EDISON S.P.A.

Oil and Gas Exploration Permit Application "d 84F.R-EL"

Environmental Impact Study

SC/ND/RB		RB	16/1/2018
	REVISION	PROJECT MANAGER	DATE

Index

ANNEXES

1. Introduction

Golder Associates srl (hereinafter referred to as Golder) has been commissioned by **Petroceltic Italia S.r.l**. and **Edison S.p.A**. (hereinafter referred to as Petroceltic/Edison or Proponent) to prepare an Environmental Impact Study (EIS) for an Oil and Gas exploration d 84F.R-EL. The Application for Exploration Permit region is located in the Ionian Sea at 14 nautical miles ahead from Santa Maria di Leuca and covers a total surface of 729,020 km^2. An area of 300 km^2 (Project Area) shall be identified within this region for the execution of a seismic survey..

The Golder Associates relied on the collaboration of the experts of the Milan-based **Istituto Tethys onlus** to highlight the present environmental conditions for the marine mammals population and revise the matters relating to the environmental impact and monitoring of the marine mammals.

This document drafted in accordance with the Law Decree No. 104/2017 issued on June 16, 2017 (new Environmental Impact Assessment Decree (EIS)) and published in the Official Gazette on July 16, 2017 entered into force on July 21, 2017. This Decree provides new regulations for the Environmental Impact Assessment procedure across the national territory and acknowledges the new EU EIS Directive 2014/52/UE by making significant amendments to Part II of the Consolidated Act on the Environment (TUA) (L.D. 152/06).

The pre-existing legislation (TUA) required that the Environmental Impact Study be divided into three parts, viz. a Program Section, an Environmental Section and a Project Section. The new EIS Decree revokes this division and adopts the scheme discussed in this document. The chapters/sections of this EIS reflect the 12 points established in Annex VII to the Law Decree 104/2017 (*Contents of the Environmental Impact Study*), specifically:

- A description of the Project with indication of the location and its characteristics, the protections and restrictions existing in the region, the assessment of the expected emissions and the method selected for carrying out the Project (para. 1) is given in **chapter 2;**
- The Project options including Zero Option and the site and technical options as well (para. 2) are illustrated in **chapter 3**;
- The existing environmental scenario and its expected evolution, should the Project be not implemented (para. 3) is analyzed in **chapter 4**;
- The environmental components that are likely to be subjected to environmental impacts from the proposed Project (para. 4) are listed and described in **chapter 6**;
- The factors that may have a significant impact on the environmental components (para. 5) are investigated in **chapter 7**;
- The predicting methods to identify and assess the impacts (para. 6) are reported in **chapter 5**;
- The actions to be taken to avoid, prevent, mitigate or offset any negative environmental effects and to fix any monitoring instructions (para. 7) are listed in **chapter 8**;
- The cultural and landscape assets, if any, the impacts they may be subjected to and the required mitigation and compensation actions (para. 8) are explained in **chapter 9**;
- The expected Project environmental impacts that may result from the Project-associated risks of severe accidents and/or disasters (para. 9) are described in **chapter 10**;
- The Non-technical Summery (para. 10) is attached as separate document;
- The list of the documental references incorporated in the EIS (para. 11) is given in **chapter 12**;
- A summarized list of the difficulties found in the collection of the data required by the legislation (para. 12) is covered by **chapter 11**.

The Project is part of the activities included in the Working Plan attached to the application for the release of the Exploration Permit by the Ministry for the Economic Development (MISE).

The application for the release of an Exploration Permit was submitted to the Ministry for the Economic Development on August 28, 2013 by Petroceltic Italia S.r.l. (Petroceltic) (50%) together with Edison S.p.A. (Edison) (50%), according to the applicable rules for granting mining rights.

More specifically, Petroceltic Italia S.r.l. lodged with the Directorate General for Energy and Mineral Resources (DGRME), now Directorate General for Safety (DGS), an application for the release of an exploration permit registered under the identification code "d 84 F.R.-.EL", in the "F" Marine Region, Northern Ionian Sea, down to a depth of more than 200 m.

The application for an Exploration Permit was published in the Official Hydrocarbons and Georesources Bulletin (BUIG) – Year LVII-9 No.9 dtd September 30, 2013 and the European Union Official Gazette No. 303 dtd October 19, 2013

On April 9, 2015, the Hydrocarbons and Mineral Resources Commission (CIRM) gave a favourable opinion. On September 24, 2015, Petroceltic received the 0013658.24-06-2015 communication covering the decision made, in which Petroceltic was requested to start the EIS procedure with the Ministry of the Environment and Protection of Land and Sea (MATTM) within 90 days, viz. within September 26, 2015, according to art. 9, para. 4, letter a of the D.D. dtd July 15, 2015.

On September 23, 2015, Petroceltic asked DGRME for an extension of the deadline for the submission of the EIS application as it intended to carry out a Scoping Phase (procedure of former art. 21 of the Law Decree No. 152/2006 as amended and supplemented) for the purpose of redefining the terms for the submission of the EIS procedure and preparing the documentation required to start said procedure.

On January 5, 2016, Petroceltic asked for an official implementation of the Scoping Phase and sent to MATTM the technical documentation required for starting the preparatory stage.

The VIA and VAS Technical Commission in charge of the verification of the VIA and VAS environmental impact gave its opinion in the letter No. 2199 dtd October 14, 2016, which contained instructions acknowledged in this Environmental Impact Study.

1.1. Results of the Scoping procedure

Petroceltic/Edison exercised the right granted in art. 21 of the Law Decree No. 152/2006 as amended and supplemented and asked for implementation of a consultation phase with the VIA and VAS TC in order to define the extent of the information and its level of detail to be incorporated in this Environmental Impact Study. For such purpose, the Proponent's request of implementing the procedure was accompanied by the following technical documents:

- Preliminary environmental study;
- Preliminary Project documentation;
- Working Plan;
- List of authorizations, agreements, concessions, licences, opinions, approvals and consents in environmental matters as required for the construction and operation of the works or the plant.

In its letter No. 2199 dtd October 14, 2016, the VIA and VAS TC supplied information on methodological, design and environmental issues to be considered when drafting the Environmental Impact Study. This information is given hereinafter.

Methodological issues

In order to identify the safety criteria being adopted to protect the marine mammals against potential risks from sound emissions generated by the Project activities, a request for submitting an environmental and bioacoustic monitoring Project containing the following information was made:

- Characteristics of the environment and cetacean population living in the area with indication of the population distribution and density and critical habitats as well existing in the operation-identified area;
- Monitoring time and methods throughout a period of not less than 60 days as specified by competent personnel;
- Mitigation measures being applied during the *air gun* operations as per the J.N.C.C. and ACCOBAMS guidelines. Calibration of the onsite propagation model inclusive of the operating parameters of the instruments used for the seismic survey (sound buoys) aimed at definining the extension of the exclusion area range was also requested.

Design issues

The time planning for development of the Project and chart plotting of the seismic lines also identified after the environmental and bioacoustic monitoring above should be detailed.

The chart plotting shall not include:

- Areas outside the permit region;
- Buffer zones (12 Nm) from protected sea and coast area external contour;
- Areas at a depth lower than 50 m;
- Areas affected by biocenosis of deep-water corals as indicated in the scientific literature;
- Biological Protection Zones (ZTB) and nursery areas, where provided and fenced, within 12 Nm from their border.

For the design of the geophysical survey, the investigated region shall be divided according to a meshgrid in order to inform the local managerial units on the areas that will be made available for the fishing activities and provide the competent Harbour authorities with a weekly calendar of the operations that will be carried out in the affected zones.

Environmental issues

The seismic survey activities shall be performed according to the investigated bathymetry-related acoustic signal modelling results as per the “less impacting” *array* configuration.

As regards the environmental issues, the VIA and VAS TC indicated a number of methodological solutions being adopted when performing the geophysical survey in order to avoid potential impacts.

Specifically, they included:

- Optimizing the source intensity according to the depth of the area being investigated to the effect that the minimum source power be always used;
- Switching off the equipment when crossing sensitive areas such as ZTB;
- Gradually ramping up the air gun intensity and operating frequency when switching on the sound source;
- Suspending or avoiding to start the sound sources when the presence of mammals is warned in the exclusion/safety zone;
- Tuning the sound power to the requirements of the seabeds being investigated;
- Configuring the *arrays* in order to reduce to a minimum the horizontal wave propagation;

- Stopping gun-shots at each line end, except for *full fold* needs aimed at getting full seismic data at the borders of the investigated areas;
- Using *Turtle Guards* devices in transit areas of species being protected and any time their presence is detected as is the case of the *Caretta caretta*; these devices shall be fixed to tail buoy structure of the seismic vessel to prevent sea turtles from being accidentally entrapped in the seismic survey equipment.

The TC's solutions also suggested to focus on the directions given by the Puglia Region in its opinion letter No. 3351 dtd March 16, 2016 16/03/2016, in which Petroceltic was required to include the following documents and information in the Environmental Impact Study:

- Technical specifications and geophysical survey parameters;
- Acoustic dispersion model in sea environment by detailing the Energy emissions, their frequency and time distribution from the source to the seabed according to a source-related plane and orthogonal representation;
- Species and density of marine mammals and reptiles living in the region as obtained from recent literature data by assuming for each species its potential exposure to the transmitted energies and consequent effects at individual and population level;
- Evaluation of possible operating options including a zero option supplemented with a cost/benefit analysis that takes into account the short- and long-term value of the predictable oil production;
- Time schedule of the survey activities showing any overlapping between adjacent surveys;
- Ongoing and *post operam* monitoring plan for an appropriate period of time detailing the detection methods of marine cetaceans and reptiles strandings in a 100 km range over at least one month after the work completion;
- API-equivalent construction standard applicable in the European context;
- Proponent's financial and operating capacity to face any emergency deriving from the exploration activity.

The Puglia Region opinion letter also required to consider the presence within the Ionian Sea EBSA region of an extensive *Lophelia pertusa* and *Madrepora* spp *reef* in the area being investigated beyond the national waters, for which a proposal of incorporation in the next ASPIM list exists (Sect. 2.2.1.2). It was finally requested that the statements in art. 5 of and Annex IV to the "Offshore Protocol" of the Barcelona Convention be taken into consideration and the information in the Environmental Impact Study comply with the Protocol statements.

2. Project Description

2.1. Project location

The region that is subject matter of the Exploration Permit application is located in the Ionian Sea at abt. 14 nautical miles from Santa Maria di Leuca (LE) and extends over a surface of 729,020 km^2. The seismic survey shall cover a surface of 300 km^2 (Project Area) within the region which an Exploration Permit is applied for. (Figure 2.1). The selected Project Area is located in the south-east part of the Application for Exploration Permit region. The reason for operating in said area was dictated by the lower environmental susceptibility of the area seabeds as described in the chapters below (with special focus on the basic environmental scenario in chapter 4) and highlighted by the impact assessment (chapter 7).

The Project Area options taken into consideration are illustrated in para. 3.2.

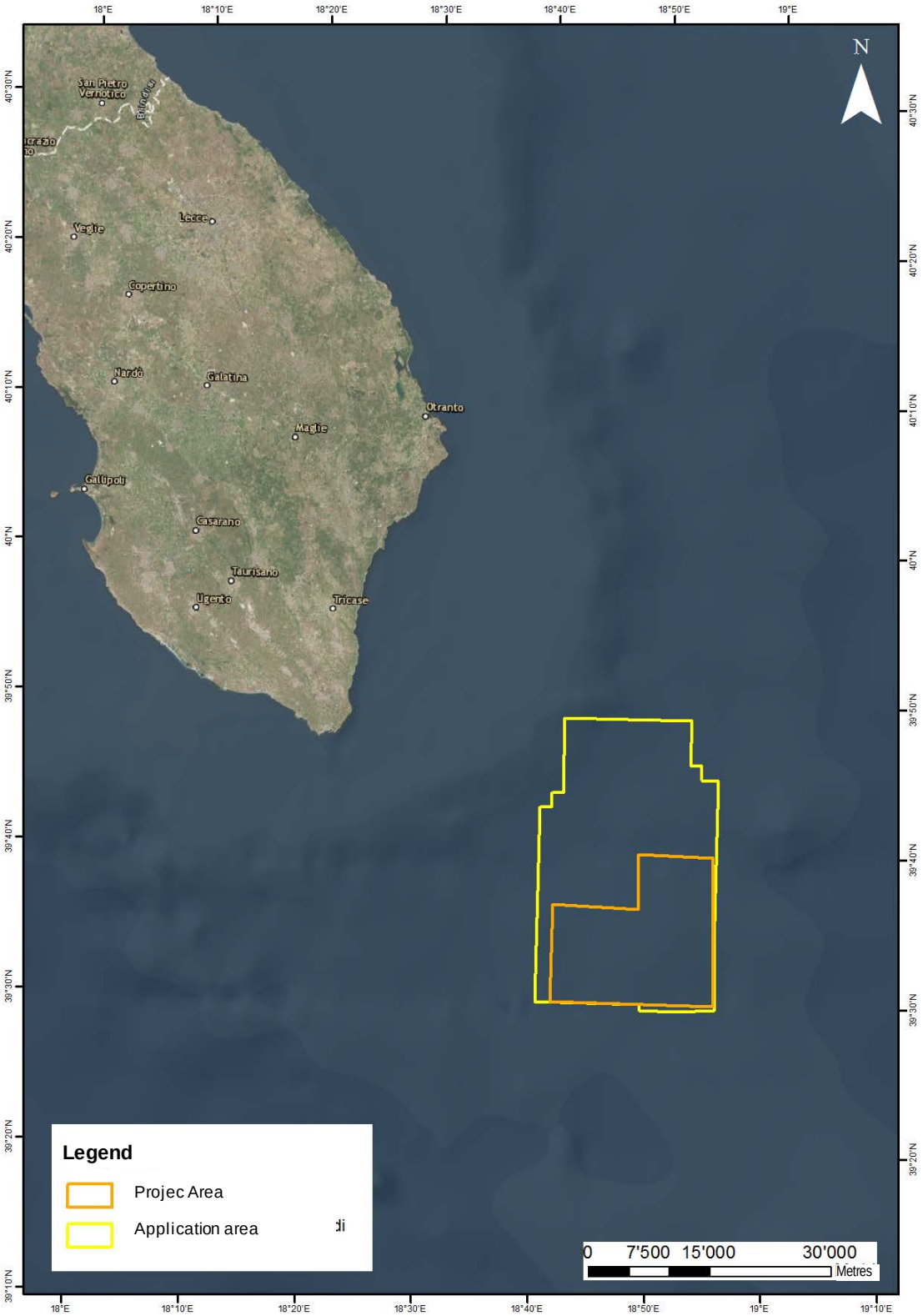


FIGURE 2.1: PROJECT AREA AND APPLICATION FOR EXPLORATION PERMIT AREA

2.2. Protections and restrictions affecting the Project Area and its surroundings

2.2.1. Protections and restrictions

2.2.1.1. Protected Marine Areas (PAM)

The Law No. 394/1991 as amended and supplemented, i.e. "Framework law on protected areas", referred to the marine environment, divided into protected areas as defined in the Barcelona Convention for the specially protected Mediterranean areas (SPA Protocol) and the areas as defined according to the Law No. 979/1982, i.e. "Provisions for the sea defence".

Activities in the protected marine areas that may jeopardize the characteristics of the environment being protected and the area establishment aims are forbidden.

The marine areas currently protected and those that are expected to be protected in the near future are illustrated in Figure 2.1 and Figure 2.2.

FIGURE 2.1: ESTABLISHED MARINE AREAS (SOURCE: MATTM WEBSITE)

FIGURE 2.2: MARINE AREAS THAT ARE EXPECTED TO BE PROTECTED IN THE NEAR FUTURE (SOURCE: MATTM WEBSITE)

The "Penisola Salentina" located at a distance of abt. 14 nautical miles from the Project Area is the sole area that will be declared protected in the Northern Ionian Sea in the near future (Law No. 394/91).

With reference to the Sites of Community Importance (SCI) identified by the "Habitat" Directive, the Specially Protected Areas (SPA) identified by the "Birds" Directive and the Wetlands as defined in the RAMSAR Convention, many protected areas are found along the southern Adriatic coast.

In detail, the protected areas close to the Project area include:

- Sea Site of Community Importance "Posidonieto Capo San Gregorio - Punta Ristola" (IT9150034);
- Sea Site of Community Importance "Litorale di Ugento" (IT9150009);
- Sea Site of Community Importance "Litorale di Gallipoli and Isola S. Andrea" (ITA9150015);
- Specially Protected Area "Coastal Area between Capo d'Otranto and Capo S. Maria di Leuca" (I.B.A. 147);
- Regional Natural Park "Costa Otranto - S.Maria di Leuca and Bosco di Tricase" (Ref. R.L. No. 30/2006), embracing some Sites of Community Importance among others: "Costa Otranto – Santa Maria di Leuca" (IT9150002), "Boschetto di Tricase" (IT9150005) and "Parco delle querce di Castro" (IT9150019);
- Regional Natural Park "Litorale di Ugento" (Ref. R.L. No. 13/2007).

More specifically, the sites that are closest to the area which an Exploration Permit was applied for include a zone located at a minimum distance of abt. 14.3 nautical miles (26.5 km) between the Project Area and the outer perimeter of the Regional Natural Park of "Costa Otranto-S.Maria di Leuca and Bosco di Tricase" and a zone located at a distance of abt. 15.9 nautical miles (29.5 km) between the Project Area and the outer perimeter of the Sea Site of Community Importance of "Posidonieto Capo San Gregorio - Punta Ristola".

For the geographical location of the protected areas with respect to the Project Area, reference should be made to para. 4.3.2.1.8.

Hence, the Project areas are located beyond the limit of 12 nautical miles set forth in the Law Decree No. 152/2006 as amended and supplemented for safeguarding the natural areas protected by national and EU regulations and International agreements and conventions from undesired potential environmental effects caused by the performance of geophysical survey activities as it is the case of the Project outlined herein.

2.2.1.2. Specially Protected Areas of Mediterranean Importance (SPAMI)

The Barcelona Convention adopted in 1978 and ratified by Law No. 30 dtd January 21, 1979 for the protection of the Mediterranean Sea from pollution extended its range of geographical coverage in 1995 and was replaced by the "Convention for the protection of the marine environment and the coastal region of the Mediterranean", whose basin is considered one of the richest biodiversity sites in the World by virtue of its wealth of species, populations and landscapes..

To promote a cooperation in the management and conservation of the natural areas and the protection of the threatened species and their habitats, the Contracting Parties drafted in 1995 the Protocol for Specially Protected Areas and Biodiversity in the Mediterranean (SPA Protocol), which established the creation of Specially Protected Areas of Mediterranean Importance (SPAMI as per English acronym).

The SPAMI list included 32 sites, among which also the internationally protected marine area of the Sanctuary for marine mammals. Ten are the protected Italian marine areas currently included in the list of the Specially Protected Areas of Mediterranean Importance, namely:

1. Portofino;
2. Miramare;
3. Plemmirio;
4. Tavolara – Punta Coda Cavallo;
5. Torre Guaceto;
6. Capo Caccia – Isola Piana;
7. Punta Campanella;
8. Porto Cesareo;
9. Capo Carbonara;
10. Penisola del Sinis – Isola di Mal di Ventre.

None of the areas mentioned above is affected by the Project.

2.2.1.3. Fisheries – Biological Protection Zones (BPZ)

The Italian legislation on fisheries (art. 98 of the Decree of the President of the Republic No. 1369/1968) either restricted or banned the fishing activity in some marine zones that were recognised to be zones that were eligible for spawining or growth of marine species of economic importance or would have been impoverished as a result of an excessively intense exploitation.

This law providing the creation of **biological protection zones** (BPZ) specifically targeted to the fishing activity was 15 years ahead of the legislation on the protected marine areas (1982), which initiated the study and creation of a first list of protected marine areas for environmental protection.

The national regulations were followed by European rules that provided possible and sometimes compulsory obligation of stopping the fishing activity for the purpose of safeguarding wetlands, lagoons or places affected by special marine biocenosis. Some Italian regions, particularly Sicily and Sardinia, having

primary capabilities in the fishing industry restricted the fishing activity in some regional areas by issuing adequate measures.

The whole of these regulations safeguarding and protecting environments and species does not exhaust the scope of area restrictions to the fishing activity, as there are many other rules that restrict or ban fishing in some areas due to a number of reasons.

Marine areas under military constraints such as for example areas designed for firearms practice are not admitted to fishing. Other marine areas are subjected to exclusive licence for aquaculture purposes or installation of off-shore shelfs for extraction of hydrocarbons or laying of power cables. Finally, there is a costal strip where no fishing of bivalve mollusks can be practiced due to health or bathing reasons or to laws on fishing as it is the case of trawling that is banned within a range of three miles from the coastline. Many are the rules that either directly or indirectly restrict fishing activites in some areas, however, the creation of biological protection zones is the fastest and most suitable system acting as a nursery of fish species of commercial interest.

The Italian authorities applied these rules many times and created biological protection zones for a specified lenght of time or unlimited period of time. The criteria for creating biological protection zones are highly flexible as they can either ban the use of or establish technical specifications for one or more fishing gears and extend the limited use to some months in a year or a full year. This policy was thought for managing the biological resources where fishing is practiced and incorporated in some management plans.

Figure 2.3 shows the BPZs currently existing on Italian territory.

FIGURE 2.3: BIOLOGICAL PROTECTION ZONES ON THE ITALIAN TERRITORY – THIS MAP DOES NOT INCLUDE BTZS AUTONOMOUSLY CREATED BY THE SICILY AND SARDINIA REGIONS (SOURCE: MINISTRY FOR AGRICULTURAL, FOOD AND FORESTRY POLICIES. FISHING SITUATION IN THE ITALIAN SEAS – CHAPT. 10.6)

The Northern Ionian Sea region affected by this Project does not include any of the currently existing BPZs.

2.2.1.4. Marine archaeological sites

The Ministry of Cultural Heritage started in year 2004 the "Archeomar Project" conforming to the UNESCO Paris Convention that established regulations and laws on protection and valorisation of the underwater cultural heritage. This Project arose from the Law No. 264/2002 mainly for the purpose of drawing up a register of the underwater archaeological heritage targeted to the protection and improvement in the site management.

Figure 2.4 shows the index map relating to the first Project stage known as "Archeomar 1", in which an inventory of the archaeological assets found in the seabeds of the Campania, Basilicata, Puglia and Calabria regions is made.

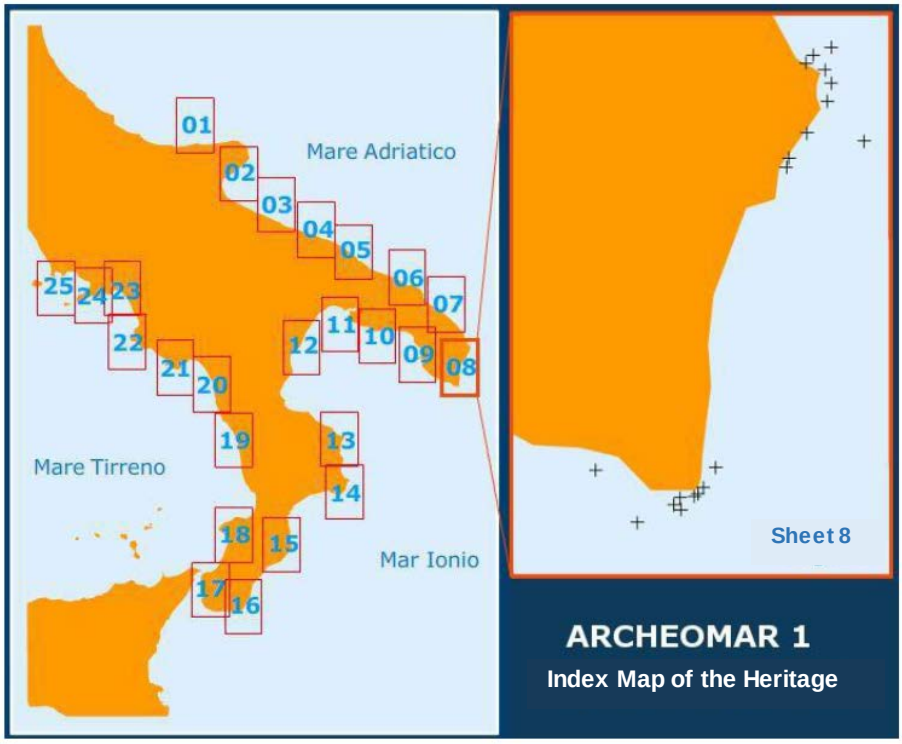


FIGURE 2.4: INDEX MAP OF THE HERITAGE SURVEYED IN ARCHEOMAR 1 AND MAGNIFIED IN SHEET 8, WHERE LOCATION OF THE ARCHAEOLOGICAL FINDINGS IS INDICATED BY A BLACK CROSS (SOURCE: ARCHEOMAR 1 ATLAS WWW.ARCHEOMAR.IT)

The region which an Exploration Permit was applied for is located at abt. 14.3 nautical miles east of Capo Santa Maria di Leuca. The Salento coasts facing this region are illustrated in "Sheet 8" of the "Archeomar 1 Index Map".

The Index Map shows no archaeological sites, historical findings or known shipwrecks within the boundaries of the investigated region or in its vicinity. However, historical and archaeological findings shown in "Sheet 8" are concentrated in the vicinity of Capo S. Maria di Leuca and located close to the coast at a distance of more than 12 nautical miles from the Application for Exploration Permit region, viz. well away from it.

The geophysical survey activity covered by this environmental study shall be carried out using fully submerged, vessel-towed equipment kept suspended in the water column at a depth of a few tenths of

meters from the surface and never interfering with the seabed. In addition, the great depth of the seabed (300 to 1000 m) shall ensure a remarkable distance between the energizing source and the findings.

2.2.1.5. Areas bound by specific provisions issued by the Harbour Office

The sea area between the Application for Exploration Permit region and the Puglia southern coasts is subjected to the operational interests of the Brindisi Harbour Office, whereas waters off the territorial boundary of said Office fall under the competence of the Bari Maritime Department.

The provisions issued by the Harbour Office are available at the webpage of the Coastguard[1].

2.2.1.6. Areas affected by landscape constraints

Areas affected by landscape constraints mean portions of the Italian territory protected in accordance with the Law Decree No. 42/2004 – Code of cultural and landscape heritage – that were declared to be of significant public or landscaping interest.

According to Law No. 431/85 and Law Decree No. 42/2004, art. 142, acknowledged by the Galasso's Law No. 431/1985, a space area of 300 m from the shoreline was provided for the entire national territory, whereby all areas within 300 m from the shoreline including areas above the sea level face landscape constraints.

The Application for Exploration Permit region does not include any banned area, as it is located offshore at over 14 nautical miles from the coast.

2.2.1.7. Military marine areas

The marine areas being used for conducting military operations of any type on the part of the State Corps are subjected to special rules and constraints that are made known via a dedicated Notice to Skippers. According to the type of operations, they may prevent navigation and give notice of hazards within the territorial and extra-territorials waters.

The precise location in Italy of the areas, in which navigation is prohibited or hazardous, is pinpointed in the "Introduction to Notices to Skippers" and shown in the 1:1,700,000 scale nautical chart No. 1050 – Areas normally used for naval and shooting exercices and restricted airspace areas – published by the Hydrographic Institute of the Italian Navy (Figure 2.5).

[1] www.guardiacostiera.it/organizzazione/showall.cfm?NAV=2eRegione=Puglia

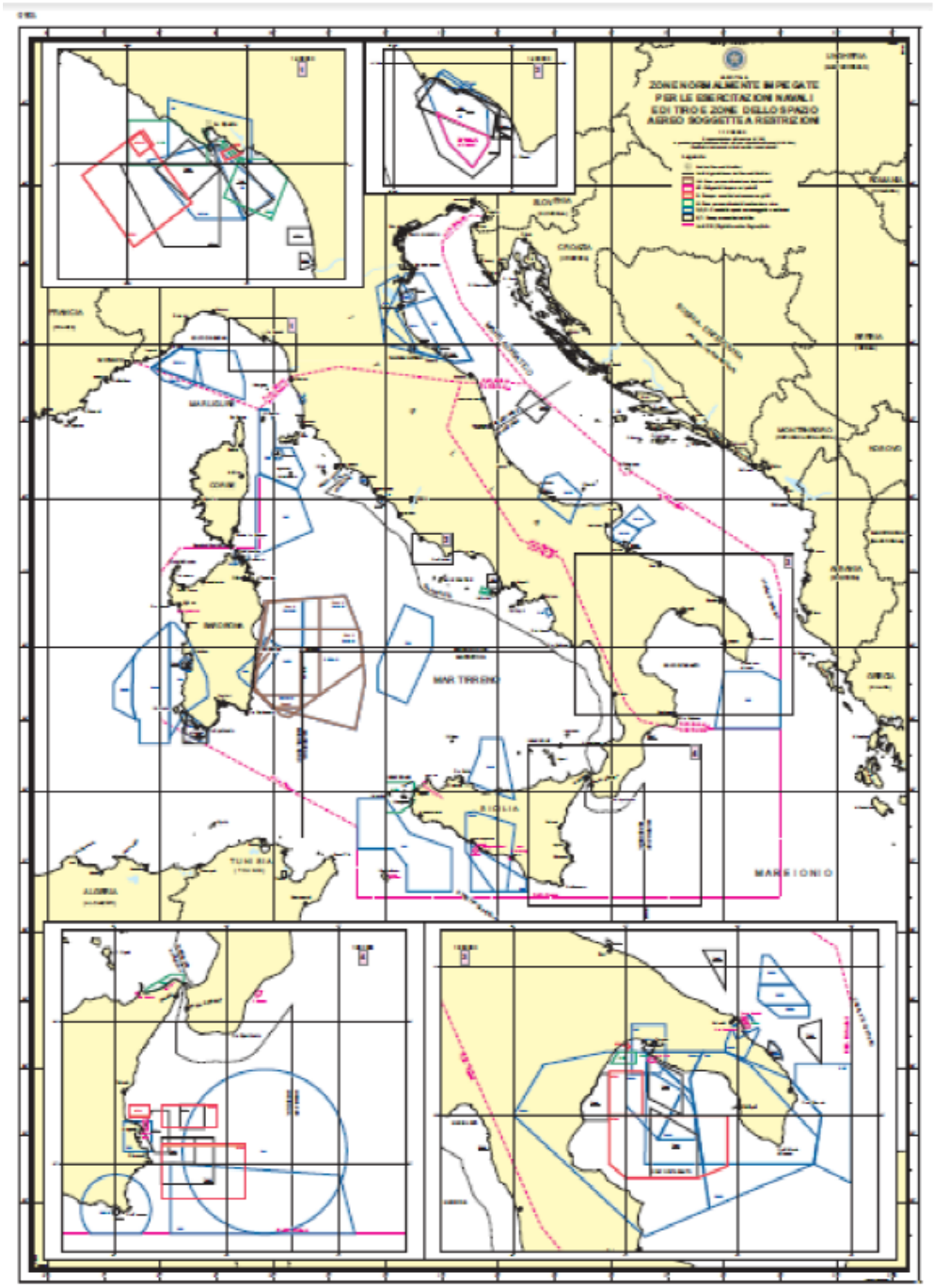


FIGURE 2.5: CHART NO. 1050 – AREAS NORMALLY USED FOR CONDUCTING NAVAL AND SHOOTING EXERCICES AND RESTRICTED AIRSPACE AREAS (SOURCE: HYDROGRAPHIC INSTITUTE OF THE ITALIAN NAVY, INTRODUCTION TO THE NOTICES TO SKIPPERS, 2014)

The Application for Exploration Permit region is located in a sea area, where no restricted military marine areas exist.

The Application for Exploration Permit region falls within the D15 area "hazardous airspace area from ground level up to 5,500 feets (abt. 1650 m) due to intense military air activity notified by an advanced notice to the airmen (NOTAM). Therefore, the company appointed for the geophysical survey shall carefully operate in the investigated area and draw utmost attention to NOTAM communications and notices to

skippers issued by the competent authorities throughout the geophysical survey to warn about ongoing exercices.

As regards the presence, if any, of unexploded remnants of war, the nautical chart shows a highlighted area identified by wording "Unexploded remnants of war" in a zone adjacent to the North-East top of the Application for Exploration Permit region. (Figure 2.6).

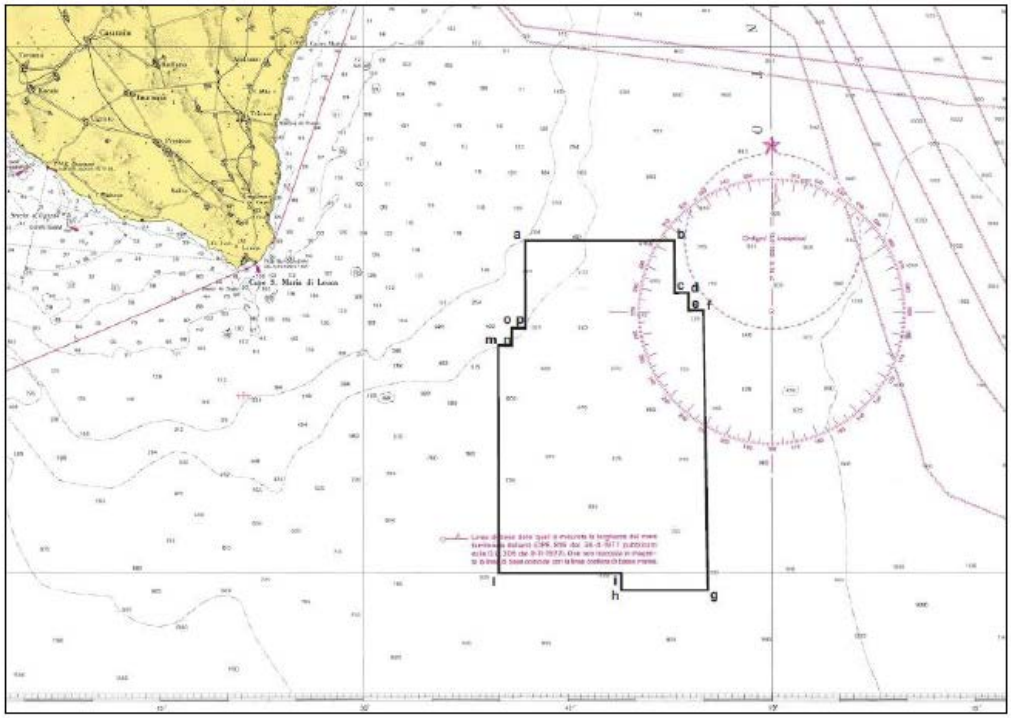


FIGURE 2.6: LOCATION OF THE APPLICATION FOR EXPLORATION PERMIT REGION TO THE "UNEXPLODED REMNANTS OF WAR" AREA

The programmatic analysis indicates that the seismic survey actitivities conducted in a location at 14 nautical miles from Santa Maria di Leuca shall not interfere with any biodiversity sensitive and protected area (protected marine and coastal areas, SPAMI, BPZ).

The minimum distance between the Project area and the outer boundary of Parks in marine, coastal and terrestrial areas and of sites making part of the Rete Natura 2000 is always greater than 12 nautical miles defined in the Law Decree No. 152/2006 as amended and supplemented to safeguard the protected natural sites against potential interferences from the seismic survey.

2.2.2. National and international legislation

2.2.2.1. European regulations

The European regulations on oil and gas exploration and production for energy uses incorporate EU directives focused on:

- Conditions for release and application of Authorizations to oil and gas survey, exploration and production;
- Protection of safety and oil and gas offshore survey, exploration and production activities;
- European regulations for the internal Energy Market covering strategies and targets for market deregulation.

A list of the main directives in this industry sector is provided hereinafter with indication of details of the most important topics of each document.

- **Directive 92/91/EEC** – Safety and health protection of workers in the mineral extracting industry through drilling.
- **Directive 92/104/EC** – Safety and health of workers in surface and underground mineral extracting industries.
- **Directive 94/22/EC** – Conditions for release and application of authorizations for prospection, exploration and production of hydrocarbons.
- **Directive 96/98/EC** – Marine equipment.
- **Directive 96/61/EC** – Integrated pollution prevention and control or Directive 2000/60/EU establishing a frame work for the Community action in the field of water policy, from both environmental and management viewpoint..
- **Directive 2002/84/EC**, acknowledged by the Law Decree No. 119/2005 on "Implementation of Directive 2002/84/EC on maritime safety and the prevention of pollution from ships" amending the past directives on maritime safety and the prevention of pollution from ships. The purpose of this directive is to improve the implementation of Community legislation on maritime safety, protection of the marine environment and shipboard living and working conditions. This directive associated with the Regulation 2002/2099/EC intends to create a sole *Committee on Safe Seas and the Prevention of Pollution from Ships* and accelerate and simplify acknowledgement of the international rules of the Community legislation on pollution from ships.
- **Directive 2005/35/EC** – Ship-source pollution and introduction of penalties for pollution offences.
- **Directive 2008/56/EC: Marine strategy framework directive.**
  The Marine Strategy Framework Directive 2008/56/CE (MSFD), entered into force in July 2008, was officially acknowledged in Italy by the Law Decree No. 190/2010 establishing a number of further actions to be implemented in the long run. They included above all definition and start of coordinated Monitoring Programmes (MP) that were part of the second phase of implementation of the Law Decree No. 190/2010 and came after the first three essential steps of the Marine Strategy:

  1) initial assessment of the environmental status of the marine waters (IA, *Initial Assessment*), carried out in accordance to art. 8 and based on the existing data and information relating to the essential characteristics of the Italian marine environments and the pressures and impacts that influence them. The initial assessment also includes an analysis covering the social and economic prospects for the use of the marine environment and the costs of its degradation;
  2) determination of *Good Environmental Status (GES*) according to art. 9 based on the 11 indicators specified in Annex I to the Law Decree No. 190/2010;
  3) establishment of *Environmental targets(ET*), according to art. 10 to channel efforts into achieving a good environmental status.

  The implementation of the Marine Strategy is one of the key pillars of the "Livorno Chart", a guideline document for a marine strategy combining environment protection with economic growth. This document passed on November 15, 2014 was the result of a cooperation work between authorities – DGRME among others – and stakeholders and recognized the necessity of meeting four requirements:

  - combined governance at national level;
  - sea to earth connections to promote participation of the coastal communities;
  - harmonization and efficiency of controls of the sea and along the coasts;
  - implementation of adequate communications and participation in the Marine Strategy.

- **Directive 2008/99/EC** – Protection of the environment through criminal law.
- **Directive 2009/123/EC** amending the directive 2005/35/EC on ship-source pollution and the introduction of penalties for infringements.

- **Directive 2010/68/EC** amending Council Directive 96/98/EC on marine equipment.
- **Directive 2013/30/EU** establishing the minimum requirements to prevent major accidents relating to offshore oil and gas operations and mitigate the effects of said accidents.

  The European Commission reacted to the accident occurred in the Gulf of Mexico in the Macondo well in April 2010 and launched a review of the regulations adopted by the Member States of the European Union.

  The European Commission expressed in 2010 its views in the Communication "Facing the challenge of the safety of the offshore oil and gas operations" , in which it was stated that an upgraded harmonization of the current legislation framework could furtherly improve the safety of such operations, even though the European Union already relies on excellent national regulations rightly including the Italian ones.

  Following the above Communication, the European Commission adopted on October 27, 2011 the Regulation Proposal Plan of the European Parliament and Council on the safety of the offshore oil and gas prospection, exploration and production activities (Offshore Regulation) aimed at fixing high minimum standards of safety of the offshore prospection, exploration and production of hydrocarbons by reducing the likely occurrence of major accidents, mitigating their effects and simultaneously protecting the marine environment. During three different Presidencies of the European Union (Poland, Danmark and Cyprus), the Council through its *Working Party on Energy* (EWP), actively attended by some DGRME's representatives, analyzed the Regulation Proposal and submitted a number of amendments. The Regulation Proposal changed into a "Directive Proposal" to meet the decisions of the Council's EWP and concurrently by the Commission of Industry, Research and Energy (IREC) of the European Parliament.

  Under the Ireland Presidency, the Directive Proposal on the safety of the offshore oil and gas operations was first approved by the EU Council and then the European Parliament and published in the EU Official Gazette on June 28, 2013 as Directive 2013/30/EU of June 12, 2013 amending the directive 2004/35/EC. The DGRME actively took part to the works by expressing opinions and views targeted to an improvement of the European safety standards. Particularly, the Italian proposal of incorporating instruments such as the "black box" was accepted. These instruments had already been introduced in the Italian legislation following the in-depth technical studies after the accident in the Gulf of Mexico and shall make part of the common safety heritage of all the Member States.
- **Directive 2014/89/EU (Maritime spatial planning).**

  Following a proposal of the EU Commission in 2013, the Directive 2014/89/EU establishing a framework for maritime spatial planning was issued on July 23, 2014 aimed at promoting a common framework for the maritime spatial planning in the European Union in order to ensure the development of the marine and coastal activities and a sustainable use of the marine resources. Purpose of a coherent application of the maritime spatial planning is a better coordination of the earth and sea activities.

  The Member States must work out a roadmap of such activities through management plans of the maritime space to promote a sustainable growth and simultaneously involve the stakeholders in the cooperation with the bordering States. The use of a sole tool contributes to create a safe climate for the investors and reduce the administrative charges for the national operators and authorities by preserving the ecosystem facilities.

  By facilitating the sustainable development and investments in maritime activities this directive intends to contribute to the achievement of the blue economy potential in Europe in terms of growth and employment. This new tool also promotes the implementation of the environmental regulations in the European Union as did the frame work directive 2008/56/EC on the marine environment strategy and the Habitat directive.

2.2.2.2. National legislation

The offshore mining activities are regulated by specific primary and implementation laws on identification of areas that can be exploited, the conditions and methods for authorization release, the amendments of the mining rights and the safety and environmental protection matters.

The national framework relating to the offshore exploration and exploitation of mineral raw materials and the main law references for this industry are specified hereinafter.

National mining activities

The mining rights for the offshore exploration and production of the hydrocarbons are granted by the Ministry of Economic Development and relate to the so called "Marine Zones" on the Italian continental shelf created through ministerial laws and decrees and identified by a letter of the alphabet. The A to E Marine Zones were opened by the law No. 613/1967 followed by the F and G Zones. In the last years, the interest expressed by the operators of this industry prompted the expansion and a new definition of the boundaries of some marine zones. Currently, the total surface of the marine zones where mining activities can be performed is abt. 139,656 km^2 and represents approximately 25% of the total surface of the Italian continental shelf.

By the Ministerial Decree dtd August 9, 2013 establishing the "Commission for Hydrocarbons and Mining Resources (CIRM)", the above zones were reshaped by stopping the execution of new activities in the Tyrrhenian regions and regions within 12 nautical miles from all protected coasts and areas. A marine area in the Balearic Sea adjacent to Spanish and French exploration areas was simultaneously identified. Purpose of reshaping was the valorisation and strengthening of this industry in marine areas where highly interesting oil opportunities exist in compliance with the environmental constraints set forth in the ruling laws (art. 6, para. 17 of the Law Decree No. 152 dtd April 3, 2006) and the highest safety levels laid down in the Directive 2013/30/EU amending the directive 2004/35/EC issued by the European Parliament and Council on June 12, 2013 on safety of the offshore oil and gas operations.

The Application for Exploration Permit region is located within the F Marine Zone.

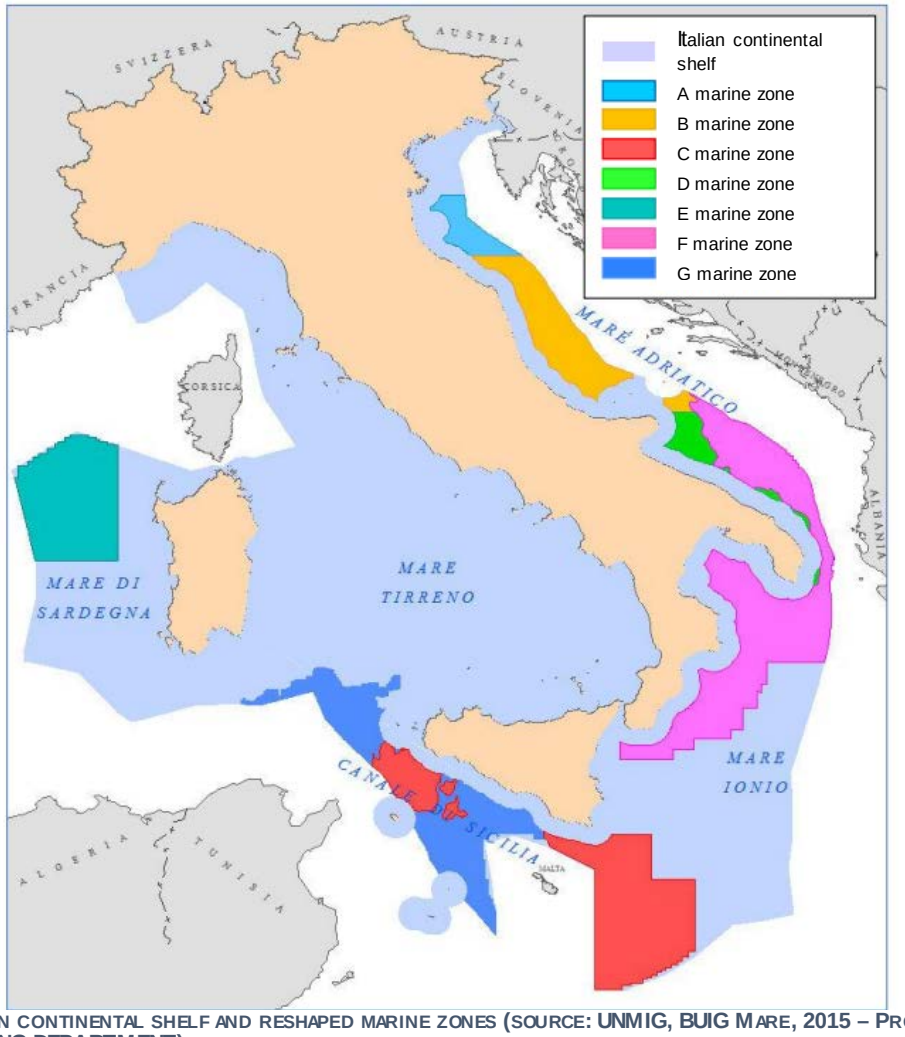


FIGURE 2.7: ITALIAN CONTINENTAL SHELF AND RESHAPED MARINE ZONES (SOURCE: UNMIG, BUIG MARE, 2015 – PROCESSING BY THE DGRME'S MAPPING DEPARTMENT)

The F zone extends into the Southern Adriatic Sea and the Northern Ionian Sea up to the Strait of Messina and is bordered by the 200 m isobath to the west, the bordering lines of Italy-Croatia, Italy-Albania and Italy-Greece to the east and meridian and parallel arcs to the south. This zone created according to the Ministerial Decree dtd June 13, 1975 – Borders of the marine zone to be designated as "F Zone" for oil and gas exploration – was opened prior to the agreements with Greece and Albania and was initially bordered by meridian and parallel arcs within the mean line. The Ministerial Decree dtd October 30, 2008 – Expansion and definition of new borders of marine areas designated for the exploration and production of hydrocarbons – defined new borders and provided an expansion to the south side of this zone to take into account the cited agreements and the new technologies that allow the performance of mining activities in deep waters.

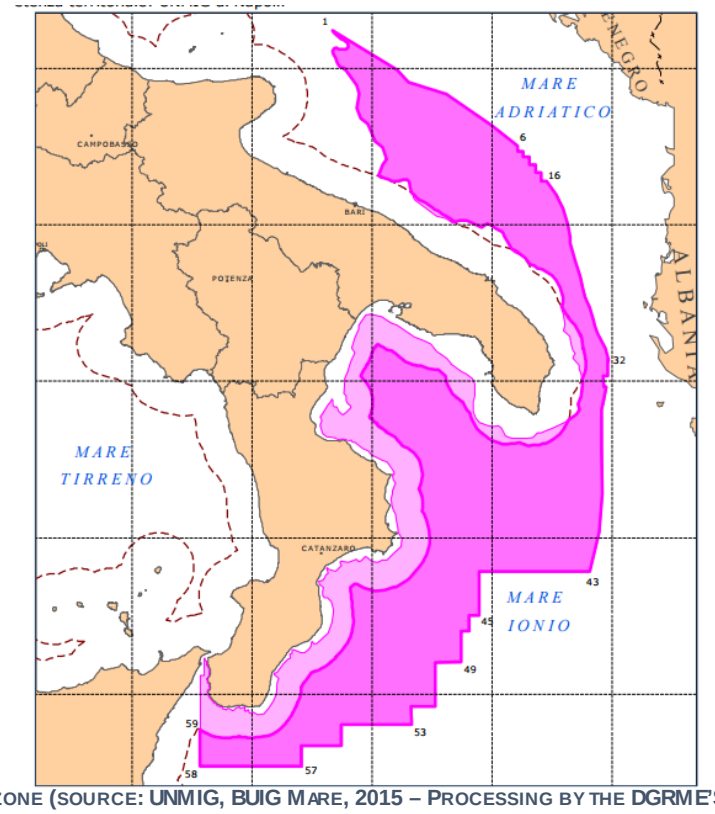


FIGURE 2.8: "F" MARINE ZONE (SOURCE: UNMIG, BUIG MARE, 2015 – PROCESSING BY THE DGRME'S MAPPING DEPARTMENT)

The F zone as such extends over abt. 50,520 km^2 and represents abt. 9% of the Italian continental shelf. The Ministerial Decree No. 9/08/2013 reshaped the marine zone and the surface allowed to be subject of new exploration applications was reduced by abt. 20%, from 50,520 km^2 to 39,960 km^2.

With reference to the activities for the offshore prospection, exploration and production of hydrocarbons conducted at domestic level, a picture of the situation based on the data published by the MISE National Mining Department for hydrocarbons and georesources (UNMIG) is reported hereinafter.

Figure 2.9 shows the offshore exploration permits released in the years 2001 to 2014 by marine zone.

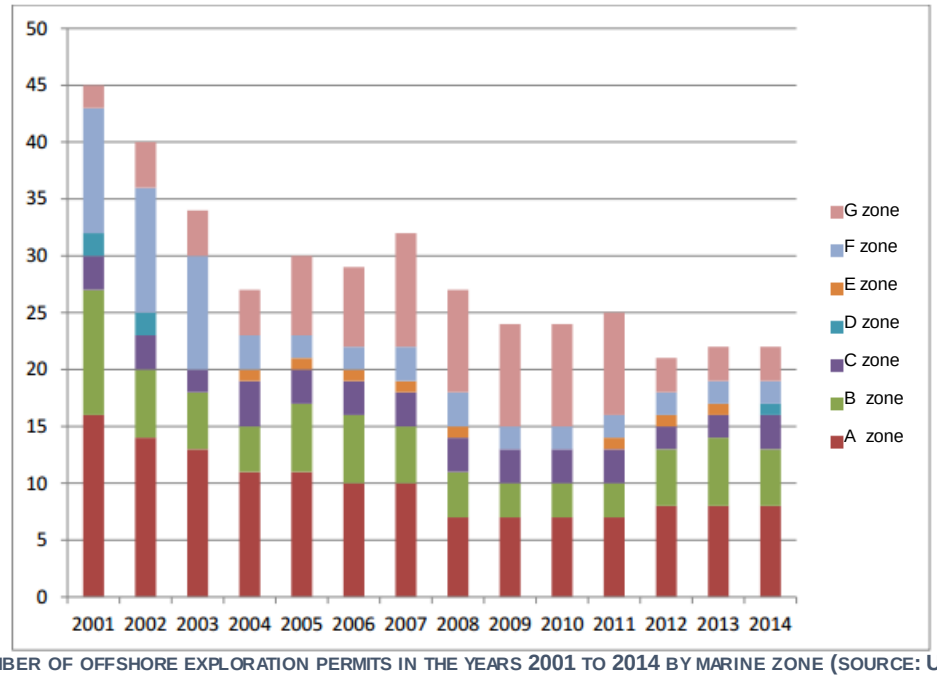


FIGURE 2.9: NUMBER OF OFFSHORE EXPLORATION PERMITS IN THE YEARS 2001 TO 2014 BY MARINE ZONE (SOURCE: UNMIG, IL MARE, MARCH 2015)

The figure below shows the offshore production licences granted in the years 2001 to 2014 by marine zone.

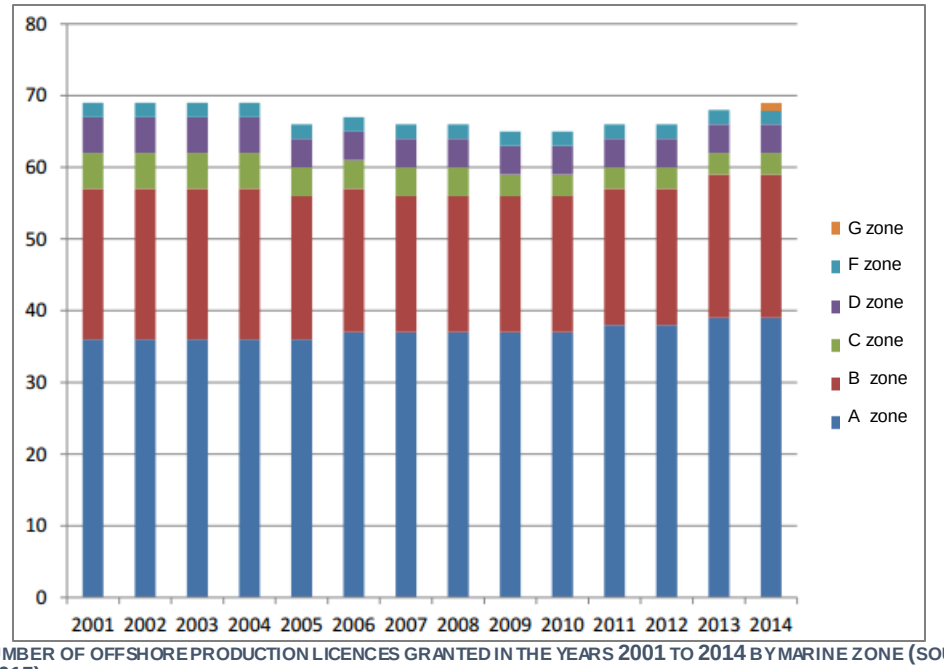


FIGURE 2.10: NUMBER OF OFFSHORE PRODUCTION LICENCES GRANTED IN THE YEARS 2001 TO 2014 BY MARINE ZONE (SOURCE: UNMIG, IL MARE, MARCH 2015)

The overall domestic situation of exploration licences granted for the production is depicted in the figure below.

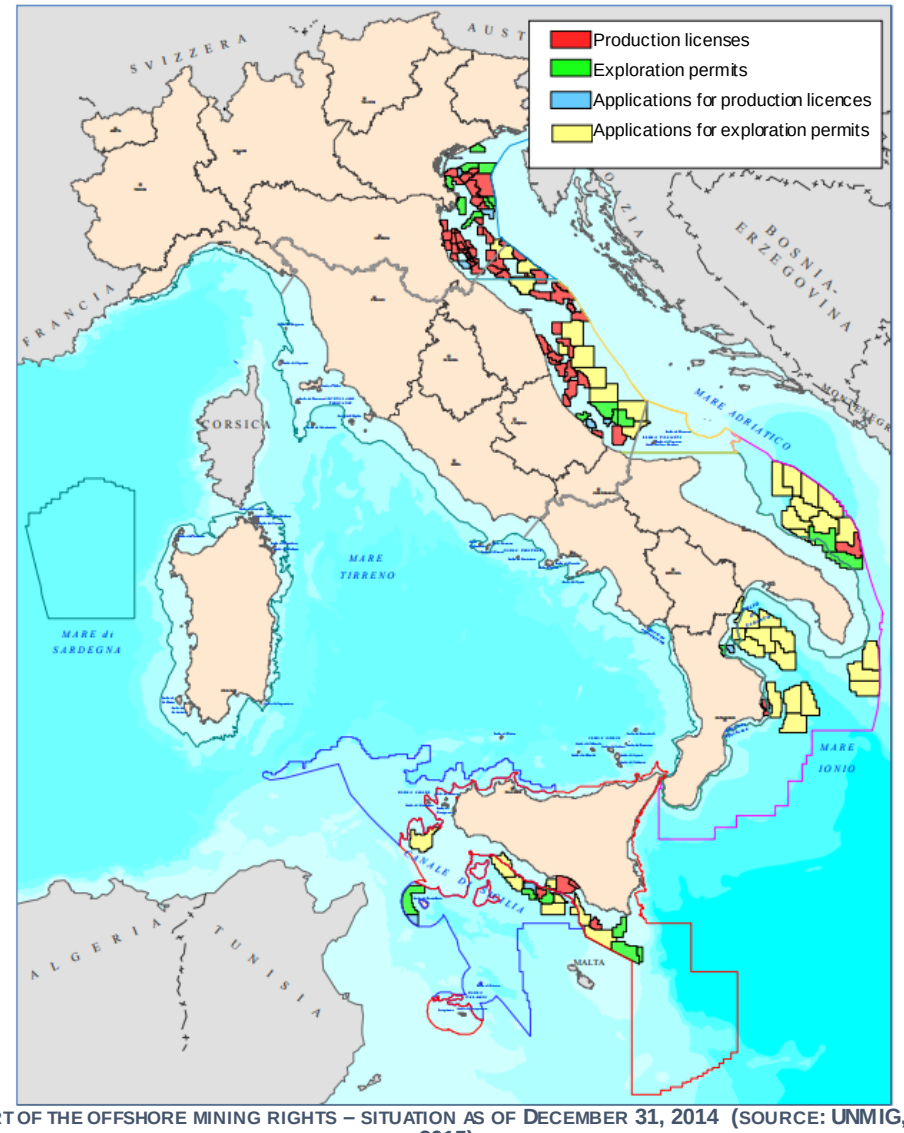


FIGURE 2.11: CHART OF THE OFFSHORE MINING RIGHTS – SITUATION AS OF DECEMBER 31, 2014 (SOURCE: UNMIG, IL MARE, MARCH 2015)

An abstract of the detailed layout (Figure 2.12) of the F marine zone discussed in the draft Project and examined in this study is given below.

