

ACCOBAMS MEDITERRANEAN TECHNICAL ASSESSMENT ON ANTHROPOGENIC UNDERWATER NOISE



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Mediterranean technical assessment on anthropogenic underwater noise

ECOLOGICAL OBJECTIVE 11 – ENERGY INCLUDING UNDERWATER
NOISE



ACCOBAMS Mediterranean technical assessment on anthropogenic underwater noise

Abstract: This report presents the first regional-scale assessment of underwater noise pollution in the Mediterranean Sea, with a focus on its impact on cetaceans. The results presented here are relevant for the implementation of an ecosystem-based management of the marine environment under the scope of the UNEP/MAP Integrated Monitoring and Assessment Program (IMAP) and the EU Marine Strategy Framework Directive (MSFD). The evaluation considers two key indicators: impulsive noise (e.g., explosions, seismic surveys) and continuous noise (e.g., shipping traffic), using a risk-based methodology to identify habitat areas where noise exposure exceeds ecological thresholds. Results indicate that noise pollution may surpass tolerable limits in different sub-regions such as the Western Mediterranean and the Aegean and Levantine Seas and may affect up to 30% of habitats for certain species and periods. Limitations, including lack of national reporting of impulsive noise and of field data for calibration of acoustic models, may affect the quality of results and underline the need for enhanced monitoring and refined modeling approaches. Nonetheless, the findings emphasize the importance of robust noise management strategies, including Marine Protected Areas, to mitigate impacts and align with global biodiversity frameworks. This report calls for strengthened international cooperation and cross-sectoral collaboration to support the resilience of marine ecosystems and promote sustainable management practices.

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Authorship

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List of Abbreviations / Acronyms

ACCOBAMS	Agreement on the conservation of cetaceans of the Black Sea, the Mediterranean Sea and the contiguous Atlantic area
ADR	Adriatic Sea Sub-region
AEL	Aegean and Levantine Seas Sub-region
AIS	Automated Identification System
CEN	Central Mediterranean Sub-region
CI	Common Indicator
cCI	Candidate Common Indicator
CORMON	Correspondence Group on Monitoring
COP	Conference of the Parties
D11	Descriptor 11 established under the EU-MSFD
EMODnet	European Marine Observation and Data Network
EEA	European Environmental Agency
GES	Good Environmental Status
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
INR-MED	International Noise Register in the Mediterranean Sea
LOBE	Level of Onset of Biological Effects
MSFD	Marine Strategy Framework Directive
MAP	Mediterranean Action Plan
MED	Mediterranean
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
PUHA	Potentially Usable Habitat Area
QSR	Quality Status Report
SAU	Spatial Assessment Units
TG-Noise	Task Group on Underwater Noise
UNEP	United Nations Environmental Program
WMS	Western Mediterranean Sea Sub-region

1. Key messages

1. This report presents the first ever assessment of underwater noise pollution at the regional and sub-regional scale in the Mediterranean Sea following the rules established under IMAP Ecological Objective 11 (energy including underwater noise). It was prepared in collaboration between ACCOBAMS and UNEP/MAP as a contribution to the Quality Status Report of the Mediterranean (UNEP, 2024).

2. The assessment methodology follows a risk-based approach and is based on the consideration of the risk that the population of sensitive cetacean species, which are selected as indicators of the status of the Mediterranean ecosystems relative to the potential impact of noise, decrease in the long-term due to the exposure to underwater noise. In this assessment, the status of a Sub-region and of the whole Region has been considered tolerable if:

- Equal or less than 10% of the habitat of cetacean species is affected by anthropogenic impulsive noise events (such as airgun noise, underwater explosions, pile driving, and sonar) in a calendar year, and
- Equal or less than 20% of the habitat of cetacean species is affected by continuous anthropogenic noise, on a monthly basis during a calendar year.

3. The assessment of impulsive noise showed that most environmental pressure is found in the Aegean and Levantine, Central Mediterranean, and Adriatic sub-regions, where the proportion of habitat affected by such noise appeared to approach the 10% threshold value for different years considered in the assessment. Based on calculations presented in this assessment, the threshold value has been exceeded for the Aegean and Levantine sub-region in 2018. Also, the results of this assessment points out that continuous noise due to shipping is spread almost everywhere and the proportion of habitat exposed may exceed 20% in the Western Mediterranean and the Aegean and Levantine sub-regions as well as for the Mediterranean region as a whole. The main outcome of the assessment, based on the adopted methodology and available data, can be summarized in the existence of non-tolerable status for some areas and periods which should induce taking actions in terms of management of underwater noise emissions.

4. However, these assessment findings should be used with great caution because of the several sources of incertitude which prevent us from clearly stating about GES or non-GES status. The quality of available data for impulsive noise is not optimal indeed and some elements of incertitude may result in overestimation (e.g. it is possible that some licensing blocks for oil and gas exploration have been used instead of actual surveys because the quality of available data did not allow to distinguish), while other uncertainties result in potential underestimation (e.g. the propagation of noise from the source have been accounted for only very roughly). On the other hand, available input data for the modelling of continuous noise were of better quality but here the incertitude lies in technical aspects relative to the modelling techniques employed to compute the exposure map of shipping noise, which is still a complex and non-standardized discipline, and in the choice of an absolute value of Sound Pressure Level as Level of Onset of Biological Effects, which is also an open subject of discussion in scientific and technical fora. Also, only a rough verification of model performance could be carried out due to the lack of specific in-situ measurements supporting the modelling exercise. Although uncertainties were handled through the use of the precautionary principle, they might have affected the quality of the output.

2. Background information and methodology

5. This document presents the first regional assessment of underwater anthropogenic noise in the Mediterranean basin as a result of the implementation of the Ecosystem Approach by the Barcelona Convention. It addresses candidate Common Indicator 26 (low- and mid-frequency impulsive sounds) and candidate Common Indicator 27 (low-frequency continuous noise).

6. The assessment is performed by ACCOBAMS thanks to the collaboration between ACCOBAMS and the Barcelona Convention as set out in a Memorandum of Understanding signed in 2016 between the two Secretariats.

7. For cCI-26 and 27, the assessment for the QSR in 2017 was not performed due to the early stage of development of some major methodological aspects as well as tools and processes for data gathering and preparation.

8. For the QSR in 2023 (UNEP, 2024) it has been possible to include cCI-26 and cCI27 as the methodological aspects related to the assessment as well as the development of tools and processes for data gathering have considerably progressed since then. Hence, available datasets produced in the framework of ACCOBAMS activities under the scope of the MSFD-D11 and IMAP-EO11 were used to produce the first ever assessment findings at the subregional and regional level and the same methodological approach was taken in all subregions and in the region.

9. The methodology employed for assessment of cCI26 and cCI27 is adapted from the technical guidance developed by the Task Group on Underwater Noise, TG-Noise, (Borsani et al., 2023; Sigray et al., 2023) established for the implementation of the Descriptor 11 (Energy including underwater noise) of the EU Marine Strategy Framework Directive (MSFD), to which ACCOBAMS in collaboration with SPA/RAC have actively contributed to ensure the applicability of the methodology to the Mediterranean region (Table 1). The assessment methodology is based on the analysis of the spatial and temporal distribution of underwater noise at the regional and sub-regional level, and on the calculation of the extent of exposure of noise over the habitats of sensitive marine fauna.

Table 1. Methodologies used for assessment of the four Mediterranean Sub-regions.

cCI 26	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The adapted exposure metrics and assessment methodology as provided in the document “Setting of EU Threshold Values for impulsive underwater sound - Recommendations from the Technical Group on Underwater Noise (TG Noise), available at this URL . The adaption of the assessment methodology was undertaken further to the proposal of the IMAP Guidance Factsheet for cCI 26.
cCI 27	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The adapted exposure metrics and assessment methodology as provided in the document “Setting of EU Threshold Values for continuous underwater sound - Recommendations from the Technical Group on Underwater Noise (TG Noise), available at this URL . The adaption of the assessment methodology was undertaken further to the proposal of the IMAP Guidance Factsheet for cCI 27.

2.1 Assessment methodology for IMAP cCI26

10. The assessment for Candidate Indicator 26 (cCI 26) (low- and mid-frequency impulsive sounds) is performed in collaboration of the ACCOBAMS and the UNEP/MAP - MEDPOL based on data of impulsive noise events reported by the Contracting Parties to the ACCOBAMS through the International Noise Register for the Mediterranean and Black Sea regions managed by ACCOBAMS, as well as by using data on further impulsive noise events generated through dedicated activities coordinated by the ACCOBAMS Secretariat which are aimed at enhancing the gathering of impulsive noise event data.

11. For the initial assessment of underwater noise within the preparation of the 2023 MED QSR (UNEP, 2024), Low and mid-frequency impulsive noise events considered for the assessment, in line with the methodology adopted, were the following: underwater explosions, geophysical surveys with the use of airguns, sonar or acoustic deterrents, pile driving. The geographical position of such noise sources, the duration of the event (start and end date) and the intensity (in dB re 1µPa or proxy) are the necessary data for the analysis of the geographical and temporal distribution of noise events. This analysis served as an indication of the anthropogenic pressures.

12. Further, by including information about the habitat of noise-sensitive species, it was possible to move towards the assessment of whether the risk of the negative impacts occurring on populations of such species is acceptable. Specifically, the methodology for cCI26 (but also for cCI27) which was based on the calculation of the extent of exposure i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE), on average over a year, ensured addressing the risk of local extinction of noise-sensitive species due to exposure to underwater noise. This concept is at the basis of the noise assessment methodology developed by the TG-Noise under the scope of the MSFD-D11 with the active contribution of the ACCOBAMS and the UNEP/MAP - SPA/RAC (Borsani et al, 2023; Sigray et al., 2023).

13. The collaboration between ACCOBAMS and UNEP/MAP - SPA/RAC allowed us to consider specificities of the Mediterranean Sea and ensure applicability of the assessment methodology developed under the scope of MSFD-D11 also for an initial assessment of IMAP cCI26. The assessment methodology conceived in this way is compatible with the initial proposal of the IMAP Guidance Fact sheets for cCIs 26 and 27¹ which were presented in 2019 for consideration of the Meeting of MEDPOL Focal Point (Istanbul, Turkey, 29-31 May 2019), prepared in line with the Monitoring strategy of ACCOBAMS developed in 2015 (ACCOBAMS, 2015; Maglio et al., 2014).

14. The proposed IMAP Guidance fact sheet for cCI 26 indicated the following target for achieving GES under cCI 26 “the number of days with impulsive sounds sources, their distribution within the year and spatially within the assessment area, are below thresholds”. It should also be noted that considering 2023 EU TG-Noise technical guidance on threshold setting for impulsive noise, the following reformulation of this target for IMAP cCI26 is needed: “the extent (%) of habitat of noise-sensitive species within the assessment area that is impacted by impulsive noise events is below thresholds”. Given that proposed IMAP Guidance Factsheet for cCI 26 was not adopted by the Meeting of MED POL FPs, the definition of the GES target proposed by EU TG-Noise was applied for the present initial assessment of cCI 26 within the preparation of the 2023 MED QSR (UNEP, 2024).

15. Particularly, under the EU TG-Noise methodology, Tolerable Status is defined when 10% or less of the habitat of noise-sensitive species is impacted by impulsive noise events, considering the average of daily exposures over a year. This threshold (extent of exposure = 10%) is valid for all MSFD regions and subregions. Therefore, it was also followed within the present initial IMAP cCI 26 assessment. The scales

¹ IMAP Guidance Fact Sheet for IMAP CI 21 (UNEP/MED WG.473/7)

of assessment recommended by the Proposal of the IMAP Guidance Factsheet for cCI26 (2019 update) were the regional and sub-regional levels. This also corresponds to the recommendations made at EU level. Hence, the initial assessment findings for cCI 26 within the 2023 MED QSR (UNEP, 2024) were provided for the four IMAP Sub-regions of the Mediterranean Sea i.e. the Aegean and Levantine Sea, the Adriatic Sea, the Central Mediterranean Sea and the Western Mediterranean Sea Sub-regions.

16. Considering the available data on impulsive noise events, the statistical calculations related to proportion of days and geographical distribution of low, and mid-frequency impulsive sounds were undertaken as far as possible in line with the Proposal of the IMAP Guidance fact sheet for cCI 26, while for performing the assessment it was necessary to calculate the extent of exposure, an additional indicator, i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE), on average over a year, as outlined in the aforementioned TG-Noise methodology. For the calculation of the extent of exposure, it is necessary to account for the propagation of noise from the source (either by modelling or other methods such as applying a buffer zone) and to consider the footprint of an impulsive noise event, where the footprint is limited by the isoline at which the LOBE is reached.

17. Despite the finalisation of the EU TG-Noise methodological framework and its approval at the EU level, the process of data production and gathering has started too recently. Hence, the quantity and quality of available data prevented optimal implementation of the above explained methodology. Therefore, an adapted methodology was applied within the preparation of the 2023 MED QSR (UNEP, 2024) whenever necessary to fit data available for impulsive noise events. This is the first such assessment of anthropogenic pressures from impulsive noise regarding both the IMAP and the MSFD implementation in the Mediterranean Sea.

2.2 Assessment methodology for IMAP cCI27

18. The assessment of cCI 27 i.e. “continuous low frequency sound” is performed in collaboration of the ACCOBAMS and the UNEP/MAP - MEDPOL based on data obtained from the NETCCOBAMS Platform ([link](#)), a digital information tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The platform contains maps of shipping noise distribution over the entire Mediterranean basin. These were obtained from theoretical modelling techniques in the frequency bands of interest further to the requirements set out in the Proposal of the IMAP Guidance Factsheet for cCI27. However, we underline that field measurements were not available to verify and calibrate the models and that this may affect the quality of results.

