QUIETMED – Joint programme on noise (D11) for the implementation of the Second Cycle of the MSFD in the Mediterranean Sea.

Deliverable

D3.4 Recommendations to Member States to set up the national registers of impulsive noise according to criterion D11C1 of the Commission Decision 2017/848/EU and ACCOBAMS premises, and generalisation for the EcAp process.

Deliverable:	D3.4 Recommendations to Memmber States to set up the national registers of impulsive noise according to criterion D11C1 of the Commission Decision 2017/848/EU and ACCOBAMS premises, and generalisation for the EcAp process.s
Document Number:	QUIETMED - D3.4
Delivery date:	5th December 2018
Call:	DG ENV/MSFD Second Cycle/2016
Grant Agreement:	No. 11.0661/2016/748066/SUB/ENV.C2

List of participants:

No	Participant organization name	Participant short name	Country
1	Centro Tecnológico Naval y del Mar	CTN	Spain
2	Instituto Español de Oceanografía	IEO	Spain
3	Universitat Politècnica de València	UPV	Spain
4	Service Hydrographique et Océanographique de la Marine	SHOM	France
5	Ispra Instituto Superiore per la Protezione e la Ricerca Ambientale	ISPRA	Italy
6	Inštitut za vode Republike Slovenije/Institute for water of the Republic of Slovenia	IZVRS	Slovenia
7	Permanent Secretariat of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	ACCOBAMS	Monaco
8	The Conservation Biology Research Group, the University of Malta	UoM	Malta
9	Institute of Oceanography and Fisheries	IOF	Croatia
10	Foundation for Research and Technology - Hellas	FORTH	Greece

DISSEMINATION LEVEL	
PU: Public	x
PP: Restricted to other programme participants (including the Commission Services)	
RE: Restricted to a group specified by the consortium (including the Commission Services)	
CO: Confidential, only for members of the consortium (including the Commission Services)	

Company/Organization	Name and Surname
ACCOBAMS	Alessio Maglio
ACCOBAMS	Maylis Salivas
CTN	Marta Sánchez Egea
IOF	Predrag Vukadin
SHOM	Florent Le Courtois
ISPRA	Junio Fabrizio Borsani

Abstract

This document is the Deliverable “Recommendations to Member States to set up the national registers of impulsive noise according to criterion D11C1 of the Commission Decision 2017/848/EU and ACCOBAMS premises, and generalisation for the EcAp process” of the QUIETMED project funded by the DG Environment of the European Commission within the call “DG ENV/MSFD Second Cycle/2016”. This call funds the next phase of MSFD implementation, in particular to achieve regionally coherent, coordinated and consistent updates of the determinations of GES, initial assessments and sets of environmental targets by July 2018, in accordance with Article 17(2a and 2b), Article 5(2) and Article 3(5) of the Marine Strategy Framework Directive (2008/56/EC). The QUIETMED project aims to enhance cooperation among Member States (MS) in the Mediterranean Sea to implement the Second Cycle of the Marine Directive and in particular to assist them in the preparation of their MSFD reports by 2018 through: i) promoting a common approach at Mediterranean level to update GES and Environmental targets related to Descriptor 11 in each MS marine strategies ii) development of methodological aspects for the implementation of ambient noise monitoring programs (indicator 11.2.1) iii) development of a joint monitoring programme of impulsive noise (Indicator 11.1.1) based on a common register, including gathering and processing of available data on underwater noise.

This document provides a short reminder with essential information on requirements in terms of monitoring and assessment objectives expected from countries. The aim of setting up a register is recalled, as well as what noise events are considered and in what cases they need to be registered, and how to compute and represent the indicator spatially. Further, we analyse the choices made by countries where a register in already operational or under development, focussing on issues identified during the execution of QUIETMED: spatial units, and procedures for data gathering. Recommendations are then drawn on methods and tools for implementing the register.

Table of Contents

1 Introduction 7

2 Requirements in terms of monitoring and assessment of impulsive noise 9
2.1 Aim of the register 9
2.2 Noise event types recorded in the register 9
2.3 Minimum thresholds set by TG-Noise for registering noise events 10
2.4 Information on noise events required to feed the register 12
2.5 Computing and representing the indicators related to D11C1 12

3 Analysis of national implementation in Mediterranean countries 14
3.1 Status of national registers 14
3.2 Focus on data collection procedures for feeding the register from different European countries 15
3.3 Focus on experiences on spatial units used in different countries 17

4 Main steps for setting up the national registers 18
4.1 Defining methods for data collection 18
4.2 What tools for the creation of the database 19
4.3 Spatial management and representation system 20
4.4 Exporting data to the international register 21

5 Annexes 22
5.1 Annex 1 – Guidance from Commission Decision 2017/848 on methods for monitoring and assessment, and consistency with guidance from TG-Noise 22
5.2 Annex 2 - Minimum thresholds for registering noise sources: a discussion from the guidance prepared by ACCOBAMS for UNEP/MAP on Ecological Objective 11 23
5.3 Annex 3 – Tables of values for reporting source intensity 25
5.4 Annex 4 – Detailed review of national implementation of the register in Mediterranean countries 26
5.5 Annex 5 – Examples of spatial management systems available from public information 31

List of figures

Figure 1. Work Plan Structure 8
Figure 2.Exemples of the output of the registers implemented in France and Italy 13
Figure 3. Data reporting form developed during QUIETMED for the regional register for the Mediterranean Sea; source: http://80.73.144.60/CTN_Geoportal/upload/ 19
Figure 6. D11C1 indicator for the French Mediterranean waters for the year 2016 (Le Courtois et al, 2018.). 27
Figure 4. Preview of noise events on the Italian impulsive noise register web interface (http://italy.noiseregister.org/, as accessed in november 2017. 29
Figure 5. impulsive noise indicator calculated for the user selected period 1.1.2016 – 31.7.2016 based on a 30' x 30' spatial grid, with zoom in on the Ligurian Sea to highlight indicator values by grid cell (http://italy.noiseregister.org/, as accessed in November 2017). 30

List of tables

Table 1. Minimum thresholds for SL as a condition for inclusion in the register. 11
Table 2. Information required to inform the register. 12
Table 3. Indicators related to D11C1 as defined in the new Commission Decision. Text in bold is the proposed disambiguation for consistency with guidance from TG-Noise (see 5.1. Annex 1 for further explanation). 13
Table 4.Review of procedures for data collection 16
Table 5. Spatial management grids used in different countries. NA=information not available 17

Bibliography

Commission, E. (2008). DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

Commission, E. (2016). DG ENV/MSFD Second Cycle/2016. Brussels.

Commission, E. (2016). Gran Agreement No. 11.0661/2016/748066/SUB/ENV.C2. Brussels.

ACCOBAMS. (2015). Ecological Objective 11: Energy including underwater noise. A basin-wide strategy for underwate noise monitoring in the Mediterranean.

Dekeling, R., Tasker, M., Van der Graaf, A., Ainslie, M., Andersson, M., Andre, M., … Young, J. (2014). Monitoring Guidance for Underwater Noise in European Seas, Part II: Montitoring Guidance Specifications. http://doi.org/10.2788/27158

UNEP/MAP. (2016a). Integrated Monitoring and Assessment Guidance. In 19th Ordinary Meeting of the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols (p. 282). Athens.

UNEP/MAP. (2016b). Report of the 19th Ordinary Meeting of the contracting Parties to the Convention for the Protection of the Marine Environment and the coastal region of the mediterranean and its Protocols. Athens.

ACCOBAMS (2017). Best Practice workshop: Fostering inter-regional cooperation in underwater noise monitoring and impact assessment in waters around Europe, within the context of the European Marine Strategy Framework Directive", held in Middelfart, Denmark, on May 2017

List of Abbreviations

CTN	Centro Tecnológico Naval y del Mar
IEO	Instituto Español de Oceanografía
UPV	Universitat Politècnica de València
SHOM	Service Hydrographique et Océanographique de la Marine
ISPRA	Ispra Instituto Superiore per la Protezione e la Ricerca Ambientale
IZVRS	Inštitut za vode Republike Slovenije
ACCOBAMS	Permanent Secretariat of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
UoM	The Conservation Biology Research Group, the University of Malta
IOF	Institute of Oceanography and Fisheries
FORTH	Foundation for Research and Technology - Hellas
MSFD	Marine Strategy Framework Directive
ECS	European Cetacean Society

1 Introduction

The QUIETMED Project is funded by DG Environment of the European Commission within the call "DG ENV/MSFD Second Cycle/2016". This call funds the next phase of MSFD implementation, in particular to achieve regionally coherent, coordinated and consistent updates of the determinations of GES, initial assessments and sets of environmental targets by July 2018, in accordance with Article 17(2a and 2b), Article 5(2) and Article 3(5) of the Marine Strategy Framework Directive (2008/56/EC).

