AIS ENVIRONMENT

Monitoring Strategy for the MSFD Descriptor 4 Trophic Guilds Monitoring Programme

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Report

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1 INTRODUCTION

The Environment & Resources Authority (ERA) has been entrusted with designing the monitoring programme for marine trophic guilds (Food Webs, Descriptor 4). This requirement branches out from the objectives of the MARINE STRATEGY FRAMEWORK DIRECTIVE (MSFD, 2008/56/EC), whereby all Member States are required to achieve "good status" in Maltese waters, including coastal surface waters.

In line with the requirements of SPD8/2021/016, the project involves the preparation of three distinct reports, as outlined below:

Result 1: Report detailing the identification of the trophic guilds and constituent species best suited to be representative of local marine ecosystems, as well as relevant associated spatial scales and assessment methodologies to be applied in determining Good Environmental Status (GES) in relation to the Marine Strategy Framework Directive's (MSFD) (2008/56/EC) Descriptor 4, 'Food Webs', in accordance with the criteria and methodological standards detailed in Commission Decision (EU) 2017/848.

Result 2: A long-term data collection and monitoring strategy, including an assessment methodology to ensure:

a. Collection of sufficient and adequate data for the assessment of the identified trophic guilds and species, at the identified scale of assessment, being cognizant of existing data sets and collection strategies in effect;
b. Appropriate analysis and interpretation of data for the assessment of Good Environmental Status (GES) in relation to the Marine Strategy Framework Directive's (MSFD) (2008/56/EC) Descriptor 4, 'Food Webs'; in accordance with the criteria and methodological standards detailed in Commission Decision (EU) 2017/848.

Result 3: A report outlining details of the implementation of selected monitoring processes as identified through Result 2 and including raw and analysed data in relation to MSFD Descriptor 4 criteria as stipulated in Commission Decision 2017/848/EU.

This document represents Report 2, which henceforth is referred to as the Monitoring Strategy for assessment of MSFD Descriptor 4 in line with SPD8/2021/016.

1.1 BACKGROUND

The objective of SPD8/2021/016 is to design a monitoring programme for MSFD Descriptor 4 and implement it on a pilot basis. Descriptor 4, which relates to food webs, is based directly on trophic guilds, and has been established by Annex I of the

MSFD 2008/56/EC as: "*All elements of marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.*" The exercise involves developing a long-term data collection and monitoring strategy to assess the environmental status of Maltese waters in line with MSFD Descriptor 4 and implement it on a pilot basis.

Trophic guilds are non-taxonomic groups of species with similar diet compositions.[1] Such groups are useful in assessing the environmental status of water bodies to determine whether anthropogenic impacts have had a detrimental effect on the functioning of food webs, through MSFD Descriptor 4. Determining the environmental status of Maltese waters in relation to Descriptor 4 of the MSFD will be carried out by means of criteria and indicators used to assess the status of various trophic guilds.

Four criteria have been established for Descriptor 4:

- D4C1 – Primary: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures.
- D4C2 – Primary: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures.
- D4C3 – Secondary: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures.
- D4C4 – Secondary (to be used in support of criterion D4C2, where necessary): Productivity of the trophic guild is not adversely affected due to anthropogenic pressures.

The primary criteria 1 and 2 of Descriptor 4 were established by ICES in 2014, while the secondary criteria 3 and 4 were established by the Working Group on Good Environmental Status in 2017.[2,3] The ICES guidance document provides a matrix of the relationship between trophic guilds and taxonomic groups (Table 1).

Section 1.2 gives a brief description of the trophic guilds to be used as part of the MSFD Descriptor 4 monitoring strategy, as identified from Report 1. Section 1.3 gives a brief description on existing data collection processes. Section 3 provides the proposed data collection & monitoring strategy, while Section 4 outlines the methodology to be used to assess Maltese waters in line with MSFD Descriptor 4.

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[1] Yodzis, P., & Winemiller, K. O. (1999). In Search of Operational Trophospecies in a Tropical Aquatic Food Web. *Oikos, 87*(2), 327–340. https://doi.org/10.2307/3546748.

[2] ICES (2014). *Report of the Workshop to review the 2010 Commission Decision on criteria and methodological standards on good environmental status (GES) of marine waters; Descriptor 4 Foodwebs*, 26-27 August 2014, ICES Headquarters, Denmark. ICES CM 2014\ACOM:60. 23 pp.

[3] Walmsley, S.F., Weiss, A., Claussen, U., Connor, D., (2017). *Guidance for Assessments Under Article 8 of the Marine Strategy Framework Directive, Integration of assessment results.* ABPmer Report No R.2733, produced for the European Commission, DG Environment, February 2017.

TABLE 1: TROPHIC GUILDS IN RELATION TO TAXONOMIC GROUPS[2]

GUILD/ TAXONOMIC GROUP	PHYTOPLANKTON[4]	ZOOPLANKTON	BENTHOS	NEKTON, EXCL. WARM-BLOODED	SEABIRDS	MARINE MAMMALS
Primary producers	X					
Secondary producers		X				
Filter-feeders			X			
Deposit feeders			X			
Planktivores			X	X	X	X
Sub-apex pelagic predators				X	X	X
Sub-apex demersal predators			X	X	X	X
Apex predators				X	X	X

[4] In shallower waters, macrophytes may also be important.

1.2 TROPHIC GUILDS & REPRESENTATIVE GROUPS/SPECIES

The below trophic guilds will be used for the fulfilment of MSFD Descriptor 4 assessment of Maltese waters:

- Primary producers (PP)
- Sub-apex demersal predators (SDP)
- Apex predators (AP)

Primary production is defined as the synthesis of organic compounds from atmospheric or aqueous inorganic nutrients, predominantly from carbon dioxide. It represents the basis of all food webs, and in the pelagic marine ecosystem, virtually all primary production is carried out by phytoplankton, which are therefore known as primary producers. For this reason, proxies to primary production such as ocean colour or chlorophyll-a concentration are often used as predictors of the potential fisheries yield of the world's oceans.[5] There is in fact a strong relationship between primary productivity and fisheries production over long-time scales.

