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

Adriatic Ionian ecoregion (AIE)

Maritime Transport

Definition

The basic concept is that maritime transport relates to the carriage of goods or/and passengers by sea by a person for commercial purposes, either in return for payment (i.e. for hire and reward) or on an organization's own account as part of its wider economic activity. Here goods transportation refers to the volume of containerized, dry bulk, liquid bulk and roll on-roll off (Ro-Ro) type of cargo handled by the ports while passenger traffic refers to the number of national, international and cruise passenger volumes transported through ports.

Regional context

The Adriatic Ionian ecoregion (AIE) constitutes an important maritime transport node due to its position on the east-west and north-south European axes (including motorway of the sea of south-east Europe) connecting the region to the eastern Mediterranean and the Levantine Sea. The region's ports benefit from their proximity to a large market that extends from the Balkan Peninsula to central Europe but compete with the ports of northern Europe and their distance from the Suez-Gibraltar sea route.

Depending on the type of cargo transportation, ports' dynamics are quite different in the region. Container market of the AIE is dominated by the northern ports and mainly by the ports of North Adriatic Ports Association (NAPA). Additionally, Southern ports are dominating the market of Roll On-Roll Off (Ro-Ro) transport. Finally, in the market of dry and liquid bulk transportation the ports that are presenting the greatest activity are located both at the

Driver	Maritime transport
Relevant contribution (%) to total GVA	26,56
Relevant contribution (%) to total employment	11,69
Intensity of environmental pressure (%)	17,89
Total %	18,71

Maritime transport is the second highest driver of ecosystem change in terms of priority for the AIE

southern and the northern parts of Adriatic-Ionian Sea.

The region has a high share of cruise traffic, as it attracts over 21% of tourist passengers calls of the total passengers' calls at European ports. It is amongst the most active European regions in international passenger traffic as 11% of all ship passengers were travelling from Adriatic-Ionian ports. In terms of merchandise transportation, the region is mostly specialized in dry bulk transport, since the relative volume against total European handling volumes is reaching around 8%. The lowest performance is observed in the container handling sector as the percentage of the Adriatic-Ionian ports to the total European volumes is just exceeding 2%. This lack of competitiveness is mostly caused by the dominance of North European ports both in terms of infrastructure and in terms of hinterland connections' quality.

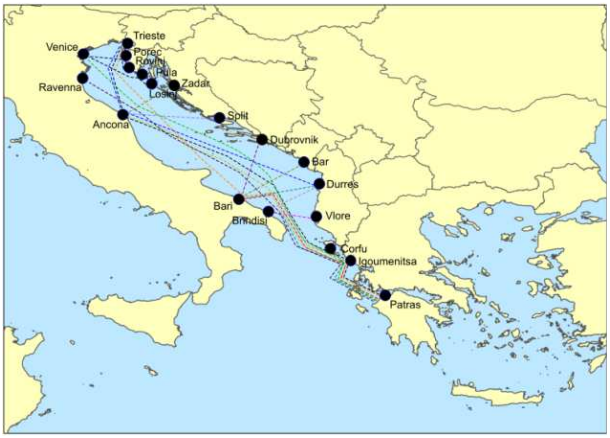
Despite the relative lack of adequate infrastructure, cruise passenger flows are steadily increasing in the last decade and many ports can accommodate ships with high carrying capacity. Additionally, port authorities strengthen their networks among shipping lines and thus, tend to attract significant traffic. The table below presents the average carrying capacity of ships and the number of cruise lines calling at each port. Bari and Venice (Italy) are the two ports that accommodate cruise ships with average capacity exceeding 3000 passengers. Additionally, concerning the connectivity of each port, Dubrovnik (Croatia), Corfu (Greece) and Venice (Italy) have established an extended lines' network as the lines calling at the ports exceed 20. In terms of annual traffic of cruise passengers, Venice is the dominant port of the Adriatic-Ionian region (1,8 million pax), followed by Dubrovnik port with about 1,1 million pax.

