Environment and Resources Authority

Cost Effective and Cost-Benefit Analysis of new measures put forward as part of Malta's Marine Strategy Framework Directive Programme of Measures

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EY
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Abbreviations

BAU	Business As Usual
B/C	Benefit-Cost
CBA	Cost-Benefit Analysis
CEA	Cost Effectiveness Analysis
CSD	Continental Shelf Department
DFA	Department of Fisheries and Aquaculture
EQS	Environmental Quality Standards
ERA	Environment and Resources Authority
FAD	Fishing Aggregating Device
GES	Good Environmental Status
IA	Impact Assessment
LDI	Logical Diagrams of Impact
MPA	Marine Protected Areas
MSFD	Marine Strategy Framework Directive
NGO	Non-Governmental Organisation
PoM	Programme of Measures
SPA	Special Protected Area
TM	Transport Malta
WCMP	Water Catchment Management Plan
WFD	Water Framework Directive
WTP	Willingness To Pay

1. Executive Summary

1. Anthropogenic activities and unsustainable practices are leading to various pressures and impacts on the marine environment in the EU, and in Malta. The MSFD provides a framework for the protection of the marine environment by aiming to achieve GES across various areas (or descriptors), namely: biodiversity; non-indigenous species; commercial fish and shellfish; eutrophication; hydrographical changes; contaminants; contaminants in seafood; litter; and energy, including underwater noise. Member States, including Malta, have established environmental targets in a Programme of Measures which defines existing measures and additional measures in an effort to achieve GES for such descriptors.

2. The scope of the Report is to undertake a CEA and a CBA of the new measures put forward as part of Malta's MSFD PoMs. The CEA aims to assess the cost-effectiveness of such measures by analysing the costs of said PoMs to meet specified objective/s. The CBA aims to analyse direct and indirect costs and benefits of implementing a measure, involving several societal actors and also including non-monetary items. Such assessment compares policy measures against the baseline scenario in terms of their advantages (benefits) and disadvantages (costs), including the consideration of negative and positive economic, social and environmental impacts accruing to all affected parties.

3. The methodology utilised to conduct this Study is based on the various guidelines issued by the EC and the Authority in Malta entrusted with the technical implementation of the MSFD.. In addition, best practice examples from other Member States developing their PoMs for the MSFD were followed, including reliance on qualitative assessments. Key stakeholders were also consulted in order to gain further insight into proposed additional MSFD measures, and their potential impacts, as well as information on similar measures proposed or implemented in the past.

4. Limitations to the study relate mainly to limited knowledge on the links between measures and their effects on the marine environment. In fact, the limited quantitative environmental targets to be achieved by the PoMs, coupled with the baseline data for the various descriptors, meant that quantitative assessment of the baseline scenario and the effectiveness of costs and benefits of the proposed measures was restricted.

5. The PoMs do not consider alternative additional measures to achieve the same objectives under each descriptor, and thus the CEA primarily focuses on a cost scale analysis. In addition, some potential new measures are linked to pilot exercises and the implementation of certain options which, to date, are naturally still not known, inhibiting the costings of such measures.

6. The limited scientific knowledge and associated uncertainties also make economic valuation of benefits of measures focused on detailed monetization challenging and unfeasible, and similarly the scope of a fully-fletched CBA.

A summary of results emanating from this Study in terms of the CEA and CBA for additional measures put forward as part of Malta's MSFD PoMs follows:

Table 1: New measures under the MSFD, and estimated costs

Descriptor	*Measure code*	*Measure description*	*Estimated Cost*	*CEA*	*CBA*	*CBA outcome*
1&4: Seabirds	MICMT-M008	Awareness and education campaigns targeting disturbance issues in recreational areas where the presence of litter has been tied to rat predation	€10k-€15k Cost of any related equipment not included, since nature of such equipment is not yet known	Generally cost-effective, but if not all users of selected sites are successfully targeted/ approached, this can reduce cost-effectiveness.	× Reduced attractiveness of recreational experiences (compliance) ✓Better recreational experiences ✓Synergies ✓ Improved habitat conditions and populations	Given the relatively low cost of compliance and benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.
1&4: Seabirds	MICMT-M009	Preparation of official guidance documents aimed at providing direction with respect to reduction/ control/ mitigation of light and noise pressures driven by both land-based and sea-based activities	€20-€25k	Official guidance can have an immediate impact on development permitting, and is hence deemed very cost-effective	×Increased infrastructural costs ×Decreases in commercial revenue ✓Improved safety at sea ✓Lower operational costs ✓Synergies ✓Improved conservation status of species; better MPAs management	Recreational activities linked to the tourism industry may be negatively impacted – the extent of such impact is still to be evaluated. There is real existing potential for reduction of noise and light pollution through this measure (given immediate impact). Hence B/C ratio depends on extent of (unknown) costs.
1&4: Seabirds	MICMT-M010[1]	Knowledge improvement on the interactions of seabirds with fisheries activity and definition of good practice as necessary	€15k-20k Need for code of good practice not yet known, and hence not included in above cost	Very cost-effective	×Additional costs to fishermen (costs of compliance) ×Change in fishing practices ✓Improved knowledge and synergies ✓Reduced bycatch and further conservation	Costs of compliance are relatively low. Extent of bycatch in Maltese waters uncertain. B/C ratio is dependent on the extent of benefits.

[1] In the final PoMs, MICMT-M010 and MICMT-M005 were amalgamated into one measure, MICMT-M073_NEW

					of seabirds	
1&4: Marine Reptiles & Mammals	MICMT-M005	Knowledge improvement on the interactions of marine reptiles and mammals with fisheries activity and definition of good practice as necessary	€15k-20k Need for code of good practice not yet known, and hence not included in above cost	Very cost-effective	✖Additional costs to fishermen (costs of compliance) ✖Change in fishing practices ✓Improved knowledge and synergies ✓Reduced bycatch and further conservation of reptiles (and mammals)	Costs of compliance are relatively low. Extent of bycatch in Maltese waters uncertain. B/C ratio is dependent on the extent of benefits.
1&4: Marine Reptiles & Mammals	MICMT-M006	Preparation and promotion of a code of good practice for sea-farers	€20-€25k	The proposed measure is aimed at increasing awareness on conduct at sea within sensitive areas (for lighting and general disturbance) beyond existing regulations. Hence this can be cost-effective	✖Change in seafarers practices ✖Additional costs to seafarers (data collation) ✖Changes in commercial revenue ✓Improved safety at sea ✓Better MPA management ✓improved conservation status of species	Recreational activities linked to the tourism industry may be negatively impacted – the extent of such impact is still to be evaluated. There is real existing potential for reduction of noise and light pollution through this measure (given immediate impact). Hence B/C ratio depends on extent of (unknown) costs.
1&4: Marine Reptiles & Mammals	MICMT-M007[2]	Promote consideration of noise impacts and mitigation measures within offshore licensing and permitting regimes	€20k – €25k	Depending on implementation of environmental measures, this can be very cost-effective	✖Increased infrastructural costs ✖Decreases in commercial revenue ✓Improved safety at sea ✓Change in operational costs ✓Synergies ✓Reduction in light and noise	Compliance costs on companies of different size are likely to increase, but extent of benefits linked to reduction of various impacts (seabed habitats and species) is

[2] In the final PoMs, MICMT-M007; MICMT-M009; MICMT-M002; MICMT-M013 were amalgamated into one measure, MICMT-M070_NEW

					pollution at sea	unknown. Hence B/C ratio depends on extent of benefits emanating from this measure.
1, 4&6: Seabed habitats	MICMT-M001	Pilot implementation of selected management options aimed at addressing impacts from anchoring on the seabed	€100k-150k for study. Capital expenditure of pilot implementation depends on option chosen, which can range anywhere between €200k and €1.5mln	Study to identify options is cost-effective. Since option of pilot study is not known, cost-effectiveness of this second part cannot be assessed	×Additional costs (including reduced attractiveness) and changes in commercial and recreational operations ✓ Better recreational experiences ✓ Information value for research and knowledge sharing ✓ Environmental improvements for species composition/ abundance and other sensitive seabed habitats and related ecosystem services.	The extent of the impact of current anchoring activity on the seabed is still uncertain. On the other hand, the yachting and bunkering industries are important contributors to the Maltese economy. B/C ratio is hence highly dependent on findings of study and application and extension of pilot.
1, 4&6: Seabed habitats	MICMT-M002	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes	€20k – €25k	Depending on implementation of environmental measures, this can be very cost-effective	×Additional costs and changes in commercial operations ✓Information value for research and knowledge sharing ✓Habitat types and species maintained in GES	Compliance costs on companies of different size are likely to increase, but extent of benefits linked to reduction of various impacts (seabed habitats and species) is unknown. Hence B/C ratio depends on extent of benefits emanating from this measure.
1, 4&6: Seabed habitats	MICMT-M003	Inventory of fishery activity in	€10k – €15k	Depending on the quality of information	×Additional costs to fisheries (data	Information value of data/research

		coastal Marine Protected Areas designated for the protection of seabed habitats		collection, this can be very cost-effective	collection) ✓Information value for research and knowledge sharing ✓Better MPAs management	needs to be compared to limited cost involved, and hence benefits should outweigh costs, resulting in a positive B/C ratio.
1, 4&6: Seabed habitats	MICMT-M004	Awareness Raising Campaign on protected species associated with benthic communities	€20k – €25k	Very cost-effective	×Lower attractiveness for recreational activities (costs of compliance) ✓Better recreational experiences ✓Positive environmental impact (variety of observable species) ✓Information value for research and knowledge sharing	Given the relatively low cost of compliance and benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.
3: Commercially Exploited Fish & Shellfish	MICMT-M011	Launching of an education programme targeting knowledge improvement to facilitate management of pressures associated with fishing activities	€175k-€200k	As in the case with most measures targeting long-term educational benefits amongst stakeholders/ actors, and given the relatively manageable investment cost involved, the measure is likely to be relatively cost-effective.	×Increased operational cost (data collation) ✓Information sharing & synergies ✓Sustainability of industry	Given the likely cost of compliance/data collation compared to the benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.
8: Contaminants	MICMT-M012	Improvement and harmonisation of data collection processes in relation to contaminants reported in Maltese waters	c. €5k	Depending on collaboration by stakeholders, this can be very cost-effective	×Additional compliance costs ✓Improved knowledge ✓Improvement in long-term management of contaminants	The information value of data/research is high. The extent of compliance costs are dependent on findings of current data collection processes.

						With low compliance costs, a positive B/C ratio is likely to result.
8: Contaminants	MICMT-M013	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes	€20k – €25k	Depending on implementation of environmental measures, this can be very cost-effective	×Additional costs and changes in commercial operations ✓Information value for research and knowledge sharing ✓Regulation of input of contaminants	Compliance costs on companies of different size are likely to increase, but extent of benefits linked to reduction of various impacts (contaminants) is unknown. Hence B/C ratio depends on extent of benefits emanating from this measure.
10: Marine litter	MICMT-M014	Identification and mapping of areas with accumulated litter on the seabed and potential removal of such litter	c. €35k-405k for preparatory costs. Actual litter removal costs depend on number of areas selected	Depending on the need for removal of litter which will only be sought in case of no additional impact on seafloor integrity, this can be cost-effective	✓Information value for research and knowledge ✓Improvement in the economic value of the sea and its resources, especially for MPAs. ✓Synergies	Given the value of information and synergies, as well as improvement to the marine environment, benefits should outweigh costs and a positive B/C ratio is expected to result.
10: Marine litter	MICMT-M015	Establish formal collaboration with NGOs for participation in Mediterranean coastal clean-up day	c. €10k for each event	Depending on the number of events organised, and considering low investment cost required, this can be very cost-effective	×Beach cleansing costs ×Decreased recreational value (temporary inconvenience) ✓Increased recreational value ✓Feel-good factor ✓Attractiveness for accommodation/ housing ✓Improved knowledge and synergies ✓Reduction in marine litter	Given the relatively low inconvenience costs (which can be waived depending on circumstances) and the synergies to be achieved across similar measures, benefits should outweigh costs, resulting in a positive B/C ratio.

10: Marine litter	MICMT-M016	Educational Campaign for seafarers on marine litter	c. €15k-20k	Depending on the extent to which seafarers implement what they learnt, this can be very cost-effective	×Data collection costs ×Commercial operational costs ×Costs of compliance ✓Increased recreational value ✓Attractiveness for accommodation/ housing ✓Improved knowledge and synergies ✓Reduced aquaculture costs ✓Reduction in commercial maintenance costs	Given the relatively low cost of compliance and benefits likely to accrue to the environment and commercial operators, benefits should outweigh costs, resulting in a positive B/C ratio.
10: Marine litter	MICMT-M017	To identify options for re-designing fishing gear or practices to reduce discarded or lost fishing gear	c. €50k – 75k, excluding investment cost of selected options to be piloted (and evaluated), which are still not determined.	Depending on the outcome of the pilot study, this can be cost-effective	×Increased commercial operational costs ✓Increased catch revenue ✓Reduction in commercial operational and maintenance costs ✓Improved knowledge and synergies	Benefits accruing to the fishing industry and marine environment itself are important whilst costs of compliance are relatively low. Fishing practices which need to be targeted are however unknown, hence the B/C ratio is dependent on findings of study and application and extension of pilot
10: Marine litter	MICMT-M018	Implementation for "Fishing for Litter" scheme	c. €20k-25k, excluding cost of waste collection facilities/ landing sites	Depending on extent of voluntary participation and investment outlay, this can be cost-effective	×Decreased catch revenue (contamination risk) ×Commercial operational costs ✓Improved knowledge and synergies ✓Reduced aquaculture costs ✓Reduction in	The impact on operational costs and revenues is unknown given uncertainties surrounding the implementation of the scheme. The extent of the impact of

					commercial maintenance costs ✓Reduction of marine litter in "trawling areas"	marine litter on commercial operations is also uncertain. The B/C ratio will be dependent on the extra costs to be borne and the extent of benefits to be accrued.
11: Underwater noise	MICMT-M019	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes	€20k – €25k	Depending on implementation of environmental measures, this can be very cost-effective	×Additional costs and changes in commercial operations ✓Information value for research and knowledge sharing ✓Control of underwater noise	Compliance costs on companies of different size are likely to increase, but extent of benefits linked to reduction of various impacts (underwater noise) is unknown. Hence B/C ratio depends on extent of benefits emanating from this measure.

2. Introduction

2.1 Project background

Our seas and ocean represent a precious environmental resource whose sustainability is increasingly being threatened due to both land-based and ocean-based human activities that are leading to pollution, litter, seabed damage, eutrophication, and climate change, amongst others. In this regard, both traditional activities such as transport, fishing, and tourism, and more recent activities such as wind farms, are causing unprecedented changes to coastal and marine ecosystems.

To this end, the EU Coastal and Marine Policy provides the legal impetus for Member States to protect the marine environment. The EU Marine Strategy Framework Directive (MSFD) adopted in 2008 calls for a comprehensive and integrated approach to the protection of all European marine waters, aiming to achieve and maintain Good Environmental Status (GES) in the marine environment by the year 2020, where GES is defined as:

"The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive."[3]

The MSFD targets different areas of the marine environment as per the MSFD Annex I GES descriptors outlined below:

- Descriptor 1. Biodiversity is maintained
- Descriptor 2. Non-indigenous species do not adversely alter the ecosystem
- Descriptor 3. The population of commercial fish species is healthy
- Descriptor 4. Elements of food webs ensure long-term abundance and reproduction
- Descriptor 5. Eutrophication is minimised
- Descriptor 6. The sea floor integrity ensures functioning of the ecosystem
- Descriptor 7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem
- Descriptor 8. Concentrations of contaminants give no effects
- Descriptor 9. Contaminants in seafood are below safe levels
- Descriptor 10. Marine litter does not cause harm
- Descriptor 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

The development and implementation of a Programme of Measures (PoMs) relative to each descriptor listed above serves to achieve GES in line with environmental targets that address various pressures on the marine environment.

[3] European Commission (2017). *Good Environmental Status - Marine - Environment - European Commission*. [online] Available at: http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm [Accessed 20 Feb. 2017].

2.2 Project rationale

Within this framework, the MSFD dictates the need for PoMs to be developed, taking into account existing measures that contribute to the achievement of environmental targets. Particularly, after a gap analysis is undertaken, additional measures are proposed that help contribute towards the achievement of GES. Within the local context, the Environment and Resources Authority [4](ERA) has been entrusted with the technical implementation of the MSFD, its related PoMs and environmental targets. Such targets were first established in 2013 as part of the first MSFD reporting cycle (this second cycle started in 2016).

Following a gap analysis to assess the contribution of existing measures towards the achievement of GES per each descriptor described earlier, where applicable new measures have been devised to address current gaps in management regimes for the achievement of GES. These new measures are classified as per the below categories:

- Category 2.a: Additional measures to achieve and maintain GES which build upon existing implementation processes regarding other EU legislation and international agreements but go beyond what is already required under these;
- Category 2.b: Additional measures to achieve and maintain GES which do not build on existing EU legislation or international agreements.

By collaborating with all relevant stakeholders, ERA is putting forward the following new measures. Many build on those identified by Malta's second Water Catchment Management Plan (WCMP) pursuant to the WFD. The new measures which form the basis of this Study are listed in ***Table 2*** below[5]:

Table 2: New measures under the MSFD

Descriptor	*Measure code*	*New Measure code*	*Measure description*
1&4: Seabirds	MICMT-M008	MICMT-M071_NEW	Awareness and education campaigns targeting disturbance issues in recreational areas where the presence of litter has been tied to rat predation
1&4: Seabirds	MICMT-M009	MICMT-M072_NEW	Preparation of official guidance documents aimed at providing direction with respect to reduction/ control/ mitigation of light and noise pressures driven by both land-based and sea-based activities
1&4: Seabirds	MICMT-M010	MICMT-M073_NEW[6]	Knowledge improvement on the interactions of seabirds with fisheries activity and definition of good practice as necessary

[4] As per Legal Notice 73 of 2011, the Competent Authority for the implementation of the regulations is the Office of the Prime Minister. This competency was delegated to the Ministry for Sustainable Development, the Environment and Climate Change (MSDEC), and the technical implementation has been entrusted to ERA.

[5] Whilst new measure codes have been proposed, the report is presented as per the original measure codes.

[6] This new measure replaces a group of measures targeting the same activity: MICMT-M010; MICMT-M005.

1&4: Marine Reptiles & Mammals	MICMT-M005	MICMT-M073_NEW	Knowledge improvement on the interactions of marine reptiles and mammals with fisheries activity and definition of good practice as necessary
1&4: Marine Reptiles & Mammals	MICMT-M006	MICMT-M074_NEW	Preparation and promotion of a code of good practice for sea-farers
1&4: Marine Reptiles & Mammals	MICMT-M007	MICMT-M070_NEW[7]	Promote consideration of noise impacts and mitigation measures within offshore licensing and permitting regimes
1, 4&6: Seabed habitats	MICMT-M001	MICMT-M075_NEW	Pilot implementation of selected management options aimed at addressing impacts from anchoring on the seabed
1, 4&6: Seabed habitats	MICMT-M002	MICMT-M070_NEW	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes
1, 4&6: Seabed habitats	MICMT-M003	MICMT-M076_NEW	Inventory of fishery activity in coastal Marine Protected Areas designated for the protection of seabed habitats
1, 4&6: Seabed habitats	MICMT-M004	MICMT-M077_NEW	Awareness Raising Campaign on protected species associated with benthic communities
3: Commercially Exploited Fish & Shellfish	MICMT-M011	MICMT-M078_NEW	Launching of an education programme targeting knowledge improvement to facilitate management of pressures associated with fishing activities
8: Contaminants	MICMT-M012	MICMT-M079_NEW	Improvement and harmonisation of data collection processes in relation to contaminants reported in Maltese waters
8: Contaminants	MICMT-M013	MICMT-M070_NEW	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes
10: Marine litter	MICMT-M014	MICMT-M080_NEW	Identification and mapping of areas with accumulated litter on the seabed and potential removal of such litter
10: Marine litter	MICMT-M015	MICMT-M081_NEW	Establish formal collaboration with NGOs for participation in Mediterranean coastal clean-up day
10: Marine litter	MICMT-M016	MICMT-M082_NEW	Educational Campaign for seafarers on marine litter
10: Marine litter	MICMT-M017	MICMT-M083_NEW	To identify options for re-designing fishing gear or practices to reduce discarded or lost fishing gear
10: Marine litter	MICMT-M018	MICMT-M084_NEW	Implementation for "Fishing for Litter" scheme
11: Underwater noise	MICMT-M019	MICMT-M070_NEW	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes

As will be explained later, some of the new measures mentioned above (under the original

[7] This new measure replaces a group of measures targeting the same activity: MICMT-M009; MICMT-M007; MICMT-M002; MICMT-M013

measure codes) are similar in nature, or cover different descriptors. No new measures were proposed for the following descriptors:

- 1&4: Fish
- 1&4: Water Column Habitats
- 2: Non-indigenous species
- 5: Eutrophication
- 7: Hydrographical changes
- 9: Contaminants in Seafood

Article 13.3 of the MSFD further adds that member states are to guarantee such new measures (not the existing ones) are cost-effective and technically feasible by way of undertaking a cost-effective assessment (CEA) and an impact assessment (IA)/ cost-benefit analysis (CBA), before any new measure is introduced. This is the nature of the Study being presented in this report.