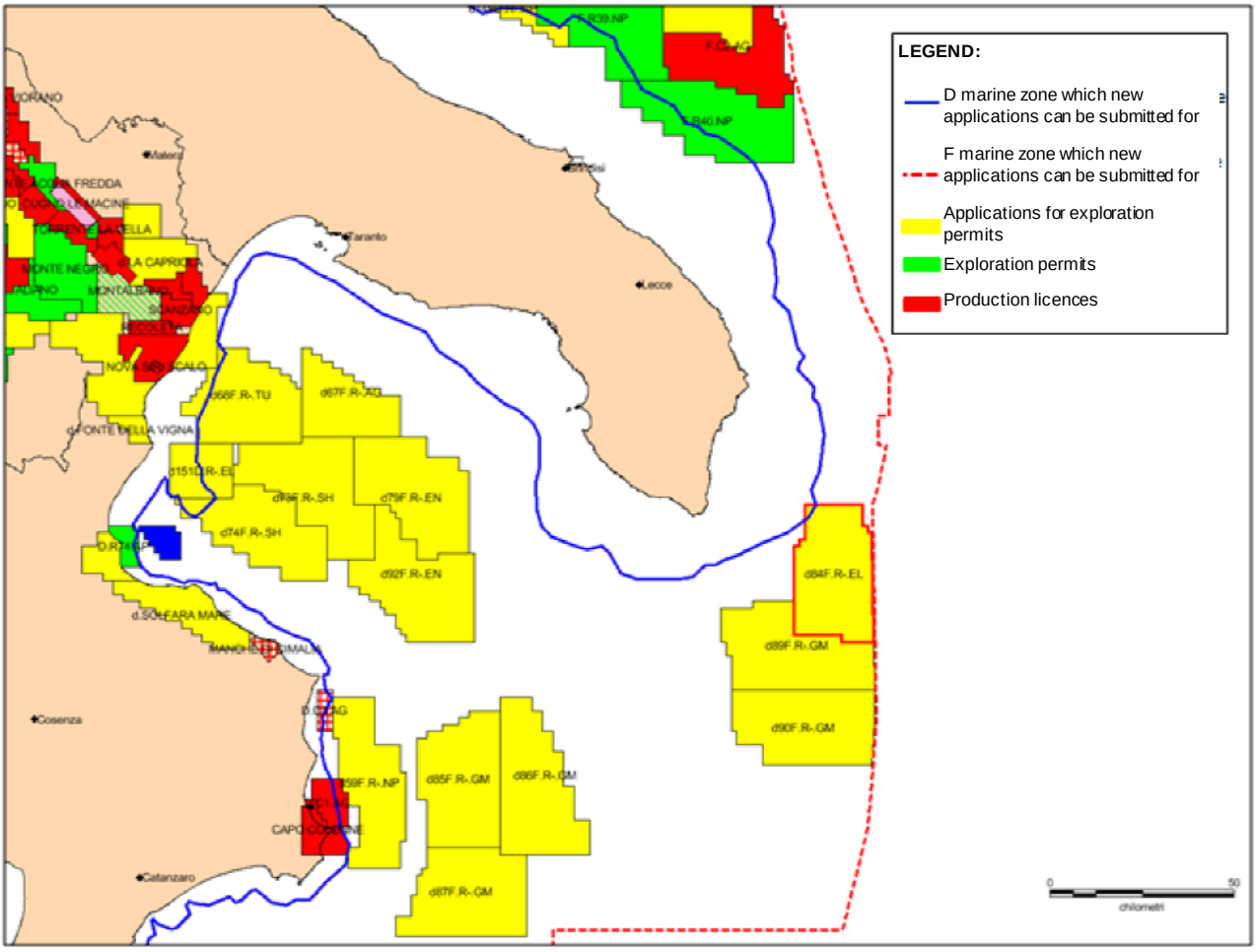


FIGURE 2.12: CHART OF THE OFFSHORE MINING RIGHTS FOR THE F AREA WHERE THE RED AREAS ARE THOSE AFFECTED BY AN EXPLORATION PERMIT FOR THE DISCUSSED PROJECT

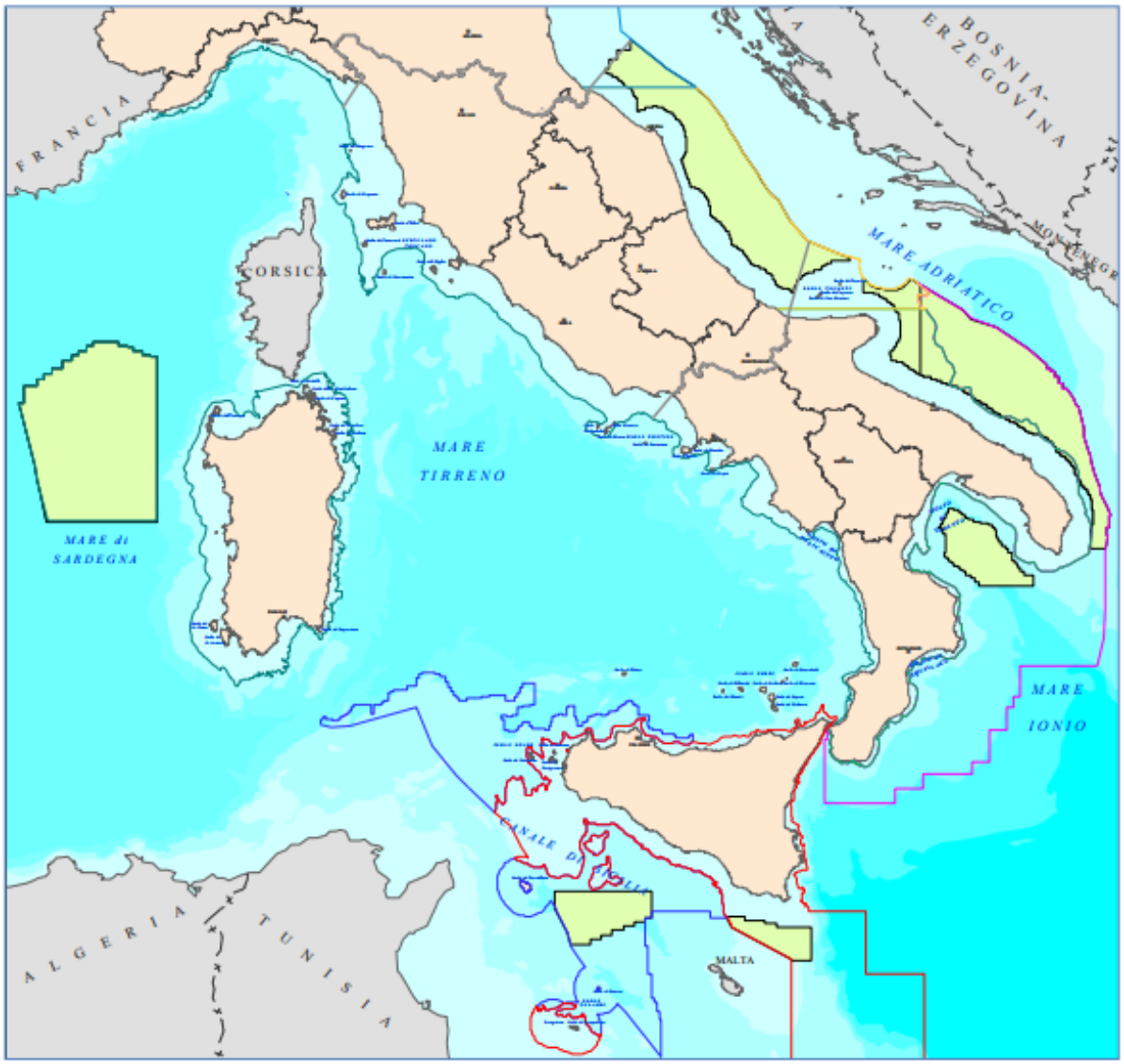


FIGURE 2.13: APPLICATIONS FOR OFFSHORE PROSPECTION PERMITS (SOURCE: UNMIG, IL MARE, MARCH 2015)

Key laws on continental shelf bordering

- **Law No. 1658 dtd December 8, 1961** – "Accession to the Convention on the territorial sea and the contiguous zone and the offshore Convention adopted at Geneva on April 29, 1958 giving effect to those Conventions".
- **Law No. 613 dtd July 21, 1967** – "Exploration and production of liquid and gaseous hydrocarbons in the territorial sea and the continental shelf amending the Law No. 6 dtd January 11, 1957 on the exploration and production of liquid and gaseous hydrocarbons".
- **Decree of the President of the Republic No. 816 dtd April 26, 1977** – "Regulatory laws on the enforcement of Law No. 1658 dtd December 8, 1961 authorizing the accession to the convention on the territorial sea and contiguous zone, adopted in Geneva on April 29, 1958 giving effect to that conventions".
- **Law No. 689 dtd December 2, 1994** – "Ratification and implementation of the UN Convention on the sea with attachments and final act agreed at Montego Bay on December 10, 1982 and of the

agreement for implementation of Part XI of said convention with related attachments made in New York on July 29, 1994".

The national legislation also refers to all laws issued by Italy aimed at regulating the following:

- emissions to the atmosphere;
- waste generation;
- protection of the marine environment;
- energy industry.

Key laws on the creation of marine zones for mining exploitation

- **Law No. 613 dtd July 21, 1967** – "Exploration and production of liquid and gaseous hydrocarbons in the territorial sea and continental shelf amending the Law No. 6 dtd January 11, 1957 on the exploration and production of liquid and gaseous hydrocarbons".
- **Ministerial Decree dtd June 13, 1975** – "Bordering of the marine zone to be designated as "F zone" for the exploration of liquid and gaseous hydrocarbons".
- **Interministerial decree dtd June 26, 1981** – "Bordering of two marine zones of the Italian continental shelf collectively designated as "G zone" for the exploration and production of liquid and gaseous hydrocarbons".
- **Ministerial Information dtd September 30, 2005** – Technical modification of the bordering line of the common Italo-Croatia continental shelf.
- **Ministerial Information dtd May 31, 2006** – Bordering of the "A", "B" and "F" marine zones following the technical modification of the bordering line of the continental shelf between Italy and Croatia.
- **Law Decree No. 112 dtd June 25, 2008** – "Urgent provisions for the economic development, simplification, competitiveness and stabilisation of the public finances and tax equalisation.
- **Ministerial Decree dtd October 30, 2008** – "Expansion and definition of new borders of marine zones opened to the exploration and production of hydrocarbons".
- **Ministerial Decree dtd March 29, 2010** – "Marine zones open to the exploration and production of hydrocarbons. Expansion of the "G Zone"".
- **Ministerial Decree dtd December 27, 2012** – "Marine zones open to the exploration and production of hydrocarbons. Expansion of the "C Zone".
- **Ministerial Decree dtd August 9, 2013** – Reshaping of the "E" zone and survey of the marine zones open to submission of new applications.

Agreements and conventions with the bordering countries

- **Decree of the President of the Republic No. 830 dtd May 22, 1969** – "Agreement between the Republic of Italy and the Socialist Federal Republic of Yugoslavia".
- **Law No. 73 dtd March 14, 1977** – "Ratification and implementation of the treaty between the Republic of Italy and the Socialist Federal Republic of Yugoslavia".
- **Law No. 347 dtd June 3, 1978** – "Ratification and implementation of the agreement between the Republic of Italy and the Republic of Tunisia".
- **Law No. 290 dtd May 23, 1980** – "Ratification and implementation of the agreement between the Republic of Italy and the Republic of Greece".
- **Law No. 147 dtd April 12, 1995** – "Ratification and implementation of the agreement between the Republic of Italy and the Republic of Albania".
- **Law No. 348 dtd June, 3 1978** – "Ratification and implementation of the agreement between Italy and Spain relating to bordering of the continental shelf between the two countries with related attachments signed in Madrid on February 19, 1974".

- **Italian-French Convention of November 28, 1986** – "Convention between the Government of the Republic of Italy and the Government of the Republic of France relating to definition of the maritime borders of the Bonifacio Strait areas".

Mining industry regulations

The key rules governing the conduction of the mining activities in Italy are specified hereinafter.

- **Law No. 613 dtd July 21, 1967** – "Exploration and production of liquid and gaseous hydrocarbons in the territorial sea and continental shelf amending the Law No. 6 dtd January 11, 1957 on the exploration and production of liquid and gaseous hydrocarbons"
- **Law No. 662 dtd September 29, 1980** – "Ratification of the International Convention for prevention of ship-sourced pollution and the offshore intervention protocol in case of pollution from substances other than hydrocarbons with related attachments adopted in London on November 2, 1973" as amended and supplemented. This law acknowledges the provisions of Annex IV to the MARPOL Convention on prevention of pollution from ship-generated wastes.
- **Law No. 979 dtd December 31, 1982** – "Provisions for Sea defence" as amended and supplemented. It provides a number of obligations for the maritime authorities, shipowners and masters of vessels engaged in surveillance and rescue services in case of sea accidents. According to art. 16, all vessels sailing in the territorial waters and internal sea waters including ports, regardless of their nationality, are prohibited from releasing or causing spillage into the sea of substances noxious to the marine environment (among which hydrocarbons and their mixtures) listed in Annex A to this law. For the vessels flying Italian flag, this ban is extended to areas beyond the Italian territorial waters. Art. 17 provides the application of penalties and sanctions for persons having committed or being liable for any infringement. The Italian vessels subjected to the rules under art. 17 must keep on board a register of hydrocarbons recording the prescribed notes in addition to the books under art. 169 of the Navigation Code. Releasing or spillage of hydrocarbons must be recorded by the captain of the vessel in the hydrocarbon register with indication of the circumstances leading to releasing or spillage and reported to the closest Harbour master. Each page of the hyrocarbon register must be signed by the office or the officers responsible for the operations and by the vessel captain, if the vessel is armed. Keeping on board of the hydrocarbon register is regulated by the provisions of article 362 et seq. of the regulations for the on-board books covered by the Code of Maritime Navigation.
- **Law No. 9 dtd January 9, 1991** – "Implementing regulations for the new National Energy plan : institutional aspects, hydroelectric plants and power lines, hydrocarbons and geothermal energy, self-productions and tax provisions"
- **Law No. 220 dtd February 28, 1992** – "Actions for sea defence" as amended and supplemented. This law states that the environmental impact should also be assessed for the construction of hubs for loading and unloading of hydrocarbons and hazardous substances, the mining exploitation of the continental shelf, the construction of underwater pipelines for transportation of hydrocarbons, the erection of plants for treatment of oil sludges, ballast and washing waters of vessels transporting hydrocarbons and hazardous substances.
- **Law Decree No. 624 dtd November 25, 1996** – "Implementation of directive 92/91/EEC on safety and health protection of workers in the mineral extracting industries through drilling and directive 92/104/EEC on safety and health protection of workers in surface and underground mineral extracting industries". This law acknowledges the European directives on safety and health protection of workers in mineral extracting industries through drilling and surface and underground mineral extracting industries.
- **Ministerial Decree of July 28, 1994, art. 1, para. 9** – "Determination of the support activities for release of authorizations to discharge into the sea of materials from prospection, exploration and production activities in oil and gas fields".

- **Law No. 179 dtd July 31, 2002** – "Environmental provisions" – Law No. 239 dtd August 23, 2004 – "Reorganization of the Energy industry and delegation of powers to the Government for re-arrangement of the applicable Energy provisions" as amended and supplemented by Law No. 99 dtd July 23, 2009 and Law Decree No. 83 dtd June 22, 2012 as amended and converted by Law No. 134 dtd August 7, 2012.
- **Law Decree No. 152 dtd April 3, 2006** – "Environmental regulations" as amended and supplemented.
  The general rules on emissions to the atmosphere from fixed installations are provided in Part V of the Code of the Environment. This Part deals with the activities generating emissions into the atmosphere and sets out the emission limiting values, prescriptions, emission sampling and analysis methods and criteria for assessing the compliance of the measured values with the limiting values. This decree also defines the characteristics of the fuels that can be used including fuels for maritime use for which the limiting values of the sulphur content are prescribed according to the European directives. Part IV of this decree deals with the waste management (waste generation, transportation, recovery and disposal to authorized plants, rehabilitation of polluted sites), whereas Part V regulates the authorization to the emissions into the atmosphere from fixed installations and the emission limiting values. For the time being, there are no rules specifically governing the air quality in a marine environment and the emissions into the atmosphere from offshore plants or activities. Reference should then be made to the international rules covered by the MARPOL convention.
- **Law Decree No. 202 dtd November 6, 2007** – "Implementation of the directive 2005/35/EC on ship-sourced pollution and related penalties". Art. 4 prescribes that all vessels sailing in the territorial waters and internal sea waters including ports, regardless of their nationality, are prohibited from discharging or causing spillage into the sea of harmful substances for the marine environment listed in Annex I (hydrocarbons) and Annex II (liquid substances transported in bulk) of the MARPOL 73/78 Convention. This Decree also provides adequate sanctions in case of violation of the prescribed obligations.
- **Law Decree No. 155 dtd August 13, 2010** – "Implementation of directive 2008/50/EC on ambient air quality and cleaner air for Europe". This decree had to implement the Directive 2008/50/EC on the ambient air quality (outdoor air in the troposphere excluding workplaces) and replace the implementing provisions of directive 2004/107/EC. This decree was aimed at protecting, improving and defining monitoring of the ambient air quality. For this purpose, it determined the ambient air quality limiting values for sulphur dioxide, nitrogen dioxide, benzene, carbon monoxide, lead and PM10 concentrations; critical values for sulphur dioxide and nitrogen dioxide concentrations in the ambient air; alert thresholds for ambient air sulphur and nitrogen dioxide concentrations; limit and target value, obligation to meet exposure concentration and National target of reducing the exposure to PM 2.5 concentration in the ambient air and target values for ambient air concentrations of arsenic, cadmium, nickel and benzo[a]pyrene.
- **Law Decree No. 190 dtd October 13, 2010** – "Implementation of directive 2008/56/EC "establishing a framework for community action in the field of marine environment policy". This decree acknowledged at national level the directive 2008/56/EC (MSFD, Marine Strategy Framework Directive) or community reference law for protection of the marine environment. It foresees that the Ministry for Environment and Territory and Sea Protection promotes and coordinates the "initial assessment of the present status and impact of the men activities on the marine environment based on the existing data and information". This decree provides a number of further actions being implemented in the long run among which definition of commencement of coordinated Monitoring Programmes (MP) following the first three substantial steps of the Marine Strategy.
- **Decree of the President of the Republic No. 209 dtd October 27, 2011** – "Regulations for creation of ecologically protected areas in the north-western Mediterranean sea, Ligurian sea and Thyrrenian sea". Art. 3 states that the ecologically protected zone, whose boundaries are defined

in art. 2), is subjected to the Italian and European Community legislation and the applicable International conventions when they refer to prevention and prohibition of any ship-sourced pollution. This does not apply to ships cited in art. 3, para. 3 of the MARPOL 73/78 Convention, viz. warships, auxiliary warships, a state-owned or –managed ships until said state uses the ships for governmental and non-commercial services, however, it applies to offshore platforms, biologic pollution from discharge of ballast waters in places where it is not allowed, pollution from waste incineration, exploration activities, exploitation of seabeds and air pollution from ships sailing under foreign flag and foreigners. This decree also covers protection of the biodiversity and marine ecosystems with special focus on marine mammals protection and protection of the cultural heritage found in the seabeds.

- **Directorial decree of March 22, 2011** – "Operating procedures for implementation of the ministerial decree of March 4, 2011 and execution methods of the activities for prospection, exploration and production of liquid and gaseous hydrocarbons and related controls according to art. 15, para. 5 of the Ministerial Decree of March 4, 2011". As the title itself indicates, this decree establishes the operating procedures for implementation of the Ministerial Decree dtd March 4, 2011 and the execution methods of the activities for prospection, exploration and production of hydrocarbons and related controls.
- **Law Decree No. 121 dtd July 7, 2011** – "Implementation of directive 2008/99/EC on criminal defence of the environment and of directive 2009/123/EC amending the directive 2005/35/EC on ship-sourced pollution and introduction of violation penalties".
- **Law Decree No. 1 dtd January 24, 2012** – "Urgent provisions for competition, facilities development and competitiveness" as amended and supplemented.
  Art. 16, para. 2 as amended and converted by Law No. 27 dtd March 24, 2012 establishes that the offshore activities being conducted by scuba divers (Art. 53 of the Decree of the President of the Republic No. 886 dtd May 24, 1979) must be performed in compliance with the good practice techniques as defined in the UNI Std. 11366 ("Safety and health protection during professional diving and hyperbaric activities serving the industry"). The specific reference to the UNI Standard intends to manage the scuba diving activities requiring rules capable of ensuring the achievement of the highest safety levels for all scuba divers and allowing the Italian companies to compete in the international market by applying their own rules with no resort to foreign organizations for the approval of the corporate procedures required for international bidding. The Italian companies performing scuba diving activities are currently more than 1,500 and their revenues exceed 700 million EUR for the offshore hydrocarbon activities only in national waters and abroad.
- **Law Decree No. 5 dtd February 9, 2012** – "Urgent provisions for simplification and development". Art. 24 as amended and converted by Law No. 35 dtd April 4, 2012 amends Art. 29-decies of the Law Decree No. 152/06 on compliance with the conditions for the Integrated Environmental Authorization (IEA) and establishes that the "offshore installations are controlled by the Istituto superiore for the environmental protection and research […] in coordination with the surveillance departments of the Ministry for the Economic Development, viz. UNMIG relying on the Management analysis laboratories.
- **Law Decree No. 83 dtd June 22, 2012** – "Urgent actions for the Country growth" as amended and converted by the Law No. 134 dtd August 7, 2012.
  Art. 35 of this decree modified the Law Decree No. 152/2006 as amended and supplemented, particularly with reference to the provisions of the Law Decree No. 128/10. It establishes that:

  - the activities for offshore prospection, exploration and production of liquid and gaseous hydrocarbons can be conducted within a range of 12 nautical miles, if they are covered by licences and authorizations ruling at the time of enforcement of the Law Decree No. 128/10, hence within August 26, 2010. On the basis of this provision the authorization procedures blocked by the enforcement of the Law Decree No. 128/10 can be restarted;
  - the activities aimed at improving the performances of the hydrocarbon production plants (*Side Track, Workover*) require an authorization to be released by the territorial UNMIG

departments, if they are conducted starting from existing works and within the limits of production and emission laid down in the already approved working programmes. For a detailed definition of the procedures subjected to the new laws, the Ministerial Circular Letter dtd October 17, 2012 described hereinafter was issued;

- the royalties the owners of licences for offshore production have to pay on a yearly basis will be increased from 7 to 10% for gas and 4 to 7% for oil contrary to the statements made in the Law Decree No. 625/96. The amounts resulting from the royalties increase shall be spent for the execution of the marine pollution monitoring and contrasting actions under the jurisdiction of the Ministry for Environment and Surveillance and Control of the safety of the offshore exploration and production plants under the Management jurisdiction.

- **Ministerial Circular Letter dtd October 17, 2012** – "Methods for application of art. 1, para. 82 – sexies of the Law No. 239 dtd August 23, 2004 introduced by article 27, para. 34 of the Law No. 99 dtd July 23, 2009 and para. 1 of article 35 of the Law Decree No. 83 dtd June 22, 2012 as amended and converted by Law No. 134 dtd August 7, 2012 issued by the Management. This circular letter provides directives on how to proceed to obtain authorizations for the execution of activities aimed at improving the performances of the hydrocarbon production plants including drilling, if they are conducted starting from existing works (art. 1, para. 82-sexies of the Law No. 239 dtd August 23, 2004), and the control of the compliance with the already approved emission and production limit values.
- **Law Decree No. 179 dtd October 18, 2012,** Article 34, para. 19 – "For the full implementation of plans and programmes relating to the development and safety of the Energy systems under the Law Decree No. 93 dtd June 1, 2011, the plants currently in operation according to article 46 of the Law Decree No. 159 dtd October 1, 2007 as amended and converted by the Law No. 222 dtd November 29, 2007 and according to articles 6 and 9 of the Law No. 9 dtd January 9, 1991 remain in operation up to completion of the applicable authorization procedures based on the original concession, whose expiry is intended to be automatically extended until completion".
- **Directorial Notice dtd February 20, 2014** – "Minimum requirements for verification of the applications made for release of permits for prospection and exploration in deep waters" by which MISE established the minimum requirements for verification of the applications made for release of permits for prospection and exploration in deep waters, viz. in areas that in most cases have never been explored and present difficult conditions due to the great depth of the seabeds and require special precautions and technical qualifications of the operators involved for the purpose of evaluating opportunities to implement mining activities in waters far away from the coasts and protected marine zones.
- **Law Decree No. 133 dtd September 12, 2014** – "Urgent actions for opening sites, constructing public works, digitizing the Country, simplifying bureaucracy, facing the hydrogeological instability and restoring the production activities" as amended and converted by Law No. 164 dtd November 11, 2014

  Article 38, para. 11-quater – Article 144, para. 4 of the Law Decree No. 152 dtd April 3, 2006 was supplemented with article 4-bis introducing the following statement: - "To protect the underground waters from pollution and promote a rational use of the national water resources, also in consideration of the precaution principle relating to the seismic risk and prevention of major accidents during the state-authorized activities for exploration and production of hydrocarbons, exploration and extraction of shale gas and shale oil and release of related mining concessions are forbidden. In this respect, any technique for injection under pressure of liquid or gaseous fluids into the subsoil including any additive aimed at obtaining or promoting fracturing of the rocks entrapping shale gas and shale oil is forbidden. Holders of exploration permits or production concessions have within December 31, 2014 to communicate to the Ministry for the Economic Development, the Ministry of the environment and protection of land and sea, National Institute of Geophysics and Volcanology and National Institute for the Protection and Research data and information relating to

the past, even experimental, use of the shale gas and shale oil techniques including the use of additives and their chemical composition. Any assessed violation of the requirements stated in this article causes revocation of the concession or permit ".

- **Directorial Decree dtd July 15, 2015** – "Operating procedures for implementation of the Decree dtd March 25, 2015 and methods for the execution of activities for prospection, exploration and production of liquid and gaseous hydrocarbons and related controls according to art. 19, para. 6 of the same decree", by which MISE has defined the implementing operating procedures of the Ministerial Decree dtd March 25, 2015 and methods for the execution of activities for prospection, exploration and production of liquid and gaseous hydrocarbons and related controls.
- **Law Decree No. 145 dtd August 18, 2015** – "Implementation of the directive 2013/30/EU on safety of the offshore operations in the hydrocarbons sector amending the directive 2004/35/EC"
  According to the directive 2013/30/EU and in compliance with the criteria set forth in the law No. 154 dtd October 7, 2014, this decree sets out the minimum requirements to prevent major accidents from the offshore operations in the hydrocarbon sector and mitigate the accident effects.
  The main innovation in terms of mining operation safety introduced by the new regulatory frame work regards the prevention of major offshore accidents to be shared by all the member states and the overall achievement of a risk safety and management target and a financial guarantee from the operators also for the purposes of the environmental responsibility via the establishment of a competent authority in charge of the work safety and the environmental protection.
  MISE Decree dtd December 7, 2016 – Standard Specification for release and use of mining concessions for prospection, exploration and production of liquid and gaseous hydrocarbons in the mainland, the territorial sea and the continental shelf -
  This decree states the methods being adopted by the Ministry for the Economic Development for granting single concessions, permits for prospection, exploration and production of liquid and gaseous hydrocarbons in the mainland, the territorial sea and the continental shelf and methods for the operation execution within the field of the mining concessions.

Law of the Sea

The *United Nations Convention on the Law Of the Sea* – UNCLOS, ratified by Italy in 1994 lays down a comprehensive regime of law in the world's oceans and seas establishing rules governing all uses of the seas and oceans.

The UNCLOS regulates the sea activities and introduces a set of specific indications on setting limits, navigation, transit regime, marine resource exploitation regime, protection of the marine environment and scientific research.

With reference to the exploration permit region, navigation aimed at offshore geophysical prospection shall occur out of the territorial waters (out to 12 nautical miles) as per the Law of the Sea enshrined in the UNCLOS, more specifically in the exclusive economic zone corresponding to the **Continental Shelf** in Italy.

The Continental Shelf of a coastal state according to the statements in the 1982 United Nations Convention on the Law of the Sea includes seabed and subsoil of the submarine areas beyond the limits of national jurisdiction through a natural prolongation of the land territory to the continental margin's outer edge or 200 nautical miles from the coastal state's baseline. The outer edge of the continental shelf may never exceed 350 nautical miles from the baseline. A coastal state has sovereingty on its continental shelf in terms of exploration and exploitation of natural resources, to the exclusion of others. Natural resources mean mineral and non-living material in the seabed and subsoil. The delimitation of the continental shelf between states with opposite or adjacent coasts shall be effected by agreement on the basis of the International Law. The principles adopted by Italy for regulating the exploration and extraction of hydrocarbons in its continental shelf are laid down in the Law No. 613 dtd July 21, 1967 governing the conditions for release of exploration permits in compliance with the provisions of 1958 Geneva Convention IV. The United Nations Convention of the Law of the Sea held at Montego Bay on December 10, 1982 was ratified and implemented by the Law No. 689 dtd December 2, 1994.

2.3. General physical characteristics and operation of the Project

2.3.1. General Project structure

2.3.1.1. Scope of the geophysical prospection Project

The proposed Project aims at performing the geophysical activities and specifically "Phase 5: Performance of the seismic data acquisition campaign" making part of the Work Program (Table 2.1) attached to the Exploration Permit Application «d 84 F.R-.EL», submitted to the Ministry of the Economic Development having jurisdiction thereon.

The effective implementation of Phase 5 is as function of the results from the preliminary acquisition and processing of the pre-existing geophysical data under point 1.3 and 1.4 of Table 2.1. Actually, during this phase performed after obtaining the mining concession, the geological setting and targets of a future seismic campaign aimed at detailing the data mapped so far can be defined.

The subsoil data acquisition stage via the use of geophysical methods is integral part of a broader Project aimed at locating an exploratory drilling according to "Phase 6: Performance of an exploratory drilling" included in the Work Program, **for which an additional START procedure will be subsequently carried out**.

The various phases of the whole Project as per the Work Program submitted to MISE together with the permit application are specified hereinafter following the same sequence of their performance.

TABLE 2.1: PHASES OF THE WORK PROGRAM ATTACHED TO THE EXPLORATION PERMIT APPLICATION SUBMITTED TO MISE

MACROPHASE	PHASE		GRANTING OF THE PERMIT
1	ENVIRONMENTAL PROTECTION	1 Environmental impact study	Preliminar
	GEOLOGY	2 Geologic studies	Within 6 months
	GEOPHYSICS	3 Acquisition of pre-existing geophysical data	Within 12 months
		4 Reprocessing of the acquired data	Within 18 months
		5 Conduction of a seismic data recording campaign (covered by this START procedure))	Within 24 months
2	DRILLING	6 Conduction of an exploratory drilling (does not make part of this START procedure)	Within 48 months

Purpose of the campaign is the acquisition of recent and high quality data to optimize the 3D image of the buried geologic structures. Interpretation of the campaign data shall allow to locate and evaluate the mining potential of the identified prospection..

2.3.2. General notes on the reflection seismology method

The most widely used method for the hydrocarbon exploration is the reflection seismology method based on recording the different times of propagation of the elastic ways in the various types of rocks characterized by a different acoustic impedance.

By the reflection seismology method, the waves from a surface Energy source are transmitted to the subsoil as an elastic pulse, whose frequency, amplitude and polarity are modified as function of the variations in the acoustic impedance (density x velocity) of the geologic layers passed through. Part of the transmitted

energy is reflected from the geologic layers to the surface where dedicated sensors (hydrophones) capture the reflected signals and send them to a recording unit.

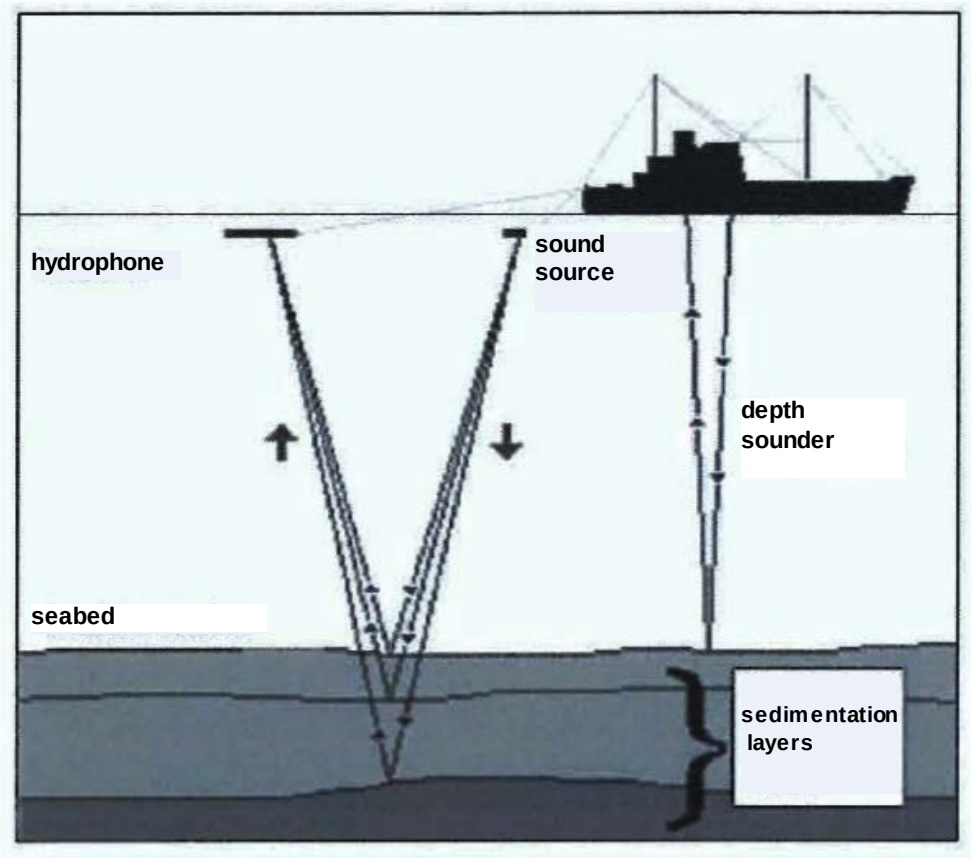


FIGURE 2.14: SCHEME OF THE SEISMIC REFLECTION PROSPECTION METHOD

2.3.3. General survey method

The Project survey method is of a *towed streamer* type, based on the use of an adequately fitted out vessel that tows at the stern both the emission system (source) and the detection system (receiver). This method shall require:

- an emission system consisting of elastic pulse generators or sources (*air gun*);
- a detection system made up of floating cables (*streamer*) accommodating sensors or hydrophones receiving the reflected wave;
- a vessel towing the equipment on board of which equipment control and data acquisition and processing systems are located.

The following figure illustrates the survey method designed for the discussed Project.

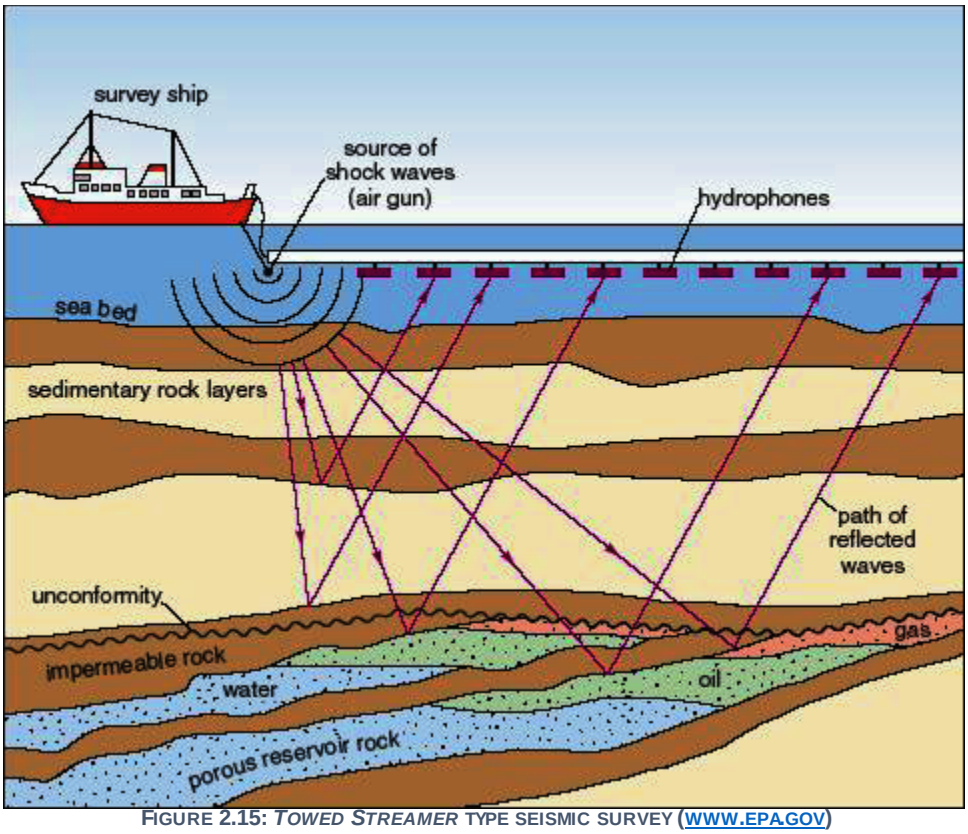


FIGURE 2.15: *TOWED STREAMER* TYPE SEISMIC SURVEY (WWW.EPA.GOV)

As provided for the acquisition program described hereinafter, the Project surveys shall be 3D type and conducted following the recording lines that fully cover a surface thanks to the receiver incorporating many parallel cables (streamers).

For the execution of the a.m. surveys, a greater number of recording devices of different size and location according to the identified target is used. The 3D survey provides a three-dimensional representation of the results.

The Figure below shows the different geometries of the 2D and 3D seismic surveys.

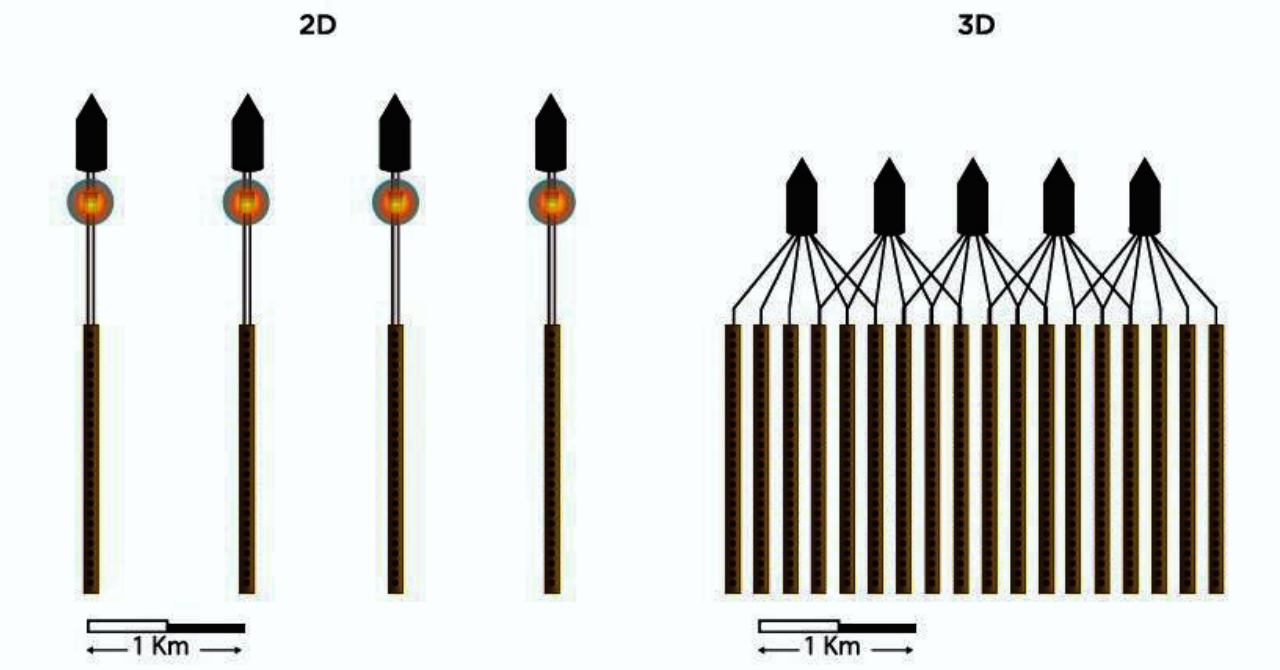


FIGURE 2.16: DIFFERENCES BETWEEN 2D AND 3D SEISMIC SURVEYS (OGP, 2011)

The Project components are described in detail in the paragraphs below.

2.3.3.1. Air gun energization system

The energy source includes a compressed air device (*air gun*) that, once activated, releases an elastic wave having a force that tunes down as long as it propagates. The *air gun* is currently the most widely used energy source in the field of offshore seismic detection and allows to release a moderate energy to protect the conditions of the marine environment affected by the operation.

The *air gun* is a cylindrical item with a top loading and bottom releasing chamber sealed by a dual hollow plunger sliding on a sole shaft. The compressed air from the compressors installed on the vessel is directly supplied to the top chamber at a pressure of abt. 2,000 psi, whereas the bottom chamber is filled through the hollow space inside the plunger connecting both chambers. Upon loading completion and achieving the desired pressure, an electronically actuated solenoid valve lifts up the plunger for almost instantaneous release of the compressed air into the water through the holes in the bottom chamber.

At the time of the so called “blasting”, i.e. the quick release of the compressed air by lifting up the plunger, an air bubble quickly expands due to pressure inside the cylinder being much higher than that of the surrounding water.

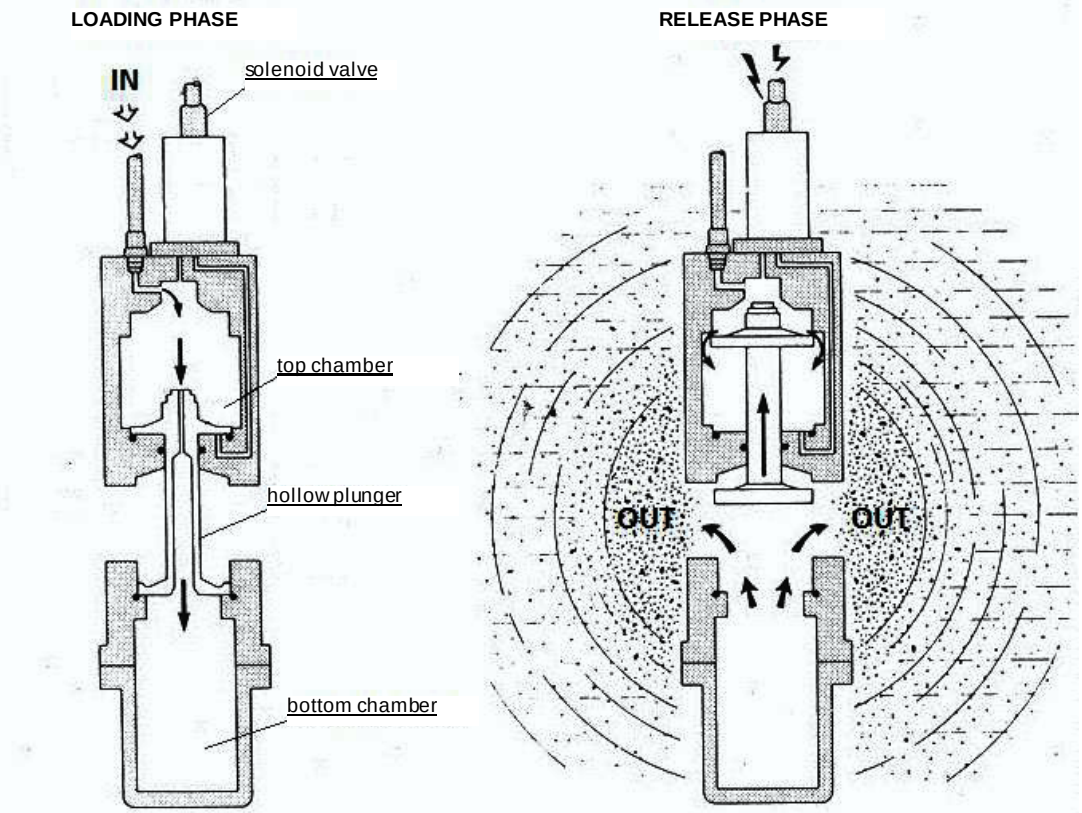


FIGURE 2.17: AIR GUN OPERATION PRINCIPLE (HTTP://WOODSHOLE.ER.USGS.GOV/OPERATIONS/SFMAPPING/AIRGUN.HTM)

The air bubble continues to grow until the internal pressure decreases and becomes equal to that of the water. Now, the air bubble starts getting compressed until the internal pressure is again higher than the external one and so on. The air bubble expansion and compression cycles generate a pressure wave that propagates first in the water and then in the subsoil and is differently reflected according to the geologic layers passed through. The repeated cycles involve an energy loss (the air bubble behaves as a damping oscillator) and continue until the air bubble comes in contact with the atmosphere at the sea-air interface point.

The type of survey being conducted and hence the type of wave being generated dictate the array arrangement of the *air guns* and their location following a pre-set geometry. Actually, a correct design of the source system geometry allows to direct the wave to the targeted point and mitigate the effects of any secondary wave in order to avoid mutual interferences with the various sources and an energy propagation other than the vertical direction.

The operating volume of an *air gun* is generally measured in cubic inches (in^3) and typically ranges from 20 to 800 in^3 (abt. 330 to13,000 cm^3 or 0.3 to 13 litres). The overall volume of an *array* depends on the total amount of its *air guns* and normally ranges from 2,000 to 9,000 in^3 (0.03 to 0.15 m3 or abt. 32 to 150 litres). The total energy required in terms of total volume depends on the type of survey and the exploration target and is so calculated as to supply sufficient energy to reach the pre-set geologic goal.

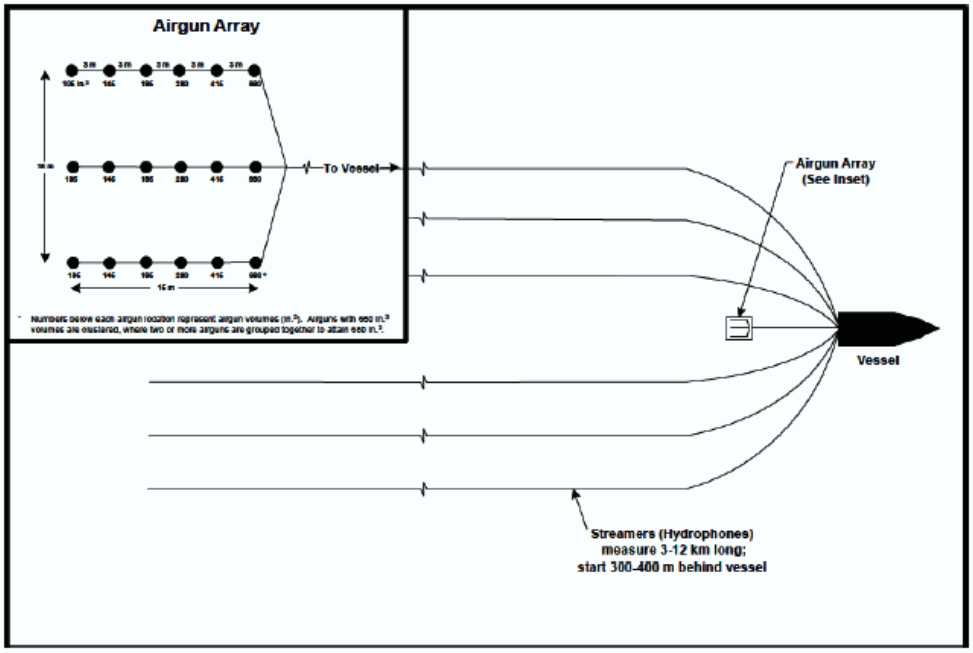


FIGURE 2.18: CONFIGURATION OF THE STANDARD *AIR GUN ARRAY* (U.S. DEPARTMENT OF THE INTERIOR, MINERALS MANAGEMENT SERVICE, GULF OF MEXICO OCS REGION, 2004)

2.3.3.2. Receiving system (hydrophone – *streamer*)

The key component of the system receiving the seismic waves released by the *air guns* and reflected by the geological subsoil structures is the seismic cable or *streamer*. It is a 5 to 8 cm dia. robust neoprene pipe internally accommodating a number of receivers (hydrophones) and wiring power circuits.

The hydrophones receiving the elastic waves reflected by the subsoil are piezoelectric transducers generally assembled in groups of 10 to 20 units at specified intervals. They are designed to convert the received signal (reflected elastic wave) to an electrical pulse generating a potential difference proportional to the instantaneous pressure of the water, which is in turn proportional to the motion speed of the wave-triggered particles.

FIGURE 2.19: PATTERN OF SEISMIC CABLE OR *STREAMER* (OGP, 2011)

The *streamer* is kept floating by means of a depth control unit (*birds*), where depth may vary according to the type of survey being conducted (5 to 15 m), and aligned to the pre-set survey direction.

The seismic cables length up to 12 km can be custom-designed to suit the survey geometry. The seismic cables are divided into sections joined to each other to help easy replacement of damaged items. 8 m long seismic cables shall be used for this Project.

The *streamer* is hooked to the vessel by an one-piece steel tow cable round which the conductors wiring the hydrophones to the on-board recording unit are wound. The submerged part of the tow cable is faired to reduce vibrations caused by vortex shedding.

The end portion of the *streamer* is connected to a *tail buoy* fitted with a position locator (GPS) to monitor alignment of the seismic cable to the vessel's race track and ensure recording along the established routes. The tail buoys are also fitted with an autonomous source of light for permanent visibility under any conditions.

2.3.3.3. General features of the seismic energizing and acquisition system

The technical specifications and the geometrical arrangement of the equipment (*air guns and streamers*) depend on the sea depth and the survey goals. The table below shows the characteristic values of the *Polarcus* equipment that is expected to be used for the discussed seismic survey.

TABLE 2.2: STANDARD CHARACTERISTIC VALUES OF THE *AIR GUNS* AND *STREAMER*

Specification	***Air gun***
Air Gun qty	33 (+ 3 spare)
Sub-*Array* qty	3
Total volume	59 litres (3640 in³)
Operating pressure	2,000 psi
Frequency range	5-300 Hz
Sub-*Array* length	14 m
Sub-*Array* w idth	14.6 m
Sub-*Array* intervals	2.8 m
Array depth	7 m
Standard *Streamer* Specifications	
Type	**Value**
Qty	10
Length	8,000 m
Depth	Abt. 18 m
Centre distance	100 m

The final technical specifications shall be communicated after identifying and defining the relationships with the reference contractors and selecting the seismic vessel.

2.3.3.4. Seismic vessels

The Project survey shall be conducted using a vessel designed and equipped for both towing the energy sources (*air guns*) and recording cables (*streamers*) and on-board transportation of the equipment for seismic data production such as:

- Compressors for source actuation;
- Systems for processing the seismic signals from the streamer cables;
- Control unit for handling the survey equipment;
- Instruments for continuous navigation positioning.

The seismic vessels generally used for these operations feature as follows:

- An *instrument room* is usually placed in the mid of the vessel and has all instruments for recording, monitoring and processing the seismic data, monitoring the receiving system and actuating the

compressors. The instrument room also accommodates the navigation system for monitoring at any instant the correct vessel location and the seismic cable alignment to the established routes;

- A *back deck* for deploying streamer reels with a place for stowing, preparing, maintaining and repairing the instruments. The back deck functions may vary according to the vessel shape configuration;
- A *compressor room*, usually located close to the back deck, accommodating the compressor engines supplying high pressure air to the *air guns* for their operation .

Living areas for the crew, on-board instruments and a *helideck* are also features of the seismic vessels.

The main features of the Seismic Vessels are as follows:

- 70 to 90 m length;
- 12 to 15 m width;
- 4 to 6 m draught;
- 2,000 to 3,000 gross tonnage (GT);
- 3 to10 knots speed;
- 1 to 2 month autonomous operation;
- diesel and power motors ;
- 300 kW motor power;
- 7 m^3/day fuel consumption;
- 50 crew people on board.

The seismic vessels normally used for the survey discussed herein are illustrated in the figures below.

FIGURE 2.20: STANDARD SEISMIC VESSELS (OGP, 2011)

FIGURE 2.21: OGS EXPLORA SEISMIC VESSEL (EXPERIMENTAL GEOPHYSICAL OBSERVATORY , WWW.OGS.TRIESTE.IT)

The vessels used for performing geophysical surveys in the field of offshore oil and gas exploration are designed to ensure a 30 to 40 day autonomous operation. In addition, the low noise propellers of the vessel provide a constant, low speed navigation (4 to 7 knots) to avoid interferences with the recording equipment.

The low maneuverability caused by towing of streamer cables requires that the seismic vessels used for seismic surveys be supported by one or more *Support vessel(s) or chase vessel(s*) of smaller size than the seismic vessel. The diuties of the chase vessels include operation control, transportation to and from the harbour of equipment, crew, supplies and on-board garbage, monitoring of the investigated area for safe navigation and warning of the presence of watercrafts or marine mammals.

2.3.4. Estimated acquisition Program and operation time scheduling

The proposed Project covers the conduction of geophysical surveys by the reflection technique aimed at acquiring data on the subsoil nature and exploring the existence of deposits suitable for hydrocarbon accumulation.

The Project is broken down into the following steps:

- STEP 1: arriving of seismic vessels at the area being investigated;
- STEP 2: executing on-board preparation work and installing equipment and support equipment offshore;
- STEP 3: energizing and performing 2D or 3D recording according to the established methods;
- STEP 4: retrieving the equipment used for the survey conduction;
- STEP 5: leaving the investigated area.

Under stable, stand-by free marine weather conditions, the geophysical survey campaign is expected to approximately last 15 to 25 days including energizing and non-energizing steps. 24 hr navigation mode shall be provided.

Time scheduling of each Project step is reported in the table below.

TABLE 2.3: TIME SCHEDULING

Step	Description	Period (days)
STEP 1	Arrival of seismic vessels	1
STEP 2	Equipment preparation and installation	4
STEP 3	Energizing and data recording	16
STEP 4	Equipment retrieval	2
STEP 5	Leaving the area	1
	TOTAL	24

2.4. Project emissions

A summary list of the emissions from the Project operations is given hereinafter. For an estimate of the emission intensity and its potential environmental impacts reference should be made to chapter 7.

TABLE 2.4: SUMMARY LIST OF EXPECTED EMISSIONS FROM THE PROJECT OPERATIONS, POTENTIALLY AFFECTED ENVIRONMENTAL COMPARTMENT AND EMISSION INTENSITY

Kind of emission	Immission environmental compartment	Emission intensity
Pollutants (gases and powders) and greenhouse gas emissions from the seismic vessel engines	Atmosphere	Average
Non-impulsive noise of the vessel engines	Airspace and marine environment	Low
Multi-pulse noise generated by the *air guns*	Airspace and marine environment	High
Night lighting	Airspace environment	Moderate
Sewage waters	Airspace environment	Negligible

2.5. Description of the selected technique – selected *array* geometry

As per the Scoping Procedure (Opinion No. 2199 dtd October 14, 2016), a "less impacting" *array* configuration has been selected using the results of the acoustic signal modeling.

The acoustic modeling results are fully reported in the RPS-drafted "*Seismic Source Array Modelling*" document (**ANNEX NO. 1**). A synthesis of the most significant results and considerations is available hereinafter.

Modeling suggested the Proponent to use the "*Polarcus 3640 in^3" air gun array*. The 3640 in^3 number indicates a total operating volume of abt. 60 litres shared by 33 active and 3 inactive *air guns*.

According to the JNCC and ACCOBAMS guidelines and the model processed data (*Seismic Source Array Modelling)*, the selected *array* geometry represents the minimum source volume capable of achieving the Project goals. Following the Project parameters, the ***air guns* shall be located at abt. 7 m depth and the streamers at a depth ranging from 8 to 15 m**. Length of the recording equipment shall be abt. 8 km.

Figure 2.22 illustrates the selected *array* geometry. Since directivity is a primary factor for data quality, min. two strings are used for each *array* to obtain a downwards energy propagation and simultaneously reduce the horizontal emissions that may create disturbance offence to the marine environment. The blue symbols are the active *air guns*, while the white ones are the inactive *air guns*; instead, size of the symbols relates to the operating volume of each individual item (Table 2.5).

