DELIVERABLE 4.5
RISK MANAGEMENT, COMMON TARGETS AND COORDINATED MEASURES FOR DESCRIPTOR 11 OF THE MSFD

Work Package	RAGES Work Package 4 Deliverable 4.5
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Preface

While the full application of the Risk Approach for Descriptor 11 is described within Deliverables 4.1, 4.2 4.3 and 4.4, this document outlines how the work of the RAGES project can assist Member States (MS) in the development of targets and measures for Descriptor 11 (Underwater Noise) of the Marine Strategy Framework Directive (MSFD). It firstly describes current targets and measures adopted by MS involved in the RAGES project for this descriptor and provides a summary of the European Commission's (EC) recommendations and guidance on the Common Implementation Strategy following the MSFD first cycle. The document goes on to specifically address how the project tackled the EC recommendations and highlights the novel and new approaches developed within RAGES that may be of greatest use for future. Lastly, it makes recommendations as to some key actions that are needed in order to improve MS ability to adopt realistic measures in the future.

1. Descriptor 11 Reporting for RAGES Member States

The MSFD aims to achieve Good Environmental Status of the EU's marine waters and as part of a broader Common Implementation Strategy (CIS), each Member State must implement a marine strategy for its marine waters in cooperation with other Member States sharing the same marine region. These marine strategies include 5 steps:

- an **initial assessment** of their marine waters (Article 8),
- the determination of the **Good Environmental Status (GES)** of their marine waters (Article 9),
- the setting of **environmental targets** (Article 10),
- the establishment and implementation of coordinated **monitoring programmes** (Article 11), and
- the identification of **measures** or actions that need to be taken in order to achieve or maintain good environmental status (GES) (Article 13)

In the following sections, the focus will be on the setting of targets and measures and on the progress made by the RAGES project towards improving and simplifying this process.

1.1 Review of Environmental Targets for D11

The MSFD defines an environmental target as:

"a qualitative or quantitative statement on the desired condition of the different components of, and pressures and impacts on, marine waters"

Article 10 of the MSFD requires that MS establish a comprehensive set of environmental targets and associated indicators for their marine waters based on their initial assessment. The aim of targets and indicators is to provide an operational tool for the management of human activities and their resulting pressures and for actions, which should lead to improvements in the environmental status of marine waters and ultimately to GES (EC, 2020). In addition, environmental targets should assure compatibility of targets with objectives to which MS have committed themselves under relevant international and regional agreements, making use of those that are most relevant for the marine region or sub-region.

The environmental targets established for each marine subdivision are classified as state, pressure or impact-based targets, and operational targets. State-based targets provide an indication on the physical, chemical or biological properties of the environment. Pressure-based targets relate to the acceptable or desired level of a particular pressure for the achievement or maintenance of GES, while impact-based targets indicate the acceptable level of impact on the components of the marine environment arising from a pressure or range of pressures. The operational targets imply concrete implementation measures to facilitate the achievement of the other targets. Therefore, they are directly related to the nature of the action required to achieve or maintain GES, without having to establish the specific measure (Annex IV of Law 41/2010). It is important to note that the environmental targets can be associated with the GES descriptor, as well as with one or several criteria and/or indicators.

These targets are reviewed on a six-year basis. The environmental targets established for D11 by France, Portugal and Spain in the 1st cycle (2012 - 2018) and 2nd cycle (2018 - 2024) are presented below.