2.3 Study objectives

The overall premise of this Study is to carry out a CEA and an IA/ CBA of the new measures put forward as part of Malta's MSFD PoMs. On 20 February 2017, EY was commissioned by ERA to undertake this Study, following a public call.

The specific objectives of the Study are the following:

1. To assess the cost-effectiveness of the new measures proposed as part of Malta's PoMs pursuant to the EU MSFD, in line with the requirements of Article 13 of the Directive and in consideration of the guidance documents available to date. A CEA involves the analysis of the costs of individual and/or sets or programmes of measures designed to meet specified objective/s, with a view to identify the highest level of benefit, given available resources and the least-cost method of reaching a prescribed target.

2. To undertake an IA/ CBA of the new measures in line with the requirements of Article 13 of the Directive and in consideration of the guidance documents available to date. An IA/ CBA relates to an analysis of the direct and indirect costs and the benefits of implementing a measure, involving several societal actors and also including non-monetary items. Such assessment compares policy measures against the baseline situation in terms of their advantages (benefits) and disadvantages (costs), including the consideration of negative and positive economic, social and environmental impacts accruing to all affected societal parties.

2.4 Guidelines and sources of data

The methodology utilised to conduct this Study is based on the various guidelines issued by the EC and the Managing Authority in Malta on the preparation of such economic evaluation tools. Specifically, the guidance includes (but is not limited to):

- KnowSeas (2013), *Deliverable D4.4 "Recognising Cost in the Assessment of Management Strategies and Options"*
- European Commission (2010), *Guidance document for Economic and social analysis for the*

initial assessment for the MSFD, heading 4.4. Valuation methods applicable to each of the approaches.

- European Commission (2014), *Indicators for ecosystem assessments under Action 5 of the EU Biodiversity Strategy to 2020, heading 5.4. Marine Services*
- European Commission (DG Regio) (2015), *Guide to Cost-benefit Analysis of Investment Projects: Economic appraisal tool for Cohesion Policy 2014-2020*
- Planning and Priorities Co-ordination Division (PPCD) (2013), *Guidance Manual for Cost Benefit Analysis* Appraisal in Malta
- European Commission (2006), *Guidance on the Methodology for Carrying out Cost-Benefit Analysis – Working Document No 4*

In addition, in guiding further our work, best practice examples from other member states developing their PoMs for the MSFD were followed, including:

- ARCADIS/ EUCC/ Coastal & Marine Union, (2015). *Background document summarising experiences With Respect To Economic Analysis to support Member States with the development of their Programme of Measures for the Marine Strategy Framework Directive*.

To carry out this assessment reference was also made to a number of publicly available documents. The full list of references in ***Section*** 6 includes further sources used in this Study, while the list below provides a list of key documents considered in preparing this Study:

- AEE Consortium, (n.d.). *MSFD Economic & Social Analysis*.
- Decision IG.22/10 - Implementing the Marine Litter Regional Plan in the Mediterranean (Fishing for Litter Guidelines, Assessment Report, Baselines Values, and Reduction Targets). (2016). In: *19th Ordinary Meeting of the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols*. p.523.
- Environment and Resources Authority, (n.d.). *MSFD Initial Assessment Economic Sectors Report*.
- Marine Strategy Framework Directive (MSFD), (2014). *Programmes of measures under the Marine Strategy Framework Directive, Recommendations for implementation and reporting*.
- Sustainable Energy and Water Conservation Unit, Environment and Resources Authority, (n.d.). *The 2nd Water Catchment Management Plan for the Malta Water Catchment District 2015 - 2021*.

2.5 Scope and Study limitations

This Study is being addressed to ERA, formalises our work described in the contract agreement dated 20th February 2017, and is to be used as part of ERA's MSFD requirements.

The information contained in this Study has been based on information provided by ERA, publicly available information and discussions held with ERA and other selected stakeholders

identified by ERA, including the Authority for Transport in Malta (TM) within the Ministry for Transport and Infrastructure, the Department for Fisheries and Aquaculture (DFA) within the Ministry for Sustainable Development, Environment and Climate Change, and the Continental Shelf Department (CSD) within the Ministry for Transport and Infrastructure. Our work in connection with this assignment is of a different nature to that of an audit and hence we have not sought to verify the accuracy of any financial data provided or the information and explanations provided by stakeholders, except for ascertaining, wherever possible, the source of the information/ estimates/ assumptions provided. Accordingly, we express no opinion or any form of assurance on any data included in this Study. Additionally, we would like to point out the following limitations related to this particular Study:

- Currently, there exists limited knowledge in relation to the links between measures and their effects on the marine environment. This is acknowledged in the ARCADIS document on best practices, as well as the MSFD, the PoMs for Malta, and the tender document for this Study. This limited information is due to the complexity of the marine environment, which leads to limited quantitative environmental targets being set. As a result, this inhibits the possible quantitative assessment of the effectiveness of and benefits of the proposed measures. Indeed, most of the measures being proposed are a tool in themselves to collect more quantitative data and information on the baseline marine environment, to be followed by informed action. To this end, in order to mitigate this limitation, where possible, this Study makes reference to and employs good/ best practice examples outlined in other Member States' experiences, which are however mainly focusing on qualitative assessments.

- This limited information also means there is also lack of a clear causal relationship between a measure and its effects on the socio-economic environment (i.e. driver-pressure-effect relationship). As a result, this limits the assessment being undertaken, even when such analysis is focused primarily on a qualitative basis.

- The PoMs do not consider alternative measures to achieve the same objectives under each descriptor (where new measures are envisaged). Hence the "least cost" assessment and the ranking of (individual and/or sets of) measures, which should indicate the (sets of) measures which should be implemented with higher or less priority, was not possible.

- Some potential new measures are linked to pilot exercises and the implementation of certain options for which information to date is limited – clearly, if the measure envisages studies to identify technical options, the pilot implementation of the chosen technical option cannot be costed at this stage since the technical options have not been identified at PoM stage.

- It is also difficult to attach cost figures to certain "soft" measures involving, for instance, policy implementation and international agreements. As such, there is scope for some measures being proposed to feature a higher cost figure than that estimated. Nonetheless, rough estimates were utilised to form cost estimates of measures, based on judgement, experiences of other member states, and costs of existing measures implemented as part of the PoMs (as outlined in Malta's second WCMP).

- Stakeholder consultation was undertaken by ERA when designing the PoMs in the first place. Despite less time was available for this Study to be completed (compared

to the PoM design), key stakeholders consulted by ERA in the design and implementation of the new potential measures (TM, DFA and CSD) were still consulted directly through meetings or email/ phone correspondence, in order to gain more information and insight into such measures, and their potential impacts. Clearly, more time available would have potentially allowed for greater stakeholder involvement and interaction.

- The lack of scientific knowledge and associated uncertainties also make economic valuation of benefits of measures focused on detailed monetization challenging and unfeasible. Even non-market valuation methods (e.g. choice experiments to derive willingness to pay) prove difficult due to the lack of valuation data, and lack of information on the economic value of ecosystem services. The scope of a fully-fletched CBA was as a result limited.

2.6 Purpose of our Report and restrictions in its use

This Study is to be used as part of ERA's MSFD requirements and should not be relied upon for any other purpose. Because others may seek to use it for different purposes, this Report should not be quoted, referred to or shown to any other parties unless so required by court order or a regulatory authority, without our prior consent in writing. Ernst & Young Limited assumes no responsibility whatsoever in respect of or arising out of or in connection with the contents of this Study to parties other than the ERA. If others choose to rely in any way on the contents of this Study they do so entirely at their own risk.

2.7 Structure of Report

This Study includes the following sub-sections:

1. This ***Section 1*** provided the background to this study.
2. ***Section 2*** provides a description of the methodology applied and justification for the selected methodology;
3. ***Section 3*** describes the baseline scenario;
4. ***Section 4*** presents the findings of the CEA and CBA for the new measures proposed as part of the MSFD PoMs, including an evaluation of their potential economic, social and environmental impacts;
5. ***Section 5*** concludes by providing:
    a. a summary of the CEA and CBA outcomes
    b. a summary of the limitations of the methodologies applied (also referred to in this chapter)
    c. reference to other relevant information to be used during the decision-making process
    d. an economic justification for the adoption of the measures as part of the MSFD PoMs

3. Methodology

This report presents two types of assessments - CEA and a CBA. The methodologies related to these two assessments are described in the next two sub-sections.

1. Cost-Effectiveness Assessment

The aim of a CEA is to determine how MSFD targets can be achieved against least costs. Given that the environmental targets put forward by Malta in the first reporting cycle are mainly qualitative in nature, and given that the new measures being put forward are all looking at addressing different aspects (i.e. no alternatives being presented) the assessment will need to focus on cost information available as at the date of this report.

The steps involved in conducting a CEA are the following (split between those covered in the PoMs and those covered in this Study):

Covered in the PoMs:

1. Gap analysis – quantification has been inhibited by the information available, and hence in many cases the gap analysis is qualitative in nature

2. Identification of pressures and impacts

3. Classification of the additional (new) MSFD measures - An important aspect of the PoMs was to distinguish between current and additional measures, since current measures will not be taken into account in the CEA and hence in this report (i.e. in the next steps explained below). Current measures are already applied in the base case/ business-as-usual (BaU) scenario, or are measures based on expected policies.

Covered in this Study:

4. Description and assessment of the effects of additional (new) measures – the aim of this step is to understand/ determine the effects of the measures on the GES indicators. This was done through information also present in the PoMs, through literature review, and through expert consultation. To describe the effects of the measures, logical diagrams of impact (LDI's) were created to show the relationship between the measure and the GES descriptor's objectives.

After having determined the effect of each measure, an attempt to quantify these effects was made. This was only possible where information was provided by experts, and where document research was available. In an ideal situation, the quantitative measure-effect relationships can be derived from scientific studies. For the majority of measure-effect relationships, however, these studies were not available. As a result, in many cases this step relied on expert opinions and literature review (e.g. case studies) to describe this relation. It is pertinent to note that expert judgment is however likely to involve a degree of uncertainty.

5. Determination of the costs of the additional (new) measures - in this step, an estimate (including upper and lower bound, where relevant) was made of the likely cost of the measure, where this was possible. Experts and literature were also

consulted to determine the costs per measure. The following costs have been considered:

- Investment costs: costs of a capital nature incurred once;
- One-off non-capital costs: costs which are not of a capital nature, but which would need to be incurred once
- Maintenance and monitoring costs: variable costs that are incurred yearly;
- Costs per year: summation of investment costs transformed into yearly costs, as well as maintenance and monitoring costs;

Once a range of costs was obtained, an evaluation of the cost-effectiveness was undertaken using the following scales to divide costs into low, medium and high categories:

- Low: < €25k
- Medium: €25k – €100k
- High: > €100k

6. Assessment of least costs to reach MSFD objectives – given that new measures being presented do not have alternatives, no ranking was required/ possible. In addition, while knowledge on the costs per measures was generally available, a cost-effect ratio could not be worked out because of lack of quantification on the effect (as explained in step 4 above).

An uncertainty/ certainty analysis was used to highlight the assumptions and uncertainties which have the most significant impact on the cost-effective assessment. This is important because it will highlight where future research needs to be concentrated.

The CEA is carried out by considering the direct costs of implementing the proposed measures and cannot take all indirect effects/ costs into account. This is a situation which relates not only to marine policy but also to other national policy documents.

Although the above steps are taken in sequence, important iteration takes place between steps. Moreover, if additional information becomes available, for example on the targets set for the GES descriptors, or on the source-effect pathway and possible solutions, the same step may be revisited, as not all information is available as at the date of this report. The outline of the various steps illustrates how carrying out a CEA is a multi-disciplinary exercise, requiring the input of and collaboration between different scientific disciplines.

2. Cost-Benefit Analysis

In addition, a CBA is conducted on each descriptor having new measures, in addition to an outline of socio-economic and environmental benefits and costs per new measure. A CBA is an economic technique used as an aid to policy decision making. Theoretically it involves identifying and measuring, in monetary terms, as many costs and benefits that relate to a measure to determine whether that measure produces a net gain or loss in economic welfare for society as a whole. In contrast to the CEA, the objectives of the MSFD are also valued in a CBA. A CBA could also possibly help to choose between a number of different possible

policy or project options.

To carry out a CBA in addition to the aforementioned CEA, the benefits of the MSFD objectives are investigated, and compared with the costs from the CEA. In the CBA, the benefits of the gap between the MSFD objectives and the BaU are identified and monetised. However, for a CBA to be undertaken quantitatively, information and data on the BaU needs to be in place. This is the main limitation in the case of the proposed measures, in that most are aimed at collecting such BaU information.

As a result, the CBA being presented in this report is a simplified form CBA, aimed at elaborating the CBA methodology for the MSFD, getting a grip on the data available to carry out such an analysis, and also acquiring an insight into the level of missing information. For this analysis use was made of the CEA carried out within this project, as well as current literature.

The next section presents an overview of the baseline for each descriptor.

4. Overview of baseline

By way of setting the scene, and as an extension to the project background introduced in ***Section 1***, this section provides a definition of the "problem" and its causes. Within the framework of this study, the "problem" is defined as the gaps identified towards achieving GES in the various descriptor areas described earlier. This is done through the development of a baseline scenario which analyses the current scenario in a no-policy change scenario over a specific time horizon. The aim of such analysis is twofold:

1. To explain how the current situation would evolve without additional MSFD measures; and
2. To provide the basis for comparing policy options (with the introduction of additional MSFD measures).

A description of the baseline for each GES descriptor having new measures is provided in the following sub-sections.

4.1 GES Descriptor 1, 4 & 6: GES Descriptor 1, 4 & 6: Biodiversity is maintained – seabed habitats

As outlined in the PoM on this descriptor and Malta's MSFD Initial Assessment, current data gaps exist in relation to seabed habitats. However, on the basis of the information available to date, the seabed habitats are considered to be in good status. Particularly:

- *Posidonia oceanica* is deemed to have a 'High/Good' status;
- Macroalgae ('Littoral Rock and Biogenic Reefs' and 'Shallow sublittoral rock and Biogenic Reefs') qualify as 'High/Good' status in the majority of WFD water bodies, with a 'Moderate' status in the main harbour area.
- Interim status for benthic invertebrates sampled from 'Shallow sublittoral sediment' up to a depth of 50m qualifies as 'High/Good' for all water bodies.

Under a no-policy change scenario, and taking into consideration that there is limited knowledge on pressures and impacts, the following could be observed:

1. Seabed habitats which are currently poorly known cannot be addressed - management measures specifically targeting these habitat types are pending further knowledge on relevant pressures. For instance, further scarring of the seabed by anchoring may lead to the degradation of benthic habitats, and regulation of moorings and anchoring may not be currently undertaken in consideration of environmental impacts on the seabed habitats.
2. Seabed habitats might continue to be impacted by the introduction of non-indigenous species (information on the extent of which is limited).
3. Despite the Fisheries policy being in place to address impact of fisheries on seabed habitats, further depletion of by-catch species by fisheries might lead to shifts in benthic community structure which can negatively impact the trophic groups within the communities. (Nature Trust Malta, 2015)

4. If the uncertainties associated with the interaction of fisheries with seabed habitats (where data on seabed habitats is limited) and species (by-catch) remain, current impacts may not be addressed;

Existing measures[8] addressing physical damage to seabed habitats target current and planned maritime users. However, they may not be addressing seabed habitats in all marine waters as per the MSFD requirements, plus there may be informal procedures in place that are being applied to manage such seabed habitats, leading to a fragmented management approach. In view of this, a number of issues have been highlighted:

(i) *Mooring and Anchoring*: beyond the impacts of mooring and anchoring in coastal areas, there is limited knowledge of the impact of such pressures on wider marine areas (within and beyond MPAs) in line with MSFD and the Habitats Directive objectives.

(ii) *Activity in offshore waters (i.e. beyond territorial waters within the area designated for hydrocarbon exploration and exploitation)*: despite the current licensing and permitting system governed by the Continental Shelf Act provides the opportunity for environmental consideration when issuing permits for activities or interventions in offshore waters, there may be scope for further strengthening of such processes (going beyond consultation processes to take into account environmental aspects)

(iii) *Localised Pressures in MPAs designated for the protection of seabed habitats:* despite measures addressing the impact of anthropogenic activity on a national basis, there is limited knowledge on the impact of localised pressures (e.g. fishing activity in coastal waters, collection of benthic species, and other activities) which may impinge upon the achievement of MSFD GES and related objectives of the Habitats Directive.

As a result of the above identified gaps, the PoM is proposing a number of new measures.

4.2 GES Descriptor 1& 4: Biodiversity is maintained – seabirds, marine reptiles and mammals

The MSFD initial assessment on seabirds, marine reptiles and mammals indicates there are significant data gaps as well as outdated data that restrict the assessment of the population (condition and abundance) of species falling under this descriptor. In the meantime, EU LIFE funded projects (LIFE Migrate; LIFE Malta Seabird Project) have tried to close this gap through collation of further information on said species. Nonetheless, the lack of longer-term data limits the reliability of a historical trend analysis. Likewise, inference on future changes in this descriptor going forward is difficult to accomplish. Based on data available to date, key points, including those identified in the PoM to this descriptor include:

[8] Improvements of operational standards of aquaculture installations; seasonal surveys to monitor and map mooring/anchorage areas; impact studies of national spoil ground; mitigation measures in permitting procedures; designation of MPAs; permits for waste disposal; regulation and permits for mooring; designated mooring/anchorage locations; Notices to Mariners; regulation on use of towed fishing gear, towed dredges, and trawl nets fisheries; establishment of conservation areas around wrecks; licensing system for oil exploratory drilling and exploitation.

- Scopoli's Shearwater, the Yelkouan Shearwater and the European Storm Petrel: the distribution range of all species remained stable over 2008-2010, but some species (in particular Scopoli's Shearwater), may have suffered declines in population of breeding pairs.
- Malta holds 10% of the global population of Yelkouan Shearwater (during breeding season, based on sightings), 5% of the Mediterranean breeding population of Scopoli's Shearwater, and 50% of the Mediterranean population of European Storm-petrel (concentrated at Filfla) (Life+ Malta Seabird Project (LIFE10 NAT/MT/090), 2017))

- Loggerhead turtle: even distribution of the species within Maltese waters, as at 2012 sightings (i.e. 'good' status), and no significant decline in population abundance, based on levels of by-catch per unit in long-line fishing during 2008-2010

- Various species of regularly occurring marine mammals (cetaceans): stable species composition in the last century, and relative abundance of the three delphinium species most frequently reported in Malta

Under a no-policy change scenario whereby existing pressures (e.g. noise and light pollution from land and sea-based activities) are not targeted, the reversal of potentially negative trends in population abundance and condition of seabirds would not be possible. In the past, through the implementation of conservation measures at Rdum tal-Madonna, Mellieha, abundance of the Yelkouan population increased slightly.