The QUIETMED project aims to enhance cooperation among Member States (MS) in the Mediterranean Sea to implement the Second Cycle of the Marine Directive and in particular to assist them in the preparation of their MSFD reports by 2018 through: i) promoting a common approach at Mediterranean level to update GES and Environmental targets related to Descriptor 11 in each MS marine strategies ii) development of methodological aspects for the implementation of ambient noise monitoring programs (indicator 11.2.1) iii) development of a joint monitoring programme of impulsive noise (Indicator 11.1.1) based on a common register, including gathering and processing of available data on underwater noise. The Project has the following specific objectives:

- ✓ Achieve a common understanding and GES assessment (MSFD, Article 9) methodology (both impulsive and continuous noise) in the Mediterranean Sea .
- ✓ Develop a set of recommendations to the MSFD competent authorities for review of the national assessment made in 2012 (MSFD, Article 8) and the environmental targets (MSFD, Article 10) of Descriptor 11- Underwater Noise in a consistent manner taking into account the Mediterranean Sea Region approach.
- ✓ Develop a common approach to the definition of threshold at MED level (in link with TG Noise future work and revised decision requirements) and impact indicators.
- ✓ Coordinate with the Regional Sea Convention (the Barcelona Convention) to ensure the consistency of the project with the implementation of the EcAp process
- ✓ Promote and facilitate the coordination of underwater noise monitoring at the Mediteranean Sea level with third countries of the region (MSFD Article 6), in particular through building capacities of non-EU Countries and taking advantage of the ACCOBAMS-UNEP/MAP cooperation related to the implementation of the Ecosystem Approach Process (EcAp process) on underwater noise monitoring.
- ✓ Recommend methodology for assessments of noise indicators in the Mediterranean Sea basin taking into account the criteria and methodological standards defined for Descriptor11 (Decision 2010/477/EU, its revision and Monitoring Guidelines of TG Noise).
- ✓ Establish guidelines on how to perform sensor calibration and mooring to avoid or reduce any possible mistakes for monitoring ambient noise (D 11.2.1). These common recommendations should allow traceability in case the sensor give unexpected results and help to obtain high quality and comparable data.
- ✓ Establish guidelines on the best signal processing algorithms for the preprocessing of the data and for obtaining the ambient noise indicators (D 11.2.1).

- ✓ Implement a Joint register of impulsive noise (D11.1.1) and hotspot map at Mediterranean Sea Region level by impulsive noise national data gathering and joint processing.
- ✓ Enhance collaboration among a wide network of stakeholders through the dissemination of the project results, knowledge share and networking.

To achieve its objectives, the project is divided in 5 work packages which relationships are shown in Figure 1.

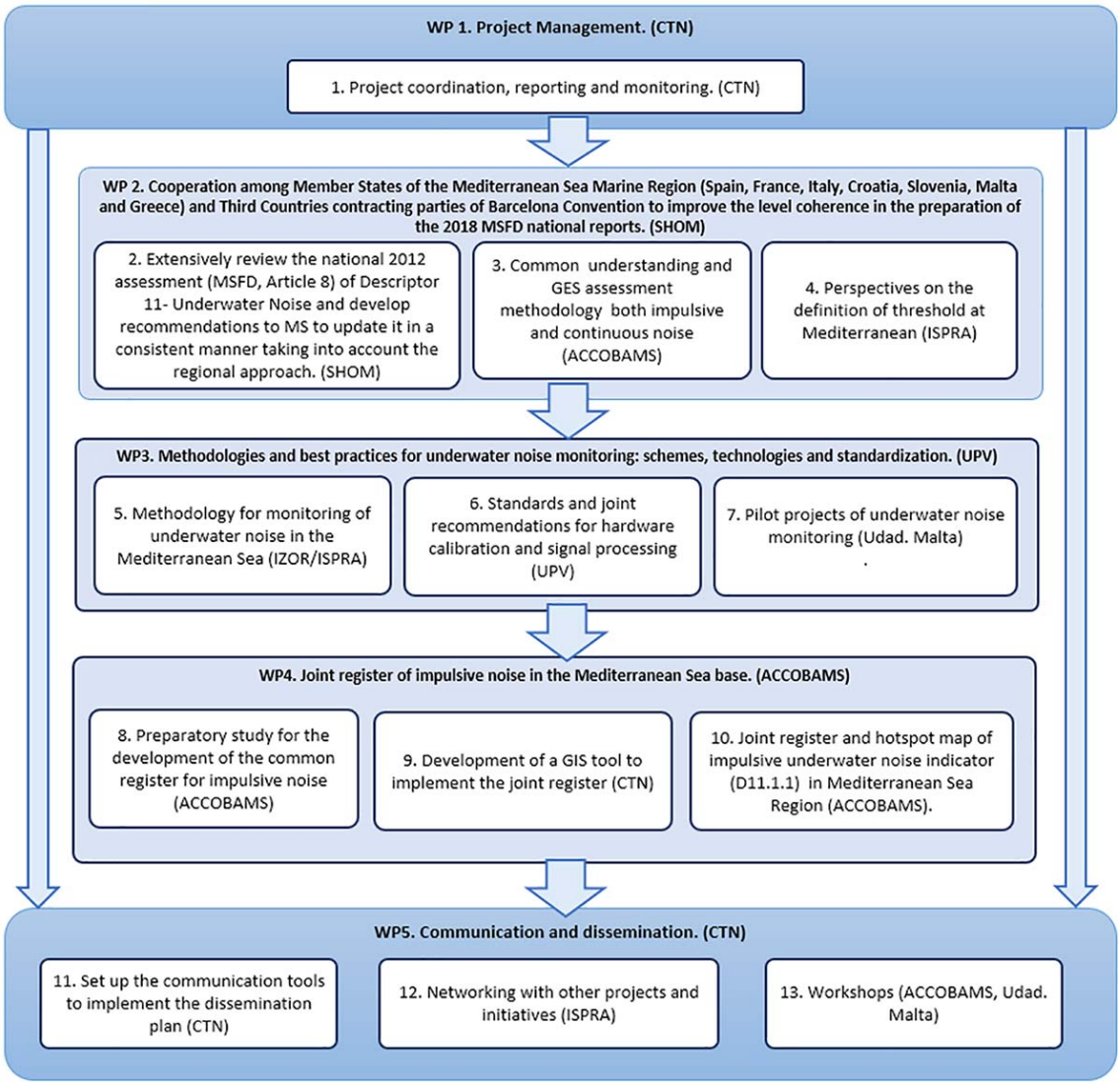


Figure 1. Work Plan Structure

The project is developed by a consortium made up of 10 entities coordinated by CTN and it has a duration of 24 months starting on January 2017.

This document reports on methods and tools for implementing the noise register, particularly in countries where the development is not ye started. This document is therefore relevant concerning the EcAp process, for which underwater noise is a topic still under development.

2 Requirements in terms of monitoring and assessment of impulsive noise

Taking the definition from the "Monitoring Guidance for Underwater Noise in European Seas, Part II: Monitoring Guidance Specifications" (Dekeling et al., 2014), the purpose of indicator 11.1.1: *is to quantify the pressure on the environment, by making available an overview of all loud impulsive low and mid-frequency sound sources, throughout the year, in regional seas*. Such concepts were developed to implement Commission Decsion 2010/474, but they appear valid for setting up a register of impulsive noise souces in EU Member States despite the changes introdued by new Commission Decision 2017/848 of 17 May 2017. A discussion on the consistency of guidance from TG-Noise in light of the new Commission Decision is proposed in Annex 1 to this document (section 4.1).

The same Guidance from TG-Noise also says: *the initial step is to establish the current level and trend of these impulsive sounds. This may be done by setting up* ***a register of these impulsive sounds***.

And finally: *the register can be used to estimate the spatial and temporal impact on the environment (the total period and total habitat loss by impulsive noise sources) and for determining the baseline level. Once a baseline and targets have been set, the register can be used for management purposes (e.g. regulating planning and licensing activities) and assist in marine spatial planning, incorporating displacement mitigation guidelines and reducing the potential for cumulative impacts.*

Such background, laying down the establishment of a register of impulsive noise sources, is also invoked in the document "Integrated Monitoring and Assessment Guidance" (UNEP/MAP, 2016a) and hence adopted for the EcAp process of the Barcelona Convention (UNEP/MAP, 2016b).

2.1 Aim of the register

In practice, the register is a database of underwater noise sources aimed at locating the activities that used those noise sources and calculate how many days the sources were used during a year or portions of a year (month, quarter). This computation can be done over a regular spatial grid and the result is a hotspot map.

The purpose of monitoring impulsive noise through a register is to quantify the pressure on the environment by producing a periodical overview of all loud impulsive low and mid-frequency sound sources in regional, subregional and national maritime areas. The ultimate goal is enabling EU Member States to get an overview of the occurrence of all the activities that produce sounds with the potential of impacting the marine environment.

2.2 Noise event types recorded in the register

For the scope of the noise register, all transient sounds of short duration are considered "impulsive noise" (Van der Saar, 2012). Such definition include pulse signals (such as those

produced by airguns, explosions, and pile driving) and non-pulse signals (such as sonar and acoustic deterrent).