Table 1. Targets proposed by RAGES member states for MSFD Cycle 1 and 2

	Cycle 1 Targets	Cycle 2 Targets
Ireland	• None yet established (primarily due to lack of data)	
Portugal		• **Continental** ABIPT-T1-D11Cont**:** To implement, up to 2021, a register system for the spatial and temporal characterisation of activities that generate low and medium frequency impulsive noise, following the specifications recommended by TG bNoise and adopted by OSPAR. • **Continental** ABIPT-T2-D11Cont: To identify, up to 2024, risk areas for marine mammals in the Continental subdivision, taking into account the regional context. • **Azores Meta-Azo17** To develop and implement, up to 2024, adequate methodologies for obtaining information for GES assessment. • **Azores Meta-Azo18** To create and install an infrastructure network for the monitoring of noise and species vulnerable to noise pressure, such as cetaceans. • **D11-AZO-M1** To identify, up to 2024, noise risk areas for marine mammals in the Azores subdivision. • **Madeira AMAPT-T001-D11MAD** To develop a study for evaluating conditions and resources necessary for the setting-up and functioning of devices for monitoring of underwater acoustic noise. • **Madeira AMAPT-T016-D11MAD** To identify risk areas for marine mammals.
Spain	**Environmental target B.1.14:** • To ensure underwater noise doesn't produce significantly impacts on the marine biodiversity. **Environmental target B.3.4:** • To improve the understanding on underwater noise and other energy inputs on the marine environment as well as their impacts on the marine biodiversity.	Environmental targets related to noise • B.N.12. / B.S.12. / B.C.11.: Develop / support measures for the prevention and / or mitigation of impacts from ambient noise and impulsive noise • B.N.14/B.S.14/.B.C.13: Promote that scientific studies, initiatives and projects on the impacts of the introduction of substances, litter and **energy** in the marine environment, respond to the knowledge gaps detected in the Initial Assessment and in the successive phases of the Marine Strategies. B.N.15/B.S.15/B.C.14:. Integrate the results and knowledge acquired through scientific studies, initiatives and projects on the impacts of the introduction of substances, litter and **energy** into the marine environment into decision-making and management processes
France	• D11.1 Limit pressures that physiologically impact the species as well as their detection capabilities and acoustic communication & protect the functional habitats from noise disturbance that has impacts on species present in these areas • D11.1.1 Limit impulsive emissions to a level not having a significant impact on the species • D11.1.2 Limit continuous emissions to a level not having a significant impact on the species • *For Bay of Biscay and Celtic Sea only:* • D11.1.3 Adapt periods, intensities and durations of underwater emissions based on the behavior of these species (breeding, feeding, resting)	

1.2 Review of Monitoring Programmes and Programmes of Measures for D11

Monitoring Programmes provide the data and information needed to assess whether GES has been achieved or is being maintained, thus assessing progress towards the delivery of the environmental targets and effectiveness of measures. Monitoring Programmes are defined based on the initial assessment of marine waters and the environmental targets already established, considering the types of measures listed in Annex IV of the MSFD. In addition, existing measures derived from other legislation or international agreements may be taken into account, especially those that are considered relevant to the MSFD environmental targets. The Monitoring Programmes and Programmes of Measures reported by the RAGES Member States for the 1st cycle are available at:

FR: https://dcsmm.milieumarinfrance.fr/

PT: https://www.dgrm.mm.gov.pt/as-pem-diretiva-quadro-estrategia-marinha

ES: https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/estrategias-marinas/default.aspx

IR: https://www.gov.ie/pdf/?file=https://assets.gov.ie/111103/e6bf39bd-c897-4c3e-a42f-81f20065571d.pdf#page=null

https://www.gov.ie/en/publication/efe63-marine-strategy-framework-directive-article-11-monitoring-programmes-report-april-2015/

For the 2nd cycle, only Spain has submitted its report at the time of writing, and the updated monitoring strategy and two programs for underwater noise can be found here: https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/estrategiaseguimientorsyprogramasasociados_tcm30-518610.pdf. The information for the 2nd cycle for France is available at: https://www.merlittoral2030.gouv.fr/donnez-votre-avis. A summary of the available Monitoring Programmes and Programmes of Measures reported by RAGES Member States for D11 are shown in Table 2 below.

Table 2. *Detail of the programmes of measures and monitoring programmes proposed for Descriptor 11 by the four RAGES Member States*

MS	Measures	Monitoring Programmes
Ireland	• M223 To establish and maintain a register of noise in the Irish Marine Assessment Area. • M224 To continue to apply the Guidance to Manage the Risk to Marine mammals from man-made Sound Sources in Irish Waters (NPWS 2014) • M225 To apply the IMO I817:2014 Code On Noise Levels On Board Ships	• Programme ACS-IE-D011 D11 Energy, including underwater noise • Sub-programme ACS-IE-D11-01): Impulsive Noise Register
Portugal	• Continental ME05-D11- CAASPER – Characterise the Portuguese submarine acoustic environment and noise effects (applicable to the continental, Azores and Madeira sub-divisions) • - MEMAD06-D4 - M3.MigraMarMad - Study and understand the migration routes of highly mobile species (applicable to Madeira) • - MEMAD07-D1 - HOME.SIC - Create a Site of Community Interest (SCI) for the bottlenose dolphin and other cetaceans in coastal waters of the Madeira Archipelago (applicable to Madeira)14 • ISMOM A - Implement a (modular) meteo-oceanographic monitoring system in the Atlantic Ocean surrounding the islands of Madeira	• Sub-programme MOM02-IV - Whales & Ships - Monitoring of whale watching activities in subdivision Madeira (applicable to Madeira sub-division). • MONITMAMIFEROS - Monitoring of cetaceans in the mainland subdivision • FISH&SHIPS - Monitoring of fishing activities and maritime traffic in Marine Protected Areas offshore • MONIAMT - Monitoring of maritime-tourism activities in coastal and oceanic areas of the Azores MONIKETOS - Monitoring of cetaceans in coastal and territorial waters of the Madeira subdivision

