Assessment of IMAP Candidate Common Indicator 27: Levels of continuous low frequency sounds with the use of models as appropriate

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	**All ACCOBAMS Contracting Parties** which participate in setting and maintenance of the NETCCOBAMS platform: Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Georgia, Greece, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Portugal, Romania, Slovenia, Spain, Syria, Tunisia, Türkiye, Ukraine
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO11. Energy including underwater noise
IMAP Common Indicator	cCI27. Levels of continuous low frequency sound with the use of models as appropriate
GES Definition (UNEP/MED WG473/7) (2019)	Noise from human activities causes no significant impact on marine and coastal ecosystems
GES Targets (UNEP/MED WG473/7) (2019)	Noise levels at monitoring stations are below thresholds; The extent (% or km²) of the assessment area which is above levels causing disturbance to sensitive marine animal is below limits, or such limits are exceeded for a limited amount of time
GES Operational Objective (UNEP/MED WG473/7) (2019)	Energy inputs into the marine, environment, especially noise from, human activities, are minimized

Available data

710. 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 which corresponds to requirements indicated in the Proposal of the IMAP Guidance Factsheets for cCI27.

711. 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).

712. 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.

713. An overview of the available data on ship traffic patterns is shown in Figure 3.1.10.1. This map, available in NETCCOBAMS, was produced based on the ship traffic density provided based on AIS data in 2017. Ship traffic patterns appears 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.

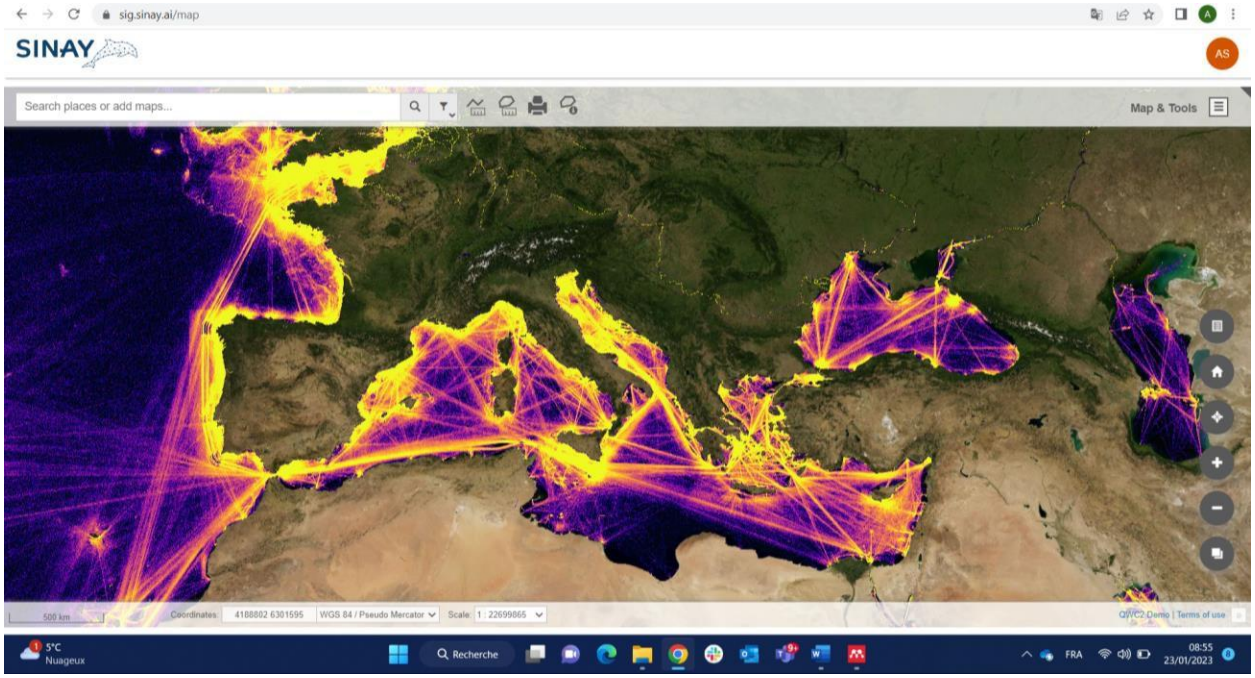

Figure 3.1.10.1: Ship traffic density as total count of AIS messages per grid cell (0.01° in latitude and longitude) for 1 year (2017 in this case). The patterns shown in this map (ship lanes, traffic hotspots, low- and high-density areas) are quite stable year-to-year and can be considered representative of usual ship traffic conditions in the Mediterranean Sea. Source of raw AIS data used in NETCCOBAMS: Spire Group.

714. 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 2022 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[127].

715. 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 calibrate the models implemented in NETCCOBAMS. Despite additional in-situ measurements are required to continue improving the model which would estimate situation in the four Mediterranean subregions. The first validation was achieved from field data which do not directly contribute to the assessment, and therefore they are not shown in the 2023 MED QSR.