19. The NETCCOBAMS platform was established, based on a specific request from the Contracting Parties to the ACCOBAMS, back in 2012 during a regional workshop on the ‘ACCOBAMS Strategy’, in order to set up a tool aimed at centralizing relevant data and support science-based decision making. The NETCCOBAMS noise mapping service delivers information to be used by the Parties, by the Scientific Committee, by the Secretariat and further by the ACCOBAMS bodies and stakeholders to pursue objectives under the scope of the ACCOBAMS Agreement (ACCOBAMS-MOP8/2022/Doc31/Annex13/Res8.7). However, the processes specifically related to IMAP GES assessment (e.g., data reporting and validation from the countries, aggregation, etc.) have been set up very recently in 2022 and are still subject to change. This prevents the full implementation of the GES assessment methodology. Nevertheless, an initial assessment was carried out within the 2023 MED QSR preparation (UNEP, 2024) as the quality of available data was sufficient and allowed producing the first assessment findings for the four Sub-regions of the Mediterranean Sea.

20. For the initial assessment of the noise within the preparation of the 2023 MED QSR (UNEP, 2024), the methodology applied for assessment of the cCI 27 served as an indication of the anthropogenic pressures. Further, by including information about the habitat of noise-sensitive species, it was possible to move towards the assessment of whether the risk of negative impacts occurring on populations of such species is acceptable. Specifically, the methodology for cCI27, which was based on monthly extent of exposure, i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE) on a monthly basis, ensured addressing the risk of extinction of a population due to exposure to underwater noise. This concept is at the basis of the noise assessment methodology developed by the TG-Noise under the scope of the MSFD-D11 with the active contribution of ACCOBAMS and SPA/RAC.

21. Like for cCI26, the collaboration between ACCOBAMS and UNEP/MAP - SPA/RAC allowed to consider specificities of the Mediterranean Sea and ensure applicability of the assessment methodology developed under the scope of MSFD-D11 also for an initial assessment of IMAP cCI 27. The assessment methodology conceived is compatible with the initial proposal of the IMAP Guidance Fact sheets for cCIs 26 and 27² which were presented for consideration of the Meeting of MEDPOL Focal Point (Istanbul, Turkey, 29-31 May 2019), prepared in line with the Monitoring strategy of ACCOBAMS issued in 2015 (Maglio et al, 2014, ACCOBAMS, 2015).

22. The Proposal of IMAP Guidance Factsheet for cCI 27 indicates the following target: “the extent (% or km²) of the assessment area which is above levels causing disturbance to sensitive marine animals is below limits”. Further to the finalisation of the work from EU TG-Noise, it is found that this GES target still stands. Therefore, it was applied for the initial cCI 27 assessment within the preparation of the 2023 MED QSR (UNEP, 2024).

23. Particularly, under TG-Noise methodology approved at EU level, Tolerable Status is defined when 20% or less of the habitat of noise-sensitive species is impacted by continuous noise on a monthly basis (central tendency over 1 month). The monthly basis implies that if any month within a year is above this threshold, the environmental status is judged not tolerable for the whole year. This threshold (20%) is valid for all MSFD regions and subregions. Therefore, it was also followed for all IMAP Sub-regions in the Mediterranean Sea within the present initial cCI 27 assessment. This also corresponds to the recommendations made at EU level. Therefore, the initial assessment findings for cCI 27 within the 2023 MED QSR (UNEP, 2024) were provided for the four Sub-regions of the Mediterranean Sea i.e. the Aegean and Levantine Sea, the Adriatic Sea, the Central Mediterranean Sea and the Western Mediterranean Sea Sub-regions.

24. For the indicator calculation it is necessary to produce noise maps in the frequency bands as outlined in IMAP Guidance Factsheet for cCI27. However, some adaptations were necessary to perform an initial assessment. In particular, noise maps are to be produced monthly to allow calculation of monthly extents of exposure, i.e. the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE) on a monthly basis, as outlined in the aforementioned TG-Noise methodology.

25. Despite some lacks in the definition of the assessment process, especially concerning the data gathering and aggregation process, the available data on shipping noise produced through the NETCCOBAMS platform, managed by ACCOBAMS, allowed the application of the optimal assessment methodology for 1 month of shipping noise i.e. in July 2020 for the four sub-regions of the Mediterranean Sea. Nevertheless, it is stressed that field data to verify and calibrate acoustic models, not available for

² IMAP Guidance Fact Sheet for IMAP CI 27 (UNEP/MED WG.473/7)

the present assessment, are necessary to reduce the model uncertainty and provide high-quality results for future assessments.

26. Given the relative stability of ship traffic levels and characteristics over a few years, and that the ship traffic is at the highest level during the Summer period, the assessment produced for month of July 2020 can be generalized to other years and can be seen as the worst scenario within a year. This is the first such assessment of anthropogenic pressures from continuous noise regarding both the IMAP and the MSFD implementation in the Mediterranean Sea.

2.3 Integration and aggregation aspects within EO11 and with other EOs

27. At the indicator level mentioned above for cCI26 only one parameter needs to be measured, i.e., the number of days with impulsive noise events per unit area which is 20 km x 20 km grid in line with the Proposal of the IMAP Guidance Factsheet for cCI 26, and hence integration of different measured parameters is not relevant for cCI 26.

28. For cCI27, five frequency bands are recommended for monitoring in the Proposal of the IMAP Guidance Factsheet for cCI27, namely the 1/3 octave bands centered at 20 Hz, 63 Hz 125 Hz, 250 Hz, 500 Hz and 2 000 Hz, but no well-structured integration rules have been defined for the levels measured/estimated at the different frequency bands. Within this initial assessment, only the 1/3 octave band centered at 63 Hz was considered because this is the frequency band where shipping noise generally dominates in ambient noise and propagates the farther and hence represents a worst-case scenario.

29. Concerning the integration of monitoring data from countries, the NETCCOBAMS platform serve this purpose for cCI26 and cCI27 whereas rules have been established for data gathering from countries. Instead, rules for aggregation of findings from national assessment programs as well as for integration of external data from scientific studies or cooperation projects are not well defined. For the present assessment, data from national programs and external data from scientific and cooperation projects were considered as far as possible for comparison purposes.

30. With regards to the integration of assessments between cCI26 and cCI27, in order to deliver an integrated assessment result for EO11, such aspects have not yet been established for IMAP nor for the MSFD process. Therefore, an integrated assessment was not delivered for Ecological Objective 11, and assessment findings were provided for cCI26 and cCI27, separately.

31. Concerning relationships with other Ecological Objectives, there is an interrelation between EO11 and EO1 given the use of biodiversity data for noise assessment. The purpose of the assessment related to cCI26 and cCI27 is to compute the amount and spatial distribution of underwater anthropogenic noise and assess whether the extent of habitats affected by noise is tolerable. Hence, the present initial noise assessment provides an insight into the risk of extinction of population of marine mammals, which are selected as focus species given their known sensitivity to noise and the overall importance of sound for these animals.

32. In the long term, as the assessment methodology will progress in addressing the risk of extinction of population of marine mammals due to noise disturbance, it can be expected that the population abundance of selected species i.e. CI 4 of EO1 will be harmonized with the assessment of EO11. For example, if the noise assessment results in an increase of the amount of habitat affected by noise in a reporting cycle compared to the preceding one (i.e., the risk of extinction has increased), then it can be expected that the abundance of the population of the species will decline at some point.

3. Good Environmental Status/Alternative Assessment

3.1 Assessment for IMAP cCI26: Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animals

3.1.1 Available data

33. Data are initially obtained from the Impulsive Noise Registry (INR-MED) managed by ACCOBAMS. As explained above in Section 2, the registry is a tool defined in the Proposal of IMAP Guidance Factsheet for cCI26 (UNEP/MED WG473/7). The INR-MED collates data reported by the countries in a standard format that is aligned with the requirements indicated in the Proposal of the IMAP Guidance Factsheet for cCI 26.

34. Data have been provided through the INR-MED by a few countries so far i.e. by France, Greece, Malta, Greece, Lebanon and Montenegro. They are related to three kinds of sound sources: seismic surveys, explosions, sonar or acoustic deterrents. These data cover, with many gaps, the period since 2016 onwards. They concern 247 explosions, 13 seismic surveys and 9 occurrences of sonar or acoustic deterrent use. These are official data which are reported in the correct format and most of them (98%) satisfy the minimum IMAP quality requirements.

35. To complete this process, data from the ACCOBAMS Noise Hotspot assessments i.e. from the 2nd edition which was issued in 2022 and covers the period from 2016 to 2021 (ACCOBAMS-MOP8/2022/Inf43), are also used. These data were collected directly by a group of experts appointed by the ACCOBAMS Secretariat for the period 2016-2021 and follow theoretically the same standards used for the impulsive noise registry. However, only 170 out of 388 impulsive noise events (43%) collected under the Noise Hotspot initiative were considered good enough to be used for the present initial assessment. These noise events are mainly seismic surveys (N = 53) and port extension works for which pile driving and/or explosions were used (N = 117). They are distributed in the four Mediterranean Sub-regions and concern almost all countries bordering the Mediterranean Sea, thus completing the data available from the INR-MED.

36. Globally, 439 impulsive noise events were used for analyses. The annual distribution of noise events is mapped in Figures 1 to 6 hereafter using a 20 km x 20 km spatial grid. Note that a 20-km fixed buffer was used from point noise source (e.g. pile driving in ports) in order to account for propagation of noise. The 20-km buffer is selected based on scientific literature (Merchant et al., 2017; Tougaard et al., 2009). Furthermore, for noise sources described with polygons (such as seismic surveys), it was considered that using polygons for describing a moving point source (the seismic vessel using the airguns) is already an overestimation of the area where the noise is produced, and hence no additional buffer was applied. Hence Fig 1 to 6 show the distribution, over a 20 km x 20 km spatial grid, of buffered point sources for port works and polygons for seismic surveys and sonar and acoustic deterrents.

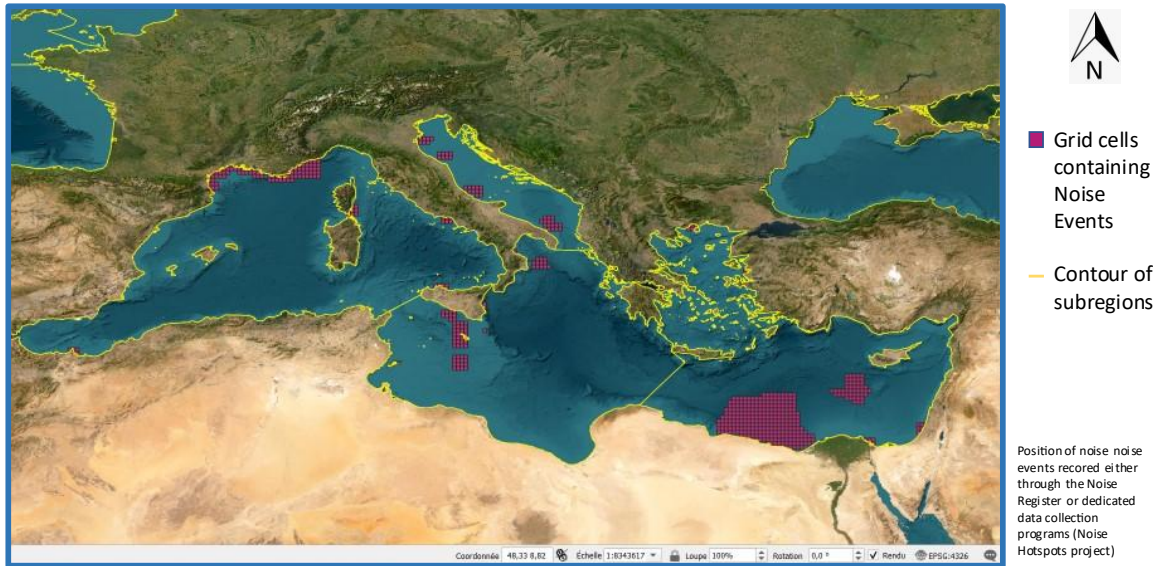


Figure 1: Impulsive noise events data for 2016. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf43).

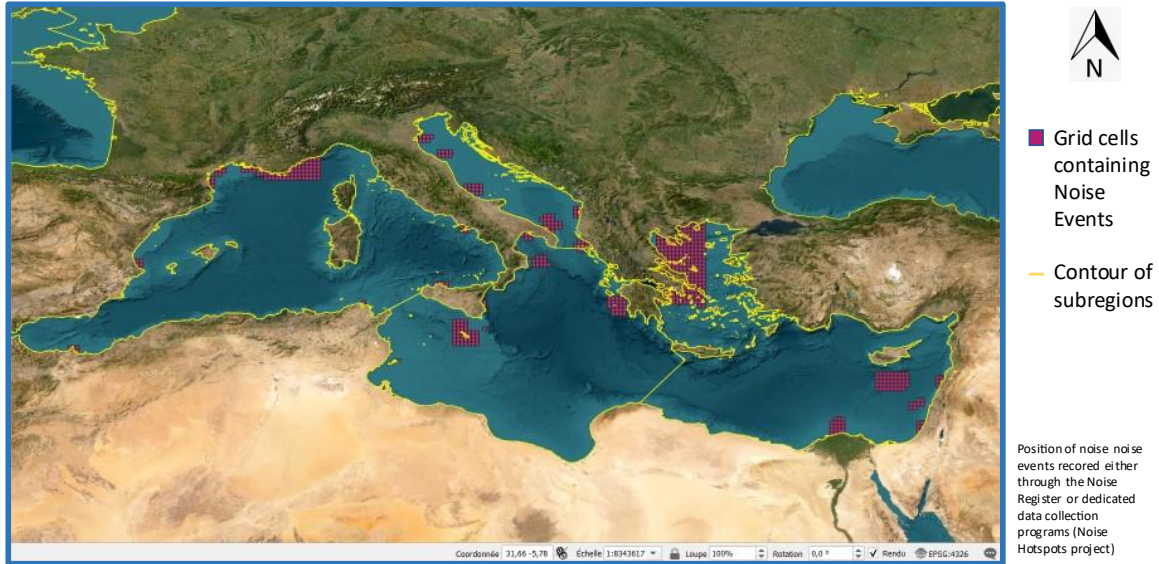


Figure 2 : Impulsive noise events data for 2017. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf43).