Spain	• New measure RS1: Regulation on criteria for projects generating underwater noise and for the preparation of EsIA for such projects.
	• New measure H1: Regulation of compatibility criteria with marine strategies as per Article 3.3. of Act 41/2010 This action, which is described in detail under section 6.9., underwater noise shall be included under compatibility criteria for certain human activities.
		• The monitoring strategy for Descriptor 11 consists of two programmes for the five sub-divisions:
		  • ES-RS-1_Acute underwater noise
		  • ES-RS-2_Difuse underwater noise
		• Two activity monitoring sub-programmes
		  • ES-A-22 Marine transport
		  • ES-A-07 Exploration and exploitation of hydrocarbons
		• One general objective programme has also been reported as relevant for D11: ES-OA-B: Environmental targets on discharges to the marine environment (B)

France	• M250-NAT1a - Regulatory framework for noise generated in the marine environment • M251-NAT1a - Regulatory framework for noise generated in the MPAs • M252-NAT1b - Improving knowledge and experience and developing noise reduction systems • M021-KTM1b - Prevention and control measures for pollution coming from urban areas or infrastructure • M021-NAT2 - Defining recommendations to limit the impact of acoustic anthropogenic emissions • M250-NAT1a and M251-NAT1a are **Existing measures** that have a **direct** effect on underwater noise and energy • M021_KTM1b is an **existing but not yet implemented** Measure referring to all WFD-related measures that focus on urban and transport pollution (KTM WFD21) • M252-NAT1b is an **existing but not yet implemented that indirectly** addresses D11 and refers to two specific human activities: shipping and offshore activities	• Campagnes halieutiques DCF optimisées – données AIS d'opportunité des navires hauturiers collaboratifs (AISOP) • Service d'analyse ENVIronnementale par Système d'Identification Automatique – données AIS (ENVISIA) • Loyd's List Intelligence – données de trafic maritime (LLI) • Système de surveillance des navires de pêche– données VMS • Registre des émissions impulsives (SIRENE) • BOuée Multimodale pour la Biodiversité et l'océanophYsique (BOMBYX) • Monitorage Acoustique et Mesures de Bruit sur Opportunités (MAMBO) • Réseau de surveillance pour la Caractérisation Acoustique du Littoral Méditerranéen et de ses Écosystèmes (CALME)

During the initial assessment - which was completed in 2012 - the commission identified a range of specific challenges, many of which were encountered in the North East Atlantic (NEA) region. In response to this, the Commission Staff Working document (EC, 2014) was drawn up, in which implementation of the MSFD was scored according to adequacy per MS and coherence within and between regions. Table 3(a) shows the assessment of the RAGES MS adequacy for Descriptor 11 on initial assessment, GES, targets and monitoring programmes Table 3(b) shows the commission's assessment of coherence between and within regions.

Table 3. ***(a)*** *Technical assessment of the Adequacy of Targets (Art 10), Monitoring Programmes (Art 11) and Programmes of Measures in the RAGES study area. N=not reported IN= inadequate PA= partially adequate; A=adequate; NAp=Not Appropriate; PAp=partially appropriate; MAp=mostly appropriate.* ***(b)*** *Commission assessment of Coherence in the North East Atlantic (NEA) region, Celtic Seas (CS) and Bay of Biscay (BB) sub-regions. The information comes from EC, 2014. Note that no assessment of coherence was possible for the Macaronesian sub-region since the reports from the Azores and Madeira islands were only produced in 2014.*

MSFD Aspect	(a) Adequacy per MS				(b) Regional Coherence		
	Ireland	Portugal	Spain	France	NEA	Bay of Biscay	Celtic Seas
Targets (Art 10)	N	IN	IN	PA	Low	Moderate	Low
Monitoring Programmes (Art 11)	PAp	NAp	MAp	PAp	Moderate	Moderate	Moderate-High
Programmes of Measures	A	PA	PA	A	Moderate	Moderate	High

While the appraisal of approaches to MSFD in the North East Atlantic shown in this table clearly recognises a range of challenges, it also presents an opportunity to build on regional and sub-regional learnings. In fact, the implementation of the MSFD for the NEA is building from a position of relative strength when compared to other regional seas, with MS within the North East Atlantic region showing the highest level of coherence of all the regional seas. Nonetheless, MS EEZ territories and financial budgets in the NEA vary widely, resulting in an unequal burden of implementation and enforcement. Continual improvements in cooperation and coherence address the need for a level playing field in MSFD implementation and the elements of the risk-based approach may offer a further solution to this imbalance.