According to the PoM, existing measures[9] in relation to seabirds are considered as adequate to address most relevant pressures on seabirds. However, due to data limitations, the use of wider marine areas by seabirds and linked sea-based pressures may not have been taken into account. In fact, areas that need further attention, as outlined in the PoM, constitute:

1. Rat predation: the implementation of a more holistic approach to rat population control needs be sought. This is through a mix of both eradication programs used to address rat predation in specific localities, and measures to address littering problems in certain areas typically used for recreational purposes
2. Light pollution: light pollution from recreational or industrial areas, as well as road lighting outside of protected area boundaries, has been identified within numerous Natura 2000 management plans as an important pressure affecting terrestrial breeding sites. As a result, a more strategic approach to mitigation measures is needed to facilitate site-specific management regimes.
3. Seabird-fishing gear interactions (by-catch): despite measures in place targeting these interactions, especially in respect of long-line fishing operations, little is known as to the extent of application of such measures, lessons learnt from the fishing community following their application and their relevance with respect to other fishing methods apart from long lining.

[9] Avoiding and monitoring pollution to ensure adequate bird habitat quality; establishment of special protection areas (SPAs); predation control programmes; establishment of code of conducts; prohibition of trespassing; fishing logbooks for by-catch incidents; by-catch reduction measures

4. MPAs: the importance of MPAs for seabirds calls for action targeting pressures specific to these marine areas, especially disturbance arising from maritime activity in these areas.

Existing measures[10] in relation to marine reptiles and mammals provide the necessary legal framework to protect marine reptiles and mammals, however their contribution towards GES is unknown due to knowledge limitations on interactions with anthropogenic activity. In fact, areas or gaps that need further attention, as outlined in the PoM, relate to:

1. Noise mitigation: the effectiveness of noise mitigation guidelines across relevant sectors is not fully understood
2. By-catch: existing mechanisms on prevention of by-catch and the extent of their application needs to be fully understood

In this regard, the PoM is proposing a number of new measures to tackle the issues identified in the gap analysis above.

4.3 GES Descriptor 3. The population of commercial fish species is healthy

According to the PoM, the following observations were made

- Regional or sub-regional stock assessments for a few species (hake, common pandora, red mullet, black-bellied angler, giant red shrimp, deep-water rose shrimp, striped red mullet) all indicate that these species were fished unsustainably within the period 2010-2012.
- On the other hand, a local preliminary assessment on selected demersal species, based on population age and size distribution (done for the MSFD Initial Assessment), indicated that most species' populations within the assessment area are likely to be healthy. This however is a preliminary analysis that needs to be re-assessed on the basis of longer-term data, and hence needs to be cautiously interpreted. Additionally, the status of some species (hake, black-belly rosefish) is uncertain, while another source (Malta's Fisheries Management Plan for Bottom Otter Trawling) implies that the Maltese fleet may be overexploiting stocks of hake and the giant red shrimp.
- 2012 estimates for the Atlantic bluefin tuna for the East Atlantic and Mediterranean note an improvement in stock status. More recent data, whilst highlighting uncertainties, also indicates an improvement in status.
- Assessments of Mediterranean swordfish indicating that the stock was below the level which can support maximum sustainable yield. A 2014-2015 report describes the results of age structured analysis indicating that the stock of the Mediterranean

[10] Regulation on contamination of the marine environment; protected area for protection and management of habitats supporting various life cycle functions; prohibition of all forms of capture, killing, and disturbance; protection from trade-related threats; protection from incidental capture; regulation of seismic surveys in terms of underwater noise generation; rescue programs; rehabilitation centres

swordfish is overfished throughout the whole period considered (1985-2013). The report, however, notes the considerable uncertainty in stock status.

- Stock assessments for the dolphinfish in the Mediterranean are not available. Malta's Fisheries Management Plan considers Maltese lampuki fishery sustainable, since catches remained stable over a long series of years. A 2013 assessment indicates that Malta did not increase the dolphinfish landings.
- In sum, the current status of stocks as determined at a regional scale implies the need for management of fisheries towards sustainable exploitation of such species. However, noting the low Maltese landings when compared to total international landings, hence the low contribution of Maltese fishers to unsustainable fishing, achievement of GES for commercial species strongly depends on action at a regional scale.
- However, Malta's PoM for this descriptor still targets sustainable exploitation of commercial stocks by Maltese fisheries, with a view to contribute to achievement of levels of Fishing Mortality and Spawning Stock Biomass as assessed at a regional or sub-regional scale reflecting levels which can produce maximum sustainable yield.

There are various existing measures in place, targeting (A) the management of 'extraction of species'[11] and (B) the management of impacts of fisheries in marine ecosystems[12]. The PoM states that existing measures are adequate to ensure that Malta contributes to the sustainable exploitation of selected shared stocks and achievement of levels which can produce maximum sustainable yield at a regional or sub-regional scale. Within this context, gaps in the fisheries management regime are mainly related to issues which cannot be fully addressed at this stage, either in view of current data limitations or of ongoing discussions. Such gaps are mainly associated with the need for:

- addressing potential effects on vulnerable commercial stocks, pending improved knowledge on species-specific catch, landings and by-catch;
- better management of discards pending further knowledge on discards associated with different fishing métiers and implementation of the landing obligations;
- better management of recreational fishery pending better understanding of the contribution of such fishery to fishing mortality.

In this regard, the PoM is proposing a new measure under this descriptor.

4.4 GES Descriptor 8. Concentrations of contaminants give no effects

[11] In terms of the management of 'extraction of species', existing measures include (a) Fisheries Management Plans (e.g. lampuki) for vessels operating within the 25 NM Fisheries Management Zone; (b) management of fishing capacity and effort (e.g. Fishing Fleet Register); (c) catch limits for the bluefin tuna; (d) restrictions on fishing gear; (e) the management of discards; (f) data collection processes and compliance (e.g. Catch Logbook for vessels 10 metres length or more, Vessel Monitoring Systems for vessels 12 metres length or more); and (g) the management of recreational fisheries

[12] In terms of the management of impacts of fisheries in marine ecosystems, existing measures include (a) spatial management measures (e.g. prohibition of use of trawl nets at depths beyond 1000m); (b) protection of vulnerable commercial species (e.g. shark finning); and (c) labelling and recovery of fishing gear (e.g. Garbage Record Book or Ship's log)

As outlined in the PoM on this descriptor, data relevant to the level of contaminants in Maltese waters contains some limitations because of data gaps (including lack of long-term data) and uncertainties related to some sources of contaminants and transboundary sources. Environmental Quality Standards (EQSs), which serve to assess the level of concentration of contaminants, is not established for all matrices either. Nonetheless, key points relating to this descriptor, as outlined in the PoM, are described below:

- Mercury was the most common contaminant detected in the water column (concentrations exceeding the annual average EQS) in all sampling stations
- Other contaminants exceeded established EQSs in the water column by way of exception or within specific sampling locations:
    - lead: annual averages exceeded EQS once at 3 sampling stations
    - nickel: annual averages exceeded EQS at 5 sampling stations
- In the sediment matrix, mercury and lead levels exceeded EQSs established in Italy with relatively high concentrations at 3 monitoring points.
- High concentrations of polyaromatic hydrocarbons were found within sediments of harbour areas.
- Mercury levels in biota, as measured in *Posidonia oceanica*, are comparable with mean values from reference sites along the Mediterranean coast, and were much lower with respect to both mild and heavily impacted sites

Discharges to the marine environment are governed by an environmental permitting process which regulates the contaminants loads of such discharges.
In respect of sea-based sources of contaminants, data is not available.

The following is the no-policy change scenario, which takes into account current data gaps and uncertainties (especially in relation to the sources of mercury), input loads from sea-based activities, operational targets for input loads, and the establishment of EQSs for all matrices:

i. The extent of transboundary sources as a potential source of pollution cannot be determined.
ii. Adequate assessment of background mercury level concentrations and interpretation of the status of the water column in Maltese waters cannot be undertaken, and as such effectiveness of existing measures cannot be evaluated either.
iii. Fragmentation in respect of different reporting and assessment streams related to input of contaminants into the marine environment.

Existing measures[13] support a solid legal framework for the prevention and regulation of land-based and sea-based pollution in relevant sectors. However, a number of issues exist, limiting the assessment of gaps for this descriptor. These include:

- Lack of assessment regarding the magnitude of transboundary sources as a potential source of pollution
- Need to investigate the sources of mercury levels

[13] Regulation of direct discharges into the marine environment; control of priority hazardous substances; environmental permitting; sewer discharge control regulations; regulations on plant protection products; reporting system for dangerous substances; reporting of pollution incidents and accidents at sea; regulations on disposal of waste at sea; exploration and production licenses

- Verification of the effectiveness of current legal framework and measures to control input of contaminants beyond coastal waters

In view of the above, new measures being proposed to address the above-mentioned gaps do not put forward new processes, but streamlining of current efforts and synergies across policy implementation.

4.5 GES Descriptor 10. Marine litter does not cause harm

As outlined in the PoM on this descriptor and Malta's MSFD Initial Assessment, there are significant data gaps for all types of marine litter addressed by the MSFD criteria and indicators, and no data is available with respect to microplastics. Also, trend data is unavailable and as such it is impossible to gather an indication of the historical trend and magnitude of the problem of marine litter. Thus, the success or otherwise of initiatives to reduce marine litter which have been undertaken to date is unknown. Likewise, inference on future changes in marine litter and effectiveness of new proposed measures going forward is difficult to accomplish.

However, "if you don't see it, it doesn't mean it isn't there". In this regard, one-off research as described in the PoM on this descriptor indicates that:

1. Marine litter on Maltese coastlines, in the water column and deposited on the seafloor seems to be predominantly composed of plastic items;
2. Litter on Maltese coastline is linked to high tourism influx and the intense use of beaches, rather than washed ashore or deposited on the coastline;
3. Marine litter on the seabed also includes limestone slabs which were attributed to Fish Aggregating Devices (FADs) for dolphinfish catch

Existing measures (e.g. beach cleansing; reduction at source; management of sea-based sources) and legislation related to litter, as described in the PoM and Malta's MFSD Initial Assessment, are collectively contributing to a reduction in litter in the marine environment. However, they are mostly targeting management of marine litter with respect to litter washed ashore or within inshore waters. Litter on deep seabed and microlitter are not deemed to be adequately addressed, also due to the limited knowledge in relation to the distribution of litter on the seabed and on microlitter in general.

As previously mentioned, there is limited data and knowledge on the distribution of litter on the seabed (including microlitter). Additionally, uncertainty surrounds policy effectiveness, particularly policy measures implemented within the shipping and fisheries sectors. However, on the basis of the above considerations and assuming a no-policy-change scenario, a deterioration of the seabed is likely to be observed through:

- Continued input of plastic material from both land-based and sea-based sources
- Increased litter from specific anthropogenic activity, including fisheries, e.g.:
    - accidental losses of cargo during transportation
    - synthetic ropes (part of discarded or lost fishing gear) and nylon lines becomes entangled with marine biota and benthic organisms such as corals

Within this context, the PoM highlights the following gaps/ current issues:

i. removal of litter from the seabed, in particular deep seabed, may not be adequately addressed and further links with management of protected areas may be sought in this regard;

ii. while existing measures are deemed to adequately target litter washed ashore and litter in coastal areas, the role of NGOs in contributing to the removal of marine litter could be strengthened;
iii. the extent to which the maritime transport sector may be contributing to marine litter (despite compliance to existing legislation) is not clearly understood. Apart from attempts to address knowledge gaps, there is also the need to identify opportunities for this sector to contribute to further reduction in marine litter;
iv. microlitter is not specifically addressed through existing measures, mainly in view of the need for knowledge improvement on this pressure.

In this regard, the PoM is proposing a number of new measures to tackle the issues identified in the gap analysis above.

4.6 GES Descriptor 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

According to the PoM on underwater noise, the current data scenario features a number of limitations, including limited data and knowledge on the level of pressures by anthropogenic activity, as well as current ambient noise levels in marine regions, their trends, and the impact of such noise levels on the distribution of marine biota.

Nonetheless, based on data available to date, key points in the PoM to this descriptor include:

- Marine biota is dependent on sound for communication, navigation, orientation and detection of predators and prey
- Affected species groups include cetaceans, turtles, fish and some invertebrates (such as decapod crustaceans)
- Impacts of underwater noise include behavioural disturbance, loss of hearing, and mortality
- Impulsive noise in Maltese waters is deemed to be majorly sourced from seismic surveys for hydrocarbon exploration
- Continuous noise is mainly sourced from shipping, which features increasing trend (and possibly also anthropogenic noise linked to it)

The following is the no-policy change scenario, which takes into account current data gaps (especially in relation to continuous underwater noise) and uncertainties in relation to the levels and distribution of underwater noise in Maltese waters:

i. Limited management regimes to address impact of underwater noise on marine environment
ii. Potential increases in levels of anthropogenic sound in marine waters from shipping

Existing measures[14] for underwater noise are also limited given it is a new entry in the policy field and given the aforementioned limitations. A number of issues, which need immediate attention, constitute:

[14] Visual monitoring of marine species before/during surveys; passive acoustic monitoring soft start methods; prohibition of all forms of capture, killing, and disturbance and degradation of habitats of all cetacean species; designation of Special Areas of Conservation (SACs); data collection of impulsive noise-generating activities.

i. Limited knowledge on occurrence, intensity and impacts of underwater noise-generating activities, which needs to extend beyond the compilation of a register of impulsive noise-generating events (e.g. spatial distribution, temporal extent and levels)
ii. Limited consideration of underwater noise on other species groups besides cetaceans, in terms of adequate impact indicators (which still need to be developed), more understanding for the determination of noise thresholds and cumulative impacts.
iii. Need for further development of monitoring processes for continuous noise, including the identification of appropriate monitoring stations and acoustic models.
iv. Need for adequate administrative frameworks structures, as well as collaborative efforts across relevant competent authorities to ensure better management of underwater noise.

In this regard, the PoM is proposing a particular measure to tackle the issues identified in the gap analysis above.

5. Cost-effectiveness analysis and Cost-benefit analysis

This section presents the CEA for additional (new) measures, followed by a CBA of the GES descriptors through analysis of economic costs and benefits of the MSFD measures.

5.1 Cost-Effectiveness analysis

In this sub-section, the list of measures is evaluated according to the methodology explained in ***Section 2***. The analysis is presented as per each GES descriptor to which a set of measures belong. It is pertinent to note that some of the measures are common across descriptors, and will hence be only analysed once. Additionally, and as explained in the introductory chapter, an exact CEA is not possible because the dose-effect relations of the measures is not known yet.

5.1.1 GES Descriptor 1, 4 & 6: Biodiversity is maintained – seabed habitats

5.1.1.1 MICMT-M001 Pilot implementation of selected management options aimed at addressing impacts from anchoring on the seabed

Anchoring, or rather the dragging of anchors along the seabed, can lead to patches of destroyed seagrass within the meadows. Sources could include various operators, including merchant vessels (bunkering), commercial operators, fishing vessels, and pleasure craft. Locally, bunkering activity has been increasing over the years, and as such any associated environmental damage has potentially also been increasing. Public and environmentalists' concern surrounding damage to seabed habitats in the area (e.g. reefs) by such activities has spurred authorities to look further into the matter. In this regard, TM is currently assessing a change in the current layout of the Sikka l-Bajda area to help safeguard marine environment, while still maintaining a bunkering zone in this area. (Xuereb, 2017).

It is by this spirit that this MFSD measure was drawn up in relation to different types of vessels and associated anchoring activity. This measure is itself a feasibility study that will include:

(i) An assessment of the type and intensity of current anchoring activities (within and beyond MPAs);
(ii) Assessment of issues and impacts of current anchoring practices;
(iii) Defining management/ technical options tailored for different scenarios (e.g. mooring systems, zoning);
(iv) Economic assessment of preferred options

Subsequent to the feasibility study, the measure will include the:

(v) Implementation of the selected management/ technical option/s on a pilot basis.

Effect of the measure on the gap

This measure will have a positive effect on biodiversity and sea floor integrity since anchoring is a major source of disturbance and physical damage to the seabed. At the first instance, data collection will permit appropriate analysis and identification of options for mitigation of impacts from anchoring activities whilst the selection of an appropriate option/s to drive the pilot study will improve seabed habitat in the targeted area of pilot

study. This measure can also augur well for the implementation of the option/s in wider areas of operation such that anchoring activities occurring in all identified areas are targeted – actual and potential physical damage to seabed habitats can as a result such be reduced.

Uncertainty/ certainty analysis
The effectiveness of the measure on biodiversity and sea-floor integrity depends primarily on the option/s selected as derived from the pilot study, per type of operator, and also according to the location which will be targeted. For instance, Sikka l-Bajda is thought of as an area of operations which is being subject to major anchoring, and as such implementation of any of the options in that area as part of the pilot study would greatly benefit the descriptors identified.

Costs of the measure

The estimated costs of this measure include a number of elements:

Feasibility study

a) Tender drafting, publication, and adjudication cost –the feasibility study would be undertaken by third party experts

b) Actual cost of the feasibility study, which will cover data collection to identify anchoring activities in Malta, and further stakeholder consultations and meetings

Once options are identified and the pilot project can be initiated:

c) Stakeholder meetings (e.g. with TM) for information purposes in respect of the implementation of pilot

d) Tender drafting, publication, and adjudication cost – for implementation of selected options derived from the pilot study

The above costs (items [a] till [d] above) are estimated to range between €100k and €150k.

e) Cost of pilot implementation of option/s – this cost will clearly depend on the technical options selected for the pilot study. Assuming that each operator will be targeted (bunkering operations, commercial operators, fishing vessels, and pleasure craft), a number of operational areas could be impacted. Selected options can include:

- Setting up of designated areas (such as that already established at Wied il-Buni, Birzebbugia) – this could cost in the region of €200k – €500k, depending on size of area and number of temporary mooring buoys installed.
- Installation of a permanent mooring buoy(s) (such as the one established off Xlendi bay) – this would entail a heftier cost, which could potentially reach €1.5mln. It is also pertinent to note that, given the depth of the sea, such systems also tend to require high maintenance, and do sometimes drag and get lost.
- Different management models, including central government management (e.g. fee to use Maltese waters; private concession of mooring areas)

5.1.1.2 MICMT-M002 Strengthening liaison between relevant Government bodies with a

view to streamline MSFD requirements in offshore licensing and permitting regimes

Note: This measure is similar to other measures being proposed to address other descriptors, namely under Descriptor 1&4: Seabirds, Marine Reptiles & Mammals, Descriptor 8: Contaminants, and Descriptor 11: Underwater noise.

The oil and gas sector in Malta is associated with a low risk of significant pollution events, however, there is still the potential for activities within the sector, especially shipping activity, to result in input of contaminants.

Besides, use of offshore waters for hydrocarbon exploration and other marine research surveys present another pressure on the marine environment due to the use of seismic reflection surveying and use of sonar. The MSFD's initial assessment on underwater noise indicates that three seismic surveys covering nearly 4,200 km of 2D data and 1,750 square km of 3D data were acquired since 2007. In terms of marine research surveys, despite the unavailability of a central data repository on frequency and/or location of the use of sonar, the CSD licensed approximately 35 research surveys during 2012 including sub-bottom profiling surveys and surveys using multi-beam echo-sounders and side scan sonars.

In view of the above, the potential of Malta's continental shelf (which is large relative to land area) strongly warrants the regulation of maritime activities on Malta's continental shelf, including through offshore licensing and permitting regimes. Such regulation is currently under the responsibility of the Continental Shelf Department.

