data so far.

Related Pressures

Additionally to the Cumulative Fishing Indicator, individual indicators were developed illustrating the fact that fishing activities influence marine ecosystems in a number of ways, including:

Physical damage to the sea floor

Physical damage to sea floor as benthic trawling alters benthic habitats, modifies and destroys the structure of seagrass meadows (particularly important for *Posidonia oceanica* beds) and their associated faunal assemblages, and reduces the number of species and of suitable habitats. In addition to physical damage, trawling impacts also include excessive suspended sediments. The overall result is the reduced complexity of the seafloor structure (UNEP/MAP/Plan Bleu 2014).

Underwater noise

Underwater Noise maritime traffic is an important source of anthropogenic noise especially in the Ligurian Sea. Excessive noise makes it harder for whales to communicate with each other or to receive acoustic cues, for example to detect approaching vessels or other hazards (UNEP/MAP/Plan Bleu 2014).

Marine litter

Marine litter issued both from fishing vessels and lost or abandoned gears is a major pressure on species and habitats. These leftovers in the sea are a major cause of entanglement or ingestion by many species including seabirds, turtles, marine mammals and others (UNEP/MAP/Plan Bleu 2014).

Over exploitation of fish stocks

Over exploitation of fish stocks is mainly caused by the increasingly efficient fishing methods used, as more than 65% of commercial stocks in the Mediterranean are beyond sustainable limits. The amount of accidental capture of non-target species is also a serious

issue in the WME, while most of the discards are wasted (UNEP/MAP 2012).

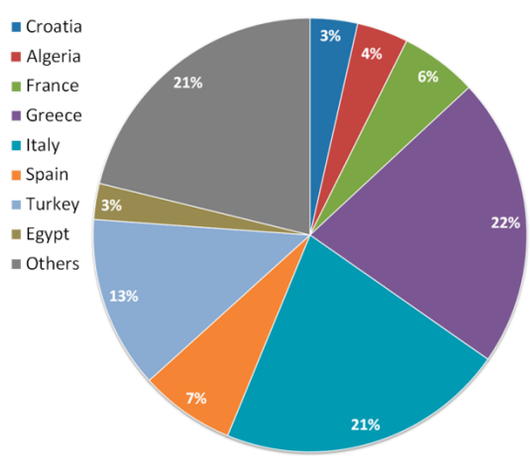
Introduction of non-indigenous species and translocations

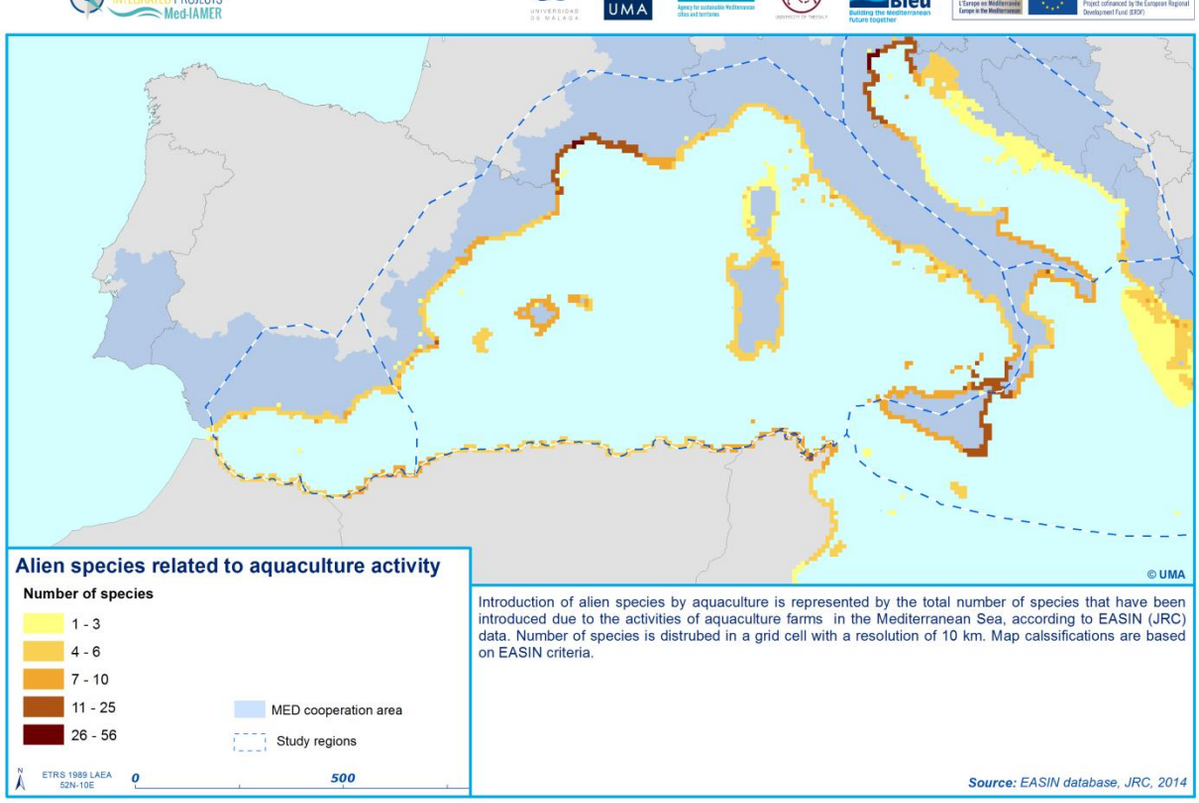
Different sources exist for introduction of non-indigenous species and translocations, including ballast water. Aquaculture is one of the main ways through which non-indigenous species enter the WME (UNEP/MAP 2012). Some non-indigenous species however have the capacity to quickly adapt to their new environment, to become established, and to compete with indigenous species for limited habitats around the Mediterranean Sea.