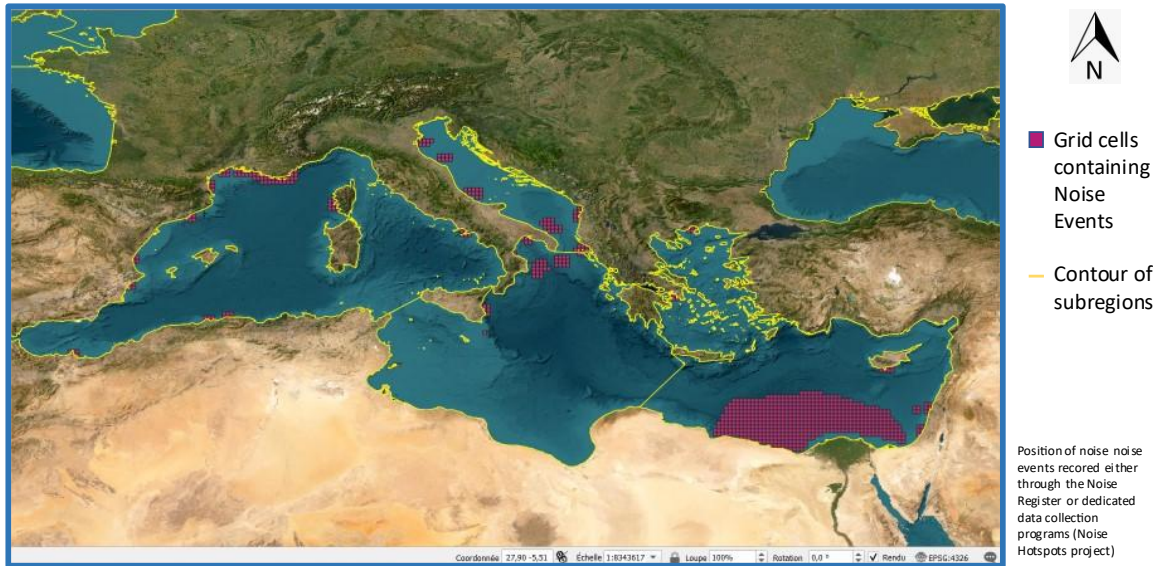


Figure 3: Impulsive noise events data for 2018. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf43).

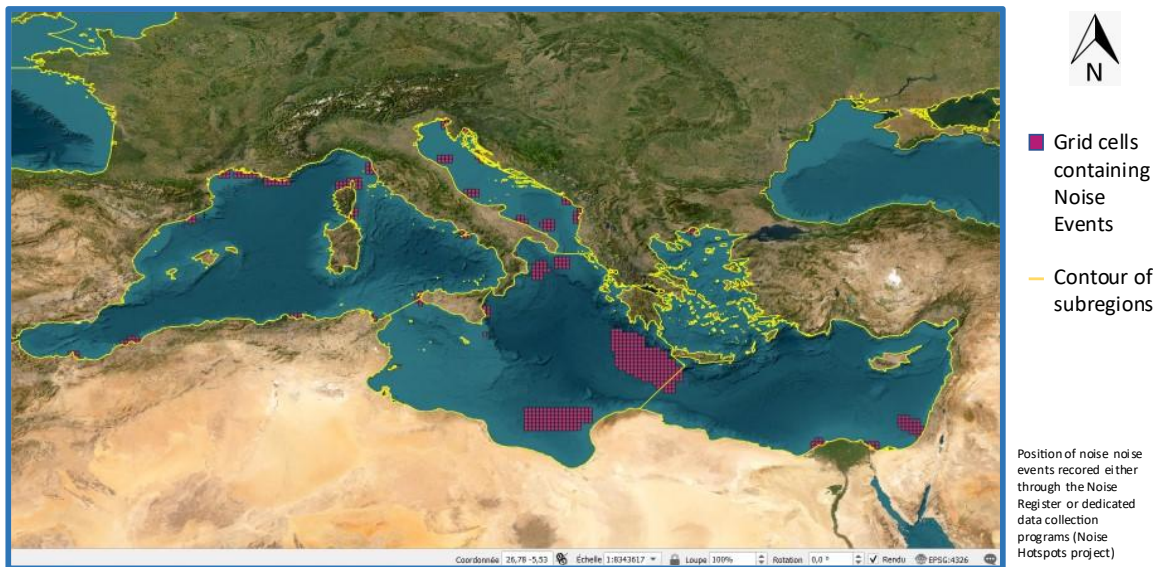


Figure 4: Impulsive noise events data for 2019. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf43).

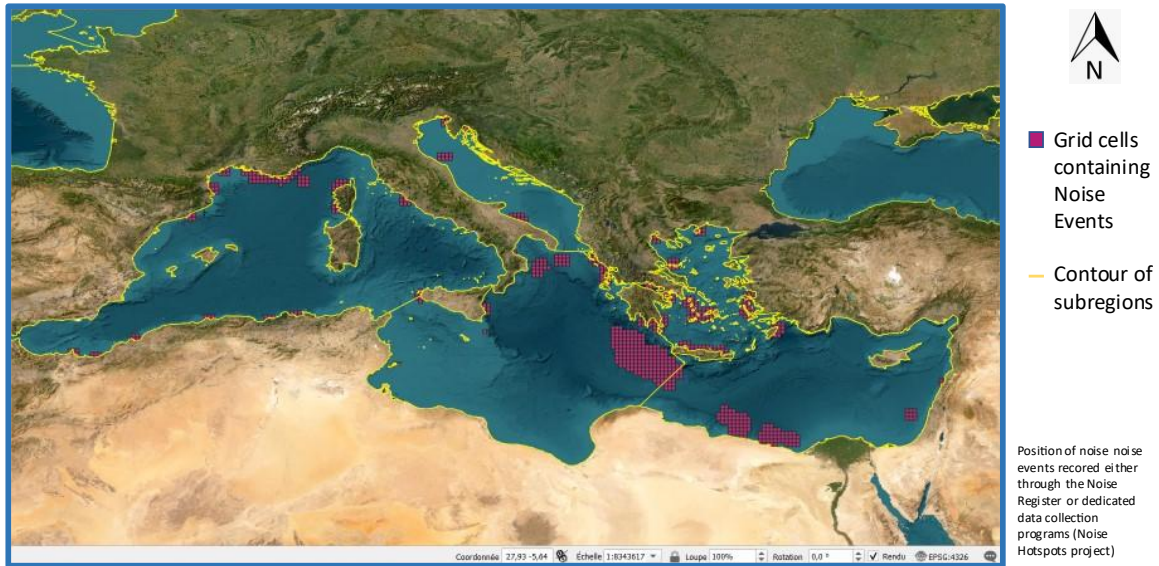


Figure 5: Impulsive noise events data for 2020. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf43).

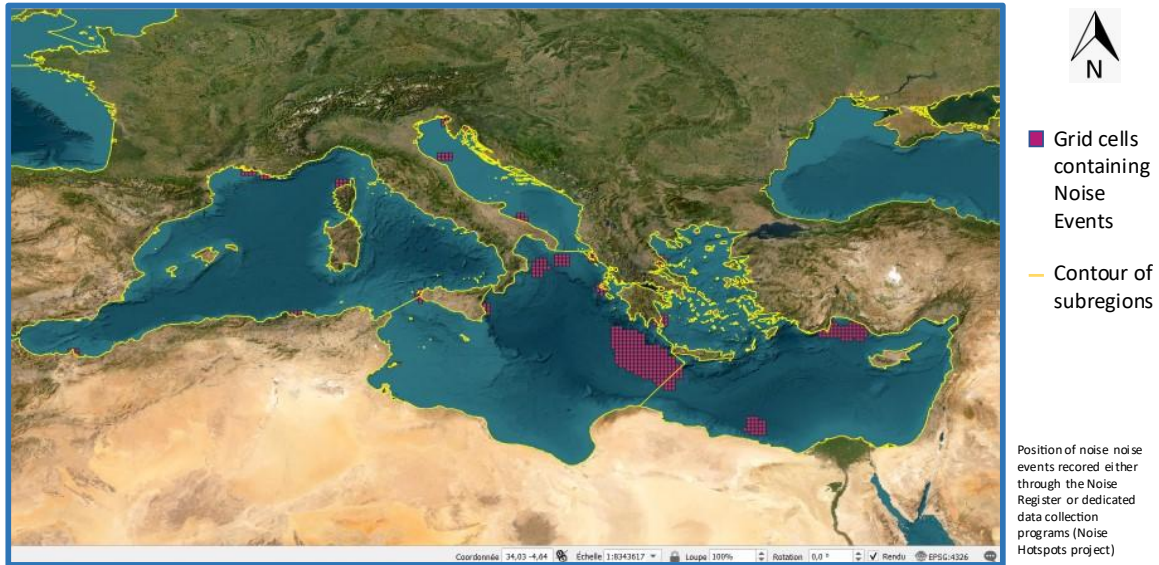


Figure 6: Impulsive noise events data for 2021. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf43).

3.1.2 Setting the threshold for tolerable/non tolerable status for cCI 26

37. As explained in Section 2.1, for the purposes of the 2023 MED QSR (UNEP, 2024) a Tolerable Status of the environment is considered when 10% or less of the habitat of noise-sensitive species is impacted by impulsive noise events over a year. For the present initial assessment, this threshold (10%) is used for the four IMAP Sub-regions in the Mediterranean Sea.

38. The 10% threshold is based on the methodology developed under the scope of the MSFD-D11 to which the ACCOBAMS in collaboration with UNEP/MAP - SPA/RAC gave a crucial contribution. Based on the scientific works which indicate that when the exposure to underwater sound is permanent, the displacement of animals due to acoustic disturbance can be considered as a habitat loss (e.g., Brandt et al., 2018; Graham et al., 2019; Thompson et al., 2013), it was considered that the present initial assessment methodology translates the loss of habitat due to acoustic disturbance into a decline of population following a linear model as suggested by Tougaard et al., 2013).

39. In other words, if 10% of the habitat of a representative noise-sensitive species is impacted by noise, it is expected that the population will decline by 10% in the long-term. Considering the risk of extinction, 10% is considered sufficiently conservative and precautionary to be selected as the boundary between tolerable and non-tolerable status of a Sub-region i.e., as the boundary value/threshold between the GES and non GES.

3.1.3 Results of the initial IMAP Environmental Assessment for cCI 26

40. Data collected through the Noise Register lacked geographical representativeness (data from only 5 countries: France, Malta, Greece, Lebanon and Montenegro) and had to be integrated with data collected from dedicated activities led by ACCOBAMS (Noise Hotspot data - ACCOBAMS-MOP8/2022/Inf43). Under the 'Noise Hotspot' project, data related to impulsive noise events were found for the period 2016-2021 in waters in front of most Mediterranean countries. However, these data presented uncertainties or gaps in the source level and duration in days of activities that made it impossible both to apply propagation modelling to noise events and compute refined noise footprints, and to compute the number of days with impulsive noise events in the Mediterranean region, as a whole, or in its Sub-regions.

41. By pooling together data from the International Noise Register (data from reporting countries) and the Noise Hotspot project (data from scientific study), a database was obtained covering the four Mediterranean Sub-regions, and with sufficient quantity and quality of data to carry out an initial assessment for cCI26.

42. The value of LOBE was not assigned due to heterogeneity of data, preventing the use of refined acoustic propagation modelling to calculate the noise footprint of the impulsive noise events. Instead, as mentioned above, a 20-km fixed buffer was used from point noise source (e.g. pile driving in ports) in order to account for propagation of noise. The 20-km buffer is selected based on scientific literature (Merchant et al., 2017; Tougaard et al., 2009). Furthermore, for noise sources described with polygons (such as seismic surveys), it was considered that using polygons for describing a moving point source (the seismic vessel using the airguns) is already an overestimation of the area where the noise is produced, and hence no additional buffer was applied. It is noteworthy that according to the adopted methodology for impulsive noise, using propagation modelling is not mandatory as it is a complex topic, and acceptable alternatives can be used. Moreover, without consideration of the duration in days for many noise events (the duration in days lacks in 38% of data), it was impossible to calculate the daily cumulated area affected

by noise (daily exposure), which is at the basis of the calculation of the average extent of habitat affected by noise over a year i.e. the extent of exposure.

43. Considering these issues, the annual surface of the four Mediterranean Sub-regions with impulsive noise events was computed by summing up the areas of all the noise events described by polygons and buffered point sources, per sub-region. Subsequently, the proportion of potentially usable habitat area (PUHA i.e. Potentially Usable Habitat Area, following habitat models developed by Azzellino et al., 2011) which is found on areas concerned by noise events is computed for selected cetacean species, namely the fin whale for the Western Mediterranean sub-region, while the bottlenose dolphin, the sperm whale and the Cuvier's beaked whale for the four Sub-regions. The result of this calculation is the amount of habitat impacted by noise, i.e., the extent of exposure, which provides an insight of the risk of decline in population of selected species of cetaceans. The choice of species is based on both the representativeness for the different sub-regions and the available knowledge about the impact of noise on individuals of the species (see for example the scientific synthesis on the impact of underwater noise on marine life issued by the CBD for a review of available knowledge (CBD, 2012)).

44. Percentages of areas covered by noise events per Sub-regions and for the whole Mediterranean since 2016 have been calculated and provided in the graphs below (Figure 7 and 8).