Sub-apex demersal predators are organisms living close to the seafloor who naturally prey on other organisms, but are themselves prey to larger predators. These organisms include a variety of species such as small fish (such as haddock and cod) elasmobranchs (such as small sharks and small rays), molluscs (such as small gastropods, bivalves and cephalopods) and crustaceans (such as lobsters and crabs).

Apex predators are organisms who naturally prey on other organisms but do not have natural predators; these organisms are therefore termed top predators. These organisms include a variety of species such as fish (such as salmon and barracuda), elasmobranchs (such as large sharks and large rays) and cephalopods (such as large squid).

The trophic level (TROPH) of a species gives an indication on where it falls within the food web, and species are assigned trophic levels between 1 to 5.5, depending on their diets.[6] Applying the TROPHs methodology, which is based exclusively on the basis of stomach content data, herbivorous and detrivorous fish species were assigned values of 2.0, whilst carnivorous and piscivorous fish species were assigned values closer to 5.0. For the Mediterranean Sea, the highest recorded TROPHs were those of 4.5, corresponding to *Dentex dentex, Xiphias gladius, Zeus faber* and *Thunnus thynnus* (TROPH values from 4.3 to 4.5), followed by *Seriola dumerili, Scorpaena scrofa, Merluccius merluccius, Lophius budegassa, Saurida undosquamis and Etmopterus spinax* (TROPH values from 4 to 4.21).

However, trophic level values are not set in stone and vary depending on the age of

[5] Uusitalo, L., Hällfors, H., Peltonen, H., Kiljunen, M., Jounela, P., Aro, E. (2013). *Indicators of the Good Environmental Status of food webs in the Baltic Sea.* GES-REG. WP3: Advance knowledge base to support assessment of GES.

[6] Stergiou, K., & Karpouzi, V. (2001). Feeding habits and trophic levels of Mediterranean fish. *Reviews In Fish Biology and Fisheries*, *11*(3), 217-254. doi: 10.1023/a:1020556722822.

the individual (e.g. TROPHs for *M. merluccius* at sub-adult stage is that of 3.43, whilst the corresponding value for adults of the same species is that of 4.20) and the geographic location in which it is found (for instance, western and central Mediterranean TROPHs for the same species differ). For the purposes of this assessment, sub-apex demersal predators constitute all demersal consumers with a trophic level of 4 or less, while apex predators constitute all species with a trophic level greater than 4.[7] This threshold is being drawn along arbitrary lines, taking into consideration the existing range of TROPHs for the Mediterranean Sea. Ideally, once data from other methodologies emerges (e.g. stable isotope analysis, fatty acid analysis), the recommended threshold should be reassessed for possible revision. These thresholds should also be discussed and agreed on a regional basis.

Report 1 (Action Plan) of SPD8/2021/016 identified the following representative groups/species for the purposes of the MSFD Descriptor 4 assessment:

- **Primary producers**: diatoms & dinoflagellates
- **Sub-apex demersal predators**: *Illex coindetii*, *Octopus vulgaris, Merluccius merluccius*
- **Apex predators**: *Squalus blainville*, *Heptranchias perlo*, *Coryphaena hippurus*

Detailed investigation on their TROPHs in the Mediterranean Sea revealed that *M. merluccius* has a TROPH of 4.17, which renders it unsuitable for use as a representative of the sub-apex demersal predator group.[6] On the basis of their TROPH value (confirming that the species belong to the particular trophic guild), two additional species were added to the list of sub-apex demersal predators and one was added to the apex predator list to increase representation of each trophic guild. For the purposes of the MSFD Descriptor 4 assessment, Table 2 presents the updated list of representative taxonomic groups/species for each trophic guild.

TABLE 2: PROPOSED TROPHIC GUILDS AND REPRESENTATIVE GROUPS/SPECIES FOR MALTA'S D4 ASSESSMENT

TROPHIC GUILD	REPRESENTATIVE GROUPS/SPECIES	TROPHS
Primary producers	Phytoplankton	1
	Diatoms	1
	Dinoflagellates	1
Sub-apex demersal predators	*Illex coindetii*	3.94[8]

[7] Essington, T., Beaudreau, A., & Wiedenmann, J. (2006). Fishing through marine food webs. *Proceedings of the National Academy of Sciences*, *103*(9), 3171-3175. https://doi.org/10.1073/pnas.0510964103.

[8] Fryganiotis, K., Margaritis, M., Antoniadou, C., Damianidis, P., & Chintiroglou, C.C. (2010). Contribution to the dietary analysis of the squid *Illex coindetii* (Cephalopoda, Ommastrephidae) at Thermaikos Gulf (North Aegean -Greece). *Rapp. Comm. int. Mer Médit., 39.*

TROPHIC GUILD	REPRESENTATIVE GROUPS/SPECIES	TROPHS
	Octopus vulgaris	3.74[9]
	Mullus barbatus	3.27[6]
	Trachurus trachurus	3.65[6]
Apex predators	*Squalus blainville*[10]	4.17[11]
	Heptranchias perlo	4.2[12]
	Coryphaena hippurus	4.5[13]
	Lophius piscatorius	4.3[6]

1.3 EXISTING COLLECTION PROCESSES

The criteria established by Commission Decision 2017/848/EU for the assessment of MSFD Descriptor 4 are generally based on comparison to threshold values which are agreed through regional or subregional cooperation. When thresholds cannot be established, sites which are impacted by anthropogenic effects are compared to those which are not. In order to enable the assessment of Maltese waters in relation to MSFD Descriptor 4 and streamline the process with those already implemented in Malta for other descriptors, the selection of trophic guilds should be based on existing data collection methods, wherever possible.