In this spirit, the Water Catchment Management Plan pursuant to the EU Water Framework Directive, through basic measure SWM 1, already caters for the need to strengthen the relationship between environmental and planning regulatory processes between ERA and the Planning Authority - through a guidance document and monitoring of projects post-completion. This MSFD measure, which builds on existing measures, will focus on MSFD requirements in respect of licensing and permitting processes for offshore activities, namely:

a) Oil exploration drilling activities
b) Laying of cables and pipelines
c) Marine scientific research
d) Artificial islands

This measure aims to strengthen current mitigation and monitoring measures in place to ensure compliance with environmental obligations:

(a) Oil exploration licenses (exploration study agreements): licensees are obliged to conduct operations in accordance with best industry practise and to employ the most advanced techniques for the prevention of environmental damage, by undertaking seismic acquisition and follow the Agreement on the Conservation of Cetaceans in the Black Sea and the Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) – to ultimately reduce the impact of anthropogenic underwater noise on cetaceans.

(b) Oil exploration and production licences (production sharing contracts): drilling of an exploration well requires an environmental risk assessment to be carried out, as well as a report on major hazards to ensure that prevention and mitigation measures are in place for the safety of operations and the protection of the environment. Government only gives its consent for oil exploration

drilling to proceed once the risk assessment and the report on major hazards have been accepted.

(c) Submarine cables and pipelines: the licence issued by Government in accordance with Regulation 5(2) of the Continental Shelf Regulations contains conditions for the reduction and control of pollution from such cables and pipelines.

(d) Marine scientific research: depending on the equipment that will be used, the applicant may be required to follow relevant ACCOBAMS guidelines.

(e) Artificial islands: licence will only be issued by Government once the consent of all government entities is given – which may be subject to certain conditions, including environmental studies.

Building on the current collaboration between ERA and the CSD, the goal of the proposed measure is to formalise the existing collaboration to ensure a streamlined approach towards achieving MSFD requirements (i.e. to go beyond consultation processes). This will be done through the drafting of a guidance document which ensures that the operational processes and adoption of mitigation measures, inclusion of environmental conditions, and monitoring requirements for offshore activities are stipulated in consideration of MSFD requirements.

Effect of the measure on the gap

The measure has a positive effect through reduction of pressures on marine ecosystems which may result from offshore activity. These pressures include physical damage to seabed habitats, contamination of the marine environment, and levels and distribution of underwater noise. Specifically, habitat types and species and water quality (from reduced pollution from contaminants) in selected areas can be maintained in GES. Since environmental risk assessments are already being carried out as part of the process by which licenses are issued for offshore drilling activity, the new MSFD measure (through inclusion of environmental conditions in application for licenses, the adoption of mitigation measures, and their monitoring) will ensure consideration of Good Environmental Status in line with MSFD objectives in offshore operations, whilst ensuring conformity with respective agreements/regulations. As a result, the marine environment is safeguarded against any physical damage, and other pressures including risk of oil spills.

Uncertainty/ certainty analysis

The effectiveness of this measure may be impacted by the current limited remit of ERA and CSD in that currently CSD is acting as an intermediary between ERA and third party applicants in streamlining MFSD requirements throughout various operational processes. Once implemented, the effectiveness of such a guidance document in impacting operations would need to be re-assessed.

Costs of the measure

The costs of establishing such a measure include the following elements:

a. Various meetings between ERA and CSD to determine contents of Guidance Documents

b. Drafting and discussion/ approval of Guidance Document

Based on the above, the cost of the measure is estimated to be around €20k-25k. This does not include any costs required to enforcement.

5.1.1.3 MICMT-M003 Inventory of fishery activity in coastal Marine Protected Areas designated for the protection of seabed habitats

Currently, there is no information on the link between fishery activity in coastal MPAs and the status of seabed habitats (and naturally the strength of the relationship between the two) – neither in respect of commercial or recreational fisheries.

Improved knowledge in this respect will be sought through this measure, which will target localised pressure from fishing activity in coastal MPAs. The inventory of fishery activity in coastal MPAs will be based on information relating to: type of gears; type of vessels; targeted species; spatial and temporal distribution within MPAs; relevant policies; and social and economic information on fisheries. The operational process by which such inventory will be populated, will in turn be based on stakeholder consultation (fishermen and divers) and official DFA data collection processes.

Ultimately, the goal of this measure is to enable quantification of the pressure and assessment of potential impacts on seabed communities, especially by taking into account information on fisheries not covered by DFA data collection processes (e.g. information on recreational fisheries, artisanal and small-scale fishery)

Also, in order to maintain and enforce regulations governing fishing activities within the 25 nautical mile Fisheries Management Zone (the environmental target tied to this measure), a holistic framework on environmental protection and sustainable use of resources is required – this can only be achieved through improved knowledge on fishing that adequately inform management regimes.

Effect of the measure on the gap
This measure will have a positive effect on seabed habitats through the analysis of the data collected, and more importantly the quantification of pressures by fishing activities occurring in the MPAs. This will inform site-specific management regimes targeting protection of certain habitat types from fisheries activities and thereby ensure GES for biodiversity and sea floor integrity.

Uncertainty/ certainty analysis
The uncertainty relating to the impact of this measure upon the gaps identified is the lack of collaboration to provide data by stakeholders, namely fishermen and divers. Especially for fishermen, the element of competition in the market may push fishermen away from sharing data on their fishing practices. Reliability of information may also be questioned if stakeholders are not abiding by set regulations and as such fail to report the true picture of their activities. As a result, the application of data to potentially inform management measures within MPAs would be limited.

Costs of the measure

The estimated costs of such a measure includes the following items:

a. Project management costs: Identification of fishing activities within MPAs and stakeholders to be contacted
b. Data collection: Identification of fishing activities within MPAs and stakeholders, through data forming part of the official DFA data collection processes, and also

through stakeholder meetings with fishermen & divers

c. Population of database based on data collection

d. Quantification of level of pressure from fishing activity on seabed community in MPAs

Based on the above, the cost of the measure is estimated to be around €10k – €15k.

5.1.1.4 MICMT-M004 Awareness Raising Campaign on protected species associated with benthic communities

A new measure is being proposed to spread awareness on a national scale regarding the impact of current pressures on protected species associated with benthic communities. Particularly, an awareness campaign (including dissemination material) and a code of conduct for divers (SCUBA divers, free drivers, and spear fishermen) will be devised.

Besides spreading knowledge on the capture of such protected species (including illegal collection) amongst the diving community, this measure will also lead to the identification of other pressures on the marine environment (especially seabed habitats) by divers.

Effect of the measure on the gap

Awareness raising and the dissemination of a code of conduct amongst divers will contribute to maintaining biodiversity since it will ultimately lead to a reduction in the collection of protected benthic species – if knowledge learnt as part of the campaign is naturally applied. Also, knowledge sharing amongst divers on other issues and pressures faced whilst diving can contribute to the application of best practices, thereby protecting benthic species further.

Uncertainty/ certainty analysis

The effectiveness of the measure upon the gap has an element of uncertainty to it in that the extent of change in behaviour of divers following the educational campaign and publication of code of conduct is unknown. However, such measure provides an intrinsic benefit to divers themselves since the protection of seabed habitat will provide a better diving experience to themselves, and thus divers are anticipated to be receptive to such measure and its outcomes.

Costs of the measure

The envisaged costs of the measure include the following elements:

a. Development of campaign and dissemination material, including printing

b. Implementation of campaign, including workshop with divers

c. Marketing cost of dissemination material

d. Drafting and discussion/ approval of Code of Conduct (including stakeholder consultation)-

The cost of the above depends on the type of material to be disseminated, but is estimated to cost around €20k – €25k.

1, 4 & 6: Seabed habitats - Results of the CEA

Table 3: GES 1, 4 & 6: Biodiversity is maintained – seabed habitats

Measure code	Specified measure	Effect on the gap	Annual costs (€)	Cost scale[15]	Cost-effectiveness
MICMT-M001	Pilot implementation of selected management options aimed at addressing impacts from anchoring on the seabed	Less damage to seabed	€100k-150k for study Capital expenditure of pilot implementation depends on option chosen, which can range anywhere between €200k and €1.5mln	High	Study to identify options is cost-effective. Since option of pilot study is not known, cost-effectiveness of this second part cannot be assessed
MICMT-M002	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes	Habitat types and species maintained in GES; better water quality	€20k – €25k	Low	Depending on implementation of environmental measures, this can be very cost-effective
MICMT-M003	Inventory of fishery activity in coastal Marine Protected Areas designated for the protection of seabed habitats	Protection of habitats in MPAs	€10k – €15k	Low	Depending on the quality of information collection, this can be very cost-effective
MICMT-M004	Awareness Raising Campaign on protected species associated with benthic communities	Protection of benthic species; reduction in diving-related pressures on seabed	€20k – €25k	Low	Very cost-effective

5.1.2 GES Descriptor 1& 4: Biodiversity is maintained – seabirds, marine reptiles and mammals

For this descriptor, new measures are mostly focused on addressing the current knowledge gaps.

5.1.2.1 MICMT-M005 Knowledge improvement on the interactions of marine reptiles and mammals with fisheries activity and definition of good practice as necessary

Note: This measure is similar to another measure (MICMT-M010) proposed to address the same descriptor (biodiversity is maintained), yet affects two different sub-sets: (a) seabirds,

[15] An evaluation of the cost-effectiveness was undertaken using the following scales to divide costs into low, medium and high categories: Low: < €25k; Medium: €25k – €100k; High: > €100k.

and (b) marine reptiles and mammals. The assessment below relates to the overall descriptor.

Seabird and reptile/mammal by-catch is a known phenomenon amongst the Maltese fishing community. While acknowledging that there are conflicting research results in relation to the extent of by-catch of seabirds and turtles in Maltese waters, some results are quoted hereunder:

- The fishing activity responsible for the highest seabird by-catch is bottom long lining, with each fisher who uses this gear catching an average of 1.41 Scopoli's Shearwater annually, with minimal catches of the Yelkouan Shearwater (Dimech et al.,2009)
- Cory's Shearwater and the Yelkouan Shearwater are the main seabird by-catch species (Dimech et al.,2009)
- The loggerhead turtle was the predominant by-catch species compared to bluefin tuna catch in field observations spread over 85 fishing days (Burgess et al.,2010)

Local fishermen's response to previous initiatives, including the development of "A Seabird Guide for Fishermen" prepared by the EU LIFE Yelkouan Shearwater project, was positive. Building on this, and in support of conservation actions by governmental authorities and NGOs, as well as the fishing community interested in reducing the incidence of disturbance caused by by-catch (e.g. unavailability of bait/hooks), this MSFD measure serves to:

a. gain an understanding of current fishing practices and application of mitigation measures, and link this information with temporal and special extent of the by-catch problem;
b. provide further guidance to fishermen, if deemed necessary, on the interactions of seabirds, marine reptiles and mammals with fishing activity; and
c. Identify the need for new/untested by-catch mitigation measures in Maltese waters.

This knowledge improvement process will entail:

1. Improving the definition of existing interactions between marine reptiles/mammals/ seabirds and fish-gear;
2. An assessment of local knowledge on by-catch issues, through workshops with the fishing community - particularly in relation to the MPAs designated for the conservation of the loggerhead turtle;
3. Through the above, raise awareness in relation to (i) the existence of rescue programs and rehabilitation centres; (ii) handling procedures to be followed upon discovery of injured/dead individuals; and (iii) the designated Marine Protected Areas; and
4. Reporting and dissemination of results amongst the fishing community, in the form of a code of good practice, if needed.

Effect of the measure on the gap

While there is a need to verify the extent of by-catch in Maltese waters, if the measure is successful, the current incidence of by-catch can decrease. Indeed, as already mentioned, the measure will be contributing to the collective conservational actions also undertaken by governmental authorities and NGOs in reducing by-catch. Besides, there might also be spill-over benefits related to sharing of fishing best practice - information gathered from workshops and interviews will allow the fishing community to benefit from reduced incidence of by-catch disturbance, thereby also contributing to the conservation efforts of

loggerhead turtle and seabirds.

Uncertainty/ certainty analysis

In this measure, uncertainty relates to the collaboration by stakeholders in providing information, and acceptance amongst stakeholders of the way forward with respect to by-catch reduction/mitigation practices. The economic and technical feasibility of the identified way forward might also lead to uncertainty. Enforcement or regulation could also play its part in the success (or otherwise) of such a measure

Costs of the measure

The estimated costs include:

a. Tender drafting, publication, and adjudication cost for undertaking the study

The actual study, which will include the following tasks:

b. Data collection through stakeholder meetings (including developing workshop/interview material)
c. Drafting of final report of findings
d. Information sessions for the dissemination/discussion of findings
e. Preparation of awareness material, including related design/ marketing costs
f. Development of a code of good practice, if necessary

The cost of the above depends on the type of material to be disseminated. The operational activities related to elements (a) to (e) above will identify the need for developing a code of good practice. Excluding the cost of element (f) at this stage, the measure can be estimated to cost around €15k-20k.

5.1.2.2 MICMT-M006 Preparation and promotion of a code of good practice for sea-farers

Note: this measure will be developed and implemented in synergy with measure MICMT-M009, and hence its assessment is included in ***Section 5.1.2.5*** *(MICMT-M009).*

5.1.2.3 MICMT-M007 Promote consideration of noise impacts and mitigation measures within offshore licensing and permitting regimes

Note: this measure will be developed and implemented in synergy with measures MICMT-M002, MICMT-M013, and MICMT- M019, and hence its assessment is included in ***Section 5.1.1.2*** *(MICMT-M002).*

5.1.2.4 MICMT-M008 Awareness and education campaigns targeting disturbance issues in recreational areas where the presence of litter has been tied to rat predation

Eight Special Protection Areas on the Maltese coastline have been identified as the most important sites for breeding seabird colonies on land – scientifically known as Important Bird Areas (IBAs) (Birdlife Malta, 2017). These terrestrial SPAs are covered by Natura 2000 management plans which propose the development of codes of conducts for specific areas as one of the conservation measures for these sites.

In an effort to enhance the conservation of the three Maltese protected seabird species, namely the Yelkouan Shearwater (Garnija), the Scopoli's Shearwater (Ċiefa) and the European Storm petrel (Kanġu ta' Filfla), SPAs need to be effectively managed (Birdlife Malta, 2017) to ensure that the distributional range of breeding sites of these three species is stable, with no loss of breeding sites due to anthropogenic disturbances. The proposed new measure will seek to build on the existing initiatives (focused on specific sites) to address a number of disturbance pressures on seabird populations, by supplementing such initiatives through a wide awareness raising campaign (in other sites) targeting popular camping/picnic areas in close proximity to seabird breeding sites –. It will also link up with the established aforementioned codes of conduct.

Rather than employing passive methods of awareness (e.g. signage, provision of bins), the measure will build on more active methods. In collaboration with local councils and NGOs, the measure will see the launch of educational campaigns informing targeted users of such sites of the impact of such anthropogenic disturbances. This will be done through awareness on:

- the presence of seabird colonies in the area;
- the existence of interspecific/predation relations;
- issues arising from anthropogenic pressures; and
- pro-environmental behaviour and habits specific for the area.

Targeted users will include on-site campers, picnic-goers, school groups, and residents of proximate urban areas or hamlets.

Effect of the measure on the gap

Through the educational campaign targeted at users of the sites, change in behaviour and attitude of these users could lead to a reduction in littering within terrestrial Special Protection Areas and hence a reduction in rat predation of seabirds' chicks and eggs. This would supplement the rat control programmes that will be implemented through other initiatives and apply a more holistic approach towards the achievement of GES for seabirds.

Uncertainty/ certainty analysis

This measure's effectiveness depends on interest and take-up by the targeted public within the campaign's activities. Also, by not targeting the whole population but rather typical users of the site (which can change frequently given the small scale of the island), new unidentified users will not acknowledge information derived out of such educational campaign and hence, at this stage, it is uncertain whether the measure will fully contribute to close the identified gap at the identified sites.

Costs of the measure

Elements making up the estimated costs of this measure include:

a. Identification of potential users and sites to be targeted by the campaign
b. Design of campaign content
c. Implementation of awareness-raising campaign in targeted sites
d. Cost of equipment supporting the campaign

The above costs have been applied on the estimated number of areas to be targeted (8). At the time of analysis, the content of the awareness raising activities is unknown (e.g. information sessions, dissemination of material). Likewise, there is no information on the type of equipment to be used to support the campaign (e.g. bins, signage). Based on past similar measures stemming from the WFD, and excluding element (d) above, the measure is estimated to cost around €10k-15k.

5.1.2.5 MICMT-M009 Preparation of official guidance documents aimed at providing direction with respect to reduction/ control/ mitigation of light and noise pressures driven by both land-based and sea-based activities

Note: The assessment of this measure is made by taking into consideration the fact that it will be developed and implemented in synergy with measure MICMT-M006, and targets two major pollution pressures, namely light and noise pollution from land-based and sea-based activities.

Land-based activities

Facts on light pollution in Malta have been highlighted in the past years. Primarily:

- There is a link between the increasingly urbanised and light polluted Maltese nightscape and the amount of birds that end up stranded inland (Barbara, Metzger and Laguna, 2014)
- Malta's light pollution levels are mainly due to 'globe lights' installed on promenades and other public areas across the islands, the over-illumination caused by the multiple rows of street lights, globe lights and spot lights unnecessarily installed in the same place, the lighting of hotels, the Malta Freeport and industrial estates (Raine et al., 2007)

Following up on further calls for action and codes of conduct called for by Natura 2000 management plans, measure MICMT-M009 seeks to reduce and mitigate light pollution emanating from developed urban/recreational/industrial areas, as well as associated infrastructure (e.g. road lighting) through the development of a guidance document. As specified in the MSFD PoM, the aim of such document is to:

a. Inform development permitting processes with a view to ensure consideration of light pollution in sensitive areas and the adoption of mitigation measures through such processes;
b. Guide urban/infrastructural planners, architects and developers with respect to mitigation measures to be adopted for sites proximate to seabird breeding sites, including advice on alternative, low-impact lighting systems; and
c. Create public and business awareness in key areas, as well as establish appropriate codes of conduct (e.g. encouraging the switching off of unnecessary lights, discouraging over-lighting in hotel porches etc.)

Sea-based activities

Seafarer practices in respect of navigation is currently guided by safety regulations including (i) COLREGS - International Regulations for Preventing Collisions at Sea and (ii) the Code of Practice for the Safety of Commercial Vessels. At the same time, newly designated protected areas for marine reptiles and mammals have been identified.

- Measure MICMT-M006 seeks to guide seafarers in respect of reducing disturbance and risk of collision through navigation by developing a code of good practice that informs them of:
    - procedures for handling injured/dead individuals of marine reptiles and mammals
    - information on existing rescue programs and rehabilitation centres
- Data gathering exercises on injuries/mortalities due to ship strikes will also be promoted, where relevant

Seafarer practices may also be negatively impacting MPAs through generated light and noise pollution. As such, measure MICMT-M009 sees the development of a guidance document with the aim to:

1. Guide seafarers with respect to appropriate codes of conduct (which build upon regulations mentioned above) when navigating within MPAs of importance to seabirds.
2. Inform and guide patrolling entities with respect to detrimental anthropogenic activity (e.g. noise from boat parties) to be controlled

Effect of the measure/s on the gap

The effectiveness of this measure can be described separately for the official guidance documents that will be drafted for the reduction of light pollution emanating from developed urban/recreational/industrial areas and for the reduction/mitigation of light and noise pollution within marine protected areas. The former would result in improved designs in coastal development and employment of mitigation measures through permitting processes resulting in reduction of light pollution and associated disturbance on breeding colonies of seabirds in coastal areas. With respect to the guidance document or code of conduct for seafarers, increased awareness, reductions in light and noise pollution, and better navigation could lead to a decrease in the disturbance to marine reptiles, cetaceans and seabirds (thereby leading to improved population heath). The conservation status of the species would also be improved.