Port	Pax/Call	Shipping Lines
Bari	3537	5
Venice	3314	20
Katakolon	2488	16
Messina	2199	11
Trieste	2195	3
Corfu	1551	21
Kefallinia	1357	7
Dubrovnik	1348	23
Ravenna	1311	6
Koper	1212	11
Zakynthos	1004	3
Split	840	16
Kotor	821	19
Zadar	501	6
Sibenik	298	3

Shipping companies and size of ships calling at Adriatic Ionian ports (2014)

AIE is well served by shipping companies and the main international lines concern the connection of the Balkan coastline to the Italian ports. The map below shows the strong established connections between ports of the Balkan Peninsula such as Patras, Igoumenitsa, Durres and Bar, and Italian ports of Bari, Brindisi, Ancona and Venezia (Synthesis Project, 2012). Connections are more intensive during the summer period because of the high tourist demand. Nevertheless, many lines remain also active during the winter period, especially in the routes between Greece and Italy. The busiest ports, in terms of passenger traffic, are those of Messina, Reggio di Calabria which are linked to Italian ports of the West coast. Additionally, in the Adriatic Sea Ancona, Patras, Igoumenitsa, Bari and Durres present the highest figures. These ports are well connected with a significant number of destinations and are called by more than

30 ships per week whose average capacity exceeds 1k passengers. High levels of connectivity are also observed in the ports of Brindisi, Split and Venice. Nevertheless, most lines of Split and Venice are characterized by seasonality and are not in operation during the winter period.



Roll on/Roll off PAX Connections in the Adriatic-Ionian Region (2014)

Related Pressures

The intensive maritime transport activity observed in the Adriatic-Ionian region implies ships and port emissions, risks of accidents, acute pollution events and the introduction of invasive alien species through ballast water discharges (EC, 2012).

Sealing

Physical alteration of coasts through sealing and the construction of relevant infrastructure while material discharge derived from ports dredging is a significant contributor to smothering (ISPRA, 2012).

Underwater noise

Underwater noise is a growing concern in the Mediterranean Sea due to the increasing maritime activity, affecting communication of marine mammals and certain fish species. There are three categories of impacts of underwater anthropogenic noise on cetaceans: Behavioral (i.e. changes in surfacing or diving), acoustic (i.e. changes in type or timing of vocalizations as well as masking acoustic signal) and physiological (i.e. hearing loss, mortality) (UNEP/MAP, 2012).

Contamination by hazardous substances

Petroleum Hydrocarbon (oil), Polycyclic Aromatic Hydrocarbons and oily residue discharges from ships represent a significant threat to marine and coastal ecosystems. These discharges may occur during normal activities (such as tank washing, loading/ discharging, bunkering, dry docking operations) (UNEP/ MAP, 2012) or may be accidental or illegal. Illegal discharges of oil from ships are often limited in size and scattered but their sum is greater than that of oil spills and they may create a chronic impact of oil in specific regions. Accidental oil spills have historically been of crude oil rather than refines products but recently this trend has reversed. Such spills have both immediate and longer term impacts including contamination of farmed fish or shellfish for human consumption. Most of the oil spills are often located along the major East – West maritime traffic lane along the Sicilian channel as well as on the Ionian stretch between Sicily and the Peloponnese. Considerable oil spills are also present along the Ionian waters off western Greece which most likely arise from the considerable maritime traffic leading into and away from the Adriatic (Metis, 2014; UNEP/ MAP, 2012). It was estimated that, at a Mediterranean level, the most important share (80%) of hydrocarbon pollution derives from routine shipping operations such as tanker washing or ballasting, while accidental spills account for 10% (SHAPE, 2013).