TABLE 2.5: TECHNICAL SPECIFICATIONS OF THE "*POLARCUS 3640 IN^3" ARRAY* (RPS ENERGY – *SEISMIC SOURCE ARRAY MODELLING*)

Gun #	*air gun* type	X (m)	Y (m)	Z (m)	Volume (in^3)	Pressure (psi)
1	BOLT 1900LLXT	7,00	7,10	7,00	45	2000
2	BOLT 1900LLXT	7,00	6,50	7,00	45	2000
3	BOLT 1900LLXT	4,20	7,10	7,00	70	2000
4	BOLT 1900LLXT	4,20	6,50	7,00	70	2000
5	BOLT 1500LL	1,40	7,30	7,00	175	2000
6	BOLT 1500LL	1,40	6,30	7,00	175	2000
7	BOLT 1500LL	-1,40	7,30	7,00	175	inactive *Air gun*
8	BOLT 1500LL	-1,40	6,30	7,00	175	2000
9	BOLT 1900LLXT	-4,20	7,10	7,00	70	2000
10	BOLT 1900LLXT	-4,20	6,50	7,00	70	2000

Gun #	*air gun* type	X (m)	Y (m)	Z (m)	Volume (in^3)	Pressure (psi)
11	BOLT 1900LLXT	-7,00	7,10	7,00	45	2000
12	BOLT 1900LLXT	-7,00	6,50	7,00	45	2000
13	BOLT 1900LLXT	7,00	0,10	7,00	90	2000
14	BOLT 1900LLXT	7,00	-0,50	7,00	90	2000
15	BOLT 1900LLXT	4,20	0,10	7,00	110	2000
16	BOLT 1900LLXT	4,20	-0,50	7,00	110	2000
17	BOLT 1500LL	1,40	0,30	7,00	290	2000
18	BOLT 1500LL	1,40	-0,70	7,00	290	inactive *Air gun*
19	BOLT 1500LL	-1,40	0,30	7,00	290	2000
20	BOLT 1500LL	-1,40	-0,70	7,00	290	2000
21	BOLT 1900LLXT	-4,20	0,10	7,00	110	2000
22	BOLT 1900LLXT	-4,20	-0,50	7,00	110	2000
23	BOLT 1900LLXT	-7,00	0,10	7,00	90	2000
24	BOLT 1900LLXT	-7,00	-0,50	7,00	90	2000
25	BOLT 1900LLXT	7,00	-6,90	7,00	45	2000
26	BOLT 1900LLXT	7,00	-7,50	7,00	45	2000
27	BOLT 1900LLXT	4,20	-6,90	7,00	70	2000
28	BOLT 1900LLXT	4,20	-7,50	7,00	70	2000
29	BOLT 1500LL	1,40	-6,70	7,00	175	2000
30	BOLT 1500LL	1,40	-7,70	7,00	175	2000
31	BOLT 1500LL	-1,40	-6,70	7,00	175	inactive *Air gun*
32	BOLT 1500LL	-1,40	-7,70	7,00	175	2000
33	BOLT 1900LLXT	-4,20	-6,90	7,00	70	2000
34	BOLT 1900LLXT	-4,20	-7,50	7,00	70	2000
35	BOLT 1900LLXT	-7,00	-6,90	7,00	45	2000
36	BOLT 1900LLXT	-7,00	-7,50	7,00	45	2000

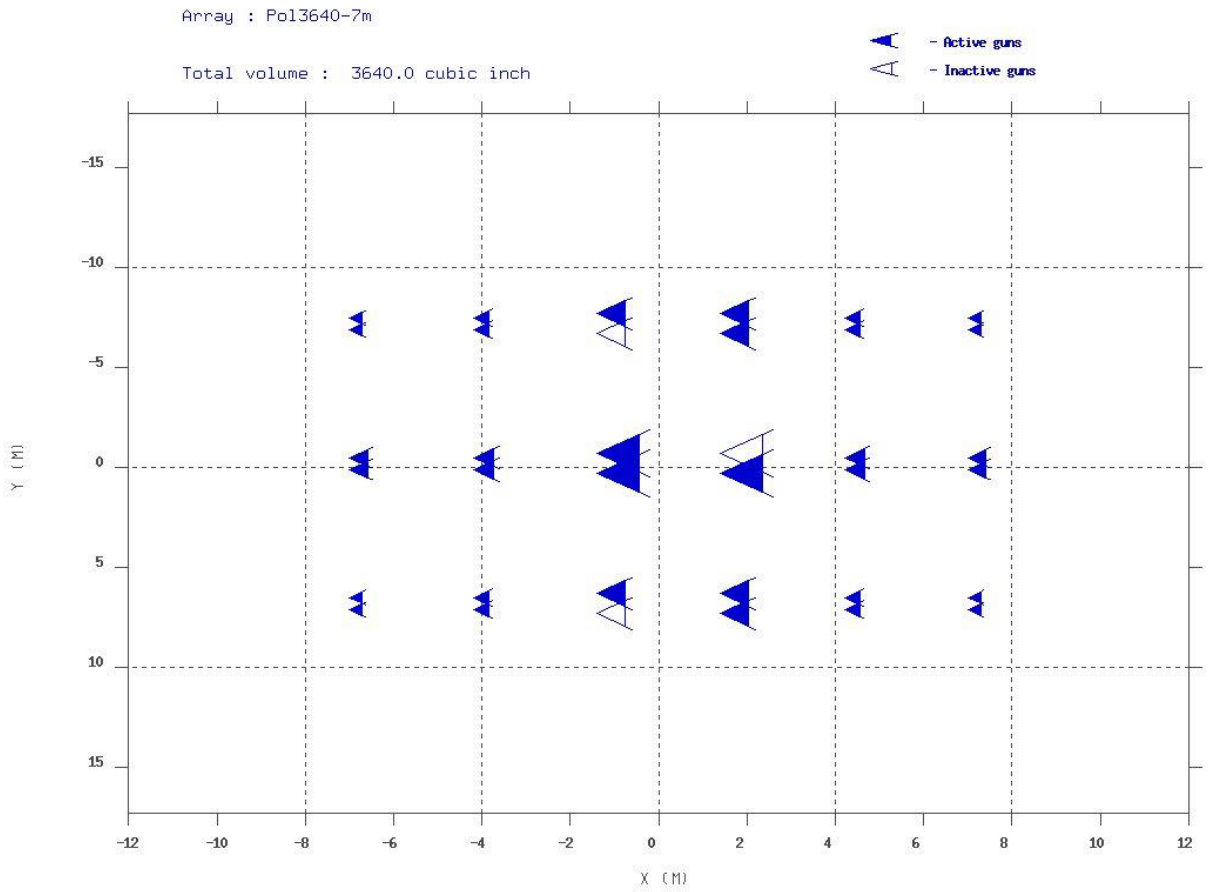


FIGURE 2.22: SELECTED *ARRAY* GEOMETRY (RPS ENERGY – *SEISMIC SOURCE ARRAY MODELLING*)

2.6. Predictable plotting of the acquired seismic lines

The acquired seismic lines within the selected Project region are plotted in the figure below. The predicted navigation direction is N-S spaced 500 m between the navigation lines. A both north- and southside *buffer* value of at least 8.5 km to the investigated region shall be considered during navigation to allow tracking of the seismic vessel. This *buffer* value is plotted in the figure.

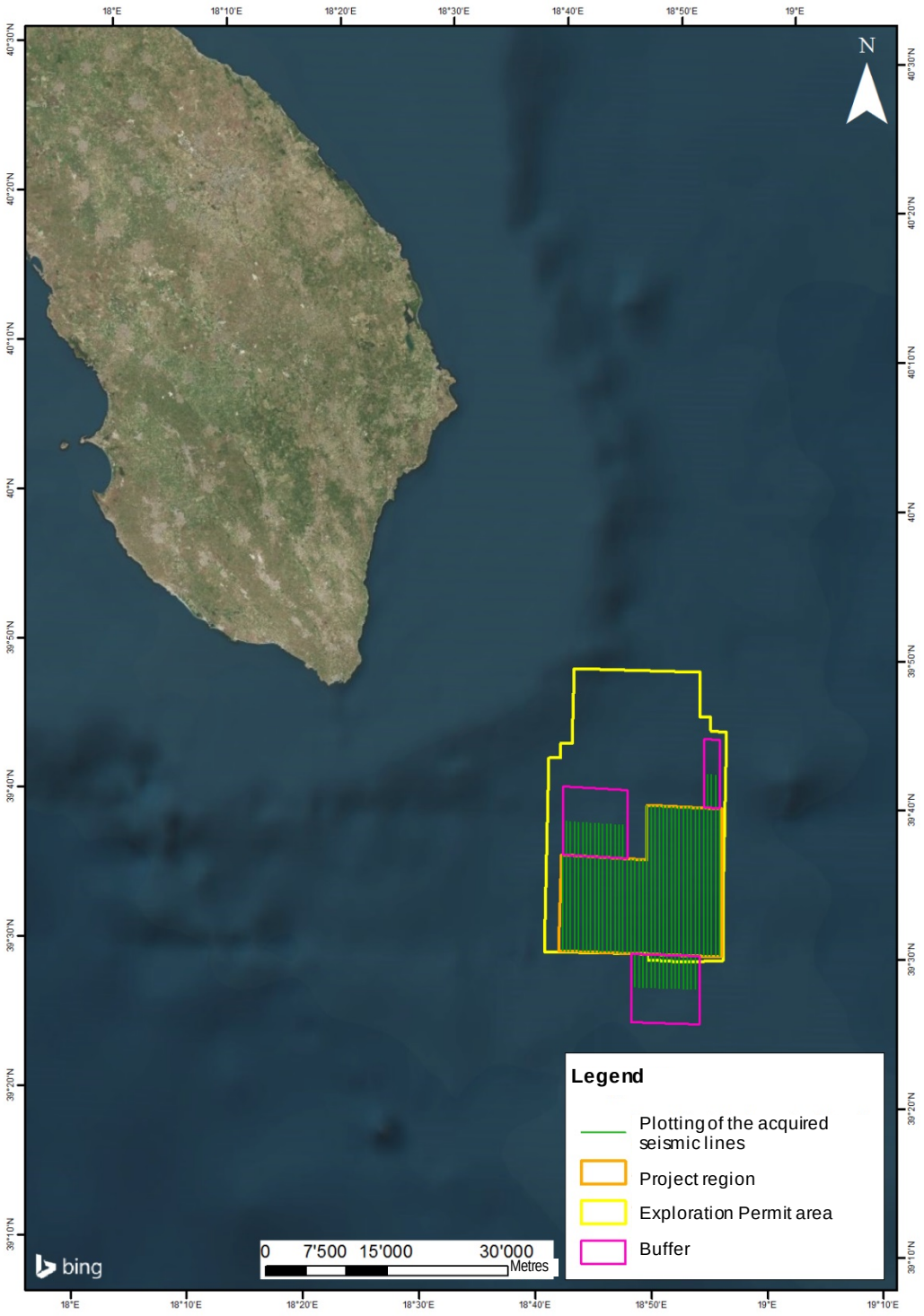


FIGURE 2.24: PLOTTING OF THE ACQUIRED SEISMIC LINES WITHIN THE PROJECT REGION

2.6.1. Investigated area divided into a mesh grid

As per the Scoping Procedure (Opinion No. 2199 dtd October 14, 2016), the Project region has been divided into a mesh grid "*also for the purpose of informing the local management departments on the areas restored to fishing and supplying the competent Harbour master's offices with a weekly schedule of the ongoing operations and affected areas*". For such purpose, 10 3 km-wide meshes have been designed within the

Project region, each of them being investigated over a period of 2 days approximately. The grid and its meshes are shown in the figure below.

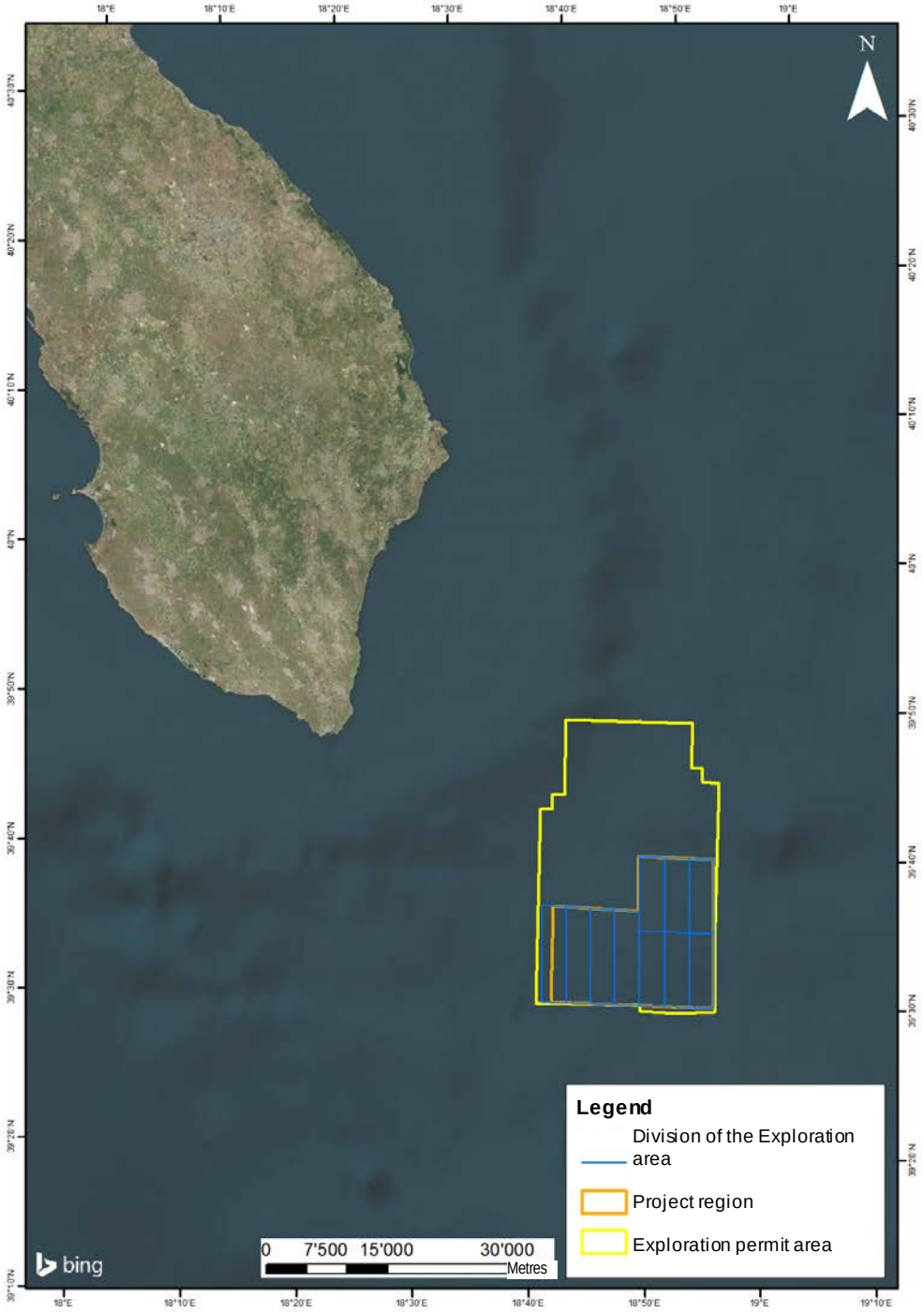


FIGURE 2.25: DIVISION OF THE PROJECT REGION INTO 3 KM-WIDE MESHES

3. Project options

3.1. Zero option

No option exists, if the Project is not implemented.

The Project goal being a better understanding of the subsurface formations and composition within the Application for Exploration Permit area, the Zero Option would be inconsistent with the current Italian Energy policy of fostering the national energy resources during the transition to a low carbon economy sponsored by the European and global policies on climate changes. Actually, the non-implementation of the survey would not allow to establish whether or not oil and gas resources of economic interest are present in the subsurface of the Application for Exploration Permit area and carry on further exploration and production operations.

The performance of exploration activities in Italy is in line with the provisions of the National Energy Strategy worked out by the Ministry for the Economic Development and approved in year 2013. Seven are the key actions being implemented in the medium and long run (up to year 2020) for the future of the Italian Energy industry. One of them is the "sustainable domestic hydrocarbon production" (action No. 6). The Italian Energy market is highly dependent on the import of fossil resources, even if important oil and natural gas resources are available on the national territory[2].

Such resources may offer economic and occupational benefits, as the oil and gas sector plays an essential role in the Italian industry by virtue of a state-of-the-art "*know-how*" and a competitive position in the global scenario. In this context, the exploration and production operations impose the highest national and international safety standards to make sure that the impacts are the least possible.

As provided for in the National Energy Strategy, the exploration program discussed herein is the first step in the comprehension of the resources available on the national territory and the development of their exploitation and/or production.

The environmental implications of the Zero Option are depicted in para. 4.4.

3.2. Site options (Project region)

Two other site options have been investigated in addition to the Project region located at the south-eastern part of the Exploration Permit application area as discussed in paragraphs 2.1 and 2.6. Both options identified by capital letters A and B and shown in Figure 3.1 have been discontinued for the following reasons:

- The A option area is close to areas that are more environmentally sensitive to benthos (white corals) and fish fauna, though they do not directly interact, (see paragraphs 4.3.2.1.4 and 4.3.2.1.5 for details) and mostly falls within a seabed zone, where some authors say there could be white coral colonies not yet found and mapped. The A option has therefore been excluded to meet the precaution principle.
- The B option area looks like the selected site, however, with respect to it, a part of the B option area falls within seabed zones where some authors say that there could be white coral colonies. Moreover, its shape would suggest that the south-western to north-eastern navigation direction is more favourable, thus resulting in an unavoidable trespassing on non-italian waters. According to the same precaution principle as above, the B option has also been excluded.

[2] Among the European countries, Italy has the greatest hydrocarbon riserve after Norway and the United Kingdom.

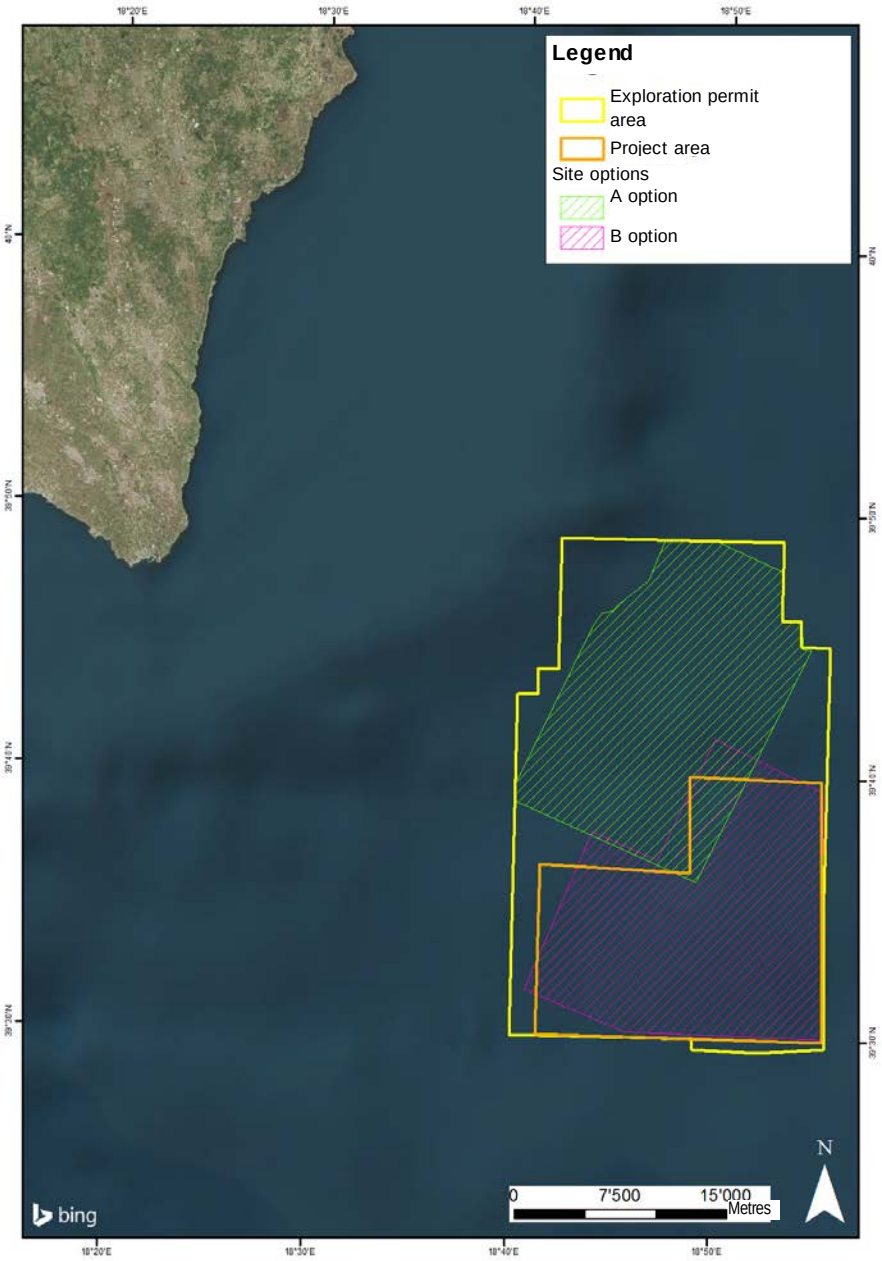


FIGURE 3.1: SITE OPTIONS WITHIN THE APPLICATION FOR EXPLORATION PERMIT AREA

3.3. Technical options

A number of options has been considered focusing on the *array* configuration and operating volume and on the in-depth location of the energizing and recording equipment.

3.3.1. Location options for energizing and recording equipment

Four more depth locations of the *air guns* and *streamers* have been investigated in addition to the selected geometry discussed in para. 2.5 in view of optimizing the emission and more specifically the signal receipt. A model has been designed based on the source and receiver depth, the emission frequencies, the bathymetry and the physical properties of water in the study area (Table 3.1 and Figure 2.23).

TABLE 3.1: LOCATION OPTIONS FOR THE EQUIPMENT (RPS ENERGY – *SEISMIC SOURCE ARRAY MODELLING*)

Option #	*air gun* depth (m)	*streamer* depth (m)
1 (blue)	3	4
2 (red)	4	5
3 (green)	5	6
4 (violet)	6	7
5 (light blue)	7	8

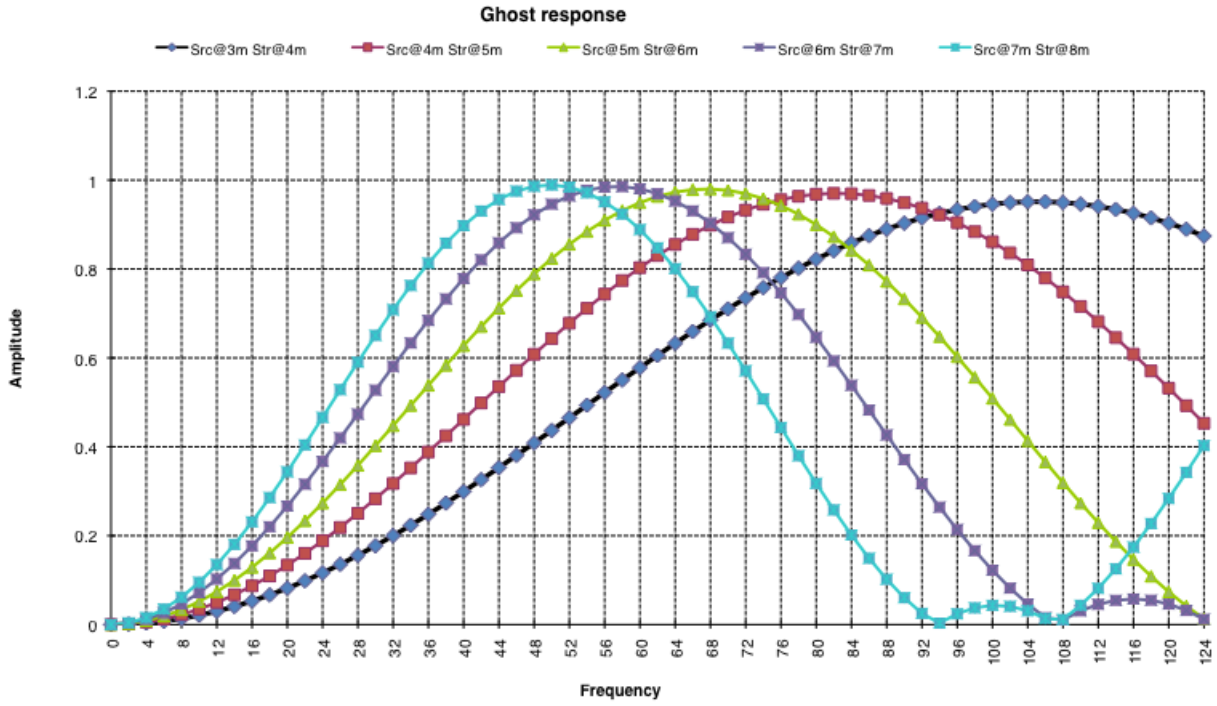


FIGURE 2.23: INTERACTION BETWEEN SOURCE AND RECEIVER PLACED AT DIFFERENT DEPTHS RELATING TO THE SIGNAL FREQUENCY (RPS ENERGY – *SEISMIC SOURCE ARRAY MODELLING*)

The modeling results indicate that :

- Systems close to the sea surface (1 and 2 options) maintain high frequencies, whereas lower frequencies are mitigated. This condition is desirable, when depth of the investigated area is not too high and an excellent resolution is required. Hence, it cannot be applied to the investigated area located in abt. 1,000 m deep seabeds.

- Deeper systems (3 and 4 options) well respond to low frequencies, while response to high frequencies is moderate. Their sensitivity to the average frequency pulses gets practically lost.
- For the interpretation of the received signal, the best situation would be a signal pulse having most acute possible mid peak and edgeways with least possible energy
- (Figure 2.24; see model document). This situation occurs only if high and low frequencies, but not the intermediate ones are increased (see graph-plot in Figure 2.23).

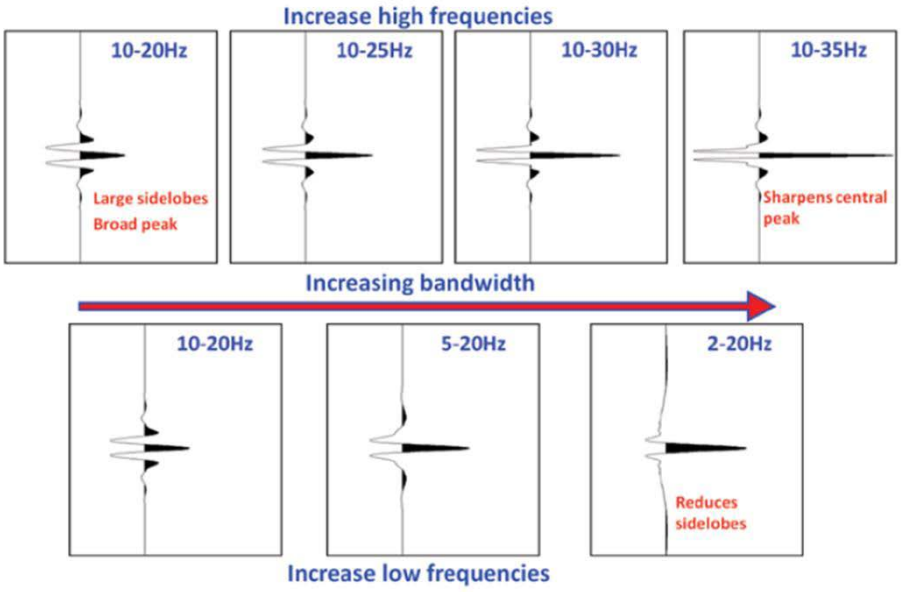


FIGURE 2.24: EFFECTS OF INCREASED HIGH AND LOW FREQUENCIES ON A SYNTHETIC SIGNAL PULSE (RPS ENERGY – *SEISMIC SOURCE ARRAY MODELLING*)

Following the above considerations, **the number 5 option** (light-blue marking in the graph-plot) **seems to be the best location option** among those depicted in Table 3.1 and the graph-plot in Figure 2.23.

3.3.2. *Array options*

The sound dispersion model dealt with three different *air gun arrays* with different operating volumes (*Seismic Source Array Modelling*):

1. *Polarcus* 3640 in^3;
2. *CGG* 4100 in^3;
3. 4390 in^3.

The main technical specifications of the discussed *arrays* are reported in the table below.

TABLE 3.2: GENERAL FEATURES OF THE THREE *ARRAYS* OPTIONS DISCUSSED

Array	*Subarray qty*	Dimensions	Comment
Polarcus 3640 in^3	33 active + 3 inactive	14 m length 15 m width	The least source volume capable of achieving the Project goals.
CGG 4100 in^3	28 active + 2 inactive	28 m length 17 m width	Average volume being used to achieve the Project goals

Array	*Subarray qty*	Dimensions	Comment
4390 in^3	33 active + 3 inactive	14 m length 15 m width	Higher source volume configuration. It provides a better guarantee of success, when considering the deepest Jurassic layer.

As mentioned above, the number indicates the total operating volume (in cubic inches, in^3). All three options have been modeled on the basis of a 7 m depth considered as most efficient for the seismic survey of the Project region. The three figures below show for each of the three *array* models how the disturbance to a marine mammal varies during the seismic survey with variation of the distance. The disturbance threshold is the distance at which the intensity is lower than 160 dB *re* 1 µPa. This is graphically represented by the crossing point between the *Marine mammal disturbance threshold* line and the *RMS sound pressure level* curve.

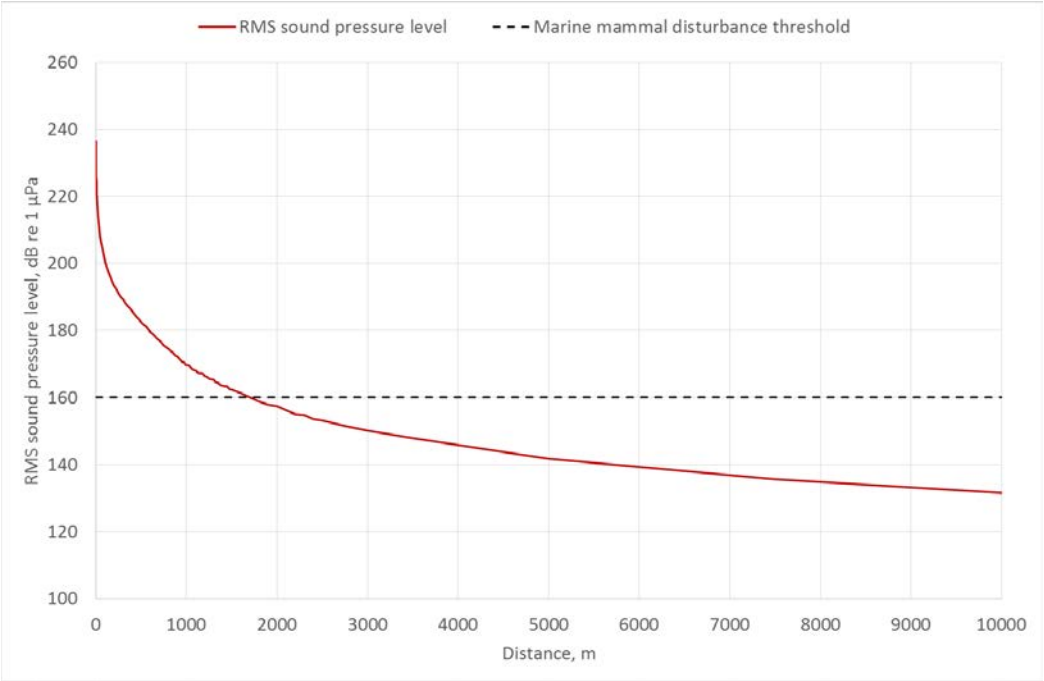


FIGURE 3.2: MARINE MAMMAL DISTURBANCE DISTANCE WITH THE *ARRAY POLARCUS* 3640 IN^3 CONFIGURATION – 1,700 M DISTANCE

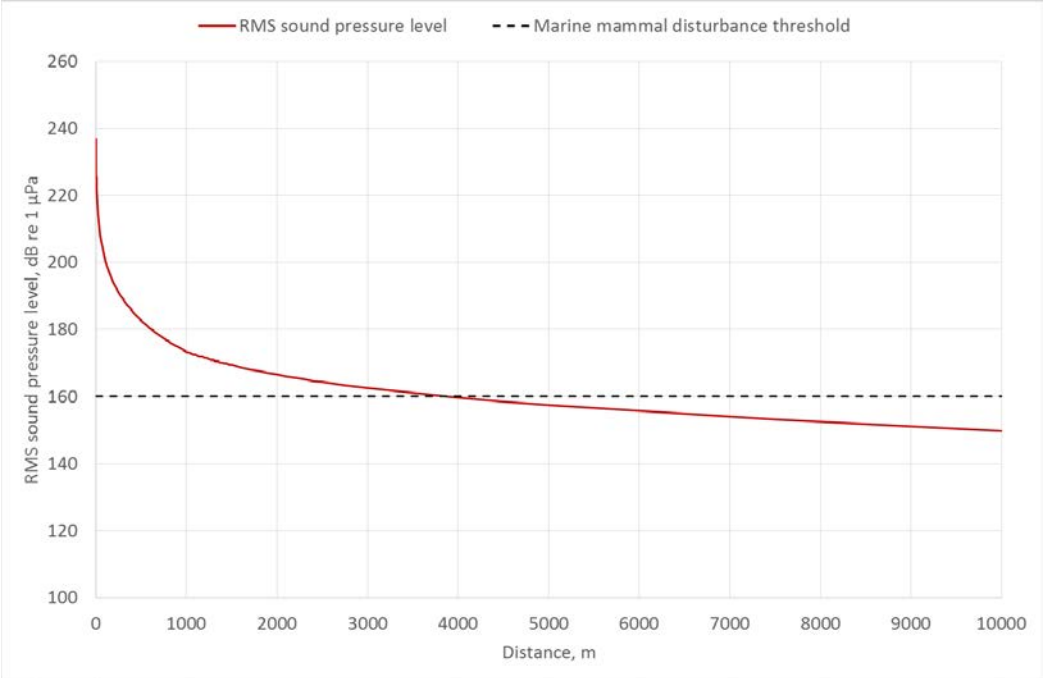


FIGURE 3.3: MARINE MAMMAL DISTURBANCE DISTANCE WITH THE *ARRAY CGG* 4100 IN^3 CONFIGURATION – 3,900 M DISTANCE

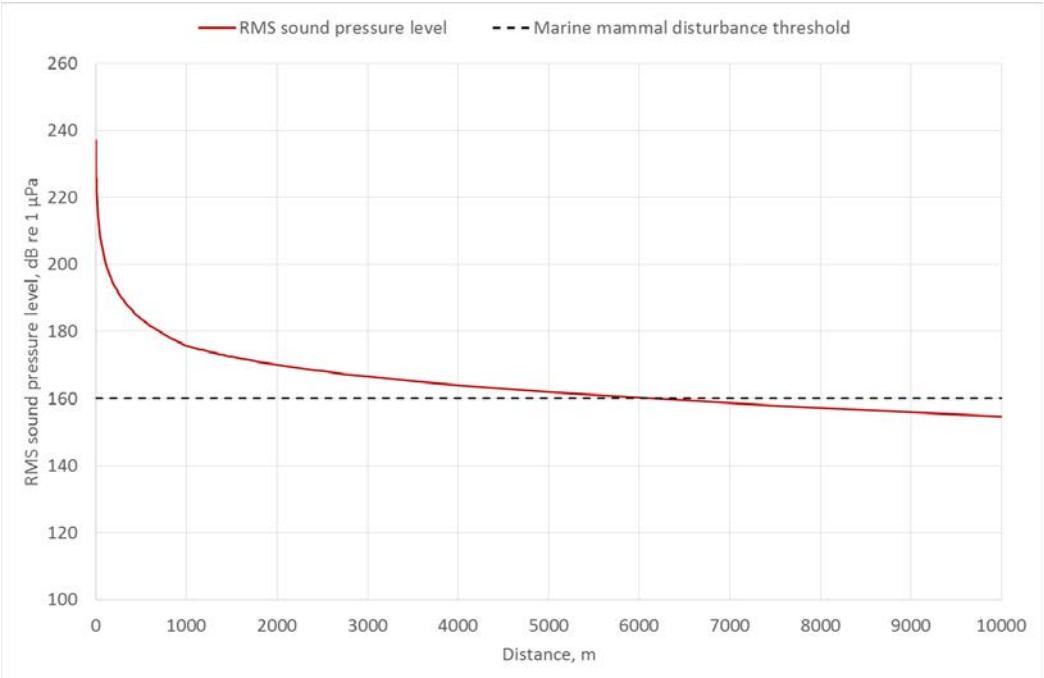


FIGURE 3.4: MARINE MAMMAL DISTURBANCE DISTANCE WITH THE *ARRAY* 4390 IN^3 CONFIGURATION – 5,800 M DISTANCE

Both *array* options have higher source volumes than the *Polarcus 3640 in^3* configuration and disturb the marine mammals at a greater distance than the selected configuration: 3,900 m for *CGG* 4100 in^3 and 5,800 for 4390 in^3 against 1,700 m of the *Polarcus* 3640 in^3 configuration. For a more detailed discussion of the induced noise modelling reference should be made to the exhaustive "*Seismic Source Array Modelling*" document worked out by RPS (**ANNEX NO. 1**).

4. Environmental baseline

4.1. Data collection

Basic information to pinpoint the baseline component conditions has been gathered from bibliographic studies targeted to the investigated environmental scenario. Information was gathered from both scientific and grey literature , i.e.:

- Similar Environmental Impact Studies already submitted to the Ministry of the Environment and the Land and Sea Protection (MATTM);
- Scientific texts and monographs published by the MATTM and ISPRA ("Italian National Institute for Environmental Protection and Research ");
- Documents and studies made by scientific associations and institutions;
- Scientific literature available in public and University databases;
- Scientific articles available in dedicated web search engines.

For information purposes only, the sources referred to are cited below. Bibliography in chapter 12 is to be referred to for a detailed list of the sources.

- Atmosphere – 3 scientific articles and 1 public Database ;
- Oceanography of the region – 2 scientific publications ;
- Soil and subsoil thereof – 2 scientific publications;
- Marine acoustics – 2 scientific publications, 1 ministerial guideline and 1 internet site;
- Cetaceans – 170 scientific publications ;
- Sea birds – 2 scientific publications, 1 database and 1 ministerial guideline;
- Marine reptiles – 9 scientific publications and 1 ministerial guideline;
- Fishes and fish stocks – 9 scientific publications;
- Benthos – 5 scientific publications;
- Zooplankton and phytoplankton – 10 scientific publications ;
- Protected areas – 4 scientific publications and 1 database;
- Marine traffic – 2 sources;

Meetings with local experts allowed enriching and fine tuning the collection of bibliographic material and providing additional information not yet published (University of Salento – Department of Sciences and Biological and Environmental Technologies (DiSTeBA) – Lecce; Department of Biology of the University of Bari; COISPA Technology and Research - Bari).

4.2. Study Area

The study area encompasses the Application for Exploration Permit Area and a surrounding *buffer* that varies to adapt to the investigated environmental component (Figure 4.1).

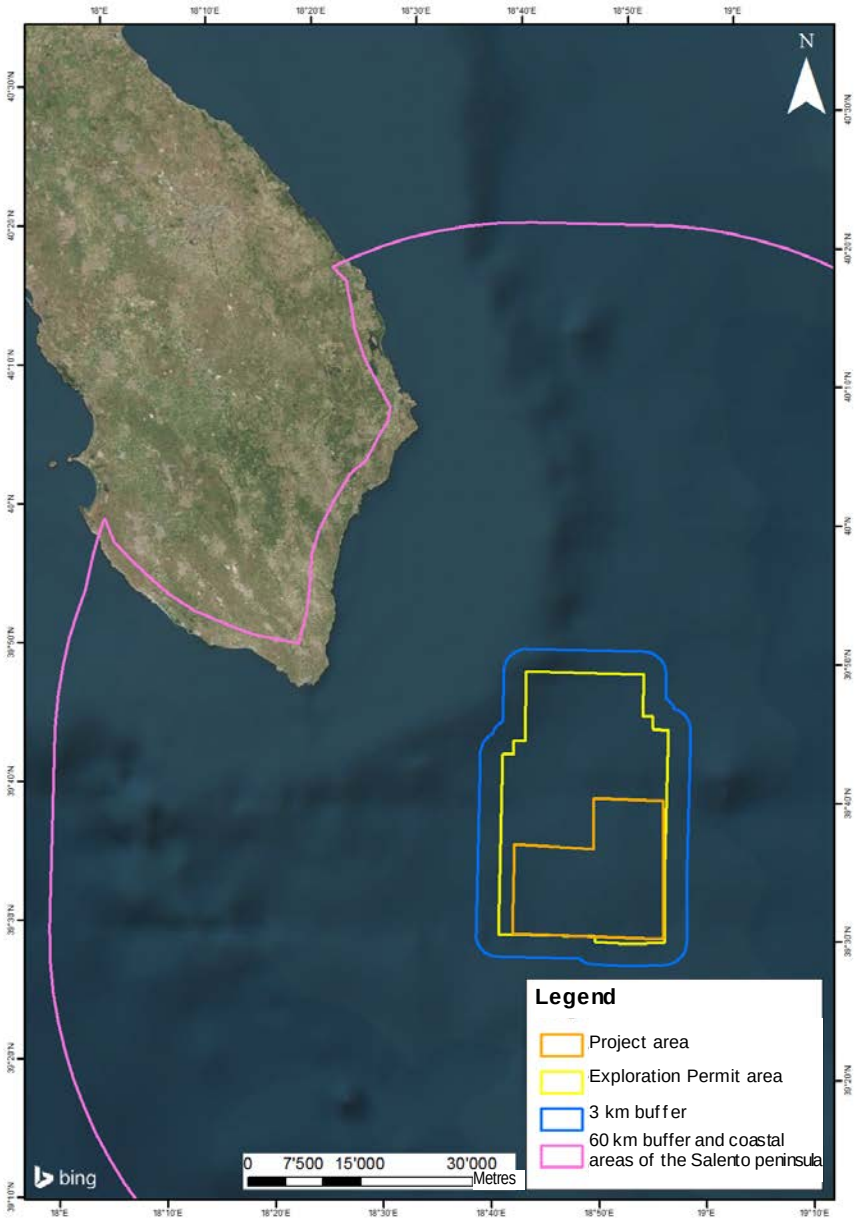


FIGURE 4.1: CRITERIA TO DEFINE THE STUDY AREA WITH RELATION TO THE DIFFERENT ENVIRONMENTAL COMPONENTS

Specifically, the buffer selected in this EIS for each specific environmental component was defined for acquiring an adequate component classification and extending the potential effect of the Project actions on the specific components investigated.

The extension of the study area for each component is specified in an explanatory box prior to dealing with the initial conditions of the component in question.

4.3. Current environment conditions

The physical, biological and social environmental components are described hereinafter. In addition to the components that may cause an environmental impact according to the matrix in Table 6.1, the discussion also extends to the sea waters (Oceanography of the area, para. 4.3.1.2). Although this component is not

expected to be affected by the Project, however, it provides useful information on the comprehension of the area ecology and the assessment of its impacts on other components.

4.3.1. Physical components

4.3.1.1. Atmosphere

4.3.1.1.1. Weather and climate conditions

Study area

The area investigated for the study of the weather and climate conditions is the Application for Exploration Permit Area (14 nautical miles from Santa Maria di Leuca – surface area of 729,020 km^2) and a surrounding buffer of abt. 130 km. The goal is gathering data from the official monitoring stations that better reflect the situation.

Data from the sea level measuring stations of Otranto and Crotone closer to the Application for Exploration Permit Area was considered for a characterization of the weather and climate conditions of the study area.

The key information on these two reference sea level measuring stations is summarized in Table 4.1. The coordinates and elevations indicated in this table originate from the accurate surveys carried out in the years 2009-2010 and are given in monographs that can be downloaded from the web site of the Italian National Institute for Environmental Protection and Research (ISPRA), in the frame of the National Tide Gauge Network (www.mareografico.it).

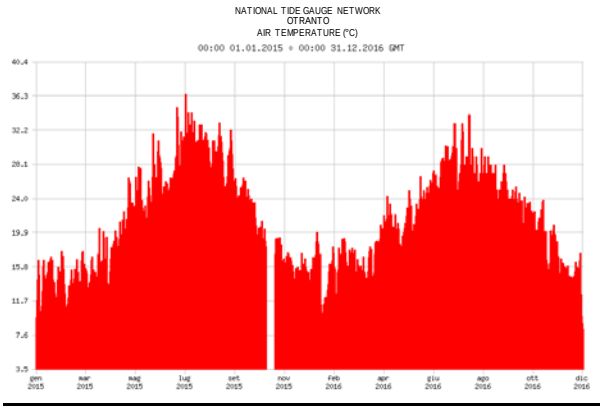
TABLE 4.1: CHARACTERISTICS OF THE CROTONE AND OTRANTO-BASED SEA LEVEL MEASURING STATIONS (WWW.MAREOGRAFICO.IT)

Station	Coordinates	Elevation
Otranto	40° 08' 49.74" LATITUDE; 18° 29' 49.52" LONGITUDE	1.302 m asl
Crotone	39° 04' 60.89' LATITUDE; 17° 08' 13.40" LONGITUDE	1.302 m asl

Air temperature

The air temperature at both stations of Crotone and Otranto in the period from January 2015 to December 2016 follows the trend shown in Figure 4.2. During this period minimum January and February temperatures and maximum July temperatures ranging from 34.2 to 36.5 °C were measured at the Otranto station.

Trends at the Crotone measuring station are very similar to those observed at Otranto.



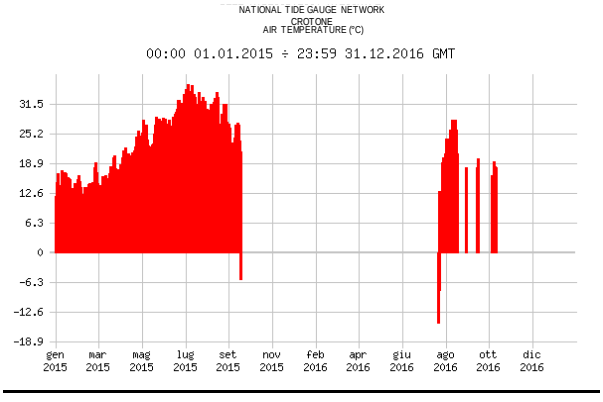


FIGURE 4.2: VARIATION IN THE AIR TEMPERATURE AT THE OTRANTO AND CROTONE STATIONS IN THE 2015 TO 2016 REFERENCE PERIOD (WWW.MAREOGRAFICO.IT)

Winds

The Mediterranean region is influenced by air masses impacting on its surface air circulation. The situation of the central triangle enclosed within South Italy, Greece and North Africa is much complicated in this respect, as combined blowing of Sirocco, Grecale and Mistral winds cause climate variations throughout the year.

The Ionian Sea basin area is affected by prevailing winds blowing from quadrant III. The Winter period is marked by a significant wind flow from north-west and north-east, which rotates on the northern side and faces the northern side of the Ionian sea. The wind flow dynamics depends on the high and low pressure areas from the west side, which cause regional variations by developing pressure gradients.

There are two main wind flows depending on the seasonal baric fields, i.e.:

- Weak flow from E-NE turning to SE in the Summer;
- Strong flows from northern quadrants sweeping the sea by storms on the Salento coast in Winter.

The analysis of the anemometry data made available by ISPRA on the website of the National Tide Gauge Network and referred to the period January 2015 to December 2016 indicates for the Otranto station prevailing winds from the W-NW quadrant, averagely stronger winds from the W quadrant and strong winds from the SE quadrant blowing at speeds sometimes higher than 12 m/sec. Instead, a clear predominance of weak winds blowing from NW was observed at the Crotone Station, even if a higher percent value of stronger winds always from the SW quadrant was noticed.

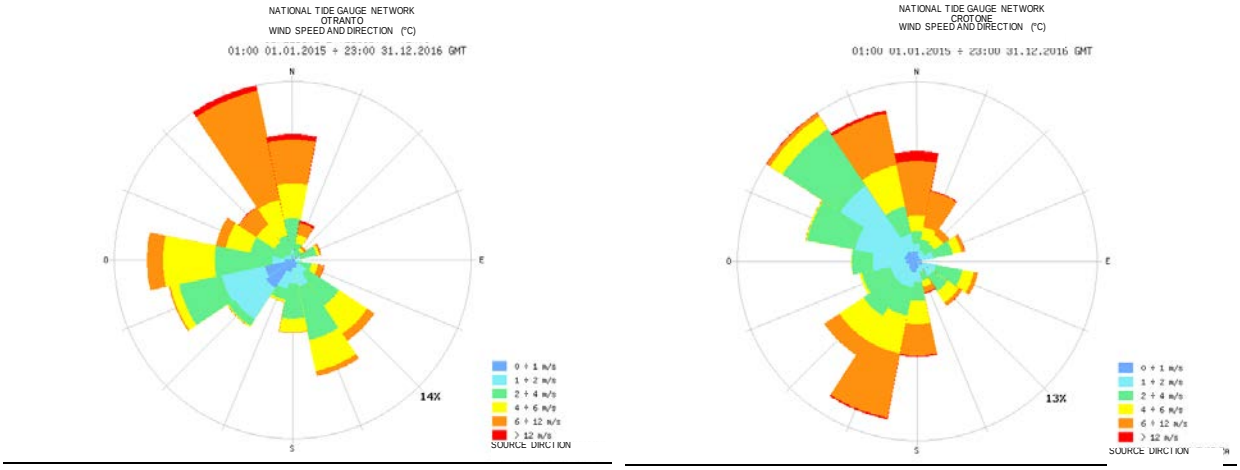


FIGURE 4.3: WIND DIRECTION COMPARISON AT THE OTRANTO AND CROTONE SEA LEVEL MEASURING STATIONS IN THE REFERENCE PERIOD 2015 TO 2016 (WWW.MAREOGRAFICO.IT)

Atmospheric pressure

The atmospheric pressure at both Crotone and Otranto stations shows for the period January 2015 to December 2016 the same trend as depicted in Figure 4.4. In this time period, lower pressure values with an upward trend were observed during the early months of the year at the Otranto station.

Trends very similar to those observed at the Otranto station were noticed at the Crotone station.

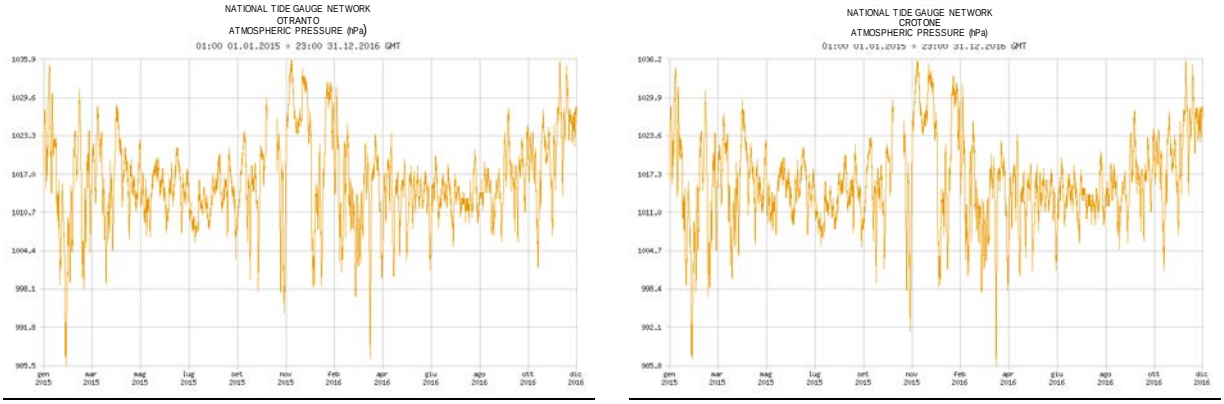


FIGURE 4.4: ATMOSPHERIC PRESSURE VALUE COMPARISON AT THE SEA LEVEL MEASURING STATIONS OF OTRANTO AND CROTONE IN THE REFERENCE PERIOD 2015 TO 2016 (WWW.MAREOGRAFICO.IT)

4.3.1.1.2. Useful information for an assessment of the impact effects from the atmospheric components

The study area being located offshore, where the air circulation is not affected by the presence of mountains and winds blowing from different quadrants, viz. W-NW, W, SE and SW, this area has a low sensitivity towards the atmosphere component.

4.3.1.2. Area oceanography – marine waters

Study area

The oceanography in the study area relates to the north-western part of the Ionian Sea.

4.3.1.2.1. Currents and tides regime

This study area is one of the hotspots of the whole Mediterranean Sea, particulary from a hydrodynamic viewpoint. Actually, it is the meeting and transition point of three important water masses (Manca e Scarazzato, 2001).

In this area, the surface waters from the Adriatic Sea (ASW) are colder, have a relatively lower salinity when compared with the northern part of the Ionian Sea and flow on the western side of the Basin. The water layer is abt. 60 to 150 m thick and characterized by temperatures ranging from 13 to 14 °C in Winter to 28°C of the first layer in Summer.

The intermediate layer is characterized by levantine intermediate waters (LIW), the Ionian sea receives from East, which may occupy a layer down to a depth of abt. 800-900 m. These waters have higher salinity values down to a depth of abt. 600 m. Both salinity and temperature tend to decrease beyond this bathymetry.

The Ionian Sea also receives from North the deep *Adriatic Dense Waters* (ADW) that cross the Otranto channel and become the main source of the *Eastern Mediterranean Deep Waters* (EMDW). They are characterized by colder temperatures (less than 14°C) and a salinity of about 38.65 psu and tend to flow southward.

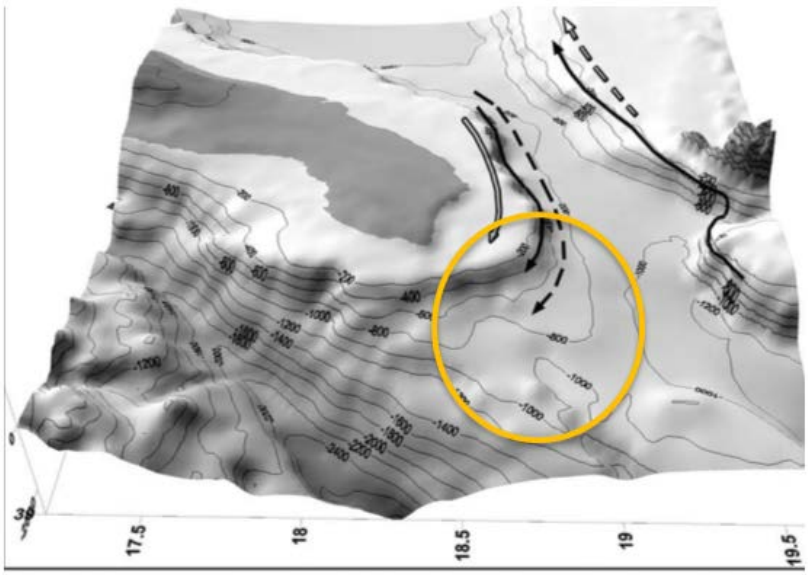


FIGURE 4.5: IMAGE OF THE MARINE ZONE SOUTH THE SALENTO PENINSULA. THE STUDY AREA (ORANGE CIRCLE) IS AFFECTED BY THREE DIFFERENT MAIN WATERS, VIZ. THE ADRIATIC SURFACE WATER (ASW), WHITE ARROW; THE LEVANTINE INTERMEDIATE WATERS (LIW), BLACK ARROW; THE ADRIATIC DENSE OR DEEP WATERS (ADW), DASHED ARROW (FROM SAVINI AND CORSELLI, 2010 – MODIFIED).

4.3.1.2.2. Waves regime

Buoys for measuring the waves regime are provided in the Puglia region. More specifically, the active buoys closer to the study area are located in the Gulf of Taranto and near Bari.

Data of the 2000 to 2005 period shows a small energy wave motion regime particularly in Summer.

The wave measuring buoy located offshore Crotone is another useful reference. From the analysis of data obtained from the Crotone-based wave measuring buoy it appears that in cases where the wave height is (Hs) > 0.5 m the spatial distribution of events occurring at intervals is marked by a strong bidirectionality along the N-NE and S-SE directions. The major occurrence interval is observed for the southern sectors (160°-200°N) and northern sectors (340°-20°N), while a lower percent value of storm tides is observed in the Sirocco sector.

Instead, events with a wave height of more than 3 m are mainly caused by the Sirocco and Tramontana winds.

4.3.1.2.3. Physico-chemical properties of the water column

The average surface temperature of the Ionian sea ranges from 14.1 °C in February to 25.8 °C in July. The average yearly temperature is around 19°C. The minimum temperature value is normally reached at depths of 200 to 350 m.

The water salinity may range from 37.4 psu to 38.9 psu and tends to decrease from the northern to southern part of the Basin. Moreover, the surface water salinity of the Ionian Sea tends to increase in the western to eastern direction.

4.3.1.2.4. Useful information for an assessment of the impact effects from the marine water component

The marine water component does not seem to be potentially affected by this Project as said in this paragraph 4.3. However, some of the parameters above provide relevant and useful information to understand the potential impact effects on the other physical and biological components that are likely to be jeopardized. Particularly, the currents and tides regime known to be one of the most complicated in the whole Mediterranean Sea is of major significance in the study area, as it is the meeting and transition point of three important water masses.

4.3.1.3. Marine soil and subsoil

Study area

The area investigated for the marine soil and subsoil is the Application for Exploration Permit Area.

4.3.1.3.1. Area geology, structure and stratigraphy

The Ionian Sea at south is geologically divided by the Taranto Valley, a canyon carved by the Brandano River, which flows in the NW-SE direction and reaches depths of more than 2,000 m.

Geologically speaking, the study area is enclosed in an anticline structure with an axis pointing in NW-SE direction. This area falls within a larger macroarea, where the continental shelf is relatively narrow (abt. 15 km) (Savini e Corselli, 2010). The interpretation of the seismic lines indicated by the Ministry lets assume a structural model, to the top of the possible carbonate units, similar to that offshore Abruzzo. According to this model, the slope *facies* of the late Mesozoic and Eocenic era (Maiolica and Scaglia formations) are deformed in large and mild anticlines buried beneath the Mio-Pliocene clastic deposits. The tertiary deposits are discontinuous and consist of Paleocene-Oligocene layers and/or calcareous facies surmounted by thin quaternary deposits (Ricchetti *et al.*, 1988).

4.3.1.3.2. Seabed morphology and bathymetry

The study area is located close to the bathymetric threshold of the Southern Adriatic Sea separating the southern Adriatic depression from the Ionian basin. This area is placed at the external edge of the continental shelf, in the zone in front of the Salento peninsula.

The depth of the seabed of the Application for Exploration Permit area ranges from 300 m to 1000 m (Figure 4.6) and has a maximum eastward slope ranging 300 to 500 m in the north-west sector at the continental slope featuring an average slope slightly higher than 5%. This slope decreases in the mid sector (1% average value) where there is a large bathyal plain at a depth of abt. 700 m. In the southern area sector, the seabed gradually drops down to a depth of 1,000 m, in the southwestern zone.