Furthermore, international populations of marine reptiles, cetaceans and seabirds (because of migratory species) also stand to benefit, and in turn impact the local scenario.

Uncertainty/ certainty analysis

It is currently unknown whether the proposed code of conduct for seafarers could create any conflict with existing notices governing seafarer practices in respect of navigation. In spite of this, the development of guidance documents, if done with consultation with all stakeholders involved, can help protect seabirds, marine reptiles and mammals from noise and light pollution at sea. The measures' effectiveness is subject to levels of enforcement and monitoring, in the sense that uptake on the basis of voluntary participation might not be enough. At the same time, a guidance document cannot be "enforced".

Costs of the measure

The costs of establishing the two measures as combined together will benefit from a number of synergies and will include the following elements:

a. Tender drafting (involving stakeholder consultation), publication, and adjudication cost (for both MICMT-M072_NEW and MICMT-M074_NEW);

b. Data collection through stakeholder meetings;

c. Drafting and discussion/ approval of (two) guidance documents/code of good practice for reduction/mitigation of light pollution (i) emanating from developed urban/recreational/industrial areas, and (ii) within MPAs;

d. Information sessions with stakeholders;

e. Adoption, publication and dissemination of guidance documents/codes of good practice.

At this stage, it is difficult to gauge what the actual adoption of the guidance documents would entail. Additionally, given we are talking about guidance documents, monitoring and enforcement costs cannot be considered. Also, dissemination costs depend on the format and length of the code of conduct and guidance documents in question. Nonetheless, excluding element (e) above, the estimated costs would roughly be €20-25k for each measure.

5.1.2.6 MICMT-M010 Knowledge improvement on the interactions of seabirds with fisheries activity and definition of good practice as necessary

Note: this measure will be developed and implemented in synergy with measure MICMT-M005, and hence its assessment is included in Section 5.1.2.1 (MICMT-M005).

GES 1 & 4: Seabirds, marine reptiles and mammals - Results of the CEA

Table 4: GES 1 & 4: Biodiversity is maintained – seabirds, marine reptiles and mammals

Measure code	Specified measure	Effect on the gap	Annual costs (€)	Cost scale	Cost-effectiveness
MICMT-M005	Knowledge improvement on the interactions of marine reptiles and mammals with fisheries activity and definition of good practice as necessary	Reduce by-catch	€15k-20k Need for code of good practice not yet known, and hence not included in above cost	Low	Very cost-effective
MICMT-M006	Preparation and promotion of a code of good practice for sea-farers	Less disturbance and risk of collision in identified hotspots	€20-€25k	Low	The proposed measure is aimed at increasing awareness on conduct at sea within sensitive areas (for lighting and general disturbance)

					beyond existing regulations. Hence this can be cost-effective.
MICMT-M008	Awareness and education campaigns targeting disturbance issues in recreational areas where the presence of litter has been tied to rat predation	Better protection of seabird breeding populations	€10k-€15k Cost of any related equipment not included, since nature of such equipment is not yet known	Low	Generally very cost-effective, but if not all users of selected sites are successfully targeted approached, this can reduce cost-effectiveness.
MICMT-M009	Preparation of official guidance documents aimed at providing direction with respect to reduction/ control/ mitigation of light and noise pressures driven by both land-based and sea-based activities	Less noise and light pollution to seabirds	€20-€25k	Low	Official guidance can have an immediate impact on development permitting, and is hence deemed very cost-effective

5.1.3 GES Descriptor 3. The population of commercial fish species is healthy

5.1.3.1 MICMT-M011 Launching of an education programme targeting knowledge improvement to facilitate management of pressures associated with fishing activities

The gap analysis highlighted the need to address potential negative effects on vulnerable commercial stocks and the better management of discards and recreational fishery. However, the gap analysis was hindered by the lack of available information. In this regard, the new measure being suggested under this Descriptor relates to an educational/ training programme aimed at partly addressing the need for knowledge improvement, by raising awareness amongst professional and recreational fishermen (primarily through the engagement of relevant actors) in relation to the importance of the Fisheries data collection processes and to specific pressures identified through the gap analysis. Knowledge improvement would:

(i) enable Malta to broaden its contribution to D3 GES for a wider range of commercial species and to elaborate more concrete targets in this regard;
(ii) ensure a holistic approach towards sustainability by considering all aspects of fisheries; and
(iii) contribute to relevant GES/targets for MSFD Descriptor 1 in terms of non-commercial species which may be affected by fisheries activity.

Specifically, this new measure will include the following actions:

- engagement of relevant experts and development of an educational programme and material;
- identification of all relevant stakeholders and agreements with fishermen for the sharing of knowledge and experience; and
- implementation of the educational/ training programme by the relevant experts and fishermen.

The educational programme will seek to address the following aspects:

- improve species identification skills in relation to selected elasmobranchs or highly migratory species and raise awareness on relevant conservation measures and restrictions. Training will be provided on species identification and handling of live specimens on board, with sessions including training on-board vessels and visits at landing sites with relevant actors. Training will be open to professional and recreational fishermen as well as relevant Government officials;
- expose professional and recreational fishermen, through the provision of training material, to information on sustainable fisheries, increase their awareness on potential impacts of fishery on food webs and the importance of the data collection processes;
- raise awareness on the impacts of lost fishing gear and provide the opportunity to professional fishermen to share knowledge and experience in relation to fishing gear recovery and prevention of fishing gear loss.

This measure is aimed at providing the following impacts:

- equip relevant actors with the necessary skills to facilitate knowledge improvement in relation to potential effects of fishing activity on vulnerable commercial stocks, in particular elasmobranchs, through both targeted fishery and by-catch;
- disseminate information to professional and recreational fishermen on the need for sustainable fisheries, with a view to engage such actors in the data collection processes;
- disseminate information to professional and recreational fishermen on the impacts of lost fishing gear and engage professional fishermen in the provision of training to prevent damage or loss of fishing gear.

Effect of the measure/s on the gap

It is difficult to measure the gap, and expert judgement indicates low contribution of Maltese fishers to unsustainable fishing. Hence the measure is a first step at collecting and sharing data and information on a local basis in respect of commercially exploited fish and species – the effect likely to be positive and of a long-term nature, but difficult to quantify.

Uncertainty/ certainty analysis

Uncertainty stems from the lack of data on specific stock levels, lack of specific monitoring data to estimate the gap and the dose-effect relation of the measure. Uncertainty is also due to the need for voluntary take-up of such initiative by actors – actual response is unknown at this stage.

Costs of the measure

The direct costs related to this measure include (a) the time needed to draft the tender, evaluate bids and manage to engagement of third party experts, (b) the actual cost of the work to be undertaken by the third party experts, which will include content and material development, stakeholder meetings and meetings with fishermen, and (c) the actual cost of implementing the training (which could also include on-vessel visits). In this regard, on the basis of similar tenders, it is estimated that the process behind such a measure will cost c. €175k-200k.

GES 3: Commercially Exploited Fish & Shellfish - Results of the CEA

Table 5: GES 3 Commercially Exploited Fish & Shellfish

Measure code	Specified measure	Effect on the gap	Annual costs (€)	Cost scale	Cost-effectiveness
MICMT-M011	Education programme targeting knowledge improvement to facilitate management of pressures associated with fishing activities	Improved knowledge capacity for better decision-making and policy setting	€175k-€200k	High	As in the case with most measures targeting long-term educational benefits amongst stakeholders/ actors, and given the relatively manageable investment cost involved, the measure is likely to be cost-effective.

5.2 GES Descriptor 8. Concentrations of contaminants give no effects

5.2.1.1 MICMT-M012 Improvement and harmonisation of data collection processes in relation to contaminants reported in Maltese waters

Current measures pursuant to the WFD and WCMP propose the development of an open-data platform to which relevant government entities contribute, thus ensuring data and information sharing takes place. The data feeding into such platform constitutes data on sources and pathways of pollution - which data is already collated as part of sectoral operations. For instance, discharges into marine environment are reported by the energy company due to the compliance that comes attached to power stations' operational permit.

This measure seeks to ameliorate the relevance of the above-mentioned open-data platform for contaminants reported in the marine environment (in Maltese waters), in that, it proposed that, as a first stage, data collation points are mapped. This applies to various cycles of:

a) Importation;
b) Production;
c) Use; and
d) Discharge.

Such a measure will serve to gain a full picture of potential sources and pathways of the input of reported contaminants in the marine environment, from both land-based and sea-based sources. Consequently, any risk elements and risk areas (e.g. high mercury levels) can be identified, and improvements to the existing data collection process can be suggested. This final step will be done through active stakeholder participation, and can possibly involve the development of a protocol to guide such data collection processes.

Ultimately, what is required is a coordinated approach for the prevention and regulation of marine pollution across relevant sectors – the ultimate goal of this measure.

Effect of the measure/s on the gap

By undertaking operational actions as part of this measure, it will be possible to improve the current data collection processes. Thereafter, reported concentration of contaminants can be linked to sources and by all relevant parties, who would have contributed to the data sharing process. Consequently, mitigation measures can be timely implemented. With a fragmented approach, the process of identifying risk areas of contamination concentration would take longer and in the meantime, damage would have bene done to the marine environment.

Uncertainty/ certainty analysis

The insight into concentration of contamination can be limited due to gaps in the data, particularly with respect to transboundary sources, e.g. mercury levels in coastal areas, and sediment contamination. The impact of this measure on the gap remains uncertain due to the required level of collaboration by stakeholders – this is crucial to make the data sharing process work. Most importantly, after data is collated, any limitations in financial and human resources to effect any necessary improvements in existing processes will make any previous operational actions for this measure less effective.

Costs of the measure

The costs of establishing such a measure include:

a. Stakeholder meetings to Identify risk elements and risk areas, and deficiencies
b. Stakeholder meetings to effect implementation
c. Development of protocol and its approval by a number of stakeholders

The cost of the above depends on the number of stakeholders involved in the process. It is assumed that the parties involved in point (a) would include (apart from ERA) the Water Services Corporation, the Malta Competition and Consumer Affairs Authority, TM, the CSD, and the National Statistics Office, but potentially also key stakeholders from the relevant sectors. Based on this, the measure can be estimated to be around €5k, mainly in terms of stakeholder time involved.

5.2.1.2 MICMT-M013 Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes

Note: this measure will be developed and implemented in synergy with measures MICMT-M002, MICMT-M007 and MICMT- M019, and hence its assessment is included in ***Section 5.1.1.2*** *(MICMT-M002).*

Table 6: GES 8 Contaminants

Measure code	Specified measure	Effect on the gap	Annual costs (€)	Cost scale	Cost-effectiveness
MICMT-M012	Widen the scope of data sharing processes: working towards improvement and harmonisation of data collection processes	Enhances regulation and prevention of input of contaminants	c. €5k	Low	Depending on collaboration by stakeholders, this can be very cost-effective

5.2.2 GES Descriptor 10. Marine litter does not cause harm

5.2.2.1 MICMT-M014 Identification and mapping of areas with accumulated litter on the seabed and potential removal of such litter

In 2015 and 2016, as part of the LIFE BaħAR for N2K project, seabed surveys were undertaken to explore 420,000m^2 of the deep seabed (within the 25nm Fisheries Management Zone surrounding the Maltese Islands). Results showed the presence/ accumulation of discarded fishing gear, plastic, glass bottles and metallic objects (including rods, cables, discarded car parts and oil drums) in deep sea (LifeBaħar, 2017).

As a result, this measure is aimed at engaging stakeholders and collecting data through existing seabed surveys in order to undertake a mapping exercise in relation to areas of accumulated litter in our marine environment. A plan for the removal of such litter will result from this measure, taking into account:

a. Areas which need prioritization, especially MPAs;
b. Methods and costs of removal, including environmental impact assessments for litter removal; and
c. Waste management considerations.

Effect of the measure on the gap

With the removal of litter, the environment can be restored, while the economic value of the sea and its resources is improved. This is especially the case for sensitive biological elements hosted in identified MPAs. A holistic plan on the collection of marine litter allows for the prevention and reduction of marine litter in the first place.

Nonetheless, the effectiveness of this measure on the gap depends on the extent of areas subject to the removal of accumulated litter – especially if the areas which are mostly targeted are MPAs.

Uncertainty/certainty analysis

The effectiveness of the measure depends on a number of elements, including the extent to

which the accumulated litter can be removed without causing any further damage to the marine ecosystems. Since the implementation of this measure depends partly on the data collected, including seabed surveys, the accuracy and reliability of such data is crucial – the frequency by which seabed surveys are undertaken, for instance, is limited by weather conditions and as such can limit the reliability of data collected. This partly guides this measure. The participation of stakeholders in the data collection exercise is also key – lack of participation or willingness to share information on accumulated areas of marine litter in a bid to avoid costs for removal will limit the potential effectives of the measure.

Costs of the measure

The costs of this measure include the following elements:

a. Data collection including (i) stakeholder meetings and (ii) review of existing surveys
b. Mapping of areas with accumulated litter
c. Data analysis and identification of options for removal of litter
d. Plan for removal, including prioritisation, impact assessment, methods and costings of options
e. Tender drafting, publication, and adjudication cost for removal of marine litter
f. Removal of litter

The cost of such measure depends primarily on the number of areas which are being targeted as well as the method by which removal of litter (and its disposal) will be undertaken. As such, the cost of this measure, excluding element f. above, is estimated to range around c. €35k- €40k.

5.2.2.2 MICMT-M015 Establish formal collaboration with NGOs for participation in Mediterranean coastal clean-up day

The current government systems in place for control and removal of litter in coastal areas have been in recent years complemented by annual clean-up events organised by NGOs for litter washed ashore and litter on shallow seabed. One such example is the "Let's Do It Malta" day, a national clean-up event on the occasion of the Mediterranean clean-up day ("Let's do It Mediterranean")[16]. This represents a further opportunity for the Maltese community to contribute towards an environmental initiative on a regional scale. This new measure aims at establishing a formal collaboration between ERA and selected NGOs to establish a more consistent and long-term approach, facilitating participation in such initiatives.

Effect of the measure on the gap

One of the gaps previously highlighted related to the following aspect:

(i) while existing measures are deemed to adequately target litter washed ashore and litter in coastal areas, the role of NGOs in contributing to the removal of marine litter could be strengthened.

[16] Last organised in May 2015

In this regard, this measure is aimed at providing such an impetus to the role of local NGOs. This provides the NGOs with a further incentive to participate in community life, continue to contribute to society's goals, and increase member/ volunteer active involvement. Additionally, with stronger collaboration between ERA and NGOs, ERA/ MTA/ the Beach Cleansing Services Directorate are more likely to be in line with their environmental obligations (both national and international).

This measure is a 'mitigation and remediation tool' which aims to reduce litter left at beaches by the public, including tourists. Campaigns which serve to raise awareness and create public interest do help in keeping beaches clean as a first step, and also contribute towards a reduction in marine litter in coastal areas. In fact, the immediate effect of such a measure is having cleaner beaches (and country) by collecting floating and sunken garbage from coastal areas and trash from remote beaches. Malta also boasts of ten Blue Flag Beaches – it is the country's common aim to ensure that beaches have sustainable operations, excellent bathing water quality, and are litter-free (also through the organisation of similar environmental activities). Such initiatives contribute to maintaining the 'Blue Flag' status of current beaches, and possibly facilitating other beaches to achieve such a status.

At the same time, such initiatives increase environmental awareness and concern among Maltese citizens and other individuals residing on the island. As more volunteers participate in these actions, their individual efforts and changes in personal behaviour can have a ripple effect on the wider community, possibly leading to a gradual change in the mindset. In addition, this measure serves as an opportunity to collect data on the extent and type of marine litter found on Malta's coastal areas.

Cleaner beaches would also improve the tourist's Malta experience, and this could have a potential further benefit on the tourist industry – locally and on a Mediterranean scale – through increased repeat and new visitors (further explored in ***Section 4.2.6***).

Besides the local consideration, depolluting the Mediterranean sea is of crucial importance to every Mediterranean citizen and its users given that the contamination and level of plastic waste (especially micro plastic in certain areas) is critically high (Solutions, 2017).

Uncertainty/certainty analysis

The effectiveness of this measure and its impact on marine litter depends on the number of clean-up events that are organised as part of the envisaged collaboration agreement, the number of coastal areas covered, as well as the number of NGOs with whom such agreement is actually established, and the volunteers such NGO's manage to enrol. In this regard, the choice of NGO/s can make a difference on the measure's effectiveness given that the success of such collaboration and resulting events depends on the number of volunteers that decide to join the clean-up events.

Costs of the measure

The elements making up the estimated costs of such a measure include:

a. ERA meetings with the NGOs and related follow-up

b. Drafting of agreement(s)

c. Research undertaken for clean-up methodologies

d. Equipment or material to be provided to the NGOs for use in such clean-up events, including bags for disposal of hazardous waste and refuse collection gloves

e. Cost of marketing the event – this depends on the type of marketing media being chosen

The cost of such a measure depends on the number of events being organised (elements d. and e.) as well as the number of NGOs being brought into the collaboration (element a. and b.). Research for clean-up methodologies might already be available given current knowledge through other past clean-up events. Nonetheless, a measure of the like, assuming one agreement covering one event, and based on likely marketing costs, would approximately cost around €10k per event. This cost does not take into account time devoted by volunteers (administration of event; data collection; actual cleansing efforts).

5.2.2.3 MICMT-M016 Educational Campaign for seafarers on marine litter

The need for a measure addressing the knowledge of seafarers in respect of marine litter stems from the importance and impact the maritime transport sector has on the Maltese marine environment. In a factual context, the Mediterranean is in fact one of the top three traffic density hot spots globally, as 25% of the world's cargo vessels go through, the Sicily Channel, Strait of Gibraltar and the Suez Canal (MEPA, 2016). Focusing on Malta:

- Cargo transport is a key source of commerce for Malta, being both a junction of traffic lanes and also a reference point for various services related to cargo transport itself. By way of shipping, bunkering zones, and the fact that around 25% of the world's most dangerous cargo vessels pass through Malta, maritime transport represents a significant source of pollution by which debris is left at sea (MEPA, 2016)
- Passenger transport, especially around the Valletta Grand Harbour, and the route between the islands of Malta, Comino and Gozo, represents a further pressure point by which marine litter can increase (MEPA, 2016).

This measure will seek to reinforce the contribution of the maritime transport sector towards reduction of marine litter through an educational/ awareness raising campaign. In an effort to ensure participation by all parties, this campaign will be delivered through courses which seafarers are already required to attend in order to attain certificates to operate their vessels. These are:

1. The Basic Seamanship and Safe Boat Handling course – leading to the attainment of the Maltese Nautical License
2. Other courses for General Purpose Hand; Boatman; Boatmaster Grades 1 and 2; Mate; Master; Engine Driver Grade 1-3; Engineer – leading to attaining Certificates of Competency for employment on local commercial vessels
3. The Safety at Sea Campaign - organized on a yearly basis by the Authority for Transport in Malta.

The educational campaign's course content itself will in turn contain information on the

impacts of marine litter and the role that seafarers have in addressing this pressure. There will also be promotion of on-board waste disposal facilities. The campaign will be supplemented by awareness-raising material given to course attendees.

Effects of the measure on the gap

This measure is a communication tool that aims to reduce marine litter on the seabed by targeting seafarers. Monitoring and compliance checks as to the tasks forming part of the role of seafarers could further supplement in making such educational campaign a success and reduce marine litter at sea.

Uncertainty/certainty analysis

The effectiveness of this measure depends on how much of the information gathered is actually implemented by seafarers, in terms of behaviour and practices with respect to marine litter. Especially with seafarers operating recreational-use vessels, this uncertainty is also highly correlated with the inconvenience any new measures will create to recreational users in terms of change in behaviour and need for compliance. Also, despite the promotion of on-board waste disposal facilities, much of the implementation again remains a question of seafarers' voluntary action (also given the additional cost). Unless some form of assessment after course completion or checks on compliance are made, the impact of such a measure on marine litter can be uncertain.