No data has been collected to date with respect to trophic guilds. Nevertheless, data collected as part of different data collection processes can be applied to the assessment of MSFD Descriptor 4. Data of relevance to the selection of trophic guilds and the constituent species/species groups is available through various data collection processes and completed projects which have been consulted as part of this report, and will be applied on a pilot basis as part of Report 3. Raw data from the following data collection processes is being used for the purposes of SPD8/2021/016:

- MSFD monitoring process, incl. data from the IMPLEMENTATION AND UPDATING OF

[9] Pan-Saniano, M., Polido, R. R. (2018). Ecology of *Octopus vulgaris*. https://www.sealifebase.ca/Ecology/FishEcologySummary.php?StockCode=3996&GenusName=Octopus&SpeciesName=vulgaris.

[10] This species is often misidentified as *Squalus acanthias*. Such a limitation should be acknowledged by the D4 monitoring and assessment exercises.

[11] Bonnici, L., Bonello, J., & Schembri, P. (2018). Diet and trophic level of the longnose spurdog, Squalus blainville (Risso, 1826) in the 25-nautical mile Fisheries Management Zone around the Maltese Islands. *Regional Studies in Marine Science*, *19*, 33-42. doi: 10.1016/j.rsma.2018.03.001.

[12] Cortés, E. (1999). Standardized diet compositions and trophic levels of sharks. *ICES J. Mar. Sci. 56*:707-717.

[13] Moltó, V., Hernández, P., Sinopoli, M., Besbes-Benseddik, A., Besbes, R., & Mariani, A. et al. (2020). A Global Review on the Biology of the Dolphinfish (Coryphaena hippurus) and Its Fishery in the Mediterranean Sea: Advances in the Last Two Decades. *Reviews In Fisheries Science & Aquaculture, 28*(3), 376-420. doi: 10.1080/23308249.2020.1757618

MARINE MONITORING PROGRAMMES, ASSESSMENT OF ENVIRONMENTAL STATUS AND DEVELOPMENT OF A MARINE DATABASE SYSTEM (CT3031/16 for EMFF project 8.3.1);

- WFD monitoring process, incl. data from the DEVELOPMENT OF ENVIRONMENTAL MONITORING STRATEGY AND ENVIRONMENTAL MONITORING BASELINE SURVEYS (Lots 1 and 3 for ERDF Project 156);
- MEDITERRANEAN TRAWL SURVEY (MEDITS); and
- Fish landings data as reported by Malta's Department of Fisheries and Aquaculture (DFA) to the General Fisheries Commission for the Mediterranean (GFCM) in line with COMMISSION DELEGATED DECISION 2021/1167.

2 LEGISLATIVE BACKGROUND

2.1 MARINE STRATEGY FRAMEWORK DIRECTIVE

The MARINE STRATEGY DIRECTIVE (MSFD), EU Directive 2008/56/EC, was adopted on 17th June 2008. The MSFD is similar to the WATER FRAMEWORK DIRECTIVE (WFD), except that it also incorporates marine waters beyond the coastal area. The MSFD is a pioneering Directive since it is the first European Union (EU) legislation which focuses on protection of marine ecosystems by managing human activities which jeopardise their integrity.

The main aim of the MSFD is to create a framework to help Member States achieve the EU target of having all marine waters of Good Environmental Status (GES) by 2020. This target is only achievable through a combination of environmental protection and sustainable developments/behaviours.

Article 1 of the MSFD defines GES as "*the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable thus safeguarding the potential for use and activities by current and future generations*". In order for GES to be achieved, three prerequisites must be met:[18]

1. Ecosystems function fully and are resilient to anthropogenically caused environmental change. This includes hydromorophological, physical, chemical status.
2. Biodiversity is protected and the deterioration of biodiversity through anthropogenic practices is prevented.
3. Substances which are anthropogenically deposited into the marine environment do not cause polluting effects, and anthropogenic noise does not adversely affect the marine environment.

In order to help recognise if marine waters have reached GES, Annex I of the MSFD provides a list of 11 qualitative descriptors which are used for the assessment of GES:

D1. Biological diversity is maintained
D2. Non-indigenous species introduced by human activities do not adversely alter the ecosystem
D3. The populations of commercial fish and shellfish species are within safe biological limits
D4. All elements of marine food webs ensure long-term abundance and reproductive capacity
D5. Human-induced eutrophication is minimised

[18] European Commission. (2016). *Achieve Good Environmental Status*. *Ec.europa.eu*. Retrieved 25 October 2016, from http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm

D6. The level of sea floor integrity ensures the structure and function of the ecosystem are safeguarded
D7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem
D8. Concentrations of contaminants are at levels not giving rise to pollution effects
D9. Contaminants in fish and other seafood are below safe levels for human consumption
D10. Properties and quantities of marine litter do not cause harm to coastal/marine environment
D11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

The MSFD has been designed to encompass four main regions: Baltic Sea, North East Atlantic Ocean, Mediterranean Sea and Black Sea, as defined in Article 4 of MSFD. Due to the heterogenous nature of the NE Atlantic and Mediterranean Seas, the MSFD further divides these regions into smaller subregions. Even though the Directive divides the seas into distinct regions, since the seas are all connected, transboundary effects always need to be taken into consideration when assessing the status of a water body.

Article 5 of the MSFD stipulates that each Member State must design and implement a marine strategy to assess, monitor and manage the waters over which they exercise jurisdictional rights. Marine strategies should be comprehensive documents which define measures required for the safeguarding of the marine environment, halting future deterioration of ecosystems, restoring damaged ecosystems to past conditions, and reducing and preventing adverse anthropogenic impacts on the marine environment.[19] The measures need to be written in line with the qualitative descriptors used for the determination of GES, outlined in Annex I of the MSFD. It is of upmost importance that the precautionary principle is used when carrying out risk assessments. For example, if there is a lack of scientific data indicating a possible adverse impact, that precautionary measures should still be written and implemented. Furthermore, marine strategies need to adopt an ecosystem-based approach to ensure that the adverse impacts of certain anthropogenic activities are kept to a minimum.

Although the Directive requires each Member State to have its own marine strategy, Article 6 of the MSFD highlights the need for regional coordination and cooperation. This is achieved through existing regional institutional bodies forming the Regional Sea Convention.