Most important sources are those considered as having a potential impact on marine wildlife:

- **Pile driving.** Pile driving is a conventional technique employed in many coastal and offshore constructions, such as wind farms, offshore platforms, harbour extensions etc. The growth of the wind energy sector caused a great increase in the use of this technique both in coastal and offshore environments.
- **Airgun**.The airgun is presently the most employed technology for carrying out marine seismic exploration. Such surveys are pervasive worldwide, in shallow and deep water as well as in coastal or offshore environments
- **Explosives**. Underwater detonations may occur for the disposal of explosives or may be planned during maritime construction, e.g. to fragment rock prior to dredging. This is the loudest source of underwater noise and need to be treated with particular care.
- **Sonar**. Low-, mid- and high frequency active sonars (LFAS, MFAS, HFAS) are employed during military exercises as well as during academic and industrial surveys, such as fish stock estimations and bathymetric surveys. Especially, low- and mid- frequency naval sonars are of great concern given the mass stranding events of cetaceans linked in space and time with military exercises and need to be addressed with particular care
- **Acoustic Deterrents**. High powered devices, designed to keep marine mammals away from fish farms by causing them pain. Frequencies range from 5-20KHz for repelling pinipeds and 30-160KHz for delphinids. (Carretta et al, 2008, Lepper et al, 2004, Lurton, 2010, OSPAR, 2009)

Countries may considered further sources, as the register is conceived to provide an overview of all loud underwater sound sources. Hence, sparkers, boomers, echo-sounders, chirps, and more sources may be considered of interest and included in the monitoring programme of impulsive noise.

2.3 Minimum thresholds set by TG-Noise for registering noise events

TSG Noise recommends thresholds for recording noise sources in the register. Thresholds were proposed to ensure that all sources that have a potential for significant population level effect will be included in the register (Dekeling et al., 2014). The generic source level (SL) threshold for inclusion in the register for non-pulse sources is 176 dB re 1 µPa m, whereas the threshold for inclusion of impulsive sources is an energy source level (SL_E) of 186 dB re 1 $\mu Pa^2 m^2 s$. For airguns and explosives it is more convenient to convert these to proxies of zero to peak source level (SL_{z-p}) and equivalent TNT charge mass (m_{TNTeq}), respectively. For impact pile-drivers no minimum threshold should be used and all pile-driving activities should be registered.

Table 1. Minimum thresholds for SL as a condition for inclusion in the register.

Noise source type	Thresholds for inclusion of noise events in the register
Explosive	mTNTeq > 8 g
Airgun	SLz-p > 209 dB re 1 µPa m
Low/mid freq sonar	176 dB re 1 µPa m
Low/mid freq acoustic deterrent	176 dB re 1 µPa m
Other pulse	186 dB re 1 μPa^2 m^2 s

Two elements are worth noting:

- source levels of registered activities are **declared**, that is to say that it is not required to measure the source levels during the activity.
- The monitoring guidance prepared by ACCOBAMS for UNEP/MAP in the scope of EcAp (ACCOBAMS, 2014), discusses the adoption of such values as **interim thresholds** for the Mediterranean and Black Seas. The guidance from TG-Noise was indeed acknowledged by the ACCOBAMS working group on underwater noise (JNWG) as too specific for northern European seas. Threshold values for pulse sources are based indeed on harbour porpoise sensitivity to underwater noise, while harbour porpoise is almost absent in the Mediterranean Sea (sightings of the Black Sea sub-species *Phocoena phocoena relicta* occur regularly only in the northern Aegean Sea) and therefore an update of these values appear necessary for more representative species of the Mediterranean. Concerning non-pulse sources, they are based on a study on Blainville's beaked whale sensitivity on underwater noise (Tyack et al 2011). Although the results of response studies show similar sensitivity to noise in different beaked whale species, the Blainville's beaked whale is absent or occasional in the Mediterranean. More recent literature present results showing lower levels eliciting responses in Cuvier's beaked whale (e.g. DeRuiter et al, 2013), which instead is resident in many areas of the basin. Again, it appears necessary to update the threshold levels presented here to include new results on Cuvier's beaked whale sensitivity to noise. The section 4.2 *(*Annex 2) presents an abstract of the noise monitoring guidance prepared by ACCOBAMS for UNEP/MAP which addresses such concepts.

2.4 Information on noise events required to feed the register

The information required to feed the register is summarised in the following table (Table 2).

Table 2. Information required to inform the register.

Data	**Units and/or comments**	**Priority**
Position	geographic position (lat/long) or pre-defined block/area which can be identified through a coding system (single identifier for each block used)	Required
Dates	Start and end day	Required
Source intensity	Source level or proxy, unique levels or in bins (see Annex 5.3 for corresponding tables of values in bins)	Required
Source spectra	Frequency range	Additional
Duty cycle		Additional
Duration of transmission	Actual time/time period	Additional
Directivity		Additional
Source depth		Additional
Platform speed	For moving sources like seismic surveys	Additional

To correctly feed the register it is important to know that:

- The minimum duration of a noise event is 1 day, assuming that at least 1 impulsive sound is emitted in that day;
- Registering a noise event lasting many days means assuming the occurrence of at least 1 impulsive sounds in each day of duration of the noise event

2.5 Computing and representing the indicators related to D11C1

Thanks to the register, it is possible to calculate the indicators linked to D11C1, which consists in computing the spatial and temporal distribution of noise sources in an assessment area. The recommended metric used for such computation is *pulse-block days*, meaning the number of days of occurrence of noise events (pulses) in a block (Dekeling et al., 2014), where:

- A noise event is the occurrence of at least one implulsive sound; the noise event can last more than one day, in this case at least one impulsive sound is assumed to be produced for each day of duration of the event;
- A block is a unit of area of a spatial management system, for example a cell of a regular spatial grid.

To correctly compute the required indicators it is worth considering the following concepts:

- If a noise event last several days in the same block (e.g. 10 days), the number of pulse-block days in that block is equal to the number of days of duration of that noise event (10 pulse-block days in this case)
- The maximum annual value of pulse-block days for a single block is 365 (366 in leap years). This means that if several noise events occur contemporarily in a single day and

in the same block (spatial and temporal overlap), the computation for that block accounts for 1 day, regardless of the number of noise events.

Following new Comm. Dec. 2017/848, two ways to represent indicators related to D11C1 are valid, one focussed on the duration in days of activities generating underwater noise, and one focussed on the extension of the area where activities are located, in absolute values or in proportion of the assessment area. Table 3 summarises the two indicators related to D11C1.

Table 3. Indicators related to D11C1 as defined in the new Commission Decision. Text in bold is the proposed disambiguation for consistency with guidance from TG-Noise (see 5.1. Annex 1 for further explanation).

Type	Units of measurement as defined in the new Comm. Dec.
Days	Number of days per quarter with impulsive sound sources (**pulse-block days per quarter**)
Days	Number of days per month with impulsive sound sources (**pulse-block days per month**)
Area	Proportion (%) of unit areas (**blocks**) of assessment area with impulsive sound sources per year (**at least 1 PBD**)
Area	Extent in square kilometres (km^2) of assessment area with impulsive sound sources per year, **calculated as the sum of the areas of all blocks with at least 1 PBD**

The simplest way to represent these indicators is the use of common GIS software to produce widely used heatmaps (also called hotspot maps). Such maps should report at least the number of *pulse-block days* per unit areas, per month or per quarter. The examples shown in Figure 2 reports a sample of data from the French register and from the first available draft of the Italian register [Le Courtois et al, 2018; Pavan et al, 2017].

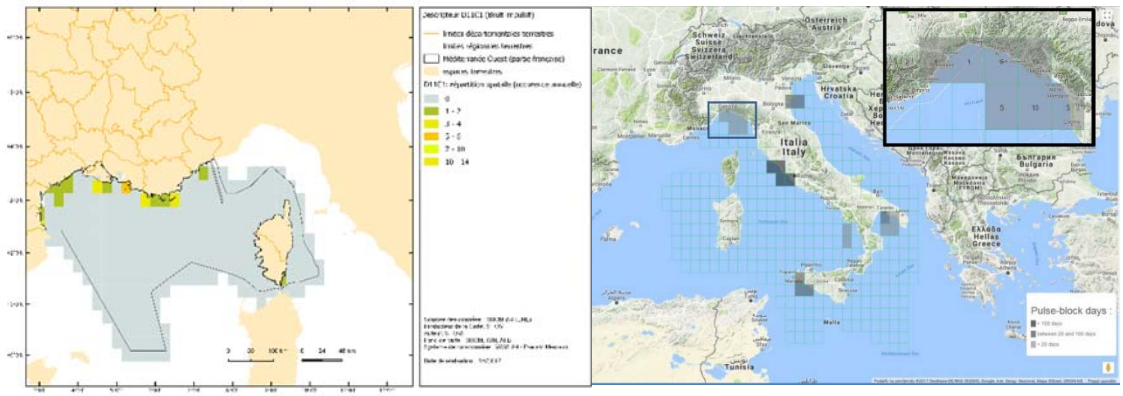


Figure 2.Exemples of the output of the registers implemented in France (left) and Italy (right).