Costs of the measure

The estimated costs of this measure are made up of:

a. Preparation of awareness material to be used in the educational campaign
b. Marketing cost attached to the awareness material (such as flyers), including design and publication costs
c. Delivery of information sessions for seafarers in the form an information segment taking place in the courses mentioned above

The cost of such a measure depends on the type of material to be disseminated. A rough estimate indicates a cost of c. €15-20k.

5.2.2.4 MICMT-M017 To identify options for re-designing fishing gear or practices to reduce discarded or lost fishing gear

As previously mentioned, seabed surveys do indicate the presence of fishing gear in deep sea. Fishermen often complain about the difficulty of getting rid of old fishing equipment - owners of landfills very often refuse to take this kind of waste (Independent.com.mt, 2017b)[17]. This situation, together with information derived from the LIFE BaHAR for N2K project (LIFE12 NAT/MT/000845) project outlined in the PoM, drives the need for changes in practices and the design of fishing gear which is currently subject to discard in the marine environment, especially in respect of Fish Aggregating Devices (FADs) used in 'lampuki' fishing.

[17] In 2016, about 8,000 kg of old fishing nets were collected in Malta.

The measure itself will serve to identify alternative designs, set-ups or practices that could prevent further marine litter through discard/loss of nets and ropes at sea. The implementation of such options amongst selected fishermen will then follow through a pilot study. For instance, in respect of FADs, as per discussions with the Department of Fisheries and Aquaculture, alternatives can include the use of long-lasting biodegradable ropes, and use of mobile FADs. In the Netherlands, such options also included the use of compostable nets as an alternative to biodegradable nets – the latter help in reducing ghost fishing, however, they tend to break up easily into smaller parts and as such increase the problem of micro plastics in the marine environment (LEI Wageningen UR, 2012).

Effects of the measure on the gap

Once best technical option/s for redesigning of fishing gear/practices are selected, reduction in marine litter from discarded fishing gear could result. In addition, spill-over effects of knowledge sharing of traditional knowledge on the relevant fishing practices amongst fishermen may also result, leading to a further reduction in marine litter. Accidental losses of fishing gear will not be impacted, but discarding can definitely be lowered.

Uncertainty/certainty analysis

The impact of the measure on the gap may be affected by the fact that certain proposed measures are not agreed upon by all stakeholders, especially fishermen. If strong competition exists in the market, knowledge-sharing amongst fishermen as to the best practices to minimize discard might also be stifled. Ultimately, without enforcement, it is difficult to know who is actually applying changes to fishing gear or practices in open seas, unless the purchase of new fishing gear is recorded as against appropriate discard of old one.

Costs of the measure

The costs of establishing such a measure constitute a number of elements, such as:

a. Tender drafting, publication, and adjudication cost for carrying out the study
b. Cost of study to identify options
c. Pilot study (depends on option selected)
d. Stakeholder meetings to discuss results
e. Evaluation of pilot study

The overall measure cost depends on the outcome of the study, that is, the option(s) which will be implemented as part of the pilot study. The cost of the evaluation of the pilot study also depends on the selected option(s). As such, without components (c) and (e), the cost of the measure is estimated to be around €50k-€75k. The pilot study is likely to lead to capital costs having to be incurred – again, depending on the option(s) selected, the capital cost will vary, but at this stage it is impossible to determine its cost.

5.2.2.5 MICMT-M018 Implementation of "Fishing for Litter" scheme

The implementation of the "Fishing for Litter" scheme in Malta originates from the commitment of contracting parties to the Barcelona Convention in line with the UNEP/MAP Regional Plan for the Marine Litter Management in the Mediterranean. Such scheme should adhere to the 'Guide on Best Practices for Fishing for Litter in the Mediterranean' adopted by COP 19, Decision IG 22/10 UNEP/MAP in February 2016, as outlined in the PoM for this descriptor.

As the name may imply, the scheme will involve the collection, to the extent possible, of litter caught incidentally during fishing activities. The way this measure will operate is through:

(i) Identification of adequate landing facilities and adequate waste collection facilities

(ii) Purchasing and distribution of collection material for fishermen

(iii) Stakeholder engagement for implementation of the scheme

(iv) Implementation of fishing for litter activities by fishermen (on a voluntary basis) according to established guidelines.

Effects of the measures on the gap

Collection and disposal of marine litter from the sea leads to a reduction in marine litter. For instance, in the Netherlands, results show that in 2009, a project involving 69 different vessels contributed to the collection of 228,000 kg of litter, increasing to 300,000 kg of litter in 2010 with the involvement of an additional 11 vessels (LEI Wageningen UR, 2012). With the removal of litter, the environment can be restored, as well as improve the economic value of the sea and its resources.

Besides, such measure serves as an educational and public relations tool as awareness of the problem of marine litter is raised amongst fishermen. Also, the removal of litter is not just an end of pipe measure. It also helps to prevent the dumping of litter in the first place – it is easier to dump litter on deck rather than overboard. However, the way by which such dumping takes place on-board vessels may lead to contamination risks to fishermen's catch (LEI Wageningen UR, 2012).

The way by which such initiative is implemented also impacts the effect on the gap - initiatives as in Southern Europe to licence fishermen to fish for litter resulted also in biota by-catch which ultimately negatively impacts the seabed (LEI Wageningen UR, 2012).

Uncertainty/certainty analysis

There is no information on the amounts of litter present at sea. The effect is likely to be positive, but difficult to quantify, since the implementation of the scheme depends on voluntary participation of fishermen. Additionally, it is still unclear whether the scheme would be providing any incentives to induce further participation of fishermen and increase the measure's chances of success. Also, other operational matters such as the disposal of litter on-board vessels also needs to be determined. The above considerations have an impact on the effectiveness of the measure on marine litter.

Costs of the measure

The estimated costs of the measure include:

a. ERA meetings with stakeholders (TM and DFA) to identify landing facilities
b. Tender drafting, publication, and adjudication cost in respect of waste landing facilities, as well as material for the collection of marine litter, based on costs for implementing other directives focusing on major impact on water management - this depends on how the scheme will work
c. The development of waste collection facilities (landing sites)
d. Waste collection tools (including distribution of such tools) – this depends on how the scheme will work
e. Cost of marketing the scheme

The cost of such measure depends on the actual setup of the scheme. At the time of analysis the type of on-board mechanisms or installations on-board are unknown, as well as the location and number of landing facilities that will be constructed to make sure the scheme works. Also, the cost of such a measure depends on the selected media chosen to market the scheme. Nonetheless, excluding cost [d] to [e] above, it is estimated that this measure would approximately cost €20k-25k.

Results of the cost-effectiveness analysis

Table 7: GES 10 Marine litter

Measure code	Specified measure	Effect on the gap	Annual costs (€)	Cost scale	Cost-effectiveness
MICMT-M014	Identification and mapping of areas with accumulated litter on the seabed and potential removal of such litter	Less marine litter on the seabed yet negative impact on seafloor integrity can arise	c. €35k-40k for preparatory costs. Actual litter removal costs depend on number of areas selected	Medium	Depending on the need for removal of litter which will only be sought in case of no additional impact on seafloor integrity, this can be cost-effective
MICMT-M015	Establish formal collaboration with NGOs for participation in Mediterranean coastal clean-up day	Less litter on the beach	c. €10k per event	Low	Depending on the number of events organised, and considering low investment cost required, can be very cost-effective
MICMT-M016	Educational Campaign for seafarers on marine litter	Less litter on seabed	c. €15k-20k	Low	Depending on the extent to which seafarers implement what they learnt, this can be very cost-effective
MICMT-M017	To identify options for re-designing fishing gear or practices to reduce	Less litter on seabed	c. €50k – 75k, excluding investment cost of selected options to be	Medium	Depending on the outcome of the pilot study, this can be cost-effective

	discarded or lost fishing gear		piloted (and evaluated), which are still not determined.		
MICMT-M018	Implementation for "Fishing for Litter" scheme	Less marine litter on the seabed yet negative impact on seafloor integrity can arise	c. €20k-25k, excluding cost of waste collection facilities/ landing sites	Low	Depending on voluntary participation and the investment outlay, this can be very cost-effective

5.2.3 GES Descriptor 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

5.2.3.1 MICMT-M019 Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes

Note: this measure will be developed and implemented in synergy with measures MICMT-M002, MICMT-M007, MICMT-M009 and MICMT- M013 and hence its assessment is included in ***Section 5.1.1.2*** *(MICMT-M002).*

5.3 Cost-benefit analysis

An estimation of economic benefits would require quantitative information on:

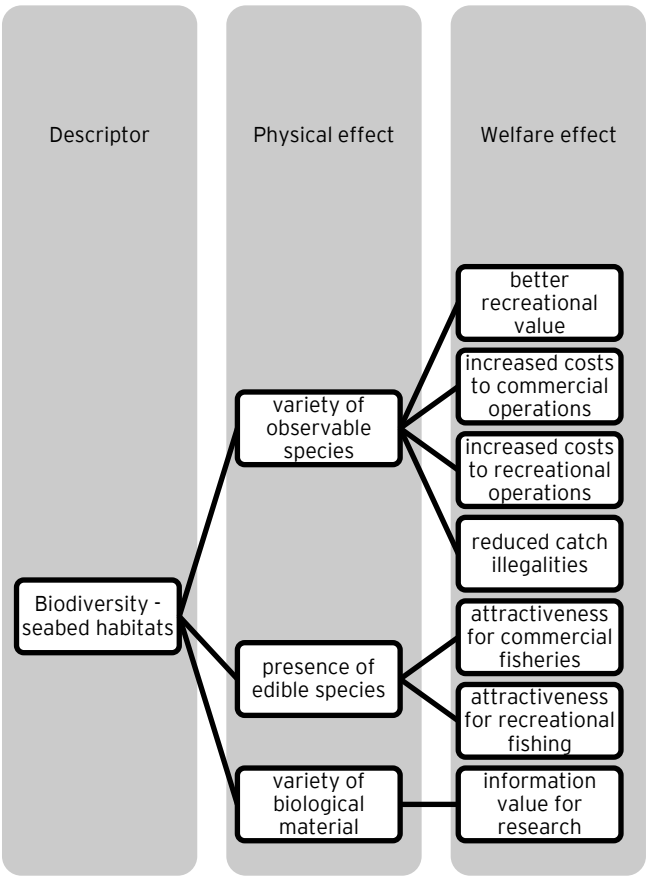
- The baseline (e.g. tonnes of marine litter; current fish populations; amount of annual discharged fishing gear, etc.)
- Targets to be achieved by each measure (e.g. increase in fish population by X%; tonnes of marine litter to be collected; amount of discharge fishing gear to be collected, etc.)
- Economic values (typically willingness-to-pay values)

For the various measures under the different descriptors below, it is impossible to carry out a full CBA due to the lack of information on the baseline and targets. The below sub-sections present simplified CBAs per descriptor and per measure, providing a qualitative description of direct and indirect socio-economic and environmental benefits and costs.

5.3.1 GES Descriptor 1, 4 & 6: Biodiversity is maintained – seabed habitats

Figure 1 shows the LDI for the physical and welfare effects related to biodiversity with respect to seabed habitats.

Figure 1: LDI for GES descriptor 1, 4 &6: Biodiversity is maintained – seabed habitats



Economic costs and benefits

1. *Additional costs and changes in commercial and recreational operations*

Measures under this descriptor, though possibly leading to increased biodiversity and a larger variety of observable species, also implies changes to current operations. This inherently could bring about an increase in costs for operators – from bunkering operators (which is an important source of local economic activity) to users of fishing vessels and pleasure yachts. The increased regulatory burden could make some of the areas in Maltese waters unattractive if designated mooring areas are applied – as opposed to simply anchoring boats or ships anywhere.

Besides the inconvenience caused, further time is lost in mooring a boat or ship – a thirty minute anchoring operation could now be transformed into an hour and a half operation in the case of permanent mooring berths. Additionally, the cost of mooring services would have to be incurred. Given the cost-consciousness of such operators, there is therefore the risk that significant operations, especially bunkering, could shy away from Maltese coastal and offshore waters. Malta, through its strategic location, is attracting a good share of the Mediterranean market, and has the potential to grow more (Pisani, 2017). As a result, the loss in GDP contribution could represent a significant indirect costs.

Furthermore, other operators involved in oil exploration and marine scientific research in offshore waters can be impacted negatively if environmental permitting/ compliance costs increase. This may be especially taxing in the case of small companies (who do not have in-house resources to fill in standard forms) and companies applying for permits linked to marine scientific research in offshore water – although it cannot be estimated, research, especially in such an area where data is limited, is quite valuable.

Ultimately, as a result of measures targeting assessment of current practices across various areas (offshore operations, fishery, diving), the affected parties need to acquaint themselves with changes to current practices as per any proposed code of conduct/ good practice, in an effort to reduce the pressures on seabed habitat (including benthic communities).

2. *Better recreational experiences*

A benefit of introducing alternatives to anchoring, such as a permanent mooring system, is the increased tourism opportunities through large vessels, mainly cruise liners which previously did not consider the Maltese Islands (especially Gozo given its lack of a cruise - liner terminal) in their itinerary. This was the case when a mooring buoy was installed off Xlendi Bay (Independent.com.mt, 2017a).

Through reduced anchoring and selection of appropriate alternative such as mooring, improvements in species composition/ abundance, as well as status of seabed can be observed. Indeed, in terms of economic benefits, a better recreational experience will result for all, including divers. Also, through potential management of mooring within bays, another economic benefit is derived as swimmers can possibly better enjoy swimmers' zone.

At the same time, the recreational experience of users of pleasure craft can be impacted

negatively and as such represent an economic cost of MSFD measures targeting biodiversity – Malta is advertised as a 'premium yachting destination' and management of anchoring may be viewed as restriction of their activities with potential negative impacts on Malta's attractiveness, and the financial and economic benefits generated by such users (direct spend on the yachting industry, and indirect spend on accommodation, restaurants and other aspects). The crowding of areas where pleasure crafts are currently anchoring remains a dilemma – it is difficult to assess whether crowding at certain places causes distress or inconvenience to current yachters, or whether it is something which they are not concerned with.

3. *Attractiveness for recreational and commercial fishing*

Recreational fisheries put a high value to the presence of fish population for private consumption purposes (LEI Wageningen UR, 2012). In this regard, MSFD measures impacting recreational fishing by improving the fish population would result in an economic benefit linked to the value assigned to fishing. Data related to Maltese recreational fisheries is not available, however, ensuring that there is presence of edible species means that there may be a lower tendency to shift towards other species. In terms of commercial fishing, scarcity of some species may drive up prices – thereby pushing away sales and driving down revenues. At the same time, another direct economic benefit of MSFD measures leading to improved biodiversity is the reduction of impacts through of by-catch of sensitive or otherwise protected species under various (national/ international) regulations.

4. *Information value for research and knowledge sharing*

The MSFD measures which impact biodiversity, specifically seabed habitats, provide an indirect value-added component through research collation that supports the measures. In fact, having a variety of biological material implies that existing data collection processes can be enhanced – with a proper inventory of data and information (including that in relation to offshore operations, benthic communities and caves), policy change and practices which negatively impact the marine environment can be targeted, whilst better management of MPAs can result. Inevitably, any data gathering exercise represents an indirect cost for recreational and commercial users of the sea but also serves as an instrument for increased knowledge and implementation of best practices going forward. Also, more environmental awareness is raised as MSFD measures related to biodiversity of seabed habitats are implemented – across various stakeholders including commercial users (marine scientists, operators in offshore waters, bunker operators, fishermen) and recreational users (divers, yachters).

The assessment of relevant socio-economic and environmental costs and benefits related to the various measures under this descriptor have been further re-explored and classified per separate measure as per Table 8 below:

Table 8: CBA for measures under GES descriptor 1, 4 &6: Biodiversity is maintained – seabed habitats

Measure code	Measure description	Socio-economic and environmental costs	Socio-economic and environmental benefits	CBA outcome
MICMT-M001	Pilot	▸Additional costs	▸Better	The extent of the

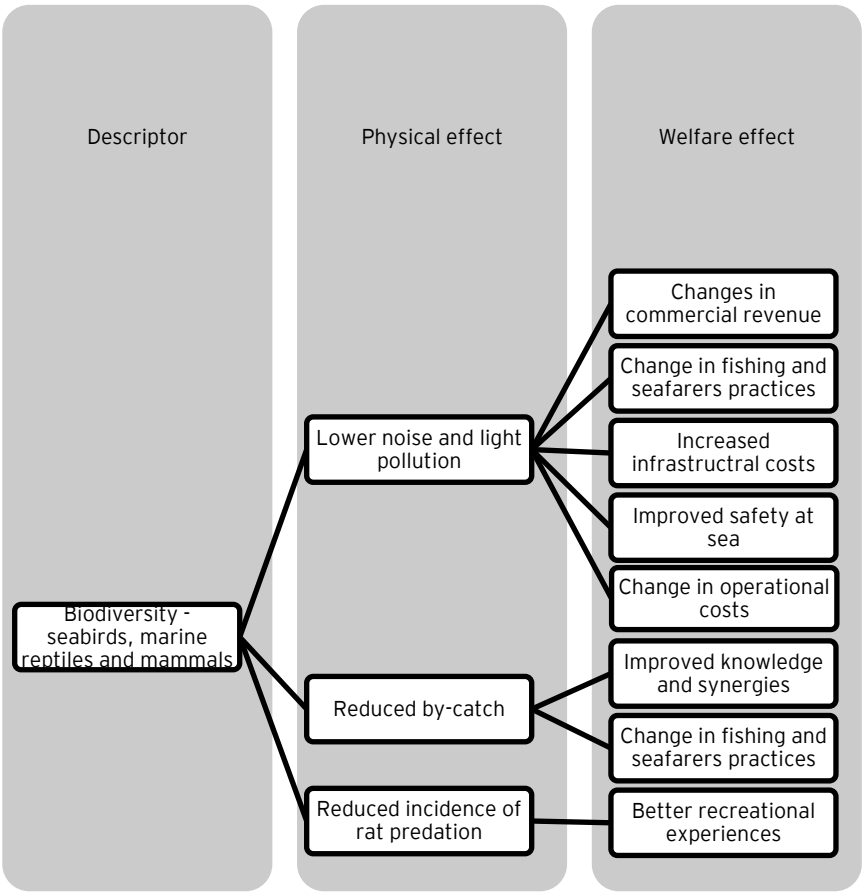
	implementation of selected management options aimed at addressing impacts from anchoring on the seabed	(including reduced attractiveness) and changes in commercial and recreational operations: changes to current practices/operations for bunkering and fishing (economic activity might be negatively impacted), and yachting (limit the value-in-use/ "freedom").	recreational experiences: increased tourism opportunities through large vessels, and a better recreational experience for divers (less damage to seabed and benthic communities) and swimmers (swimming zones) ‣Information value for research and knowledge sharing: relevant entities to obtain information on current impacts, potential options and evaluation of selected option, to guide future policy and improve management of situation (e.g. management of MPAs) ‣Environmental improvements in species composition/ abundance, seagrass meadows (for MPAs), reefs and other sensitive seabed habitats and related ecosystem services.	impact of current anchoring activity on the seabed is still uncertain. On the other hand, the yachting and bunkering industries are important contributors to the Maltese economy. B/C ratio is hence highly dependent on findings of study and application and extension of pilot.
MICMT-M002	Strengthening liaison between relevant Government bodies with a view to streamline MSFD requirements in offshore licensing and permitting regimes	‣Additional costs and changes in commercial operations: Regulatory burden linked to increase of environmental permitting/ compliance costs; time needed for stakeholders to acquaint themselves with changes to current practices as per any proposed guidance document	‣Information value for research and knowledge sharing: ERA (and CSD) are more likely to be in line with their international and environmental obligations. Permitting also provides increased data collection opportunities. ‣Habitat types and species, water quality (reduced pollution from contaminants and underwater noise)	Compliance costs on companies of different size are likely to increase, but extent of benefits linked to reduction of various impacts (seabed habitats and species, contaminants, underwater noise) is unknown. Hence B/C ratio depends on extent of benefits emanating from this measure.

			in selected areas can be maintained in GES.	
MICMT-M003	Inventory of fishery activity in coastal MPAs designated for the protection of seabed habitats	▸Information value for research and knowledge: data provision burden for data collection purposes through stakeholder meetings (small-scale fishermen and divers)	▸Information value for research and knowledge sharing: Through the inventory, improved knowledge on fishing activity within MPAs; Enhanced data collection process which supplements the existing fisheries data collection processes. ▸Facilitating MPAs management to ensure protection of habitats.	Given information value of data/research compared to limited cost involved, benefits should outweigh costs, resulting in a positive B/C ratio.
MICMT-M004	Awareness Raising Campaign on protected species associated with benthic communities	▸Attractiveness for recreational activities: Time needed for divers to acquaint themselves with new Code of Conduct, as well as change in behaviour of divers in order to abide by the new Code of Conduct, could reduce the attractiveness of the activity.	▸Better recreational experiences and positive environmental impact: the environment can be improved through the reduction in the collection of protected benthic species and potential control of other pressures exerted by divers, leading to a better recreational experience of divers themselves. ▸Information value for research and knowledge sharing: Collation of knowledge on other pressures exerted by divers (beyond the impact on benthic communities; Opportunity for divers to contribute to the safeguarding of their activity.	Given the relatively low cost of compliance and benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.