The MSFD provides guidance for Member States on how to carry out their initial

[19] Farmer, A. (2012). Marine Strategy Framework Directive. In Institute for European Environmental Policy, *Manual of European Environmental Policy* (1st ed., p. 1043). Routledge, London: Earthscan.

assessment in Article 8, by ensuring that:

- Monitoring methods are consistent with those from other marine regions/sub-regions; and
- Transboundary impacts and features are also considered.

Article 9 relates to the determination of GES while Article 10 requires the establishment of environmental targets and appropriate indicators, including the consideration of pressures and impacts as defined in Annex III of MSFD.

The necessity for Member States to adopt and implement a monitoring programme for marine waters is stipulated in Article 11. The monitoring programmes must be a continuous activity which enable the environmental status of the marine waters to be assessed based on the indicative lists of characteristics, pressures and impacts defined in Annex III (Directive 2017/845/EU). In accordance with Commission Decision 2017/848/EU the monitoring programmes should consider and make reference to both community and international legislation, such as the HABITATS DIRECTIVE (92/43/EEC) and BIRDS DIRECTIVE (79/409/EEC). The standard methods outlined in Commission Decision 2017/848/EU ensure that the results of the initial assessment and monitoring are comparable, both within a single Member State and between Member States. The initial assessments to establish the environmental baselines of the conditions of the waters of the Maltese Islands have been completed with a second update published in 2020. The methodology to be used to monitor these waters is published in the form of monitoring factsheets.

2.1.1 Assessment Under Art. 8 of the MSFD

The MSFD working group on GES have established a set of assessment guidelines to assist Member States in assessing environmental status of their marine waters.[20] The guidance document summarises the overarching principles and approaches, the recommended methodologies to assess pressure related descriptor assessments for all relevant components (e.g. non-indigenous species and contaminants) as well as the standard methodologies for biodiversity descriptor assessments (separate methods provided for each species group e.g. mammals and reptiles).

The method which will be used to assess the status of Maltese waters in line with Descriptor 4 (food webs) is provided in Section 2.1 of the working group guidance document (2016), and replicated hereunder.[20] Steps 1 to 5 have already been completed as part of Deliverable 1 and 2 of SPD8/2021/016. At this stage, we are taking all primary and secondary criteria into consideration in order to inform eventual implementation of the monitoring strategy. The decision on the use of secondary criteria will be confirmed/amended at a later stage. Steps 6 and 7 will be performed as part of this project on a pilot basis.

Step 1: Determine the criteria to address

[20] DG Environment (2016). *Guidance for Assessments Under Article 8 of the Marine Strategy Framework Directive: Integration of assessment results.*

- *Primary criteria are EU minimum requirements for assessment at the prescribed scale. Establish whether such conditions are met, necessitating and/or justifying the use of a secondary criterion. Other secondary criteria may be used in addition to primary criteria.*
- *Establish for each secondary criterion whether it should be applied based on the conditions set out in the revised Commission Decision.*

Step 2: Determine the elements for assessment

- *For each criterion selected in step 1, the elements for assessment should be identified, i.e. the features and pressures under Article 8 and the corresponding characteristics of GES under Article 9(1) (e.g. substances, species, habitats) For some criteria, the Commission Decision specifies the elements to be used, but in a number of cases there is need for further definition of these elements by the Member States.*
- *Where the Commission Decision refers to lists of elements established by existing EU legislation, these elements are set as the EU minimum requirement for assessment at the prescribed scale.*
    - *Note: An element can be excluded from the assessment through deselection from the existing list, based on the procedures of the EU legislation under which the list has been established.*
- *Where elements are not determined by existing EU legislation or where regional coordination goes beyond existing EU legislation, the regionally agreed elements should be applied for assessment.*
    - *Note: A regionally agreed element can be excluded from the assessment through deselection from the existing list, based on the agreements under which the list has been established.*
- *Member States may choose to select additional elements for assessment which are specific for assessing GES in their national waters*

Step 3: Determine scales and areas for assessment

- *Determine the areas for which the elements should be assessed based on the specification of scales of the revised Commission Decision, agreeing these at (sub)regional level using a 'nested approach' as far as possible.*
- *Where possible, elements to be integrated should be assessed at the same spatial scale and in the same assessment areas.*
- *Where the selected elements are assessed at different geographic scales, up or down-scaling of results may be necessary before integrating results.*
- *For principles on determining areas of assessment see Section 2.3.*

Step 4: Assign indicators to criteria

- *Establish which regionally agreed indicators address each criterion in the revised Commission Decision. Establish whether the indicator covers all the required elements and scales determined in steps 2 and 3.*
- *Where there are gaps in the coverage of criteria, elements or scales, determine the need for additional national assessment, pending the development of regionally coordinated assessments. Existing assessments*

may be used where appropriate, such as those under EU legislation, e.g. WFD, CFP, Habitats Directive, and assessments developed for national purposes. This may cover the following situations:

- *Gaps in the set of RSC indicators which should be filled regionally, but for which national assessments (if available) can fill the gap in the interim;*
- *Elements that are specific to national waters (i.e. have no regional dimension), which are assessed nationally and are complementary to the regional assessment.*

- *Where additional national elements are being assessed, they should be assigned to the relevant revised Commission Decision criteria. These need to have a threshold value, where appropriate, and should follow the agreed structure for reporting indicators.*
- *For principles on relating national assessments to regional assessments, see Section 2.5.*
- *If, after assigning all relevant regional, EU (e.g. WFD) and national indicators to the revised Commission Decision criteria, there are still gaps (either in relation to criteria or to elements to be addressed within the criteria), these gaps should be identified and addressed in the next implementation cycle.*
- *Indicators should follow the agreed structure for reporting indicators, noting that formal reporting requirements will be determined through the Working Group on Data, Information and Knowledge Exchange, WG DIKE.*