The Commission Staff Working Document (EC, 2014) outlined a suite of actions to be taken at the regional scale to enhance MSFD implementation within the NEA, and these were specifically addressed within the RAGES project:

- Stimulation of regional and sub-regional coordination between member states
- The development of region or ecosystem specific criteria for GES which are compatible with MSFD for descriptors where legislation and parameters do not exist
- Ensuring regional work benefits from progress at the EU level
- A systematic identification of gaps in knowledge that prevent a more ambitious risk-based setting of GES and collaborate to close the gaps.

The RAGES project aimed to harness the flexibility and robustness of risk assessment principles to address the above goals from a theoretical point of view, but more importantly it also tested the practical application of these principles. Although the monitoring of continuous underwater noise has been performed by MSs, data analysis and assessment are not fully developed and therefore in the (Article 20) report on MSFD implementation for the first cycle, underwater noise was reported as lacking significant monitoring information and knowledge (EC, 2020). The project also considered the 2018 European Commission document on programmes of measures (EC, 2018), which stated that *"……when knowledge is too scarce to design effective measures, it is useful to indicate actions taken via research initiatives to address these gaps…"*. This spoke to the need for additional research identified by RAGES for Descriptor 11 and it likely also applies to several other descriptors.

2. Key developments in RAGES for Descriptor 11

2.1 Summary of the RAGES Risk-based approach to Descriptor 11

The risk-based methodology developed by RAGES sets out a common framework for assessment across which the European Commission can fairly assess efforts made in achieving GES for the MSFD. The project took a harmonised approach underpinned by the structure of the ISO standards, demonstrating clear synergies between these standards, the risk approach advocated by the MSFD and the elements of the DAPSI(W)R(M) frame (see Elliott et al., 2017 for more detail). The RAGES Risk-based Approach is summarised in Figure 1, the full description of the method can be found in RAGES Deliverable 2.3 and its application to Descriptor 11 is outlined in D4.4.