A brief assessment of the overall accident exposure in the Adriatic Sea has recently been undertaken by Det norske Veritas who concluded that the Adriatic Sea has the highest accident frequency, more than five times as high as the world average (Thana and Patuzi, 2013). Regarding the number of ship accidents in the Adriatic Sea over the past 15 years period, a total of 174 accidents have occurred. This increases the pressure of pollution, where

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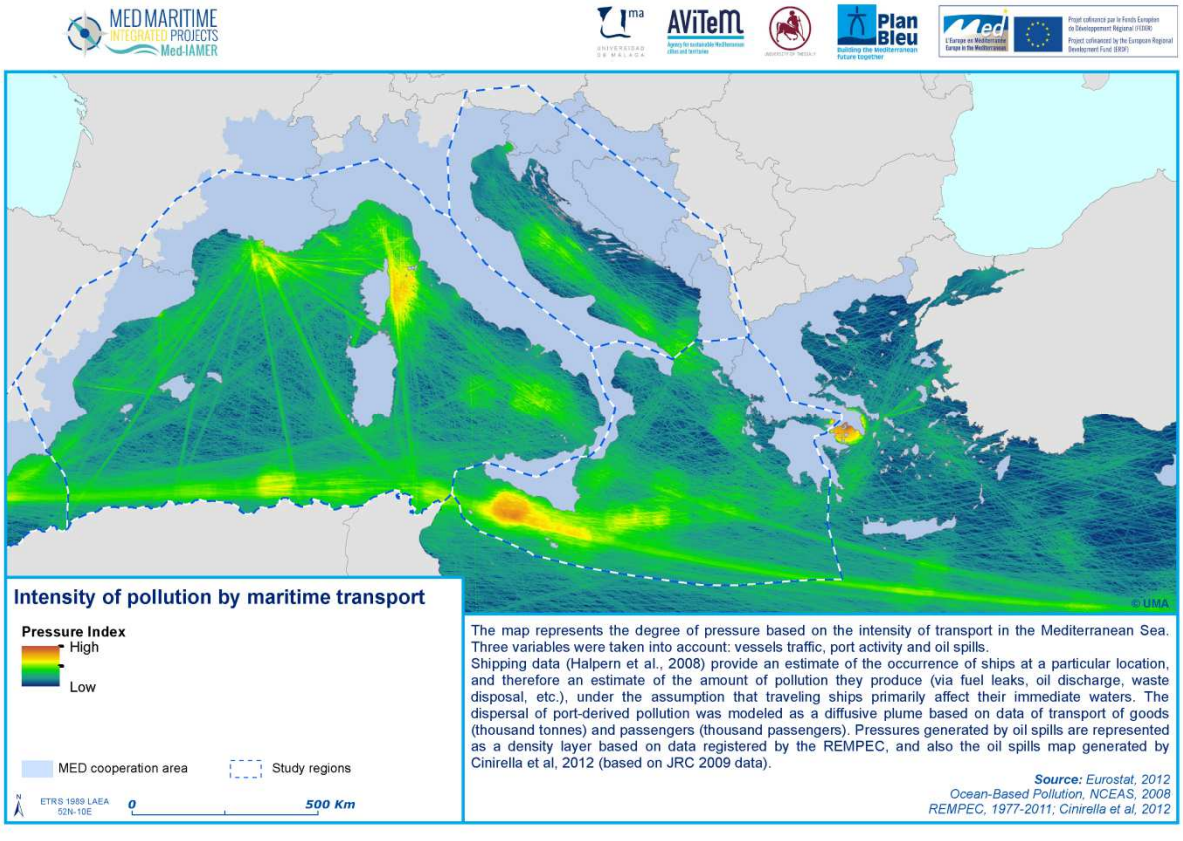
257 oil spills from ships in 1999; 263 in 2000; 184 in 2001; 244 in 2002 were detected in the Adriatic Sea (D. Vidas).

The main impacts of PAHs include effects on the functional traits of marine species at the genetic, cellular, biochemical and physiological levels. Genetic damage may result in chromosomal aberrations, impacts on embryonic stages and long-term effects such as carcinogenic and mutagenic growth in vertebrates.