Step 5: Establish levels and thresholds

- *Threshold values should be established for each element, indicator or criterion, as appropriate.*
- *Depending on the criterion, the revised Commission Decision requires Member States to use existing threshold values established under EU legislation or, in the absence of existing EU-values, to establish threshold values at Union level, or through regional or subregional cooperation. Threshold values should be developed through an inclusive scientific process, using best-available evidence.*
- *Where it has not been possible to establish threshold values for the 2018 assessments, the revised Commission Decision provides for use of national threshold values, trends and pressure-based proxies. The establishment of national threshold values, trends and pressure-based proxies should follow the principles laid down in Article 4(1) of the revised Commission Decision including on the basis of the precautionary principle and on the best available evidence.*

Step 6: Assess status

- *The status of each indicator should be determined, for each relevant assessment area, based on the value of the indicator compared to the levels and thresholds established in step 5.*

Step 7: Integrate indicators and criteria

- *The indicators relating to each criterion should be brought together to provide a judgement on each criterion, and criteria or assessed elements should be integrated to an appropriate level for an overall judgement on the extent to which good environmental status is achieved in relation to the descriptors.*
- *Note that for some descriptors the integration of information to descriptor level is not envisaged, but integration may stop at criteria level. The level of integration is specified for each descriptor in the respective 'Level of integration' sections in Sections 3 and 4, which record the state of discussion in relation to the specified integration rules.*

2.2 WATER FRAMEWORK DIRECTIVE

The WATER FRAMEWORK DIRECTIVE (WFD) (2000/60/EC) is the legal framework which aims to protect and restore surface and groundwater bodies. The WFD is transposed into Maltese legislation through the WATER POLICY FRAMEWORK REGULATIONS (S.L.549.100) as part of the ENVIRONMENTAL PROTECTION ACT (Chapter 435) and the MALTA RESOURCES AUTHORITY ACT (Chapter 423). S.L.549.100 came into force on 23rd October 2015 and has not been subject to any amendments. This project will also identify synergies in the implementation of the monitoring processes across the MSFD and WFD by linking the features to be used for MSFD D4 with the biota to be assessed for levels of contaminants under WFD processes.

The WFD is one of several EU and regional environmental legislative documents which provides a framework for the sustainable protection, use and management of inland, transitional and coastal water bodies. The EU is currently focusing on an ecosystem-based management framework which integrates a variety of water related polices to manage the impact of human activities on water bodies.[21]

Malta published its first version of the WATER CATCHMENT MANAGEMENT PLAN (WCMP) in March 2011. Since the Maltese Islands do not have any rivers, the WCMP considers the Maltese Islands as a single water catchment district, as in line with Article 3 of the WFD (regulation 13 of S.L.549.100). The first WCMP covered the period until the year 2015. Consequently, a second WCMP was adopted in 2016. This second WCMP encompasses the period between 2015 and 2021. The Environment & Resources Authority (ERA) are in in the process of drafting a third plan which will cover from the year 2022 to 2027.

The WFD's main objective is to ensure that all inland, transitional and coastal waters achieve good status by 2015. Despite the fact that the WFD has been in force since 2000, the European Environment Agency reports on the status of European waters in both 2012 and 2018, reveal that the EU Member States still have a long way to go

[21] Apitz, S. E., Elliott, M. Fountain, M., Galloway, T. S. (2006). European Environmental Management: Moving to an Ecosystem Approach. *Integrated Environmental Assessment and Management, 2*. 80-85.

before they manage to achieve good ecological status in all water bodies.[22,23]

2.3 SYNERGIES WITH EXISTING MSFD & WFD MONITORING

The criteria established by Commission Decision 2017/848/EU for the assessment of MSFD Descriptor 4 are generally based on comparison to threshold values which are agreed through regional or subregional cooperation. When thresholds cannot be established, sites which are impacted by anthropogenic effects are compared to those which are not. In order to enable the assessment of Maltese waters in relation to MSFD Descriptor 4 and streamline the process with those already implemented in Malta for other descriptors, the selection of trophic guilds and representative species should be based on existing data collection methods, wherever possible. The following subsections provide further information on both.

2.3.1 Trophic guilds

No data has been collected to date with respect to trophic guilds. Nevertheless, data collected as part of different data collection processes can be applied to the assessment of MSFD Descriptor 4. Data of relevance to the selection of trophic guilds and the constituent species/species groups is available through various data collection processes and completed projects which have been consulted as part of this report, and will be applied on a pilot basis as part of Report 3. Raw data from the following data collection processes is being used:

- MSFD monitoring process, incl. data from the IMPLEMENTATION AND UPDATING OF MARINE MONITORING PROGRAMMES, ASSESSMENT OF ENVIRONMENTAL STATUS AND DEVELOPMENT OF A MARINE DATABASE SYSTEM (CT3031/16 for EMFF project 8.3.1);
- WFD monitoring process, incl. data from the DEVELOPMENT OF ENVIRONMENTAL MONITORING STRATEGY AND ENVIRONMENTAL MONITORING BASELINE SURVEYS (Lots 1 and 3 for ERDF Project 156);
- MEDITERRANEAN TRAWL SURVEY (MEDITS); and
- Fish landings data as reported by Malta's Department of Fisheries and Aquaculture (DFA) to the General Fisheries Commission for the Mediterranean (GFCM) in line with COMMISSION DELEGATED DECISION 2021/1167.

The above data, which was used in the second cycle assessment of MSFD D1, D3 and D8, will also be used for the assessment of MSFD D4.

2.3.2 Representative species

The second cycle assessment of MSFD D1, D3 and D8 also involved selecting and assessing representative fish and cephalopod species. In order to ensure synergy between the monitoring exercises, assessment of MSFD D4 will make use of representative sub-apex demersal predator and apex predator species also used in the second MSFD cycle, as outlined in Table 3.

[22] EEA (2012). *European waters - assessment of status and pressures*.

[23] EEA (2018). *European waters - assessment of status and pressures*.