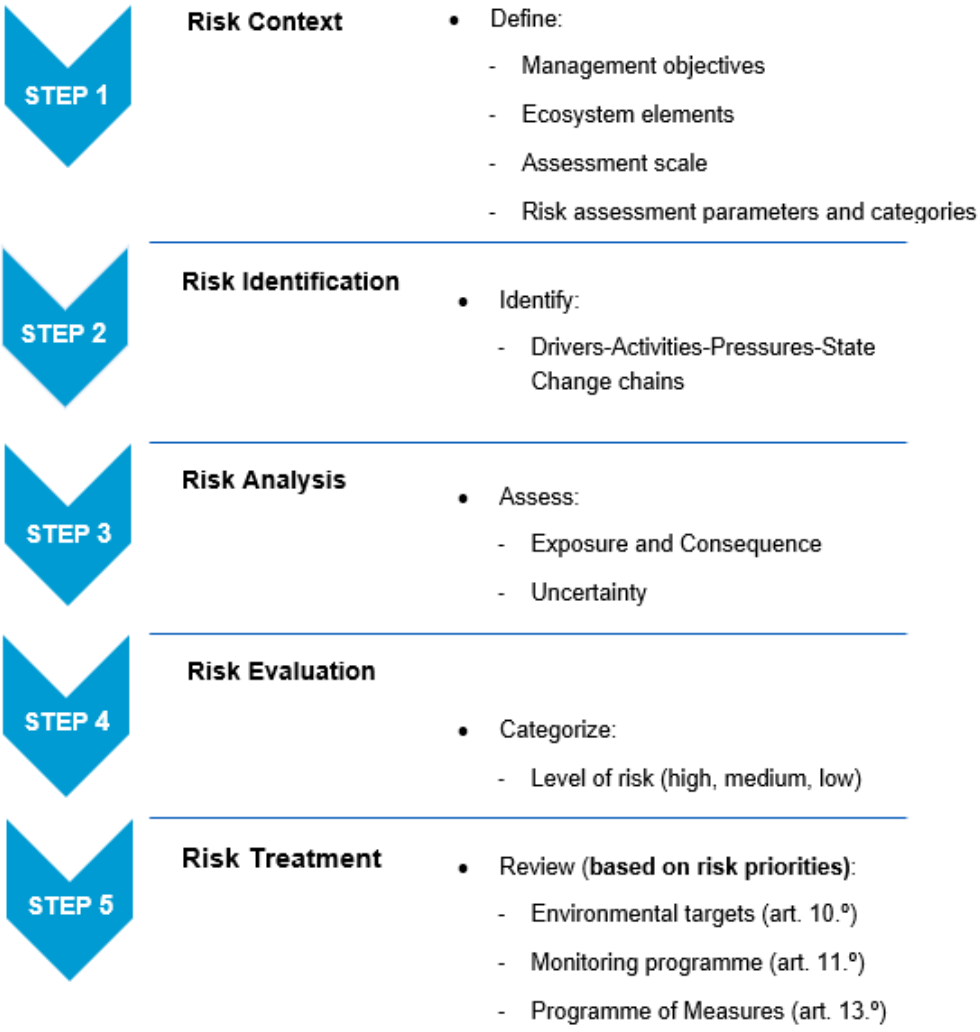

Figure 1. *The Risk-based approach as developed by the RAGES project (taken from RAGES Deliverable 2.3, where a more detailed description of the risk process can be found)*

Each MSFD descriptor is different in its focus – for example the directive itself acknowledges that there are both Pressure and State descriptors - thus the data and information that go into the risk-based process will differ from descriptor to descriptor. This is explored further in RAGES Deliverable 5.1 but importantly, there is much flexibility in the approach that would allow it to be applied in a wide range of different situations, in particular where datasets are improving and changing as the knowledge base increases. The full application of the Risk-based approach to Descriptor 11 is outlined in Deliverables 4.1, 4.2, 4.3 and 4.4 (and summarised in Verling et al. 2021 (submitted), and will not be fully reproduced here, however the key developments will be highlighted, in particular those with the potential to inform future development of measures, targets and monitoring programmes.

The RAGES project focussed mainly on D11.C2 and a number of novel approaches were taken in order to undertake the work, and these are illustrated in Figure 2. Within Step 1, Establishing the Context, the project focussed on Continuous underwater noise and applied the approach at two different spatial scales. The bulk of the analytical work fell into Step 3, the 'Risk Analysis', in which two different analyses were undertaken. Firstly, the **Likelihood** analysis examined the *overlap between the pressure and the receptor* and required spatial data on both the pressure (in this case a pressure proxy) and for the receptor (cetacean species). The datasets used differed between the two different spatial scales. For the broadscale work, in the absence of a noise model covering the North East Atlantic, a shipping density dataset processed and provided free of charge by EMODnet was used as a proxy for pressure. Cetacean data was obtained from ObSERVE, SCANS and Macaronesia surveys. For the local scale work, a noise model was produced and validated by deploying a noise-monitoring device. The work focussed on the effect of masking, which was assessed using Communication Distance Reduction (CDR) in one cetacean species, the bottlenose dolphin *Tursiops truncatus* (Montagu, 1821).

The **Consequence** analysis examined the *impact of the pressure on the receptor* and this is an area where there are many uncertainties. Cetaceans are often highly mobile, experiencing different noise fields depending on their location relative to a noise source, and despite decades of research, there remain large uncertainties in the effects of noise on behaviour and survival (Erbe et al, 2019), which make identification of areas and species at risk particularly challenging. To address the lack of quantitative data on the impact of noise on cetaceans, the RAGES project developed a sensitivity approach, designed to use expert judgement to identify those species and populations most at risk from continuous underwater noise. The project also tested the approach using a number of experts focussing on a sub-set of species.

The Risk-based approach to Descriptor 11 is outlined in detail in RAGES Deliverable 4.4 but the novel techniques and methods used by the project are highlighted in Figure 2. The Risk based approach allows for the development of flexible and creative solutions whilst still offering a robust repeatable method. Ultimately, using a risk-based approach, even in the face of data and knowledge gaps may go some way towards enabling Competent Authorities to focus efforts on the most at-risk areas and species.