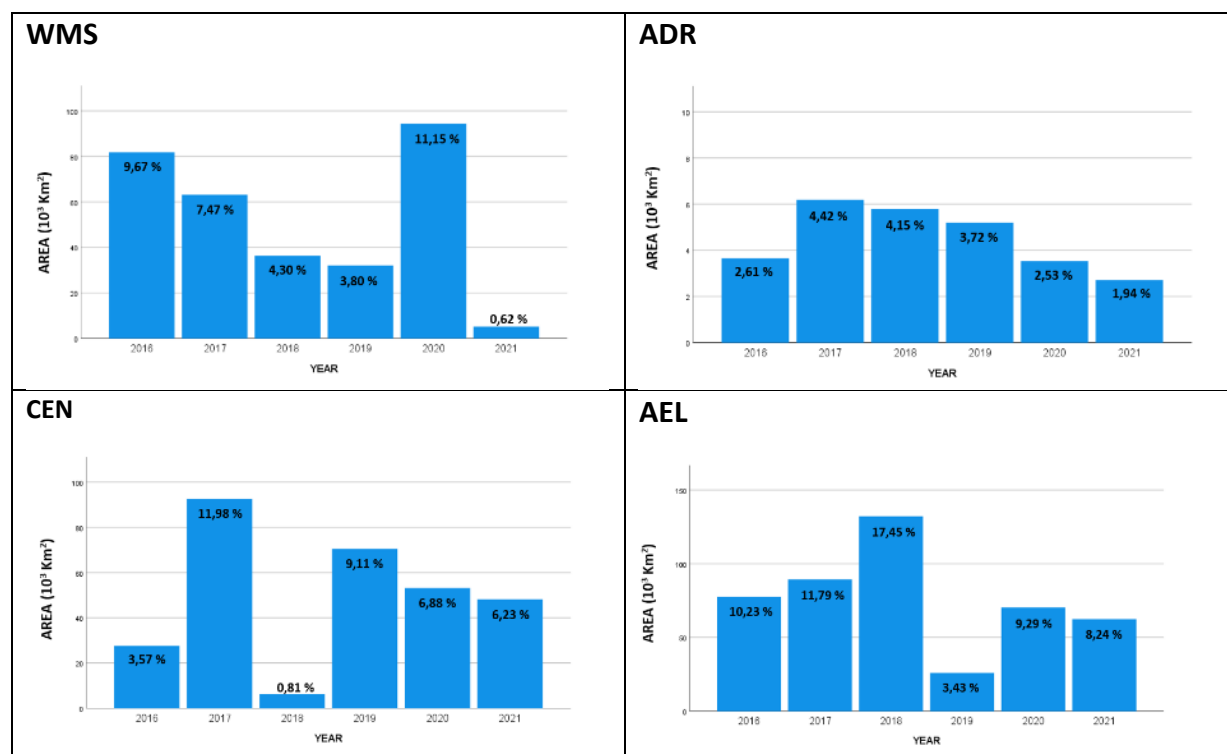


Figure 7. % of sub-regions covered by noise events per year since 2016: **WMS**= Western Mediterranean; **ADR** = Adriatic Sea; **CEN** = Ionian and Central Mediterranean Seas; **AEL**= Aegean and Levantine Seas.

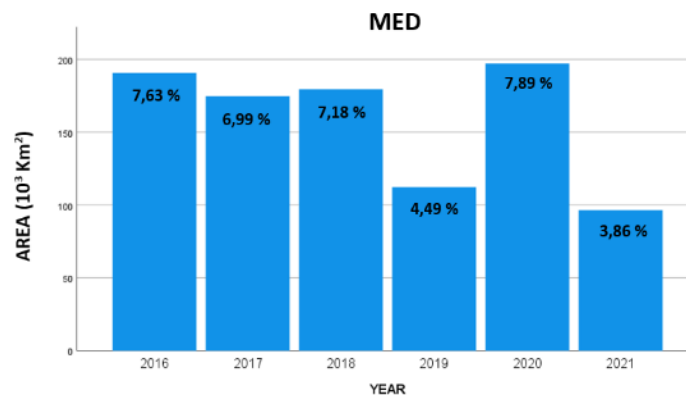


Figure 8. % of the Mediterranean region covered by noise events per year since 2016:

45. To overlap noise event areas to the species habitat an analysis grid is used of about 20 km mesh size (i.e. 10' x 10' grid cells) and the concept of PUHA, here applied as habitat proxy. The PUHA is computed from presence/absence habitat models using physiographic predictors as covariates (depth and slope statistics) which estimate the presence probability of the representative cetacean species in the area of interest. Based on this presence probability for a species, called Habitat Suitability (HS), the usable habitat (in km²), is calculated in every cell unit of the analysis grid by multiplying the HS for the area (km²) of the cell unit. The PUHA is then calculated (in km²) for the subregions by summing up the usable habitats from single grid cells in the different subregions.

46. The Table 2 shows the percent of habitat (PUHA) of a species which is affected by impulsive noise for every year from 2016 to 2021. Four species are considered: bottlenose dolphin, sperm whale and Cuviers' beaked whale, and only for the WMS subregion the fin whale.

Table 2: Summary of the percent impacted PUHA for the four selected cetacean species (e.g. bottlenose dolphin, sperm whale and Cuviers' beaked whale, and fin whale). For the year 2018, the percent of impacted PUHA for sperm whale and Cuvier's beaked whale is highlighted in red and percent of impacted PUHA of bottlenose dolphin, being close but lower than the 10% GES/non GES boundary limit is highlighted in light blue.

IMAP SUB-REGIONS	AFFECTED AREA (% POTENTIALLY USABLE HABITAT AREA IMPACTED BY IMPULSIVE NOISE) PER YEAR IN THE PERIOD 2016-2021						
	Bottlenose dolphin						
	2016	2017	2018	2019	2020	2021	Median
ADR	4,81	6,59	6,48	6,27	3,03	2,88	5,54
AEL	4,76	5,21	8,62	1,17	4,27	1,39	4,52
CEN	1,28	1,45	0,66	4,02	2,9	2,48	1,97
WMS	1,52	1,34	1,26	1,48	1,63	0,45	1,41
	Fin whale						
	2016	2017	2018	2019	2020	2021	Median
WMS	0,99	1,02	0,67	0,74	1	0,23	0,87
	Sperm whale						

	2016	2017	2018	2019	2020	2021	Median
ADR	1,48	2	1,97	1,77	0,69	0,64	1,63
AEL	8,2	2,59	11,51	0,88	3,36	2,12	3,11
CEN	0,63	0,83	0,55	7,39	5,62	5,47	3,15
WMS	0,84	0,94	0,47	0,49	0,78	0,16	0,63

Cuvier's beaked whale							
	2016	2017	2018	2019	2020	2021	Median
ADR	1,41	2,44	2,37	1,78	0,25	0,28	1,59
AEL	6,18	4,77	10,15	0,97	4,75	1,95	4,76
CEN	1,27	1,64	0,83	6,1	4,88	4,41	3,02
WMS	1,22	1,17	0,99	1,19	1,49	0,38	1,18

47. It can be observed that in the 2016-2021 average scenario (median level), the 10% GES/non GES boundary limit was not exceeded, being very far for all the considered species. However, for some year (e.g. in 2018), the 10% GES/non GES boundary limit might have been exceeded in the Aegean-Levantine Sub-region (AEL) concerning the habitat of sperm whale and Cuvier's beaked whale. In such a case, the environmental status may be considered non tolerable for the year 2018 i.e. the non GES can be indicated.

48. For the Western Mediterranean (WMS), the Adriatic Sea (ADR) and the Central Mediterranean Sea (CEN), the environmental status appears as tolerable for all years.

3.1.4 Limitations of the assessment relative to cCI26

49. With regards to data, there is still a great incertitude regarding the data on impulsive noise events. Despite the implementation at the regional level of an international impulsive noise register which has been operational since 2018, there is a lack of engagement from many countries with regards to data reporting. The consequence of this has been that data from the noise register had to be completed with additional data derived from dedicated effort allocated by ACCOBAMS to gather more impulsive noise event data. Such data are globally of lower quality as for none of these the intensity level (Sound Pressure Level or proxy) was available. For this and the reasons described in the following paragraphs, it was decided not to attempt to define and use LOBE for impulsive noise as this would modify the extent of the areas of the noise events, adding more uncertainty to the assessment process.

50. Only 43% of such additional data were considered as satisfying minimum quality to be considered for the assessment. Minimum quality was considered when at least the position and year of occurrence was known based on trusted sources of information (e.g., web portals of national Administrations, Ministries, or publicly available information provided by marine geophysical companies through their websites, etc.). Such additional data were scored in four quality classes:

- i) Confirmed, when there is at least one trusted source of information clearly confirming the occurrence of a noise event and which reports the position and year of occurrence.
- ii) Likely, when a trusted source of information reports more generic information about the beginning of works in a port, or the plan for a seismic survey in a given area but with rather vague indication of the period of occurrence, and similar.
- iii) Low confidence, when the source of information is still trusted but the data contains major gaps

iv) Unknown, for data with major gaps from doubtful sources of information.

51. In order to have data distributed in all Mediterranean areas for the analysis and based on the precautionary principle, data scored as Confirmed, Likely and Low Confidence were used (i.e. the 43% of available additional data from the Noise Hotspot project, where the Low Confidence represent 8%). Hence, data scored as Low Confidence and some Likely may carry some errors or inaccuracies, where most are thought to deal with possible confusions between the licensing period for the exploration of an area for Oil and Gas, and the effective execution of a seismic survey (for example in Greece, Italy and Israel). This may lead to overestimate the area affected by seismic surveys if a licensing area is used instead of an effective survey, but on the other hand not including any Low Confidence or Likely data would certainly lead to underestimation, thus breaking the precautionary principle.

52. Another issue when working with seismic survey data is that the licensing area is usually much larger than the actual area of a survey, so even for confirmed data for which seismic lines are not available there may be overestimation of the affected area. However, this is an issue not related to the methodological choices made for this assessment because current rules allow countries to report data using their licensing blocks, without details about the exact position of seismic lines.

53. These issues obviously impact on the quality of the assessment findings and imply careful utilization for management purposes. The above issues should be taken into account especially where the assessment of affected habitat results in percentages that are close to or exceed the thresholds suggested by TG Noise (10% of the habitat of a target species, on average over 1 year). For the present assessment, this might be the case for the AEL sub-region.

54. Finally, with regards to the choice of species and to the assessment approach in general, it is still uncertain to what extent the impact of noise on individuals of species reflects into an impact on the population, which is the ecosystem component used to address anthropogenic pressures on the ecosystems of the Mediterranean Sea. For example, Gomez and co-authors (2016) have found that in both baleen whales and toothed whales, responses of different severity are equally likely above a certain received sound level indicated to be at around 110 dB re 1 μ Pa (broadband). The mechanisms that induce a more or less severe response to underwater noise are still a matter of scientific research as well as their importance relative to long-term changes in population dynamics. This uncertainty leaves the door open for further research and for improvement of the methodological approach adopted here, for future assessments.

3.2 Assessment for IMAP cCI 27: Levels of continuous low frequency sounds with the use of models as appropriate

3.2.1 Available data

55. For cCI27 data are obtained from the NETCCOBAMS Platform, the digital information tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The platform contains maps of shipping noise distribution over the entire Mediterranean basin in the two out of the five frequency bands of interest (1/3 octave bands centered at 63 Hz and 125 Hz). Shipping noise maps were obtained from modelling techniques corresponding to the requirements indicated in the Proposal of the IMAP Guidance Factsheets for cCI27 (UNEP/MED WG473/7).

56. Availability of these NETCCOBAMS maps of shipping noise in the two frequencies is also aligned with the ACCOBAMS Monitoring Strategy (2015) on underwater noise monitoring and the EU

recommendations contained in the Monitoring Guidance prepared by TG-Noise for the MSFD-D11 (Dekeling et al, 2014).

57. These maps are produced by modelling tools provided by SINAY, a company specialized in underwater acoustics which developed the necessary technologies to set up the NETCCOBAMS platform (ACCOBAMS-SC14/2021/Doc36) which include modeling techniques widely used in environmental studies on noise pollution (e.g., Maglio et al., 2015, 2017; Drira et al, 2018). Such techniques are based on the RAM model (Collins, 1993) and inputs data available from the AIS data for ships parameters and ship traffic (source: Spire Group, a US based company), as well as in EMODnet and COPERNICUS data platforms (EmodNet and Copernicus) providing environmental variables influencing the propagation of noise.

58. An overview of the available data on ship traffic patterns is shown in Figure 9. This map, available in NETCCOBAMS, was produced based on the ship traffic density provided based on AIS data in 2017. Ship traffic patterns appear quite stable year-to-year and the ship density maps that can be obtained from AIS data generally shows the same picture overall, regardless of the period chosen for analysis. Major ship lanes are found indeed between the Gibraltar Strait and the Suez Canal as well as in other lanes connecting the major ports in the Mediterranean Sea area. High traffic areas are especially located in the northern side of the Mediterranean.

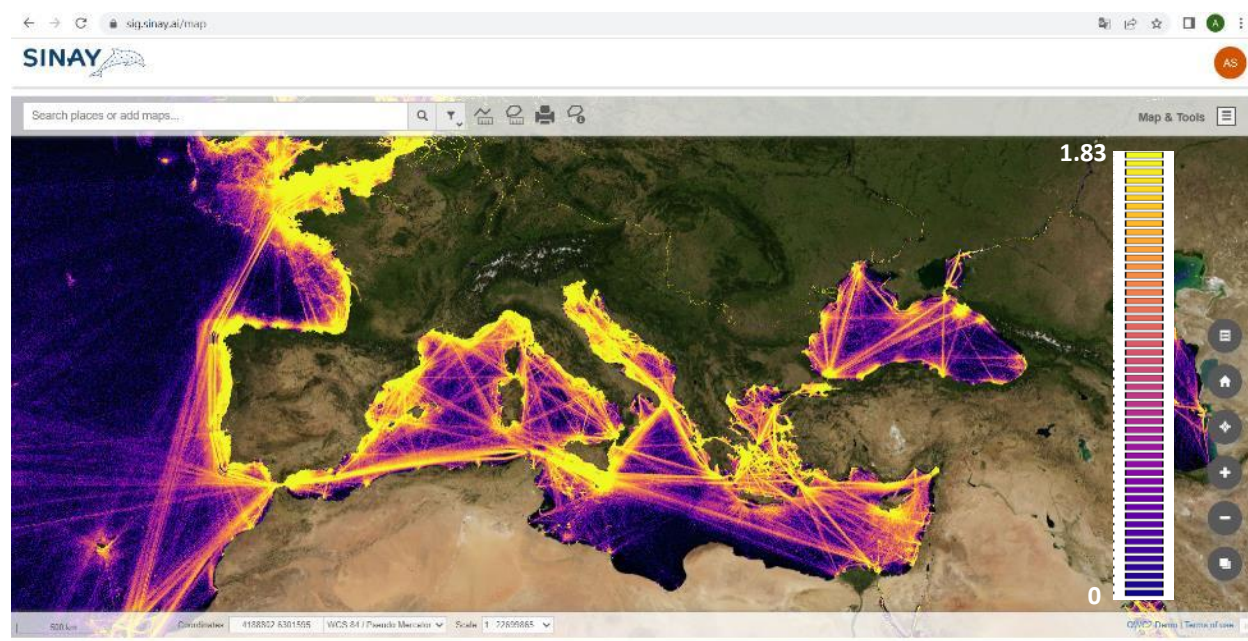


Figure 9: Ship traffic density as total count of AIS messages per grid cell (0.01° in latitude and longitude) for 1 year (2017 in this case). Density values shown in the legend are log-transformed (base 10). The patterns shown in this map (ship lanes, traffic hotspots, low- and high-density areas) are quite stable year-to-year and can be considered representative of usual ship traffic conditions in the Mediterranean Sea. Source of raw AIS data used in NETCCOBAMS: Spire Group.