3 Analysis of national implementation in Mediterranean countries

The implementation status of the register in Mediterranean EU Member States was analysed in detail during the QUIETMED project. This analysis represent a further step compared to the analysis carried out and presented in Deliverable 2.1 *Report on lessons learned of national 2012 assessment and GES definition*. Table A-3 of Deliverable 2.1 presents a synthesis of the content of monitoring programs in Mediterranean EU Member States, i.e. what is planned for D11 (C1 and C2) to meet the requirements of the MSFD. Instead, what is presented here is uniquely focussed on the noise register and describes the progress achieved by Mediterranean countries to date in such practical aspects as the development and use of the register, with a view to identify potential issues or hindrance to implementation, and hence outline workable recommendations. Information is also included concerning Mediterranean contracting parties to ACCOBAMS which are not EU member states, but are committed with the implementation of the EcAp process.

Much of the information presented in this chapter is based on the outcomes of a workshop organised by ACCOBAMS, ASCOBANS, the CMS, and the ECS in 2017: "*Best Practice workshop: Fostering inter-regional cooperation in underwater noise monitoring and impact assessment in waters around Europe, within the context of the European Marine Strategy Framework Directive"*, held in Middelfart, Denmark, on May 2017 (ACCOBAMS 2017), hereafter referred to as simply "ECS Workshop".

3.1 Status of national registers

The result of the analysis at the national level is that several Mediterranean EU Member States have already started the establishment of a national register of impulsive noise sources. At the time of writing this deliverable, the most relevant outcomes of the analysis are the following:

- France has established and maintains an operational register;
- Italy developed a first version of the register that included a web GIS tool available on the internet. However, the operational phase has not started due to ongoing changes in the management framework of the MSFD;
- Spain started the development of the register but the operational stage is not yet reached;
- Greece has scheduled to start the development focussing on airgun use (commercial seismic surveys). The formal decision on the register, expected to be taken at the Ministry of the Environment, is pending;
- Regarding Croatia, Malta and Slovenia, actions aimed at monitoring and assessing impulsive noise sources have been undertaken to some extent, but the practical implementation has not started or is not scheduled.
- No information could be collected concerning Cyprus;

For completeness, we report also information concerning other Mediterranean countries which are Contracting Parties to ACCOBAMS, based on available information from the ECS Workshop (ACCOBAMS 2017). Monitoring and assessment programs for noise has not started in reviewed countries. The analysis is limited to Algeria, Tunisia, Lybia and Egypt. Instead, all countries have adopted the UNEP/MAP Resolution on EcAp (UNEP/MAP, 2016b) and are hence committed for implementing actions also for impulsive noise (called *Indicator 26*). At the moment, the principle progress achieved is the identification of the concerned actors which can have a role in setting up the register:

- Algeria: Centre National pour la Recherche et le Développement de la Pêche
- Tunisia: different Ministries (Agriculture, Water Resources and Fisheries, Defense, Energy), the Tunisian company of petroleum activities and National Frequency Agency
- Egypt: Ministry for environment, Egyptian Authority for Maritime Safety, National Research Centre, Universities, NGOs
- Lybia: National bodies that could help in the implementation are the Environmental General Authority, the Marine Biology Research Centre, the National Agency for Scientific Research in collaboration with local universities

The section 5.3 (Annex 3) show the details of the analysis of national progress. Annex 3 id focussed on EU Member States but includes information for non-EU countries. Based on this review, it appears that the principle issues (beyond common administrative slowliness, which of course cannot be addressed here) that hinder the establishment of an operational registers are the following:

- Rules and procedures for data collection
- The use of spatial units for representation of indicators

Therefore, the following two sections present a focussed review of experiences of EU countries on such two elements, with a view of pointing out hints and guidance for facilitating the setting up of the register.

3.2 Focus on data collection procedures for feeding the register from different European countries

As stated at the beginning of the chapter, much of the information reported here was gathered during the ECS Workshop cited above (ACCOBAMS, 2017). This baseline information was then validated and/or updated by QUIETMED partners during the project. One of the objectives of the ECS Workshop was understanding as far as possible how data are collected and fed into the register in the different countries where a national register is operational or under development. Information was gathered for the following countries: France, Germany, Greece, Italy, Spain, and the UK.

Table 4.Review of procedures for data collection

Country	**Procedures in place**
FRANCE	Data are gathered essentially in two ways through active and passive monitoring (Le Courtois et al, 2017). Active monitoring includes gathering information from **official sources on licensed activities** (e.g. Environmental Impact Assessments), **by directly by contacting them**; while passive monitoring includes gathering information through **public information networks** (e.g. notices to mariners).
GERMANY	**Data are collected by state agencies mostly in the frame of license procedures for offshore activities**. The data are then forwarded to the national registry hold by BSH. A data management system is used for administration, assessment and exchange of the data with the noise registry at ICES.
GREECE	The register will be implemented from HCMR in **close collaboration with Hellenic Hydrocarbon Resources Management S.A. (HHRM), which will provide the relevant data**. The first version of the register will be focussed on seismic surveys.
ITALY	The first draft of the register was designed and developed in 2017, and data were collected for 2016. Multiples sources were used: only **activities submitted to EIA are available in public databases**. **Seismic exploration for research** only are not submitted to EIA, thus **data were requested directly** to companies and institutions. Other info such as weapon destruction can be found in ordinances of the Coast Guard, but not centralized archive is available. Navy operations were poorly defined.
SPAIN	The register **data is obtained from the documentation required in the formal procedures of environmental control** for activities that generate underwater noise: Environmental Impact Assessments (EIA); Environmental Impact Statement (DIA); Environmental Monitoring Plan (PVA); Compatibility Report. The source is: SABIA Database from the Directorate General of Environmental Quality and Evaluation and the Natural Environment (Ministry level)
UK	Data is collected via **consenting regimes and license conditions** for impact pile driving, seismic surveys, sub-bottom profiling, multi-beam echosounders, and explosions. Data on unclassified military sonar, acoustic deterrent devices and non-oil and gas geophysical surveys is collected via voluntary submissions. **Data are collected prior to the activity taking place (forward look) and on completion of the activity (backward look)**. **Data are entered** into the UK Marine Noise Registry **through a number of processes** based on discussions **and agreed statements of intent with individual regulators**.

The key message here is that all reviewed countries established direct links to some extent with data holders (regulators and institutions already collecting data on activities generating underwater impulsive noise). Furter, public repositories such as the notices to mariners appear to be used as a complementary way of gathering data.

3.3 Focus on experiences on spatial units used in different countries

A review of spatial units is also presented based on results from the ECS Workshop and validated and/or updated during QUIETMED by project partners.

Table 5. Spatial management grids used in different countries. NA = information not available

Country	**Spatial grid used**	**Reason for this choice**	**Use of the grid**
FRANCE	15'x15'	NA	Representation of indicators
GERMANY	Currently, ICES rectangles and German naval tills	NA	NA
ITALY	30'x30'	Same dimensions as the GFCM grid adopted by ACCOBAMS for the regional register	Reporting of data and Representation of indicators
SPAIN	5' x 5'	The "Regulations for implementation of the law on research and exploitation of hydrocarbons" of 37 June 1974, indicates that the area on which the granting of research must be between two meridians and two parallel equidistant an exact number of minutes and in multiples of five, resulting in a cell size of five for five minutes.	NA
UK	10' x 12'	Spatial grid used for mapping Oil and Gas Licensing Blocks; The grid was chosen for ease of recording of seismic survey activities as this is the spatial area used during licensing.	Reporting of data and Representation of indicators

The sysnthesis reported here highlights the variability of choices made at the national level across the different countries. The reasons grounding the different choices, presented in table 5, can help guiding countries which are at the development stage of the register. In almost all cases, the choice of a spatial grid lied on existing spatial management systems, either nationally (like in the cases of Spain and UK) or internationally (as for Germany and Italy).

However, it is worth noting that one of the conclusions of the ECS Workshop, also supported in this document, is that the emphasis today should be put to the collection of good quality raw data rather than to the development of common standards for spatial representation.

4 Main steps for setting up the national registers

The previous chapters were focussed on: describing what the register is, what it does and what information needs to be collected (chapter 2); and on reviewing the implementation status of the register in European and Mediterranean countries, and their experiences in addressing some practical aspects of the implementation (chapter 3).

On this basis, chapter 4 addresses and outlines recommendations on the main steps to set up and maintain an operational national register for impulsive noise. Many of the concepts described in the following sections were first outlined during the ECS Workshop aforementioned (ACCOBAMS 2017) and then reviewed, completed and updated during the QUIETMED project.