5.3.2 GES Descriptor 1& 4: Biodiversity is maintained – seabirds, marine reptiles and mammals

Figure 2 shows the LDI for the physical and welfare effects related to biodiversity with respect to seabirds, marine reptiles and mammals.

Figure 2: LDI for GES descriptor 1 & 4: Biodiversity is maintained – seabirds, marine reptiles and mammals



Economic costs and benefits

1. *Better recreational experiences*

Increasing biodiversity through measures targeting disturbance issues in recreational areas where the presence of litter has been tied to rat predation (e.g. through awareness campaigns) implies an indirect economic benefit for users of such recreational areas. In fact, the public stands to enjoy better recreational experiences with a lower incidence of rat predation (which leads to improved biodiversity and improved seabird habitats). At the same time, there is a cost to the public because, inevitably, change in behaviour and attitudes will be required – this also takes time to get accustomed to.

2. *Change in fishing and seafarers practices*

Measures targeting fishing practices imply additional economic costs in terms of time

devoted by fisherman to participate in data collection/ sharing process. In addition, fishermen and seafarers need to acquaint themselves with changes to current practices as per any proposed code of conduct/ good practice, in an effort to reduce noise and light pollution practices (including from underwater acoustic equipment), as well as reduce and mitigate by-catch. For instance, this includes greater effort by fishermen to implement newly learnt procedures for handling injured and dead marine reptiles and mammals.

At the same time, an indirect economic benefit to fishermen results since MSFD measures can lead to reduced bycatch which is economically detrimental to the fishermen (loss of gear; death of seabirds and marine reptiles and mammals; reduced space on board vessel).

3. *Changes in commercial revenue*

Latching on to the above point, changes in commercial revenue represent an indirect cost to sea-farers and operators of land-based activities. In minimizing noise and light pollution, there might be restrictions on certain activities such as boat parties and entertainment activities in coastal locations – which are highly in-demand in the summer season as part of the promoted touristic experience, and hence this could negatively impact the revenue streams of such operators.

4. *Increased infrastructural costs*

MSFD measures ensuring biodiversity through lower noise and light pollution imply a change in behaviour and practices of hoteliers/ restaurateurs/ on-shore establishments. This implies that urban/infrastructural planners, architects, and developers also need to feature measures to reduce or mitigate noise and light pollution in associated infrastructure plans in sensitive areas (e.g. soundproof doors and windows) – thereby increasing the cost of development. This is a key considerable for a sector which is deemed of significant importance to the local economy.

5. *Change in operational costs*

An indirect cost relating to reduction in noise and light pollution results. Existing land-based activities will need to change their lighting practices such as dimming outdoor and beachfront lighting, thereby benefiting from lower operational costs.

As also the case for GES 1, 4 &6, operators involved in oil exploration and marine scientific research in offshore waters can be impacted negatively through increased compliance costs.

6. *Improved safety at sea*

By ensuring appropriate adherence to codes of conduct or guidance documents in relation to navigation at sea, more safety at sea is ensured. This clearly carries an indirect economic benefit.

7. *Improved knowledge and synergies*

Through the MSFD measures, relevant entities will be benefiting from increased knowledge and information sharing. Also, more information will be gathered from the fishing community and this would directly impact biodiversity (e.g. knowledge on reduced incidence of by-catch disturbance, contributing to conservation of loggerhead turtle and seabirds). Any data gathering exercise (e.g. incidents) represents an indirect cost for seafarers but also serves as an instrument for increased knowledge and implementation of best practices going forward.

Also, synergies across various environmental efforts taken up by authorities and NGOs in Malta will be enabled, and as such an indirect economic benefit is derived through a reduction in effort duplication. For instance, through awareness campaigns and devising of educational material and code of conduct:

- management of MPAs will be facilitated;
- the MSFD PoMs will be contributing to the collective conservational actions also undertaken by governmental authorities and NGOs in reducing by-catch; and
- There will further improvements/ synergies with other codes of conduct and conservation efforts by the Natura 2000 network.

The assessment of relevant socio-economic and environmental costs and benefits related to the various measures under this descriptor have been further re-explored and classified per separate measure as per Table 9 below:

Table 9: CBA for GES descriptor 1 & 4: Biodiversity is maintained – seabirds, marine reptiles and mammals

Measure code	Measure description	Socio-economic and environmental costs	Socio-economic and environmental benefits	CBA outcome
MICMT-M005; MICMT-M010	Knowledge improvement on the interactions of marine reptiles and mammals with fisheries activity and definition of good practice as necessary	▸Additional costs to fishermen: time devoted to participate in data collection/ sharing process to devise code of good practice ▸Change in fishing practices: seafarers need to acquaint themselves and apply best practice examples in respect of own fishing practices	▸Reduced bycatch leading to conservation of loggerhead turtle and seabirds. ▸Improved knowledge and synergies: fishing community to benefit from spill-over effects related to sharing of fishing best practices; increased knowledge and information sharing; Synergies across collective conservational actions in reducing by-catch.	Costs of compliance are relatively low. Extent of bycatch in Maltese waters uncertain. B/C ratio is dependent on the extent of benefits.
MICMT-M006	Preparation and promotion of a code of good practice for sea-	▸Change in seafarers practices: Voluntary change in behaviour of sea-farers due to	▸Improved safety at sea: By ensuring appropriate adherence to	Recreational activities linked to the tourism industry may be

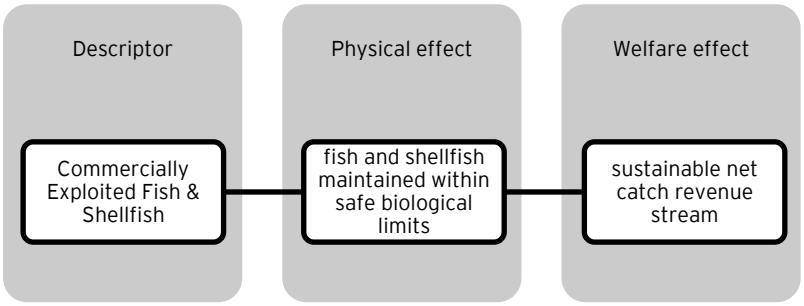
	farers	code of good practice will require greater effort. ▸Additional costs to seafarers: time devoted by seafarers to participate in data collection/ sharing process (e.g. incidents) ▸Changes in commercial revenue: restrictions on certain recreational activities could negatively impact the revenue streams of such operators	proposed code of good practice in relation to navigation at sea, more safety at sea is ensured ▸Environmental impact: facilitating the management of MPAs; Decrease in the disturbance to marine reptiles, cetaceans and seabirds; Conservation status of species is improved; benefits to international populations.	negatively impacted – the extent of such impact is still to be evaluated. There is real existing potential for reduction of noise and disturbance through this measure (given immediate impact). Hence B/C ratio depends on extent of (unknown) costs.
MICMT-M008	Awareness and education campaigns targeting disturbance issues in recreational areas where the presence of litter has been tied to rat predation	▸Change in recreational experiences: public's change in behaviour and attitudes will be required following awareness and education campaign.	▸Better recreational experiences: public will enjoy better recreational experiences ▸Synergies: campaign will link up with other conservation efforts by Natura 2000 network. ▸Environmental impact: improved habitat conditions; benefits to the international populations of migratory seabirds	Given the relatively low cost of compliance and benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.
MICMT-M009	Preparation of official guidance documents aimed at providing direction with respect to reduction/ control/ mitigation of light and noise pressures driven by both land-based and sea-based activities	▸Increased infrastructural costs: measures to reduce/mitigate noise and light pollution in associated infrastructure plans in sensitive areas increase the cost of development for hoteliers/ restaurateurs/ on-shore establishments, thereby also affecting contribution of such activity (tourism) to the Maltese economy.	▸Improved safety at sea: By ensuring appropriate adherence to guidance documents which build on existing regulations in relation to navigation at sea, more safety at sea is ensured ▸Change in operational costs: lower light-related costs for land-based activities may result ▸Synergies: further improvements/	Recreational activities linked to the tourism industry may be negatively impacted – the extent of such impact is still to be evaluated. There is real potential for reduction of noise and light pollution through this measure (given immediate impact). Hence B/C ratio depends on extent of (unknown) costs.

		▸Changes in commercial revenue: restrictions on certain recreational activities could negatively impact the revenue streams of such operators	synergies with other codes of conduct and plans as per the Natura 2000 network. ▸Environmental impact: facilitating the management of MPAs; Decrease in the disturbance to marine reptiles, cetaceans and seabirds; Conservation status of species is improved; benefits to international populations.	

5.3.3 GES Descriptor 3. The population of commercial fish species is healthy

Figure 3 shows the LDI for the physical and welfare effects related to commercially exploited fish and shellfish.

Figure 3: LDI for GES descriptor 3: Commercially Exploited Fish & Shellfish



Economic costs and benefits

1. *Information sharing and synergies*

In terms of direct economic benefits, by implementing the educational programme, the PoMs will contribute to better fisheries data collection processes (also benefiting the Department of Fisheries and Aquaculture and fishermen themselves). In addition, by strengthening the management of fisheries' stock, the relevant entities will be better aligned with Malta's fisheries Management plans and its legal enforcement.

2. *Sustainability of industry*

Indirectly, if the training programme is successful, the measure would contribute (even if not in a significant way) to ensuring fish and shellfish are maintained to support maximum sustainable yield. And if the sustainability of fish stocks is maintained, the livelihood of the Maltese fisheries industry that commercially exploits such a resource is also protected -

commercial fishery as such is based on economic benefits. Another indirect economic benefits relates to possible reduced marine litter through reduced entanglement and ghost fishing. Also, if migratory species are better managed, there will be a positive ripple effect on other Member States sharing the same stocks.

3. *Increased operational cost*

In terms of economic costs, for those fishermen who choose to participate, time will need to be devoted to attend information/ training sessions, provide feedback, and also allow time for visits on-board vessels (if relevant). After the communication of the educational material, some fishermen might change their usual practices to conform to findings/ best practices, which represents a cost (apart from the benefits referred to above).

The assessment of relevant socio-economic and environmental costs and benefits related to the various measures under this descriptor have been further re-explored and classified as per Table 10 below:

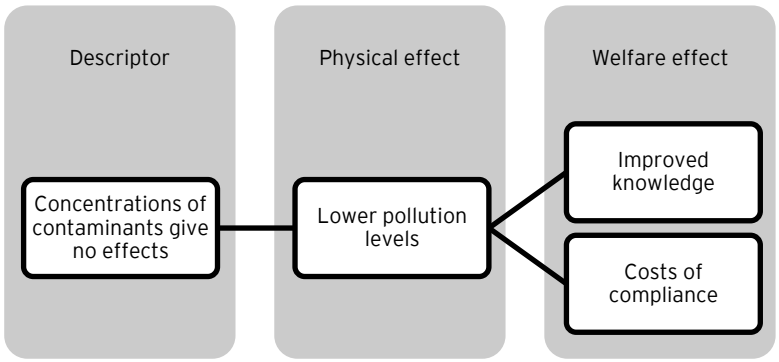
Table 10: CBA for GES descriptor 3: Commercially Exploited Fish & Shellfish

Measure code	Measure description	Socio-economic and environmental costs	Socio-economic and environmental benefits	CBA outcome
MICMT-M011	Launching of an education programme targeting knowledge improvement to facilitate management of pressures associated with fishing activities	▸Increased operational cost: Time allocated by fishermen to attend information/ training sessions, allow visits on-board vessels and also time to get acquainted with and conform to resulting best practices	▸Information sharing & synergies: better fisheries data collection processes; better alignment with Malta's fisheries Management plans and its legal enforcement ▸Sustainability of industry: ensuring fish and shellfish are maintained and reduced marine litter through reduced entanglement and ghost fishing will support maximum sustainable yield. If migratory species are better managed, there will be a positive ripple effect on other Member States sharing the same stocks	Given the likely cost of compliance/data collation compared to the benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.

5.3.4 GES Descriptor 8. Concentrations of contaminants give no effects

Figure 4 shows the LDI for the physical and welfare effects related to concentrations of contaminants in the marine environment.

Figure 4: LDI for GES descriptor 8: Contaminants



Economic costs and benefits

1. *Improved knowledge*

In terms of direct economic benefits, by working with other stakeholders to improve and harmonise the data collection processes in relation to concentration of contaminants, relevant entities are more likely to be in line with their international and national obligation, and as a result are in a better policymaking position. All relevant parties will also have access to improved knowledge through the availability of more data.
By having a comprehensive data platform, and based on the successful compilation of a database, long-term management of selected contaminants is improved, such that the level of marine pollution (especially with respect to chemicals) can be better regulated and prevented.

2. *Additional compliance costs*

In terms of economic costs, these relate to regulations or protocols emanating from data collected and strengthening of relationships as part of the chain of measures for this descriptor - certain industries (and maritime activities) might have to bear additional compliance costs in order to enhance the current data collection process as well as comply with newer considerations within the environmental permitting process (as encountered for GES descriptor 1, 4 &6, and GES descriptor 1&4)

The assessment of relevant socio-economic and environmental costs and benefits related to the various measures under this descriptor have been further re-explored and classified as per Table 11 below:

Table 11: CBA for GES descriptor 8: Contaminants

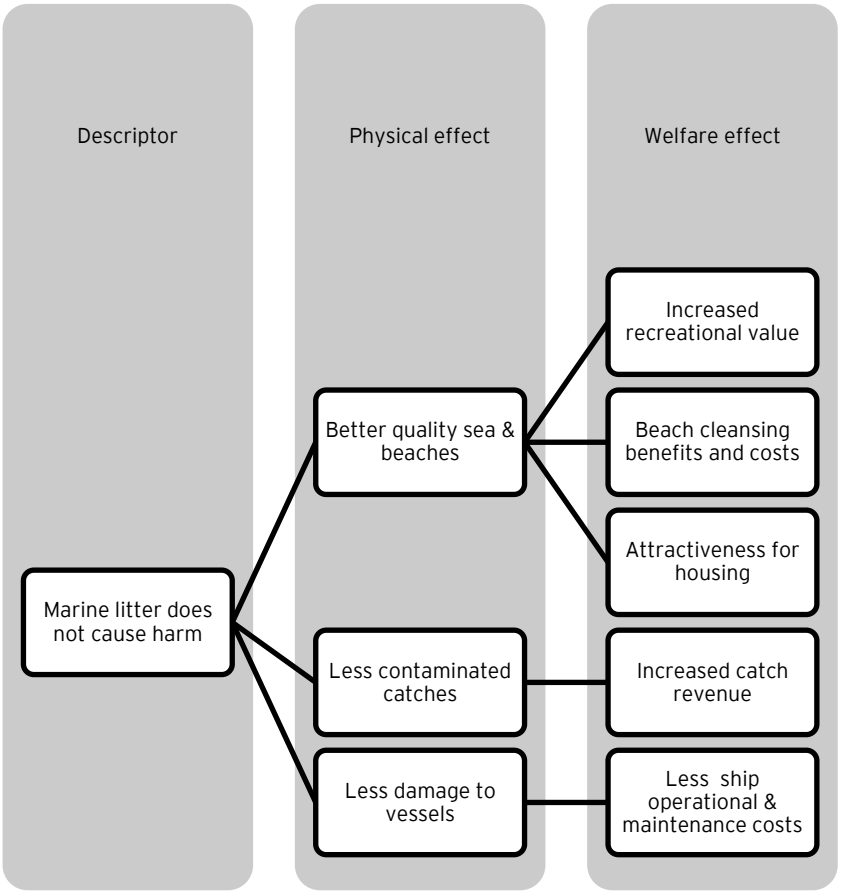
Measure code	Measure description	Socio-economic and environmental costs	Socio-economic and environmental benefits	CBA outcome
MICMT-M012	Improvement and harmonisation of data collection processes in relation to contaminants reported in Maltese waters	▸Additional compliance costs: certain industries to bear extra costs to enhance data collection process as per eventual findings/protocol	▸Improved knowledge: Relevant entities are more likely to be in line with their international and national obligations, and as	The information value of data/research is high. The extent of compliance costs are dependent on findings of current data collection

			a result are in a better policymaking position; access to improved knowledge through the availability of more data ▸Improvement in long-term management of selected contaminants; the level of marine pollution can be better regulated and prevented	processes. With low compliance costs, a positive B/C ratio is likely to result.

5.3.5 GES Descriptor 10. Marine litter does not cause harm

Figure 5 shows the LDI for the physical and welfare effects related to marine litter. Only effects related to direct and indirect use values are shown. In particular health damage to marine species and individual organisms as well as damage to ecosystems and habitats are not taken into account. On the other hand potential benefits are shown.

Figure 5: LDI for GES descriptor 10: litter (only use value related effects shown)



Economic costs and benefits

1. *Beach cleansing benefits and costs*

The benefits of the MSFD measures aiming at a reduction of litter at beaches, including through the formalisation of clean-up events, mainly revolve around:

1. Direct use effect: reduction in beach cleansing costs
2. Indirect use effects: attractiveness of the beach for recreation and increased attractiveness of the seaside.

The costs of beach cleansing constitute variable costs related to the equipment and disposal of collected litter (e.g. waste separation; landfilling; incineration). The cost of direct labour can be waived due to the participation of volunteers during clean-up initiatives. Selected literature in the area shows that in the UK, 63% of beach cleansing costs can be attributed to labour, 12% to disposal and 10% to collection (Mouat et al. (2010), cited in LEI Wageningen UR (2012). Furthermore, whilst beach cleansing is taking place, disturbance to the users of the beach will result, especially if such initiative is taking place during the spring and summer months.

In terms of benefits, the impact of a reduction in litter depends on a number of factors, such as the number of targeted beaches for cleansing, and the intensity of removal of litter at the site. Such data is not yet available for the local scenario, thus inhibiting the possibility of estimating the impact of such a measure. Literature, however, does indicate that only a substantial reduction of litter would generate larger benefits (LEI Wageningen UR, 2012), as evidenced in the case of Den Haag (cited in LEI Wageningen UR (2012). For instance, two studies look into the reduction in beach cleansing costs through such initiatives:

- Mouat et al. (2010), cited in LEI Wageningen UR (2012): average costs of beach cleansing in the Netherlands (and Belgium) stands at €34,400/km/year
- McIlgorm et al. (2011), cited in LEI Wageningen UR (2012): mechanical shoreline clean-up for France stands at €32,600/km/year

In addition, in terms of qualitative benefits, a feel-good factor is created amongst the community of labourers or volunteers participating in beach cleansing initiatives or events – irrespective of the scale of impact, contributing towards a larger cause creates a good vibe amongst the wider community.