TABLE 3: SYNERGIES IN MSFD D4 REPRESENTATIVE SPECIES WITH MSFD D1, D3 AND D8

TROPHIC GUILD	REPRESENTATIVE GROUPS/SPECIES	MSFD ASSESSMENT			
		D4	D1	D3	D8
Sub-apex demersal predators	*Illex coindetii*	✓	✓	✓	
	Octopus vulgaris	✓	✓	✓	
	Mullus barbatus	✓		✓	✓
	Trachurus trachurus	✓		✓	
Apex predators	*Squalus blainville*	✓	✓	✓	
	Heptranchias perlo	✓	✓		
	Coryphaena hippurus	✓		✓	
	Lophius piscatorius	✓		✓	

In relation to the MSFD D8C2 (contaminants in biota) assessment, the scale of assessment required by is within coastal and territorial waters.[24] Assessing sub-apex demersal predator and apex predator species for contaminants in biota is ideal for the purpose of D8C2, since such species have high TROPHs, meaning they are sensitive to the bioaccumulating and sometimes biomagnifying nature of contaminants in their tissues. While the species proposed as part of the D4 assessment could be used for the assessment of D8C2, these species are collected through MEDITS, which are all outside coastal water bodies and generally also fall outside territorial waters.

Some of the species proposed as part of the D4 assessment are deep-water species (*I. coindetii*, *S. blainville*, and *H. perlo*); such species would therefore not be useful for implementation of D8C2 in coastal and territorial waters. However, the remaining species (*O. vulgaris, M. barbatus, T. trachurus, C. hippurus*, and *L. piscatorius*) could be sampled through other means and assessed in relation to D8C2. Making use of the same species, although not crucial, would facilitate interpretation of the results of Descriptor 4 by helping to identify/reject contaminants as a possible pressure on these species, trophic guilds and the overall food web. New monitoring procedures would need to be designed for use of these species for D8C2 assessment. In line with Commission Decision 2017/848/EU, regional or subregional cooperation is necessary to select the species, method and threshold levels for assessment of D8C2.

[24] ERA (2020). *Update of Articles 8, 9 and 10 of the Marine Strategy Framework Directive (2008/56/EC) in Malta's Marine Waters: Second Assessment Report*. https://era.org.mt/wp-content/uploads/2020/06/MSFD-Art.-17-Update-Malta_FINAL.pdf.

3 DATA COLLECTION & MONITORING STRATEGY

3.1 PRIMARY PRODUCERS

3.1.1 Monitoring Parameters

Table 4 provides the criteria, indicators and taxonomic groups/species applicable for the assessment of primary producers. Further detail on how the data for each of these parameters will be used to assess the status of the Descriptor 4 criteria is provided in Section 4.

TABLE 4: CRITERIA, INDICATORS AND TAXONOMIC GROUPS/SPECIES APPLICABLE TO PRIMARY PRODUCERS

CRITERIA	INDICATOR	TAXONOMIC GROUPS/SPECIES	PARAMETERS	UNIT
D4C1: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures	Dia/Dino index	Diatoms & dinoflagellates	Diatom/dinoflagellate ratio	Ratio
	Large microphytoplankton vs small microphytoplankton	Large microphytoplankton & small microphytoplankton	Phytoplankton sizes	µm
D4C2: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures[25]	Phytoplankton abundance	All phytoplankton	Phytoplankton abundance	Cells per litre
D4C3: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures	Large microphytoplankton vs small microphytoplankton	Large microphytoplankton & small microphytoplankton	Phytoplankton sizes	µm
D4C4: Productivity of the trophic guild is not adversely affected due to anthropogenic pressures	90th percentile chlorophyll-a	All phytoplankton	Phytoplankton biomass (chlorophyll-a)	µg/L

[25] The parameters across each of the selected trophic guilds will be used to apply this indicator.

3.1.2 Monitoring Methodologies

3.1.2.1 Sampling and preservation

Chlorophyll-a

Chlorophyll-a at the sampling stations will be measured at subsurface levels (between 1m and 5m from surface). Two measurements (replicates) will be taken using an *in situ* fluorescence sensor.

Phytoplankton

Two replicate samples will be collected at subsurface levels (between 1m and 5m from surface). As recommended by UNEP(DEPI)MED WG.427/4, samples will be collected using Niskin bottles. Due to the paucity of plankton within Maltese oligotrophic waters, we suggest that at least 5L of water are collected from each replicate. The samples will be stored in dark glass bottles and preserved with 2mL of Lugol's Iodine.

3.1.2.2 Sample analysis

Phytoplankton

Full species composition and abundance will be obtained by enumeration and identification of the phytoplankton to the lowest taxon possible using a phase-contrast optical microscope. The number of cells recorded in a subsample will then be calculated as a function of the volume of sample and the magnification used to arrive at the estimate of 'number of cells per litre'.

3.1.3 Monitoring Area

The areas to be monitored for the assessment of primary producers in line with MSFD Descriptor 4 are mapped in Figure 1 and Figure 2. Table 5 provides the coordinates for the monitoring stations. The maps are provided in relation to the Marine Reporting Units (MRUs) to be used for this assessment.

The stations used in the existing MSFD data collection and monitoring programme of phytoplankton (chlorophyll-a) are confined to territorial waters. This means that a large portion of the spatial scale proposed in Report 1 is not represented by these monitoring stations. Although one of the primary pressures on these primary producers are from land-based sources, including monitoring stations in offshore locations would be useful for the assessment of D4, thereby facilitating comparison between different trophic guilds in similar geographic locations. Such additional stations are mapped in Figure 3 and listed in Table 5.