4.1 Defining methods for data collection

The general approach suggested is to **undertake the development of the register in steps, whereby the general idea is that gathering some data is better than gathering none**. Though this approach may appear quite rough, it should be considered as just the inception of a long-term process, where the resolution and quality of data is continuously improved with time and support from data suppliers made more and more efficient.

It is indeed widely acknowledged that data collection and submission should be a task that is clearly supported by national institutions and should be well integrated in the environmental conservation policies of a country (e.g. in licensing procedures). As many activities using loud noise sources require a permit, incorporating the data into the national register of the country delivering the permit could be set as a requisite of the permit procedure. However, this may require the modification of regulation and therefore should be seen as a long-term objective.

More in practice, this approach can be started through the following actions:

- Focussing on noise event types considered as the easiest in terms of data search. For example, a country may start the development of the register focussing on airgun use in a preliminary phase, then extend to further noise event types with time;
- Contacting and entering in agreement, or subscribing statements of intent, with individual regulators and institutions that centralise data on the different activities generating impulsive noise. This is valid for all kinds of activities, either requiring a license (seismic exploration for oil and gas, pile driving, use of explosive, etc.) or not (such as the use of airguns for geophysical research, acoustic deterrents, and more);
- Studying and figuring out effective methods for the collection of data on the use of impulsive noise sources where no license is required and the information may not be organised in a database.
- Defining clearly with data holders the key information to capture and ensure it is well defined and documented;
- Focussing on indispensable data in the first period of implementation. The following are considered indispensable data to meet minimum objectives:

- Position of the noise events, dates, intensity of the source, as described in **table 2** (chapter 2)

Concerning classified or sensitive information, it is acknowledged that data on military activities (exercises involving sonar, explosive disposal) are a sensible issue and the preliminary approach suggested here follows the recommendations from the TG-noise, i.e. that such data might be integrated into the national register on a voluntary basis. In a second phase, initiatives should be undertaken to promote a "cleaning" of data to be done by a competent authority at the country level, which would enable the national responsible to import such cleaned data into the national register.

4.2 What tools for the creation of the database

Very simple tools are needed to meet the minimum requirement of the MSFD with regards to D11C1. A basic scenario would require a spreadsheet built with any suitable software such as *MS Excel*, *openoffice* or similar. This tabular form would include the fields for entering the data listed in table 2. The example in Figure 3 presents the spreadsheet developed during QUIETMED for the regional register for the Mediterranean basin.

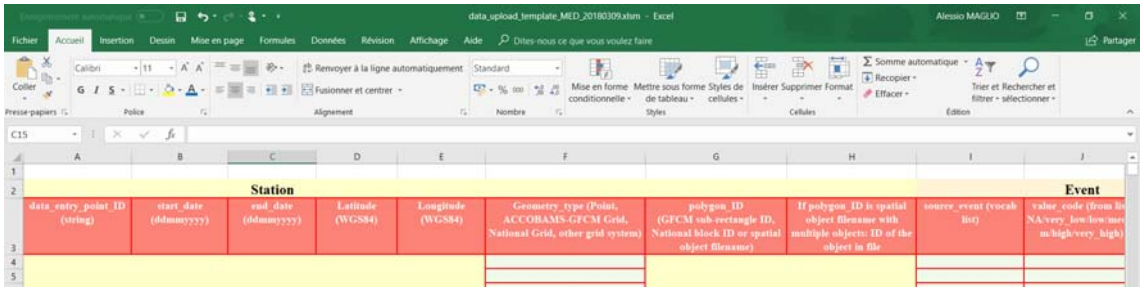


Figure 3. Data reporting form developed during QUIETMED for the regional register for the Mediterranean Sea; source: http://80.73.144.60/CTN_Geoportal/upload/

This simple database might be sufficient to calculate basic indicators such as the number of days with impulsive noise per month and per quarter (Cf. Table 3). Instead, to calculate areas with impulsive sounds, common GIS software may be necessary.

In the framework of QUIETMED, **the joint use of a spreadsheet (MS Excel or similar) and commmon GIS software is considered as the recommendation to meet the minimum requirements of D11C1**.

Further, more advanced scenario may contemplate the use of web technologies to create a web application for the management of the entire process of data collection/reporting, analysis, and presentation of results of the monitoring. Such applications present many advantages:

- Facilitating data collection from different actors involved in the data reporting process;
- Automating some processes like calculating indicators and plotting on a map;

- Allowing accessibility to monitoring data and information to a network of users (stakeholders), as appropriate

However, considering that international registers are being established in all Regional Seas around Europe, it appears that the priority for EU-Member States is to establish an effective system for the collection of good quality data. Dedicated web tools for data management can be also established if this is considered beneficial in terms of data accessibility, to facilitate the reporting from national stakeholders, and for other purposes of national relevance. For example, a country may use a web noise register application to include functions relative to the Maritime Spatial Planning and other planning processes, or to manage other information linked to licensing processes.

4.3 Spatial management and representation system

With regards to the spatial management and representation of noise events and indicators, the use of a grid system is widely considered as an effective and easy way to organise spatially the information and obtain meaningful results.

All countries we analysed where a register is operational or under development use a spatial grid system for at least the representation of data, and sometimes also for data reporting (Cf. section 3.3):

- Representing noise events through the spatial grid means simply the plotting on a map of data such as the noise events themselves or the indicators. For the case of noise events, a country may choose not to show the actual area or point or navigation path of a noise event but only the grid cells overlapping the events. Concerning the indicator, the calculation of pulse-block days is done for each grid cell, as described in section 2.5.
- Reporting noise events in the register through the grid can be done if a single code, i.e. an identifier (ID), corresponds to each cell of the grid. Therefore, the user can indicate the ID of the cell where a noise event occurs together with the rest of data on the noise event (date, intensity, etc.) in a spreadsheet like in Figure 3. This method avoids the need to feed the register with more complex spatial information and data (coordinates in lat/lon or other coordinate systems, GIS files and similar); however, the use of a grid with a stable coding system (single ID for each cells) is necessary, like in the cases of the GFCM and ICES grid systems.

Concerning the definition of the grid, three different approaches were used by countries analysed during this work: i) the adoption of the spatial management system for hydrocarbon exploration and extraction; ii) the adoption of the grid system used in the regional register; iii) in one case a new spatial grid was developed for the specific purpose of the national register. This is the basis for formulating the following alternative recommendations, where the order of presentation does not represent an order of priority, and thereby the easiest option out of the three should be the preferred one:

- If a spatial grid is used in a country for the management of maritime activities requiring permits, such as commercial seismic surveys, but also fisheries and other kinds of

regulated activities, that country may use that grid to report and/or represent noise events. This option may also facilitate the gathering of data on that particular noise event type which is usually managed through the spatial grid. From publicly available information, it appears that many coutries have developed and use a grid system for such purposes (see Annex 5 to this document) which could be used or adapted for the register;

- The grid system developed by the General Fisheries Commission for the Mediterranean (GFCM) was proposed by ACCOBAMS as the grid system to be used for the international noise register for the Mediterranean Sea and the Black Sea regions, and used for the implementation of a demonstrator (Maglio et al., 2016). This proposal was adopted during QUIETMED for the further development of the register and will likely be confirmed and definitely adopted by ACCOBAMS after the end of the QUIETMED project. The dimensions of the GFCM grid is 30 minutes in latitude and longitude and cover the Mediterranean Sea and the Black Sea. A coding system provides a single code (ID) for each cell. The grid is available for download from the website of the FAO, and from the website of the register developed during QUIETMED[1]. This grid is ready-to-use for data reporting or representing, or both.
- Defining a specific grid is also a very simple option where the focus is put on the representation of noise events and indicators on a map and not on the reporting of data through the grid. For data reporting through the grid, a coding system with single ID for each grid cell is also needed and should be developed. Examples of spatial resolution of specific grids are 15 minutes in latitude and longitude as used by France, or the 20 km in latitude and longitude originally suggested by ACCOBAMS [ACCOBAMS 2015] and adopted by UNEP/MAP for the EcAp process (UNEP/MAP 2016).

4.4 Exporting data to the international register

The system built at the national level should allow an easy exporting of data to the international register. The recommendations formulated above in this chapter are indeed made in order to be compatible with the requirement of the international noise register for the Mediterranean basin. The Excel template for reporting data into such register should be taken into account wen developing the national system, to allow since the beginning an easy conversion of data into the international format proposed through the Mediterranean register.

In the future, automated services could be developed to produce outputs such as impulsive noise pressure maps/summary tables/etc., and to convert national register data into the formats used by regional noise registers to ensure ease and accuracy of data sharing.

[1] http://www.fao.org/gfcm/data/map-statistical-grid/fr/ or http://80.73.144.60/CTN_Geoportal/map/

5 Annexes

5.1 Annex 1 – Guidance from Commission Decision 2017/848 on methods for monitoring and assessment, and consistency with guidance from TG-Noise

With regards to anthropogenic impulsive sound in the marine environment, Commission Decision 2017/848 states that the extent to which GES has been reached will be determined based on:

"The duration per calendar year of impulsive sound sources, their distribution within the year and spatially within the assessment area, and whether the threshold values set have been achieved".