Carriage of chemicals is also a common threat from maritime transport mainly through accidental incidents. TBT (Tributyltin) is considered the most toxic substance that is intentionally introduced into marine environments. It affects non target biota, especially in areas with high vessel density and restricted water circulations. Highest concentrations of TBT are found in sediments from harbors, marinas and shipping channels because TBT is broken down only very slowly in sediments with low oxygen content. Its use in large vessels is currently the major source of input to the sea. Marine invertebrates are very sensitive to TBT, effects include morphological changes, growth inhibition, suppressed immunity, reduced reproductive potential and changes in population structure while another known effect is the development of male sexual characters in female prosobranch gastropods as collected in areas of Venice (Italy) and Rovinj (Croatia). Besides the impact of gastropods, TBT and its degradation products accumulates in tissues of marine organisms and move up the food chain. Very high concentrations have been found in top predators including the bottlenose dolphin, bluefin tuna and blue shark collected off Italy (ICES, 2003; UNEP/ MAP, 2012).

Highlighted features

The map represents the estimated intensity of pollution by maritime transport, based on shipping tracks and port influence. The relatively low pressure index for the Adriatic contrasts with the high density of shipping tracks in the



The map represents the degree of pressure based on the intensity of transport in the Mediterranean Sea. Three variables were taken into account: vessels traffic, port activity and oil spills.
Shipping data (Halpern et al., 2008) provide an estimate of the occurrence of ships at a particular location, and therefore an estimate of the amount of pollution they produce (via fuel leaks, oil discharge, waste disposal, etc.), under the assumption that traveling ships primarily affect their immediate waters. The dispersal of port-derived pollution was modeled as a diffusive plume based on data of transport of goods (thousand tonnes) and passengers (thousand passengers). Pressures generated by oil spills are represented as a density layer based on data registered by the REMPEC, and also the oil spills map generated by Cinirella et al, 2012 (based on JRC 2009 data).

Source: *Eurostat, 2012*
Ocean-Based Pollution, NCEAS, 2008
REMPEC, 1977-2011; Cinirella et al, 2012

Southern Ionian Sea, leading to high potential pressure of pollution. Only some important ports (Venice, Dubrovnik, Koper-Trieste) have major influence on marine pollution.

Data/Indicator used

Three variables were taken into account: vessels traffic, port activity and oil spills. Shipping data (Halpern et al., 2008) provide an estimate of the occurrence of ships at a particular location, and therefore an estimate of the amount of pollution they produce (via fuel leaks, oil discharge, waste disposal, etc.), under the assumption that traveling ships primarily affect their immediate waters. The dispersal of port-derived pollution was modeled as a diffusive plume based on Eurostat data of transport of goods (thousand tonnes) and passengers (thousand

Gaps

N/A

Limits of methodology

The pollution by ships estimation is based on a global model with its inherent uncertainty. Hence a more regionalized modeling approach may provide some more adapted information. No distinction is being made between cruisers, ferries and commercial good ships. Oil spills pollution does not consider ocean currents and dispersion of pollution produced by them.

Introduction of alien species from transport

A matter of increasingly serious concern in the Adriatic Sea is the introduction of harmful aquatic organisms and pathogens through ships' ballast waters and sediments. The quantity of ballast water released in the Adriatic ports of Italy, Croatia and Slovenia estimated for the year 2003 was approximately 8 mil tons, of which around 80% was discharged in Italian Adriatic ports, while the remaining volume was shared between the Slovenian port of Koper and all the Croatian ports. However, most of ballast water arrives from locations in the Mediterranean (58%) and due to inter-Adriatic traffic (34%) while only 8 % of ballast water volume released is currently originating from ports located outside the Mediterranean Sea (UNEP/MAP – Plan Bleu, 2009). With expected changes in import and export flows, and especially if a major new oil export route is introduced from a deep – sea port in the Adriatic, those proportions could change considerably. According to specific studies on alien species along Italian coasts based on data collected during years 1945-2009, 51 alien species have been identified in the northern Adriatic, 9 in central, 32 in southern Adriatic and 42 in northern Ionian. Venice and Taranto have been also identified as hot spots. Available data show that vessels contribute significantly (54%) to alien species occurrence in Italian seas (SHAPE, 2013).