[127] Furthermore, a new noise map for the month of July 2021 should be available in NETCCOBAMS in the coming months. The noise map for July 2021 will allow to compare the status in July 2020 with the status in July 2021, to test assumptions described in this assessment.

Additional information on data and the calibration process of the acoustic models is found in QUIETMED Deliverable 3.3 (Taroudakis et al., 2018).

716. Finally, data produced under national programs as well as from sub-regional cooperation projects (e.g. the INTERREG-SOUDSCAPE project in the northern Adriatic Sea), were listed and can be used to put into context and compare with assessment findings produced here, thus allowing more robust conclusions. This activity is currently ongoing and will complete the present document at a later stage of the 2023 MED QSR development process.

Setting the GES/non GES boundary value/threshold for the initial environmental assessment of cCI 26

The assessment of IMAP Candidate Indicator 27 was performed by using data obtained from the NETCCOBAMS Platform, a digital information tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The quality of available data was sufficient and allowed to produce the first assessment findings of cCI 27 in the four Sub-regions of the Mediterranean Sea. For this initial assessment of cCI 27, the methodology 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 that 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 MSFD TG-Noise.

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 in 2022, 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.

717. The overall assessment methodology developed by TG-Noise (2022) 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.

718. 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).

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

720. 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.

721. 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 proportion of the potentially usable habitat areas (PUHA, following Azzellino et al, 2011) of these species, found on areas with median shipping noise higher than LOBE (125 dB re 1 µPa), 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.

722. 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. It is used for all four Mediterranean sub-regions. 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 the 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.

723. 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. If one month is above 20%, the environmental status is considered non tolerable. 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 the 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.

Results of the initial IMAP Environmental Assessment of cCI 27 in the Mediterranean region.

724. Figure 3.1.10.2 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 3.1.10.2, 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.

725. Beyond indication of the typical values of ambient noise of an area, the median noise can also indicate 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.

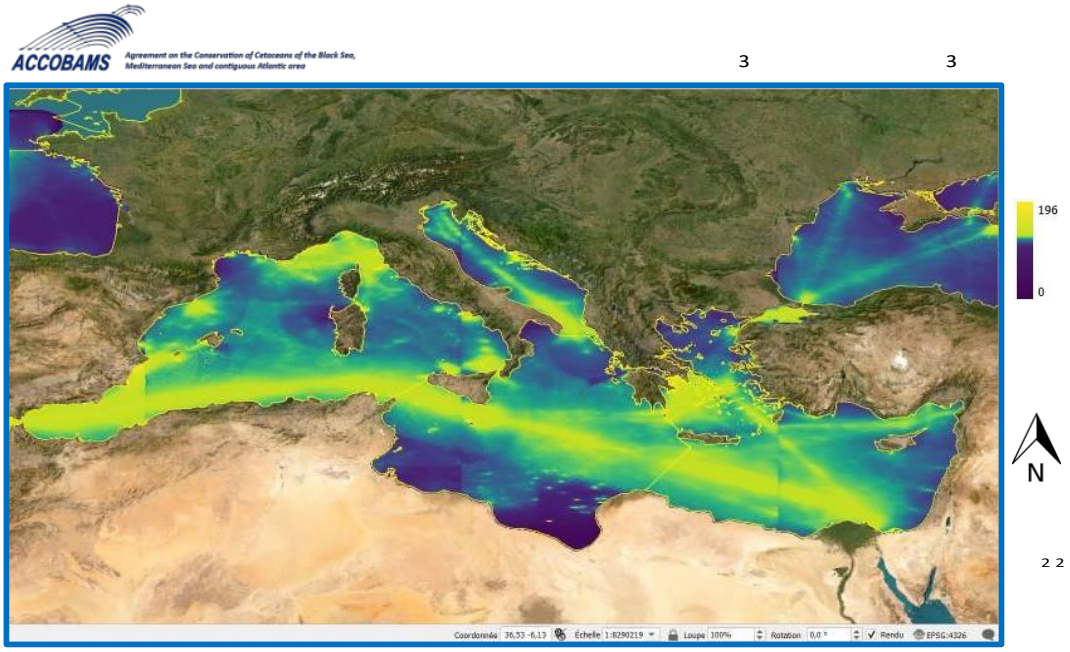

Figure 3.1.10.2: Median shipping noise levels in month of July 2020 based on the acoustic model RAM (Collins, 1996), contained in the NETCCOBAMS platform.

726. By analyzing Figure 3.1.10.2. 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 1µPa 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) present median noise levels in the range 100-110 dB re 1µPa. A few areas present the median values below 100 dB re 1µPa, 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).

727. 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 1µPa 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 3.1.10.1.

Table 3.1.10.1: 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