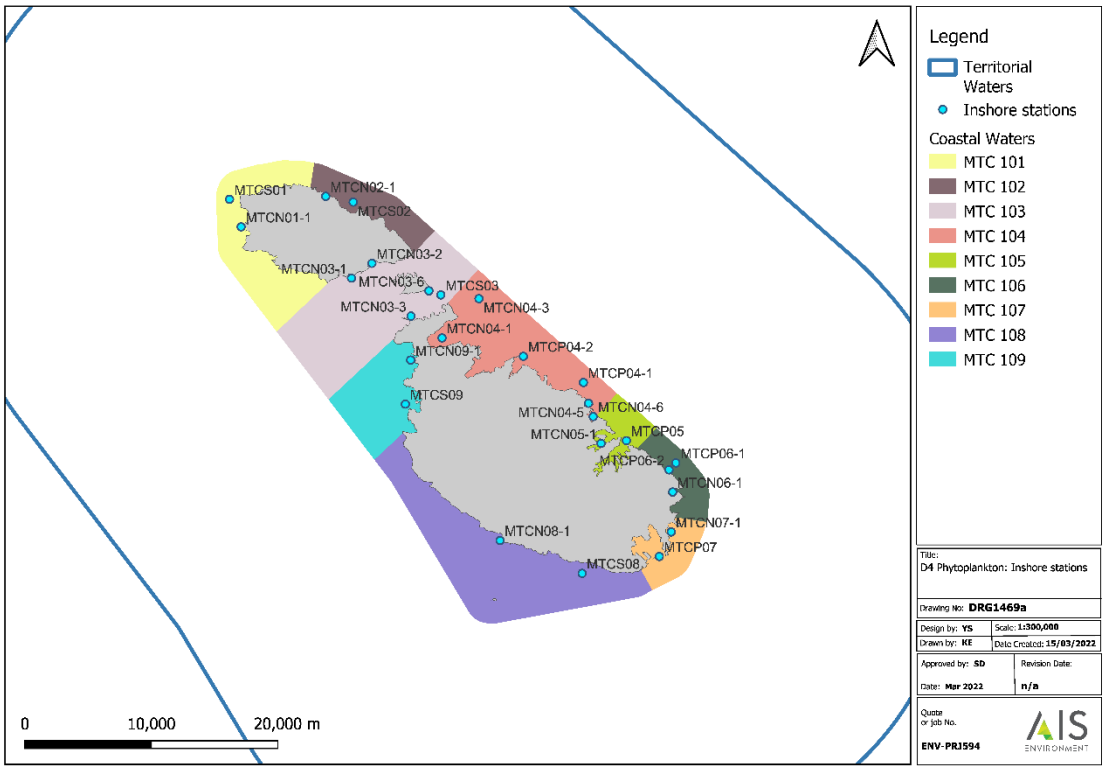

FIGURE 1: PRIMARY PRODUCERS: INSHORE MONITORING STATIONS AND MRUS

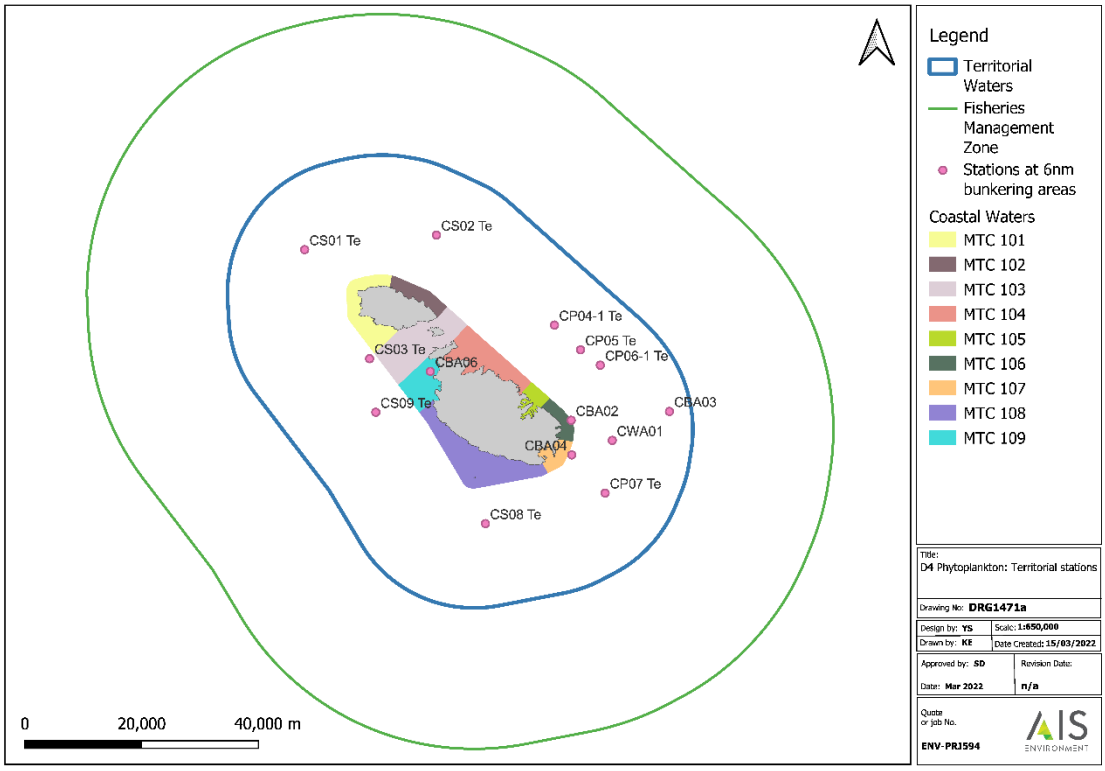

FIGURE 2: PRIMARY PRODUCERS: TERRITORIAL MONITORING STATIONS AND MRUS

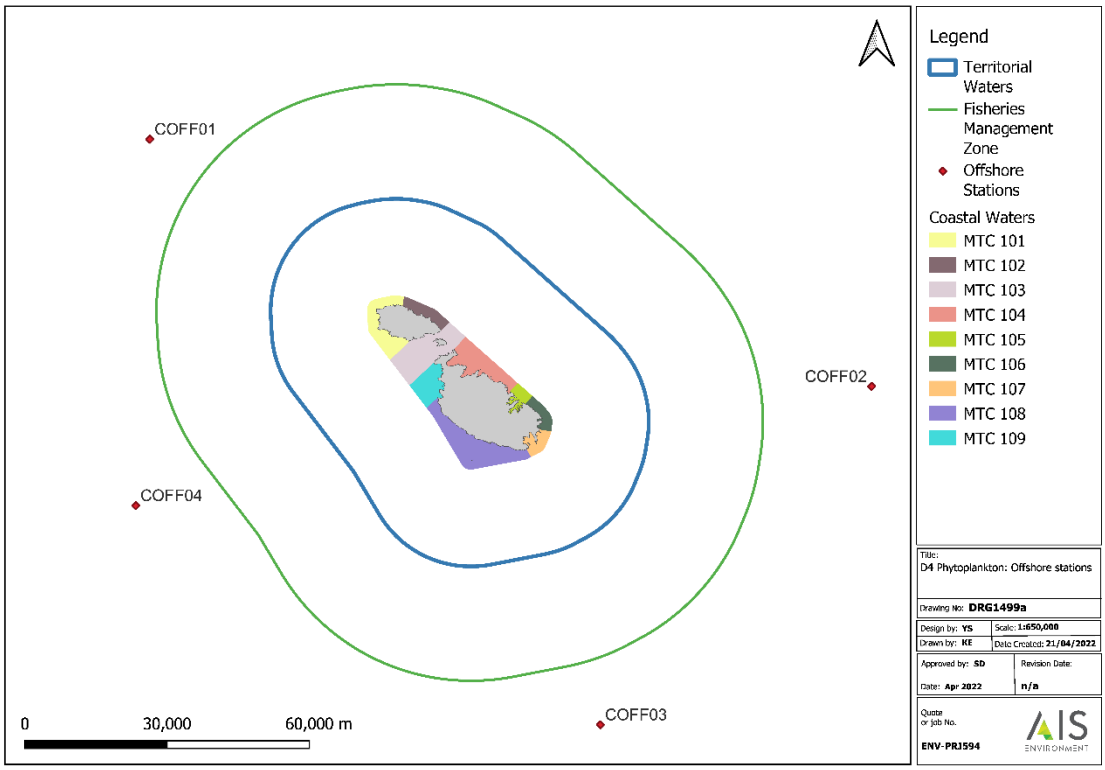

FIGURE 3: PRIMARY PRODUCERS: OFFSHORE MONITORING STATIONS AND MRUS

TABLE 5: PRIMARY PRODUCERS: COORDINATES OF MONITORING STATIONS

STATION TYPE	STATION	LATITUDE	LONGITUDE
Existing monitoring programme			
Inshore	MTCN01-1	36.0512342	14.18556084
	MTCN02-1	36.07332724	14.25953685
	MTCN03-1	36.01533672	14.28268959
	MTCN03-2	36.02595287	14.30060172
	MTCN03-3	35.98858563	14.33518281
	MTCN03-6	36.00666347	14.35068026
	MTCN04-1	35.97327492	14.36250523
	MTCN04-3	36.00133641	14.3946628
	MTCN04-5	35.92734386	14.49124344
	MTCN04-6	35.91795329	14.49536539
	MTCN05-1	35.89891467	14.50240341
	MTCN06-1	35.86452423	14.5653463
	MTCN07-1	35.83613114	14.56418871

STATION TYPE	STATION	LATITUDE	LONGITUDE
	MTCN08-1	35.82946996	14.41438275
	MTCN09-1	35.95737383	14.33511038
	MTCP04-1	35.94214308	14.48663552
	MTCP04-2	35.96051883	14.43392914
	MTCP05	35.90096515	14.52457868
	MTCP06-1	35.88526113	14.56797791
	MTCP06-2	35.88032267	14.56201305
	MTCP07	35.81866928	14.55387485
	MTCS01	36.07072149	14.17514886
	MTCS02	36.06936635	14.28371492
	MTCS03	36.0037945	14.36121806
	MTCS08	35.80640012	14.4863989
	MTCS09	35.9259835	14.33074822
Stations at 6nm and bunkering areas	CS01 Te	36.13597915	14.08307777
	CS02 Te	36.16013938	14.33387571
	CS03 Te	35.96909273	14.20839517
	CP04-1 Te	36.02254638	14.55927843
	CP05 Te	35.98462676	14.60900914
	CP06-1 Te	35.96110392	14.64670866
	CP07 Te	35.76423935	14.65670778
	CS08 Te	35.71634266	14.43031353
	CS09 Te	35.88650024	14.22097305
	CS01 Te	36.13597915	14.08307777
	CS02 Te	36.16013938	14.33387571