2. *Increased recreational value*

Clearly, litter free beaches are more attractive than litter spoilt beaches – for both aesthetical reasons and potential health hazards (Mouat et al., 2010, Ten Brink et al., 2009, cited in LEI Wageningen UR (2012). A litter-free area enhances the user experience and helps prevent users from shying away to different areas of the island – whilst the Maltese economy in general might not be impacted as a whole, regional differences may be experienced as users displace themselves from one geographical area of the Maltese Islands to another (e.g. a shift towards a particular well-kept and unspoilt beach, leading to unsustainable pressures of overcrowding in this area). In the long run, however, litter might

not just regionally displace visitors, but might "force" visitors to look for other countries as their touristic destination (e.g. reduced repeat visitors). A similar argument also applies to recreational experiences related to diving and yachting. At the same time, the reduction of marine litter in relation to any recreational use of marine waters and its impact on water quality carries with it additional indirect costs - recreational users (e.g. yachters) need to acquaint themselves with new compliance procedures in order to safeguard said water quality.

Naturally, hotels and restaurants are impacted in this process as the number of visitors change and there is a limit on the premium one can charge for a 'sea view experience', or a clean 'beach view experience'.

Given the lack of data on marine litter in Malta, monetization of this effect cannot be undertaken. Also, data about the relation between the level of litter pollution and deterrence of tourists in wider literature is limited (Mouat et al., 2010, cited in LEI Wageningen UR (2012), whilst Willingness To Pay (WTP) estimates are not uniform across users either. However, attempts to estimate such relationship derived the following results[18]:

- Ballance et al. (2000): 85% of South African beach visitors would not visit a beach with a litter density of more than 2 items/m.
- Ruigrok (2008): Based on the deterrence of swimmers due to low water quality, the effect of litter is monetised at €3m/year for the Dutch North Sea shore.
- Le Goffe (1995): WTP for improved water quality of 38.90 €/household/year in France
- Markowska and Zilicz (1996, 1999): WTP for improved water quality of 4.42-137.36 €/person/year in Poland
- Söderqvist (2000): WTP for improved water quality of 72.00 €/person/year in Sweden
- Hanley et al.(2001): WTP for improved water quality of 11.40 €/person/year in Scotland
- Hanley and Kristrom (2002): WTP for improved water quality of 11.84-19.44 €/person/year in Scotland
- Mourato (2003): WTP for improved water quality of 8.64-17.28 €/household/year in England/Wales
- Kosenius (2004): WTP for improved water quality of 24.90 €/person/year in Finland
- LEI Wageningen UR (2012): WTP of Dutch households for improved water quality ranges from €61-€122m/year

3. *Attractiveness for housing*

Living in a good neighbourhood carries with it a premium in the form of higher prices for housing. In fact, usually houses in the vicinity of beaches derive a part of their value from sea and beach views given that these are considered attractive. However, the relation between having clean beaches and coastal waters and the price of houses is largely circumstantial. The estimation of such a link for the local scenario is limited due to unavailability of data related to: (i) affected beaches and coastal area in past initiatives; and (ii) average price of houses overlooking different-quality beaches in different localities. A number of international studies have however attempted to perform a rough estimation of

[18] Studies below were cited in LEI Wageningen UR (2012)

such relationship, taking into account the fact that house prices are affected by other variables:

- Ruigrok (2008), cited in LEI Wageningen UR (2012): an increase in value of 0.5% of house prices and a volume of 56,300 houses affected by improvement of beach quality in Netherlands, resulting in a maximum annual benefit of €2.2m.
- LEI Wageningen UR (2012): reduction of 50% of litter generated annual benefits of less than €1m in Netherlands

4. *Catch revenue and aquaculture*

Marine litter in the sea, especially smaller plastic objects, affects the quality of catches for fishermen – increased marine litter leads to a degradation of catches and as such decreased catch revenue. Reasons for these impacts include ghost fishing, and reduced fishing time due to fish selection in catches (LEI Wageningen UR, 2012; Mouat et al., 2010). Similarly, aquaculture operators lose costly time to remove debris around stock cages (Mouat et al., 2010). As such, the benefits of measures targeting marine litter are represented by increased catch revenue and better aquaculture. At the same time, the reduction of marine litter through the involvement of fishermen who collect and land marine litter on board their vessels present a potential cost for fishermen due to risk from contamination on-board vessels results.

Due to data limitations, the link between marine litter and fishermen's catches in the local scenario is unknown, however, a few studies suggest that:

1. Losses from contamination amount to €2,200/year/vessel (Mouat et al., 2010, cited in LEI Wageningen UR, 2012).
2. Lost fishing time by a single trap fisher in Scotland was translated into a cost of $38,000 in 2002 (Macfadyen et al 2009, cited in Mouat et al., 2010).

5. *Commercial operational & maintenance costs*

The effect of marine litter on commercial operations (ships), considered as benefits of measures targeting marine litter, is twofold: ships (from fishery vessels and aquaculture producers to pleasure crafts) incur extra operational and maintenance costs due to marine debris (especially large pieces of litter or ropes) – mostly resulting in fouled propellers, anchors, blocked intake pipes and valves. The economic costs related to such damages are represented in time lost due to delays, reparation cost, and also passenger lives (LEI Wageningen UR, 2009)

Operational costs have been monetised in some studies as follows[19]:

- Ferry traffic: an effective cleaning system in Asia cost €14,000/year/vessel (McIlgorm et al., 2010)
- Fishery vessels: damage to Scottish finishing vessels cost €180/year/vessel (Mouat et al., 2010)
- Removal of debris and disentangling fouled propellers: £1,200 per incident (Hall 2000)

In terms of maintenance costs, repairing of nets, but mostly cleaning of nets represents a major cost of marine litter, monetised as follows:

[19] The below studies were cited in LEI Wageningen UR (2012)

- Cleaning of nets: time lost of 41 working hours/year/vessel for Scottish vessels (Mouat et al., 2010, cited in LEI Wageningen UR, 2012)
- Repairing of nets: amounts to one third of clearing costs, equating €3,800/year/ vessel for Scottish vessels (Mouat et al., 2010, cited in LEI Wageningen UR, 2012)

As for other commercial operations such as fishing vessels and commercial recreational cruising, indirect economic costs and reduction in revenue linked to costs of implementing of measures targeting marine litter, arise, in the form of:

i. Potential changes in fishing practices, including replacement of fishing gear deemed as leading to unsustainable fishing and marine litter (e.g. FADs);
ii. Inconvenience in the form of time spent on collection and landing of litter by trawlers (as well as reduced space for landing of fish catch if landing of litter takes up limited space available). Fuel costs for this additional time spent towards collection of marine litter represents another inconvenience. If any installations on-board vessels are required, and as such there is reduced space for landing of fish catch, lost catch revenue may result;
iii. Additional costs to comply with guidance on reduction of marine litter arises (e.g. installing waste disposal facilities; informing their recreational users of need for compliance).

6. *Improved knowledge and synergies*

Through some of the MSFD measures which involve a data collection process (as by-product), relevant entities will be benefiting from increased knowledge and information sharing. Also, more information will be gathered from the fishing community and this would directly impact marine litter (e.g. fishing practices which need to be targeted).

Also, synergies across various environmental efforts taken up by authorities in Malta will be enabled, and as such an indirect economic benefit is derived through a reduction in effort duplication. For instance, through educational campaigns, devising of educational material and code of conduct, and stronger collaboration on setting up of environmental events:

- The PoMs will help link up better with international and national policies and projects (e.g. Marine Litter management in the Mediterranean; Common Fisheries Policy & MARPOL convention; UNEP/MAP Regional Plan for the Marine Litter Management)
- The PoMs will be contributing to the collective conservational actions also undertaken by NGOs in beach cleaning.

The assessment of relevant socio-economic and environmental costs and benefits related to the various measures under this descriptor have been further re-explored and classified per separate measure as per Table 12 below:

Table 12: CBA for GES descriptor 10: litter

Measure code	Measure description	Socio-economic and environmental costs	Socio-economic and environmental benefits	CBA outcome
MICMT-M014	Identification and mapping of areas with accumulated	▸Information value for research and knowledge: data provision burden	▸Environmental impact: with the removal of litter, the environment	Given the value of information and synergies, as well as improvement to the

	litter on the seabed and potential removal of such litter	for data collection purposes through stakeholder meetings	can be restored, as well as improve the economic value of the sea and its resources, especially for MPAs. ‣Synergies: PoMs will help link up better with international and national policies and projects in this area	marine environment, benefits should outweigh costs and a positive B/C ratio is expected to result.
MICMT-M015	Establish formal collaboration with NGOs for participation in Mediterranean coastal clean-up day	‣Recreational value: Inconvenience to beach users during clean-up events might be caused	‣Beach cleansing: reduction in beach cleansing costs by any private operators (given volunteering) ‣Increased recreational value: cleaner beaches lead to better recreational experiences of tourists and users of beaches/seaside in general. The industry sector of hotels and restaurants is also positively impacted as users go for good (litter-free) sea view or beach views. ‣Feel-good factor: volunteering in initiatives leads to a feel-good factor amongst volunteers and wider community ‣Attractiveness for accommodation and housing: property close to cleaner beaches will carry a higher premium ‣Improved knowledge and synergies: Synergies will be achieved across ERA and NGOs; ERA/MTA/Beach Cleansing Services Directory more likely to be in line with their environmental	Given the relatively low inconvenience costs (which can be waived depending on circumstances) and the synergies to be achieved across similar measures, benefits should outweigh costs, resulting in a positive B/C ratio.

			obligations; more information on marine litter through the data collection process. ▸Environmental impact: a reduction in marine litter can be obtained.	
MICMT-M016	Educational Campaign for seafarers on marine litter	▸Knowledge: seafarers need to devote time to acquire new knowledge in existing courses. ▸Commercial operational costs: seafarers might incur costs to install waste disposal facilities on board their vessels, and inform their recreational users of need for compliance. ▸Recreational value: recreational users also need to acquaint themselves with new compliance procedures.	▸Increased recreational value and attractiveness for accommodation and housing: reduced sea surface marine litter implies better swimming experiences and better sea views ▸Improved knowledge and synergies: Through an educational campaign, relevant entities is likely to be in line with their environmental obligations ▸Environmental impact: Reduction in marine litter (and better water quality) will result. ▸ Reduced aquaculture costs: aquaculture operators benefit from a reduction of costly time to remove debris around stock cages ▸Reduction in commercial maintenance costs: less marine litter leads to lower maintenance costs in terms of repairing and cleaning of nets, as well as operational costs in terms of damage to ships and disentangling fouled propellers.	Given the relatively low cost of compliance and benefits likely to accrue, benefits should outweigh costs, resulting in a positive B/C ratio.
MICMT-M017	To identify options for re-designing fishing gear or practices	▸Commercial operational costs: Depending on choice of option,	▸Increased catch revenue: Reduced ghost fishing, contamination of	Benefits accruing to the fishing industry and marine environment itself

	to reduce discarded or lost fishing gear	operators selected for pilot will be "obliged" to change practices during the course of this study.	catches and reduced fishing time due to fish selection in catches will result in increased catch revenue. ▸Reduction in commercial operational and maintenance costs: less marine litter in the form of discarded fishing gear leads to lower maintenance costs in terms of repairing of nets, as well as operational costs in terms of damage to ships and disentangling fouled propellers ▸Improved knowledge and synergies: relevant entities are more likely to be in line with their environmental obligations (e.g. Common Fisheries Policy & MARPOL convention).	are important whilst costs of compliance are relatively low. Fishing practices which need to be targeted are however unknown, hence the B/C ratio is dependent on findings of study and application and extension of pilot
MICMT-M018	Implementation for "Fishing for Litter" scheme	▸Catch revenue: collection of hazardous litter risks contamination of fish catch, whilst reduction of on-board space for fish landing might reduce catch revenue. ▸Commercial operational costs: fishermen need to devote time for collecting and landing of litter by trawlers, and will also face increased fuel costs because of increased weight. Installation of waste collection facilities in landing sites will cause inconvenience to other commercial operators and once completed, reduce	▸Environmental impact: reduction of marine litter in "trawling areas"; environmental restoration; benefit to MPAs; increased economic value of the sea and its resources. ▸Reduced aquaculture costs: aquaculture operators benefit from a reduction of costly time to remove debris around stock cages ▸Reduction in commercial maintenance costs: less marine litter leads to lower maintenance costs in terms of repairing and cleaning of nets, as well as	The impact on operational costs and revenues is unknown given uncertainties surrounding the implementation of the scheme. The extent of the impact of marine litter on commercial operations is also uncertain. The B/C ratio will be dependent on the extra costs to be borne and the extent of benefits to be accrued.

		space of operations for fishermen.	operational costs in terms of damage to ships and disentangling fouled propellers. ▸Improved knowledge and synergies: With implementation of the scheme, Relevant entities are more likely to be in line with their environmental obligations (e.g. UNEP/MAP Regional Plan for the Marine Litter Management in the Mediterranean)	

5.3.6 GES Descriptor 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

Ensuring the consideration of impulsive sounds as an environmental issue when permitting activities in offshore waters (and use of best practices in this regard) affects the ecosystem and the marine environment through the reduction of noise pollution. This links up with economic costs and benefits (welfare effects) in the areas of changes to seafarer practices, which have already been encountered in GES descriptor 1, 4&6, GES descriptor 1&4, and GES Descriptor 8.

6. Conclusion

This final section of the report provides an overview of the key study limitations, a summary of the CEA and CBA, as well as reference to other relevant information to be used during the decision-making process.

6.1 Limitations

a. Due to the complexity of the marine environment, there is currently limited knowledge in relation to the links between measures and their effects on the marine environment (i.e. dose-effect relations). Given the lack of information on the effect of the measures (particularly the new ones), in some cases Member States' experiences and expert opinion were used to guide the assessment of cost-effectiveness and economic costs and benefits.

b. Due to data limitations and uncertainties related to selection of technical options (which represent the outcome of some of the measures), it is not possible to quantify the exact costs and effects of every measure. Cost estimation methods are used to fill such gaps, but such estimates represent the best available information to date, and hence are by nature imprecise.

c. The PoMs do not consider alternative measures to achieve the same objectives and hence the "least cost" assessment and a ranking was not possible. Assessment was based on a cost scale consideration.

d. The methodology applied for is relevant in circumstances of limited data availability as it reveals the missing knowledge gaps that enable a fully-fletched CBA to be carried out. In this regard, as most of the targets are of a qualitative nature, and dose-effect relations are missing, the information currently available was not sufficient available for a full CBA. Whilst the physical and welfare effects of potential measures were identified, they could not be quantified. Similarly, the pressures being addressed by a measure were identified, but the extent of the contribution of such measures upon achieving GES is not yet known.

6.2 Summary of CEA and CBA

The CEA highlights that most of the measures are cost-effective, with eight of them related to educational campaigns and strengthening of relationships and existing environmental efforts being assessed as very cost-effective. Some proposed measures are, however impacted by a high degree of uncertainty given the complexity of the marine environment, the lack of information linked thereto, as well as uncertainty on the actual eventual results following the measure.

The CBA in itself provides an economic justification for the adoption of the measures as part of the MSFD PoMs. As per the simplified CBAs, eight of the measures are expected to give a positive B/C ratio – the majority being related to data collation and knowledge increase initiatives (events; educational and awareness campaigns; inventory-type of study; data collection processes). In terms of breakdown by descriptor:

i. Measures related to improved biodiversity through seabed habitats lead to a greater variety of observable species (including edible species) and biological material, which

manifest themselves in a mix of welfare effects: increased attractiveness for commercial and recreational fisheries (which however are also impacted by increased costs due to changes in current operational regulations), better recreational value and reduced by-catch, and information value for research. ***Data on targeted habitat types and species, based on availability of long-term data on distribution and abundance of species and habitat types, would enable quantification of the effects of these measures. Nonetheless, the simplified CBA shows that a positive B/C ratio could emerge for measures linked to data collation and education/awareness raising whilst other measures are linked to the extent of benefits as well as the findings emanating from the implementation of the measure itself.***

ii. Measures related to improved biodiversity through seabirds, marine reptiles and mammals lead to lower noise and light pollution, reduced by-catch, and reduced incidence of rat predation. In turn, changes in commercial revenue and in practices of seafarers are expected – this could lead to higher operational costs to abide by newer guidance. At the same time, increased safety at sea and better recreational experiences are to be experienced. ***The availability of long-term data with respect to by-catch and species' population distribution and abundance would establish trend data. This, together with data on targeted recreational areas and seabird breeding sites, would enable quantification of such measures. Nonetheless, the simplified CBA shows that a positive B/C ratio is likely to be linked to the measure involving education/awareness raising whilst other measures depend on the extent of costs emanating from compliance with code of conducts or guidance documents for the operation of users in the industry.***

iii. Measure related to concentration of contaminants may lead to lower pollution from said contamination and as such welfare effects of improved knowledge and costs of compliance result. ***Quantification of such welfare effects was however not possible due to the lack of quantitative targets set for this descriptor (e.g. no deterioration trends for synthetic contaminants in relevant matrices). Nonetheless, the simplified CBA shows that the measure linked to data collation is likely to produce a positive B/C ratio whilst the other measure linked to offshore operations is linked to uncertainties on the extent of benefits.***

iv. Measures related to marine litter lead to better-quality sea and beaches, less contaminated catches, and less damage to vehicles which in turn leads to positive welfare effects: increased recreational value, attractiveness for accommodation and housing, increased catch revenue, and less ship operational and maintenance costs. ***The lack of data on marine litter (especially microplastics) as well as the qualitative environmental target for this descriptor rendered quantification of such measures impossible. Nonetheless, the simplified CBA shows that three out of the five additional measures provide a positive B/C ratio, with the outcome of other measures dependent on operational actions of the measure and findings emanating from implementation of the measure itself.***

v. The measure related to underwater noise is linked with a reduction in noise pollution, as encountered in other descriptors. The welfare effect again is here linked to compliance costs for commercial operators. ***The lack of qualitative targets for this descriptor, however did not enable quantification of the measure. The simplified CBA shows that the B/C ratio for this measure (which applies to other descriptors) depends on the extent of benefits to the marine environment (reduction in pressures).***

6.3 Other relevant information

Besides the above considerations and outcomes deriving out of the CEA and CBA, it is imperative to take into account other relevant information for the feasibility and sustainability of measures in the PoM that enhance the decision-making process. This information relates to the following aspects:

1. Stakeholder engagement

Whilst the effect and distribution of effect of measures on stakeholders has been taken into account, direct stakeholder engagement beyond that which was covered by this Study (e.g. divers, fishermen, industry) adds more certainty to the CEA and CBA outcomes and ensures that the measures to be implemented do not bring about issues of fairness, affordability, regulatory or administrative burden, or unprofitable investment in terms of ineffective benefits to society.

2. Public perception

Whilst a number of measures are a means by which to increase awareness of several pressures impacting the marine environment, gauging the consideration of civil society towards the various descriptors ensures the implementation of measures is successful. Whilst awareness on marine litter is quite considerate amongst public, public view on the problem of anthropogenic pressures and impacts on seabirds, reptiles & mammals, commercially exploited fish & shellfish, and underwater noise might represent a knowledge gap to be tackled.

3. Transboundary cooperation

Some measures in the POMs impact other member states and the international populations of targeted species by way of the migratory nature of such targeted species. Our territorial waters and their use are also subject to agreements and political ties with a number of geographically-close countries. In such cases, transboundary cooperation ensures that individual member states' measures are effective. It also allows for synergies to be leveraged in case of identification of common environmental problems, knowledge and experience sharing, and the creation of a regional data and information system.

4. Links with other policy areas

Consideration of other EU policies, namely the WFD, the Birds and Habitats Directives, the EU Biodiversity Strategy, and the Maritime Spatial Planning Directive is important to guide the implementation of particular measures in the PoMs, especially those which contain the selection of technical options for pilot implementation.

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