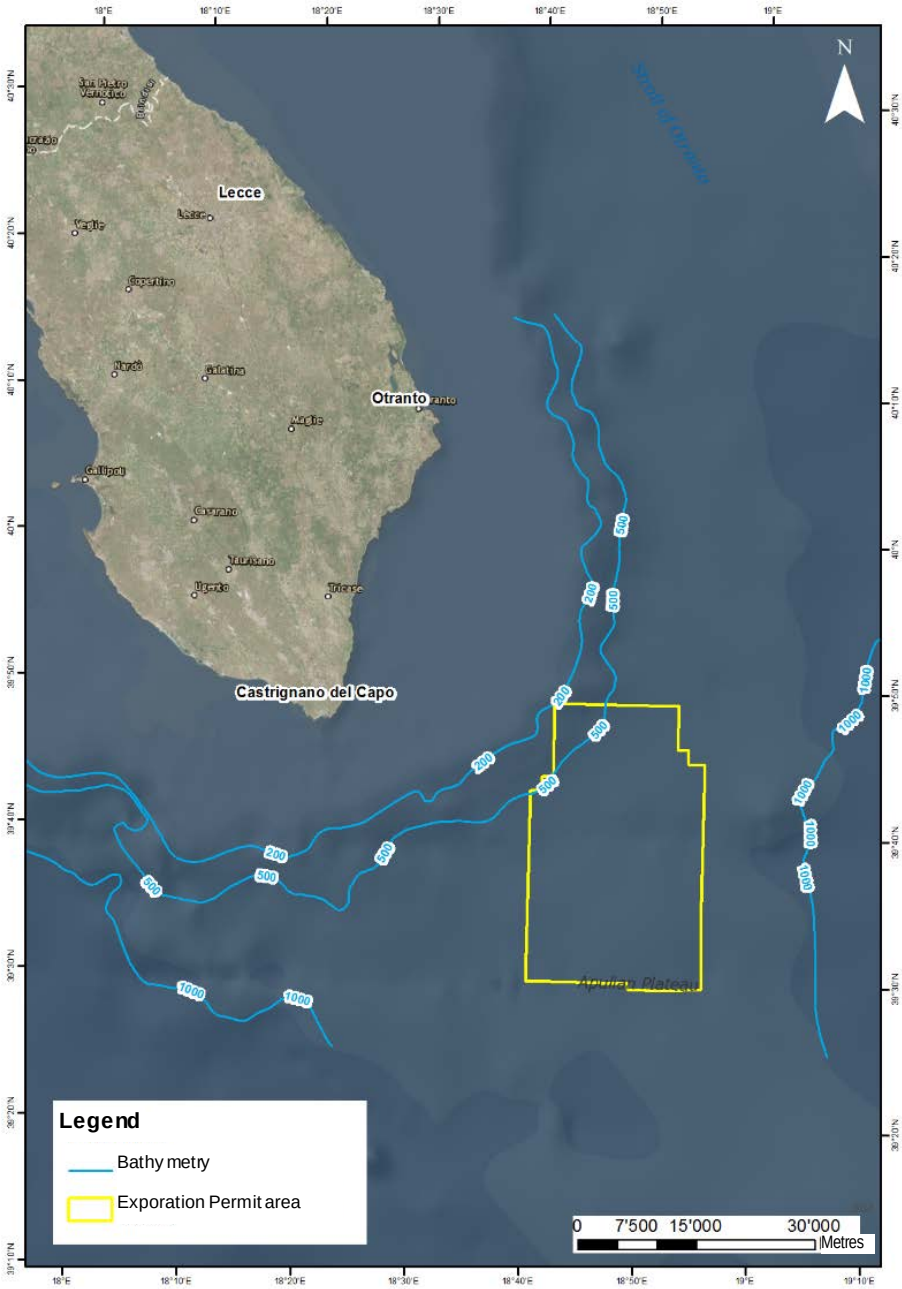


FIGURE 4.6: MAIN BATHYMETRIES OBTAINED FROM THE NAUTICAL CHART WITH INDICATION OF THE STUDY AREA BOUNDARIES (APPLICATION FOR EXPLORATION PERMIT AREA)

4.3.1.3.3. Useful information for an assessment of the impact effects on the marine soil and subsoil

As far as the marine soil and subsoil is concerned, the sensitivity is low when considering the high bathymetry and regularity of the seabeds.

4.3.1.4. Marine acoustics

Study area

The area investigated for the marine acoustics is the waters offshore the northwestern Ionian Sea.

4.3.1.4.1. Characteristics of the underwater noise

No specific studies on the underwater noise have been conducted in the study area or adjacent areas. Hence, this paragraph deals with considerations made on the basis of literature information on potential noise sources in the sea.

The study area being far away the coast, the environmental analysis does not take into account anthropogenic activities connected with the land- or coastal water-based works.

Many are the offshore natural physical and biological factors determining a noise source. The natural factors contributing to the underwater noise include wind, weather events (rains for example) and waves. Generally, the wave noise generated by the wind is prevailing. In absence of anthropogenic noise sources, the wind-generated environmental noise can be recorded at a frequency interval ranging from 1Hz to 100 kHz. The sound levels may vary in relation to the activities (for ex., rains may increase the environmental noise up to 35 dB in a frequency range between 100 Hz and 20 kHz). Some species may produce sounds for communication, orientation and navigation purposes. These sounds may range from a low frequency value of abt. 10 kHz of some whales to a high frequency value of 200 kHz of some dolphins.

The **artificial factors** have led to an increase in the sound emissions in the sea environment, particularly in the low frequency *range*, due to the ship traffic. This level has averagely increased by abt. 20 dB compared to the pre-industrial period.

For the purposes of this study, the noise sources from artificial factors are classified as non-impulsive noise source (for ex., the overall noise from ships in transit) and multi-impulsive noise source (for ex., generated by geoseismic activities).

4.3.1.4.2. Current status: maritime noise sources in the Ionian Sea

Currently, the main source of unnatural underwater noise in the study area is likely to be generated by the ship traffic. About one third of the worlwide ship-transported goods traffic moves in the Mediterranean Sea and the waters in the study area are an important crossroads (motorways of the sea), if we consider the maritime links between the Adriatic Sea and both western and eastern sectors of the Mediterranean Sea, the Gulf of Taranto and the shipping routes to the Sicily harbours and the Malta Island.

The marine traffic is the main low frequency source (< 300 Hz) and the ocean background noise is estimated to have increased by abt. 15-20 dB compared to the pre-industrial period.

The large commercial vessels generally produce relatively loud, low frequency sounds (state-of-the-art cargo vessels may also produce high frequency sounds). The main noise sources include propellers cavitation, vibration of engines and related facilities and water displacement caused by the moving hull. The source noise levels may range from 180-195 db *re* 1 µPa at 1 m with peak levels in the 10-50 Hz frequency band. At frequencies lower than 200 Hz, the propeller systems mostly contribute to the underwater noise. Large modernest cargo vessels may emit high frequency sounds with sound levels over 150 dB *re* 1 µPa at 1 m around 30 kHz. This kind of noise may interfere with the communication systems of the odontocete cetaceans.

Additional noise sources may be the on-board equipment (for ex., equipment in the machine room or auxiliary systems) and the hydrodynamic flow around the vessel hull.

The noise also increases with an increase in the vessel speed and the sound pressure levels depend on the vessel propeller system.

Figure 4.7 shows the main shipping trade routes for the oil and gas industry in the Mediterranean Sea, whereas Figure 4.8 shows the main shipping routes of the "motorways of the sea" in the Adriatic sea.. The available data indicates that over 2,000,000 cruise passengers passed through and over 217 million tons of goods were transported in the Adriatic-Ionian basin in year 2007. This data indicates that a heavy marine traffic affected the Adriatic-Ionian basin with consequent noise pollution.

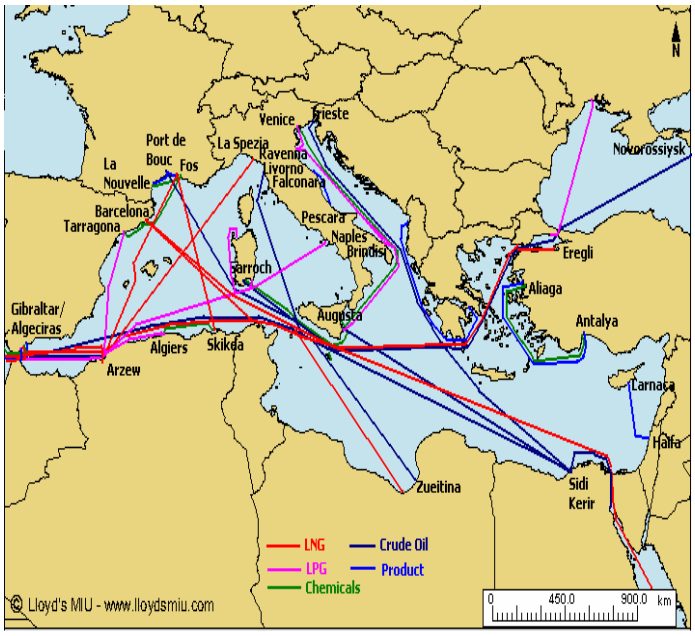


FIGURE 4.7: MAIN SHIPPING TRADE ROUTES IN THE MEDITERRANEAN SEA FOR THE O&G INDUSTRY

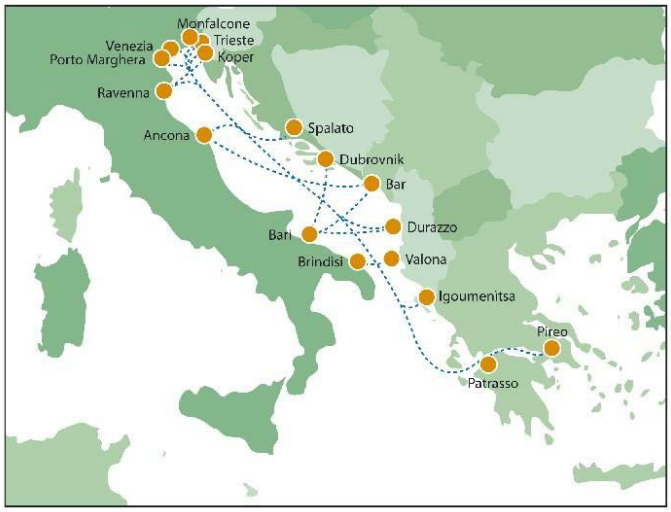


FIGURE 4.8: MOTORWAYS OF THE SEA IN THE ADRIATIC SEA (ISPRA GUIDELINES – PART I)

If we focus on the study area, it seems that it is not particularly affected by the main routes at least.

The analysis of the nautical chart in Figure 4.9 highlights that the main routes for the passenger traffic move at the northern and eastern side of the study area without crossing it.

The analysis of the marine traffic roadmap (passengers and goods) in 2015 and 2016 summarized in Figure 4.10 confirms that the study area is only marginally affected by the main routes.

However, this does not exclude sailing of ships in the study area.

Moreover, the study area is a fisheries area crossed by **fishing boats** generating noise from both engines and seabed friction of the trawling activities..

Medium size boats as those used for fishing activities have large and sophisticated propeller systems often including "*bow-thrusters*". The typical sound emission range of these boats is approximately 165-180 db *re* 1 µPa at 1 m. Many boat types have low frequency emission characteristics (< 1 kHz band) similar to those of the large vessels. The generated noise also varies as a function of the equipment and efficiency of the boat. As an example, hauling of the nets generates loud noises due to the winch. The most impacting noise normally generates from net trawling on the seabed, where the boat engines are under stress, and the fishing sonars.

It is known that trawling activities are carried out in the southeastern part of the Application for Exploration Permit area, while the whole area is potentially affected by longline fisheries .

Finally, in the Summer months, the area can be affected by **recreational craft** sailing to and from Greece. Recreational craft for offshore navigation (for ex., offshore motorboats) may generate noise at frequencies lower than 5kHz with an instantaneous pressure sound level equal to 126 dB *re* 1 µPa at 1 m, a value that can be compared to heavy vessel traffic (119.8 dB *re* 1 µPa at 1 m).

The offshore recreational traffic may affect the study area in the Summer months of July and August.

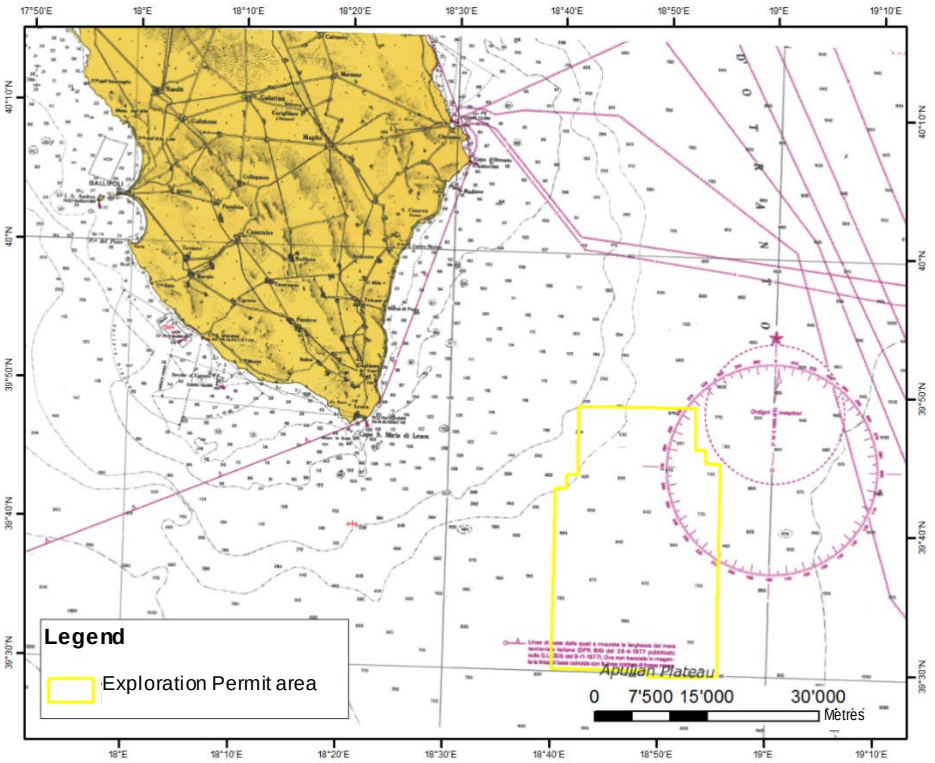


FIGURE 4.9: NAUTICAL CHART

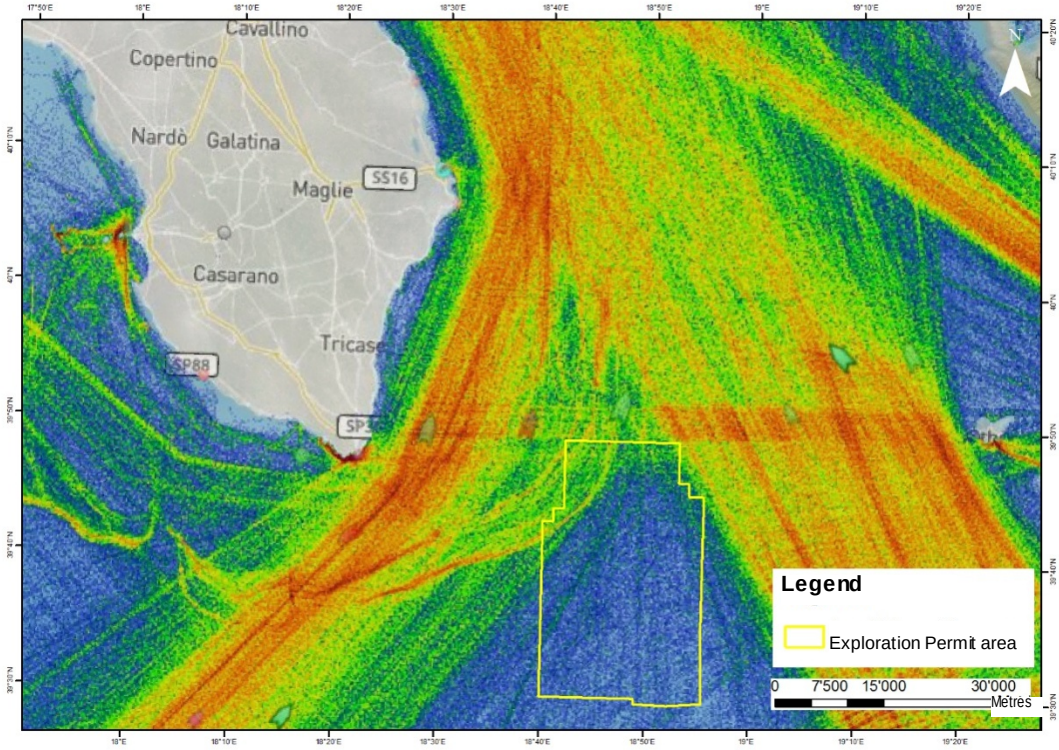


FIGURE 4.10: MAP DOWNLOADED FROM THE MARINE TRAFFIC SITE SHOWING THE MARINE TRAFFIC DENSITIES IN YEARS 2015 AND 2016 (WWW.MARINETRAFFIC.COM)

4.3.1.4.3. Useful information for an assessment of the impact effects from the noise

Apart from noises due to natural physical and biological factors, the study area may be mainly affected by low frequency non-impulsive noise generated by fishing boats potentially operating all year round, but mainly in the Summer period, and recreational craft mainly operating in the Summer period. This area is crossed by the main trade routes only marginally close to its northwestern boundaries.

The marine traffic as main noise source being limited, it is assumed that the artificial background noise is quite low in the area during the Winter period, when fishing and recreational activities are furtherly minimized. Therefore, the area has a medium to high sensitivity to the noise component (high in Winter and medium in Summer).

4.3.2. Biological components

4.3.2.1. Fauna, flora, ecosystems

4.3.2.1.1. Marine mammals

Study area

The Application for Exploration Permit area (14 nautical miles from Santa Maria di Leuca –729,020 km² surface area) affected by seismic prospections has been not specifically monitored so far. Long term and systematic monitoring of the potential cetacean species fails. It turns out that information on this narrow field between the Adriatic and Ionian seas is partly fragmentary and non-exhaustive. In the light of the above, the information supplied herein on presence and distribution of cetaceans in the Application for Exploration Permit area is based on recent and past studies carried out in the adjacent and surrounding sea portions and on stranding events, taking into account that the various species generally cover long distances on a weekly, monthly and seasonal basis and that the presence, distribution and abundance of the species may suffer seasonal and time variations depending on the oceanography characteristics and the presence of preys. To conclude, information on the Adriatic and Ionian seas is provided with special focus on their northern and southern parts respectively.

4.3.2.1.1.1. Cetaceans in the Mediterranean Sea

It is reported that 29 cetacean species live in the Mediterranean Sea (Notarbartolo di Sciara and Birkun, 2010). Only eight species are stationary residents, viz. fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), long-finned pilot whale (*Globicephala mela*), Risso's dolphin (*Grampus griseus*), beaked whale (*Ziphius cavirostris*), striped dolphin (*Stenella ceruleoalba*), short-beaked dolphin (*Delphinus delphis*) and bottlenose dolphin (*Tursiops truncatus*). Genetic studies suggest that these species are sub-populations of the Atlantic species with a limited genetic flow across the Strait of Gibraltar (Bérubé *et al.*, 1998; Drouot *et al.*, 2004; Engelhaupt *et al.*, 2009; Gaspari *et al.*, 2013, 2007, 2006, Natoli *et al.*, 2008, 2006, 2005, 2004; Palsbøll *et al.*, 2004). The conservation status of said sub-populations classified on the basis of the criteria adopted by the International Union for the Conservation of Nature (IUCN) is illustrated in the

Table 4.2 below.

TABLE 4.2: CONSERVATION STATUS OF THE EIGHT CETACEAN SPECIES RESIDING IN THE MEDITERRANEAN SEA (WWW.IUCN.ORG)

Species	Region	IUCN criteria	Year of assessement
Sperm whale *Physeter macrocephalus*	Mediterranean sub-population	**Endangered** C2a(ii)	2012
Short-beaked common dolphin *Delphinus delphis*	Mediterranean sub-population	**Endangered** A2abc	2003
Fin whale *Balaenoptera physalus*	Mediterranean sub-population	**Vulnerable** C2a(ii)	2012
Bottlenose dolphin *Tursiops truncatus*	Mediterranean sub-population	**Vulnerable** A2cde	2012
Striped dolphin *Stenella coeruleoalba*	Mediterranean sub-population	**Vulnerable** A2bcde	2012
Risso's dolphin *Grampus griseus*	Mediterranean sub-population	**Data Deficient**	2012
Long-finned pilotwhale *Globicephala melas*	Mediterranean sub-population	**Data Deficient**	2012
Beaked whale *Ziphius cavirostris*	Mediterranean sub-population	**Data Deficient**	2012

Table 4.3 shows the main laws, agreements and conventions for protection and conservation of the eight cetacean species regularly living in the Mediterranean Sea. The Italian laws mainly acknowledge and apply Community Directives and Rules such as the Habitat Directive and the most recent Marine Strategy Framework Directive. The National laws that do not stem from the European legislation include the Ministerial Decree dtd May 3, 1989 (published in the Official Gazette No. 113 dtd May 17). – Regulation for the cetacean, tortoise and sturgeon capture and Hunting Regulations – Law No. 157 dtd February 11, 1992 (Article 2).

TABLE 4.3: MAIN LAWS FOR PROTECTION AND CONSERVATION OF THE EIGHT CETACEAN SPECIES RESIDING IN THE MEDITERRANEAN SEA

Species	Protection and conservation laws, agreements and conventions
Fin whale	Bern Convention, App. II Bonn Convention, App. I, App. II CITES, App. I SPA/BD Protocol, Barcelona Convention, Annex II
Sperm whale	Bern Convention, App. II (Mediterranean) Bonn Convention, App. I, App. II CITES, App. I SPA/BD Protocol, Barcelona Convention, Annex II
Beaked whale	Bern Convention, App. I CITES, App. II SPA/BD Protocol, Barcelona Convention, Annex II
Long-finned pilotwhale	Bern Convention, App. I Bonn Convention, App. II (North and Baltic Seas) CITES, App. II SPA/BD Protocol, Barcelona Convention, Annex II

Species	Protection and conservation laws, agreements and conventions
Risso's dolphin	Bern Convention, App. I Bonn Convention, App. II (North and Baltic Seas) CITES, App. II SPA/BD Protocol, Barcelona Convention, Annex II
Bottlenose dolphin	Bern Convention, App. I Bonn Convention, App. II (North and Baltic Seas, Western Mediterranean) CITES, App. II EU Habitats Directive, Ann. II SPA/BD Protocol, Barcelona Convention, Annex II
Striped dolphin	Bern Convention, App. I Bonn Convention, App. II (Eastern Tropical Pacific, Mediterranean) CITES, App. II SPA/BD Protocol, Barcelona Convention, Annex II
Short-beaked common dolphin	Bern Convention, App. I Bonn Convention, App. I (Mediterranean), App. II (North and Baltic Seas, Mediterranean, Eastern Tropical Pacific) CITES, App. II SPA/BD Protocol, Barcelona Convention, Annex II

The native cetacean populations living in the Mediterranean Sea are stressed by a high number of human activities adding to the natural environmental changes and the increasingly pressing effects of the climate changes (Coll *et al.*, 2008; Hoegh-Guldberg and Bruno, 2010; Lejeusne *et al.*, 2010). These stress factors make the Mediterranean Sea one of the most degraded marine ecosystems worldwide (Bianchi and Morri, 2000; Coll *et al.*, 2010; Danovaro *et al.*, 2010; Piroddi *et al.*, 2015) requiring first priority conservation actions at global level (Myers *et al.*, 2000; Olson and Dinerstein, 2002).

The main factors that are potentially and really threatening the life of cetacean sub-populations in the Mediterranean Sea include fatal and non-fatal collisions with large vessels (Panigada *et al.*, 2006; Panigada and Notarbartolo di Sciara, 2012), chemical pollution (Aguilar *et al.*, 2002; Aguilar and Borrell, 2005; Borrell *et al.*, 1996; Fossi *et al.*, 2013, 2001), inteactions with fisheries (Lewison *et al.*, 2014; Reeves *et al.*, 2013), direct killing and capture (Bearzi *et al.*, 2004), acoustic pollution (Castellote *et al.*, 2012a, 2012b, 2009; Notarbartolo di Sciara *et al.*, 2016) and the general loss, fragmentation and degradation of the habitat (Bianchelli *et al.*, 2016; Coll *et al.*, 2010, 2008; Goffredo and Dubinsky, 2014; Walle *et al.*, 1993). Finally, the climate changes affecting the whole basin may adversely impact the cetacean populations and the marine biodiversity in general (Adloff *et al.*, 2015; Giorgi, 2006; Marbà *et al.*, 2015; Rivetti *et al.*, 2014; Schroeder *et al.*, 2016; Simmonds *et al.*, 2012).

The following paragraphs provide brief information on the current knowledges in the field of biology, ecology, conservation status and life-threats to the native cetacean species in the Mediterranean Sea..

Fin whale (*Balaenoptera physalus*)

The fin whale is the only mysticete living in the Mediterranean. It is a prevailing pelagic species distributed all over the basin, although a greater density and abundance have been reported to be in the western Mediterranean (Frantzis *et al.*, 2003; Notarbartolo di Sciara *et al.*, 2003; Notarbartolo di Sciara and Demma, 2004; Panigada *et al.*, 2011; Geijer *et al.*, 2016). An estimate of the fin whale abundance in the whole Mediterranean basin is not currently available. However, the estimate from monitoring activities carried out in a large portion of the central and western Mediterranean early '90s (Forcada *et al.*, 1996, 1995) amounted

to approximately 3,500 animals, 900 of which living in the Pelagos Sanctuary for the Mediterranean Marine Mammals (Notarbartolo di Sciara *et al.*, 2008). Most recently, Panigada et al. (Panigada *et al.*, 2011, 2017) reported that the amount of animals in the Pelagos Sanctuary is remarkably lower than estimated in the past studies.

From genetic studies, it turns out that the Mediterranean species is a sub-population genetically diferring from the North Atlantic species and is now classified as *Vulnerable* according to the IUCN criteria (Panigada and Notarbartolo di Sciara, 2012).

Collision with large vessels is the main cause of mortality of this species (Panigada *et al.*, 2006).

While the constant presence of this species in the north-western Mediterranean is well documented (for example, Notarbartolo di Sciara *et al.*, 2016, 2003), the presence of the fin whale in the Adriatic and Ionian Seas appears to be less abundant in other Mediterannean regions (Lipej *et al.*, 2004; Notarbartolo di Sciara *et al.*, 2016, 2003; Pierantonio e Bearzi, 2012). In Winter, the southern Adriatic sea (*e.g.* Lipej *et al.*, 2004; Pierantonio e Bearzi, 2012) and the waters adjacent to the north-western Ionian Sea region seem to be a potential feeding ground for this species (Notarbartolo di Sciara *et al.*, 2016).

Sperm whale (*Physeter macrocephalus*)

The sperm whale is an odontocete of large body size mainly living in the continental escarpment waters of the Mediterranean (Azzellino *et al.*, 2008; Praca *et al.*, 2009). Genetic studies revealed that the Mediterranean species is a subpopulation of the Atlantic species (Drouot *et al.*, 2004; Engelhaupt *et al.*, 2009) categorized as *Endangered* by the IUCN (Notarbartolo di Sciara, 2014; Notarbartolo di Sciara *et al.*, 2013; Rendell and Frantzis, 2016).

The occurence of this native species of the Mediterranean was reported since mid XVI century (Bearzi *et al.*, 2011b; Pierantonio and De Pascalis, 2015), the Ionian Sea, the Strait of Messina, the Hellenic trench and the northeastern basin being the areas where this species mostly occurs (Frantzis *et al.*, 2014; Gannier *et al.*, 2002; Gannier and Praca, 2007; Notarbartolo di Sciara, 2014; Rendell and Frantzis, 2016). This species is rare in the central and northern Adriatic Basin and the waters of the Strait of Sicily (Notarbartolo di Sciara *et al.*, 2013; Rendell and Frantzis, 2016). Results from a recent study based on data gathered in the last decade during sea and air navigation visual and acoustic surveys indicate that the Mediterranean sperm whale subpopulation counts abt. 2,000 individuals (Lewis et al., 2017) according to previous forecasts based on studies conducted in single basin portions (Rendell *et al.*, 2014).

Entanglement in pelagic nets and large vessel strikes (Pesante *et al.*, 2002) are the main causes of mortality of this species and of its potential decline in the last decades (Notarbartolo di Sciara, 2014; Notarbartolo di Sciara *et al.*, 2013; Rendell and Frantzis, 2016). The pelagic nets have been declared to be illegal in the Mediterranean by many International bodies among which the European Commission, the *International Commission for the Conservation of Atlantic Tuna* (ICCAT), the General Fisheries Commission for the Mediterranean, the Convention on Migratory Species (CMS) and the *Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area* (ACCOBAMS). Despite the reduced use of the nets, the presence of abandoned nets is deemed to be still a severe life-threat to this species and is therefore constantly monitored (Rendell and Frantzis, 2016). Additional life-threats are the underwater noise (Notarbartolo di Sciara and Gordon, 1997) and ingestion of plastic debris (de Stephanis et al 2013).

This species is a resident population living in the Ionian Sea (Lewis *et al.*, 2007, 2017). Although the sperm whale mainly lives in the southern region of the Adriatic basin in lower numbers compared to other contiguous areas such as the Hellenic trench (Frantzis *et al.*, 2014; Gannier *et al.*, 2002) and the Strait of Messina (Caruso *et al.*, 2015), historical data (Bearzi *et al.*, 2010, 2011b; Pierantonio and De Pascalis, 2015) and recent data (Frantzis *et al.*, 2011; Marsili *et al.*, 2014; Mazzariol *et al.*, 2011; Squadrone *et al.*,

2015) on strandings and sightings[3] indicates this sea stretch to be an important corridor wherethrough this species is travelling.

Bottlenose dolphin (*Tursiops truncatus*)

The bottlenose dolphin is one of mostly observed cetaceans in the Mediterranean, mainly in the coastal waters of the whole basin. The Mediterranean subpopulation differs from the Atlantic one (Natoli *et al.*, 2005, 2004) and is categorized as "*Vulnerable*" by the IUCN (Bearzi *et al.*, 2012).

Although significant data is not yet available to date, the Mediterranean bottlenose dolphin subpopulation is considered to be furtherly fragmented from a genetic viewpoint and thus consisting of geographycally separate individuals, some of which live in the Adriatic Sea, where this native species was abundant in the past while dramatically declining in the past decades (Bearzi *et al.*, 2012, 2009, 2004). The overall amount of individuals of this subpopulation is unknown, however, the current knowledges and the results obtained from many Mediterranean regions indicate that the amount of sexually mature individuals is less than 10,000 (Bearzi *et al.*, 2008).

Deliberate killing was the main cause of mortality of this species till late '80s of the past century (Bearzi *et al.*, 2009, 2004); now, the contributing causes of decline are accidental entanglement in fishing gear, decreased food availability caused by overfishing and environmental degradation. For an exhaustive revision of knowledges of the species ecology and biology and its conservation status reference shall be made to Bearzi *et al.* (2012, 2009).

This species is living in the coastal waters of the northern Ionian and lower Adriatic regions (for more details refer to the next paragraph "Ionian Sea Cetaceans").

Striped dolphin (*Stenella ceruleoalba*)

The striped dolphin is the most abundant species dwelling in the Mediterranean Sea (Aguilar, 2000). It is a purely pelagic species (Azzellino *et al.*, 2008), whose Mediterranean subpopulation is categorized as "Vulnerable" by the IUCN (Aguilar and Gaspari, 2012).

According to recent studies, this subpopulation genetically (Gaspari *et al.*, 2007) and morphologically includes other sub-units (Calzada *et al.*, 1997). Despite the occurrence of this species throughout the Mediterranean, its abundance and density is lower in the Mediterranean eastern basin than in the western one (Aguilar, 2000; Bearzi *et al.*, 2011a; Frantzis *et al.*, 2003; Notarbartolo di Sciara and Birkun, 2010; Panigada *et al.*, 2011, in press). Failing abundance estimates for the whole Mediterranean Sea, the slow, but ongoing decline of striped dolphin subpopulation is observed mainly due to extreme morbillivirus infections (Domingo *et al.*, 1995, 1992, 1990), both recently (Casalone *et al.*, 2014; Di Guardo *et al.*, 2013; Di Guardo and Mazzariol, 2013) and in the past decades (Aguilar and Raga, 1993; Raga *et al.*, 2008).These high mortality events likely favored by high PCB pollution levels (Aguilar and Borrell, 1994), caused a dramatic abundance decline of this species (Aguilar and Raga, 1993; Forcada *et al.*, 1994; Panigada *et al.*, in press).

The species occurrence is observed in the waters at the north part of the Ionian Sea and in lower Adriatic Sea (for more details reference shall be made to the next paragraph «Cetaceans in the Ionian Sea).

Short-beaked common dolphin (*Delphinus delphis*)

It being a very common species in the Mediterranean till the second half of the 20th century, the Mediterranean population of short-beaked dolphin is considered to have been cut by 50% in the past decades (Bearzi, 2003; Bearzi *et al.*, 2003). Although abundance estimates for the whole basin fail, it is difficult to define the true extent of this negative trend. Today, this species is relatively abundant in the Alborán Sea (Cañadas and Hammond, 2008), offshore western Sardinia, in the Strait of Sicily around the

[3] http://www.telegraf.rs/english/2324741-giant-whales-come-out-to-the-coast-of-adriatic-sea-12-meters-long-people-in-panic-photo-video

Malta and Lampedusa islands, in the eastern Ionian Sea, in the Aegean Sea and waters in front of Israel. Instead, this species has disappeared from many Mediterranean regions representing in the past a fundamental habitat for this species, viz. the Adriatic Sea (Bearzi *et al.*, 2004, 2003), Balearic Sea, Provence basin and Ligurian Sea (Bearzi, 2003; Bearzi *et al.*, 2003). The species occurrence is encountered in both pelagic and neritic environments often with other species such as striped dolphin, bottlenose dolphin and Risso's dolphin (Bearzi *et al.*, 2016, 2011a, 2003; Frantzis and Herzing, 2002). It is suggested that the decline of the Mediterranean short-beaked common dolphin population was largely caused by overfishing and degradation of the habitat (Bearzi, 2003; Bearzi *et al.*, 2003). This species is now categorized as *Endangered* according to the IUCN criteria (Bearzi, 2003).

The species occurrence is observed in the waters at the north part of the Ionian Sea and in lower Adriatic Sea (for more details reference shall be made to the next paragraph «Cetaceans in the Ionian Sea).

Long-finned pilot whale (*Globicephala mela*)

The long-finned pilot whale is one of the less known native species of the Mediterranean. Information on habitat preferences and use, distribution and other aspects of the species ecology and biology is a few and fragmentary (Cañadas, 2012a). Thus, the current knowledges do not allow to define the conservation status of this species in the Mediterranean. The long-finned pilot whale is actually classified as *Data Deficient* according to the IUCN parameters (Cañadas, 2012a).

The long-finned pilot whale is mainly present in the western basin of the Mediterranean and its occurrence in the eastern sector was reported following the very few and often non-confirmed sightings (Notarbartolo di Sciara and Birkun, 2010; Verborgh *et al.*, 2016). Abundance estimates are available for the Strait of Gibraltar and a portion of the Alborán Sea, where this species appears to be particularly abundant with a higher sighting number compared to the rest of the Mediterranean (Cañadas, 2012a; Notarbartolo di Sciara *et al.*, 1993). However, a 15% cut in the population in this region of the Mediterranean started since early '90s of the past century (Cañadas, 2012a). This species prefers the pelagic waters of over 500 m depth rather than the continental escarpment waters (Azzellino *et al.*, 2008; Cañadas *et al.*, 2005, 2002). Possible threats to this species are bycatch, vessel strikes and acoustic pollution (Cañadas, 2012a; Rendell and Gordon, 1999). Moreover, this species is especially vulnerable to morbillivirus infections (Banyard *et al.*, 2011; Bellière *et al.*, 2011; Fernández *et al.*, 2008; Van Bressem *et al.*, 2014; Wierucka *et al.*, 2014).

This species is not present in the Ionian Sea and poorly present in the Adriatic Sea (for more details reference shall be made to the next paragraph «Cetaceans in the Ionian Sea).

Risso's dolphin (*Grampus griseus*)

This is a relatively widespread, though apparently not abundant, species in the Mediterranean (Bearzi *et al.*, 2011c; Boisseau *et al.*, 2010; Gaspari and Natoli, 2012; Notarbartolo di Sciara and Birkun, 2010). The Mediterranean Risso's dolphin subpopulation that genetically differentiates from that of North Atlantic (Gaspari *et al.*, 2006) is now classified as *Data Deficient* according to the IUCN criteria (Gaspari and Natoli, 2012).

Occurrence and distribution of this species in the Mediterranean are heterogeneous and fragmented with a marked preference for the continental escarpment waters (Azzellino *et al.*, 2008; Cañadas *et al.*, 2002). Abundance estimates for the whole Mediterranean basin are not available to date. This species is abundant in the northwestern portion of the basin, particularly in the Ligurian Sea, where it has however declined, particularly in the waters near the coast and continental escarpment waters, since early years of the 21th century (Azzellino *et al.*, 2016). Additional abundance estimates are available for a portion of the Mediterranean Spanish waters (Gómez de Segura *et al.*, 2006). This species is present in a portion of the Ionian Sea (Dimatteo *et al.*, 2011; Frantzis *et al.*, 2003; Frantzis and Herzing, 2002), in the Corinth Canal, in the Adriatic Sea and along the North Africa coasts (Azzellino *et al.*, 2016; Bearzi *et al.*, 2011c; Notarbartolo di Sciara and Birkun, 2010), though the sighting frequency is lower than in the rest of Mediterranean (Bearzi *et al.*, 2011c; Notarbartolo di Sciara *et al.*, 1993). Main life-threats to this species

are bycatch (Gaspari and Natoli, 2012), chemical pollution (Fossi and Marsili, 2003; Marsili and Focardi, 1997) and potentially acoustic pollution (Azzellino *et al.*, 2016).

This species is poorly present in the Ionian and Adriatic Sea (for more details reference shall be made to the next paragraph «Cetaceans in the Ionian Sea).

Cuvier's beaked whale (*Ziphius cavirostris*)

The Cuvier's beaked whale is the only ziphii native species of the Mediterranean (Notarbartolo di Sciara and Birkun, 2010; Podestà *et al.*, 2006). The occurrence and distribution of this species is characterized by high density zones (Podestà *et al.*, 2016), including the Alborán Sea, Ligurian Sea, Central Tyirrhenian Sea, southern Adriatic Sea and Hellenic trench, where the animals seem to be relatively abundant (Frantzis *et al.*, 2003; Gannier and Epinat, 2008; Podestà *et al.*, 2016, 2006). Recent studies of the habitat preferences and use gave clear evidence that this species prefers the continental escarpment waters associated with underwater canyons (Azzellino *et al.*, 2008; D'Amico *et al.*, 2003; Lanfredi *et al.*, 2016; MacLeod *et al.*, 2006; Moulins *et al.*, 2007). This species is particularly vulnerable to the acoustic pollution from military sonars that in the past decades caused atypical mass strandings both in the Mediterranean and the ocean environment (D'Amico *et al.*, 2009; Filadelfo *et al.*, 2009; Frantzis, 1998; Podestà *et al.*, 2016, 2006).

The species occurrence is observed in the waters at the north part of the Ionian Sea and in lower Adriatic Sea (for more details reference shall be made to the next paragraph «Cetaceans in the Ionian Sea).

Protection and conservation rules

The above species are protected by national and international agreements, regulations and by-laws among which the Bonn Convention (*Convention on the Conservation of Migratory Species of Wild Animals*), the Barcelona Convention (*Convention for the Protection of the Mediterranean Sea Against Pollution*), the Habitat Directive (*Community directive 92/43/EEC*) and the *Convention on International Trade in Endangered Species of Wild Fauna and Flora*.

Many studies on the ecology, biology, natural hystory and impact of the human activities on the various cetacean species living in the Mediterranean have been conducted in the past decades, however, a number of matters relating for example to migration and migratory pathways and the presence of breeding areas need be clarified. Occurrence and abundance of the species within the basin strongly vary as a function of the species and the season. In general, on the basis of the information currently available and despite the lack of abundance and density estimates for all the species, the Western Mediterranean is a sector of the basin affected by a higher number of species and a major occurrence in terms of number of individuals per each species.

4.3.2.1.1.2. Cetaceans in the Ionian Sea

The region affected by the prospections discussed in this study is a hydrogeological and hydrodynamic hotspot of the Mediterranean. Actually, the Ionian Sea is a meeting and simultaneously transition point of three important water masses, i.e. the *Modified Atlantic Water* (MAW), the *Levantine Intermediate Water* (LIW) and the *Adriatic Deep Water* (ADW) (Manca and Scarazzato, 2001). This hydrogeological complexity associated with the particular morphology of the coastline and seabed makes this region of the Ionian Sea a core environment for many animal species.

It should also be pointed out that the northern portion of the Ionian Sea is strongly affected by the marine trade and military traffic and stressed by the local metalworking industries, whose impact effects on the marine eco system have not yet been fully assessed.

Also knowledges on occurrence, distribution and abundance of the cetacean populations in this region of the Ionian Sea are just a few. Notarbartolo di Sciara and colleagues (1993) reported for the first time the occurrence of six different species, viz. bottlenose dolphin, striped dolphin, fin whale, sperm whale, Risso's dolphin and short-beaked common dolphin, and highlighted that the striped dolphin was the most common cetacean in the region and that the sighting intervals for the various species were smaller than in other

regions of the Mediterranean. A recent study (Panigada *et al.*, *2017*) has estimated that the number of striped dolphin individuals in a portion of the Ionian Sea contiguous to that affected by this study is 27,800 with a density of 0,2858 individuals per km^2 (Figure 4.11).

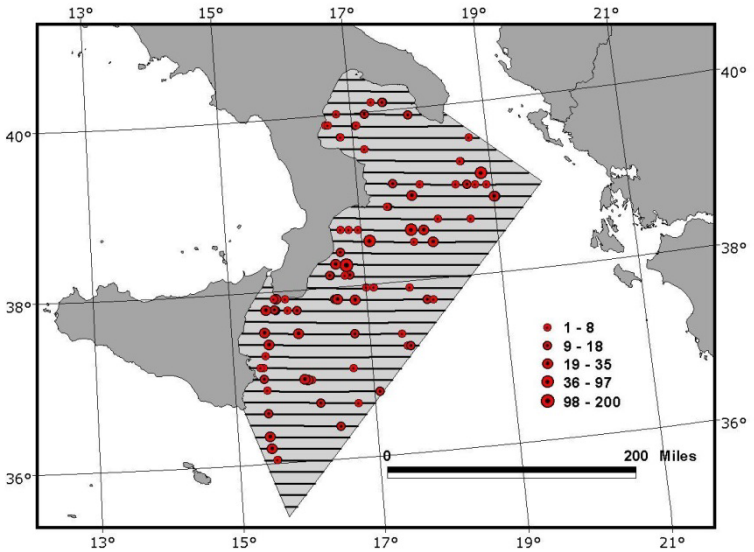


FIGURE 4.11: STRIPED DOLPHIN SIGHTINGS IN THE IONIAN SEA (PANIGADA *ET AL.*, 2017)

Other authors reported the occurrence mainly in the Gulf of Taranto of the sperm and fin whale during the Summer season, however, they did not provide information on their distribution and abundance (Dimatteo *et al.*, 2011).

The occurrence of the beaked whale in the Ionian Sea along the Hellenic trench (Frantzis *et al.*, 2003; Gannier and Epinat, 2008; MacLeod *et al.*, 2006; Podestà *et al.*, 2016, 2006) and recently along the Albania coastline (Bräger *et al.*, 2014) and generally in the southern Adriatic Sea (Gomerči *et al.*, 2006; Holcer *et al.*, 2007; Podestà *et al.*, 2016, 2006) (Figure 4.12; Figure 4.13; Figure 4.14; Figure 4.15) has been observed and confirmed.

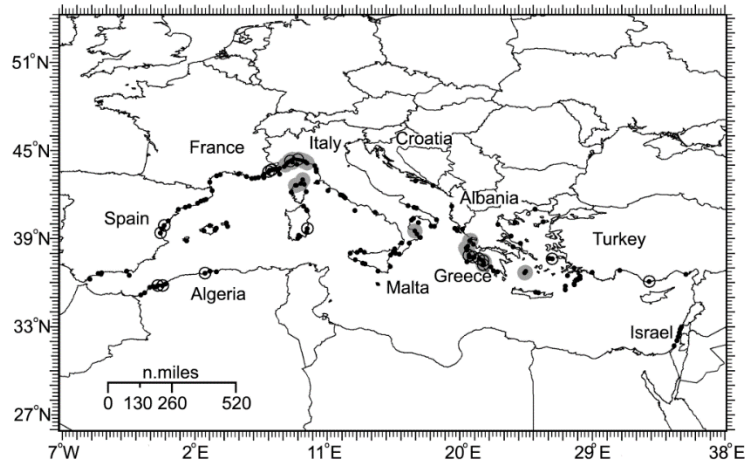


FIGURE 4.12: BEAKED WHALE STRANDINGS RECORDED IN THE PERIOD 1803 TO 2003 (PODESTÀ *ET AL.*, 2006)

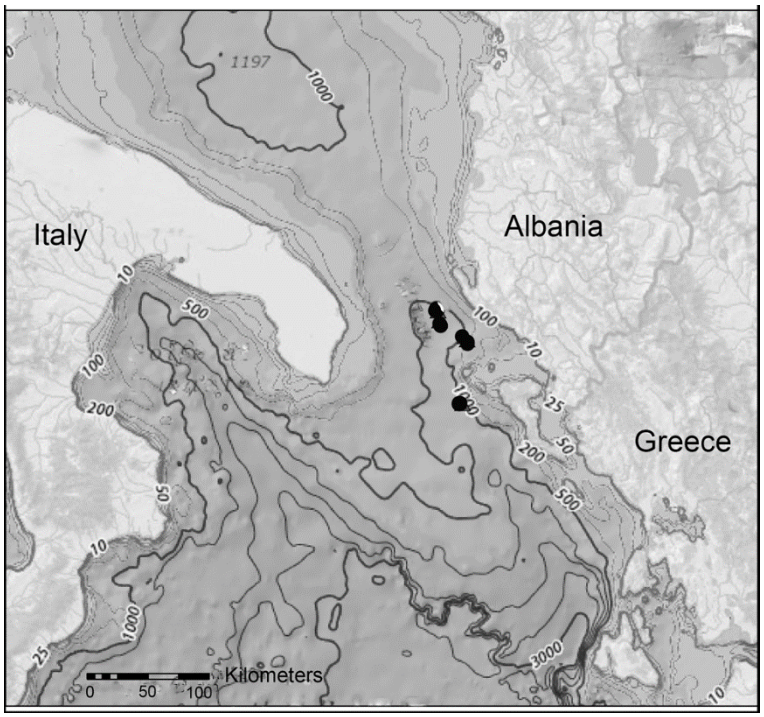


FIGURE 4.13: LOCATION OF 5 BEAKED WHALE SIGHTINGS RECENTLY OBSERVED IN THE BOUNDARY WATERS BETWEEN ALBANIA AND GREECE (BRÄGER *ET AL.*, 2014)

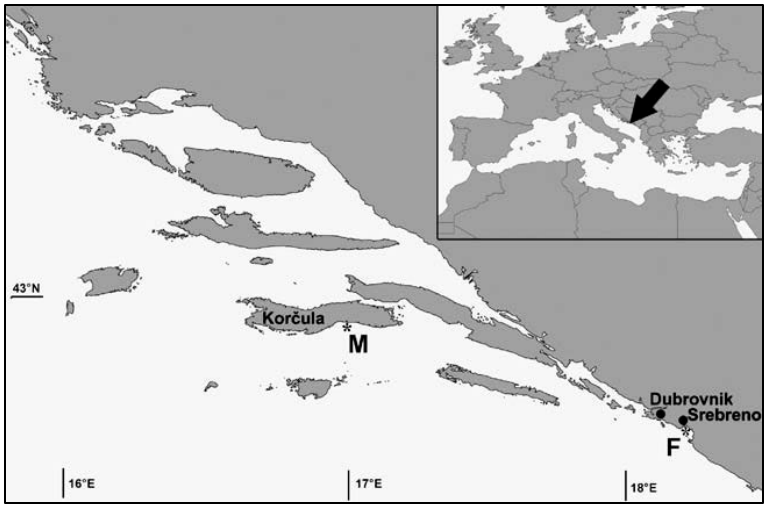


FIGURE 4.14: LOCATION OF TWO BEAKED WHALE SIGHTINGS/STRANDINGS ALONG THE CROATIAN WATERS AT THE SOUTH OF THE ADRIATIC SEA (GOMERČI *ET AL.*, 2006)

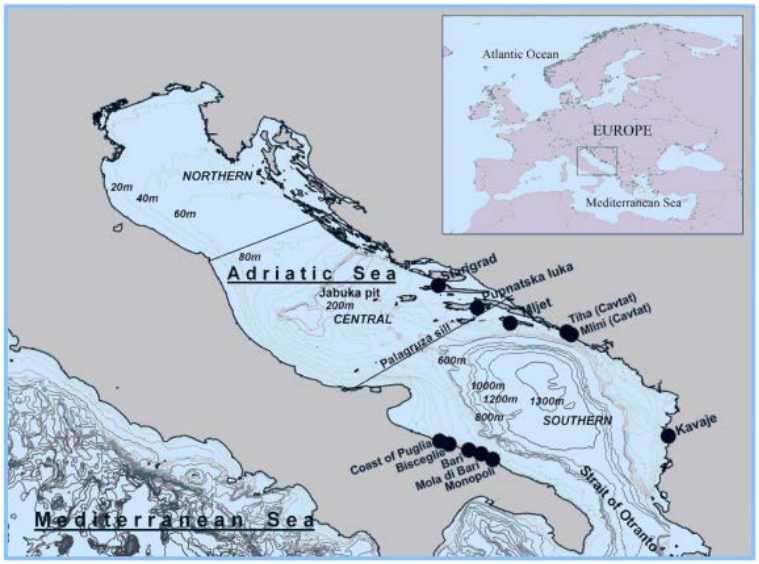


FIGURE 4.15: BEAKED WHALE STRANDINGS OBSERVED IN THE LOWER ADRIATIC SEA (HOLCER *ET AL.*, 2007)

No sighting of the long-finned pilot whale is reported apart from a carcase found in the Gulf of Taranto. The occurrence of this species in the eastern Mediterranean is practically nil (Frantzis *et al.*, 2003), except for a sighting in the Adriatic Sea in year 2010 (Verborgh *et al.*, 2016). The Risso's dolphin is barely present in the northern region of the Ionian Sea and southern region of the Adriatic Sea and is occasionally observed in the central Adriatic Sea, along the Croatian coastline and in the waters of the Ionian Greece (Bearzi *et al.*, 2011; Frantzis *et al.*, 2003; Gaspari and Natoli, 2012; Azzellino *et al.*, 2016).

As compared to the rest of the basin, the Ionian Sea is a region of moderate, but not negligible significance for the fin whale, which is the sole permanently resident mysticete in the Mediterranean. Actually, whilst the permanent occurrence of this species in the northwestern and central Mediterranean is well documented (e.g. Notarbartolo di Sciara *et al.*, 2016, 2003), the fin whale is a permanent resident in the Adriatic and Ionian Seas, however, its abundance and density are lower than in other regions of the Mediterranean (Lipej *et al.*, 2004; Notarbartolo di Sciara *et al.*, 2016, 2003; Pierantonio and Bearzi, 2012) In addition, specifically in the Winter months, the southern region of the Adriatic Sea (e.g. Lipej *et al.*, 2004; Pierantonio and Bearzi, 2012) and the waters near the western Ionian Sea (Sciacca *et al.*, 2015a, 2015b) seem to be a potential feeding ground for this species (Notarbartolo di Sciara *et al.*, 2016). Sightings, captures and strandings of this species in the region affected by this study are rare and reported starting from early 19th century (Notarbartolo di Sciara *et al.*, 2016, 2003; Pierantonio and Bearzi, 2012; Pierantonio and De Pascalis, 2015) (Figure 4.16 e Figure 4.17).

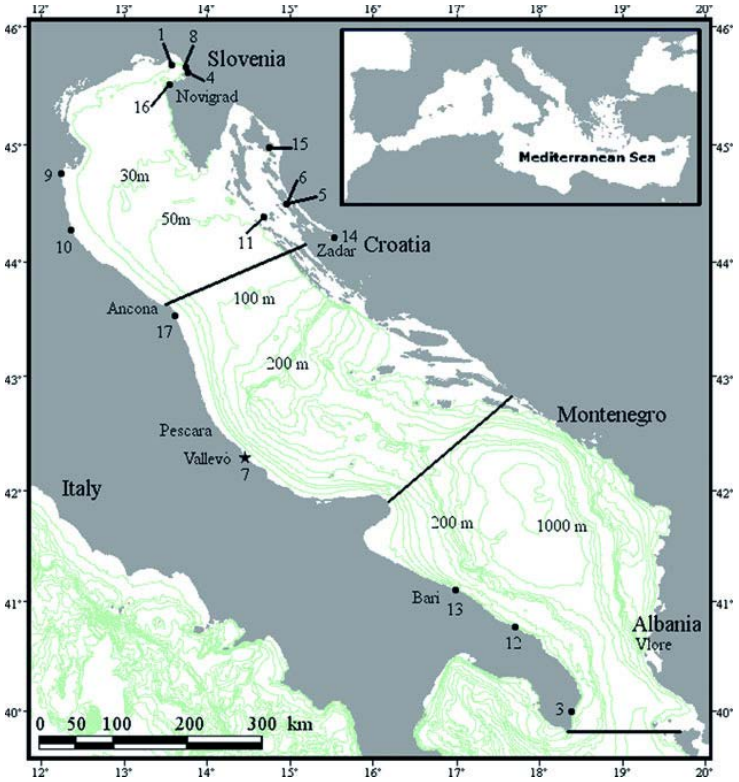


FIGURE 4.16: HISTORICAL STRANDINGS (5 CENTURIES) OF THE FIN WHALE IN THE ADRIATIC SEA (PIERANTONIO AND BEARZI, 2012)

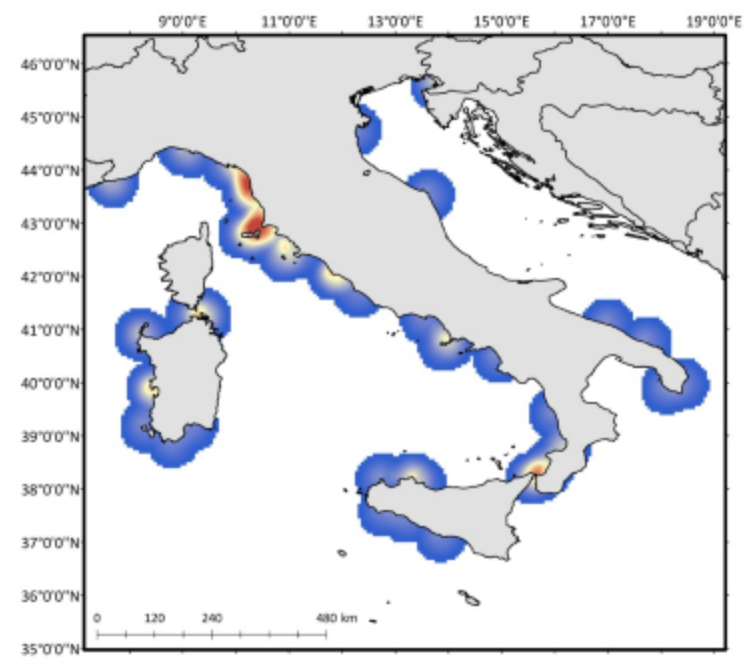


FIGURE 4.17: EXTENT OF HISTORICAL FIN WHALE MORTALITY EVENTS IN THE ITALIAN SEAS (PIERANTONIO AND DE PASCALIS, 2015)

The sperm whale has been recently object of an abundance estimate with the help of acoustic monitoring activities. (Figure 4.18). Lewis and colleagues (2007, 2017) estimated an occurrence of 62 animals in the whole region of the Ionian Sea thus prompting additional monitoring and conservation actions for preservation of this species. The occurrence of this species in the study area was systematically reported starting from the first half of the 16th century (Bearzi *et al.*, 2011b; Pierantonio and De Pascalis, 2015) (Figure 4.19) and more recently (Bolognari, 1951, 1950, 1949), (Frantzis *et al.*, 2014, 2011; Rendell and Frantzis, 2016) (Figure 4.20), (Marsili *et al.*, 2014; Mazzariol *et al.*, 2011), (Notarbartolo di Sciara, 2014; Notarbartolo di Sciara *et al.*, 2013).

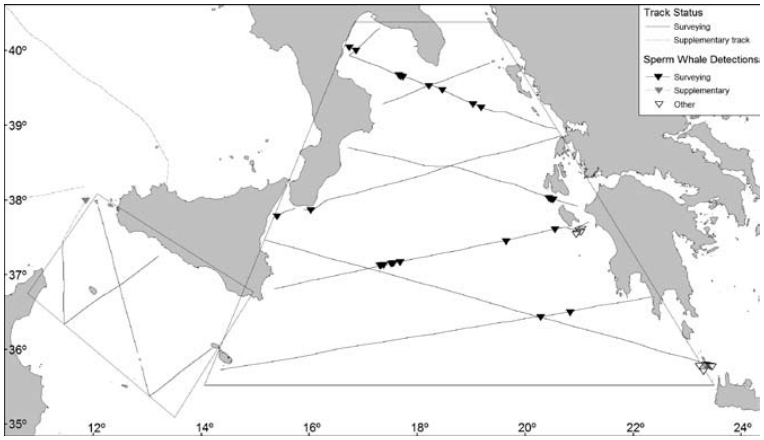


FIGURE 4.18: SPERM WHALE SIGHTINGS IN THE IONIAN SEA WATERS (LEWIS *ET AL.*, 2007).IO

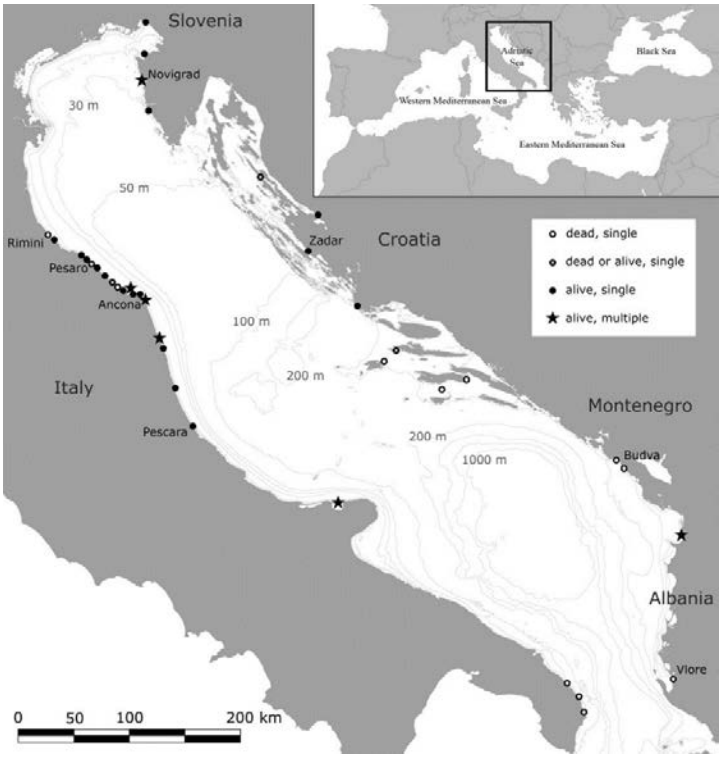


FIGURE 4.19: GEOGRAPHICAL DISTRIBUTION OF THE HISTORICAL SPERM WHALE MORTALITY EVENTS IN THE ADRIATIC SEASTARTING FROM YEAR 1555 (BEARZI *ET AL.*, 2011B)

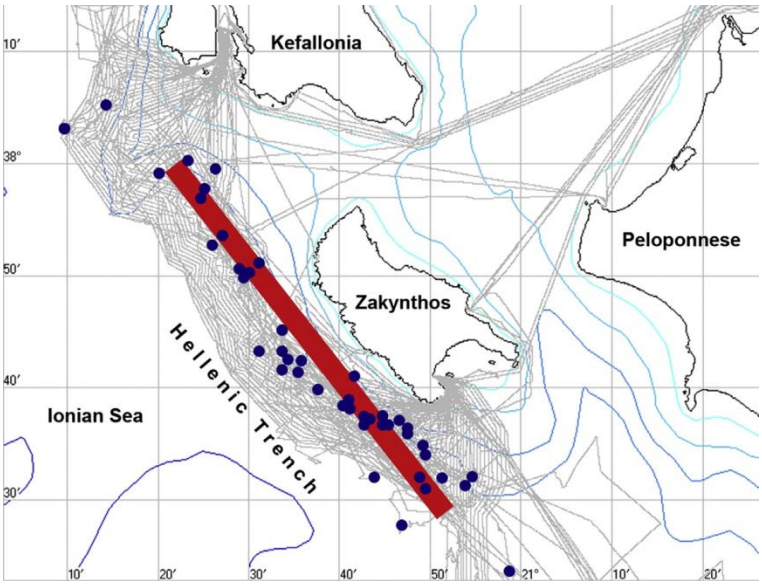


FIGURE 4.20: SPERM WHALE SIGHTINGS ALONG THE HELLENIC TRENCH, GREECE (FRANTZIS ET AL., 2014; RENDELL AND FRANTZIS, 2016)

442 strandings up to a total of 460 animals found along the Ionian coasts of Puglia, Calabria, Sicily and Malta are reported in the stranding database for the northern Ionian Sea (http://mammiferimarini.unipv.it/), starting from year. According to the same database, 478 strandings up to a total number of 488 animals found stranded were reported starting from year 1902. The striped dolphin was mostly affected by this phenomenon, which is consistent with the fact that the occurrence of this species is most abundant in the region (Fortuna *et al.*, 2011; Panigada *et al.*, 2017) and in the whole region of the Mediterranean as well (Aguilar, 2000).