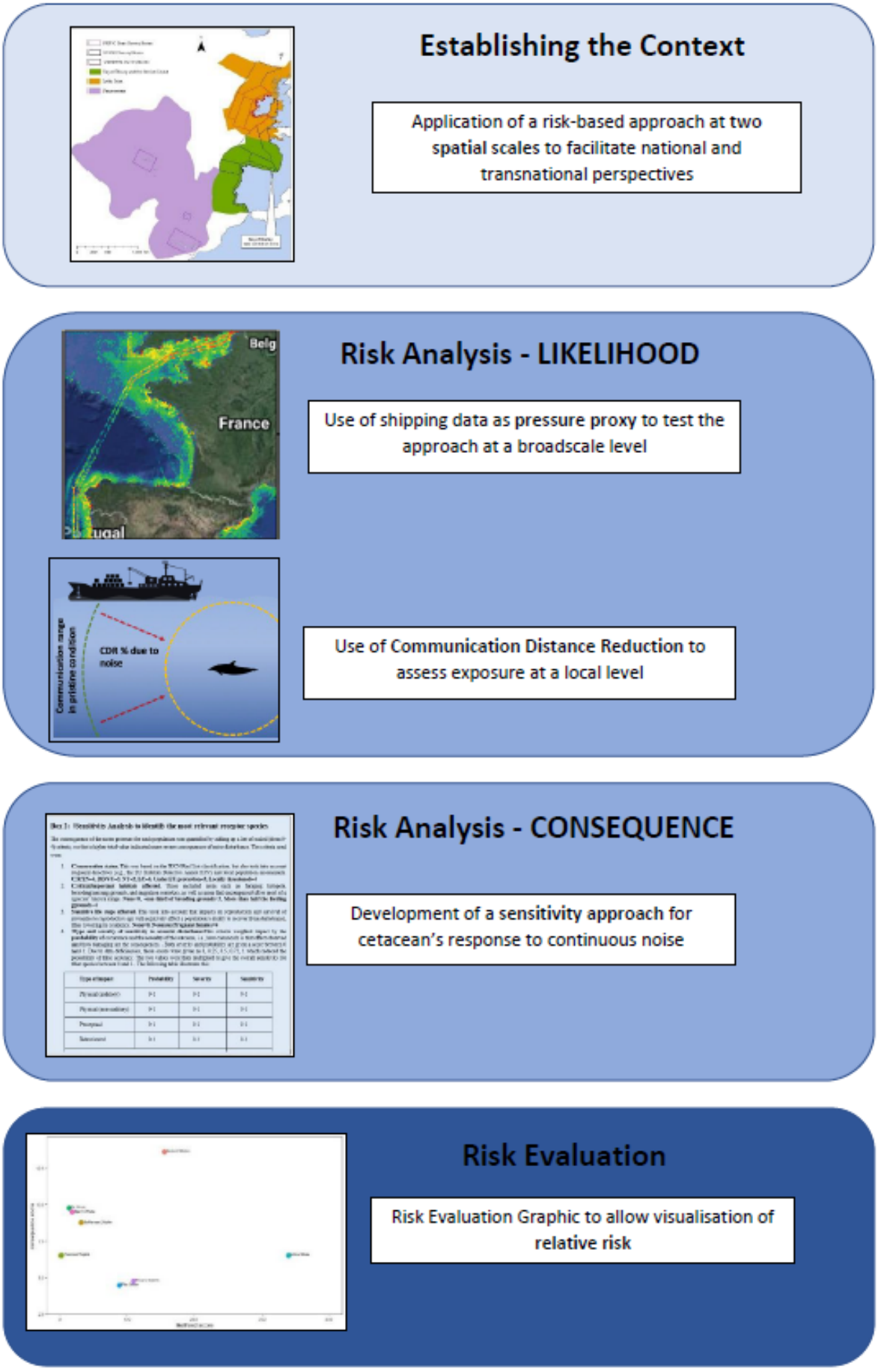

Figure 2. *Detail of some novel approaches adopted by the RAGES project, linked to the risk approach steps*

3. Recommendations for future targets and measures

The work of RAGES aimed to improve options for regional harmonization and to make best use of available data. The ISO-based standard methodology developed by the project provides an ideal framework within which regional and sub-regional comparisons can be nested. It facilitates regional cooperation even where data availability is patchy or non-existent and it can identify knowledge gaps and steer capacity building efforts in appropriate directions. The approach could be repeated at any desired spatial or temporal scale, for example to enable the EC to get a broad overview of Descriptor 11 but also to assist MS with large territorial waters (where risks are potentially high) to prioritise efforts and to focus measures where problems are evident, rather than to spread monitoring efforts over vast geographic areas. Nonetheless, the potential for MSFD to assess GES with the support of realistic targets and effective measures is currently undermined for Descriptor 11 due to lack of data and the inadequate knowledge base. These two major issues should be addressed in order for the benefits of the approach to be fully realised. The recommendations from this work are summarised in Box 1 and outlined in detail below.