Highlighted features

The map shows the number of invasive species introduced through transport activities, i.e. through ships. It clarifies that the intensity of invasive species introduction in the Adriatic and Ionian is concentrated at the coasts, indicating the impact of ships' ballast waters close to the ports.

Data/Indicator used

Data are taken from the EASIN database, elaborated by EC's Joint Research Centre (see also Katsanevakis et al. 2014) at a resolution of 10 km.

Gaps

N/A

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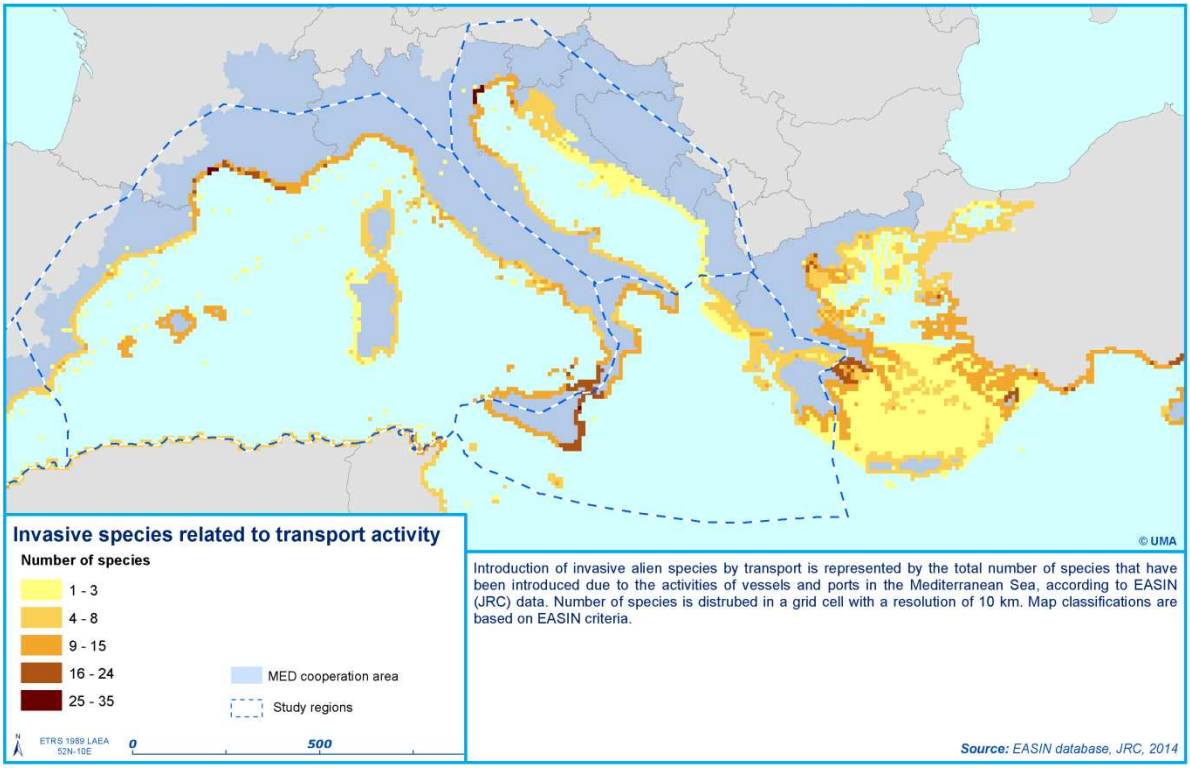

Limits of methodology

Model-based approach with low degree of uncertainty, as based on species databases and peer-reviewed literatures.

List of proposed indicators

The following table lists the indicators developed and mapped within Med-IAMER on the pressures and impacts of maritime transport 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
TP01	Marine exposure due to port activity: goods transport
TP02	Marine exposure due to port activity: passenger transport
TP03	Marine exposure due to port activity: ferry transport
TP04	Marine exposure due to port activity: cruise transport
TP05	Intensity of pollution by maritime transport
TP06	Intensity of maritime traffic
TP07	Invasive species related to transport activity
ML02	Marine litter by transport influence

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