Various species such as rough-toothed dolphin (*Steno bredanensis*), false killer whale (*Pseudorca crassidens*), orca (*Orcinus orca*) and North Atlantic right whale (*Eubalena glacialis*) were rarely seen in the Ionian Sea and sithings were often not confirmed (Notarbartolo di Sciara and Birkun, 2010).

We would like to underline how much important is the sea region affected by the discussed prospections for movements of the species within the Mediterranean basin and the maintenance of the connectivity for the species in question (Panigada and Pierantonio, 2016). Different cetacean species such as the sperm whale (Frantzis *et al.*, 2011; Pierantonio *et al.*, 2017; Rendell and Frantzis, 2016) (Figure 4.21) and the short-beaked common dolphin (Genov *et al.*, 2012) (Figure 4.22) could travel across this region of the Mediterranean on both regular and seasonal basis.

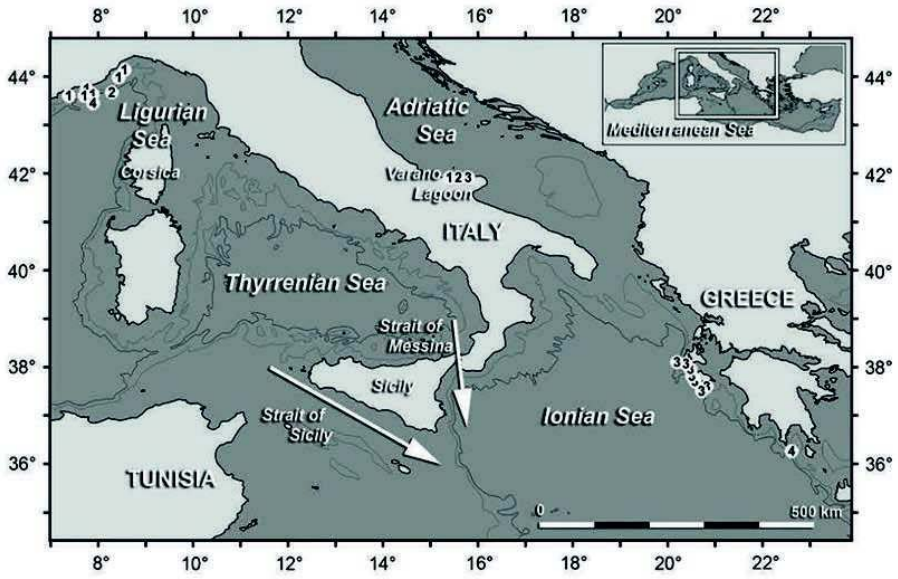


FIGURE 4.21: RECAPTURE MAP OF SOME SPERM WHALE INDIVIDUALS BETWEEN THE LIGURIAN SEA AND THE HELLENIC TRENCH (GREECE) THEN MASS STRANDED IN THE CENTRAL ADRIATIC SEA. DESPITE THE LACK OF INFORMATION ON THE ANIMAL SWIMMING PATHWAYS, IT IS CLEAR THAT WATERS OF THE NORTHERN IONIAN SEA AND SOUTHERN ADRIATIC SEA AND THOSE IN THE COASTAL BASINS OF GREECE, ALBANIA AND SOUTH ITALY ARE AN IMPORTANT TRANSIT BASIN FOR THIS SPECIES (FRANTZIS *ET AL.*, 2011)

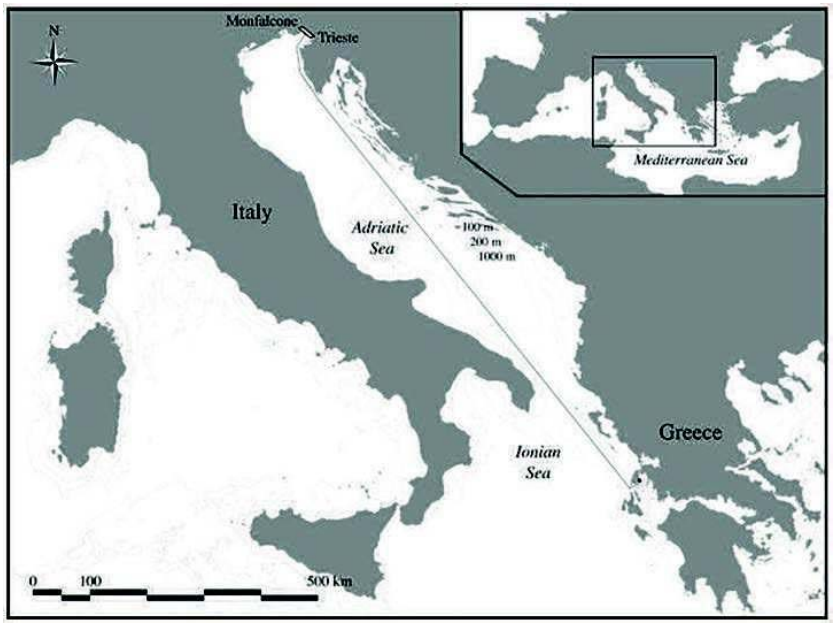


FIGURE 4.22: MINIMUM STRAIGHTLINE DISTANCE TRAVELLED BY A SHORT-BEAKED COMMON DOLPHIN INDIVIDUAL CROSSING THE NORTHERN IONIAN SEA AND THE SOUTHERN ADRIATIC SEA AND THE COASTAL BASINS OF GREECE, ALBANIA AND SOUTH ITALY TO MOVE FROM THE GREEK BASINS TO THOSE OF THE GULF OF TRIESTE; IT IS CLEAR THAT WATERS OF THE NORTHERN IONIAN SEA AND SOUTHERN ADRIATIC SEA AND THOSE IN THE COASTAL BASINS OF GREECE, ALBANIA AND SOUTH ITALY ARE AN IMPORTANT TRANSIT BASIN FOR THIS (GENOV *ET AL.*, 2012).

4.3.2.1.1.3. Useful information for an assessment of the environmental impact effects on cetaceans

According to the data available, the following four species are found to be permanent residents in the Application for Exploration Permit Area and its surroundings (waters off the northern Ionian Sea and southern Adriatic Sea):

- Striped dolphin, the largest and more common species;
- Fin whale, though its number is lower than in other Mediterranean regions and is likely to be concentrated in Winter months;
- Sperm whale, a potential resident, though 62 individuals only were counted in the whole Ionian Sea basin according to the available information;
- Beaked whale, whose presence in the region has been confirmed.

Other potentially resident species are occasional in the study area and its surroundings. They include the Risso's dolphin, the bottlenose dolphin preferring areas nearer to the coastline and the short-beaked common dolphin counting a quite smaller population in the Mediterranean mainly residing in other areas..

The available data suggests that the northwestern Ionian Sea could be a migration basin for some species (mainly sperm whales) and a potential feeding ground for the fin whale in Winter.

A review of the dedicated literature indicates that the **main threats** to cetaceans off the northern Ionian Sea and southern Adriatic Sea mostly derive from the following human activities (presented not in order of relevance) that lead to death:

- Collisions with large vessels (sperm whale and fin whale);
- Entanglement in driftnets (sperm whale);
- Direct and indirect interactions with fishery activities including accidental takes in driftnets (bottlenose dolphin, striped dolphin, short-beaked common dolphin, Risso's dolphin).

Other anthropogenic activities may more or less disturb the cetaceans leading to mortality in extreme cases:

- General acoustic pollution from military sonars and seismic prospection activities (mainly, beaked whale, sperm whale, fin whale and potentially Risso's dolphin);
- Chemical pollution (all species);
- Habitats degradation, fragmentation and loss (all species);
- Marine traffic (mainly, fin whale and sperm whale threatened by collisions and all species threatened by acoustic pollution).

More specifically, **the seismic survey** is considered by many authors as a potential threat to survival of marine mammals, mainly mysticetes and sperm whale (Cerchio *et al.*, 2014; Di Iorio and Clark, 2010; Madsen *et al.*, 2006, 2002; Madsen and Møhl, 2000; Miller *et al.*, 2009), since its hearing range could overlap the low frequency emission sound of the *air guns* (Au, 2000; Ketten, 2000). Many studies however assume that even small size odontocetes more vulnerable to higher frequencies may be subjected to impact effects from this activity, particularly in shallow waters (Au and Hastings, 2008; Richardson *et al.*, 1995).

Potentially adverse effects detected include habitat displacement, disruption of biologically important behaviors, masking of communication signals, chronic stress and potential auditory damage (Nowacek *et al.*, 2015).

Recent information on each species or species functional groups is available to date and covers possible exposure criteria to the under waternoise including that from seismic activities and potential behavioural, biological and physiological response of the different species (Southall *et al.*, 2009, 2007) (https://tethys.pnnl.gov/publications/marine-mammal-noise-exposure-criteria-initial-scientific-recommendations).

The foregoing indicates a "high" sensitivity of the marine mammals sub-component within this EIS.

4.3.2.1.2. Sea birds

Study area

The area investigated for the study of sea birds relating to the potential range of the impact effects on this group from the Project *activities is the Application for Exploration Permit Area (14 nautical miles from Santa Maria di Leuca –729 km² surface area).*

Birds are the group of vertebrates better studied at both national and international level because of the faster way of collecting data all year round. Many species are extremely vulnerable to environmental changes and represent a good indicator of the environment quality.

Detailed data for this study area is not available, however, the pelagic species present in the area mainly belong to the orders of the Procellariformes, Pelecaniformes and Charadriformes.

The table below summarizes the species that are potentially present in the study area, their law-regulated protection, their vulnerability according to the IUCN Red Lists (*International Union for Conservation of Nature*) and the Italian Red Lists. Where possible, this table also shows the range of the species nesting areas.

TABLE 4.4: BIRD SPECIES POTENTIALLY PRESENT IN THE STUDY AREA

Order	Family	Scientific name	Common name	Nesting areas in Italy	Law 157/92	2009/147/CE All.I	IUCN Red List	Italian Red List
Charadriiformes	Laridae	Larus cachinnans	Caspian gull	NA	X	-	LC	NA
Charadriiformes	Laridae	Larus canus	Mew gull	NA	X	-	LC	NA
Charadriiformes	Laridae	Larus fuscus	Lesser black-bucked gull	NA	X	-	LC	NA
Charadriiformes	Laridae	Larus genei	Slender-billed gull	Expanding area	X	X	LC	LC
Charadriiformes	Laridae	Larus melanocephalus	Mediterranean gull	502 km², (Boitani *et al.*, 2002)	X	X	LC	LC
Charadriiformes	Laridae	Larus ridibundus	Common gull	Larger than 20,000 km² (Boitani *et al.*, 2002)	X	-	LC	LC
Pelecaniformes	Phalacrocoracidae	Phalacrocorax carbo	Great cormorant	Smaller than 5,000 km² (Boitani *et al.*, 2002)	X	-	LC	LC
Procellariiformes	Hydrobatidae	Hydrobates pelagicus	Storm-petrel	5 nesting sites	X	X	LC	NT
Procellariiformes	Procellariidae	Calonectris diomedea	Scopoli's shearwater	641 km² (Boitani *et al.*, 2002)	X	X	LC	LC
Procellariiformes	Procellariidae	Puffinus yelkouan	Yelkouan shearwater	862 km², Boitani *et al.* 2002	X	X	VU	DD

IUCN classes used:
DD: Data deficient (carenza di dati)
LC: Least Concern (minor preoccupazione)
NT: Near Threatened (quasi minacciata)
VU: Vulnerable (vulnerabile)

As illustrated in the table, most of the species potentially present is not affected by conservation critical issues, however, the storm-petrel (Hydrobates pelagicus) is considered a domestically threatened species and the Yelkouan shearwater (*Puffinus yelkouan*) is enalisted in the International IUCN red lists as *Vulnerable* (VU). There is no national sufficient data to make an adequate assessment.

These two typically pelagic, partially migratory species nest in caves of high and rocky coasts far away from the mainland. Spawning sites in the study area have been not reported so far.

The presence of a coastal Important Bird Area (IBA) (IT147 - "Coastline between Cape of Otranto and Cape of Santa Maria di Leuca") emphasizes the importance of the study area as transit point of many migratory birds.

The study area finally encompasses the *Mediterranean/Black Sea Flyway* (Figure 4.23). It is also reported that the coastal IBA is a "bottleneck" site for many species of birds of prey (mainly, *Circus sp.* and *Pernis apivorus*) migrating along the Adriatic coastline at Spring time. Over 3,000 transits of birds of prey are recorded every Spring (Birdlife 2016). The migratory phenomenon resulted to be different in the Spring and Fall period, as the migratory movements are massive and concentrated in Spring and time delayed at Fall following different routes.

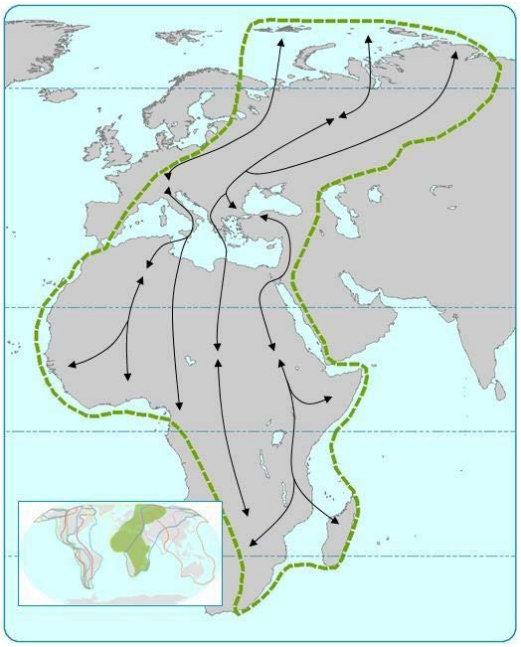


FIGURE 4.23: MEDITERRANEAN/BLACK SEA FLYWAY

This matter deserved an in-depth analysis by ISPRA in the "Conservation of Migratory Species and protection of Migration Processes" document, in which the importance of Italy as "route of maximum importance" for a wide range of species was emphasized.

32 specially important sites for seasonal migration of these birds were identified in Italy, 14 of which are regularly monitored. Six sites are located in Southern Italy, viz. Marettimo, Ustica, Strait of Messina, Monte Covello, Capri and Cape of Otranto (Giraudo 2007), the last being closest to the Application for Exploration Permit Area.

Finally, this document indicates that more abundant wintering species include Eurasian Coot (*Fulica atra* - over 200,000/yr), Common Gull (*Larus ridibundus* - over 170,000/yr) and Mallard (*Anas platyrhynchus* - over 100,000/yr). The Gray Heron (*Ardea cinerea*), the Cormorant (*Phalacrocorax carbo*), the Mallard and the Eurasian Coot make part of the most widespread species.

4.3.2.1.2.1. *Useful information for an assessment of the impact effects on the sea birds*

Literature and action plans for the species conservation indicate the following factors as **main threats** to the birdlife of the migratory species in particular:

- Habitats destruction and degradation;
- Presence of high-impact facilities (for ex., wind parks and overhead power lines);
- Poaching and hunting;
- Climate changes.

The study area is visited throughout the year by pelagic birds mainly and shorebirds rarely. The latter go that far from the coastline for trophic activities. As said in the previous chapter, the study area is also a transit area for the species that migrate from Europe to Africa and vice versa during Spring and Fall seasons. The transit species include birds of prey, small migrators (passerines, for example) and water birds. Migrations to the Puglia coastline as resting place occur day- and night time. The most critical months for migration are February to April and end of August to October.

The foregoing indicates a "moderate" vulnerability of the birds within this EIS.

4.3.2.1.3. Marine reptiles

Study area

The area investigated for the study of marine reptiles relating to the potential range of the impact effects on this group from the Project *activities is the Application for Exploration Permit Area (14 nautical miles from Santa Maria di Leuca –729 km^2 surface area).*

4.3.2.1.3.1. *General results*

Three species of sea turtles are regularly found in the Mediterranean, namely *Caretta caretta* (loggerhead sea turtle), *Chelonia mydas* (green turtle) and *Dermochelys coriacea* (leatherback sea turtle)[4]. These three species are potentially present in the Ionian Sea, even if the occurrence of the leatherback and green turtles is occasional. All the three species are protected by Italian laws (Law No. 503/81, Law No. 42/83, Law No. 150/92 as amended by the Law Decree No. 275 of year 2001, Law No.175/99, Decree of the President of the Republic No. 357/97), European directives (Habitats Directive 92/43/EEC: Annexes II *C. caretta* and IV all the three species) and many International conventions (Washington Convention, Bonn Convention and Barcelona Convention).

Dermochelys coriacea is a mainly pelagic species with occasional occurrence in the Mediterranean and hence in the Ionian Sea and study area. The Mediterranean is not a nesting site for this species. Only limited information on the swimming routes and migrations of the leatherback turtle is available. It is however known that this species covers vast distances. The Mediterranean occurrence of the leatherback turtle was occasionally observed in Turkey, Israel, France and Italy, mainly in Sicily.

Chelonia mydas can rarely be found in the western Mediterranean basin (and thus in the Ionian Sea), its native range being mainly restricted to the eastern basin (Turkey, Cyprus and Syria) because of its nesting grounds (Kasparek *et al.*, 2001).

Caretta caretta is the most abundant species in the Mediterranean Sea with occurrence in the Ionian Sea and potentially in the study area. The marine neritic domain is the Mediterranean habitat selected by this species, namely the water basin above the continental shelf down to a maximum depth of 200 m (Groombridge, 1982). This basin combines a number of areas, viz. feeding grounds, wintering, mating and nesting sites and migration routes. The key nesting sites are located in the eastern basin (Greece, Turkey and Cyprus), however, they have also been identified on the Italian coastline, mainly along the southern coasts and the islands, sometimes in the Tyrrhenian Sea and recently in the middle Adriatic Sea. The main

[4] Other two species, the hawksbill turtle (*Eretmochelys imbricata)* and the kemp's ridley turtle (*Lepidochelys kempii*) are identified on irregular basis only and their occurrence in the Mediterranean is merely accidental (Tomas *et al.*, 2003).

wintering and foraging sites in the Mediterranean include the Gulf of Gabès in Tunisia, the Lybian coasts, the central and northern regions of the Adriatic Sea and the Turkish coasts. For most of the year the adults live isolated in the foraging coastal areas.

Migration, representing an important part of the life cycle of the *Caretta caretta,* is prompted by spawning, feeding or wintering reasons.

Whilst the spawning, mating, wintering and nesting phases are restricted to the neritic domain or beaches, marine pelagic regions could accommodate migration routes beyond the neritic domain. It is during the migration phases that this species could be also present in the study area occupying an areal extent dropping down to over 800 m depth from a bathymetry of more than 200 m. In addition to the migration routes, juveniles in pelagic phase could be also potentially identified in the study area. Actually, the newborns leave beaches and spend the earliest years of their life in a basically pelagic environment within large current systems to move to the coastal feeding and wintering places at a more mature age. The pelagic fish diet at the initial stage progressively changes into a diet made up of coastal bentonic preys.

In the frame of this study, attention is focused on the migration processes and the juvenile pelagic phase rather than on the coastal feeding or reproduction and mating phases that do not involve in any way the study area.

4.3.2.1.3.2. Caretta caretta *migrations*

In the breeding period concentrated in the Summer months from mid June to mid September, the mature animals move from foraging to spawning areas and vice versa. Males are supposed to travel the Mediterranean every year, whereas females would mate every 2-3 years (Groombridge, 1990).

The available literature information lets assume a correlation between the turtle movements and the surface sea currents. Migration speed is generally constant both in favour of and against the current. The pelagic feeding activity occurs at a lesser speed and mainly in favour of the current.

During migration, the *Caretta caretta* turtles are generally alone to aggregate in the wintering and foraging areas. Small aggregation groups are seen in the mating areas (Carr, 1995).

Most populations migrate, but others are permanent residents as in Turkey, where at least a part of the individuals do not migrate (Geldlay,1984).

The literature data suggest that the turtle females nesting on the coasts of Greece tend to migrate to the foraging regions in the northern Adriatic Sea or in the Gulf of Gabès, whereas those nesting in Cyprus migrate to the Egypt coastal zones.

The data obtained via satellite telemetry during the post-spawning migration to foraging places indicate that the adults travel day and night at a constant speed up to achievement of their objectives. Swimming during migration occurs in the vicinity of the surface waters.

4.3.2.1.3.3. Pelagic juvenile phase of Caretta caretta

The newborns leave the beaches immediately after birth and start a long-term pelagic life period within large current systems. The earliest years of pelagic life are practically unknown and defined as "*the lost years*" by virtue of the objective difficulties in studying this biological phase. Only recently, some satellite telemetry studies in the Mediterranean provided information on movements of the juveniles in this period, which often showed a vagabond behavior crossing vast pelagic areas.

In this phase, the turtle juveniles prefer to be driven by the surface currents for their movements rather than swimming actively.

The available data allow neither to exclude nor to confirm the occurrence of current-driven juveniles in the study area. A recent study (Casale and Mariani, 2014) indicates that the turtle juveniles tend to remain located in the pelagic waters closer to the spawning area. Therefore, the juveniles born in the eastern seabord mainly live in the southern and central regions of the Mediterranean, whereas those born in the

Ionian Sea are distributed in the pelagic waters of the Ionian and Adriatic Sea. Though the most important spawning sites are located in the eastern basin (Greece, Turkey, Lybia and Cyprus), the Ionian Sea could host juveniles born in the Greek Ionian Islands and in the Ionian part of southern Calabria. The Ionian Sea is described by Casale (2010) as an important site for the juveniles in their earliest years of life.

4.3.2.1.3.4. Useful information for an assessment of the impact effects on the Caretta caretta *species (marine reptiles)*

Literature and action plans for the species conservation indicate the following human activities as **main threats** to the loggerhead sea turtle:

- Accidental takes in fishery activities (entanglement in pelagic driftnets and gillnets and trawling);
- Sea-side tourism and other activities having an impact on the nesting and spawning sites;
- Degradation of the nesting and spawning habitats.

The seismic survey is generally not reported as one of the main threats to the species. However, the ISPRA guidelines on the acoustic impact supported by scientific studies indicate "alert or escape attitude as quick reaction to the sound pulses from the *air gun.* Controversial results were obtained from monitoring activities carried out during seismic surveys. Notwistanding, many authors report a greater number of turtle sightings in periods of activity discontinuation.

The risk for the turtles to be entangled in the *streamers* used during the seismic survey works and stern towed by the boats is to be considered.

This study has highlighted the following **key elements**:

- The species migrations seem to be predominantly concentrated in late Spring (May-June) and late Fall (second half of September, October and November).
- The migrating animals generally move alone.
- The migrating animals swim day and night at constant speed and near surface.
- The study area could be visited by individuals moving from the Greek coasts to the foraging sites in northern Adriatic Sea (Fall) and from the northern Adriatic Sea to the Greek spawning sites (Spring).
- The Ionian Sea (and hence the Application for Exploration Permit area) could host pelagic juveniles born in the Ionian islands of Greece and Ionian part of southern Calabria.

The foregoing indicates a "moderate-high" sensitivity of the "marine reptiles – *Caretta caretta*" within this EIS.

4.3.2.1.4. Fishes and fish stocks of molluscs and crustaceans

Study area

The area investigated for the study of fishes and fish stocks of molluscs and crustaceans relating to the potential range of the impact effects on this biological component from the Project *activities is the Application for Exploration Permit Area (14 nautical miles from Santa Maria di Leuca –729 km² surface area) and a surrounding 3 km buffer area.*

4.3.2.1.4.1. General results

The deep-water fauna living off Santa Maria di Leuca has been scientifically investigated by the universities of Bari and Lecce (D'Onghia *et al.*, 2010, 2011, 2016; Mastrototaro *et al.,* 2010). D'Onghia *et al.* (2010) compared to fishes and fish stocks associated with the biocoenosis of the white corals to biocoenosis-free deep water fauna. The species indicated in the document plays a significant role for the study area. Actually, the bathymetric ranges investigated by D'Onghia and colleagues (300 m to 799 m) match those

of the Application for Exploration Permit area. Both areas are geographically close to each other and the white corals are present on the boundaries of the Application for Exploration Permit area and outside it in the western sector.

The available information lets assume that the species listed below are potentially present in the Application for Exploration Permit area and distributed in accordance with the typical densities of each species and the bathymetric range thereof. Moreoever, a greater concentration of most abundant or exclusive white coral species is expected at the central part of the western boundary of the Application for Exploration Permit area. Many authors think that the white coral zones serve as shelter areas for many species leaving more flat areas affected by intense trawling activities (D'Onghia *et al.*, 2010). Finally, a third area hosting the species listed hereinafter, though with a different distribution, could correspond to the northwestern sector of the Project area. 38 km^2 (corresponding to 5 % of the whole Application for Exploration Permit area) feature an escarpment that from abt. 200 m quickly drops down to a bathymetric range of 450-500 m. The morphological characteristics of this sector of the study area would allow hosting a more diversified fauna and observing a more abundant occurrence of the following species, specifically the blue and red shrimps (*Aristeomorpha foliacea* e *Aristeus antennatus)* among the fish stocks.

The following osteichthyes are the predominant fish population in the study area:

- *Phycis blennoides* (greater forkbeard) – it is likely to be one of the most abundant species in terms of density, particularly at central portion of the western edge of the Project area bordering white coral zones. Its occurrence is however also significant in the biocoenosis-free deep waters.
- *Micromesistius potassou* (blue whiting) – it is particularly abundant at the central sector of the western boundary of the study area.
- *Helicolenus dactylopteurs* (blackbelly rosefish) – it is abundant over the entire study area.
- *Caelorhincus caelorhincus* (blackspot grenadier) – this species is likely to be uniformely distributed over the entire study area.
- *Chlorophthalmus agassizii* (shortnose greeneye) – it is likely to be abundant over the entire Project area with more significant densities at the area western border.
- *Hymenocephalus italicus* (glasshead grenadier) – this abysall species dwells the entire study area and is likely to be more abundant in white coral-free deep water.
- *Merlucius merlucius* (European hake) – it seems to live in the entire area, however, its density is remarkably higher at the western border of the study area.
- *Capros aper* (boarfish) – it is present in the entire study area, but is substantially more abundant in the vicinity of the central sector of the western border.
- *Gadiculus argenteus* (silvery pout) – this small fish is potentially dwelling the entire study area at a significant density.
- *Conger conger* (European conger) – the European conger is potentially present in the entire study area.
- *Lepidorhombus boscii* (four-spot megrim) – this flat fish is potentially living in the entire study area and its density is likely to increase near the western sector.
- *Lophius budegassa* (blackbellied angler) – this species is potentially present over the entire study area.
- *Arnoglossus ruppeii* (Ruppel's scaldback) – this flat fish potentially dwells the deep water of the study area.
- *Molva dipterygia* (blue ling) – this species is potentially present over the entire study area.
- *Nezumia sclerorhynchus* (bluntsnout grenadier) – this species is potentially present over the entire study area. It prefers white coral-free zones
- *Mora moro* (common mora) – densities of this gadiform fish potentially present over the entire study area are quite low.
- *Trygla lyra* (piper gurnard) – This species is likely to be abundant near the western border of the study area (central sector), but is likely to be rearely present in deep water.

- *Trachyrincus scabrus* (roughnout grenadier) – this species is potentially present over the entire study area.
- *Pagellus bogaraveo* (blackspot seabream) – the blackspot seabream of significant commercial value almost exclusively lives in white coral regions (western border portion only) or in morphologically rough deep water (it could be also present in the escarpment area).
- *Polyprion americanus* (wreckfish) – this species is potentially present in the study area, though densities are lower.

The study area also potentially hosts some shark species.

- *Galeus melanostomus* (blackmouth catshark) and *Etmopterus spinax* (velvet belly) – they are the two most abundant cartilaginous fish species found in the entire study area with a major occurrence near the central sector of the western border.
- *Chimaera monstrosa* (rabbitfish) – this species is likely to be found in the entire study area, though densities are slightly lower than those of the above species. It is mostly concentrated near the central sector of the western border.
- *Leucaraja circularis* (sandy skate) – it is potentially present in the entire area, however, densities are negligible.
- *Hexancus griseus* (bluntnose sixgill shark), *Centrophorus granulosus* (gulper shark) and *Dipturus oxyrinchus* (sharpnose skate) – their low density occurrence is likely to be found near the western border of the study area.

A more exhaustive characterization of the Project area deep water requires the inclusion of the crustacean fish stocks such as *Aristeomorpha foliacea* (blue shrimp), *Aristeus antennatus* (red shrimp, potentially present in the escarpment area), *Macropipus tuberculatus* (knobby swimcrab) and *Nephrops norvegicus* (Norway lobster). The *Plesionika martia* and *Plesionika heterocarpus* shrimps and the *Parapenaus longirostris* rose shrimp are also potentially present on the western border of the study area and the escarpment area (northwestern sector of the study area).

The fish stocks include molluscs like the *Illex coindetii* (short-finned squid), the *Pcteroctopus tetracirrhus* octopus of the octopodidae family, the *Sepietta oweniana* (common bobtail squid) and the *Todaropsis eblanae* (lesser flying squid). This last species is likely to be more abundant on the western border of the study area.

In addition to the mainly demersal species mentioned above, the occurrence of pelagic species is expected in the water column of the study area. The main species of greater interest for fisheries are: *Engraulis encrasicolus* (European anchovy); *Sardina pilcardus* (European pilchard); *Xiphias gladius* (swordfish); *Coryphaena hippurus* (common dolphinfish), *Brama brama* (angel fish), *Sarda sarda* (Atlantic bonito); *Thunnus alalunga* (albacore) and *Thunnus thynnus* (Atlantic bluefin tuna). This last species could be present in the study area, specifically in the months of May/June when migrating to the Adriatic Sea.

None of the osteichthyes, cartaligineous fishes, crustaceans and cephalopod fish stocks mentioned above charcterizing the study area fish populations are listed among the nationally and internationally protected species.

4.3.2.1.4.2. Nursery *and* spawning *areas*

The abundance of juveniles in the *nursery* area on the western border of the study area and likely the escarpment area located northwest of the sector suggests according to many authors (D'Onghia, 2010; Mastrototaro, 2010) the presence of *nursery* grounds for the following species in particular, blackbelly rosefish (*Helicolenus dactylopteurs*), velvet belly (*Etmopterus spinax*), European hake (*Merlucius merlucius*), blue whiting (*Micromesistius potassou*) and greater forkbeard (*Phycis blennoides*).

A *nursery* area for the rose shrimp (*Parapenaeus longirostris)* was identified on the basis of the data available on the *nursery* areas in the northern Ionian Sea and specifically of the probability indices for *nursery* area identification (Colloca *et al.*, 2015; SIBM, 2012) northwest of the study area (at the borders of the Application for Exploration Permit area), at the continental shelf waters (thus at lower bathymetric

ranges than the Application for Exploration Permit area). An important *nursery* area for the *Merlucius merlucius* species (hake) can be found also outside the study area in northwestern direction in addition to the western boundary of the study area and the escarpment area. According to the literature (*Mediterranean Sensitive Habitats*, 2013), a greater concentration of hake juveniles is found in deep water at a bathymetric range of abt. 250 m (thus close to, however, outside the Application for Exploration Permit Area).

Videos recorded by researchers of the Bari University show a given abundance of the juveniles of the *Pagellus bogaraveo* species (blackspot seabream) at areas with white coral colonies. This species is known to dwell waters nearer to the coastline at the early juvenile stage and reach greater depths at mature age. Juveniles found close to white coral banks could be either individuals preferring deep water as an alternative to the coastal areas in the early life stages or older juveniles moving to deep water after living under coast during their early life stages.

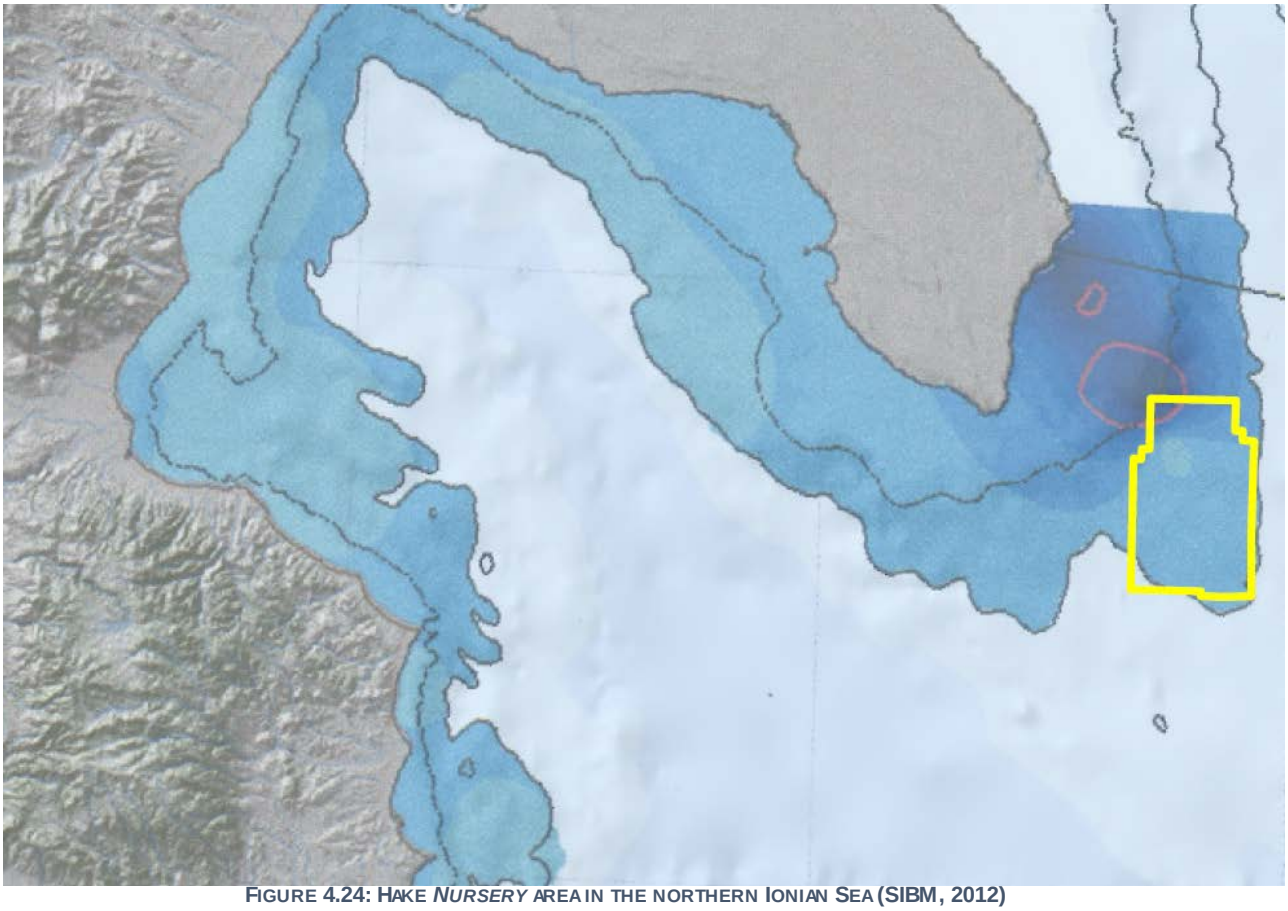


FIGURE 4.24: HAKE *NURSERY* AREA IN THE NORTHERN IONIAN SEA (SIBM, 2012)

The central part of the western border of the study area could also be a ***spawning*** ground for some species**.** Specifically, the occurrence of many mature individuals of the blackbelly rosefish (*Helicolenus dactylopteurs)* would suggest a role of *spawning* ground played by the white coral biocoenosis for at least this species (D'Onghia, 2010; Mastrototaro, 2010). Spawning of this species is concentrated in the Winter months, specially January and February (Muñoz and Casadevall, 2002) with multiple clutches.

4.3.2.1.4.3. Useful information for an assessment of the impact effects on fishes and molluscs and crustaceans fish stocks

The most **important threats** to the fishes and molluscs and crustaceans fish stocks include fisheries activities, pollution and development of the coastal anthropogenic system.

Though the **seismic survey** is not reported to be one of main threats to the fish stocks, it can however produce an adverse effect on fishes and fish stocks.

Fishes perceive the water noise through both the ear (otolith and swim bladder) and the lateral line. Also molluscs and crustaceans have noise perception organs. Sound may be used by fishes, molluscs and crustaceans with special reference to the fish stocks above for perception of prey and predator presence, orientation and communication.

Sensitivity varies from species to species and depends on distance from the seismic source. Most fish species are sensitive to low frequencies. For example, bony fishes seem to be sensitive to sounds at a frequency ranging 100 Hz to 2 kHz (ISPRA Guidelines, Part I).

Sounds are also important for crustaceans fish stocks in deep water. For example, it seems that sensitivity to sounds having a frequency ranging 30 Hz to 250 Hz allows deep-water crustaceans to identify preys or food descending the water column up to 100 m distance (ISPRA, 2012).

This study has highlighted the following **key elements** affecting fishes and molluscs and crustacean fish stocks:

Time. Critical periods for some species may be identified. The bluefin tuna could be seen in the migration transit areas to the Adriatic Sea in May-June. The blackbelly rosefish, which is abundant in the area, spawns between January and February. The hake juveniles are more abundant in winter and autumn, however its occurrence is observed all year round. Juveniles of the *Etmopterus spinax* shark are more abundant in the spring season.

Space. Information collected on fishes and molluscs/invertebrate fish stocks (summarized in paragraphs above) allows to identify three areas within the study area:

- Area around the western border of the study area characterized by the abundance of many bony fish species due to the presence of the white coral biocoenosis and a greater concentration of sharks. Mastrototaro *et al*. (2010) have identified 40 different demersal fish species in the white coral banks off Santa Maria di Leuca. This area also accommodates some *nursery* grounds (for example, for the blackbelly rosefish and blackmouth catshark). This area could also be a *spawning* area for the blackbelly rosefish. This is a high sensitivity area.
- Area northwest of the study area characterized by rough seabeds (escarpment) sharply declining from a bathymetric range of 200 m to that of abt. 450 m. As the above area, also this area is peculiar in terms of species abundance and hosts *nursery* grounds for osteichthes and crustaceans species. This is moderate sensitivity area.
- The rest of the study area hosting a typical fauna of the Ionian Sea deep water, specially in its eastern sector, is known to be affected by trawling. This is a low sensitivity area.

4.3.2.1.5. Benthic fauna

Study area

The area investigated for the study of the benthic fauna relating to the potential range of the impact effects on this biological component from the Project activities is the Application for Exploration Permit Area (14 nautical miles from Santa Maria di Leuca –729 km^2 surface area) and a surrounding 3 km buffer, similarly to what discussed in the chapter above.

4.3.2.1.5.1. General results

The study area has different morphological characteristics and benthic assemblages and can be divided into three different zones at least:

- Area around the western border corresponding to the eastern boundary, where the occurrence of white coral colonies was documented (4 km^2) (Mastrototaro, 2010; Taviani *et al*., 2004);

- Area northwest of the study area characterized by continental slope deep water declining from a bathymetric range of 200 m to that of abt. 500 m (38 km^2).
- Rest of the study area with predominantly flat seabeds declining from abt. 500 m depth to abt. 900-1,000 m depth with 1% average slope (889 km^2).

These three areas being remarkably different, the benthic fauna is separately discussed for each area.

The area around the western border of the study area deserves a more in-depth investigation and relies on many data obtained from the researches carried out in the area by the researchers of the Universities of Bari and Lecce. The presence of white coral colonies promotes the development of a rich benthic fauna thanks to creation of a three-dimensional environment encompassing many space niches. Colonies form small reliefs of abt. 5-7 m dia. and 10 m lower height (Taviani et al 2004). The studies undertaken in this area and the adjacent seabeds (sector southwest of the area) report the presence of the following benthic species (Mastrototaro, 2010):

- 31 coral species (6 Gorgonians, 2 Antipatharians, 6 Actiniaria, 6 Scleractinian, 1 Zoantharia, 1 Scyphozoa e 9 Hydrozoa). The six Scleractinia species include Madrepora oculata, *Lophelia pertusa*, *Dendrophyllia cornigera*, Desmophyllum dianthus, Stenocyathus vermiformis and *Caryophyllia calveri*;
- 36 Poriferi species among which the most common are *Desmacella inornata*, *Poecillastra compressa*, *Sceptrella insignis*, *Erylus papulifer* and *Thrombus abyssi*;
- 35 molluscs species (8 gasteropods, 14 bivalve molluscs, 1 scaphopod and 12 cephalopods). The 12 cephalopods also include the species already previously described in the fish and molluscs/crustaceans fish stocks);
- 24 anellid species;
- 23 crustacean species included in some fish stocks already discussed such as *Aristaeomorpha foliacea*, *Aristeus antennatus*, *Nephrops norvegicuse*, *Parapenaeus longirostris*;
- 19 bryozoan species;
- 2 brachiopod species ;
- 9 echinoderm species (1 Asteroidea, 4 Echinoidea, 2 Holothuroidea, 1 Ophiuridae).

Some of the coral species found like the Madrepora oculata and *Lophelia pertusa* enter in the IUCN red list as Critical Risk species. Others are categorized as Vulnerable (VU) like the *Dendrophyllia cornigera* and *Desmophyllum dianthus* corals. The *Madrepora oculata* and *Lophelia pertusa* species are included in the list of threatened species in Annex II to the SPA Protocol (Barcelona Convention).

No specific studies on the **escarpment area at northwestern corner of the study area** were found. Instead, information is available on the fauna including the benthic one observed in the Bari canyon at abt. 200 km further north (Angeletti *et al.*, 2014; D'Onghia *et al.*, 2014) and the canyon off Tricase (Angeletti *et al.*, 2014), located at abt. 10 km further north than the exploration area.

The morphological characteristics of this area and its relative vicinity to both canyons above allow to make assumptions on benthic populations at northwestern corner of the study area. No specific researches were undertaken in this area.

The Madrepora oculata coral is likely to be present in the escarpment deep sea, specifically in morphologically diversified areas, if any, however, colonies are smaller and much rare (Angeletti *et al.,* 2014) compared to the area previously discussed and known to host white coral banks (area around the western border of the study area). The coral species could also include *Dendrophyllia cornigera* and *Lophelia pertusa*. *Peachia* anemones belonging to the same cnidarian group are likely to be present. In the slope seabeds, corals may come along with massive sponges like *Pachastrella monilifera* and *Poecillastra compressa* and serpulids like *Serpula vermicularis.* The echinoderms that are more likely present are the *Cidaris cidaris and Echinus melo* species*;* the occurrence of crustaceans may include the *Plesionika martia* shrimp and *Paromola cuvieri* crab in addition to the fish stocks already listed in the previous paragraph like *Aristeomorpha foliacea, Aristeus antennatus* and *Parapenaus longirostris*. The molluscs present may include *Spondylus gussonii, Bathyarca philippiana* and *Asperarca nodulosa.*

Also this area as that above is potentially likely to host some coral species like the *Madrepora oculata* and *Lophelia pertusa* entered in the IUCN red list as Critical Risk species. The slope area could be a biodiversity hotspot , should high structurally complex zones or sectors be present.

The remaining vast area characterized by predominantly flat seabeds between 500 and 800 to 1,000 m bathymetric ranges does not seem to be covered by ad-hoc researches. Thus, considerations on the benthic fauna are supported by morphological features and bathymetric ranges, information supplied and assumptions made by local experts and data obtained from a study of Capezzuto et al 2010 on bathyal seabeds of the northern Ionian Sea. Some scientific fishing campaigns included in the Ground, Medits and Aplabes programmes and discussed in the Capezzuto's (2010) study are conducted inside or in the vicinity of the study area. Available information however mainly relates to the fish stocks rather than benthos.

This area may host species associated with the biocoenosis of bathyal muds such as *Antalis agile* and *Entalina teragona* scapopods, *Thenerea muricata* and *Pheromena carpenteri* sponges, *Funiculina quadrangolaris and Isidella elongata* cnidarians, *Odonaster mediterraneus, Brisingella coronata and Brissopsis lyrifera* echinoderms *Triticellopsis tisseri* bryozoan and crustaceans of interest for fisheries like *Aristeomorpha foliacea* and *Aristeus antennatus* shrimps.

The *Funiculina quadrangolaris and Isidella elongata* species may become dominant and form *facies*.

It is known that this species aggregation previously described is often severly damaged and affected by trawling in deep sea with bathyal muds. It is likely that the southeastern sector of the study area has been more severly affected by trawling. According to testimonials, trawling is carried out using boats from Leuca fishing facilities mainly and from other near fishing facilities occasionally. It is therefore likely that the southwestern sector of the study area is characterized by the species above to a strongly reduced extent and that the *Funiculina quadrangolaris and Isidella elongata facies* are a few or totally failing. Both species are classified as Critical Risk species by the IUCN.

According to some authors (Angeletti *et al.*, 2014), the portion nearer to the escarpment could also theoretically host white coral colonies in addition to the species typically living in bathyal mud deep sea habitat and be characterized by the same species seen in the area around the western margin of the study area. Some authors (Angeletti *et al.*, 2014) assume that the white corals form a continuous strip running parallel to the coast and composed of white corals existing south of Santa Maria di Leuca and white coral populations found in the Adriatic Sea off Tricase and further north in the Bari open sea. Such assumptions are not supported by study campaigns and field data.

4.3.2.1.5.2. Useful information for an assessment of the impact effects on benthos

Trawling is the first i**important threat** to benthos followed by pollution (chemical, debris) and dumping of dragged sediments that could damage benthic assemblages.

The **seismic survey** is not normally treated as one of main threats to deep sea benthic communities. It should however be pointed out that many marine invertebrates use or perceive acoustic signals according to the phylum and the species. The crustacean species has internal mechanoreceptors capable of perceiving acoustic vibrations. The cnidarians seem not to respond to acoustic stimuli, apart from anemones that perceive noise generated by a prey swimming nearby. Information on bivalve molluscs and gastropods is a few.

The report on the workshop held in Dublin on 2014 dealing with "*Cold-water corals and offshore hydrocarbon exploration operations on the Irish Atlantic Margin*" provides information on seismic operations and vulnerability of previously discussed *Lophelia* sp. and *Madrepora* sp. white corals as most interesting benthic species in the study area.

Some case studies on monitoring before and after sound detection demonstrated that corals and associated species did not suffer negative effects. There is however a threshold defined by Hastings *et al.* (2008), beyond which sound may cause a physical damage to the octopus colonies and their structure.

This study highlighted the following **key elements** for benthos:

According to the information gathered, the study area can be subdivided into three distinct benthos zones having different sensitivity levels:

- Area around the western border of the study area characterized by the presence of white coral colonies and benthic fauna associated therewith. This area is marked as of high sensitivity.
- Area northwest of the study area characterized by the escarpment deep sea, where some white coral colonies and relatively diversified benthic communities may be present, if canyon-affected rougher sectors exist. This area is marked as of medium sensitivity .
- A remaining portion of the study area with species typically living in bathyal mud deep sea as indicated by the available data. This area shows a more degraded and impoverished southeastern sector affected by trawling campaigns and a less degraded northweastern sector, where some authors assume the unproven occurrence of white coral colonies. This area is marked as of low sensitivity.

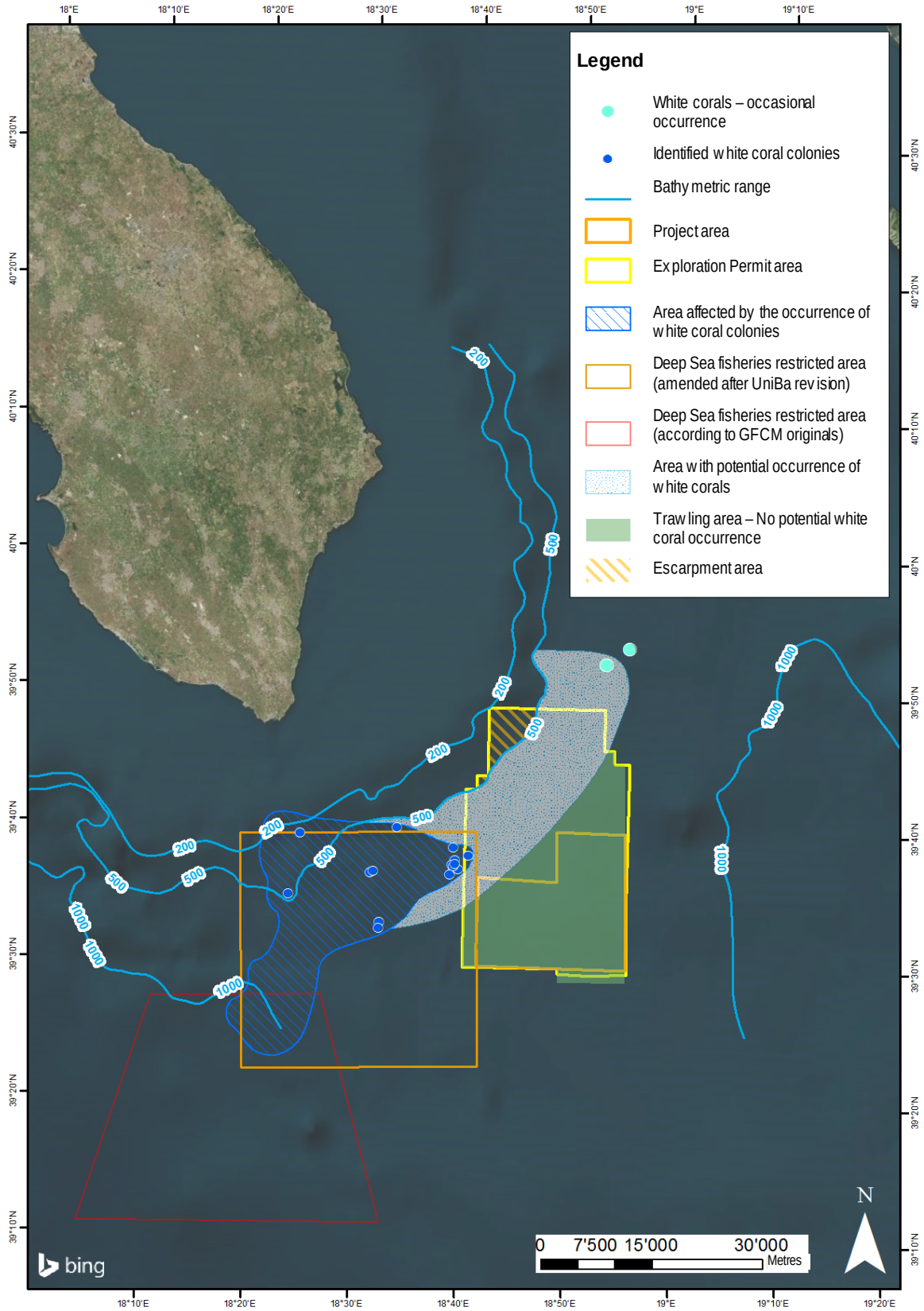


FIGURE 4.25: BENTHOS VULNERABILITY (SOURCE: INFORMATION OBTAINED FROM THE SCIENTIFIC LITERATURE PREVIOUSLY CITED AND GIS PROCESSED BY GOLDER)

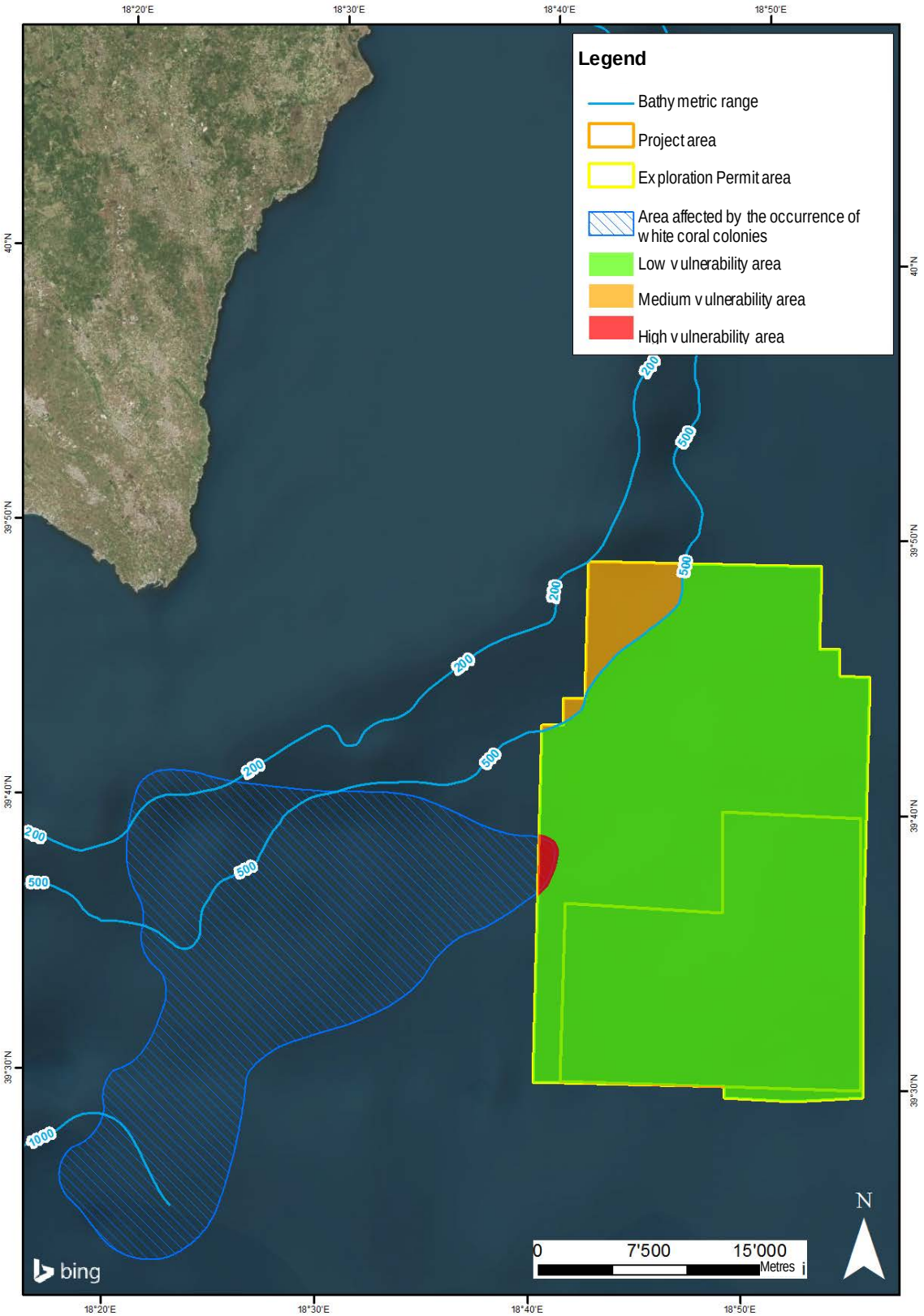


FIGURE 4.26: DIFFERENT BENTHOS SENSITIVITY AREAS BASED ON AVAILABLE DATA AND INFORMATION SUMMARIZED IN THE FIGURE ABOVE

4.3.2.1.6. Zooplankton e phytoplankton

Study area

The area investigated for the study of the phytoplankton component relating to the potential range of the impact effects on this biological component from the Project activities is the Application for Exploration Permit Area (14 nautical miles from Santa Maria di Leuca –729.020 km² surface area) and a surrounding 3 km buffer, similarly to fishes and benthos discussed in the chapters above.

Phytoplankton are living organisms that passively drift along waves and currents. They are divided into two classes including photosyntetic autotrophic organisms capable of self-nourishment by using organic materials (phytoplankton) and heterotrophic animal organisms (zooplankton).

Phytoplankton is the base of aquatic food webs.

The Adriatic basin is strongly affected by seasonal changes due to supply of fresh water from the Po basin introducing large amounts of nutrients and determining seasonal variations in the water circulation (Artegiani *et al.*, 1997) and ecosystem structure and functionality as well (Zavatarelli *et al.*, 1998). The fresh water transporting nutrients flows along the western coastline of the Adriatic Sea till it reaches the central sector and then the southern sector, where the influence of the fresh water flow and its dynamics on the water column is generally more evident in autumn.

A study undertaken by Sabetta *et al.* (2004) in the southern region of the Adriatic Sea and northern region of the Ionian Sea indicated that the distribution variations associated to the size and abundance of the nanophytoplankton and microphytoplankton are relatively independent from the taxonomic composition. Specifically, this study identified 320 *taxa* of nano- and microphytoplankton. The dominant groups were characterized by Bacillariophyceae and Dinophyceae. Coccolithophores occurrence was minor. The taxonomic richness resulted to change in the various seasons, from max. 221 *taxa* in June to min. 98 *taxa* recorded in March.

The more representative *taxa* with indication of the detection month are reported below (Table 4.5).