59. The noise map used for this assessment referred to the median ambient noise levels for the month of July 2020. The use of median level over 1 month satisfies the minimum requirements for the assessment related to cCI27 according to the TG-noise guidance. This map is presented below in this document. Given the relative stability of the ship traffic levels and characteristics within a time window

of a few years, and that the ship traffic is at the highest levels during summer months, the assessment produced for month of July 2020 can be generalized to other years and can be seen as the worst-case scenario within a year.

60. Other relevant sources of data are indirectly explored. These are the ambient noise levels from *in-situ* measurements in the Balearic Sea collected within the QUIETMED project (quietmed-project.eu) which were used to verify the models implemented in NETCCOBAMS back in 2018. However, as these data do not directly contribute to the assessment, they are not shown in the 2023 MED QSR (UNEP, 2024). The reader is referred to QUIETMED Deliverable 3.3 (Taroudakis et al., 2018) where additional information is found. Despite this first comparison with field data, additional *in-situ* measurements as well as additional analytical steps are required to calibrate models in the four Mediterranean subregions and improve the quality of results.

61. Finally, as mentioned above (Section 2.3), data produced under national programs as well as from sub-regional cooperation projects were listed with a view to comparing with assessment findings produced here and to reach more robust conclusions. Data on shipping noise which may be relevant for comparison come from the INTERREG-SOUNDSCAPE project in the northern Adriatic Sea, the QUIETSEAS project (modelling exercises carried out in different contexts and areas of the Mediterranean Sea) as well as national monitoring programs and especially from Spain, France, Italy and Greece. Especially, France have issued results on continuous noise monitoring from the early stage of implementation of MSFD-D11C2. However, the first steps of the comparison activities have highlighted common issues due to the heterogeneity of modelling approaches, computational set up, quality of input data, approximation of environmental and source level properties, formatting of results, and potentially more elements. Such heterogeneity does not generally affect the comparison of the geographical distribution of noise which appears consistent indeed across the data available for this assessment and the other studies available from national activities (IEO, FORTH-HCMR, SHOM, ISPRA) and cooperation projects (SOUNDSCAPE). However, issues arise when dealing with absolute sound levels where differences of several dB may appear from different modelling exercises for the same unit area. A detailed comparison is not provided since this would require too technical discussion on this topic at this stage, which is not part of the scope of this assessment. For this reason, with regards to the regional scale, it will be crucial in the next future to work on the calibration and validation step by implementing the rules, defined during the QUIETSEAS project, that imply a contribution of *in-situ* measurements from countries in the data management platform of ACCOBAMS (i.e., NETCCOBAMS) for subsequent periodical check.

3.2.2 Setting thresholds for tolerable/non tolerable status for cCI 27

62. The overall assessment methodology developed by TG-Noise could be fully implemented for IMAP cCI27 for the month of July 2020, which is taken as basis for assessing the status i.e. tolerable/non-tolerable that might be considered correspondent to GES/non GES status of marine waters at the sub-regional level.

63. The average noise level for the month of July 2020 is defined as the median ambient noise level. The median is calculated from the statistical distribution of noise values obtained from the acoustic modelling (N = 93 noise maps corresponding to shipping noise levels at 93 instants, 1 every 8 hours for the period of 31 days).

64. The Level of Onset of Biological Effect (LOBE) was set as a sound pressure level of 125 dB re 1 μ Pa in the 1/3 octave band centered at 63Hz and each grid cell. The value of 125 dB re 1 μ Pa was defined based on the models developed by Gomez et al 2016.

65. The frequency band centered at 63 Hz is selected from the list of frequency bands indicated in the Proposal of the IMAP Guidance Factsheets for cCI27 (1/3 octave bands centered at 20, 63, 125, 250, 500, 2 000 Hz) as shipping noise in this frequency bands generally dominates in the underwater ambient noise.

66. With regards to cetacean species selected for the assessment, the fin whale is selected for the Western Mediterranean Sea Sub-region, and the bottlenose dolphin for the other three Mediterranean Sub-regions. The choice of species is based both on their representativeness for the different sub-regions and on the available knowledge about the impact of ship noise on individuals of the species (see for example Erbe et al., 2019 for a review of available knowledge). The proportion of the potentially usable habitat areas (PUHA, following Azzellino et al, 2011) of these species that is found on areas with median shipping noise higher than LOBE (125 dB re 1 μ Pa) is computed. The result of this calculation is the amount of habitat affected by noise, i.e., the extent of exposure, which provides an estimate of the risk of decline of the selected species' population.

67. For the purposes of the 2023 MED QSR (UNEP, 2024), a Tolerable Status of the environment is defined when 20% or less of the habitat of noise-sensitive species is impacted by continuous noise on a monthly basis. This threshold of 20% applies to all months of the year. If one month is above 20%, the environmental status is considered non tolerable. It is used for all four Mediterranean sub-regions.

68. The 20% threshold is based on the methodology developed under the scope of the MSFD-D11 to which the ACCOBAMS and the UNEP/MAP - SPA/RAC gave a crucial contribution. Based on the scientific works demonstrating that the exposure to underwater continuous noise induce adverse effects (e.g. behavioral disturbance, stress, reduced communication space, and temporary or permanent habitat loss) which in turn could reduce the fitness, and hence the reproductive success of individuals (e.g. CBD, 2012), it was considered that the present initial assessment methodology translates the degradation of portions of habitat due to acoustic disturbance into a decline of population following a linear model as suggested by Tougaard et al (2013). In other words, if 20% of the habitat of a representative noise-sensitive species is impacted by high levels of continuous noise, it is expected that the population will decline by 20% in the long-term.

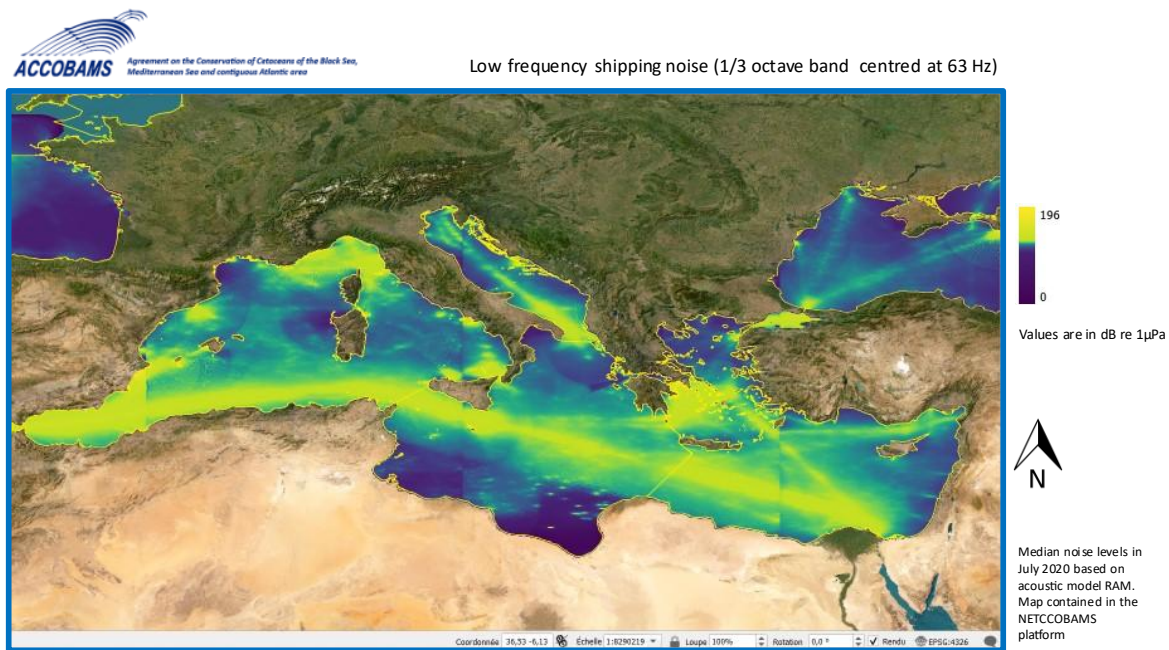
69. An acceptable status i.e. the GES relative to continuous noise is achieved if in every month over a year, the area exposed to noise level higher than LOBE is equal to or below 20% of the habitat of a selected species. This is found as an optimal boundary value after considering that shipping is nowadays a permanent characteristic of the habitats and it has probably shaped the carrying capacity of habitats and hence the size of populations since decades. This consideration, along with the fact that the scientific literature about the noise effects does not suggest any strong relationship of shipping-related noise with any dramatic reduction of the population sizes, determines the setting for continuous noise of a less restrictive threshold than for the impulsive noise. This threshold of 20% of habitat of a species exposed to continuous noise in the long term is hence used as a baseline to assess whether at least this initial minimum target is achievable. It should ensure the viability of a population size at 80% of the carrying capacity. This number is therefore subject to further possible adjustments.

3.2.3 Results of the initial IMAP Environmental Assessment of cCI 27.

70. Figure 10 shows the distribution of median noise levels in the 1/3 octave band centered at 63 Hz for the month of July 2020. Considering that the median divides a distribution of values sorted from lowest to highest in the two parts, each containing 50% of the values, the median noise informs that during 50% of the time the levels are higher than those shown at each point of the area as depicted in Figure 10, and in the other 50% the values are lower. The median value is a good indicator of a 'typical' ambient noise

value that can be measured in a zone because it is not influenced by small portions of very high or very low values, as it would be the case by applying the arithmetic mean.

71. Beyond indication of the typical values of ambient noise of an area, the median noise can also indicate that where the values are high enough to induce the negative effects in individuals of sensitive marine species, they are even higher for the 50% of the time. In such a case, the exposure to the levels inducing negative effects would occur very frequently i.e. during 50% of the time and potentially for a long period of time (e.g. hours to days of continuous habitats' exposure), eventually increasing the risk for populations.



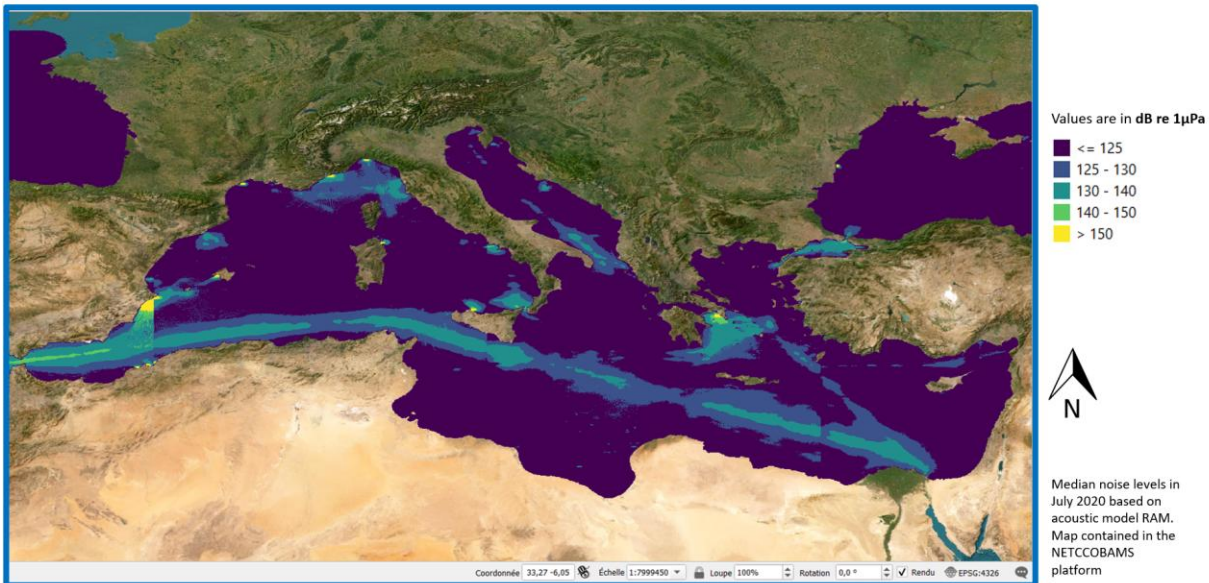


Figure 10: Median shipping noise levels in the month of July 2020 based on the acoustic model RAM (Collins, 1996), contained in the NETCCOBAMS platform. Upper panel: smoothed colour palette; Lower panel: discrete colour palette highlighting areas of exceedance of LOBE (125 dB μPa) and some intervals of median noise values higher than LOBE to help contextualizing the map. The lower panel shows that high median values (e.g., higher than 150 dB μPa) are limited to very small areas around a few ports. Also, the highest level shown in the upper panel map (196 dB re μPa) is due to constant and dense ship traffic levels around such ports and represents a negligible number of pixels around a few ports, not representative of underwater noise conditions of the Mediterranean Sea.