3.1 Availability of data

At present, the availability and accessibility of appropriate data is a block to both national and transnational work towards designing and implementing programmes of measures. The RAGES project identified some practical actions to enable further regional cooperation in data gathering, storage, analysis, and spatial data infrastructure to enable continued harmonisation of regional approaches.

Collection and processing of data relevant to the assessment of Descriptor 11 is expensive. The mobility of Cetaceans combined with the large areas over which these species range presents a major challenge to the assessment of populations size and densities. For example, for less abundant species such as Fin Whale, densities may be as low as 1-2 animals per 1000 km^2 in the North East Atlantic. In such cases detecting the presence or absence of a species is a major effort in itself, while drawing conclusions on the effects of underwater noise on the species is as yet almost impossible. The costs of data collection and analysis can result in the situation where valuable data are retained in silos and not used as effectively as they could be.

Considering the application of the RBA at a sub-regional scale for example, there are some drawbacks associated with the pressure (or proxy) data currently available to perform a risk-based analysis. Shipping data such as AIS data are very expensive to purchase, particularly for a large area. Although RAGES made use of the freely available shipping density data from EMODnet, there is a coastal focus to these data so that shipping away from the coast is under-represented. In addition, although ship types are identified within the EMODnet dataset, there is no clear relationship between these ship types and the noise they generate. For this reason, the data can only ever be used as a proxy layer for continuous underwater noise, and not to generate a pressure layer *per se* for which modelling would be necessary. Current approaches to the collection and processing of AIS data also vary, limiting the inter-comparability of individual noise modelling activities. There are a number of existing and emerging spatial datasets of underwater noise (e.g. Farcas et al., 2020) but to date, these are not freely available, which constrains efforts at regional assessment.

A further challenge lies in the fact that the Cetacean datasets for European waters are not currently available in a central location, which is a significant drawback in terms of their ease of use and harmonisation. There hasn't been a joined-up approach at a European scale to collection or archiving of cetacean data (although OSPAR have recently launched a data call to gather and analyse data on cetacean abundance and distribution at an EU scale). While repeat surveys would go a long way towards understanding the complexity of Cetacean population distributions, the current data represent only a snapshot in time. Improving the quality and access to cetacean data at a European scale would offer MS more scope to undertake risk-based analyses.

Publicly available data pertinent to the assessment of D11 are currently housed in a range of online locations including the ICES impulsive noise register (designed to support OSPAR and HELCOM activities) and the EMODnet portal. While

these and similar initiatives represent a significant first step towards FAIR[1] data principles, a more integrated approach to the curation of impulsive noise and cetacean data could greatly improve the efficiency and effectiveness of efforts to coordinate assessment on a regional basis. Establishment and maintenance of such spatial data infrastructure also incurs costs. Establishing a permanent centralised repository for noise (and other MSFD relevant) data should be a long-term goal under the Common Implementation Strategy. The Joint Research Centre (JRC) could potentially play a role in Assessment of Descriptor 11.

All of these recommendations are supported by the stipulations of the Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters (United Nations Economic Commission for Europe, 1998), for which data sharing, data archive centres and freely available environmental data are central pillars, and to which the EU Member States are contracting parties. As such, MS individually and the commission centrally have the responsibility to make such data freely available, given the regional and super regional nature of the marine noise problem, a centralised data portal would be of more practical use than a series of distributed portals. The feasibility of developing such portals and options for implementation should be considered by the Marine Strategy Coordinating Group.

3.2 The evidence base

The evidence to support conclusions on the impacts of noise on cetaceans remains inconclusive, despite decades of study undertaken around underwater noise, its propagation and impact on individual species. To date for example, research has not yielded the data to allow robust, quantitative scores to be assigned to a sensitivity process and this is an impediment to the setting on of targets and measures. Empirical data on noise impacts of cetaceans remain some way off, and Member States must proceed with implementing the MSFD using the best available data and methods. RAGES has developed an expert-judgement based sensitivity process to identify the most at-risk species, and while expert judgement is time-consuming and potentially reduces the confidence and comparability of outputs, it remains a legitimate way to make assessments in the absence of quantitative data. However, the use of this process is dependent upon the input of an appropriate expert group, such as a harmonized regional expert working group to apply the process to particular scenarios and generate results that could be used for multiple purposes. A group such as this does not currently exist and this impedes MS ability to harness the expertise that is currently available. Such an expert group could be set up under OSPAR (for example via the ICG-Noise group) or could also be a European Commission initiative through the Task Group on Noise. Such a centralised EC risk-based process involving expert judgement has previously been successfully employed, for example in the creation of the list of Invasive species of Union concern. As such there is a legally enforced precedent for the application of such approaches and there is centralised institutional experience in the development and implementation of such approaches at the commission level. The group could meet for a number of days, initially to agree the sensitivity approach (this could be done remotely beforehand) and then to work through the approach and determine sensitivity value for the common species in European waters. Importantly, this would have to be undertaken for a number of noise scenarios in order to maximize the application of the resulting data (eg. an impulsive noise scenario and a continuous noise scenario, perhaps more than one of each). Because of the relatively slow emergence of new evidence about the impact of noise on cetaceans, a major update on the results of this group exercise would not have to be repeated for a number of years.