TABLE 4.5: *TAXA* OF IDENTIFIED PHYTOPLANKTON

March	June	September	December
Guinardia striata	Dinoflagellate athecate > 20 µm	Phytoflagellates undetermined	Cryptoficeae undetermined
Pseudo-nitzschia seriata	Phytoflagellates undetermined	Dinoflagellate athecate < 20 µm	*Thalassionema nitzschioides*
Chaetoceros closterium	Dinoflagellate athecate < 20 µm	Cryptoficeae undetermined	*Pseudo-nitzschia delicatissima*
Dictyoca fibula	*Pseudo-nitzschia sp.*	*Gymnodinium* sp.	*Cylindrotheca closterium*
Thalassionema nitzschioides	*Nitzschia sp.*	*Plagioselmis* spp.	*Navicula transitans*
Thalassiosira guillardii	*Chaetoceros sp.*	*Pseudo-nitzschia sp.*	*Thalassionema frauenfeldii*
Dinoflagellate athecate > 20 µm	*Amphidinium acutissimum*	*Nitzschia sp.*	Dinoflagellate athecate < 20 µm
Guinardia flaccida	*Pseudo-nitzschia seriata*	*Chaetoceros closterium*	*Chaetoceros rostratus*

The different nutrients distribution involves a different concentration of the phytoplankton biomass. As reported by D'Ortenzio and Ribera d'Alcalà (2009), this means an average chlorophyll α concentration (chl α) which is reduced at the first optical depth, viz. at a depth where irradiance decreases by 63% (Figure 4.27).

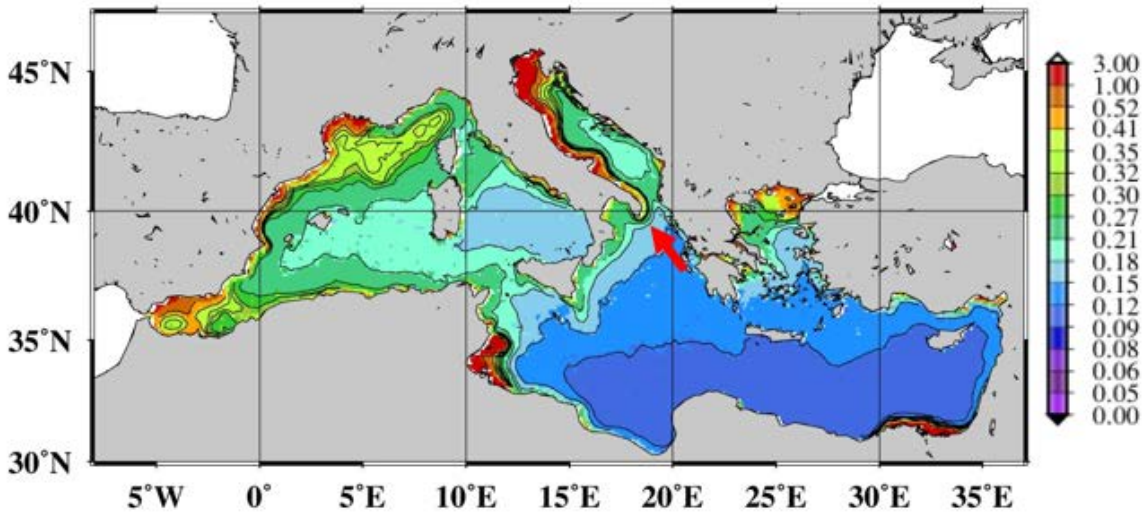


FIGURE 4.27: CHLOROPHYLL A (CHL A) SPATIAL DISTRIBUTION FROM SATELLITE IMAGE (D'ORTENZIO E RIBERA D'ALCALÀ, 2009)

In this study, a satellite-based measurement of the phytoplankton concentration was performed to measure the chlorophyll a concentration in the water column. In the northern Ionian Sea region, the chlorophyll concentration value appears to be homogeneous with variations from 0.21 µg/l to 0.30 µg/l. The study area is located in an area where the chlorophyll values range from 0.18 µg/l to 0.21 µg/l and the chl α values are average values often associated to high nutrients supply from fresh water as previously discussed.

Zooplankton are the heterotrophic animal plankton composed of a large variety of organisms which spend their entire life cycle in a pelagic zone (holoplankton) or only a part of their life (meroplankton).

The zooplankton distribution shows high local variability with remarkable spatial changes even during the same season (Nival *et al.*, 1975).

Most epipelagic mesozooplankton in the Mediterranean open sea are concentrated in the first 100 m of the upper layer and sharply decrease beyond this depth (Scotto di Carlo *et al.*, 1984; Weikert e Trinkaus, 1990; Mazzocchi *et al.*, 1997). A campaign conducted in the northern Ionian sea in the spring of 1999 revealed an average biomass value of 7.9 mg/m^3 (in a range from 4.4 to 13.4 mg/m^3) in the first depth layer down to 100 m (Mazzocchi *et al.*, 2003). In April 1990, a value of 0.1 to 7.4 mg/m^3 was measured in the first 50 cm depth of southern Adriatic Sea (Fonda Umani, 1996).

The taxonomic composition of the epipelagic mesozooplankton communities is highly diversified, the copepods being the largest members in terms of abundance and biomass. Copepods with a total length of less than 1 mm are the dominant species of the mesozooplankton communities in the Mediterranean Sea and along the coastline (Calbet *et al.*, 2001). Most epipelagic biomass consists of Calanoids (*Clausocalanus* and *Calocalanus*, along wigh *Ctenocalanus vanus*) and Ciclopods (*Oithona*, Oncaeides, Corycaeides). Many species belonging to this group show distinct spatial distribution profiles along the water column and in the different seasons, suggesting different ecologic characteristics. Though their populations widely overlap, peaks of *Clausocalanus paululus*, *C. pergens*, *C. arcuicornis* and *C. furcatus* in the Ionian Sea were reported (Siokou-Frangou *et al.*, 2010).

A strong occurrence of the *Nyctiphanes couchi* of the Euphausiacea order was observed in the study area supplying surface nutrients to cetaceans (Canese *et al.* 2007).

Some survey campaigns within the CoCoNet (Coast to Coast NETworks) Project (Guglielmo *et al.,* 2013), were conducted in the southern Adriatic Sea offshore Santa Maria di Leuca in October 2000 and April-May 2001. The results indicated that zooplankton predominantly consist of holoplankton in both seasons with increasead meroplakton contribution in spring due to the occurrence of bivalve larvae and polychaetes. Adults of *Clausocalanus furcatus, Temora stylifera, Paracalanus parvus* and *Acartia clausi* were mostly found.

The occurrence of white coral colonies is reported in the vicinity of the western margin of the study area (mainly Scleractinia corals of the *Madrepora oculata* and *Lophelia petrusa* species). According to the available studies, the occurrence of zooplankton consisting of Copepods, Euphausiacea, Cumacea and Chaetognatha families around the coral colonies is abundant, *taxa* described as nourishment source for deep sea Scleractinia corals (Mastrototaro *et al.*, 2011). Specifically, the following larval forms could be present:

- *Alpheus platydactylus* (decapod larvae);
- *Pandalina profunda* (decapod larvae);
- *Stylocheiron* sp. (Euphasiacea);
- *Aristaeomorpha foliacea* (decapod larvae);
- *Aristeus antennatus* (decapod larvae);
- *Bathynectes maravigna* (decapod larvae);
- *Nephrops norvegicus* (decapod larvae);
- *Parapenaeus longirostris* (decapod larvae);
- *Munida intermedia* (decapod larvae);
- *Munida tenuimana* (decapod larvae);
- *Flaccisagitta hexaptera* (chaetognatha larvae).

4.3.2.1.6.1. Information for an assessment of the impact effects on phythoplankton and zoo plankton

Plankton play a key role in the dynamics of marine ecosystems and has a decisive influence on control of the sea physical processes. Data on phythoplankton and zooplankton vulnerability to the discussed Project activities are limited, however, the literature studies indicate a vulnerability of the fish eggs and larvae to the acoustic waves in the geophysical prospection (Payne *et al.*, 2009; Kostyuchenko, 1973).

The foregoing indicates a “moderate-high” vulnerability of the “phythoplankton and zooplankton » within this EIS.

4.3.2.1.7. Biocoenosis

Study area

The area investigated for the biocoenosis study is the Application for Exploration Permit Area ((14 nautical miles from Santa Maria di Leuca –729 km² surface area) and a 3 km surrounding buffer*, similarly to what defined for the benthic component.*

The following benthic biocoenoses can be identified in the study area according to discussions in the chapters above, specifically paras. 4.3.2.1.4 and 4.3.2.1.5 relating to the fish fauna and molluscs and crustaceans fish stocks:

- **Deep sea coral (or white coral) biocoenosis.** This biocoenosis marginally affects an approx. 4 km² surface of the study area at its western border including a *buffer* surrounding the mapped

colonies. Biocoenosis is a marine biodiversity hotspot being protected and represents a *nursery* and *spawning* ground for many fish and crustacean fishes according to many authors..

- **Escarpment habitat.** The biocoenoses in the escarpment habitat are a matter of ongoing scientific interest particularly in the past decades by virtue of the state-of-the-art exploration technologies. The deep sea sediment consists of argillaceous mud that may become fluid at sharp slopes and canyons. These biocoenoses are attributable to often rich and diversified bathyal mud biocoenosis thanks to the morphology of the seabed and the presence of currents. They may be affected by coral colonies and host a crustacean fauna, in which *Aristeomorpha foliacea* (blue shrimp) and *Aristeus antennatus* (red shrimp) prevail. At the canyon zones they are partly similar to the white coral biocoenosis and may also host the same madrepores species characterizing the white coral biocoenosis though to a reduced extent and the presence of smaller colonies. To the current knowledges, canyons do not seem to be present in the escarpment area within the study area. We cannot exclude that the upper edge of the escarpment accommodates areas at a depth of 300 m that can be assimilated to the offshore detritus. The escarpment habitats are deemed of interest for conservation and considered as a *nursery* ground for many fish and crustacean species. They affect abt. 38 km^2 of the study area.
- **Biocoenosis of reduced slope or flat bathyal mud.** The deep sea is characterized by argillous compacted or wet mud potentially hosting *Isidella elongata* compacted mud *facies* or *Funiculina quadrangularis* wet mud f*acies*. In consideration of the trawling activities in at least a good portion of the study area, the existence of these *facies* is unlikely or very limited to the few areas not impacted by trawling. A quite low density distribution of this biocoenosis species is often observed. Biocoenosis also distinguishes for homeothermy (below 13 °C) and a quite total absence of light.

The pelagic habitat also deserves consideration. The marine biocoenosis classification is mainly hystorically based on benthic components, however, the need of considering the pelagic biocoenoses is gradually gaining recognition in the last years, specifically in scientific environments.

- Water in the study area (pelagic habitat) is characterized by a special current regime, is a meeting and transition point of three important water masses (see para. 4.3.1.2.1), is potentially dwelled by 4 different cetacean species, is a migratory route for the C. caretta turtle and hosts big pelagic fishes among which the bluefin tuna on a seasonal basis. This leads to classify the pelagic habitat of the study area as highly vulnerable.

4.3.2.1.7.1. Useful information for an assessment of the impact effects on biocoenoses

Fisheries (trawling) first and then pollution are the **most important threats** to the marine biocoenoses in the study area.

The seismic survey is not a threat to the study area biocoenoses as reported in the literature and highlighted for fishes and benthos. Some species and larval stages may be more or less vulnerable to the acoustic waves potentially disturbing the biocoenoses.

The different biocoenosis distribution in the study area creates **three differently sensitive zones and a pelagic habitat:**

- High sensitivity area around the western border characterized by deep sea coral (or white coral) biocoenosis;
- Medium sensitivity area northwest of the study area with escarpment habitats (high slope bathyal mud biocoenosis);
- Medium-low sensitivity area with reduced slope or flat bathyal mud biocoenosis;
- High sensitivity pelagic habitat due to its current regime and presence of a diversified pelagic fauna.

4.3.2.1.8. Protected and restricted areas

Study Area

The area investigated for the study of protected and restricted areas is the Application for Exploration Permit area (14 nautical miles from Santa Maria di Leuca - 729 km² surface area) and a surrounding 60 km buffer *including the Salento Peninsula coastline.*

The Application for Exploration Permit area does not include any regional, national or international protected area. The Salento peninsula is 12 nautical miles far from the Application for Exploration Permit area and is characterized by the presence of many protected and Natura 2000 sites as described hereinafter.

4.3.2.1.8.1. Marine Protected Areas

Two Marine Protected Areas (MPAs) are present in the study area, viz. the Torre Guaceto MPA (EUAP0169 code) located in the Brindisi and Carovigno municipalities (BR), which coincides with the "Torre Guaceto" Marine Nature Reserve, and the Porto Cesareo MPA (EUAP0950 code), coinciding with the "Porto Cesareo" Natural Marine Protected Area (Figure 4.28). Both MPAs are also designated as Specially Protected Areas of Mediterranean Importance (SPAMI) by the Protocol relating to the Specially Protected Areas and Mediterranean Biodiversity (SPA Protocol) in the frame of the Barcelona Convention in 1978.

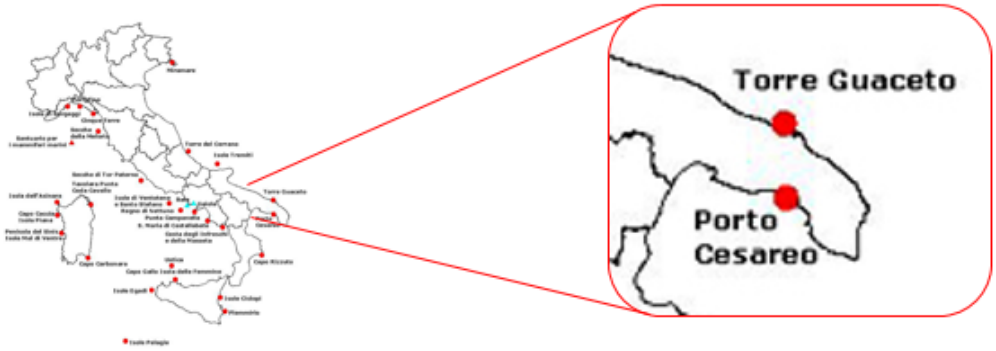


FIGURE 4.28: MARINE PROTECTED AREAS WITHIN THE PUGLIA STUDY AREA (MPA - HTTP://WWW.MINAMBIENTE.IT/PAGINA/AREE-MARINE-PROTETTE)

As reported in the website of the Ministry for Environment and Land and Sea Protection (MATTM), an area in the northern Ionian Sea close to the Project Area is being created and denominated "Salento Peninsula coastal Marine Protected Area". The assessment process requires for the 48 Habitat sites listed in the laws Nos. 979/82 art. 31 and 394/91 art. 36. This site should be approximately 14 nautical miles far from the Project area.

Micheli *et al.* (2013) report that the site off Santa Maria di Leuca coastline (Figure 4.29) and contiguous to the Project area hosts deep sea white coral colonies. This site makes part of a number of Mediterranean marine areas defined as "priority areas" for implementation of the conservation measures.

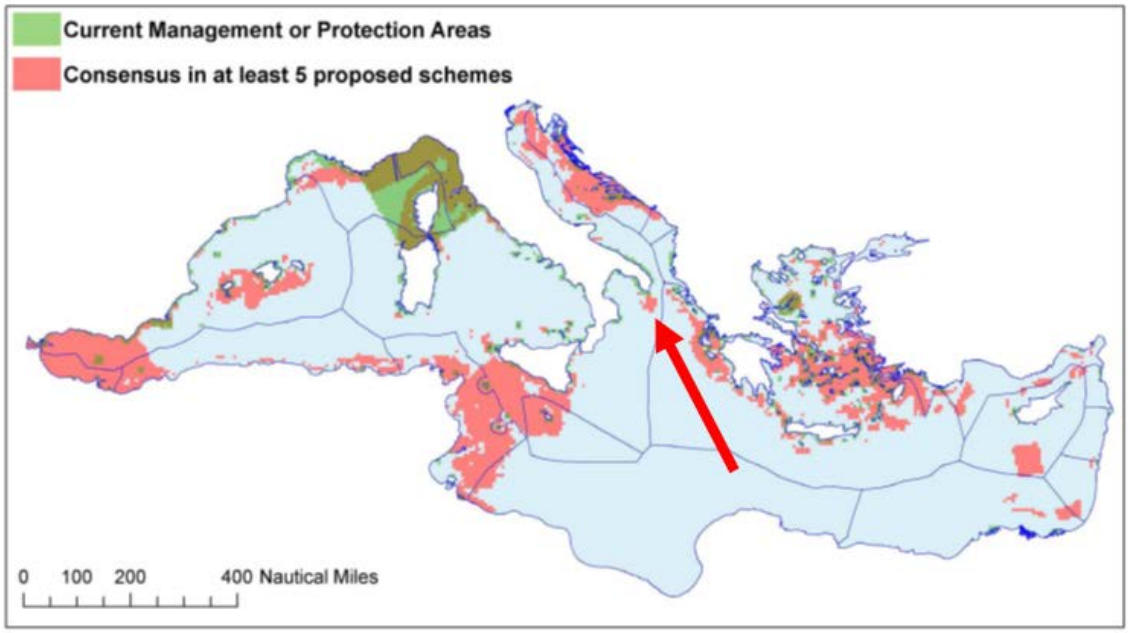


FIGURE 4.29: OVERLAPPING BETWEEN THE EXISTING PROTECTED AREAS (GREEN) AND THE PROPOSED PRIORITY CONSERVATION AREAS (ROSE) (MICHELI *ET AL.*, 2013)

According to a comparison with the international conservation plans made by Micheli et al (2013) , 5 out of 12 analyzed conservation schemes (WWF, EBSA, Fisheries Restricted Areas, CIESM, GreenPeace, Oceana MedNet, ACCOBAMS. Cumulative Impact Map, Vulnerable habitats (de Juan & Lleonart, 2010), Fish Biodiversity (Mouillot *et al.*, 2012), Important Sea Bird Areas (Requena & Carboneras, 2010) e Conservation concern areas (Coll *et al., 2012*) indicate that the marine area bordering the Project area is a top priority for conservation.

4.3.2.1.8.2. Natura 2000 areas, Important Bird Areas *(IBA) and protected coastal areas*

The following Natura 2000 sites (Sites of Community Importance (SCI) and Specially Protected Areas (SPA) and Parks established in the marine coastal and land area have been identified:

- Marine SCI "Posidonieto Capo San Gregorio – Punta Ristola" (identification code: IT9150034);
- Marine SCI "Litorale di Ugento" (identification code: IT9150009);
- Marine SCI "Litorale di Gallipoli e Isola di Sant'Andrea" (identification code: ITA9150015);
- SCI "Costa tra Capo d'Otranto e Santa Maria di Leuca" coinciding with IBA (Important Bird Areas) under the same designation.
- Natural Regional Park "Costa Otranto - Santa Maria di Leuca and Bosco di Tricase" embracing some SCIs like "Costa Otranto – Santa Maria di Leuca (IT9150002), "Boschetto di Tricase" (IT9150005) and "Parco delle querce di Castri" (IT9150019);
- Natural Regional Park "Litorale di Ugento".

The Figure 4.30 shows location of the above areas to the Application for Exploration Permit area. As shown, the minimum distance between the Project area and the external bounderies always exceeds 12 nautical miles as defined in the Law Decree No. 152/2006 as amended and supplemented for conservation of the natural protected areas against potential interferences with the seismic prospection activities.

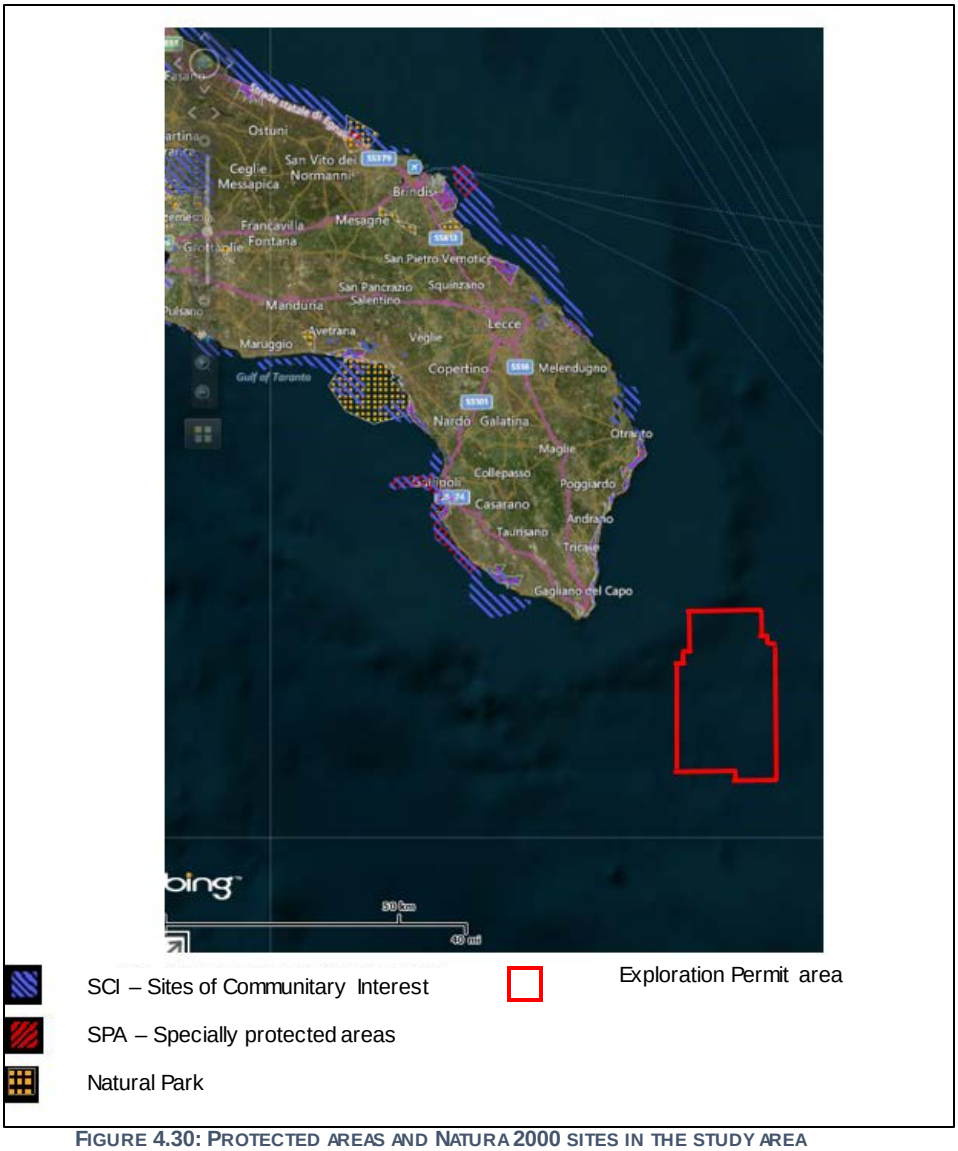


FIGURE 4.30: PROTECTED AREAS AND NATURA 2000 SITES IN THE STUDY AREA

4.3.2.1.8.3. Information for an assessment of the impact effects on the protected areas

Vulnerability of the protected and restricted areas is based on their capacity to maintain biodiversity intrinsic values the areas have been designed for. Any activity carried out within the study area that might interfere with the site integrity or any activity performed outside the site boundaries that could indirectly impact on the site failing management or control by Management Plans or responsible bodies is a threat interfering with the site ecologic processes.

The foregoing indicates a "high" sensitivity of the protected and restricted areas within this EIS.

4.3.3. Social and economic components

4.3.3.1. Fisheries

Study area

The study area investigated for fisheries is the Application for Exploration Permit area and a surrounding 3 km buffer.

4.3.3.1.1. Fisheries general considerations

The Mediterranean Sea basin has been object of in-depth studies on fisheries. Thus, type and quality of the data available for the study area is good, even though the most recent data date back to some years ago. Moreover, data sometimes refer to regional situation and sometimes to geographic area or sub-area. This means that data are not always comparable.

The General Fisheries Commission for the Mediterranean consisting of 23 Member Countries along with the European Union has drawn up a FAO-approved subdivision of the Mediterranean, where the northewestern part of the Ionian Sea corresponds to the Geographic Sub-Area No. 19 (GSA) (Figure 4.31).

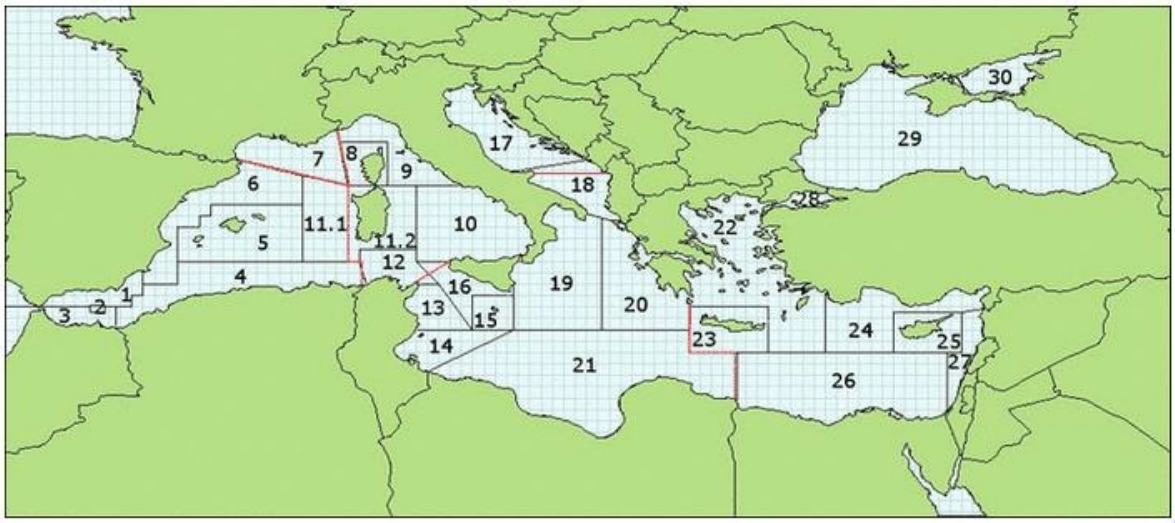


FIGURE 4.31: MEDITERRANEAN SUBDIVISION INTO GEOGRAPHIC SUB AREAS (GSA) (GENERAL FISHERIES COMMISSION FOR THE MEDITERRENEAN – GFCM)

The GSA No. 19 covers a 16,500 km^2 area over a bathymetric range from 10 to abt. 800 m including more than 1,000 km of Puglia, Basilicata, Calabria and Sicily coasts, from Capo d'Otranto (Lecce) to Capo Passero (Syracuse). This area accommodates 8 maritime Districts.

The Ionian Sea and most Mediterranean rely on oligotrophic habitats (Rabitti *et al.*, 1994).

White coral formations in the bathyal plain off Santa Maria di Leuca at a depth of 350 to 1,100 m from the western boundaries of the Project area extend west- and eastwards over a 900 km^2 surface area. More than 220 species have been identified in this area and many of them of even commercial interest offer shelter, food resources, spawning and recruitment sites.

The most important demersal resources in the study area include lobsters (*N. norvegicus*) along a wide bathymetric gradient and bathyal red shrimps (*A. antennatus* e *A. foliacea*) along the escarpment. Other species of commercial interest include anglers (*Lophius piscatorius* and *Lophius budegassa*) along a wide bathymetric gradient, greater fork-beard (*Phycis blennoides*), blackbelly rosefish (*Helicolenus*

dactylopterus) and shrimps *Plesionika edwardsii* and *Plesionika martia* along the escarpment. Many species of fishes, crustaceans and cephalopods are returned to the sea because of their negligible or no economic value (wastes) like *Galeus melastomus* and *Etmopterus spinax* small sharks or *Hoplostethus mediterraneus*, *Coelorinchus caelorhincus*, *Nezumia sclerorhynchus* and *Hymenocephalus italicus* deep sea fishes.

The 2012 fisheries production in the whole Ionian region ranks second-to-last among the Italian seas as illustrated in the table below.

TABLE 4.6: ITALIAN FISHERIES PRODUCTION PER GSA (2012)

	Fisheries day	Catches (tons)	Revenues (million €)
Northern Tyrrhenian	171.079	16.561	105,51
Southern Tyrrhenian	306.024	21.185	116,17
Sardinia	159.681	7.822	55,60
Sicily channel	169.653	23.654	154,87
Northern Adriatic	370.489	88.298	274,32
Southern Adriatic	144.297	21.524	99,71
Ionian	234.498	15.164	99,11
Total	**1.555.722**	**194.208**	**905,28**

MIPAAF-IREPA source. Buefin tuna amounts to their net production value

With reference to the Ionian region (GSA 19), Calabria contributes to production by 38%, Sicily by 37% and Puglia by 24%, which is the lowest value.

From a bathymetric viewpoint, the Project area encompasses a small escarpment portion and a wide abyssal plain portion. The continental shelf does not lay within the bounderies..

4.3.3.1.2. General considerations on types of fisheries

The whole GSA 19 is mainly characterized by a coastal artisanal fishing activity using fishing gears like driftnets, seine fishing nets, longliners, pots and traps. Trawling ranks second in order of importance in terms of both boat number and production (IREPA, 2010). Trawling predominantly affects demersal resources and small-scale fisheries. Specialized systems are used in some areas only. Boats sailing in the Ionian areas have "polyvalent" fishing licence that frequently changes to meet fishing requirements according to season, availability of sea resources and market demand.

Structurally speaking, the trawling fleet of GSA 19 operating along the Ionian coast line of Calabria and Puglia (and thus potentially in the study area too) is composed of 225 boats totalling a 4,000 *Gross Tonnage* ("GT") and featuring an engine power slightly over 30,000 kW (IREPA, 2010). The employed involved are 611 units.

Fisheries of large pelagic fishes

Most part of the Ionian Sea and Gulf of Taranto is affected by eugenic trophic migrations of many nektonic species (teleost and shark-like species). For nearly 20 years, many boats have dedicated themselves to the swordfish and albacore fisheries. Fisheries is seasonal occurring from April to November (swordfish in spring and summer, albacore in autumn) in sea areas located much far away from the coastline particularly as fas as the swordfish is concerned. This activity may also potentially affect the study area.

Trawling

Most assessment attention is focused on trawling in the study area deep sea (southeastern sector).

Catch changes throughout the year as a consequence of the fish migrations. Different species organisms are catched even in very close areas as a function of the deep sea configuration.

Fishing trawlers account for 21% of fishing effort with respect to other fleet types operating the area, i.e. 64% and 56% of GT (*Gross Tonnage*) and total kWs in GSA 19 respectively. Fishing trawlers in the area are more active compared to the national average. In 2008, the trawler fleet operation time was 154 days as compared to domestic average of 147 days. Most trawlers in GSA 19 operate on one-day fishing trip basis (Gallipoli, Taranto, Crotone), except for some fleets, specifically the Roccella Ionica (Reggio Calabria) fleet, engaged in 2 to 3 day fishing trips. Trawlers contribute by a greater production and higher product value in GSA 19.

In 2008, the trawling fisheries production amounted to abt. 5,000 tons totalling to 28.57 million € revenues with an impact somewhat less than total catches in the area and 44% revenues. Overall, trawling catches in the three largest ports of landing (Crotone, Taranto and Gallipoli) in the GSA 19 account for 3% of the entire fish quantity domestically landed (Maiorano *et al.*, 2010).

Fisheries of clupeiforms

Fisheries of clupeiforms in the Ionian Sea is of minor importance. Fisheries is carried out generally along the coastline and rarely offshore, where European pilchard (*Sardina pilchardus*) is mainly catched.

4.3.3.1.3. Fisheries sector in Puglia

Puglia confirms its role of relevant importance within the domestic frame. The capacity of the Italian fishing fleet is greatly concentrated in this region (13% of the Italian fishing fleet in terms of number and tonnage). Trawling in Puglia is by far the most important industrial sector of the entire regional fishing compartment. Boats performing this activity are predominantly concentrated in the compartments of Molfetta and Manfredonia (350 units).

Distribution of the Puglia-based fleet per tonnage classes highlights that boats with a tonnage lower than 15 GT are abt. ¾ of the total target corresponding to 22% of the overall GT. Boats of 16 to 50 GT are 273 equal to 16% of the fleet and 25% of the GT. Boats of 50-100 GT are 106 corresponding to 28% of total GT. Finally, large size fishing vessels over 100 tons account for 1% of the regional fleet (only 23 in absolute value) and ¼ of the fishing fleet capacity. Large size vessels are items of interest for this study as they can potentially fish off the coast and specially in deep sea as it is the case of the study area.

The regional data suggest that trends of the fishing industry in Puglia differentiate between the Adriatic and Ionian regions encompassing the Project area. Approximately one third of the Puglia-based fleet operates in the Ionian region. Tonnage is averagely smaller, it being 3,000 GT against 26,000 GT totally, viz. one tenth of the overall tonnage in Puglia, however, revenues amount to one fifth thus confirming that catches are economically more valuable.

TABLE 4.7: CAPACITY OF THE FISHING FLEET IN PUGLIA AND PUGLIA IONIAN REGION (2007)

Capacity indicators	Puglia	Puglia Ionian Region
Units (N.)	1,704	576
Tonnage (GT)	26,482	3,138
Engine power (kw)	158,512	33,294
Average tonnage (GT/boat)	15.5	5.44
Average power (kw/boat)	93.2	57.8

Source: Regional Fisheries Observatory, Puglia, 2008

TABLE 4.8: TECHNICAL SPECIFICATIONS AND COMPOSITION OF THE FISHING FLEET IN PUGLIA AND PUGLIA IONIAN REGION (2007)

	Puglia						Puglia Ionian Region					
Type of fisheries	**Units**	**%**	**Tonnage (GT)**	**%**	**Engine power (kW)**	**%**	**Units**	**%**	**Tonnage (GT)**		**Engine power (kW)**	**%**
Trawling	601	35.3	17,067	64.4	99,512	62.6	125	21.7	1,794	57.2	18,025	54.1
Flying gears	32	1.9	2,647	10.0	13,777	8.7	-	-	-	-	-	-
Seine	20	1.2	3,246	12.3	9,137	5.8	8	1.4	160	5.1	1,057	3.2
Hydraulic dredges	76	4.5	820	3.1	7,543	4.7	-	-	-	-	-	-
Small-scale	893	52.4	1,576	6.0	18,651	11.7	405	70.3	791	25.2	10,467	31.4
Polyvalent passive gears	24	1.4	277	1.0	2,038	1.3	18	3.1	204	6.5	1,847	5.5
Longliners	58	3.4	849	3.2	8,235	5.2	20	3.5	189	6.0	1,899	5.7
Total	**1,704**	**100**	**26,482**	**100**	**158,893**	**100**			**3,138**	**100**	**33,294**	**100**

Source: Regional Fisheries Observatory, Puglia, 2008

Structure of the Puglia fleet per type of fisheries confirms the multispecific fisheries in the area. The Manfredonia and Gallipoli-based fleet ranks first in terms of number followed by the Bari-, Molfetta-, Taranto- and Brindisi-based fleet. Even though small-scale fisheries activities dominate in the whole region, each compartment remained committed to its fisheries type vocation. Trawling is strongly concentrated in Manfredonia, Molfetta and Bari (79% of all regional trawlers), however, is less important in the Ionian region. Boats using pelagic nets operate in Molfetta and Manfredonia. Types of fisheries in the Ionian region are less varied compared to the rest of the Puglia region. There are no boats using hydraulic dredges and flying fishing gears.

TABLE 4.9: AVERAGE DAYS OF OPERATION PER TYPE OF FISHERIES (2007)

	Puglia	**Puglia Ionian Region**
Trawling	159	170
Flying fishing gears	156	0
Seine gears	123	162
Hydraulic dredges	107	0
Small-scale fisheries	144	150
Polyvalent passive gears	87	87
Longliners	99	121
Total	**145**	**151**

Source: Regional Fisheries Observatory, Puglia, 2008

TABLE 4.10: PRODUCTION AND REVENUES PER TYPE OF FISHERIES (2007)

	Puglia		Puglia Ionian Region	
	Catches(t)	Revenues (million €)	Catches (t)	Revenues (million €)
Trawling	17,720	117.49	1,431	19.6
Flying fishing gears	9,763	16.22	0	0
Seine gears	4,312	7.96	182	0.9
Hydraulic dredges	2,015	4.83	0	0
Small-scale fisheries	3,250	29.35	1,375	14.84
Polyvalent passive gears	690	3.06	690	3.0
Longliners	1,367	9.80	264	1.78
Total	**39,117**	**188.71**	**3,941**	**40.18**

Source: Regional Fisheries Observatory, Puglia, 2008

In Puglia, trawling is the most productive fishing system followed by flying and seine fishing, which together account for more than 80% of the regional production in terms of tonnage and 75% in terms of revenues. Also in this case, the situation of the Ionian region differs from the rest of the Region, as here production from trawling and small-scale fisheries is almost identical to that of the small-scale fisheries in terms of tonnage, though revenues from trawling slightly exceed those from the small-scale fisheries.

The investigations made with the support of local marine and fisheries experts confirmed that the Project area and its buffer area are zones of potential interest for industrial fisheries, mainly **trawling** and **deep sea bottom longline fishing. Surface longline fishing** of bluefin tuna and swordfishes could be also carried out in these zones in summer.

No more than 3 to 6 boats of the Leuca fleet can operate in the study area, Leuca being closest to it. Occasionally, boats of the Molfetta, Monopoli, Brindisi and Porto Cesareo fleet may reach the study area.

Fish species like hake (*Merlucius merlucius*), lobster (*Nephrops norvegicus*) and angler of the *Lophius piscatorius* and *Lophius budegassa* species are the main trawled target fishes dwelling the flat seabed of the Project area at a depth of 400 to 600 m. Red (*Aristaeomorpha foliacea)* and blue (*Aristeus antennatus)* shrimps could be also catched. No important shrimp coves are found in the Project Area. Most frequently longline catched fishes include wreckfish (*Polyprion americanum*), blackspot seabream (*Pagellus bogaraveoe*), hake (*Merlucius merlucius*), greater fork-beard (*Phycis blennoides*), silver scabbardfish (Lepidopus caudatus), conger (*Conger conger*) and blackbelly rosefish (*Helicolenus dactylopterus*) (D'Onghia *et al.*, 2014).

It should be outlined that a "*Fisheries Restricted Area*" imposed by the General Fisheries Commission for the Mediterranean in the FAO exists at the Project area boundaries, where white coral habitats are found. This restriction bans trawling in that area.

4.3.3.1.4. Information for an assessment of the impact effects on fisheries

Considering the distance from the ports and the characteristics of the fishing vessel fleet operating in the area, the number of local units capable of catching in the area is quite reduced (4-6 units)[5] and can occasionally increase when fishing vessels from other compartments come to operate in the area. The information gathered from local experts indicates that trawling is conducted in the southeastern sector,

[5] COISPA pers. communication

while the rest of the area is affected by surface longline fishing in summer and deep sea longline fishing in the escarpment zone. The area as a whole seems to be prone to moderate fisheries.

The considerations above suggest a medium sensitivity for fisheries.

4.3.3.2. Landscape and archaeological heritage

Study area

The area investigated for landscape and archaeological heritage is the marine Application for Exploration Permit area between the Application for Exploration Permit area itself and the Salento peninsula.

This chapter briefly deals with the main characteristics of the archaeological heritage identified in the study area. The reported information is extracted from the Archeomar database, a Project started in 2004 by the Ministry of Cultural Heritage and Activities with the aim of compiling a registry, positioning and documenting the archaeological heritage submerged along the coasts of some Italian regions. The Archomar survey activities were of bibliographic and sea survey nature focused on the coastal shelf, where archaeological heritage is likely to be found.

According to the Archeomar atlas, 19 underwater archaeological artifacts were recorded along the coastline of the Salento peninsula, specifically in the section between Otranto and Santa Maria di Leuca . Most of them are located not far offshore (< 1 km) and only two lie beyond this distance. In most cases (11 sites) they are wrecks, in other cases they are anchors or non-identified objects. Two sites only dated back to the Roman age, while the remaining artifacts dated back to recent times. 4 artifacts related to episodes of war of the second world war. Dating of other 4 was not possible.

The Roman age archaeology included in one case a cargo shipwreck dated between second and first century AC with profusion of remains of amphoras and a big anchor and in another case an area with remains of bronze statues found in 1994, that are likely to date back to imperial times, and objects of uncertain interpretation among which remains of anchors and roof tiles.

Reports indicate that underwater artifacts have not been directly identified in the Application for Exploration Permit area. The Archeomar Project results show that most underwater findings are located along the coastline, where historical human and navigation activities were carried out. Though unlikely, we cannot exclude the presence of submerged artifacts within the Application for Exploration Permit area .

4.3.3.2.1. Useful information for an assessment of the impact effects on landscape

No submerged archaeology was found in the Project area according to available information. The 19 submerged findings along the Salento coasts are not exceptional artifacts of testimonial value. Moreover, all recorded artifacts are located in coastline waters 10 nautical miles far from the point nearest to the study area.

The foregoing indicates that the sensitivity of the landscape and archaeological heritage covered by this EIS is “negligible”.

4.3.3.3. Marine traffic

Study area

The area investigated for marine traffic is the northwestern Ionian Sea.

4.3.3.3.1. Characteristics of the marine traffic in the study area

This chapter summarizes the key elements of the marine traffic, partly illustrated also in pararagh 4.3.1.4. dealing with the marine traffic-generated underwater noise affecting the study area.

The Ionian-Adriatic basin is crisscrossed by the motorways of the sea involving a heavy marine traffic (over 2,000,000 cruise liners and over 217 million ton cargos) (Simonella 2008).

The marine traffic can be divided into the following main classes:

- Cargo transport;
- Passenger transport;
- Recreational crafts;
- Fisheries.

Despite the heavy traffic volume in the Ionian-Adriatic basin, the study area is not crisscrossed by the main routes for cargo and passenger transport. An analysis of the nautical map showing the main passenger routes and the *Marinetraffic* site (https://www.marinetraffic.com) highlights an area only marginally affected by the main marine routes concentrated in the vicinity of the northwestern border (Figure 4.32),

According to the information gathered, the number of the fishing vessels reaching the study area from the Leuca navy is very small also by virtue of the study area distance from the coast (3 to 6 vessels). We cannot exclude that deep sea fishing vessels from the Molfetta, Monopoli, Brindisi and Porto Cesareo navies occasionally sail in the study area (trawling and longline fishing) .

The study area may be affected in July and August by the recreational traffic of leisure boaters sailing to and from Greece .

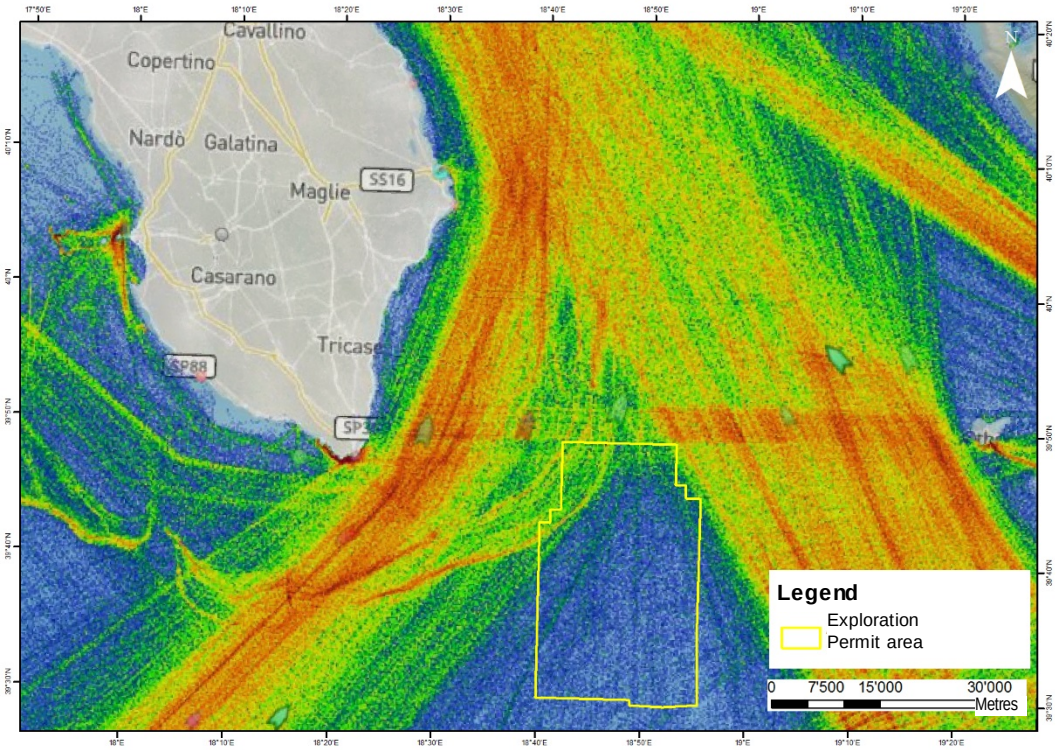


FIGURE 4.32: MAP OBTAINED FROM THE MARINETRAFFIC SITE WITH INDICATION OF THE MARINE TRAFFIC DENSITY IN THE YEARS 2015 AND 2016 (WWW.MARINETRAFFIC.COM)

4.3.3.3.2. Useful information for an assessment of the impact effects on the marine traffic

The Application for Exploration Permit area is only marginally (northwestern sector) affected by the main cargo and passenger transport routes. The marine traffic in the Application for Exploration Permit area is thus predominantly limited to the small number of fishing vessels sailing in the study area and the recreational craft that can crisscross the Application for Exploration Permit Area when sailing the Ionian Sea to Greece in the summer. The marine traffic as a whole is thus limited in the study area. A low sensitivity of the study area to the marine traffic is evidenced.

4.3.3.4. Tourism

Study area

The area investigated for tourism is the Application for Exploration Permit area and the sea length between this area and the coastline of the Salento Peninsula .

The Application for Exploration Permit area is 14 nautical miles far from the coast and has no touristic infrastructures. It can be crisscrossed by the leisure boaters to and from Greece in summer and occasionally by sport fishermen in possession of boats capable of reaching the study area.

Due to the absence of touristic infrastructures in the Application for Exploration Permit area, this chapter focuses on the touristic activities developed on the coastline of the Salento peninsula .

This coastline length is known for its tourism offer linked to the sea, culture and wine and food traditions. The information contained in this paragraph has been obtained partly from the Tourism Observatory of the Puglia Region and partly from the *Economical Report 2014* drafted by the Chamber of Commerce of Lecce .

The touristic sector in Puglia enjoys a reputation that promoted the development of this industry particularly in the past decades . According to ISTAT, in the years 2007 to 2013 the number of beds in the tourist accommodation establishments (hotels and extra hotel facilities) has grown by 18% against a national average of 5.4%. The presence of tourists in the hotels in the cited period has raised to 18% against a national average of 0.2%, while growth in extra hotel facilities reached 13.6% against a 0.2% decrease in national demand. The tourism in Puglia is characterized by a strong seasonal trend whereby the peak of the resident visitors is reached in the period June to September. The presence of non-resident visitors is spread over a wider period. The EU countries are the pool of international users and Germany ranks first. The United States are the first non-EU country in terms of visitors. In 2012, the touristic sector impacted by 8% on GDP of Puglia region.

According to the 2012 ISTAT data, the concentration rate of tourists in the Province of Lecce is lower compared to the Italian average (122.9% against 171.1%). Within the Puglia region, however, the Province of Lecce ranks second only surpassed by the province of Foggia. The touristic internationalisation index, viz. the percent value of foreign visitors on the total tourist arrivals recorded by ISTAT, is approximately 15% in the province of Lecce against an Italian average of 47%. The average stay of visitors on the territory is 4.72 days against 3.67 days reported at national level. This is likely due to offering of sea resorts alluring the tourists to stay for a longer period. The indicator of the hotel quality shows that there is a great number of higher class hotels (4 and 5 stars) equal to 33% on the province territory against a national average of 17%.

No significant touristic activities are carried out in the Project area, if we consider the area distance from the coast. The touristic-recreational navigation activities generally occur near the coastline and hardly reach offshore. As mentioned above and discussed in the marine traffic paragraph, tourism in the Application for Exploration Permit area mainly regards the sea boaters sailing to and from Greece in the months of July and August.

4.3.3.4.1. Useful information for an assessment of the impact effects on tourism

A tourism increase thanks to bathing, cultural and wide and food tourism was observed in the Puglia region and Salento coastline in the past decades. Despite of this, the statistical data indicate a developed touristic sector, specially if referred to national averages, with no outstanding elements with respect to the rest of the country.

The above considerations lead to classify sensitivity of the study area to tourism as "medium" within this EIS.

4.4. Predictable environment evolution failing the Project

The relatively short time required for the Project execution (20 to 30 days) lets us assume that the environment will not change, regardless of the seismic survey being performed or not. Actually, the implementation of the dedicated exclusion, mitigation and prevention actions proposed (refer to single paragraphs of chapters 7 and 8) shall reduce the potential Project-generated impacts as illustrated in Chapter 7 herein.

To provide tentative considerations on predictable evolution of the environment in the next decades, failing the Project, the current *trends* on species vulnerability from the Project activities in the Mediterranean Sea and the Study Area, where feasible, are listed below.

- The Mediterranean sub-population of the *Caretta caretta* marine turtle is currently growing (IUCN Red List) and categorizaed by IUCN as *Least Concern*, contrary to the currently negative global trend (IUCN Red List). The Mediterranean situation is the result of long years of conservation actions and protection programmes and this trend is expected to remain constant in the long run.
- Generally, the *trend* of the Mediterranean cetacean sub-populations explored by IUCN is negative (IUCN Red List) as a consequence of a long lasting intentional bycatch and killing. However, all cetaceans living in the Mediterranean are protected for the time being as it is the case of C. *caretta*.
- The fish *stocks* generally show a negative trend, being however stable in the central Mediterranean (Tsikliras *et al.,* 2015). The state of *stocks* is currently declining in the other areas and we cannot exclude that in the future this *trend* will become negative also in the central Mediterranean .
- Formations of white corals close to the Study Area have been recently discovered and studies are being conducted to better investigate the *status* and improve knowledges. Information on the *trend* of the deep sea white coral communities cannot be supplied so far.
- The current climate changes are having an impact on the sea water and the organisms living therein. The main contribution is attributable to an increase in the temperature (and thus a decrease in the thermocline) and water acidification. While rejecting impacts from a temperature increase due to the depth of the study area seabed , (~1000 m), we cannot exclude impacts due to weakening of the skeletal structure of corals and other carbonate formations (for example, shells) caused by acidification.

5. Methods implemented for an assessment of the impacts

The concept methodology adopted by Golder for an assessment of the Project on the environment is consistent with the DPSIR framework (Driving forces-Pressures-State-Impacts-Response) developed by the European Environment Agency (EEA). This model is based on the identification of the following elements:

- **Driving forces:** human activities that significantly interfere with the environment, them being key generators of environmental pressures;
- **Pressures:** direct or indirect stresses that human activities place on the environment ;

- **State:** set of conditions that characterizes the current and/or trend quality of a given environmental compartment and/or its resources;
- **Impact:** changes in the environment due to the driver-generated pressures;
- **Response:** human activities improving the environment conditions and mitigating pressures and negative impacts from the man-made activities (mitigation measures).

The applied analysis methodology was developed on the basis of the experience gained in the field of the environmental assessment. This methodology was increasingly fine-tuned after its application for the environmental assessment of many project types. The version proposed in this EIS is the most recent version of the analysis method and covers the following steps.

This prospection Project does not fall within the classic division into three distinct stages (construction, operation and divestment) as no construction or divestment, but only the operation stage is provided. Therefore, only operation including all activities required for preparation (or mobilisation), survey execution and demobilisation of the prospection shall be considered in this EIS.

The applied methodology covers:

- Preliminary control of potential impacts:
  - Identification of the Project activities for the prospection execution (corresponding to the Driving forces of the DPSIR model);
  - Identification of the environmental components that can be impacted by the Project (through the Leopold matrix),
- Impact assessment:
  - Characterization of the *ante-operam* environmental components consisting in defining the current status of the different components that could possibly be affected;
  - Identification of the impact factors (corresponding to the Pressures of the DPSIR model) that may influence the environmental components;
  - Definition and assessment of the environmental impact acting on each individual component after implementation of the expected mitigation actions (corresponding to the Responses of the DPSIR model).

5.1. Preliminary control of the potential impacts

5.1.1. Identification of the Project activities

The Project activities that may interfere with the environmental components are the result of an analysis and breakdown of actions designed for the Project execution during the operation stage.

The Project actions then correspond to the activities being carried out during the operation stage (navigation of vessels to/from the Project Area; navigation of vessels inside the Project Area during the data acquisition campaign; energizing and recording; towing of the *streamers*), which may change the current status of one or more environmental components .

5.1.2. Identification of the environmental components that could be affected

After identifying the Project actions, a cross-reference matrix between the environmental components and the Project actions was prepared with the aim of identifying the environmental components that could possibly be affected during the operation stage .

5.2. Impact assessment

5.2.1. Definition of the status of the environmental components that could possibly be affected

The status of the individual environmental components that could possibly be affected was defined via identification and description of the key characteristics of the components. The components were analyzed

with reference to a study area, the size of which was established on the basis of the extent of the potential impact from the Project on the investigated component, the characteristics of the territory, the type of the component that could be influenced and the existing vulnerability/critical issues, if any.

The study area is therefore investigated for each of the different environmental components identified.

To define the component status, data managed by the Public Administration (Region, Province, Municipality, Regional Agency for the Environment Protection, national bodies), the results from studies and surveys conducted on the study area or contiguous areas by public and/or private entities, the competent scientific literature and the documentation collected at local experts' premises (University of Lecce, University of Bari, COISPA) were considered.

The global status assessment of the investigated component is expressed by a vulnerability value of the impact taking into account both the **component characteristics** and the presence of the **sensitivity elements** described below.

- **Atmosphere:** zones with limited circulation of the air masses,
- **Oceanography:** zones with limited circulation and water mass exchange; wide sectors with limited bathymetric range,
- **Soil and marine subsoil:** escarpment areas or irregular and rough seabeds, law waters (< 100 m),
- **Marine acoustic climate:** areas not affected by noise generated by artificial sources and areas known to be important for cetaceans and ecologically significant for the marine fauna in general,
- **Ionizing and non-ionizing radiations:** areas with an emission source of ionizing and/or non-ionizing radiations,
- **Marine mammals:** areas with fish species concentration; areas characterized by frequent sightings; *nursery*, spawning or feeding grounds; migration routes,
- **Seabirds:** spawning habitats; migration routes; important feeding grounds; species subjected to higher vulnerability (nationally and/or internationally protected species; less common/rare species),
- **Marine reptiles:** spawning habitats; migration routes; important feeding grounds,
- **Fishes:** spawning habitats; *nursery* grounds; large pelagics migration routes; presence of higher vulnerability species (nationally and/or internationally protected species, less common/rare species, species of high economic interest),
- **Benthos:** higher vulnerability species (nationally and/or internationally protected species, less common/rare species, species of high economic interest); presence of indigenous species,
- **Zooplankton and phytoplankton:** *upwelling* zones (high plankton form densities),
- **Biocoenosis:** habitats affected by a lower extent of human activities and a conservation status closer to the natural conditions, priority marine habitats according to the SPA/BIO Protocol (Barcelona Convention),
- **Protected and restricted areas:** protected areas, SICs, SPAs, IPAs, IBAs, RAMSAR,
- **Fisheries:** areas with concentrated fisheries activities,
- **Public health:** presence of vulnerable human receptors,
- **Landscape and archaeological heritage:** presence of archaeological sites or artifacts, areas of greatest visual value, highly visible areas,
- **Marine traffic:** key routes affected by heavy marine traffic,
- **Tourism:** tourist attraction areas.

A component sensitivity is classified as follows:

- **Negligible sensitivity –** the component is not sensitive;
- **Low sensitivity –** the component features limited or scarcely relevant sensitivity;
- **Moderate sensitivity –** the component is affected by many, but scarcely relevant sensitivity elements;
- **High sensitivity –** the component is affected by significant sensitivity elements .

5.2.2. Identification of the impact factors

The Project actions can possibly impact on the components, viz. positively or negatively, directly or indirectly influence the quality status of each component.

The potential impact factors influencing each environmental component during the operation stage are thus identified .

5.2.3. Definition and assessment of the environmental effects

The **assessment of the environmental effects** on each affected component is carried out by preparing specific **environmental impact matrices** intersecting the component status expressed in terms of impact susceptibility with the assessed impact factors quantified on the basis of a set of parameters that define their key characteristics in terms of **duration** (short, medium-short, medium, medium-long, long), **frequency** (concentrated, discontinuous, continuous), **geographic extent** (local, regional, global) and **intensity** (negligible, low, moderate, high).

Each impact from each of the factors influencing the environmental component is quantified by comparing each aspect of the impact factor with the extent of the impact itself.

The aspects of the assessed impact factors are discussed hereinafter.

Duration (D) defines the period over which an impact is expected to last and is:

- short, when the time interval is within one day
- medium-short, when the time interval is within 1 day and no more than 2 months;
- medium, when the time interval ranges from 2 to 6 months;
- medium-long, when the time interval ranges from 6 months to 1 year;
- long, when the time interval exceeds 1 year .

Frequency (F) defines the frequency of occurrence of a potential impact. Frequency may be:

- concentrated, there is only one short occurrence;
- discontinuous, an event occurs repeatedly or accidentally;
- continuous, an occurrence is uniformely distributed in the long run.

Geographic extent (G) coinciding with the zone influenced by a potential impact may be:

- local, when an impact affects a territorial portion of variable extension that cannot be precisely defined, whose components can be exhastively described and/or boundaries can be quite accurately determined;
- regional, when an impact affects a territorial portion of variable extension that cannot be precisely defined, whose elements cannot be described because of their number and complexity and/or boundaries are smoothly faded and can be hardly determined;
- global, when an impact globally affects the territory .

Intensity (I) means the extent of changes and/or impairments affecting an environmental component due to a potential impact also assessed as variation from an impact condition originating from activities that already existed prior to the Project activities. Intensity may be:

- negligible, when the extent of changes/impairments is such that they cannot be detected by instruments or sensorially perceived;
- low, when the extent of changes/impairments is such that they cannot be detected by instruments or sensorially perceived, however, influences the directly affected component without altering the component balance and relationship system;
- medium, when the extent of changes/impairments is such that they influence both the directly affected component and the component balance and relationship system;
- high, when substantial changes occur to a point that changes jeopardize the environmental value of a component.

The assessment of an impact also takes into account its **reversibility** (short-term reversibility, long-term reversibility or irreversible), the **probability of occurrence** (low, medium, high, certain) and its **mitigation** (none, low, medium, high).

The above parameters are rated in accordance with ratings discussed above. Rating increases when an impact is irreversible, is more likely to occur and its mitigation chances diminish.