Further, the Decision gives the units of measurement for the monitoring and assessment of the impulsive noise criterion:

"D11C1: Number of days per quarter (or per month if appropriate) with impulsive sound sources; proportion (percentage) of unit areas or extent in square kilometres (km2) of assessment area with impulsive sound sources per year".

The main recommendation from TG-Noise about methods for monitoring and assessments of anthropogenic impulsive noise, that is the establishment of a register of impulsive noise sources at the national and regional levels, appear consistent with definition from new Commission Decision.

However, one main practical consideration appear necessary to implement guidance from TG-Noise consistently with new Commission Decision, i.e. the role of the metric recommended by TG-Noise for the assessment of the pressure from impulsive noise on the marine environment.

The metric recommended by TG-Noise is *pulse-block days*, i.e. the number of days that a certain threshold (pulse) is exceeded in an area (block), for a calendar year (Dekeling et al., 2014, 2013; Van der Graaf et al., 2012). The number of pulses occurring in a given block in a single day is not relevant for the computation of the indicator value, which is 1 for such a case, regardless of the number of pulses. In practice, in the case of a noise source emitting several times in the same day (e.g. an airgun for seismic surveys, or during a piling work), or where two or more noise sources are emitting in the same block in the same day, the computation results in 1 pulse-block day, for that day and that block.

Therefore, the question to solve is how the *pulse-block days* metric fits the definition of the units of measurement given in the new Commission Decision: "*days [...] with impulsive sound sources"* and "*[area] with impulsive sound sources"*. We propose here that "*days with impulsive sound sources*" be interpreted as simply *pulse-block days*, as defined by Dekeling and co-authors (2014). Hence, the first part of the definition from new Commission Definition can be understood as:

- The sum of pulse-block days from each spatial unit (i.e. grid cell), calculated per quarter (or per month if appropriate), in the assessment area (region, subregion, or subdivision);

Further, "*[area] with impulsive sound sources"* can be interprested as [area] with at least 1 pulse-block day. Hence, the second part of the definition above could be:

- The proportion (percentage) of unit areas (grid cells) or extent in square kilometres (km²) of assessment unit (region, subregion, or subdivision) with at least 1 pulse-block day, per year;

With these clarifications, the use of pulse-block days for the measurement of the spatial and temporal distribution of impulsive noise sources appears consistent for the implementation of new Commission Decision.

5.2 Annex 2 - Minimum thresholds for registering noise sources: a discussion from the guidance prepared by ACCOBAMS for UNEP/MAP on Ecological Objective 11

We present here an abstract of the document "ECOLOGICAL OBJECTIVE 11: ENERGY INCLUDING UNDERWATER NOISE – A basin-wide strategy for underwater noise monitoring in the Mediterranean", hereafter referred to as ACCOBAMS Noise Monitoring Guidance (ACCOBAMS, 2015). This document was prepared by members of the Joint Noise Working Group (JNWG) of ACCOBAMS, ASCOBANS and the CMS, and adopted as technical guidance for the implementation of the Ecological Objective 11 (Energy including underwater noise) of the Ecosystem-Approach process undertaken by the UNEP/MAP-Barcelona Convention. The ACCOBAMS Noise Monitoring Guidance is today included in the Integrated Monitoring and Assessment Guidance (IMAG) issued by the UNEP/MAP in 2016 (UNEP/MAP, 2016a).

The ACCOBAMS Noise Monitoring Guidance reports the following:

- No threshold system is recommended for low-frequency sound sources, based on evidence of behavioural disruption on fin whales at very long distances (> 200 km) from emissions of impulsive noise (Borsani et al., 2008; Castellote et al., 2012)
- The activities with a minimum threshold for inclusion in the register include the following mid-frequency noise sources:
    - Mid frequency military sonar: SL > 176 dB re 1 µPa m
    - Mid frequency acoustic deterrent: SL > 176 dB re 1 µPa m
    - Other non-pulse sound source: SL > 176 dB re 1 µPa m
    - Other pulse sound source SLE > 186 dB re 1 $\mu Pa^2\ m^2\ s$

The recommendations on threhold values as proposed by TG-Noise are maintained for mid-frequency source. The conceptual framework followed by TG Noise to derive such thresholds (Dekeling et al., 2013) is presented hereafter: first, received noise (RL) levels eliciting behavioural

reactions are identified through a literature review. Second, it is assumed that significant impact occurs when such RL reach a range of 1000 m from the noise source, meaning that sources producing levels that cause behavioural reaction at 1000 m from the source need to be included in the register. Finally, RL eliciting behavioural reaction at 1000 m are back calculated to find the source level (SL). This last (SL) is the value selected as minimum threshold for inclusion of the noise source in the register, indicated in the list above.

For non-pulse sound sources (sonar, acoustic deterrent devices and other non-pulse sources), thresholds are based on available literature regarding beaked whale reaction to mid-frequency military sonar. A study focussing on Blainville's beaked whale (*Mesoplodon densirostris*) suggests 140 dB re 1µPa as the thresholds for the onset of behavioural reaction due to mid-frequency sonars (Tyack et al., 2011). After back calculation (see Dekeling et al., 2013 Part III for details), the source level threshold is **176 dB re 1µPa: this is the value selected by TG-Noise as minimum threshold for impulsive noise sources defined as non-pulse** (Van der Graaf et al., 2012)

However, it is worth recalling a recent study from DeRuiter et al. (2013) focussing on Cuvier's beaked whale behavioural reaction to simulated mid-frequency sonar. This work suggests lower levels, i.e. values ranging from 89 to 127 dB re 1µPa, for triggering behavioural reactions in Cuvier's beaked whale. Such reactions include ceasing normal fluking and echolocation, changing swim pattern and extending both dive duration and subsequent non-foraging interval (DeRuiter et al., 2013).

This latter study appears more coherent for the Mediterranean case because it addresses Cuvier's beaked whale, resident in the region, instead of Blainville's beaked whale, which is absent or occasional; but the range of noise levels triggering a response, as suggested by DeRuiter and co-authors, appear very large and hence difficult to transform in a single threshold value. Furthermore, the same study shows that distant sonar exercises incidentally exposing a tagged whale to comparable received levels (78 – 106 dB re 1µPa) did not elicit such responses.

Hence, the JNWG proposes as interim criterion to use the noise level recommended by TG-Noise and based on Tyack et al. (2011), i.e. 176 dB re 1µPa, as a threshold for mid-frequency non-pulse noise sources. Updating this threshold will be necessary once deeper knowledge will be available.

For pulse sound sources (airguns, pile driving, explosions), the **JNWG advices to adopt as interim criterion the threshold used in the technical guidance from TG-Noise (186 dB re 1 µPa² m² s)**. Such threshold is based on the onset of behavioral disruption at 1000 m away from the source for the harbor porpoise, which is the marine mammal with lowest TTS thresholds known to date (Lucke et al., 2009). This is therefore highly conservative, but since harbour porpoise is almost absent in the Mediterranean Sea (sightings of the Black Sea sub-species *Phocoena phocoena relicta* occur regularly only in the northern Aegean Sea), an update of these values appear necessary for more representative species of the Mediterranean Sea.

5.3 Annex 3 – Tables of values for reporting source intensity

Where levels are reported in bins instead of a precise level, TG-Noise proposes the following reference tables:

- Sonar or acoustic deterrents (source level, rounded to nearest decibel):
    - Very low: 176-200 dB re 1 µPa m
    - Low: 201-210 dB re 1 µPa m
    - Medium: 211-220 dB re 1 µPa m
    - High: above 220 dB re 1 µPa m
- Generic explicitly impulsive source (energy source level, rounded to nearest decibel):
    - Very low: 186-210 dB re 1 $\mu Pa^2\ m^2\ s$
    - Low: 211-220 dB re 1 $\mu Pa^2\ m^2\ s$
    - Medium: 221-230 dB re 1 $\mu Pa^2\ m^2\ s$
    - High: above 230 dB re 1 $\mu Pa^2\ m^2\ s$
- Airgun arrays (zero to peak source level, rounded to nearest decibel):
    - Very low: 209-233 dB re 1 µPa m
    - Low: 234-243 dB re 1 µPa m
    - Medium: 244-253 dB re 1 µPa m
    - High: above 253 dB re 1 µPa m
- Explosions (equivalent TNT charge mass, rounded to nearest 10 g if less than 10 kg and to nearest 1 kg otherwise)
    - Very low: 8 g to 210 g
    - Low: 220 g to 2.1 kg
    - medium: 2.11-21 kg
    - high: 22-210 kg
    - Very high: above 210 kg
- Impact pile driver (hammer energy, rounded to nearest 10 kJ)
    - Very low: less than 280 kJ
    - Low: 290 kJ-2.80 MJ
    - Medium: 2.81-28 MJ
    - High: above 28 MJ

5.4 Annex 4 – Detailed review of national implementation of the register in Mediterranean countries

Croatia

In Croatia the national impulsive noise register is currently in preparatory phase. IOF is collaborating with national responsible institutions (Ministry of Environment and Energy and Croatian Environment Agency) in the preparation of the register by proposing the legal framework, form and content of the register. A national register is not yet in place and not yet operational.