72. By analyzing Figure 10 on the median shipping noise, the main ship lanes can be distinguished (e.g., Gibraltar to Suez) from the areas of diffused noise around port areas, where the median noise levels are estimated at around 140 dB re μPa or higher. Also, the areas with lower or very low ship traffic levels (e.g. offshore waters between Sardinia, the Balearic Islands and southern French coast in the Gulf of Lion) present median noise levels in the range 100-110 dB re μPa . A few areas present the median values below 100 dB re μPa , and especially those in Libyan waters due to very low ship traffic and the distance from heavy traffic areas. Also, some high vessel traffic areas do not correspond to high median noise levels (e.g. waters around Cyprus, the Central and the Northern Adriatic Sea).

73. The percentage of habitat of the fin whale and the bottlenose dolphins which is found where the median shipping noise is higher than 125 dB re μPa is calculated for the Western Mediterranean Sea Sub-region, and for all four Mediterranean Sub-regions, respectively. The results of the assessment indicating tolerable/ non-tolerable i.e. GES/non GES are summarized here-below in Table 3

Table 3: Summary of the percent impacted habitat (PUHA) for the two selected cetacean species (i. bottlenose dolphin for all subregions, and ii. fin whale for Western Mediterranean Sea,) for the month of July 2020. The 20% threshold is exceeded in the Western Mediterranean Sea with relationship to both bottlenose dolphin and fin whale habitats, and in the Aegean and Levantine Seas with the relationship of bottlenose dolphin habitat.

BOTTLENOSE DOLPHIN

IMAP SUB-REGION	Affected habitat: % of potential usable habitat area (PUHA) overlapping median shipping noise levels higher than LOBE (125 dB re 1µPa)	Result of the assessment
WMS	35.02%	Non tolerable
ADR	15.53%	Tolerable
CEN	15.84%	Tolerable
AEL	27.59%	Non tolerable

FIN WHALE

IMAP SUB-REGION	Affected habitat: % of potential usable habitat area (PUHA) overlapping median shipping noise levels higher than LOBE (125 dB re 1µPa)	Result of the assessment
WMS	31.53%	Non tolerable

74. The computation of the extent of exposure results in non-tolerable i.e. in non GES for the Western Mediterranean Sea and the Aegean Levantine Sea Sub-regions i.e., % affected habitat > 20%, while the status is tolerable i.e. GES in the Adriatic Sea and Central Mediterranean Sea Sub-regions.

3.2.4 Limitations of the assessment relative to cCI27

75. As the methodology employed here is quite recent also regarding continuous noise, it still presents elements of incertitude which are subject to improvement and/or adjustment in the future. Aware of the risks related to a first-of-a-kind study, the ACCOBAMS Secretariat proposes this assessment exercise as a way to set a first reference study and hence help future improvement and adjustments of the methodology as well as drawing the first data-driven conclusions for an ecosystem-based management of continuous anthropogenic noise.

76. The use of absolute SPL values as LOBE may open up the debate about the reliability of the propagation models employed. In the scientific literature, several approaches and methodologies are found, and even for the same methodology there are numerous ways to configure and set up model parametrization, potentially leading to difficulties comparing models and potential misinterpretation of results. A scientific discussion about this topic is not in the scope of this assessment, however it should be

taken into account because it is a source of uncertainty that is to be considered with regards to the utilization of assessment findings for management purposes.

77. Also, the LOBE level is set at 125 dB re 1 μ Pa with reference to the work of Gomez and co-authors (2016): "A systematic review on the behavioural responses of wild marine mammals to noise: the disparity between science and policy" (Gomez et al., 2016). This article is a synthesis of the behavioural acoustic impact, weighted by the behavioural responses, through several hundred publications and works. The article states that behavioural responses were observed starting at approximately 110 dB re 1 μ Pa and 125 dB re 1 μ Pa is a sound level at which behavioural reactions are observed for the species groups mentioned in the article. However, this value is not indicated explicitly as a threshold for management and hence it solely represents the choice made by the evaluators appointed by ACCOBAMS for the assessment of cCI27 for the QSR (UNEP, 2024). The LOBE value may change for future assessments.

78. The shipping noise modelling technique employed here is based on renowned propagation models (RAM, Collins, 1993) and a first comparison analysis between model estimates and in-situ measurements was carried out during the QUIETMED project with field data coming from Cabrera Island (Balearic Islands) collected from bottom recorders deployed at 80 m depth. The analysis allowed calibrating the model and the final set up of the computational environment resulted in outputs with less than 5 dB of difference compared to in-situ measurement, which is considered acceptable. However, model results should be regularly checked against systematic in-situ measurements to confirm their validity for all areas and, in case, (re)calibrate the models. With regards to IMAP (and the related EU-MSFD in the Mediterranean Sea), such a process is not yet in place at the regional level although it is foreseen for the next future.

79. The fact that the assessment for continuous noise is based on shipping noise in July 2020 may raise questions regarding the COVID19 pandemic. One could expect that the year 2020 is not representative because of simultaneous lockdowns in many countries and consequent decrease of economic activities, including port and shipping. However, Millefiori et al. (2021) suggests that the recovery of the ship traffic mostly occurred in June 2020 (also shown in EMSA report: COVID-19 – impact on shipping, June 2021). Also, recent work in QUIETSEAS has shown that the effects on ambient noise of the reduction of ship traffic during the simultaneous lockdowns in several countries is not obvious (unpublished data), with areas even showing an increase of noise levels during March-April-May 2020 compared to the same period in 2019. Hence, data for other years and other months, especially winter months, would be needed to draw a better overview of continuous noise pollution for management purposes. A recent study has found indeed that shipping noise levels in Winter are higher than Summer for the same ship distribution for both shallow and deeper waters in Eastern Mediterranean (Skarsoulis et al., 2023).

80. Finally, like for impulsive noise, the choice of species and to the assessment approach in general is based on current knowledge on the impact of noise on individuals of noise-sensitive species but it is still uncertain to what extent this reflects into an impact on the population, which is the appropriate ecosystem component to address anthropogenic pressures on the ecosystems of the Mediterranean Sea. For example, it has been reported in different research studies that fin whales adapt their vocalisations by lowering the bandwidth, peak frequency, and centre frequency under increased levels of background noise from large vessels (Castellote, 2012; Borsani, pers. comm, May 2, 2023). Further, as already mentioned Gomez and co-authors (2016) have found that in both baleen whales and toothed whales responses of different severity are equally likely above a certain received sound level indicated to be at around 110 dB re 1 μ Pa. The methodological approach adopted here for continuous may be subject to changes according to new information becoming available in the future.

4. Key assessment findings per CI

4.1 Key assessment findings for IMAP candidate Common Indicator 26

81. For the years 2016, 2017, 2019, 2020, 2021 and for all the 4 cetacean species considered (bottlenose dolphin, fin whale, sperm whale, Cuvier's beaked whale), all subregions are below threshold, i.e., less than 10% of the potentially usable habitat area is affected by noise events as calculated following the adapted assessment methodology.

82. For the year 2018 and for all the 4 species considered (bottlenose dolphin, fin whale, sperm whale, Cuvier's beaked whale), 3 sub-regions are below threshold of affected habitat (ADR, CEN, WMS).

83. The year that resulted in the higher percentage of habitat of cetaceans exposed to impulsive noise events was 2018. That year, the proportion of affected habitat was higher than 10% i.e. the GES/non-GES boundary value/threshold in the Aegean and Levantine Sea Sub-region (AEL) considering sperm whale and Cuvier's beaked whale habitats but was lower than 10% considering the bottlenose dolphin habitat. AEL Sub-region presents the higher likelihood of being non-tolerable i.e., non-GES based on available data and adapted assessment methodology. See Fig 11 below.

84. Overall, for the Mediterranean Sea region, the environmental status is probably acceptable based on the present preliminary assessment findings, since the whole Mediterranean seems to comply with the 10% GES/non-GES boundary value of impacted habitat of cetaceans selected for this assessment. This conclusion is also supported by the computation of the simple coverage (i.e., without considering the habitat of cetaceans) of the Mediterranean Sea by impulsive noise events, which is below 10% for all year considered (see Figures 7 and 8 above).

85. Figures 11 and 12 provide a mapping of main assessment findings, especially highlighting potential non-GES situations found for the year 2018. It is noteworthy that the red areas highlighted in those maps do not correspond to non-tolerable, i.e., non-GES, positions, but are simply the position of all noise events for periods and areas considered (2018, all sub-regions). Tolerable or non-tolerable status is derived by dividing the extent of habitat of a species which is covered by impulsive noise events in the sub-region by the overall extent of the habitat area in that subregion. Tolerable or non-tolerable status is therefore indicated by one number, i.e., the proportion of affected habitat in %, which is assigned to a sub-region and is plotted in the maps of Figures 11 and 12. Beyond this, highlighting the areas that determine the exceedance of the 10% threshold (non-tolerable, i.e. non-GES areas) during a year will be possible when the ACCOBAMS International Noise Register will be fed with enough data to allow for an optimal assessment. However, from a management perspective the way the red areas are interpreted has little importance as bringing a sub-region below thresholds will imply taking measures to reduce the extent of the red areas, wherever they are found.

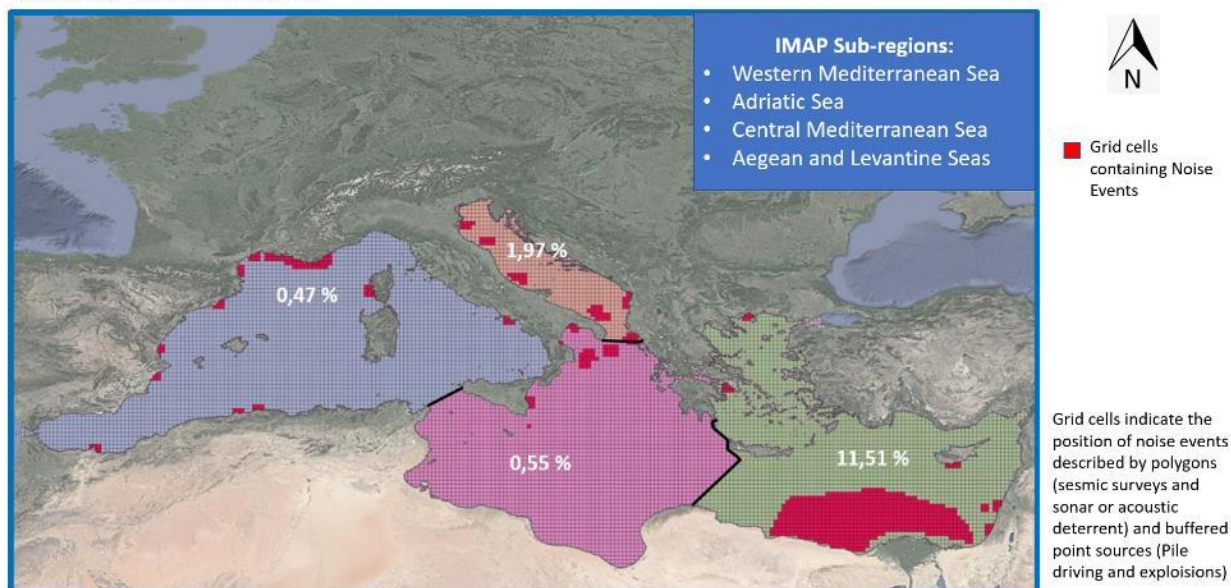


Figure 11. Percentages of habitat (PUHA) exposed to impulsive noise events, in 2018, per four IMAP Sub-regions in the Mediterranean and considering sperm whale as target species. Red grid cells indicate the position of noise events in 2018, irrespective if they are classified as GES or non GES. The 4 sub-regions are indicated in different colours.

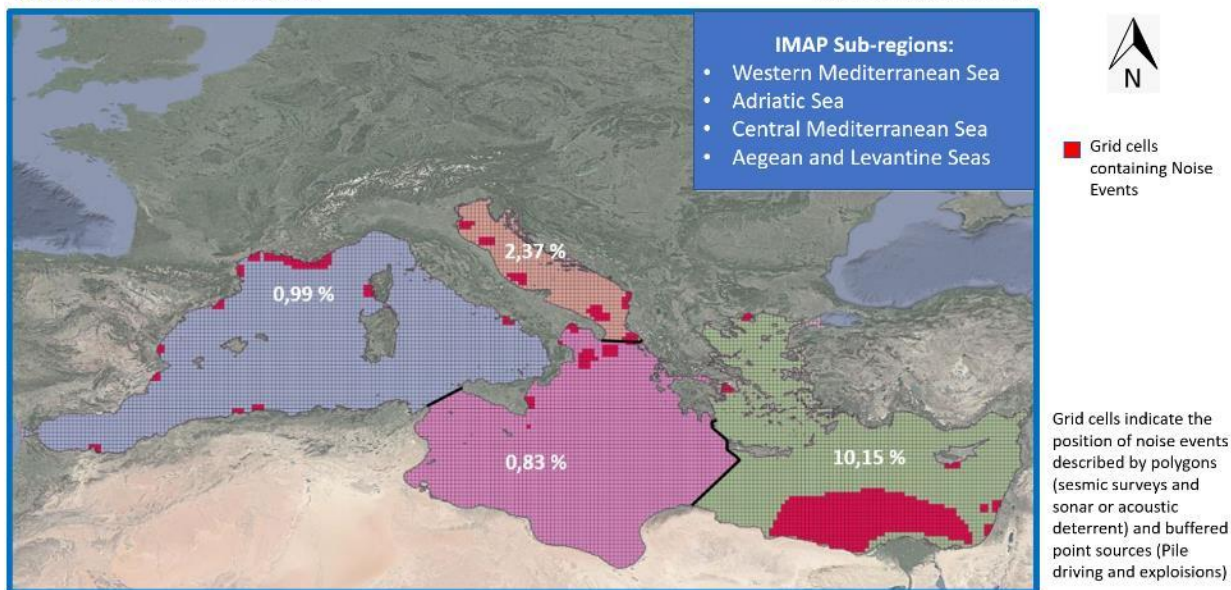


Figure 12. Percentages of habitat exposed to impulsive noise events, in 2018, per four IMAP Sub-regions and considering Cuvier's beaked whale habitat. Red grid cells indicate the position of noise events in 2018, Irrespective if they are classified as GES or non-GES. The 4 sub-regions are indicated in different colours.