Other issues around the evidence base relate to how best to use the available information on underwater noise to indicate areas of risk. There is no doubt that modelling underwater noise confer some clear advantages over the use of proxy datasets. Modelled datasets are bolstered by the – often superior quality - raw data available at a local scale. AIS data, for example is cheaper and less time consuming to process when gathered for a smaller area. The modelling work within RAGES suggested that models are relatively robust and could provide a good basis for the standardisation of risk assessment for the purposes of the MSFD (see RAGES Deliverable 4.4). While the regional scale analysis was

[1] Findable, Accessible, Interoperable and Re-useable (FAIR).

capable of identifying the relative levels of risk to species at broad spatial scales (with relatively low levels of confidence) the local scale analysis involving noise modelling provided more detailed, quantitative information about which areas are most at risk. While both Sound Pressure Level (SPL) and Communication Distance Reduction (CDR) can discriminate those areas where there is a risk of masking, the population level effects of such masking remain unknown and this a major obstacle in establishing ecologically based thresholds for the assessment of GES. The use of CDR to assess masking effects is nonetheless a promising new approach, which used the difference between the ambient Communication Distance in the environment and that expected in pristine ambient conditions as an indicator for the risk analysis. Continued advances in the science of noise modelling as well as the development of continuous noise indicators within the EC Task Group on Noise will increase our understanding of ocean soundscapes and it will also improve the knowledge base for the use of risk-based approaches.

However, at present the modelled data for the North East Atlantic is patchy and crucially, does not exist at a scale that would facilitate regional harmonisation of approaches; there are different computational methods to modelling which means that individual local-scale models cannot be easily combined in many cases. It is therefore important not to rule out the utility of shipping density data in the medium term, because there is much evidence that in certain circumstances it may assist greatly in identifying areas at most risk. For example, the local-scale modelling work undertaken in the Bay of Biscay complemented the broad-scale work of RAGES, by showing that the areas of greatest noise were the busiest areas from a shipping perspective. A noise modelling study of the Azores undertaken as part of a collaboration between the JONAS and RAGES projects (see RAGES Deliverable 4.6) showed that while noise extended beyond shipping areas, the noisiest areas were also the areas of greatest shipping density. Thus, more work is needed to better understand the utility of shipping data. Given the uncertainties associated with the propagation of sound underwater, and particularly the limitations in the accuracy of predicting the exact location of a receptor at a given time, it may not be necessary (or financially practical) to model the exact level of sound pressure at all locations. Over vast areas such as the North East Atlantic, minor variations in relative location of pressure and receptor have major consequences for the levels of exposure (See Hazelwood & Connelly, 2005 for an example). Under such conditions, assessing relative risk levels using vessel location as a proxy for pressure may be justified on the basis that even with entirely accurate pressure maps, exposure level cannot be accurately assessed. More consideration is needed as to innovative and novel ways to maximise the use of the knowledge gained from modelling outputs as well as the freely available shipping density data. As with Cetacean data, a centralised repository for underwater noise data could facilitate improved regional coordination. The potential to develop and harmonise the ship types in the EMODnet shipping density dataset with the ship types (vessel size data) commonly employed in the modelling of underwater noise represents one potential low-cost solution that could improve regional assessment.

Box 1 - RECOMMENDATIONS: The work of the RAGES project indicated that the most pressing needs with regard to improving the existing evidence base and data quality and access are:

1. A freely available EU scale map of maritime transport (including more offshore shipping) that can be accurately related to noise
2. A harmonised EU-scale database of cetacean density distribution – spatially standardised, freely available and with appropriate metadata
3. Assembling a panel of experts to apply the sensitivity approach under a number of scenarios and to agree a risk-based assessment for cetaceans
4. Identifying situations where robust vessel data may serve as a reliable proxy for modelled noise and understanding how freely available vessel data could be

4. References

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