Cyprus

No information available

France

In France Shom is committed by the French Ministry for the Ecological and Inclusive transition to collect data on impulsive noise emitting activities and to shape the collected data into a national impulsive noise register SIRENE (*Sons Impulsifs: Registre National des Emissions*). The current state of the system is sufficient to be the basis for the 2018 assessment in the second cycle of MSFD implementation.

Currently the main focus in preparing the national register is on data collection, more than the system itself. The work is focused on preparing yearly tabular datasets of impulsive noise emitting activities. Spatial representations of the data are prepared with python and qGIS library. A continuously (and publicly) available GIS platform is not planned. Instead it is planned to rely on regional registers (ICES and the pending Mediterranean register) for spatial representation and presentation of D11C1 common indicator (pulse-block-days). The main purpose of the French national register is to prepare consistent datasets to be exported to regional registers.

Data are gathered essentially in two ways through active and passive monitoring (Le Courtois et al, 2017). Active monitoring includes gathering information from official sources on licensed activities (e.g. Environmental Impact Assessments), while passive monitoring includes gathering information through public information networks (e.g. notices to mariners). All gathered data undergoes a quality check with 4 categories:

1. An impulsive noise emitting activity is suspected in a certain area without confirmation of precise location and time
2. An impulsive noise emitting activity is suspected with a known location and date, but it is not confirmed that it actually occurred
3. An impulse noise emitting activity is confirmed, but the location and time are not precisely known

4. An impulsive noise emitting activity occurred with sufficiently precise date and location.

Category 1 is never included in the calculation of the indicator, in some cases category 2 is included, while categories 3 and 4 are directly included in building the indicator. Based on this, yearly GIS representations of the D11C1 indicator are prepared in QGIS (Figure 9).

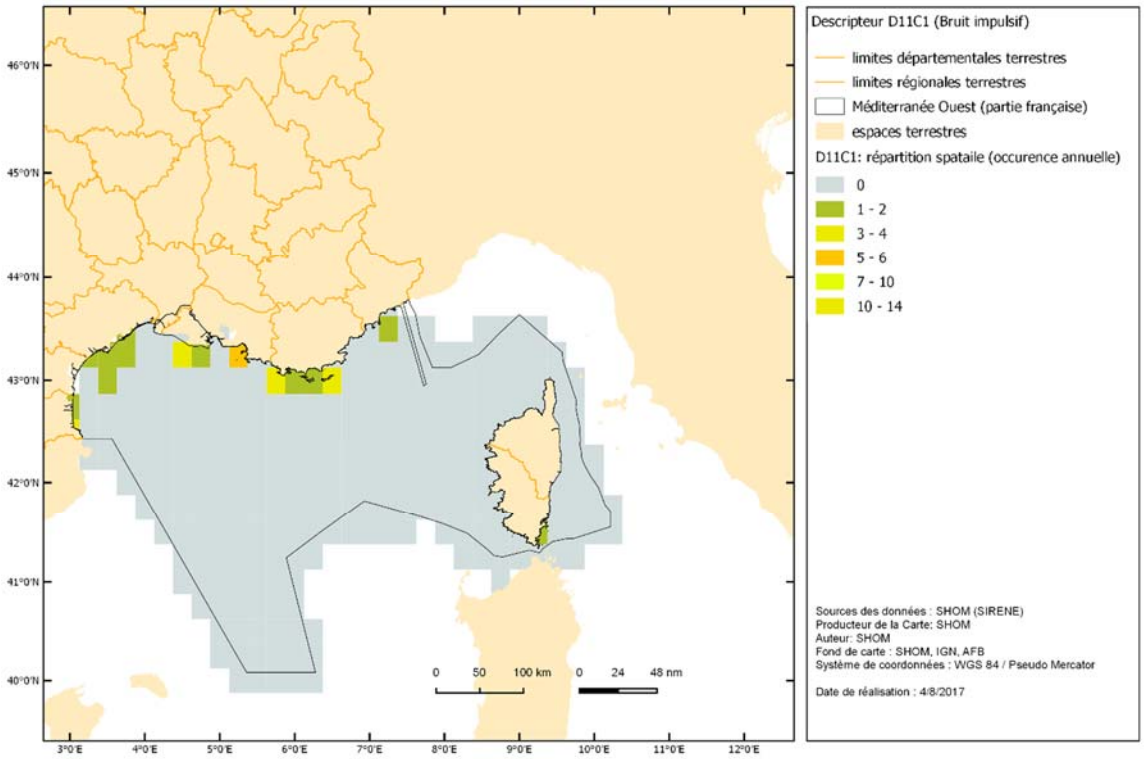


Figure 4. D11C1 indicator for the French Mediterranean waters for the year 2016 (Le Courtois et al, 2018.).

SIRENE will encompass two levels of protection: a non-protected level including data with no use restriction and a protected level encompassing all possible data which may not be made public due to technical or operational reasons. The unrestricted yearly datasets will be exported to regional registers and the national information portal and thus made publicly available, while the restricted data will remain inaccessible.

Greece

In Greek waters, there is no established network or action for monitoring and/or accessing low and mid frequency impulsive sounds. Their main accessible noise sources are generated from seismic surveys for hydrocarbon exploration or research purposes. Monitoring of low and mid frequency impulsive sounds consists of establishing a noise register with activities related to loud impulsive sounds, i.e. measured over the frequency band 10 Hz to 10 kHz, exceeding the energy source level 186 dB re 1 $\mu Pa^2 m^2 s$ or zero to peak source level 209 dB re 1 $\mu Pa^2 m^2$ over the recorded areas. The aforementioned values are the thresholds suggested by the MSFD Technical Subgroup on Underwater Noise as regards the categories “airgun” and “other pulse

sound source". There is a preliminary suggestion by HCMR "that the register will include at least the following data: position data (geographic position (lat/long), licensing block/area), date of operation, noise category, source level and depth." The register will be implemented from HCMR in close collaboration with Hellenic Hydrocarbon Resources Management S.A. (HHRM), which will provide the relevant data and will actively participate in the design of the register. HHRM has been transitionally appointed as the Competent Authority for Offshore Safety in Oil and Gas Operations in Greece since July 28th, 2016, through Law 4409/2016 (transposition of Directive 2013/30/EU). The formal decision on the register expected to be taken at the Ministry of the Environment is still pending.

Italy

In 2016 the the University of Pavia was requested by CONISMA (a consortium of Italian Universities) to implement the Italian Impulsive Noise Register. This task officially included collecting the data on impulsive noise sources for 2016 and providing the data in tabular form (spreadsheet). The official task was extended to include also the development of an experimental web interface. Therefore, at the time of writing this web interface should not be considered as officially part of the Italian impulsive noise register. It is available at the following URL: http://italy.noiseregister.org/ for demonstration and testing purposes.

The data on impulsive noise sources were gathered by accessing the databases of the Italian Ministry of Industrial Development and the Italian Ministry of Environment, which include information on requested and authorised seismic surveys for oil exploration and other major industrial activities. Since scientific seismic surveys did not need authorisation until 2017, information on this kind of activities were gathered by contacting the institutions that execute these kind of surveys (OGS, CNR and CONISMA). A new law no in force since September 2017 requires EIA and authorisation also for scientific surveys with airguns, and this will probably facilitate the reporting of such activities to the national register. However, for the year 2016 no scientific seismic surveys were declared by Italian institutions. It is noteworthy that that scientific seismic surveys conducted by foreign institutions may have occurred without any communication to the Italian authorities.

Another important source of information on impulsive noise emitting activities was the Italian Coast Guard website, where all operations that require navigation restrictions are recorded. This was the source of information on areas of navy exercises with impulsive noise relevance (live fire, sonar testing, but without specific details), operations related with explosions (World War II unexploded ordnance) and information on one seismic research cruise (with sparker technology). All this information however includes only temporal and spatial data, with no indication on source sound level, repetition rate, frequencies etc.

As for the developed web interface, though not official, it can offer some insights that can be included beneficially in the development of the QUIETMED register. The web interface allows wide public access to the information on impulsive noise sources (Figure 7). It enables

previewing on a map information on activities using impulsive noise sources gathered in the following layers:

- Sonar or acoustic deterrents,
- Ordnance explosion,
- Navy live fire exercise,
- Impact pile driver,
- Explosions,
- Airgun arrays and
- Generic explicitly impulsive noise sources.

It is important to mention that, due to the 2017 law on mandatory EIA for scientific use of airgun (the law explicitely cite “airguns”), companies are evaluating the possiblity to prefere the use of alternatives such as sparkers and waterguns.

The web interface provides additional information on noise events (type of event, start date, end date, value code and source spectra) from pop-up windows when a noise event is selected.