86. As stated in the paragraphs above, the assessment needs to be refined, when the ACCOBAMS Noise Register will reach a higher level of completeness, enabling to simulate the effect of the concurrent activities of impulsive noise sources through appropriate simulation techniques (including acoustic modelling), and enabling to apply the optimal methodological framework as elaborated in Section 2.

4.2 Key assessment findings for IMAP candidate Common Indicator 27

87. The overlap between continuous noise (median noise in July 2020) and the habitat of cetacean species clearly shows the exceedance of the 20% boundary value/threshold of the habitat area affected by continuous low frequency noise in the Western Mediterranean Sea and the Aegean Levantine Seas Sub-regions. The implementation of the assessment methodology for cCI 27 is overall complete for the month of July 2020 and hence, if the methodological approach is assumed to be adequate, it can be concluded that these two sub-regions may be in non-tolerable status i.e., non-GES during that one month. While it cannot be said much regarding the status during other months, based on the methodological framework elaborated in Section 2, one single month exceeding 20%, is sufficient to induce non-tolerable environmental status, i.e. non-GES for continuous noise, for the entire year. Therefore, the assessment findings for 2020 appear to be non-tolerable status, i.e. non-GES, for WMS and AEL sub-regions.

88. Figures 13 and 14 provide such mapped assessment findings. It is worth noting that tolerable/non tolerable, i.e. GES/non-GES status is indicated by the proportion of affected habitat to see whether the value is above the 20% threshold as specified in the methodology described in Chapter 2. Red areas determine the non-tolerable status of a sub-region but are not to be considered non-GES areas. However, from a management perspective the way red areas are interpreted has little importance as bringing a sub-region below thresholds will induce taking actions to reduce the extent of the red areas, wherever they are found.

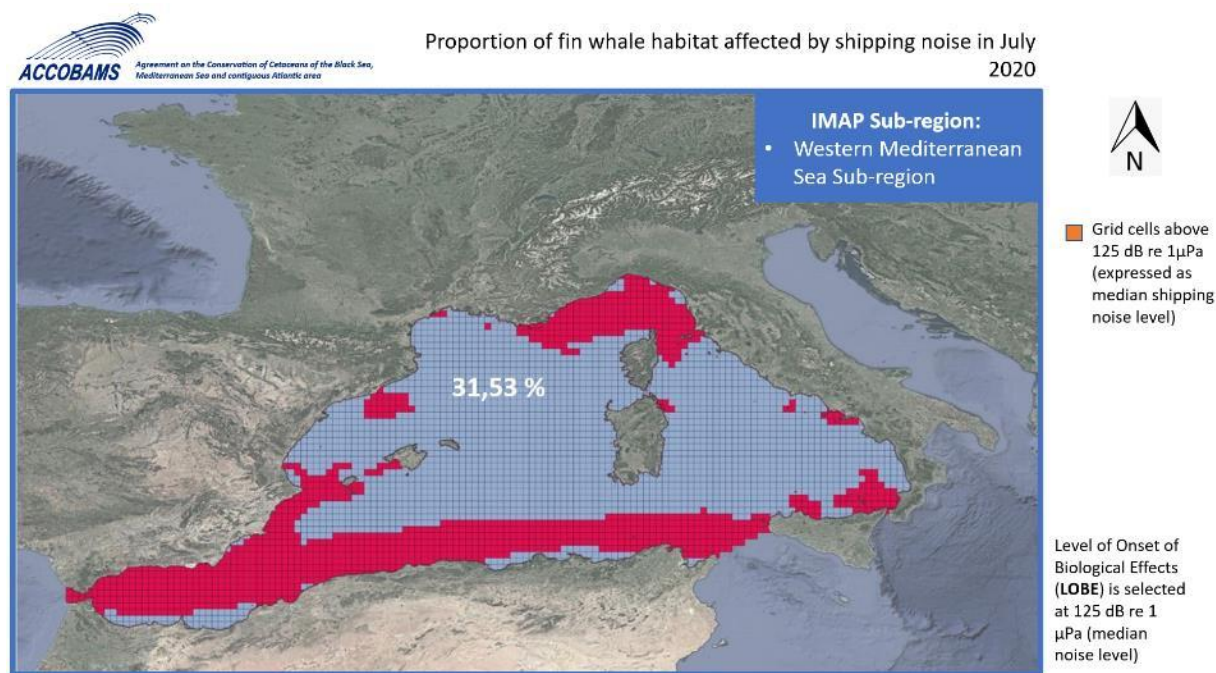


Figure 13. Percent of fin whale habitat (PUHA) exposed to a monthly noise level higher than 125 dB re 1 μPa (LOBE) in the Western Mediterranean Sea Sub-region (WMS). Red cells indicate the area where the Level of Onset of Biological Effects (LOBE, set as median noise level = 125 dB re 1 μPa) is exceeded for the month of July 2020.

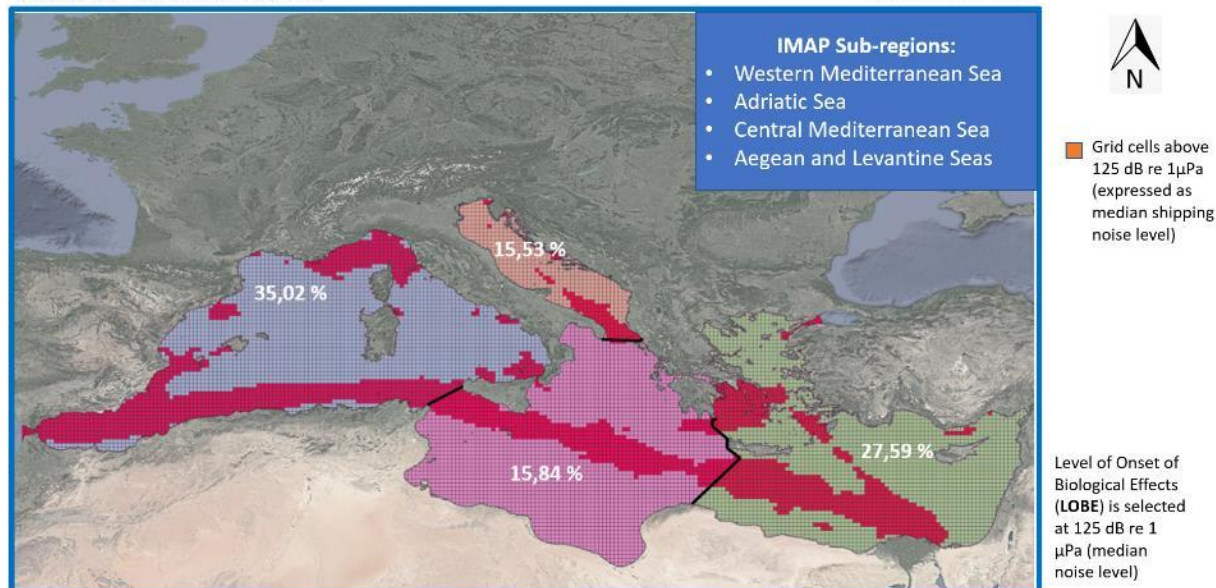


Figure 5.7.2. Percent of bottlenose dolphin habitat (PUHA) exposed to a monthly noise level higher than 125 dB re 1 µPa (LOBE) in the Western Mediterranean Sea Sub-region (WMS), Adriatic Sea (ADR), Central Mediterranean (CEN) and Aegean and Levantine Sea (AEL) sub-regions. The picture shows exceedance of thresholds (20% of habitat affected by continuous noise) in the WMS and AEL sub-regions, and compliance in the ADR and CEN sub-regions. Red cells indicate the area where the Level of Onset of Biological Effects (LOBE, set as median noise level = 125 dB re 1 µPa) is exceeded for the month of July 2020. Different sub-regions are indicated in different colours.

89. For the Adriatic Sea (ADR) and Central Mediterranean (CEN) sub-regions, the result of the assessment was a tolerable status, i.e. GES for continuous noise, considering that the proportion of habitat of the species considered (bottlenose dolphin) affected by continuous noise was below 20%. As elaborated in Section 2, the summer months are those with the highest levels of vessel traffic and hence the analysis done on a month of July 2020 can be seen as the worst case scenario. Based on this, even though quantitative data were not produced for other months, it is possible to conclude that if the month representing the worst-case scenario results in tolerable status, i.e. GES for continuous noise, this result can be generalized for the entire year, i.e. the ADR and CEN sub-regions were likely in GES in 2020.

90. Finally, based on these preliminary results, the Mediterranean Sea region is not fully tolerable status, i.e. GES, since the Western Mediterranean Sea and the Aegean Levantine Sea Sub-regions do not comply with the 20% threshold of impacted habitat over the monthly scenario.

5. Background and Explanations for the Measures and Actions proposed to achieve GES regarding noise

91. Underwater noise generated by human activities is one of the pressures identified and assessed in the framework of the implementation of the Marine Strategy Framework Directive (descriptor 11 of the Directive) and its complementary process at the Mediterranean level (Ecosystem Approach Process (EcAp) led by the Barcelona Convention).

92. The level of anthropogenic noise pollution in the marine environment is increasing at an alarming rate. In some areas, underwater noise levels have been doubling decade by decade over the last 60 years (McDonald, 2006). In the Mediterranean basin, anthropogenic noise levels have been steadily increasing over the past 50 years as shipping traffic has increased (MEPC 79/10, 2022).
93. The activity causing the greatest impact in terms of underwater impulsive noise is the deployment of air guns, predominantly used for seismic acquisition in hydrocarbon exploration, which are right after underwater nuclear explosions, in second position, in terms of worldwide introduction of acoustic energy per year (Hildebrand, 2005).
94. According to the report "Overview of underwater noise hotspots in the ACCOBAMS area, Part I - Mediterranean Sea", for the period 2005 to 2015, commissioned by the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS), the increase in seismic acquisition activities (acoustic surveys) over this period, particularly in connection with oil exploration, is particularly worrying. Thus, whereas in 2005, 3.8% of the Mediterranean area was affected by acoustic surveys with airguns, by 2013 this percentage had risen to 27%.
95. In the same vein, according to the joint European Maritime Safety Agency (EMSA) and European Environment Agency (EEA) "European Maritime Transport Environmental Report 2021", underwater radiated noise generated by commercial shipping has significantly increased in all EU seas since 2014. Specifically, total noise energy emissions have more than doubled between 2014 and 2019 in EU waters. In terms of noise energy levels for all the EU sea areas, container ships, followed by cargo ships and tankers, are responsible for the highest noise emissions in the 125 Hz one-third octave band.
96. There is growing scientific concern about the proliferation of noise pollution as it poses a significant threat to all of marine ecosystems and marine life, including to the survival of mammals, turtles, fish, and other ocean-dwelling animals. Scientific studies have documented the negative impacts of underwater noise on around 150 marine species, from marine mammals (47 species) to fish (66 species) and invertebrates (36 species). These species numbers do not include zooplankton, though they are also impacted.
97. Ocean noise affects the entire ecosystem and the interactions between species. It also affects ecosystem services, such as water filtration and nutrient availability, which are necessary for the ocean to be productive. Moreover, these effects are transboundary and can occur thousands of kilometers from the noise source. Sound is the most important sense for almost all marine life. Animals depend on sound to communicate with the group, find and choose mates, stay in contact with their young, find food, escape predators and hazards, orient, and navigate—all vital processes. Noise causes stress in animals, interferes with feeding and reproduction, disrupts development, can cause hearing loss, masking (obscuring vital natural sounds), and a depressed immune response. Overall physiology can be compromised by noise as well as DNA integrity. Ocean noise can also lead to Internal injuries and even death. Animals may avoid important feeding or reproductive habitat, if noise levels become too high. Behaviourally, human induced underwater noise can cause greater alarm responses, increased aggression, decreased anti-predator defense, worse nest care, and decreased foraging can occur. Commercial fisheries catch rates can also drop substantially due to noise.

5.1 Preliminary recommendations, data quality and availability

98. There is an urgent need to improve the data set so as to provide assessment results that better reflect the noise emission patterns in the Mediterranean Sea.

99. Such is only possible when all Mediterranean Range States provide complete and accurate data to the Impulsive Noise Registry in the Mediterranean Sea (INR-MED) managed by ACCOBAMS. So far, only a few countries provided such data. Furthermore, an accurate assessment allowing for the conclusion of whether a good environmental status (GES) has been reached within a certain time period, requires the inclusions of data about noise levels arising from naval activities, including the deployment of low- or midfrequency sonar. The INR-MED collates data (related to three kinds of sound sources: seismic surveys, explosions, sonar or acoustic deterrents) reported by the countries in a standard format that is aligned with the requirements indicated in the Proposal of the IMAP Guidance Factsheet for cCI 26.

100. Parties to the Barcelona Convention shall be aware of ACCOBAMS Resolution 7.13 point 11, which “strongly encourages Parties to contribute to the ACCOBAMS regional register for impulsive noise sources, especially by sharing their data, and calls the Parties for the development of a co-operation mechanism to identify the source of long-distance underwater noise in order to address its long-distance effects”.

101. Military events and activities may increase noise levels. As military activities generating noise are not reported and no data is available, it is impossible to provide an actual and precise assessment reflecting the real situation.

102. The current assessment provides an excellent example of the methodology which can be applied in the future to provide assessments of activities generating the noise. While the present assessment has been undertaken by splitting the Mediterranean into four geographical regions, as applied with UNEP/MAP and ACCOBAMS, an alternative approach shall be tested by applying specific assessments for species and their habitat. For such exercise, the identified (and candidate) Important Marine Mammal Areas (IMMA) could be used as defined habitats.