Highlighted features

Aquaculture is an important path of introduction of alien species (AS) in most Mediterranean countries. The pie chart shows the pressure by AS represented as the % of AS introduced through aquaculture in the coastal areas of the Mediterranean Sea. These percentages are based on the coastal account of AS according to the 10 km grid of the European Alien Species Information Network (EASIN) Database (JRC, 2014). The Eastern part of the Mediterranean seems to be more affected by AS than the WME. Greece, Italy and Turkey present the highest invasion levels, being a 56% of the total in the Mediterranean Sea.

% Alien species introduced through aquaculture in the Mediterranean coast





Introduction of alien species by aquaculture is represented by the total number of species that have been introduced due to the activities of aquaculture farms in the Mediterranean Sea, according to EASIN (JRC) data. Number of species is distrubed in a grid cell with a resolution of 10 km. Map calssifications are based on EASIN criteria.

Source: EASIN database, JRC, 2014

The map on alien species illustrates the number and distribution of AS introduced by aquaculture activities in a grid cell of 10km resolution. In the WME, the highest pressure is observable along the coastal water of the Languedoc-Roussillon region (France). The northern part around the Strait of Messina (Italy) and some isolated areas on the coast of Valencia (Spain) also show higher values of alien species. The pressure is nevertheless lower in coastal water in Southern Catalonia, Baleares as well as in the Bouches-du-Rhone area. However, the figures reported on the distribution map of AS should be considered with great caution since the information depends on the scientific investigation efforts within the countries.

Data/Indicator used

The indicator presents the total number of alien species introduced due to aquaculture activities in the Mediterranean Sea. Species count was made by the EASIN, an initiative of the Joint Research Centre of the European Commission that aggregates data from different data providers (see Katsanevakis et al. 2014 for more details).

Gaps

N/A

Limits of methodology

Model-based approach with low degree of uncertainty, as based on species databases and peer-reviewed literatures. The indicator does not reflect the state of invasion and the extent of the harmful effects of alien species. It does not consider the pressure caused by specific species but rather counts the number of alien species per area (density).

List of proposed indicators

The following table lists the indicators developed and mapped within Med-IAMER on the impacts of fisheries and aquaculture on coastal (land) and marine environments. **All maps, identified by the indicator ID, can be found at the project's web page:** http://www.medmaritimeprojects.eu/section/med-iamer redirect/outputs

ID	Indicator description
FI01	Marine exposure due to port activity: fishing
FI02	Aquaculture production: fish farms influence
FI05	Aquaculture production: production by km of coast
FI08	Aquaculture production: production per capita, main species
FI09	Alien species related to aquaculture activity
FI12	Exploitation of marine regions: catches of overexploited or relevant species
FI15	Fishing power of Mediterranean countries: overexploited or relevant species (kg/km coast)
FI16	Fishing power of Mediterranean countries: overexploited or relevant species (kg/kW)
FI20	Sea bed exposure to fishing activity: % trawlers and dredgers
FI35	Sea bed exposure to fishing activity: density of trawlers and dredgers

FI36	Marine species exposure to bycatch: density of surrounding and seine nets
FI37 - FI42	Marine species exposure to bycatch: density of [fishing gear type] (seiners, hook and lines, etc.)
FI47	Turtle species exposure to bycatch: density of long liners
FI48	Cetaceans species exposure to bycatch: density of gillnets and entangling nets
FI49	Potential fishing pressure along the Mediterranean Sea coast
FT01_2000 - 2014 FT01_v2000-2007 - v2007-2011	Exploitation of marine regions. Total landings. Year 2000, 2007, and 2014. Variations between 2000-2007, 2000-2011, and 2007-2011
FT02_2000 - 2014 FT02_v2000-2007 - v2007-2011	Exploitation of marine regions. Landings of overexploited or relevant species. Year 2000, 2007, and 2014. Variations between 2000-2007, 2000-2011, and 2007-2011
FT03_2000 - 2014 FT03_v2000-2007 - v2007-2011	Number of vessels by port in 2000. Year 2000, 2007, and 2014. Variations between 2000-2007, 2000-2011, and 2007-2011
FT04_2000 - 2014 FT04_v2000-2007 - v2007-2011	Average length overall (m) of vessels by port in 2000. Year 2000, 2007, and 2014. Variations between 2000-2007, 2000-2011, and 2007-2011
FT05_2000 - 2014 FT05_v2000-2007 - v2007-2011	Total tonnage (GT) of fishing vessels by port in 2000. Year 2000, 2007, and 2014. Variations between 2000-2007, 2000-2011, and 2007-2011

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