Reversibility (R) means the possibility of restoring the baseline conditions of a component after the changes caused by human actions and/or the possibility of a spontaneous restoring of a component by virtue of its resilience features. An impact may be:

- short-term reversibility, when restoring of the baseline conditions is possible within a short timescale;
- long-term reversibility, when restoring of the baseline conditions is possible within a generation cycle;
- irreversible, when there is no reasonable chance of action to reverse an impact.

Probability of occurrence (P) is an estimate of how often an impact occurs. A review of the assessor experience and/or the available bibliography assists with this determination. The probability of occurrence is:

- minor, when an event is unlikely to occur, however, occurrence cannot be excluded, though considered accidental;
- moderate, when an event is likely to occur;
- high, when an event is very likely to occur;
- certain, when an event cannot be avoided.

Mitigation (M) means the possibility of mitigating a potential impact through adequate design and/or management actions. Mitigation is ranked as follows:

- high, when a potential impact can be effectively mitigated;
- medium, when a potential impact can be mitigated in a sufficiently effective manner;
- low, when a potential impact can be mitigated, but results are scarcely effective;
- none, when there is no chance of mitigation.

The component impact influence per impact factor is assessed on the basis of the levels below interconnecting all parameters without disregarding the **Sensitivity** (S) of the affected component .

The impact magnitude of each impact factor is variable and depends on the impact being positive or negative against the affected component. An impact is positive when already existing negative impacts or future positive impacts on each environmental component can be minimized/mitigated.

A negative or positive impact referred to any impact factor influencing an environmental component is rated according to the following ratings:

- level 1 – negligible overall impact;
- level 2 – low overall impact;
- level 3 – medium-low overall impact;
- level 4 – medium overall impact;
- level 5 – medium-high overall impact;
- level 6 – high overall impact.

In the impact matrices, the box of negative impacts is orange coloured and that of positive impacts is green coloured.

5.2.4. Assessment supporting tools

As support to an impact assessment, **GIS mapping** on an ArcGIS platform and **modeling of water sound diffusion** have been used in addition to the matrices discussed above.

- GIS was used for mapping, distance calculation and checking of interferences between the project and the more vulnerable sites .
- Modeling allowed to select a minor impact *air gun* configuration, check for sound intensity at various distances from the source and define the cetacean exclusion zone .

6. Environmental and social components prone to be affected by the Project environmental impacts

The impacts dealt with in this EIS were assessed following the method described in the above paragraph.

This study included a preliminary check of potential impacts by identifying the Project activities interfering with the environmental components. The Project nature prompted an analysis of the operation stage only, i.e. the execution of the seismic survey. Hence, the study did not distinguish between construction, operation and discontinuation stages, such distinction being not applicable to a seismic survey.

The Project activities that can influence the environmental components are summarized as follows:

- Operation stage
  - Navigation of vessels while mobilizing/demobilizing to/from the survey area (cruising speed of abt. 10-15 knots). The use of at least two vessels is expected, of which one performing the survey and the other as support to ensure safety of the operations, check for the environmental conditions, resolve any logistic problem and face the requests of the master vessel.
  - Navigation of two vessels within the Project Area during the data acquisition activity (4-5 knot constant speed),
  - Energizing and recording, pulse transmission into water via *air guns* and recording of waves reflected by the geological structures.
  - Towing of the receiver system (hydrophone or *streamer* cable). At least 6 *streamer*s, 8 km long each, are stern towed by the master vessel. The hydrophones convert the reflected pressure signals into electric signals that are digitilized and transmitted to the on-board recording system, where the acquired data are recorded on a magnetic tape.

A crossreference matrix between the environmental components and the identified Project activities was drafted (Table 6.1).

TABLE 6.1: PROJECT ACTIVITIES- ENVIRONMENTAL COMPONENT MATRIX

Design stage	Project activities/ components	Atmosphere	Soil and subsoil	Marine acoustic climate	Sea water	Ionizing and non-ionizing radiations	Marine fauna, flora and ecosystems	Protected areas	Public health	Fisheries	Landscape and archaelogical heritage	Marine traffic	Tourism
Operation stage	Navigation of vessels to/from the Project Area	X		X								X	
	Navigation of vessels within the Project Area during the data acquisition activity	X		X			X	X		X	X	X	X
	Energizing and recording	X	X	X			X	X		X	X		
	Towing of the receiver system						X			X		X	X

The results of the preliminary checks suggest that the environmental components prone to potential impact are:

- atmosphere;
- soil and subsoil;
- marine acoustic climate;
- fauna, flora, ecosystems;
- protected areas ;
- fisheries;
- landscape and archaeological heritage;
- marine traffic;
- tourism.

Three environmental components originally investigated are not influenced by the Project activities.

No **ionizing and non-ionizing radiations** shall be emitted in any of the activities for data acquisition. Apart from specifically governed standard on-board equipment, the key potential sources of non-ionizing radiations (electromagnetic radiations) include the electric signals transmitted by the *streamers* to the recording system on board the vessel, where the acquired data will be recorded. The frequencies used shall range from 5 Hz to 300 Hz. Therefore, the created electromagnetic fields shall be “extremely low frequency fields” comparable to those present in dwellings or office rooms served by a power network or household appliances.

As regards the **Public Health,** the geophysical survey shall be conducted far off the coastline (14 nautical miles corresponding to 25.9 km). Hence, neither interactions with the coastal population and vulnerable human receptors nor impairment of the fish stocks as human food are expected in consideration of the Project features. None of the Project activities shall interfere with the public health.

The "Ionizing and non-ionizing radiations" and the "Public Health" components shall no longer be discussed hereinafter.

A detailed assessment of the potential impacts influencing each affected environmental component was started after completion of the preliminary checking.

This assessment involves:

- definition of the current baseline conditions of each component;
- identification of the impact factors influencing each component;
- assessment of the following impacts.

The Component – Project activities – Impact factors correlations are indicated in the summarizing table below (Table 6.2), providing a methodological reference for the next chapters. Some components have been furtherly divided into subcomponents at the next impact assessment stages in order to ensure an in-depth examination (for example, the "Flora, fauna, ecosystems and protected areas" component was divided into Plankton, Cetaceans, Seabirds, Marine reptiles, Fishes, Benthos, Marine biocoenoses and Protected Areas).

A potential impact on the **sea waters** could derive from discharge into the sea of unprocessed waters, bilge waters and wastes.

This possibility was excluded in advance as vessels are obliged to conform to the national and international laws. More specifically:

- Unprocessed waters include toilet waste and dirty water from the facilities on board the vessel (toilet rooms and kitchens). They shall be discharged onto the sea after appropriate treatment according to Annex IV to the MARPOL Convention ("Regulations for prevention of pollution from sewage discharged by the vessels".
- Bilge waters will be discharged at the port according to the applicable rules.
- No waste will be generated from the Project activities, except for crew-generated waste similar to municipal waste. This type of waste will be landed and disposed of in suitable authorized disposal plants.

TABLE 6.2: CROSSREFERENCE MATRIX FOR COMPONENT – PROJECT ACTIVITIES – IMPACT FACTORS

Component	Project activity	Impact factor
Atmosphere	Navigation of vessels to/from the Project Area	Emissions of atmospheric pollutants Emission of green house gases
	Navigation of the vessels within the Project Area during the data acquisition activity	Emissions of atmospheric pollutants Emission of green house gases
Soil and subsoil	Energizing and recording	Generation of compression w aves
Marine acoustic climate	Navigation of vessels to/from the Project Area	Emission of non-impulsive noise
	Navigation of the vessels within the Project Area during the data acquisition activity	Emission of non-impulsive noise
	Energizing and recording	Emission of multi-pulse noise (multi-impulsive)
	Navigation of vessels to/from the Project Area	Physical presence of moving vessels

Component	Project activity	Impact factor
Fauna, flora, ecosystems and protected areas		Emission of non-impulsive noise
	Navigation of the vessels within the Project Area during the data acquisition activity	Physical presence of moving vessels Emission of non-impulsive noise Night lighting
	Energizing and recording	Emission of multi-pulse noise (multi-impulsive)
	Towing of the receiver system	Physical presence of towed *streamers*
Fisheries	Navigation of vessels within the Project Area	Physical presence of moving vessels
	Energizing and recording	Emission of multi-pulse noise (multi-impulsive)
	Towing of the receiver system	Physical presence of towed *streamers*
Landscape and archaeological heritage	Navigation of the vessels within the Project Area during the data acquisition activity	Physical presence of moving vessels
	Energizing and recording	Generation of compression waves
Marine traffic	Navigation of vessels to/from the Project Area	Physical presence of moving vessels
	Navigation of the vessels within the Project Area during the data acquisition activity	Physical presence of moving vessels
	Towing of the receiver system	Physical presence of towed *streamers*
Tourism	Navigation of the vessels within the Project Area during the data acquisition activity	Physical presence of moving vessels
	Towing of the receiver system	Physical presence of towed *streamers*

7. Description and estimate of environmental impacts that are likely to occur

7.1. Impacts on physical components

7.1.1. Atmosphere

The impact factors from the Project activities influencing quality of the ambient air are:

- Emission of atmospheric pollutants;
- Emission of greenhouse gases.

The emission scenario shall be mainly determined by the emission of atmospheric pollutants from vessels navigating to and from the Project Area and within the Project Area during the seismic survey.

Vessels used for the Project execution shall include:

- A master seismic vessel, viz. a vessel designed and equipped for both towing the Energy sources (*air guns*) and the *streamers* and onboard transporting the equipment as support to the seismic survey;
- One or more chase vessels of smaller size compared to the master seismic vessel for control of the operations, transport of equipment, staff, supplies and onboard-generated waste to and from the reference port, monitoring of the investigated area to ensure safe navigation and warn of the presence of watercrafts or marine mammals.

These vessels shall make one outward and one return journey to and from the Project Area and the routes of the seismic survey over abt. 20 days on a 24-hour basis.

The atmospheric pollutants shall mainly be carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), nitrous oxides (N_2O), methane(CH_4) and other volatile organic compounds (VOC).

The atmospheric emission amount shall depend on the amount of fuel burnt during the seismic survey, the type of fuel (conforming to the European regulations for the S content) and the type of vessel engines.

The following actions shall be taken to mitigate the pollutant emissions:

- vessels with perfectly maintained combustion engines shall be used;
- the used vessels shall be duly certified to meet the requirements for atmospheric pollutant emissions .

A **negligible negative impact** on the atmosphere component is expected in consideration of the very small number of vessels used, the globally limited duration of the activity for geophysical data acquisition (abt. 20 days), the temporary movement of the vessels and the implementation of adequate mitigation measures taken throughout the working time.

The generated emissions are comparable to those from boats and fishing vessels usually navigating in the study area.

The table below summarizes the impact on the atmospheric component of each of the two identified impact factors involved in the Project.

TABLE 7.1: MATRIX FOR THE ASSESSMENT OF THE NEGATIVE IMPACTS – ATMOSPHERE

MATRIX FOR ASSESSMENT OF THE IMPACT ON THE ATMOSPHERE		Emission of atmospheric pollutants	Greenhouse gas emission
Duration (D)	short		
	medium-short		
	medium		
	medium-long		
	long		
Frequency (F)	concentrate		
	discontinuous		
	continuous		
Geographic extent (G)	local		
	regional		
	global		
Intensity (I)	negligible		

MATRIX FOR ASSESSMENT OF THE IMPACT ON THE ATMOSPHERE		Emission of atmospheric pollutants	Greenhouse gas emission
	low		
	medium		
	high		
Reversibility (R)	short-term		
	long-term		
	irreversible		
Probability of occurrence (P)	low		
	medium		
	high		
	certain		
Mitigation (M)	high		
	medium		
	low		
	none		
Sensitivity (S)	negligible		
	low		
	medium		
	high		
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.24	0.55
		Negligible	**Negligible**

7.1.2. Marine soil and subsoil

The compression waves generated by the Project construction activities are the sole impact factor that could possibly influence the marine soil and subsoil component.

It should be actually outlined that no anchoring operations shall be performed due to bathymetric range restrictions and that the *streamers* used for the seismic survey shall be kept floating at a depth ranging 5 to 15 m from the surface. Hence, no mechanical interactions with the marine soil and subsoil are expected.

The compression waves as potential impact could theoretically bring about a resuspension of surface sediments mainly due to the expansion of the air bubbles from the air *gun.* The air bubbles tend to oscillate depending on the operating pressure, depth, temperature and volume of the air injected into the water. At the very beginning, the internal bubble pressure shall be higher than the outdoor ambient and shall expand till expansion diminishes and the internal pressure equals the outdoor pressure. As soon as the internal bubble pressure starts lowering with respect to the outdoor pressure, the bubble starts collapsing due to the hydrostatic pressure. The balance condition shall be exceeded after collapse and the cycle shall start again. The bubble shall continue to oscillate over a typical period lasting ten to hundred milliseconds. Finally, oscillation shall stop due to the friction forces.

Generally, the bubble formation stops at abt. 20 to 30 m depth (50 to 60 feets as shown in Figure 7.1) from bubble generating site located in this case a few meters beneath the sea surface. This means that the bubble expansion shall occur far away from the seabed sediments and cause no resuspension at all.

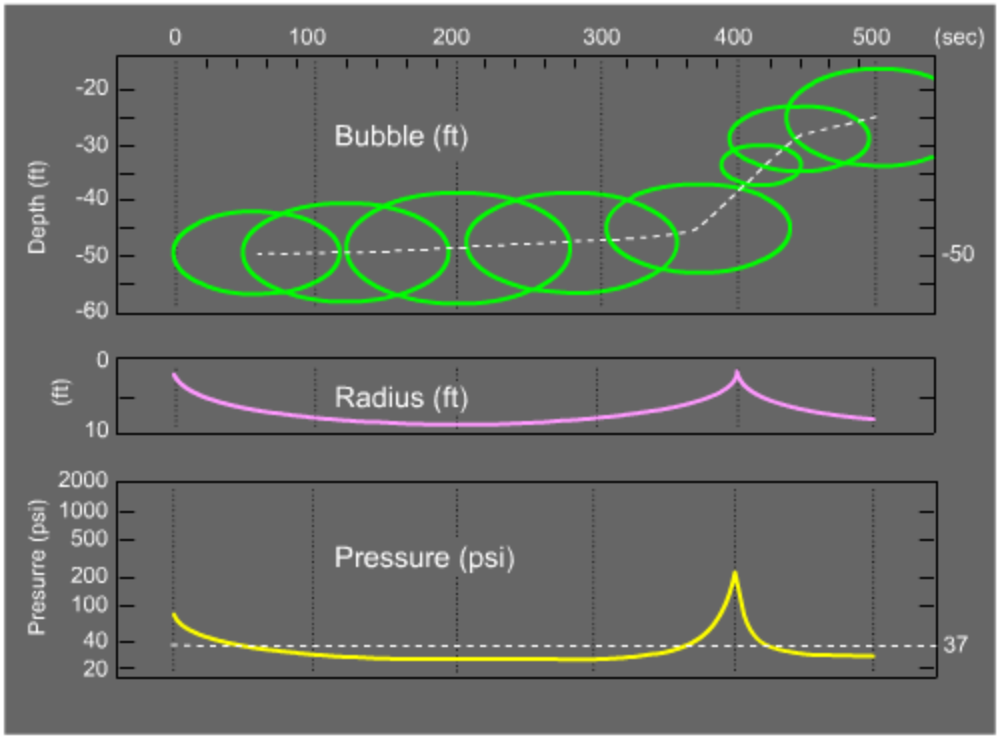


FIGURE 7.1: BUBBLE OSCILLATION FROM THE *AIR GUN* (SOURCE: UNIVERSITY OF BERGEN HTTP://BUSTER,GEO,UIB,NO)

If we consider the sediment location in the Project area, we can assume that the bubble impact on the marine soil and subsoil is very unlikely to occur.

The above considerations suggest that the **magnitude** of negative impacts on the marine soil and subsoil shall be **negligible.**

The table below summarizes the impact on the marine soil and subsoil from the identified impact factors involved in the Project.

TABLE 7.2: MATRIX FOR THE ASSESSMENT OF NEGATIVE IMPACTS – MARINE SOIL AND SUBSOIL

MATRIX FOR THE ASSESSMENT OF NEGATIVE IMPACTS – SOIL AND SUBSOIL		Generation of compression w aves
Duration (D)	short	
	medium-short	
	medium	
	medium-long	
	long	
Frequency (F)	concentrate	
	discontinuous	
	continuous	

MATRIX FOR THE ASSESSMENT OF NEGATIVE IMPACTS – SOIL AND SUBSOIL		Generation of compression w aves
Geographic extent (G)	local	
	regional	
	global	
Intensity (I)	negligible	
	low	
	medium	
	high	
Reversibility (R)	short-term	
	long-term	
	irreversible	
Probability of occurrence (P)	low	
	medium	
	high	
	certain	
Mitigation (M)	high	
	medium	
	low	
	none	
Sensitivity (S)	negligible	
	low	
	medium	
	high	
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.48
		Negligible

7.1.3. Marine acoustic climate

The current baseline study lets assume that the study area is not affected by any environmental noise from human activities, except for low frequency non-impulsive noise generated by the fishing vessels operating all year round, but predominantly in the summer period, and the recreational boats mainly sailing in summer. Crisscrossing of the main commercial routes is marginally confined near the northwestern boundaries of the study area. A medium-high sensitivity of the study area to noise was observed (high in winter and medium in summer).

The impact factors from the Project activities like “vessel navigation” and “energizing and recording” that can influence the marine acoustic climate include:

- emission of non-impulsive noise;
- emission of multi-pulse noise (multi-impulsive).

Emission of non-impulsive noise from engines is common to any vessel crossing the study area. More specifically, vessels equipped with low noise propellers shall be used to avoid jeopardizing the recording activity. The non-impulsive noise generated during the seismic survey shall be lower than noise generated

by fishing, recreational and cargo vessels and boats occasionally sailing or operating in the study area. Generally, this impact factor shall be considered as scarcely significant in the next assessments relating to the potentially affected biological components.

The multi-pulse (multi-impulsive) noise generated during the seismic survey shall feature as follows:

- 252 dB *re* 1 µPa intensity at 1 m at the source;
- noise dispersion in water reducing the noise intensity to:
  - 180 dB *re* 1 µPa at 1 m at 600 m from the source;
  - 160 dB *re* 1 µPa at 1 m at 1700 m from the source.

The direct impact on the marine acoustic climate from the Project was not assessed as an acoustic rating with related subdivision of the marine environment into acoustically homogeneous areas is not provided. Instead, the acoustic climate was broadly dealt with for the other biological and social components that could be possibly affected, either directly or indirectly, by the emission of non-impulsive noise, specifically the multi-pulse noise generated by the *air gun.* Information on the acoustic climate gathered under the baseline conditions (4.3.1.4) and the assumptions made in this chapter were taken into consideration any time an impact from "Emission of non-impulsive noise" and mainly "Emission of multi-pulse (multi-impulsive noise" on marine mammals (cetaceans); marine reptiles (turtles); fishes; benthos; zooplankton; phytoplankton and biocoenosis was assessed.

7.2. Impacts on the biological components

7.2.1. Fauna, flora, ecosystems

The impact factors from the Project activities that can influence the fauna, flora and ecosystems include:

- emission of atmospheric pollutants;
- emission of greenhouse gases;
- physical presence of moving vessels;
- emission of non-impulsive noise;
- emission of multi-pulse (multi-impulsive) noise;
- physical presence of towed *streamers*.

These impact factors are mainly imputable to the following activities:

- navigation of vessels to and from the Project Area;
- navigation of vessels within the Project Area during the seismic survey;
- energizing and recording;
- towing of the recording system.

Since each impact factor differently affects the marine organisms, the impact assessment below refers to individual species groups.

7.2.1.1. Marine mammals

According to the *baseline* study, 4 cetacean species are expected to live in the study area, viz.:

- striped dolphin, *Stenella coerueoalba* (Mediterranean sub-population, VU IUCN Red List);
- fin whale, *Balaenoptera physalus* (Mediterranean sub-population, VU IUCN Red List);
- sperm whale, *Physeter macrocephalus* (Mediterranean sub-population, EN IUCN Red List);
- Cuvier's beaked whale, *Ziphius cavirostris* (Mediterranean sub-population, DD IUCN Red List),

Other species are supposed to live in the Mediterranean basin, however, sightings and available data suggest that they are only occasional visitors in the study area. There is no evidence of the presence of the long-finned pilot whale (*Globicephala melas*) in the study area.

The following impact factors among those listed in Sect. 6 may significantly affect the cetaceans in the study area (see Table 6.2):

- physical presence of moving vessels;
- emission of non-impulsive noise generated by the vessel engines;
- emission of multi-pulse noise (*air gun*).

The physical presence of moving vessels may possibly affect the cetacean species in the study area. Collisions between vessels and large size species are frequently observed (Panigada *et al.*, 2006). Specifically, the fin whale and the sperm whale potentially present in the study area are mostly affected. Laist et al., 2001 indicate that most collisions involve vessels exceeding 14 knot speed. It is worth mentioning that cruising speed of the seismic vessels is 4-5 kn, as discussed in para. 2.3.3.4 this impact factor is therefore unlikely to be significant for the marine mammals in the study area.

Emission of non-impulsive noise generated by the vessel engines (master vessel and chase vessels) is a disturbance factor common to any cargo and passenger transport vessel or recreational boat sailing in the study area or near it. Low noise vessels shall be used during the seismic survey to avoid interfering with the *streamer* recording activity and speed of these vessels shall be cut down to 4-5 knots. It is therefore expected that this impact factor shall be not much significant.

Emission of multi-pulse noise (seismic survey) is a threat to the marine biodiversity, specifically to the cetaceans. Recent studies indicate that noise from an explosion event as well as noise generated by the *air guns* may propagate over 4,000 km, thus producing negative effects not only in the vicinity of the prospection areas (Nieukirk *et al.*, 2012, 2004). Most of the energy in the sound generated by the *air gun* being a low frequency one, studies on noise impacts on marine mammals from seismic prospections mainly focused on large and medium size mysticetes and the sperm whale (Cerchio *et al.*, 2014; Di Iorio and Clark, 2010; Madsen *et al.*, 2006, 2002; Madsen and Møhl, 2000; Miller *et al.*, 2009), whose alleged high hearing capacity at low frequencies (Au, 2000; Ketten, 2000) is such that overlaps the low frequencies of the emission range from the *air guns.* Recent studies (DeRuiter *et al.*, 2006; Goold and Fish, 1998; Madsen *et al.*, 2006) aroused concern on the assumption that the seismic noise may also negatively affect smaller size marine mammals having a hearing capacity more sensitive to the higher frequency (Au, 2000; Kastelein and Jennings, 2012; Malakoff, 2002; Pirotta *et al.*, 2014; Reynolds, 2005; Romano *et al.*, 2004; Weir, 2008; Williams *et a.,*, 2015). In relatively low deep waters (Au and Hastings, 2008; Richardson *et al.*, 1995), which is not the case of this study, the Application for Exploration Permit area is located in a bathymetric range of 300 m to 1000 m and most portion of it falls within bathymetric ranges of 500 m and 800 m). The investigated zone within the Project Area is the deepest one, particularly in the bathymetric range of 1,000 m.

The noxious effects due to the noise from the *air guns* tend to vary as function of the following parameters/factors:

- cetacean species;
- vicinity to the sound source;
- source features (for ex., *air gun* volume and number) and prospection duration;
- physiographic and geomorphological features of the seabed;
- behaviour of an animal or a group of animals (Caldwell, 2002; Costa, 2012; Finneran *et al.,* 2002; Pirotta *et al.,* 2014).

The model for sound dispersion in water highlights that a cetacean swimming in surface waters is much less affected than one swimming in deep sea beneath the source, the distance being equal and the sound emission being mainly vertical (Figure 7.2).

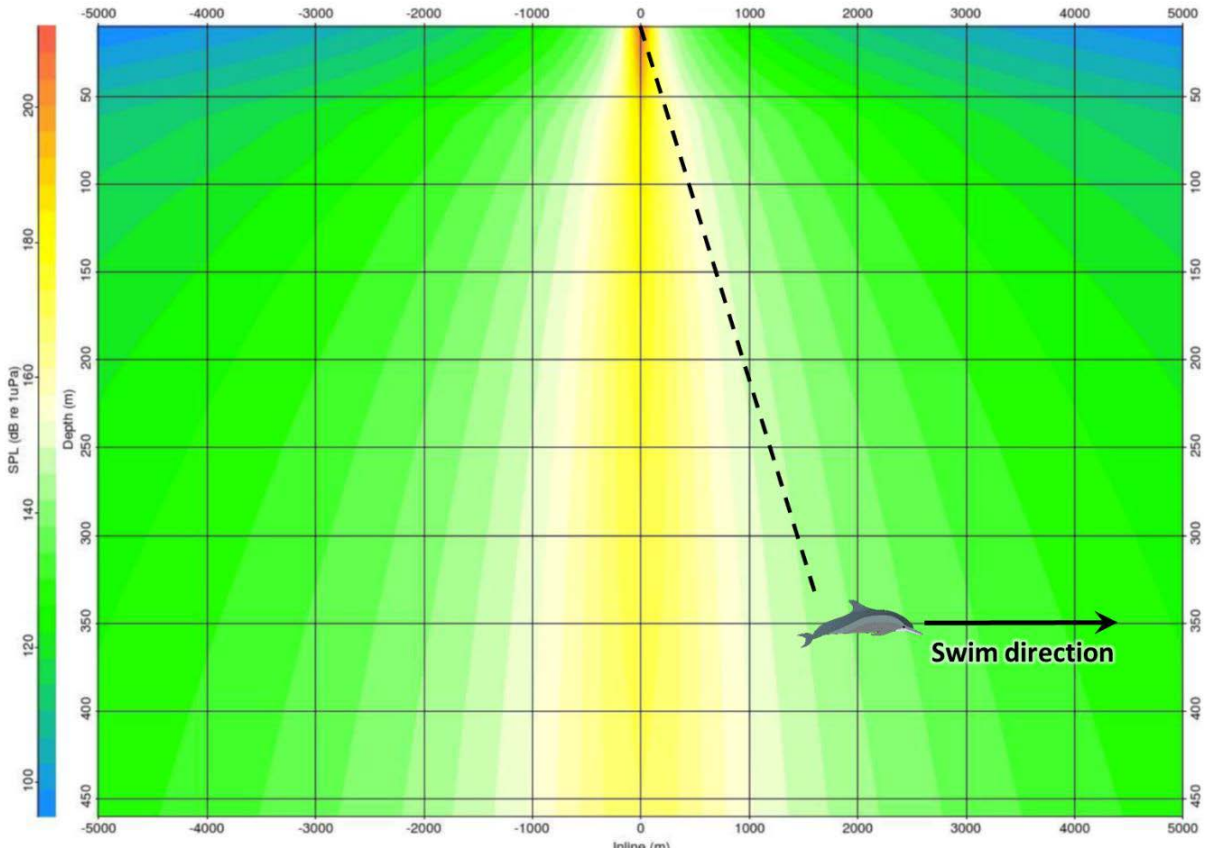


FIGURE 7.2: VARIATION OF THE SOUND INTENSITY AS FUNCTION OF THE DISTANCE AND LOCATION TO THE SOURCE

The potential negative effects found among others as a consequence of the seismic survey include animal displacement from the survey areas, disturbance of biologically important behaviours, masking of communication signals, chronic stress and temporary or permanent hearing loss (Nowacek *et al.*, 2015). This may however be insufficient to minimize the impacts the animals are subjected to.

SEL (*Sound Exposure Limit*) is an important tool to assess the total Energy of an event or a set of events an animal is subjected to. If a cetacean were nearby at the beginning of the survey, it would be scared by a given sound intensity and would leave the place by swimming at an estimated speed of abt. 1.5 m/sec. When departing, the sound intensity it was exposed to would diminish as function of the distance and the cumulative SEL would continue to raise till the distance increases to a point that it is no longer disturbed (see figure). The *Ramp Up* or *Soft Start* approach based on a progressive start of the seismic survey lowers the cumulative SEL down to the minimum and minimizes the impact risks.

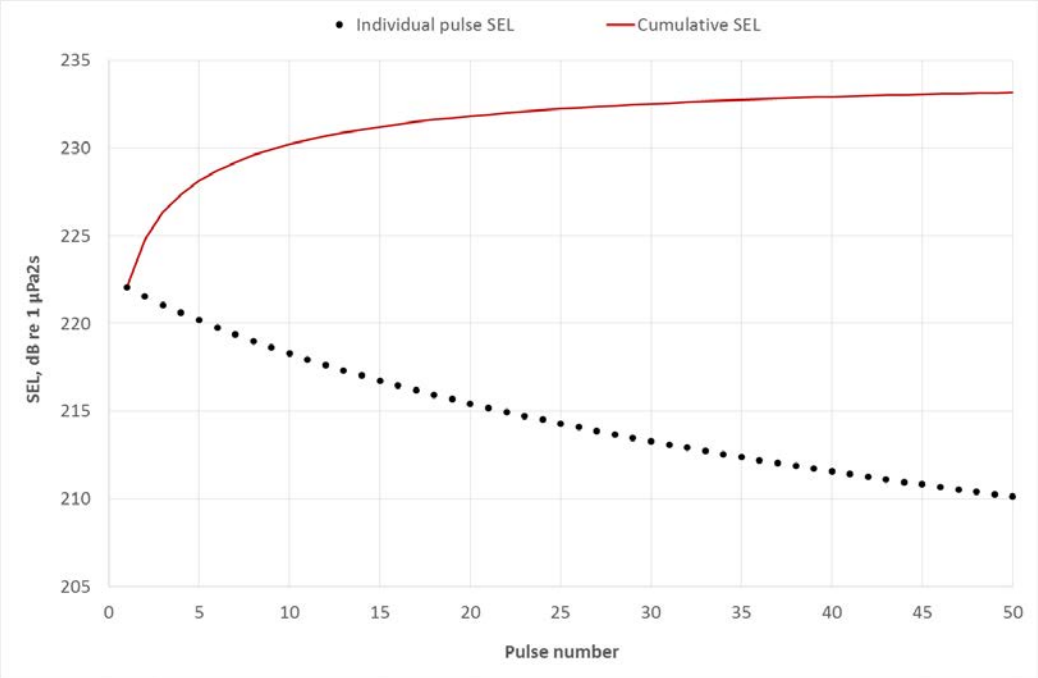


FIGURE 7.3: CUMULATIVE EFFECT (SEL) AS FUNCTION OF THE *AIR GUN* PULSE NUMBER

As known in the literature, the cetacean capacity to perceive sounds changes from species to species. The large size mysticetes like the fin whale have a hearing range from 7 Hz to 35 kHz and the smaller size dolphins (striped dolphins) a hearing range between 150 Hz and 160 kHz (NOAA, 2016).

This impact factor was considered as "continuous" according to the precautionary principle. It should however be pointed out that energizing shall be suspended during the *turning* stages. Generally, energizing and *turning* periods shall be alternated every 2.5 hours approximately.

The statements made in the ACCOBAMS and JNCC guidelines and the national guidelines worked out by ISPRA and CIBRA prompt the implementation of exclusion/prevention/mitigation measures with the aim of mitigating the impacts on the marine mammals.

1. A minor impact *air gun* configuration was selected as discussed in paragraphs 2.5 and 3.3.2 above relating to the *air gun* geometry and the Project technical alternatives.
2. No seismic survey shall be carried out in winter because of the possible presence of the fin whale species in the study area during that period.
3. An exclusion zone was defined based on the *air guns* used and the water properties, beyond which the intensity must not exceed 180 dB *re* 1 µPa at 1 m. This zone range is 600 m from the sound source as per the drafted acoustic model.
4. Skilled personnel with proven experience as *Marine Mammal Observer* (MMO) shall be employed on board the seismic vessel. Visual monitoring at day time shall be continuous. The observers shall wear binoculars including *big eyes* for a 360-degree view.
5. A 24-hour *Passive Acoustic Monitoring* (PAM) by means of hydrophones shall be provided during the seismic *survey* to ensure the localization of cetaceans in deep sea at night. Identification of the possible distance of the animal vocalizations requires the presence of sound experts.

6. During the seismic survey and prior to switching on the *air guns*, the absence of marine mammals shall be constantly checked for at least 120 min[6] (*pre-shooting search*) and over a range of at least 600 m corresponding to the Exclusion Zone (EZ) according to the sound dispersion model in deep sea.
7. Switching on/off of the *air guns* during the seismic survey shall occur progressively (*Ramp Up* or *Soft Start*) to allow the cetaceans in the EZ to abandon the area. The source shall be started at the minimum power and increased by no more than 6 dB *re* 1 µPa at 1 m every 5 minutes till achievement of the desired power.
8. During the seismic survey, the energizing system shall be immediately stopped, if marine mammals are approaching the EZ even outside it.
9. During the seismic survey, the energizing and recording activities shall be suspended, should marine mammals be sighted in the EZ, and be restored only 30 min. after the animals have left the area. In case of sighting loss, the diving time of *taxa* shall be precautionarily added to the 30-min. time (15 min. for small cetaceans, 30 min. for mystecetes and 120 min. for Cuvier's beaked whales and sperm whales).
10. The minimum power configuration designed to achieve the survey targets shall be provided.
11. It shall be a task of the responsible MMO to ask for suspension or termination of the activities in case of abnormal behaviour of the cetaceans due to the operations.
12. An end of activity report shall be drafted showing date and place of the seismic survey, *air gun* features, vessels used, sightings of marine mammals, procedures followed in case on sightings and general or sighting problems. This report shall be made available to the competent authorities, where required.
13. First aid fishing nets for cetacean strandings shall be ready during the operations.
14. An *ante-operam* monitoring shall be carried out prior to the seismic survey execution as required by the EIS/VAS Commission in the frame of the Scoping Procedure. For monitoring details refer to paragraph 8.2.1.
15. A *post-operam* monitoring shall be carried out as required by the EIS/VAS Commission in the frame of the Scoping Procedure. Reference is to be made to para. 8.2.3.

The table below summarizes the assessment of the Project impacts on cetaceans, whereby three impact factors were identified.

The implementation of the 15 exclusion/prevention/mitigation measures should allow to keep the impact on cetaceans at a **medium-low level.**

TABLE 7.3: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – CETACEANS

MATRIX FOR IMPACT ASSESSMENT – CETACEANS		Physical presence of moving vessels	Emission of non-impulsive noise	Emission of multi-pulse (multi-impulsive) noise
Duration (D)	short			
	medium-short			
	medium			
	medium-long			

[6]The JNCC guidelines require a control of at least 30 min. to be extended to 60 min. in case of waters with > 200 m depth, when the presence of deep sea species is not known (e.g. Cuvier's beaked whale and sperm whale). If this is not the case, 120 min. continuous observation shall be provided to increase the likelihood of tracking cetaceans diving deep and for long time in the study area.

MATRIX FOR IMPACT ASSESSMENT – CETACEANS		Physical presence of moving vessels	Emission of non-impulsive noise	Emission of multi-pulse (multi-impulsive) noise
	long			
Frequency (F)	concentrate			
	discontinuous			
	continuous			
Geographic extent (G)	local			
	regional			
	global			
Intensity (I)	negligible			
	low			
	medium			
	high			
Reversibility (R)	short-term			
	long-term			
	irreversible			
Probability of occurrence (P)	low			
	medium			
	high			
	certain			
Mitigation (M)	high			
	medium			
	low			
	none			
Sensitivity (S)	negligible			
	low			
	medium			
	high			
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.31	0.47	1.97
		Negligible	**Negligible**	**Medium-low**

7.2.1.2. Sea birds

A literature review made to identify the environmental scenario indicated the presence of mainly pelagic species in the study area. Birds living offshore are excellent swimmers with webbed feet facilitating the propulsion thrust when swimming. Most of their life cycle is spent offshore, except for nesting and growth of offspring that occur in the coastal areas.

The Project seismic survey may bring about many impacts on the sea birds. The most affecting impacts among those listed in para. 6.2.1 include emission of non-impulsive and multi-pulse noise, physical presence of moving vessels and lights at night.

The most significant impact on birds relates to the *air gun*-generated noise that could disturb the species when fishing or diving away. No limit values of noise emission causing a physiological damage to the

auditory system of sea birds is known so far. However, observations made on the occasion of similar projects suggest that a bird should be very near to the noise source to suffer significant damages. Similarly to the cetaceans, progressively increasing the sound emission level at the seismic survey start would be an adequate mitigation measure to minimize a potential impact on birds as it allows the individuals to leave the zone by diving. A progressive start of the seismic survey while the vessel is slowly moving should allow the birds to perceive the noise in advance and keep far off the area also during operations under steady state conditions. Documenting the observed behavior of the sea birds is another mitigation measure to improve the knowledge of the effects from a seismic survey on this species.

Moreover, the space propagation of the sound from the *air guns* occurs both horizontally (reduced) and vertically. When assessing the potential impacts on birds, the horizontal propagation deserves more attention than the vertical propagation, which is unimportant as the swimming birds are unlikely to reach higher depths than the emission source and the *streamers* (5 to 15 m).

A few studies in the literature have dealt with the effects of the seismic survey on birds. Lacroix et al, (2003) studied such effects on the long-tailed duck (*Clangula hyemalis)* in the Beaufort sea (Artic Ocean) and reached the conclusion that effects from seismic survey on moving and diving of these animals are unlikely to occur.

The *air gun*-generated noise could also alter the prey availability to the seabirds with consequent impairment of the trophic activity. However, researches carried out on this subject matter show that the noise affects only the invertebrates living at a few meter distance from the noise generation source (see para. 0; Brand e Wilson, 1996; McCauley, 1994). It is then deemed that the noise emission cannot alter the invertebrate availability (mainly crustaceans).

It may be that the seismic survey also affects fishes near the noise emission source (see 7.2.1.4). In such a case, the fishes affected by the *air gun*-generated noise move away from the emission source and the birds feeding on this trophic resource may in turn temporarily move away with the result that they will suspend fishing at some kilometer distance from the seismic activity.

It should also be pointed out that this species is unlikely to approach the seismic vessels when looking for food because of the noise generated by the moving vessels and the trend shown by this species to move away from the noise source. Some individuals could approach the vessels in the same way as they approach cargo vessels and depart shortly after without suffering any damage.

It shall be advisable not to leave uneaten food on the vessel during the seismic survey to avoid that birds are attracted therefrom. Food residues should be stored in confined closed containers.

Finally, the physical presence of moving vessels could cause the birds to be struck by the seismic vessel in case of low visibility due to heavy rain or fog. Similar collision could occur as a consequence of the attraction generated by lights at night. Birds are attracted by lights, whose high intensity may confuse them with consequent collision against the vessel. Reducing the light intensity where unrequired or using "*bird-friendly*" lights could help mitigate the effects (for example, lower wave length green or blue lights).

Any collision should be documented by indicating the species involved (or showing diagnostic photographs where identification is not feasible), date and time, coordinates, weather conditions and the vessel structure supposed to be involved in the collision.

The following exclusion/prevention/mitigation measures are suggested for the seabirds:

- Soft start of the seismic survey (*Ramp Up* o *Soft Start*)[7]. This approach already indicated as a mitigation measure for the cetaceans shall be also effective for the seabirds that can thus leave the study area.

[7] The source shall be switched on at minimum power and increased by not more than 6 dB *re* 1 µPa every 5 min. till achievement of the desired power.

- No deposit of food residues on the vessel during the seismic survey and storing of such residues in confined closed containers.
- Reduction of light intensity where feasible or use of "*bird-friendly*" lights.

The above considerations and the implementation of the proposed mitigation measures let categorise the Project impact as **low.**

The table below summarizes the assessment of the Project impact on the birds according to the identified impact factors.

TABLE 7.4: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS - BIRDS

MATRIX FOR IMPACT ASSESSMENT – BIRDS		Emission of non-impulsive noise	Emission of multi-pulse (multi-impulsive) noise	Physical presence of moving vessels	Lights at night
Duration (D)	short				
	medium-short				
	medium				
	medium-long				
	long				
Frequency (F)	concentrate				
	discontinuous				
	continuous		*		
Geographic extent (G)	local				
	regional				
	global				
Intensity (I)	negligible				
	low				
	medium				
	high				
Reversibility (R)	short-term				
	long-term				
	irreversible				
Probability of occurrence (P)	low				
	medium				
	high				
	certain				
Mitigation (M)	high				
	medium				
	low				
	none				

MATRIX FOR IMPACT ASSESSMENT – BIRDS		Emission of non-impulsive noise	Emission of multi-pulse (multi-impulsive) noise	Physical presence of moving vessels	Lights at night
Sensitivity (S)	negligible				
	low				
	medium				
	high				
Negative impact = (2,6*D+2,2*Di+2,4*A+7*Ri)*R*P*M*S		1.09 Low	1.16 Low	1.41 Low	1.41 Low r

* The multi-pulse noise emission was considered as "continuous" according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

7.2.1.3. Marine reptiles

As discussed in para. 4.3.2.1.3, the study area could be affected by the presence of *Caretta caretta* adults migrating from the Greek coasts to the foraging sites of northern Adriatic Sea in winter and individuals migrating from the northern Adriatic Sea to the spawning grounds in spring. Usually, migrations regard solitary individuals rather than groups.

The whole Ionian Sea (and hence the study area) could be dwelled by *C, caretta* pelagic juveniles born on Greece Ionian islands and Ionian portion of southern Calabria.

According to the statements made in para. 4.3.2.1.3, a high vulnerability of the "marine reptiles" is observed by virtue of the potential presence of the *C, caretta* species.

The most significant impact factors among those listed in Sect. 6 that can affect the *C, caretta* turtles include:

- Physical presence of moving vessels;
- Emission of non-impulsive noise generated by the vessel engines;
- Emission of multi-pulse noise (*air gun*);
- Physical presence of towed *streamers*.

Collisions between the moving seismic vessels physically present and the marine turtles are almost unlikely as speed of the seismic vessel at least (master vessel) shall be rather low (4-5 knots) during the seismic survey and the *air gun*-generated noise shall cause the *C, caretta* to move away, thus making a collision impossible. The risk of collision with the turtles during the approaching route of the seismic vessel (navigation to and from the study area) shall, however, be comparable to that arising out of navigation of any cargo and passenger transport vessel or recreational boat. These considerations prompted to disregard a matrix analysis of this impact factor .

The "emission of non-impulsive noise" generated by the vessel engines as an impact factor shall be common to any vessel navigating in the study area and in this case feature a lower intensity. Actually, vessels equipped with low noise propellers shall be used to avoid interferences with the seismic survey. This potential impact factor was therefore considered as negligible and excluded from the next assessment stages.

The multi-pulse noise from the *air gun* is not a key threat to the marine turtles. However, the ISPRA guidelines on the acoustic impact based on scientific studies highlight "alarm or escape attitudes as immediate reaction to the noise pulses generated by the *air gun*". Some authors suggest that the marine

turtles initially tend to escape at 175 dB *re* 1µPa or higher level (O'Hara and Wilcox 1990; McCauley *et al.,* 2000; Lenhardt 2002), a trend that progressively becomes less frequent over time, thus showing a sort of adaptability on the part of the marine reptiles. According to McCauley et al, (2000), an *air gun* seismic survey carried out at low depths (100-200 m) may influence the behaviour of the marine turtles up to a distance of 2 km and cause them to move away in a range of 1 km. Though the monitoring results obtained during seismic surveys are controversial, many authors report a greater number of turtle sightings in periods when no seismic survey is performed. A study conducted in the Mediterranean Sea on *C, caretta* off the Algerian coasts reported that most turtles reacted to shots every 19.4 seconds at a maximum intensity of 252 dB *re* 1 µPa at 1 m from the source by suspending the ongoing activity and diving down immediately. These impacts on behaviour were observed up to distance of 839 m from the seismic source.

Air guns with an intensity of 252 dB *re* 1 µPa at 1 m from the source being used in this research Project, turtles are expected to be affected from a behavioural point of view at least up to max. 839 m from the source. We can assume that the 600 m exclusion area defined for cetaceans and applied to turtles too may mitigate possible direct damages to *C, caretta*.

Streamers shall be abt. 8 km long. The "physical presence of towed *streamers*" might cause an impact on turtles, mainly due to the risk that the reptiles remain entangled in the submerged structures of the tail buoys located at the end of the *streamers* to warn their presence and perform a continuous monitoring by means of radar reflectors and GPS systems mounted on the surface of said buoys. The issue connected with this impact was studied (https://www,ketosecology,co,uk/Turtle-Guards/) and the results indicated that the use of "*Turtle Guards*", placed on the buoy submerged structures are capable of avoiding the occurrence of these incidents. These devices are simple metal bars to be added to the buoy structure to prevent the turtles from being entangled.

To conclude, two main impact factors, viz. *air gun* multi-pulses and physical presence of tail buoy-towed streamers, may significantly affect the marine turtles. The following exclusion/prevention/mitigation measures are suggested:

1. Soft start of the seismic survey (*Ramp Up* o *Soft Start*)[8]. This approach already indicated as a mitigation measure for the cetaceans shall be also effective for the turtles that can thus leave the study area.
2. Visual observation of the turtles and power reduction or suspension of the activity. The MMOs shall observe and take into account also the presence of marine turtles in the exclusion area during the visual monitoring to search for cetaceans. If an animal is sighted, the MMO shall be responsible for reducing the power or suspending the activity.
3. Use of "*Turtle Guards*", mounted on the submerged parts of the *streamer* tail buoys.

The above considerations and the implementation of the proposed mitigation measures let us assume that the Project potential impact on the marine turtles is of **low to negligible magnitude.**

The following table summarizes the assessment of the Project impact on the marine turtles according to the identified impact factors.

[8] The source shall be started at the minimum power and increased by not mor than 6 dB *re* 1 µPa every 5 minutes till achievement of the desired power.

TABLE 7.5: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – MARINE REPTILES

MATRIX FOR IMPACT ASSESSMENT – MARINE REPTILES		Physical presence of moving vessels	Emission of non-impulsive noise	Emission of multi-pulse (multi-impulsive) noise	Physical presence of towed *streamers*
Duration (D)	short				
	medium-short				
	medium				
	medium-long				
	long				
Frequency (F)	concentrate				
	discontinuous				
	continuous			*	
Geographic extent (G)	local				
	regional				
	global				
Intensity (I)	negligible				
	low				
	medium				
	high				
Reversibility (R)	short-term				
	long-term				
	irreversible				
Probability of occurrence (P)	low				
	medium				
	high				
	certain				
Mitigation (M)	high				
	medium				
	low				
	none				
Sensitivity (S)	negligible				
	low				
	medium				
	high				
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.24	0.12	0.32	0.38
		Negligible	**Negligible**	**Negligible**	**Negligible**

* The multi-pulse noise emission was considered as “continuous” according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

7.2.1.4. Fishes and fish stocks of molluscs and crustaceans

According to the description of the component status, the study area seabeds are populated by a number of fish species in addition to crustaceans and molluscs of fisheries interest. There is however no evidence of the presence of fish species protected at national and international level.

The possibly significant impact factors among those listed in Sect. 6 affecting the fish fauna (and the crustaceans and molluscs fish stocks) include :

- Emission of non-impulsive noise generated by the vessel engines;
- Emission of multi-pulse noise (*air guns*).

The non-impulsive noise generated by the engines is an impact factor common to any vessel navigating in the study area. In this case, vessels equipped with low noise propellers shall be used to avoid interferences with the recording activity. The non-impulsive noise generated therefrom shall be even lower than that of fishing and recreational boats or cargo vessels occasionally navigating or operating in the study area. The potential of this impact factor has been considered irrelevant and disregarded at the next assessment stages.

The *air gun* (multi-pulse noise) is instead a factor that mostly affects the fish and invertebrate fish stock community present in the study area because of the nature of the generated acoustic pulse (Table 7.6).

TABLE 7.6: TECHNICAL FEATURES OF THE SELECTED *AIR GUN*

***Air gun* features**	**Values**
Air Gun qty	33
Sub-*Array* qty	3
Total volume	59 litres (3640 in³)
Operating pressure	2,000 psi
Frequency range	5-300 Hz
Sound intensity at source	252 dB *re* 1 µPa at 1 m
Sub-*Arra* length	14 m
Sub-*Array* w idth	14.6 m
Distance betw een Sub-*Arrays*	2.8 m
Array depth	7 m

Teleosteos and chondrichthyes use sounds for many survival functions like identification of potential preys or predators. The perception *range* of acoustic stimuli is between 100 and 2,000 Hz for bone fishes and 200 and 600 Hz for cartilageneous fishes (ISPRA, 2011).

Among the cartilageneous fishes, the pelagic species would be according to some authors (Carrol *et al.*, 2017) more vulnerable than the demersal species. Among the invertebrate fish stocks, decapod crustaceans and cephalopods have a greater capacity to perceive the underwater noise. Cephalopods perceive sounds between 10 Hz and 400 Hz (Carrol *et al.*, 2017; Hu *et al.*, 2009; Mooney *et al.*, 2010). Data on crustaceans refer to lobate, which is a species not registered in the study area. The tests made showed a lobster capacity to perceive sounds up to 5,000 Hz,

The emission frequency *ranges* for the *air gun* correspond to 5-300 Hz (Table 2.2).

According to the literature information, the fish level of vulnerability to the *air gun* is controversial. From a behavioural viewpoint, ISPRA (2011) reported disintegration phenomena within bluefish schools, while Peña *et al.* (2013) did not find any response in the Atlantic herrings. On the contrary, a greater cohesion was observed by Fewtrell & McCauley (2012) in demersal species coinciding with a swim direction to deep sea. Also controversial is the information on crustaceans fish stocks. If some authors (Day *et al.,* 2016) observed damages in lobesters at statocytes level due to low frequency emissions, other authors (Christian *et al.,* 2003) did not observe any effect on Alaska shrimps after 200 shots at 10 second intervals and a frequency of 17 to 31 Hz. It is then likely that species differ from one another and variability is associated to environmental factors.

The distance from the emission source plays an essential role in determining physiological responses. In this respect, McCauley *at al,* (2003) report injuries to the fish auditory system at a distance of 5m to 300 m from the acoustic source with an acoustic intensity equal to 222,6 dB *re* 1 µPa at 1 m. Given that the intensity of the selected configuration is similar (little over), a potential impact on the fish fauna in a comparable *range* can be expected. It should also be considered that vulnerability depends on the nature of the species, both for fishes and invertebrate fish stocks, and on distance from the source. It therefore varies from species to species.

In the *baseline* study three different levels of sensitivity in three different zones of the study area were assigned as function of the presence, abundance and diversity of the fish species and invertebrate fish stocks and of the possible presence of recruitment and/or *spawning* phenomena, i.e.:

- Zone around the western border of the area characterized by abundance of many bone fish species (40 different species of demersal fishes were registered) associated with the presence of white coral biocoenosis, greater concentration of sharks than the rest of the area, presence of *nursery* sites (for ex., blackbelly rosefish and velvet belly lanternshark) and alleged presence of *spawning* grounds for the blackbelly rosefish. It is a high-sensitivity zone.
- Zone north west of the study area characterized by the escarpment dropping down from abt. 200 m to abt. 450 m, rich in fish fauna, with *nursery* sites for various osteocytes and crustacean fish stocks. It is a medium-sensitivity zone.
- Rest of the study area with partially flat mobile seabeds hosting a fauna typical of the Ionian deep sea, which is known to be subjected to trawling, particularly in the eastern sector. It is a low-sensitivity zone.

Periods of higher vulnerability of the fish fauna related to migration, spawning and presence of juveniles of some species present in the study area have been also identified. These periods are summarized in Table 7.7.

TABLE 7.7: PERIODS OF HIGHER VULNERABILITY OF SOME FISH SPECIES

Fish species	Notes	Periods of higher vulnerability of somespecies of the fish fauna present in the study area (recruitement, spawning, abundance of juveniles)											
		Winter			Spring			Summer			Autumn		
		G	F	M	A	M	G	L	A	S	O	N	D
Thunnuns thynnus	presence												
Helicolenus dactylopterus	spawning/juveniles												
Merlucius merlucius	juveniles												
Phycis blennoides	spawning/juveniles												
Etmopterus spinax	juveniles												

Some of the exclusion/prevention/mitigation measures proposed for cetaceans (para. 7.2.1.1) provide exclusion/prevention/mitigation impact effects also on fish fauna. They are:

1. Selection of minor impact *air gun* . As discussed in paras 2.5 and 0 relating to the selection of the *air gun* geometry and the Project technical options, a minor impact geometry and configuration of the *air gun* has been selected (*Polarcus 3640 in*^{3}).
2. Switching on/off of the air guns shall follow a *Ramp Up* approach (as previously described in the paragraph on cetacean impact – 7.2.1.1) to allow pelagic fishes to move away from the emission source.

The following exclusion/prevention/mitigation measures shall be implemented in addition to the ones mentioned above :

3. Consistently with other restrictions, the performance of the seismic survey shall be as far as possible avoided in the Winter period and fisheries biological rest periods.
4. The MMOs shall during the visual monitoring for search of cetaceans consider the possible transit of large pelagic species (i.e., tuna and/or sharks) within a range of 300 m from the sound source. The MMO shall be entitled to decide on the survey suspension.
5. Investigations in higher vulnerability zones shall be avoided (white coral and escarpment zone).

   Since McCauley *et al,* (2003) found impacts up to 300 m distance, the seismic survey lines should be planned to ensure a 500 m distance at least between the higher vulnerability zone (white coral zone) and the acoustic source. Such a distance shall already be ensured by the bathymetric range of the study area, which far exceeds 500 m in the zone near the western border of the exploration area, where white coral colonies associated to a diversified fish community were found. To additionally ensure an impact exclusion, the position of the Project Area in the southeastern sector of the Application for Exploration Permit Area shall avoid any potential impact on the zones with higher vulnerability for the fish component.

On the basis of the nature, intensity and temporary nature of the impact factor and of the implementation of adequate mitigation measures as described during the Project activities, an **impact of low to negligible magnitude** on fishes and molluscs/crustaceans fish stocks is expected in the study area.

The following table summarizes the assessment of the Project impact on fishes and invertebrate fish stocks according to the identified impact factor and the adoption of the suggested mitigation measures.

TABLE 7.8: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – FISHES AND INVERTEBRATE FISH STOCKS

MATRIX FOR IMPACT ASSESSMENT – FISHES AND INVERTEBRATE FISH STOCKS		Emission of multi-pulse (multi-impulsive) noise		
Different vulnerability zones		Zone with presence of white corals	Escarpment zone	Partially flat mobile seabed zone
Duration (D)	short			
	medium-short			
	medium			
	medium-long			
	long			
Frequency (F)	concentrate			
	discontinuous			
	continuous	*	*	*

MATRIX FOR IMPACT ASSESSMENT – FISHES AND INVERTEBRATE FISH STOCKS		Emission of multi-pulse (multi-impulsive) noise		
Different vulnerability zones		Zone with presence of white corals	Escarpment zone	Partially flat mobile seabed zone
Geographic extent (G)	local			
	regional			
	global			
Intensity (I)	negligible			
	low			
	medium			
	high			
Reversibility (R)	short-term			
	long-term			
	irreversible			
Probability of occurrence (P)	low			
	medium			
	high			
	certain			
Mitigation (M)	high			
	medium			
	low			
	none			
Sensitivity (S)	negligible			
	low			
	medium			
	high			
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.77	0.58	0.77
		Low	**Negligible**	**Low**

* The multi-pulse noise emission was considered as “continuous” according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

7.2.1.5. Benthos

The study area was subdivided into three different zones hosting present or potentially present benthic communities with different vulnerability.

- A very small zone around the western border of the Application for Exploration Permit Area categorized as highly vulnerable due to the presence of white coral colonies. This zone including the *buffer* area around the Application for Exploration Permit Area extends over abt. 4 km^2 at the lowest sea level.
- A small zone located northwest the Application for Exploration Permit Area characterized by escarpment sea floors with potential presence of moderately vulnerable benthic species covering abt. 38 km^2 surface including *buffer*;

- A wide partially flat seabed zone located in the rest of the Application for Exploration Permit Area and related *buffer* classified as low vulnerable zone on the basis of the bibliographic surveys (this zone extends over 800 km^2 including *buffer*).

Sound plays a significant role for many benthic invertebrate species among which many crustaceans species and anemones. The seismic activity is not listed in the literature as one of key threats to the vagile and sessile benthic fauna remarkably more affected by other anthropic activities like trawling, pollution and dumping.

The white coral colonies are the most valuable benthic organisms in the study area because of them being an internationally protected species and playing the role of biobuilders and hence of structural pillars and core elements of the communities living around.

Studies conducted in both North Sea waters and tropical waters revealed the absence of damages to corals and their associated species after seismic explorations. One of the most important studies was conducted in western Australia in 2007 (Battershill *et al.,* 2007; 2008), which employed surveys before and after a 3D seismic survey near a coral reef extended for 237 km^2 at a maximum depth of 60 m (*Scott Reef*). The study results based on the implementation of standard mitigation measures revealed neither damages or stresses to the coral-associated fauna nor short- and long-term impacts on fish populations nor evidence of damages to the coral polyp colonies.

There is however a threshold value defined by Hastings *et al,* (2008), beyond which sound may cause damages to the coral polyps or their structures:

- Damages to the coral skeleton structures may occur when 270 dB *re* 1 µPa are exceeded;
- Damages to the coral polyps may occur when 260 dB *re* 1 µPa are exceeded.

It should be pointed out that the study area depth is abt. 1,000 m and the sound intensity shall never reach the indicated threshold values not even at one meter from the source by virtue of the selected *air gun* technical features and the sound dispersion model (252 dB *re* 1 µPa).

Some of the exclusion/prevention/mitigation measures already addressed for cetaceans, fishes and birds provide an impact mitigation effect also on benthos, specifically:

1. Selection of minor impact *air gun*. As discussed in paras 2.5 and 0 relating to the selection of the *air gun* geometry and the Project technical options, a minor impact geometry and configuration of the *air gun* has been selected (*Polarcus 3640 in^3*).

The most effective exclusion measure in addition to that above is as follows:

2. Appropriate selection of the seismic survey area (Project Area) to avoid all zones classified as highly and moderately vulnerable to the benthic component. Deciding to operate in the southeastern sector of the Application for Exploration Permit Area shall avoid any possible risk of impact on the white coral biocoenosis in zones, where these species have been certainly observed and zones that according to some authors could be possibly colonized by white corals, and on other sensitive assemblages present in the northern sector of the Application for Exploration Permit Area named escarpment area.

The matrix below shows different impact magnitudes in the investigated zones, despite the mitigation measures implemented:

- Low impact in the white coral dwelled zone;
- Negligible impact in the escarpment zone;
- Negligible impact in the partially flat mobile seabed zone.