5.2 International and Regional management measures to reduce underwater noise emissions and achieve GES

103. Noting the threat anthropogenic underwater noise poses to marine species, , Mediterranean Countries are recommended to promote and engage in the implementation of numerous measures to prevent, reduce, and mitigate underwater noise emissions. The following well developed guidance shall serve as guidance in that respect:

- Regulating underwater noise generating activities by different sectors by applying the “GUIDELINES TO ADDRESS THE IMPACT OF ANTHROPOGENIC NOISE ON CETACEANS IN THE ACCOBAMS AREA” (as adopted by ACCOBAMS Resolution 7.13 in Annex 2).
- The CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities (adopted by CMS Resolution 12.14 on Adverse Impacts of Anthropogenic Noise on Cetaceans and Other Migratory Species and by ACCOBAMS Resolution 7.13) should be applied when conducting Environmental Impact Assessments (EIAs) prior to the authorization of noise-generating activities.

104. Mediterranean Countries shall take note that the International Maritime Organization (IMO) has just finalized the revision of the Guidelines for the reduction of underwater radiated noise from commercial shipping. At the 80th Meeting of the IMO’s Marine Environment Protection Committee (MEPC) a decision will be made regarding the adoption of the Guidelines, and subsequent actions will be identified.

105. In this regard, for some Parties who are signatories to the Law of the Sea, the relevance of the following provisions of Resolution 77/248, adopted by the United Nations (UN) General Assembly on 30 December 2022, is highlighted:

- Para. 304. Notes the ongoing work at the International Maritime Organization to review the Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life and to develop a proposal for a programme of action to further prevent and reduce underwater radiated noise based on the findings of the review, and notes with appreciation the GloNoise project within the International Maritime Organization, which will focus on building capacity in developing States to implement the Guidelines;
- Para. 305. Encourages States, acting through the International Maritime Organization or individually, to implement the recommended solutions to address adequately the barriers that have prevented the uptake and implementation of the current Guidelines by the industry

106. Mediterranean countries shall also take into consideration the Report of the First Coordination Meeting on the Mediterranean Strategy for the Prevention of, Preparedness, and Response to Marine Pollution from Ships (2022-2031), issued by REMPEC in March 2023 (REMPEC/WG.52/8), where underwater noise is one of the seven Common Strategic Objectives (CSO7 – Underwater Noise).

107. Parties to ACCOBAMS already decided the following actions to be taken:

- ACCOBAMS Resolution 8.17 on Anthropogenic Noise, adopted in December 2022, includes
 - 5. Encourages Parties to
 - d) promote the application of vessel speed reductions (e.g., slow steaming) as an operational measure that results into multi-environmental benefits, including the reduction of underwater noise and greenhouse gas emissions, as well as of the risk of ships strikes, and to promote such measures in the context of the proposal of Particularly Sensitive Sea Area in the North-western Mediterranean;
 - e) note that the issue of underwater noise pollution from ships can only be effectively addressed through IMO measures and international cooperation, and that applying mandatory measures provides an equal playing field level for the private sector;
- ACCOBAMS Resolution 7.13 on Anthropogenic Noise, adopted in 2019, includes:
 - 16. Encourages Parties to:
 - Fully address the issue of anthropogenic noise in the marine environment, including cumulative effects, in the light of the best scientific information available and taking into consideration the applicable legislation of the Parties, particularly as regards the need for environmental impact assessments being undertaken before granting approval to proposed noise-producing activities;
 - Integrate the issue of anthropogenic noise in management plans for marine protected areas;
 - Avoid or minimize producing noise in marine protected areas, as well as in particular in areas containing critical habitat of cetaceans likely to be affected by man-made noise;
 - 17. Strongly urges Parties to fully apply the precautionary approach and to envisage the appropriate mitigation measures, including a provision for expert review by specialists

and a provision for the action to be taken if unusual events, such as atypical mass strandings, occur

5.3 Application of Best Available Technologies and Best Environmental Practices

108. As part of the implementation of the Barcelona Convention and its Protocols, the Contracting Parties adopt programmes and measures which contain, where appropriate, time limits for their completion and utilize the best available techniques (BAT) and best environmental practices (BEP). In this endeavor, the application of, access to and transfer of environmentally sound technology, including clean production technologies, taking into account the social, economic and technological conditions of the Contracting Parties, constitute overarching considerations.

109. Therefore, the concept to apply and promote the usage of BAT and BEP is endorsed by Parties to the Barcelona Convention, CBD, CMS and ACCOBAMS.

110. The Convention on Migratory Species (CMS) is just about to publish a Technical Series on “Best Available Technology (BAT) and Best Environmental Practise (BEP) for Mitigating Three Noise Sources: Shipping, Seismic Airgun Surveys, and Pile Driving”.

111. In this context, some examples of recommended BAT and BEP for shipping noise include:

- minimizing cavitation by, e.g., better maintenance and optimizing the propeller design to the hull and to usual operating conditions, which often improves energy efficiency as well;
- slow steaming, or reducing ship speed: e.g. modest, 10%, speed reductions across global fleet could reduce total sound energy produced by shipping by 40%, no retrofitting is required with this measure, and greenhouse gas emissions are reduced;
- implementation of underwater noise management plans developed for individual vessels.

112. For seismic airgun surveys, quieting technologies, such as Marine Vibroseis, that could replace airguns show the most promise, as much of the energy (the mid- or high-frequencies) emitted by airguns is wasted and unused. A controlled sound source, like Marine Vibroseis, tailor-made to the specific environmental conditions and without the damaging sharp rise time of airguns would also likely be more environmentally friendly. Mitigation measures for airgun surveys should show proof of their efficacy and should include: avoiding sensitive areas and times and not proceeding in conditions of poor visibility, such as at night.

113. Many new quieting technologies and alternative low-noise foundations have been developed for pile driving, mainly due to the German government’s noise limits and restrictions.

114. Application of quieting technologies that reduce sound at source will likely be the most effective way to reduce the environmental impacts of underwater noise, and quieting methods that also reduce greenhouse gas emissions or encourage technological innovation should be especially encouraged.

5.4 The Particularly Sensitive Sea Area (PSSA) of the North-Western Mediterranean as a tool for the management of continuous underwater noise generated by shipping

115. On the initiative of 4 ACCOBAMS Countries: France, Italy, Monaco and Spain³, the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) decided in December 2022⁴ to designate the North-Western Mediterranean as a Particularly Sensitive Sea Area (PSSA) in order to reduce ship collisions with the large cetaceans (sperm whales and fin whales), which continue to inhabit this area of intense maritime traffic. Both fin and sperm whale subpopulations in the Mediterranean Sea are classified as endangered on the IUCN Red List.

116. This IMO decision acknowledges the fact that collisions with ships are the main cause of human-induced death for fin whales and sperm whales in the North-Western Mediterranean, an area of great environmental value. The associated protective measures (APM) proposed for the PSSA are merely recommendations to seafarers, such as that “to navigate with particular caution within the NW Med PSSA, when and where large and medium cetaceans are present, and to limit their speed to between 10 and 13 knots as voluntary speed reduction”. Due to the voluntary nature of the proposed APMs, it is unlikely that they will significantly reduce the risk of lethal collisions with great whales. Only the adoption of a mandatory vessel speed reduction measure would effectively safeguard large whales while creating a level playing field for all shipping companies.

117. In Annex 1 “Information supporting the proposal of a Particularly Sensitive Sea Area (PSSA) in the North-Western Mediterranean Sea” of the aforementioned submission MEPC79/10, it is concluded that “(...) the whale population has suffered ship strikes in the region and therefore the cetacean population is at risk. Without associated protective measures to mitigate the risk of collision within the perimeter of the PSSA, a decline in the populations of medium and large cetaceans is to be expected. Implementing a speed reduction strategy will allow a significant decrease in the likelihood of collision and fatal wildlife-related injuries”.

118. In fact, scientific knowledge of the distribution and habitat use of these large whales has led to the conclusion that in this part of the Mediterranean it is nearly impossible to predict where these mammals will be at any given time, so the option for ships to divert their routes to avoid collisions with them is not feasible in this case. Therefore, there is only one demonstrated measure to reduce the risk of fatal ship strikes: reducing ship speed, as reflected in ACCOBAMS Resolution 8.18 on Ship Strikes.

119. Numerous studies have shown that the risk of collision decreases with reduced speed and can be avoided at a maximum speed of 10 knots. Several options can be considered: 1) reducing ship speed to a certain percentage of the design speed; 2) reducing ship speed to a specific speed limit per ship category; and 3) implementing a 10-knot speed limit within marine protected areas.

120. To reduce the growing climate and ecological footprint of shipping and to reach Good Environmental Status (GES) as required by the EU MSFD implementation process via the Regional Seas Conventions, the measures needed shall be both simple to implement and capable of achieving multiple environmental benefits. Speed reduction meets all these criteria: it is currently the most cost-effective method to reduce greenhouse gas emissions, air pollutants, underwater noise and the risk of collision with marine fauna, with immediate effect and at minimal cost. The multi-environmental advantages of vessel speed reduction have also been acknowledged in ACCOBAMS Resolution 8.17 on Anthropogenic Noise.

³ MEPC 79/10. Designation of a particular sensitive sea area in the North-Western Mediterranean Sea to protect cetaceans from international shipping. Submitted by France, Italy, Monaco and Spain. 9 September 2022

⁴ MEPC79 agreed to approve it in principle. The final decision is expected to happen at MEPC80 in July 2023, after review of the proposal by the Sub-Committee on Navigation, Communications and Search and Rescue, as required by IMO internal procedures

121. Although the proposal for the designation of this PSSA in the NW Mediterranean is motivated by the urgency to reduce the mortality of fin whales and sperm whales caused by collisions with ships, the high and increasing intensity of maritime traffic in this area makes it a hotspot for underwater noise pollution. In fact, there are approximately 220,000 ships per year passing through this area at velocities ranging from 14 to 20 knots for merchant vessels and up to 35 knots for high-speed vessels.

122. The movement of a ship's engine propeller is the primary source of underwater radiated noise caused by shipping. The noise level increases with the shape of the propeller, the ship's state of wear, its size, speed and loading. Research demonstrates a direct correlation between speed and noise (McKenna et al., 2013; Zobell et al., 2021). Leaper (2019) concluded that a 10% speed reduction would reduce the global total acoustic energy from shipping by approximately 40%.

123. The assessment conducted in the document Mediterranean Quality Status Report (UNEP, 2024) - Pollution Ecological Objectives - EO11, Energy including underwater noise (in prep.), using July 2020 data (during one of the most critical phases of the Covid-19 pandemic) concluded that the Western Mediterranean Sea Sub-region appears to be in non-tolerable status, i.e. non GES, with regard to candidate Common Indicator 27 (cC27, low-frequency continuous noise).

124. Due to the double problem of ship strikes and underwater noise in the North-Western Mediterranean area, it is highly recommended to consider the inclusion of a mandatory speed reduction measure, not only in order to ensure the high effectiveness of the PSSA in reducing the risk of ship strikes with lethal effects on cetaceans, but also to reduce the level of underwater noise to levels that do not adversely affect these mammals and the other marine fauna impacted by this form of pollution.

125. By establishing internationally recognized ship speed limits, the North-Western Mediterranean PSSA would also serve as an effective protection mechanism against underwater noise.

126. NETCCOBAMS would be a crucial tool for monitoring compliance with the agreed measures, such as those that might be imposed on vessel speed, mapping temporal and geographical distribution and abundance of whales with comparable data on shipping routes and densities.

5.5 The priority measures related to IMAP Candidate Indicators 26&27

a) Improve underwater noise data quality and availability

127. For the improvement of underwater noise data quality and availability, the following specific actions should be undertaken by the Parties:

- A contribution should be provided to the ACCOBAMS regional register for impulsive noise sources, especially by sharing national data, along with the development of a co-operation mechanism to identify the source of long-distance underwater noise in order to address its long-distance effects;
- Reporting noise generating military activities is needed to provide an actual and precise assessment reflecting the real situation;
- An alternative approach needs to be tested by applying specific assessments for species and their habitats. For such exercise, Important Marine Mammal Areas (IMMA) could be used as defined habitats.

b) Implement International and Regional management measures to reduce underwater noise

128. Further to the above there is a need to implement measures to prevent, reduce, and mitigate underwater noise emissions, taking into account well developed guidance (e.g. CMS, IMO, Oceans, ACCOBAMS, etc), including the following:

- Promote the application of vessel speed reductions by supporting for example ship speed limits in the proposed North-Western Mediterranean Particularly Sensitive Sea Areas (PSSA);
- Address the issue of anthropogenic noise in the marine environment, including cumulative effects;
- Integrate the issue of anthropogenic noise in management plans for marine protected areas and avoid or minimize producing noise in MPAs, and in areas containing critical habitat of cetaceans likely to be affected by man-made noise;
- Apply the precautionary approach and envisage the appropriate mitigation measures, including a provision of expert review by specialists and a provision of the action to be taken if unusual events, such as atypical mass strandings, occur;
- Support NETCOBAMS that would be a crucial tool for monitoring a compliance of the agreed measures, such as vessel speed, mapping temporal and geographical distribution and abundance of whales with comparable data on shipping routes and densities.

c) Apply Best Available Technologies and Best Environmental Practices

129. For marine traffic, the following noise related technologies and BATs should be applied:

- Minimize cavitation, e.g., better maintenance and optimizing the propeller design;
- Slow steaming or reduce ship speed;
- Implement underwater noise management plans developed for individual vessels.

130. For seismic air gun surveys, the following technologies and BATs should be applied:

- Quieting technologies, and controlled sound source, like Marine Vibroseis, tailor-made to the specific environmental conditions and without the damaging sharp rise time of air guns;
- Mitigation measures (avoiding sensitive areas and times and not proceeding in conditions of poor visibility, such as at night).

6. Acknowledgments

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