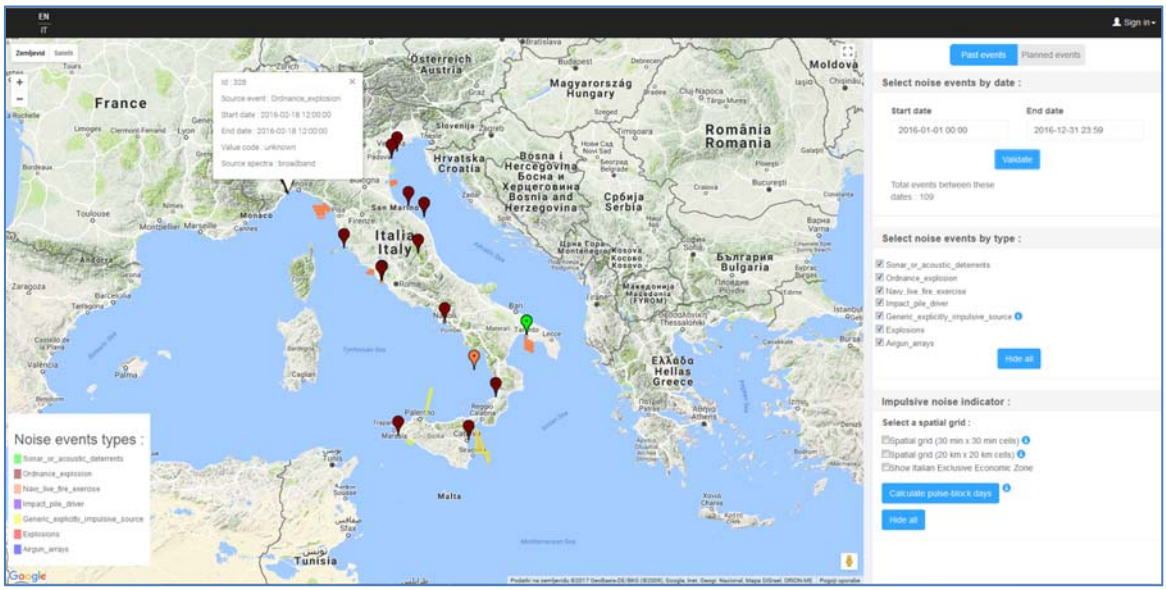


Figure 5. Preview of noise events on the Italian impulsive noise register web interface (http://italy.noiseregister.org/, as accessed in november 2017.

The interface also allows selecting noise events per date by defining start and end date. The interface includes calculation of the impulsive noise indicator (pulse-block-days). The indicator is calculated on the fly according to the selection of noise events per date by the user (Figure 8). The indicator is presented in a greyscale palette with three classes (less than 20 days, between 20 and 100 days and over 100 days). The exact number of pulse-block-days per grid cell is also presented at appropriate map scale (when zoomed-in).

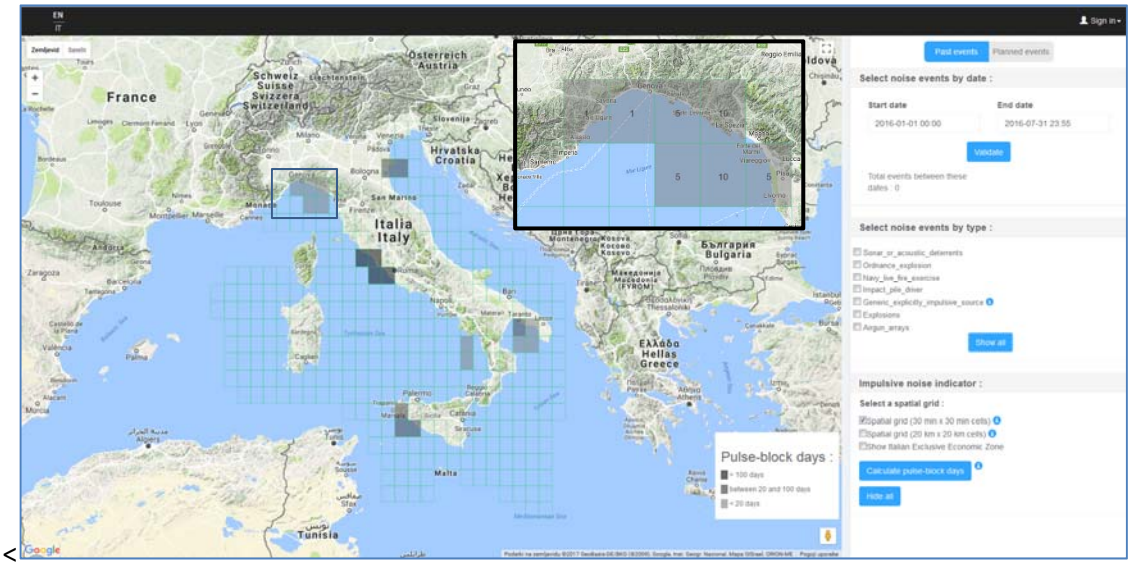


Figure 6. impulsive noise indicator calculated for the user selected period 1.1.2016 – 31.7.2016 based on a 30' x 30' spatial grid, with zoom in on the Ligurian Sea to highlight indicator values by grid cell (http://italy.noiseregister.org/, as accessed in November 2017).

For public users (not logged-in), neither event data nor indicator data can be downloaded. The interface however offers an interesting feature that allows users to get an overview of planned noise events. Especially, these are requested licenses, whose planning can be inserted according to the permits request deposited in the database of the Ministry of Economic Development. Overall the GIS web interface is user friendly, since the application features are intuitive and easily accessible. All map displays are equipped with a readable legend that offers users quick understanding of the data that is being presented. Future developments (not necessarily and uniquely related to MSFD) may go towards integrating external data, such as biological data (e.g. the Italian cetacean stranding database also hosted by the University of Pavia) and further data on environmental management (e.g. Marine Protected Areas) and human activities offshore.

Malta

There is no Maltese national impulsive noise register in place as yet but data is being collated from seismic surveys. Currently the authorised authorities are discussing possible development or the registry internally and with possible stakeholders.

Slovenia

In Slovenia, an impulsive noise register has not been developed yet. There has been some development in past years: an overview of main activities emitting impulsive noise being carried out in Slovene sea, keeping track of impulsive noise emitting activities etc. but a functioning register has not been developed.

Spain

In Spain, CTN collaborates with the Spanish Government (Ministry of the Agriculture and Fisheries, Food and the Environment-MAPAMA) as advisor and/or consultant in the development of the national register. Currently the Spanish register is under development and not operational and as such could not be reviewed.

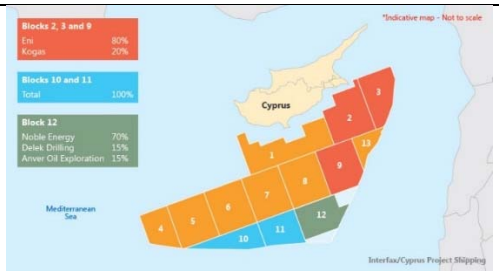
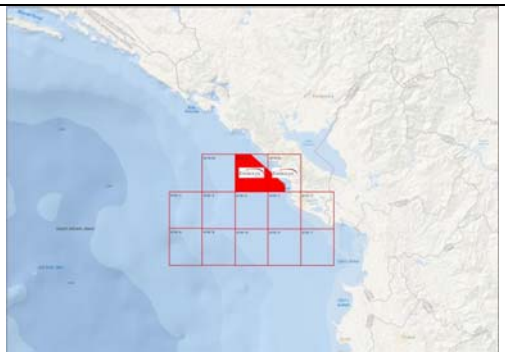
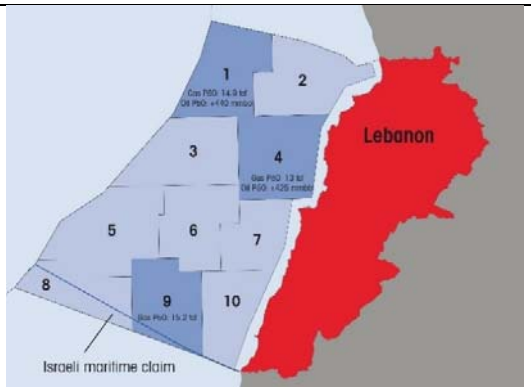
Based on information from the ECS Workshop on Noise (ACCOBAMS 2017), implementation in other Mediterranean countries has not started.

5.5 Annex 5 – Examples of spatial management systems available from public information

The following table show examples of spatial management systems for several Mediterranean countries[2] concerning the management of oil and gas ecploration activities. Such systems may constitute the basis for the development of the reporting system of national registers in countries where the register is yet to be developed.

Country	Spatial systems used for manging oil and gas exploration activities
Croatia	

[2] Only publicly available information was used here. Examples of spatial systems reported here might be obsolete or not updated.

Chypre	
Greece	
Montenegro	
Lebanon	

Malta