TABLE 7.9: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS –BENTHOS

MATRIX FOR IMPACT ASSESSMENT– BENTHOS		Emission of multi-pulse (multi-impulsive) noise		
Differently vulnerable zones		White coral dwelled zone	Escarpment zone	Partially flat mobile seabed zone
Duration (D)	short			
	medium-short			
	medium			
	medium-long			
	long			
Frequency (F)	concentrate			
	discontinuous			
	continuous	*	*	*
Geographic extent (G)	local			
	regional			
	global			
Intensity (I)	negligible			
	low			
	medium			
	high			
Reversibility (R)	short-term			
	long-term			
	irreversible			
Probability of occurrence (P)	low			
	medium			
	high			
	certain			
Mitigation (M)	high			
	medium			
	low			
	none			
Sensitivity (S)	negligible			
	low			
	medium			
	high			
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.84	0.63	0.42
		Low	**Negligible**	**Negligible**

* The multi-pulse noise emission was considered as “continuous” according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

As the Project Area falls within the partially flat mobile seabed area, the impact can be classified as **negligible.**

7.2.1.6 Phytoplankton and zooplankton

As already discussed, the plankton (phytoplankton and zooplankton) plays a vital role for the dynamics of the marine ecosystems and decisively influences the physical sea environment. The study area characterization results have demonstrated that a quite diversified abundance of phytoplankton and zooplankton species live in this area.

Limited data on phytoplankton and zooplankton vulnerability to the discussed Project are available, however, the multi-pulse noise generated when switching on the *air gun* has been identified as the mostly affecting impact factor among those listed in para. 6.2.1.

Davis et al, (1998) reported a plankton mortality rate up to 1% in the first 50 m of water column during a 3D seismic prospection in Nova Scotia, while Kenchington *et al,* (2001) estimated a 6% mortality rate of the plankton living in the first 10 m depth. More specifically, Thomson *et al,* (2000) reported that impacts on phytoplankton and zooplankton are generally observed at 5 m depth around the seismic survey area, thus leading these organisms to die and depleting an important trophic resource for whales, fishes and birds.

The literature provides other studies focused on the fish egg and larvae sensitivity to the acoustic waves in geophysical prospections. ISPRA 2012 highlights that Payne *et, al,* (2009) reported the results of an experiment designed to monitor any *air gun* short-term effect on fecundated eggs and larvae of some species. No significant mortality differences were found in the exposed organisms compared to the controls during the first 4 days of exposure. This is also confirmed by the fact that mortality of or damage to fish larvae were observed at distances lower than 5 m from the noise emission source (Kostyuchenko, 1973; Booman *et al.,* 1996). Data available in the literature suggest to think that fish eggs and larvae die only when they live at short distances from the seismic source. Kostyuchenko (1973) reports that more than 75 % of the fish eggs survive at 0.5 m distance from the seismic source (233 db at 1 m) and more than 90% survive at 10 m from the source. Since the plankton larvae quickly disperse and the potential damage caused by the *air gun* sound waves is highly localized, then the mortality rate due to the noise is likely to be negligible as compared to the natural mortality rate (Morrison *et al.,* 2011; Booman *et al.,* 1996; Dalen and Maestad, 2008; Saetre and Ona, 1996).

The above considerations suggest that magnitude of the Project impact on plankton is **low.**

The following table summarizes the assessment of the Project impact on plankton according to the identified impact factors .

TABLE 7.10: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – PLANKTON (PHYTOPLANKTON AND ZOOPLANKTON)

MATRIX FOR IMPACT ASSESSMENT - PLANKTON		Emission of multi-pulse (multi-impulsive) noise
Duration (D)	short	
	medium-short	
	medium	
	medium-long	
	long	
Frequency (F)	concentrate	
	discontinuous	

MATRIX FOR IMPACT ASSESSMENT - PLANKTON		Emission of multi-pulse (multi-impulsive) noise
	continuous	*
Geographic extent (G)	local	
	regional	
	global	
Intensity (I)	negligible	
	low	
	medium	
	high	
Reversibility (R)	short-term	
	long-term	
	irreversible	
Probability of occurrence (P)	low	
	medium	
	high	
	certain	
Mitigation (M)	high	
	medium	
	low	
	none	
Sensitivity (S)	negligible	
	low	
	medium	
	high	
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		1.45
		Minor

* The multi-pulse noise emission was considered as "continuous" according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

7.2.1.7 Biocoenosis

The study area has been also subdivided into three zones with a different level of sensitivity of benthic biocoenosis as done for the fish and benthos components:

- High-sensitivity biocoenosis of deep sea corals (or white corals). This biocoenosis only marginally affects the study area at its western border cover a surface of less than 4 km^2.
- Escarpment habitat. The biocoenosis here results from the biocoenosis of bathyal muds, often rich and diversified thanks to the seabed morphology and the presence of currents. The more rough the sea floor characterized by canyons or different structure walls and formations, the more valuable are these characteristics. The available data suggest that the escarpment area falling within the Application for Exploration Permit Area is not particularly rough and shows an average

slope little higher than 5%. No valuable elements are likely to be there, however, a medium sensitivity rating is assigned based on the precautionary principle.

- Biocoenosis of bathyal muds in reduced slope or flat habitats. The sea floor is characterized by argillaceous muds that may be compacted or wet. The species in this biocoenosis are often distributed at quite low density. A low sensitivity rating was assigned to this zone.

In addition to the benthic biocenosis, the pelagic biocenosis including the water mass of the study area was also considered . A high sensitivity rating was assigned to this biocenosis as discussed in the "*baseline* characterization of the environmental components.

The impact assessment at biocoenosis level requires that the whole of impact considerations and assessments for the different environmental components, particularly marine soil and subsoil, fishes, benthos, phytoplankton and zooplankton, marine turtles and cetaceans, be taken into account.

All the exclusion/prevention/mitigation measures for the above components shall therefore be addressed for the biocoenesis impact.

The following conclusions can be drawn.

- A potential impact on white coral biocenesis can be excluded as the seismic survey shall not affect the area where white corals live or are supposed to live according to some authors.
- A potential impact on the escarpment habitats of no particular value according to the available data can be fully excluded, as the seismic survey shall be not carried out in the study area.
- A potential impact on the bathyal seabed biocenosis shall be minor by virtue of both biocenosis low sensitivity and the distance between the noise source (mainly *air guns*) and the biocenesis itself (the study area depth is abt. 1,000 m and the sound emission source is located at abt. 7 m depth).
- A potential impact on the pelagic biocenosis including all cetaceans and the pelagic fish fauna shall be of moderate-minor magnitude thanks to the exclusion/prevention/mitigation measures adopted for cetaceans, marine reptiles and fishes.

7.2.1.8 Protected and restricted zones

The identified impact factors interfering with the protected and restricted zones as consequence of the Project activities shall include:

- Emission of multi-pulse noise;
- Physical presence of moving vessels;
- Emission of non-impulsive noise;
- Lights at night .

The potential impacts influencing the protected zones are therefore mainly linked to navigation of the vessels to and from the investigated areas, navigation of vessels during the data acquisition campaign and energizing and recording operations.

The study area environmentally assessed with reference to this component covers the marine area, where the Project activities shall be carried out, and the shoreline of the Salento peninsula. The analysis results have demonstrated that the Application for Exploration Permit Area does not fall within any nationally or internationally protected area, even though the Salento peninsula is rich in coastal Regional Natural Parks identified as SCI and SPA belonging to Natura 2000 Network and has an *Important Bird Area (IBA)*.

The minimum distance between the Project Area for seismic prospection and the protected areas shall always be higher than 12 nautical miles according to the Law Decree No. 152/2006 as amended and supplemented for safeguarding the protected natural areas and avoiding the potential of impacts from the seismic survey.

The table below shows the core elements for assessment of the protected areas with indication of the biodiversity values of the individual zones, the minimum distance from the Application for Exploration Permit Area and any impact caused by the Project activities.

TABLE 7.11: PROTECTED AREAS AND POTENTIAL IMPACTS

Name	Designation reasons and biodiversity values	Distance from the Project Area (nautical miles)	Potential Project impacts
Marine SCI "Posidonieto Capo San Gregorio – Punta Ristola" (IT9150034)	*Posidonia* prairies in good vegetation conditions . The main biocenoses found in this sea stretch are –biocenosis of the photophilic –coralligeneous algae in hard substrates. The rocky substrates are always covered by green and brown algae (*Halimeda tuna*, *Padina pavonica*, *Acetabularia acetabulum*) also because of the transparency of water. The coralligeneous habitat is extremely characteristic with peaks that progressively increase with an increase in the depth. It comprises many vegetal and animal species among which the Porifera *Petrosia ficiformis* and *Axinella sp.*; the Anthozoa *Cladocora coespitosa* and the Tunicate *Halocynthia papillosa*.	> 15	None
Marine SCI "Litorale di Ugento" (IT9150009)	The Ugento scrubland is the widest Mediterannean maquis now present in Salento. The pinewood hosts a population of the endemic *Ophrys parvimaculata*,	> 18	None
Marine SCI "Litorale di Gallipoli e Isola di Sant'Andrea" (ITA9150015)	A site characterized by the presence of encrusting algae pavements .	> 20	None
SCI "Costa tra Capo d'Otranto e Santa Maria di Leuca" (ITA9150002), within the IBA IT147 "Cape Otranto and Cape Santa Maria di Leuca coast"	Site of paramount importance because of the presence of endemic and transadriatic species and of encrusting algae pavements and Garigues of *Euphorbia spinosa*, As IBA, this site is an important "*bottleneck*" site for birds of prey travelling along the Adriatic coasts in spring. More than 3,000 birds of prey are estimated to travel every spring, though the sole information available dates back to 1989, when 1,500 individuals were counted, mainly birds of prey of the *Circus* order and European honey buzzards (*Pernis apivorus*).	> 12	The Project could affect the birds migrating at night during spring. However, these species tend to fly along the coast, so that an impact is unlikely to occur due to the Project Area distance from the coastline.
Regional Natural Park "Costa Otranto - Santa Maria di Leuca e Bosco di Tricase", including the SCIs "Costa Otranto – Santa Maria di Leuca (IT9150002), "Boschetto di Tricase" (IT9150005) e "Parco delle querce di Castri" (IT9150019)	This Park houses a flora rich in rare endemisms listed in the National "Red List" and transadriatic and transionian species enhancing the phytogeographic value of the coastline. The fauna comprises important colonies of bats living in caves, troglobionts listing some rare species and endemic invertebrates like *Italodytes stammeri*, *Typhlocaris salentina*, *Haloblothrus gigas*, small crustaceans and other marine organisms finding shelter and survival conditions in submerged and half-submerged caves. The Park partially coincides with the SCI ITA9150002 and IBA IT147 described above.	> 12	The Project could affect the birds migrating at night during spring. However, these species tend to fly along the coast, so that an impact is unlikely to occur due to the Project Area distance from the coastline,
Regional Natural Park "Litorale di Ugento"	The basin system, particularly that of Rottacapozza Sud, is important because of the presence of many bird species, migratory and sedentary birds using this area as shelter, spawning and feeding ground. Basins are located along the main migration routes and host birds coming from North Africa, the Balkans and North Europe. In addition to the many colonies of yellow legged gulls (*Larus michahellis*) and great cormorants (*Phalacrocorax carbo*), purple herons (*Ardea purpurea*) and grey herons (*Ardea*	> 18	The Project could affect the birds migrating at night during spring. However, these species tend to fly along the coast, so that an impact is unlikely to occur due to the Project Area distance from the coastline

Name	Designation reasons and biodiversity values	Distance from the Project Area (nautical miles)	Potential Project impacts
	cinerea), reed warbles (*Acrocephalus scirpaceus*) or rare individuals of American flamingo (*Phoenicopterus ruber*) are found. Many common coots (*Fulica atra*), common moorhens (*Gallinula chloropus*) and mallards (*Anas platyrhynchos*) swim in clear waters, while the gross snake (*Natrix natrix*) and the rare European pond turtle (*Emys orbicularis*) live in reed beds		

Finally, as already discussed in the environmental baseline study, the Project Area borders an area defined as priority for conservation of the biodiversity for which an application is being submitted to the Ministry for Environment and Territory (MATTM) for its establishment as coastal Protected Marine Area named "Salento Peninsula" (http://www,minambiente,it/pagina/aree-marine-di-prossima-istituzione). Aim of establishing this PMA is completion and promotion of the Puglia-based Protected Marine Area system in addition to those already existing (Isole Tremiti, Torre Guaceto and Porto Cesareo).

Given the distance between the Project Area and the established and investigated coast and land protected areas, a **negligible or null intensity** is assigned to the latter.

The Project impact on the investigated protected areas was assessed on a cautionary basis for the marine area being established, as it is nearer to the Project Area, and rated as minor (summary in the table below).

TABLE 7.12: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – PROTECTED AREAS

MATRIX FOR IMPACT ASSESSMENT – PROTECTED AREAS		Emission of non-impulsive noise	Emission of multi pulse (multi-impulsive) noise	Physical presence of moving vessels	Lights at night
Duration (D)	short				
	medium-short				
	medium				
	medium-long				
	long				
Frequency (F)	concentrate				
	discontinuous				
	continuous		*		
Geographic extent (G)	local				
	regional				
	global				
Intensity (I)	negligible				
	low				
	medium				
	high				
Reversibility (R)	short-term				
	long-term				

MATRIX FOR IMPACT ASSESSMENT – PROTECTED AREAS		Emission of non-impulsive noise	Emission of multi pulse (multi-impulsive) noise	Physical presence of moving vessels	Lights at night
	irreversible				
Probability of occurrence (P)	low				
	medium				
	high				
	certain				
Mitigation (M)	high				
	medium				
	low				
	none				
Sensitivity (S)	negligible				
	low				
	medium				
	high				
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		1.45	0.97	1.45	1.26
		Low	**Low**	**Low**	**Low**

* The multi-pulse noise emission was considered as "continuous" according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

7.3. Impacts on social and economic components

7.3.1. Fisheries

The factors of impact from the Project activities that may interfere with fisheries are as follows:

- Emission of multi-pulse (multi-impulsive) noise;
- Physical presence of moving vessels;
- Physical presence of towed *streamers* .

The potential impacts influencing fisheries are mainly due to navigation of vessels within the Project Area during the data acquisition campaign, energizing and recording operations and towing of the receiver system.

Impacts on fisheries are both direct due to navigation banning around the operating seismic vessel and indirect due to potential impacts on the fish species from multi-pulses.

Navigation banning shall be extended to a limited sea portion, where the master vessel is operating. Banning shall therefore reduce the water pool available for fisheries and interfere with the ordinary activities. Banning shall be temporary and change place within the Application for Exploration Permit Area according to the daily activities.

To minimize interferences with fishing vessels, Petroceltic/Edison shall inform the competent Port Authorities on location of the zones involved in the seismic survey within the Project Area, which in turn will inform the vessels navigating in the area through the usual communication methods (for example, bulletins and notices to skippers). The fishing activities can then be planned to avoid possible interferences.

Given the number of fishing vessels operating in the study area and the small size of the banned area, the direct impact is considered negligible. As no unique species are present in the study area, it is possible that the fishing vessels can fish the same species in other areas.

It is also possible that the seismic survey be carried out at no fishing periods. In such a case, impacts on fisheries would be furtherly reduced.

As already pointed out in para. 7.2.1.4, there is no accepted and shared opinion on the magnitude of the real indirect impacts on fishes from the *air gun* technique between experts and public institutions.

An abstract from page 19 of the Technical Report "Assessment and mitigation of the sound impact from geophysical prospections" worked out by ISPRA in May 2012 is reported below.

"It seems that there are effects also on fisheries (less catch), however, the results are controversial. Some studies have demonstrated a reduction in catches even after some days from operation completion and a reduction in egg availability probably due to the prolonged exposure of fishes to low frequency sounds (Engas et al, 1996; Hirst et al., 2000; Wardle et al., 2001). Pickett et al, (1994) instead did not report significant catch differences during the seismic prospections".

On the basis of the foregoing, we cannot finally determine what will be the impacts. However, as illustrated in para. 7.2.1, the exclusion/prevention/mitigation measures proposed for the "fauna, flora, ecosystem" component shall significantly minimize the Project negative impacts, if any.

If we assume that fishes are affected, then the impact shall result in limited catches by the fishing vessels that fish the affected species. In any case, the impacts would be of temporary nature due to the short time required for the operations and shortly reversible once the seismic activities have been completed and the species conditions restored.

The following table summarizes the assessment of the Project impact on fisheries according to the identified impact factors .

TABLE 7.13: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – FISHERIES

MATRIX FOR IMPACT ASSESSMENT – FISHERIES		Emission of multi-pulse (multi-impulsive) noise	Physical presence of moving vessels	Physical presence of towed *streamers*
Duration (D)	short			
	medium-short			
	medium			
	medium-long			
	long			
Frequency (F)	concentrate			
	discontinuous			
	continuous	*		
Geographic extent (G)	local			
	regional			
	global			
Intensity (I)	negligible			
	low			
	medium			
	high			
Reversibility (R)	short-term			

MATRIX FOR IMPACT ASSESSMENT – FISHERIES		Emission of multi-pulse (multi-impulsive) noise	Physical presence of moving vessels	Physical presence of towed *streamers*
	long-term			
	irreversible			
Probability of occurrence (P)	low			
	medium			
	high			
	certain			
Mitigation (M)	high			
	medium			
	low			
	none			
Sensitivity (S)	negligible			
	low			
	medium			
	high			
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		1.04	0.82	1.26
		Low	**Low**	**Low**

* The multi-pulse noise emission was considered as "continuous" according to a precautionary principle. However, energizing shall be suspended during the *turning* stages. Generally, the energizing and *turning* stages shall be alternated every 2.5 hours approximately.

According to the considerations above and as highlighted in the above table, a cautionary **low impact** rating was assigned .

7.3.2. Landscape and archaeological heritage

The sole impact factor interfering with the landscape and archaeological heritage component as a consequence of the identified Project activities is the following:

- Physical presence of moving vessels

The potential impacts influencing the landscape and the archaeological heritage are mainly due to navigation of vessels within the Project Area during the data acquisition campaign and the energizing and recording operations.

The assumption that any artifacts lying in the investigated seabed are impacted by generation of compression waves is excluded as discussed in para. 7.1.2 relating to the impacts on the marine soil and subsoil. Actually, the bubbles generated by the *air gun* shall stop at abt. 30-40 m depth. Therefore, their expansion, that could theoretically generate a potential impact on the artifacts present in the study area seabeds, shall occur at abt. 950 m distance from potential targets.

The potential impacts on the landscape shall be mainly connected to the presence of vessels that can be seen from the coast and create a visual impact compared to the normal perception of the marine landscape. The presence of the seismic vessels shall create an impact similar to that of any other vessel navigating in that sea portion.

For a better understanding of the visual impact from vessels, a mathematical modeling of the maximum theoretical visual range in a marine context was used.

The maximum visual range was determined by making reference to the methodology explained in the nautical charts of the Italian Navy Hydrographic Institute used to calculate the maximum distance at which a lighthouse may be seen from a vessel to the horizon. The h elevation of a lighthouse is the height above the sea level of the focal plane of the light source. The lighthouse elevation indicates its geographical position(D), defined as the maximum distance at which a lighthouse can be seen with respect to the earth's curve and the eyesight level H of the observer. (Figure 7.4). Such a distance is therefore calculated by a formula based on simple trigonometric rules:

$$\mathbf{D = 2{,}04\ (\sqrt{h}\ +\ \sqrt{H})}$$

where h e H are measured in meters and D is measured in nautical miles. The 2.04 coefficient takes into account the trigonometric relations, the atmospheric optical refraction phenomena and the conversion from meters to nautical miles.

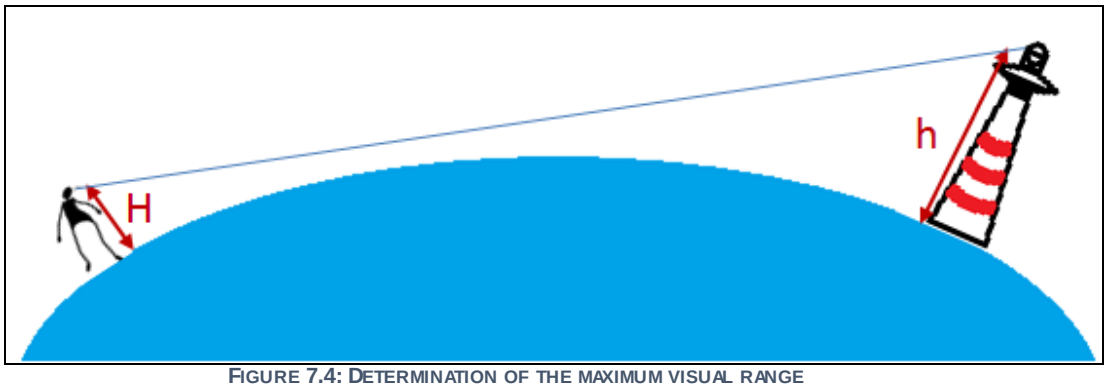


FIGURE 7.4: DETERMINATION OF THE MAXIMUM VISUAL RANGE

The above formula assumes that there is no obstruction between both points.

The table below shows the maximum theoretical visual ranges of a vessel compared to the different heights of an observer staying on the coast. The height above sea level of one of the largest seismic vessels used is 7 m.

TABLE 7.14: MAXIMUM VISUAL RANGES OF VESSELS

Vessel height [m]	Observer height [m]	Theoretical visual range [nautical miles]
7	2	8.6
7	10	12.2
7	20	14.9
7	40	18.7

As already mentioned, the point nearest to the coast of the Application for Exploration Permit Area is placed at 14 nautical miles. According to the table above, the vessels operating in areas bordering the Project Area can be seen from a 20 m high observation point. The lower the heights or the greater the distances (more than 14 nautical miles), the less visible are the vessels. This applies only when the visual range is at top.

It shall then be difficult to see the seismic vessels operating in the Project Area, unless they are navigating to/from the Project Area as it is the case of any vessel navigating in that sea portion.

The following table summarizes the assessment of the Project impact on landscape and archaeological heritage according to the identified impact factors .

TABLE 7.15: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – LANDSCAPE AND ARCHAEOLOGICAL HERITAGE

MATRIX FOR IMPACT ASSESSMENT – LANDSCAPE AND ARCHAEOLOGICAL HERITAGE		Physical presence of moving vessels
Duration (D)	short	
	medium-short	
	medium	
	medium-long	
	long	
Frequency (F)	concentrate	
	discontinuous	
	continuous	
Geographic extent (G)	local	
	regional	
	global	
Intensity (I)	negligible	
	low	
	medium	
	high	
Reversibility (R)	short-term	
	long-term	
	irreversible	
Probability of occurrence (P)	low	
	medium	
	high	

	certain	
Mitigation (M)	high	
	medium	
	low	
	none	
Sensitivity (S)	negligible	
	low	
	medium	
	high	
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.48
		Negligible

The impact factor is rated as **negligible** as shown in the table above.

7.3.3. Marine traffic

The impact factors on the marine traffic from the Project activities that can interfere with the marine traffic are as follows:

- Physical presence of moving vessels;
- Physical presence of towed *streamers*.

The potential impacts influencing the marine traffic mainly arise out of the navigation of the vessels to and from the Project Area, navigation of the vessels within the Project Area during the data acquisition campaign and towing of the *streamer* system.

The impacts on the marine traffic shall be direct due to navigation banning around the area where the master vessel operates. The other vessels normally sailing in this area shall therefore have to change their routes. These impacts shall be temporary and reversible and be limited to a period of abt. 20 days. The competent Port Authorities duly informed on the ongoing activities shall in turn inform the other vessels thereon. As highlighted in para. 4.3.3.3 of the baseline study, location of the study area is out of important routes and the impact shall influence only a few number of vessels as illustrated in the figure below.

The location of the Project Area in the southeastern sector of the Application for Exploration Permit Area fully excludes any risk of interference with the navigation routes.

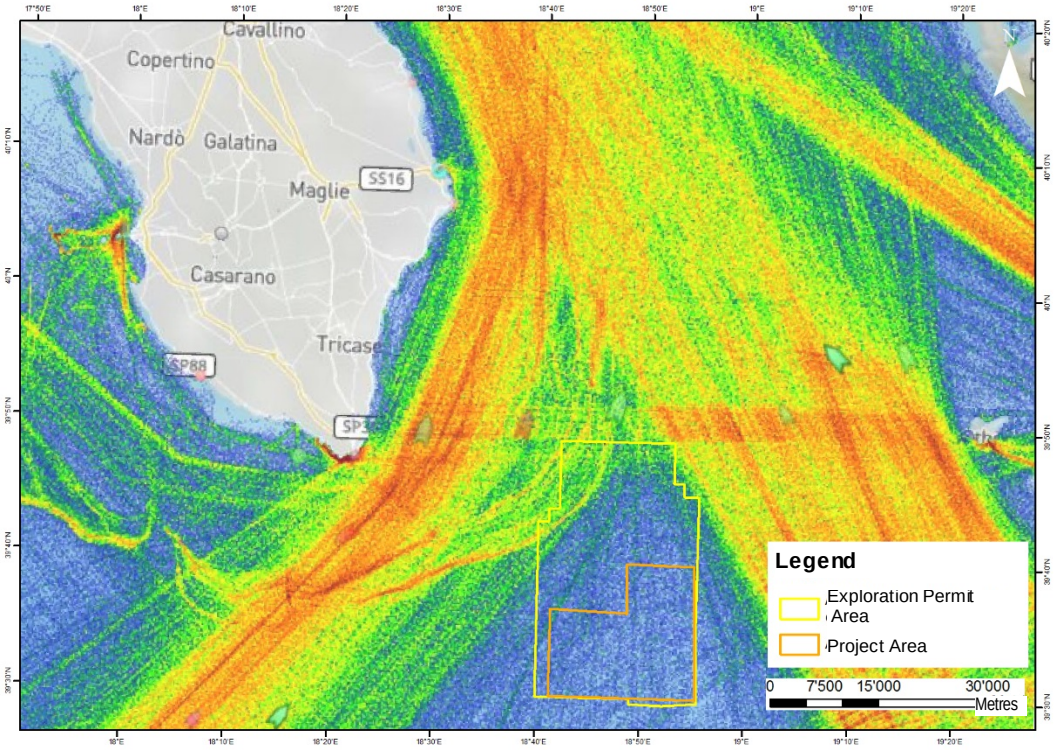


FIGURE 7.5: MAP EXTRACTED FROM THE MARINE TRAFFIC SITE SHOWING THE MARINE TRAFFIC DENSITIES IN THE YEARS 2015 AND 2016 (WWW.MARINETRAFFIC.COM)

Similar impacts shall affect the recreational boats that usually sail along the shoreline and rarely reach distances such as those of the Project Area. Some recreational boats travel along the Puglia to Greece route at the north side of the Application for Exploration Permit Area (shown in para. 4.3.3.3) and could possibly interfere with the Project activities. The number of boats involved may increase in summer when their number increases, however, it shall remarkably decrease in winter, when the number is decisively lower. The seismic activities shall then be planned in such a way as to avoid the months of July and August when the number of recreational boats increases due to the tourism season.

The following table summarizes the assessment of the Project impact on marine traffic according to the identified impact factors .

TABLE 7.16: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – MARINE TRAFFIC

MATRIX FOR IMPACT ASSESSMENT – MARINE TRAFFIC		Physical presence of moving vessels	Physical presence of towed *streamers*
Duration (D)	short		
	medium-short		
	medium		
	medium-long		
	long		
Frequency (F)	concentrate		
	discontinuous		

MATRIX FOR IMPACT ASSESSMENT – MARINE TRAFFIC		Physical presence of moving vessels	Physical presence of towed *streamers*
	continuous		
Geographic extent (G)	local		
	regional		
	global		
Intensity (I)	negligible		
	low		
	medium		
	high		
Reversibility (R)	short-term		
	long-term		
	irreversible		
Probability of occurrence (P)	low		
	medium		
	high		
	certain		
Mitigation (M)	high		
	medium		
	low		
	none		
Sensitivity (S)	negligible		
	low		
	medium		
	high		
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S		0.48 **Negligible**	0.84 **Minor**

The impact factors have been individually rated as **negligible.**

7.3.4. Tourism and use of the shoreline

The impact factors on the tourism and use of shoreline from the Project activities shall be as follows:

- Physical presence of moving vessels;
- Physical presence of towed *streamers* .

The potential impacts influencing the tourism and use of the shoreline mainly arise out of the navigation of the vessels within the Project Area during the data acquisition campaign and towing of the *streamer* system.

Given the kind of the Project activities, no direct impacts on tourism and use of the shoreline are expected. Since the seismic survey is carried out at a distance of more than 14 nautical miles from the coast, no direct and indirect interferences with the touristic activities along the coast are expected. The visual impact shall be practically nil as outlined in para. 7.3.2 and in any case shall be the same arising out of other vessels of

similar tonnage navigating in the area. As already illustrated in para. 7.3.3, no significant interferences with the marine traffic including ferries, cruise liners or recreational boats are expected.

The tourism along the coast being mainly a seaside tourism concentrated in the months of July and August, avoiding performance of the seismic survey in this period shall furtherly reduce interferences with recreational boating.

The following table summarizes the assessment of the Project impact on tourism and use of the shoreline according to the identified impact factors .

TABLE 7.17: MATRIX FOR ASSESSMENT OF NEGATIVE IMPACTS – TOURISM

MATRIX FOR IMPACT ASSESSMENT - TOURISM		Physical presence of moving vessels	Physical presence of towed *streamers*
Duration (D)	short		
	medium-short		
	medium		
	medium-long		
	long		
Frequency (F)	concentrate		
	discontinuous		
	continuous		
Geographic extent (G)	local		
	regional		
	global		
Intensity (I)	negligible		
	low		
	medium		
	high		
Reversibility (R)	short-term		
	long-term		
	irreversible		
Probability of occurrence (P)	low		
	medium		
	high		
	certain		
Mitigation (M)	high		
	medium		
	low		
	none		
Sensitivity (S)	negligible		
	low		
	medium		
	high		

MATRIX FOR IMPACT ASSESSMENT - TOURISM	Physical presence of moving vessels	Physical presence of towed *streamers*
Negative impact = (2,6*D+2,2*Di+2,4*A+7,0*Ri)*R*P*M*S	0.72	1.04
	Low	**Low**

The impact factors in the table above have been individually rated as **low.**

7.4. Cumulative impacts

Assessing the cumulative impacts connected with the seismic activities is extremely difficult due to the temporary nature of the *air gun* activity and continuous displacement of the sound source.

Many are the mining rights granted for the wide investigated area (see para. 2.2.2) and we can assume that exploration activities shall be performed in the next 5-year period. A most significant cumulative impact could therefore occur, if this Project were carried out simultaneously with other seismic prospections in adjacent areas.

Contiguous areas nearer to the Project Area are located in both the Italian and Greek waters (Figure 7.6 and Figure 7.7) as follows:

- Application for Exploration Permit "d89F.R-GM" (Ionian Sea) applied for by the Global Med LLC, currently under a decision making process via the EIS decree at the Services Conference and waiting for release of the granting decree (MSE). The Application for Exploration Permit Area is located at the southern border of the Application for Exploration Permit Area "d84F.R-EL";
- Application for Exploration Permit "d90F.R-GM" (Ionian Sea) applied for by the Global Med LLC, currently under a decision making process via the EIS decree at the Services Conference and waiting for release of the granting decree (MSE). The Application for Exploration Permit Area is located at the southern border of the Application for Exploration Permit Area "d89F.R-GM" at abt. 30 km from the southern border of the investigated Project area;
- Exploration Permit "F.R 40.NP" (southern Adriatic Sea), granted to NORTHERN PETROLEUM (UK) LTD, located at more than 100 km north of the investigated Project Area;
- "1", "2" and "4" Exploration Permit Area application in Greek waters (Ionian Sea). The first two areas border the eastern side of the investigated Project Area, while the "4" area is located south of the "2" area and therefore near the investigated Project area.

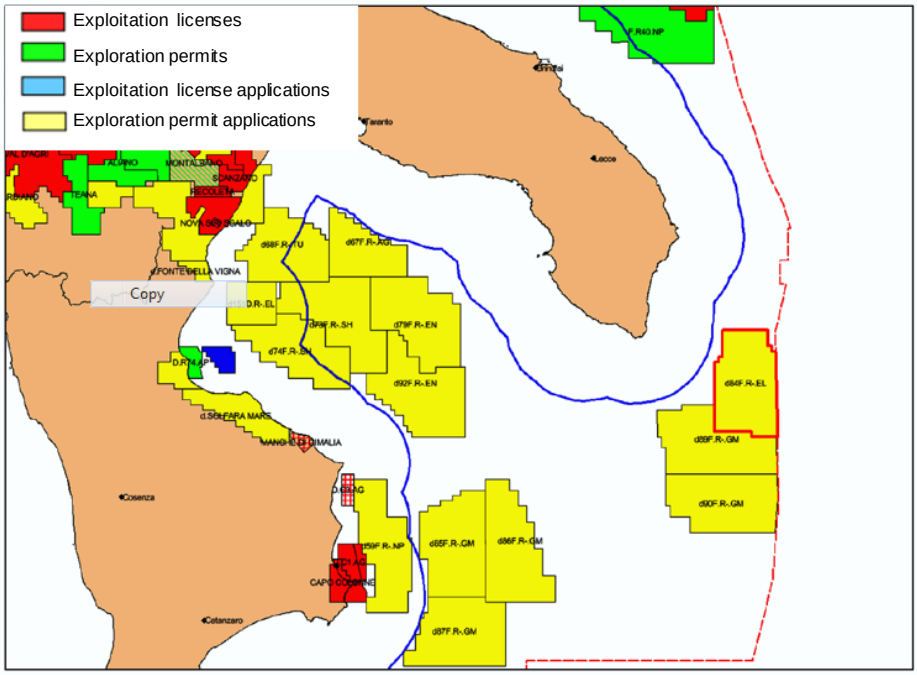


FIGURE 7.6: LOCATION OF THE APPLICATION AREA (THE BLUE LINE INDICATES THE 12 NAUTICAL MILES FROM THE ITALIAN COAST AND THE DASHED RED LINE THE LIMIT OF THE ITALIAN COASTAL WATERS)

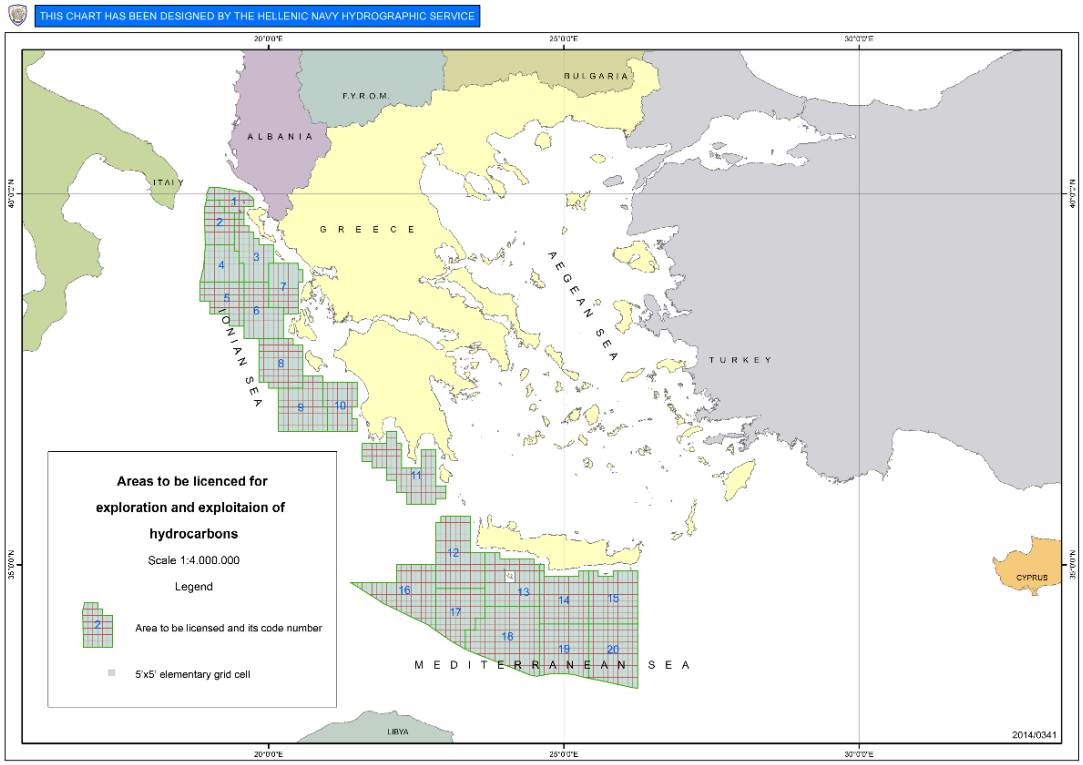


FIGURE 7.7: LOCATION OF AREAS UNDER PERMIT APPLICATION IN THE GREEK WATERS (SOURCE: GREEK MINISTRY OF ENVIRONMENT AND ENERGY - HTTP://WWW.YPEKA.GR/DEFAULT.ASPX?TABID=875&LANGUAGE=EN-US)

If seismic prospections are simultaneously carried out, the impact factors that are most significant for an assessment of the cumulative impacts include the emission of multi-pulse noise (*air gun*) and the physical presence of towed *streamers*.

A cumulative impact from the emission of multi-pulse noise would significantly affect the marine fauna and specifically the marine mammals. As already discussed in para. 7 of this document, the emission of multi-pulse noise is considered a threat to the marine biodiversity, particularly to the cetaceans. Should future *air-gun* seismic survey activities be simultaneously carried out in the contiguous areas, cetaceans could be more impacted. Actually, sound waves of equal frequency and phase could theoretically bring about the so called "constructive interference" and generate a magnification of the amplitude of the waveform and an increase in the sound pressure.

The physical presence of the *streamers* could increase the risk of impact on turtles, specifically the risk that turtles remain entangled in the submerged structures of the tail buoys (see para. 7.2.1.3). A cumulative impact from simultaneous performance of seismic surveys in contiguous areas could be that of an extension of the critical areas in which individuals may be entangled. This impact could be significant for the *Caretta caretta* adults migrating from the Greek coasts to the foraging areas in the northern Adriatic Sea in autumn and from the northern Adriatic Sea to the Greek spawning grounds in spring.

The strongly recommended mitigation measure consists in avoiding a simultaneous performance of the survey activities in the contiguous areas (specifically, the "d89F.R-GM" and d90F.R-GM areas) in order to avoid using two or more *air guns* and groups of *streamers* at the same time. The magnitude of resulting impact shall not increase, but the time duration shall be higher. It is worth mentioning that an interference between simultaneous surveys deeply affects the final quality of a prospection, so that it shall be avoided at all even in the interest of the data quality.

The following measures shall have to be implemented in this respect:

- Coordination among holders of future authorizations with the support, where possible, of the central authorities and the Port authorities;
- Communication of the seismic survey schedule to the Greek authorities and vice versa.

8. Exclusion, prevention, mitigation and compensation measures for the identified impacts and monitoring provisions

8.1. Exclusion, prevention, mitigation and compensation measures

The table below generally summarizes the exclusion/prevention/mitigation measures previously described for each environmental and social component in para. 7.

Exclusion, prevention and mitigation measures have been identified. No compensation measure was proposed in consideration of the minor magnitude of the residual impacts.

TABLE 8.1: SUMMARY OF THE IDENTIFIED EXCLUSION, PREVENTION AND MITIGATION MEASURES

Measure	Type of measure	*Target* (key component)	Secondary *target*s	Expected effectiveness
Use of vessels with engines in excellent maintenance conditions	Mitigation	Atmosphere		High
Use of vessels with certification on pollutant emissions and routine monitoring of the exhaust fumes	Mitigation	Atmosphere		Moderate
Use of "minor impact" *air gun* configuration	Mitigation	Cetaceans	Fishes and invertebrate fish stocks; biocoenosis	Moderate
Identification of an Exclusion Zone of 600 m range, where continuous absence of cetaceans has been demonstrated.	Prevention	Cetaceans		High
Continuous visual (MMO) and acoustic passive (PAM) monitoring	Prevention	Cetaceans	Marine reptiles; fishes and invertebrate fish stocks; biocoenosis	High
Start of the *air guns* by *Ramp Up* or *Soft Start*	Mitigation	Cetaceans	Birds; marine reptiles; fishes and invertebrate fish stocks; biocenosis	High
Suspension of the activities, if cetaceans and other important large size pelagic species are present in the Exclusion Area, and waiting for a given time as outlined in para. 7.2.1.1 and required to allow the species to move away before resuming the activities via the *Ramp Up* approach.	Prevention	Cetaceans	Marine reptiles; fishes and invertebrate fish stocks; biocoenosis	High
Use of a minimum power *air gun* configuration to meet the Project targets	Mitigation	Cetaceans	Marine reptiles; fishes and invertebrate fish stocks; biocoenosis	Moderate
Management of the food residues to be stored in confined closed containers	Prevention	Birds		Minor
Less lights at night , where unnecessary, or use of *bird-friendly* lights	Mitigation	Birds		Minor
Use of *Turtle Guards* on the submerged parts of the *streamers*	Mitigation	Marine reptiles		High
No performance of the Project activities in winter	Mitigation	Cetaceans		Moderate
No performance of the Project activities in spring and winter	Mitigation	Fishes		Moderate
No performance of the Project activities in the escarpment zone	Exclusion	Invertebrate fish stocks; Benthos; Biocenosis		High
No performance of the Project activities in the zone known to host or potentially host white corals	Exclusion	Invertebrate fish stocks; Benthos; Biocenosis		High
No performance of the Project activities in July and August	Mitigation	Marine traffic ; Tourism and use of the shoreline		Moderate
No performance of the Project activities simultaneously with similar projects in contiguous areas	Mitigation	Cumulative impacts		High

Reporting and *ante-operam* and *post-operam* monitoring as provided for in this study in addition to the measures illustrated in the table:

- Drafting of an end of activity report covering the Project information inclusive of animal sightings and implemented measures;
- *ante-operam* monitoring aimed at acquiring additional information on cetacean distribution in the Project Area as illustrated in para. 8.2.1;

- *post-operam* monitoring aimed at detecting cetacean strandings after the seismic survey as described in para. 8.2.3.

8.2. Monitoring provisions

The environmental monitoring shall be carried out before, during and after the seismic survey. The *ante-operam* monitoring shall regard cetaceans, while monitoring of cetaceans, large size pelagic fishes and turtles shall be effected during the ongoing activities and that of cetaceans and turtles after the completed survey. The proposed monitoring is consistent with the core guidelines and national and international protocols.

The main program targets shall be:

- Acquiring data on the presence and distribution of marine mammals in the Application for Exploration Permit Area;
- Checking for impacts on cetaceans and turtles that can be imputed to the Project.

8.2.1. A*nte-operam* monitoring

As discussed in the Scoping Procedure document (Advice No. 2199 dtd October 14, 2016), the methods for developing a visual and bioacoustic project to be carried out before the activity performance are reported below.

Scope of monitoring. The *ante-operam* monitoring shall aim at determining distribution, density and use of the seismically investigated marine area on the part of the marine mammal populations living there. The results therefrom can be also used to review the routes before the seismic survey is performed in order to avoid cetacean aggregation areas (feeding or spawning zones), if highlighted by the *ante-operam* monitoring.

General monitoring description. Monitoring shall last 60 days. The monitored study area shall be covered by an appropriate platform including a set of pre-established routes. Monitoring shall be based on two combined approaches widely proven and tested in the literature in accordance with ACCOBAMS protocols and guidelines:

- The study area shall include the whole Project Area and a buffer of at least 5 km around it .
- The visual and acoustic monitoring shall be carried out by applying the *Distance Sampling* methodology. Monitoring shall occur on board a vessel equipped with a towed hydrophone array suitable for the acoustic monitoring of *deep diver* species like sperm whale and Cuvier's beaked whale. 2 at least or 3 monitoring cycles, if possible, shall be performed in a 60-day period in order to detect time and space differences in the presence, distribution and density of cetaceans.
- A continuous acoustic monitoring shall be carried out using a deep sea sound buoy. This system shall consist of an automatic recorder mounted at the sea floor, approximately in the mid of the Project Area (~ 800-900 m depth) and kept suspended at 10 m from it by means of a floating buoy. This system shall come complete with an acoustic release system for recovery. Each recorder shall be battery supplied and have memory cards for broadband sampling over long periods of time (> 80 kHz). Sampling shall occur at 192 kHz.
  10 min. time interval recording shall be programmed at the start of each half hour for a total recording time of 8 hours/day. A 90 day self-supply time of the system shall be provided, however, data shall be retrieved every 20-30 days by *distance sampling* concurrently with the monitoring cycles for real time association of data to the surface acoustic and visual detections and prevention of data loss due to malfunctions/failure of the instruments.

Both detection methods shall ensure a good coverage of the study area and reliable estimates of the cetacean populations living in the area. They shall also provide an overview of the time trend of the

environmental noise and daily activity cycles of the cetaceans. The operators shall visually and/or acoustically identify the species and, where applicable, provide a size estimate of the identified groups, their distance from the monitoring platform and their general behaviour (for ex., swimming, feeding, mating/spawning, etc.).

List of instruments and vessels used

- Vessel operating beyond 12 nautical miles with cabin to accommodate at least a total of 5 operators and crew . The vessel shall be at least 10-15 m long and have covered areas for the use of computers and detection instruments.
- Binoculars and *big eyes* for a 360° vision
- 200 m long horizontally towed hydrophone array equipped with at least two wide frequency range ceramic piezoelectric sensors and one depth sensor.
- External sound card for sampling at frequencies higher than 44.1 kHz – 48.0 kHz (standard for lap tops and desktops) for application of a minimum sampling frequency of 192.0 kHz.
- Audio power amplifier with balanced connections.
- Dedicated software for collection of visual and acoustic data on cetaceans (*SeaPro 3* o *Pamguard*) with data collection card and possible real time tracking of the sound source, display of spectrogram and sound recording .
- GPS-linked lap tops .
- Cameras
- Fixed acoustic buoy or sound buoy (*Wildlife Acoustics SM3M DEEP* or similar) equipped with broadband hydrophone (> 80 kHz), batteries and memory cards for long time sampling.

Staff

The staff in charge of monitoring shall be composed of experts in the field of detection and monitoring of the marine environment, specifically the cetaceans.

Time schedule

The time schedule for *ante-operam* monitoring shall foresee:

- 2-3 visual and acoustic monitoring cycles from vessel (MMO e PAM) to be performed in a time period of two months before the Project execution. Each cycle shall consist of abt. 4-5 working days and cover lengths of abt. linear 400-500 km.
- Continuous 60-day monitoring by a depth buoy (sound buoy).

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8.2.2. Ongoing monitoring

The ongoing monitoring already previously discussed in para. 7.2.1.1 in the frame of the mitigation measures is briefly summarized hereinafter.

Scope of monitoring. The core target of the ongoing monitoring is checking for the presence of marine mammals within the exclusion area or approaching area and implementing a specific protocol for reduction or suspension of the seismic prospection activities in the presence of cetaceans. The ongoing monitoring shall also allow to implement adequate measures for minimizing the environmental impact on large size pelagic and turtle species, should they be sighted, as illustrated in para. 7.2

General monitoring description. The staff in charge of the field activities shall comprise MMO (*Marine Mammal Observer*) e PAM (*Passive Acoustic Monitoring*)-certified biologists/naturalists. An adequate number of MMOs shall be taken on board the seismic vessel for continuous visual monitoring at day time. A passive acoustic monitoring via hydrophones shall be carried out by PAM operators on a 24-hour basis (day and night time).

A protocol already defined and illustrated in para 7.2.1.1 of this EIS shall be followed in case of sightings. Should cetaceans be sighted in the exclusion or approaching areas, the seismic survey shall be suspended and restored after a given time as set forth in the protocol to allow the animals to move away (they shall be visually followed by *focal follow*). An end of activity report shall be drafted and available to the competent authorities. It shall show date and place of the seismic survey, features of the *air guns*, vessels used, sightings of marine mammals, procedures implemented in case of sightings and general and sighting issues.

The sound buoy shall operate throughout the Project time to record the deep sea sound, the presence of deep sea marine mammals and the *air gun* noise level. At the start of the seismic survey, once the final parameters are available, the sound propagation model shall be checked for via reconstruction of the real sound decay curve and confirmation of the exclusion range. Upon the survey completion, an exhaustive report on the actual acoustic dispersion recorded during the seismic survey operations shall be drafted. This shall contribute to a comparison with the acoustic modeling data and allow to assess the real extent of the sound emissions.

8.2.3. *Post-operam* monitoring

In compliance with the requirements of the scoping procedure (Advice No. 2199 dtd October 14, 2016), a 60-day *post-operam* monitoring shall be carried out aimed at detecting cetacean and turtle strandings, if any, after completion of the Project activities.

In addition, sound recording via a sound buoy shall go on for 60 days after the seismic survey execution to obtain monitoring data comparable to each other.

General monitoring description

- The cetacean presence and distribution in the study area shall be checked for by continuous deep sea sound detection via a sound buoy in the same way as done for the *ante-operam* monitoring (except for one time data retrieval at the end of 60 days).
- Given the direction of the prevailing surface currents, strandings shall be monitored along the coast stretch between Lecce and Taranto. This coast stretch extending over 200 km between eastern and western Puglia should fully comply with the authorities' requests in the frame of the scoping stage (it is required that stranding monitoring be extended to a coast stretch of at least 100 km length near the geophysical detection area).
  The existing networks for monitoring of strandings on the part of research institutes and local associations shall be taken into account when executing the *post-operam* monitoring of the seismic survey and completed/supplemented by strengthening investigations on the selected coast stretch as site of possible stranding of cetaceans and turtles impacted by the seismic prospection activities.

9. Cultural assets and landscapes

The cultural assets and landscapes have been described in para. 4.3.3.2 (baseline environmental scenario) and dealt with in para. 7.3.2 as regards the potential of impacts on this component from the Project activities.

In this chapter, the "cultural heritage and landscape" mean the assets set forth in the Law Decree No. 42/2004 "*Code of cultural heritage and landscape*" including:

- Movable and immovable assets of artistic, historical, archaeological and ethnoanthropological interest intended as a property of the State or other public body;

- Territorial coasts and conterminous areas to lakes embracing a zone at a 300 m depth from the shoreline;
- Waterways and related banks or embankments over a 150 m zone;
- Mountains elevating over 1600 m a.s.l. for the Alpes and 1200 m a.s.l. for the Apennines and islands;
- National and regional parks and areas of natural interest;
- Forests and woodlands, wetlands, glaciers, volcanos, ...

No cultural assets and landscapes comparable to those defined in the Law Decree No. 42/2004 are present in the study area and its surroundings.

10. Description of environmental impacts from the Project susceptibility to the risk of accidents and force majeure events

The seismic survey Project discussed in this EIS is a peculiar one as it involves a temporary investigation requiring no construction of any structure. The activities connected thereto are navigation in the designated area and *streamer* towing only.

Since events of force majeure nature have been rarely recorded in the Mediterranean Sea, the master vessel and the chase vessels used are unlikely to suffer damages or shipwreck and hence to adversely affect the area in which they operate.

All vessels used shall conform to the national and international safety standards required by the IMO (*International Marine Organization*), be bound to international conventions like Load Line[9], SOLAS[10], MARPOL[11] and Tonnage[12], and certified[13] by class certificates issued by bodies such RINA (Italian Naval Register). The crew shall be trained according to the STCW code (*Standards of Training, Certification and Watchkeeping for Seafarers*). The compliance with these standards shall minimize the risk of accidents impairing the safety of the staff working on board the vessels and the surrounding environment.

The decision of stopping, suspending or postponing the activities due to adverse weather conditions such as stormy sea involving a risk for the crew, vessels and equipment shall be up to the Captain.

Without prejudice to the above considerations and given the unlikeliness that severe accidents may occur on board the vessels during the seismic survey, accidents and force majeure events are discussed herein as required by the standards.

Magnitude and severity of the accidents may vary and include:

- Accidental release and spillage of fuel oil and oils;
- Loss of towed equipment (mainly *streamers*);
- Shipwrecking of one or more vessels.

Accidents of this kind may be a threat to the crew safety and affect all physical, biological, social and economic environment components. The possible accidents mentioned above are briefly examined below.

[9] Regulating the vessel freeboard according to the function.
[10] Safety Of Life At Sea, regulating the safety of human life at sea.
[11] MARine POLlution, regulating the prevention of pollution from the vessels.
[12] Regulating the ship tonnage.
[13] The design certificate certifies that a vessel has been designed and constructed according to the rules of the International Marine Organization and is authorized to perform the work it has been designed for.

Accidental release and spillage of fuel oil and oils

Environmental disasters from this kind of accidents are known. The vessels used for the Project execution do not transport fuel oil in amounts exceeding the tank capacity. The extent of a spillage, if any, may not be compared to that of oil tankers responsible for such disasters.

The physical characteristics of the Study Area and the amount of spillage prompt the following considerations:

1. The Project Area is located offshore;
2. The Project Area is located in a sea portion with averagely high depths in the order of 1,000 m;
3. The Hydrodynamics of the study area is one of the most complicated of the whole Mediterranean basin (see para. 4.3.1.2) and subjected to a significant water mixing;
4. According to the preceding points, the pollutant dispersion and dilution should minimize the environmental impacts from accidental release.

Should a fuel oil or oil release occur, all actions shall be taken to restrain leakage (local repairing, leak patch) and mitigate the environmental impact (physical or chemical reclamation techniques, containment). The competent authorities shall be immediately informed thereon.

Streamer loss

The *streamers* are generally floating by means of buoys and arranged in arrays along ropes extending to abt. 8 km. The *streamer* loss could involve drifting of a many kilometer long structure that could possibly impact navigation and fisheries in the area.

Floating of the *streamers* prevents the benthos and large size pelagic fishes (fishes, turtles and cetaceans) from being impacted by virtue of floating ropes rather than nets, so that entanglement of animals in these structures is unlikely. Moreover, *Turtle Guards* as mitigation measure are mounted on *streamers* to minimize entanglement of marine reptiles (para. 7.2.1.3).

In any case, the competent authorities shall be informed of such an event and the drifting *streamers* shall be recovered as soon as possible.

Shipwrecking

A shipwreck is extremely unlike. The study area being located offshore at a depth of abt. 1,000 m, an event like this may occur only in case of a collision between vessels or onboard firing/explosion.

The competent authorities shall be immediately informed of any shipwrecking and safety of the crew ensured. The environmental impacts connected to the shipwreck of one or more vessels shall include:

1. Spillage and release into the sea of hydrocarbons and other pollutants;
2. Impact on the seabed and related benthic biocenosis colonies.

For spillage of oils, hydrocarbons and other pollutants reference shall be made to information given in the paragraph above relating to “accidental release and spillage of fuel oil and oils”.

As regards the impact on sea floor, seabeds in the Project Area are mainly characterized by the biocenosis of bathyal muds. The biocenosis consists of more or less compacted argillaceous muds with possible presence of *Isidella elongata* forming compacted mud *facies* and *Funiculina quadrangularis* forming wet mud *facies.* If these *facies* are present, they have probably remained intact only in the deepest bottoms of the area less affected by trawling. Actually, it is known that the area is partially affected by trawling that has likely destroyed a good portion of these *facies*, if any.

A shipwreck impact on the biocenosis of the bathyal muds would initially cause an unavoidable mechanical damage to the species and habitats squeezed and covered by the shipwreck and damages due to pollutants

released by the shipwreck and onboard instrumentation, but would increase the area biodiversity in the long run. The presence of a shipwreck could bring about a higher structural complexity, the availability of hard substrates for introduction of species and creation of spaces and shelters for juveniles. It would also obstruct trawling with consequent protection and benefit to the fauna. An exhaustive literature is available on positive effects and biodiversity increase due to the presence of shipwrecks, platforms or artificial barriers.

11. Critical analysis – Summary of the difficulties encountered in gathering data and predictable impacts

Data were collected from both the scientific and grey literature and enriched by interviews with local experts of the Salento and Bari universities.

More than 250 scientific articles and sources were referred to. The baseline study on cetaceans is based on 170 scientific publications.

The data sources were globally satisfactory, although the following three main shortcomings have been identified.

- The cetacean quantitative estimates regard the striped dolphin and the sperm dolphin, while qualitative rather than quantitative information is given for the fin whale and the Cuvier's beaked whale present in the area.
- The literature on turtles assumes that the Ionian Sea may host pelagic juveniles, however, information thereon is poor.
- The literature on white coral biocenesis is quite exhaustive thanks to the researches mainly conducted by the local research institutes (Bari and Salento Universities) in the sea portion bordering the Application for Exploration Permit Areas (at eastern and southeastern side). Instead, a biocenosis mapping of the northwestern sector of the Application for Exploration Permit Area is not available and some researchers assume that the white coral biocenesis could possibly dwell this marine area. According to this assumption, the biocenesis could be released by the muds off Santa Maria di Leuca, where it was northwards mapped up to the waters in front of Tricase (outside and on the border of the Application for Exploration Permit Area). This assumption has been not confirmed by data or observations.

The above shortcomings were faced and/or commented as follows.

- The information on the distribution of the Cuvier's beaked whale in the whole Mediterranean Sea is quite a few because of the difficulties in tracking this species. The literature reports that the fin whale lives in the area mainly in winter, though quantitative data are not available. Performing the seismic survey in periods other than winter shall minimize the risk of interferences with this species. Moreover, monitoring before and during the seismic survey and implementation of mitigation measures according to the main national and international standards should minimize the consequences of such a lack of information.
- The pelagic phase of turtle juveniles in the whole Mediterranean Sea and not only in the Ionian Sea is little known. The earliest years of the caretta pelagic life are very little known to the point that they are called the "*the lost years*" due to the objective study difficulties in this biological phase.
- By applying a precautionary approach to avoid areas that can possibly host the white coral biocenosis, the investigated area within the Application for Exploration Permit Area was located in the southeastern sector, which minimizes any risk of interactions with the zones where the presence of white corals was merely assumed.

The method for predicting the impacts is based on a trasparent approach widely used by Golder for the study of worldwide environmental impacts and accepted by many national authorities and international organizations such as for example IFC, EBRD.

Unlike the methods used in most impact studies, this method has the merit of not only qualifying, but also numerically quantifying (semi-quantitative approach) the potential environmental impacts for each impact factor and component, however, it is yet somewhat limited. Specifically, the method used for the assessment of the cumulative impact bases on a simpler qualitative rather than semi-quantitative approach. This limit assumes a relative importance in anthropized areas and complex projects, where there is an accumulation of impacts deriving from a number of projects and ongoing human activities. In this Project executed offshore and mostly affected by noise as cumulative impact, the critical issue here highlighted is negligible.

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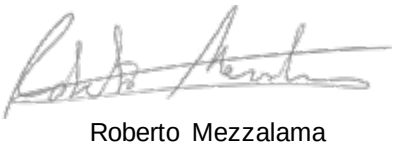

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