	CWA01	35.84539374	14.66989124
	CBA06	35.950176	14.32386752
	CBA04	35.82288368	14.59319254
	CBA03	35.89006171	14.77823766
	CBA02	35.87599594	14.59186849
Additional monitoring stations			
Offshore	COFF01	36.39041758	13.64857386

STATION TYPE	STATION	LATITUDE	LONGITUDE
	COFF02	35.69525411	13.62785533
	COFF03	35.28715188	14.71159721
	COFF04	35.92883793	15.34321526

3.1.4 Monitoring Frequency

Table 6 provides the monitoring frequency for each of the phytoplankton parameters. Malta's existing monitoring programmes for other MSFD descriptors does not include the assessment of phytoplankton cell sizes. The monitoring frequency included in Table 6 is recommended to facilitate integration into the existing monitoring programmes.

TABLE 6: MONITORING FREQUENCY FOR PARAMETERS OF PRIMARY PRODUCERS

PARAMETERS	MONITORING STATIONS	MONITORING FREQUENCY
Phytoplankton biomass (chlorophyll-a)	Inshore	Monthly
	Territorial, bunkering and waiting areas	6-monthly
	Offshore	6-monthly
Phytoplankton abundance	Inshore	3-monthly
	Territorial, bunkering and waiting areas	6-monthly
	Offshore	6-monthly
Diatom/dinoflagellate ratio	Inshore	3-monthly
	Territorial, bunkering and waiting areas	6-monthly
	Offshore	6-monthly
Phytoplankton sizes	Inshore	3-monthly
	Territorial, bunkering and waiting areas	6-monthly
	Offshore	6-monthly

3.1.5 QA/QC Procedures

All methodologies to be followed during the implementation of tender CT 3031/2016 will follow relevant standard methodologies. Such methodologies cover both collection of samples and related laboratory analyses. Quality assurance and quality control (QA/QC) activities will be included as part of the monitoring program. These

procedures are outlined in Table 7, and were adapted from literature.[27,28]

TABLE 7: QA/QC PROCEDURES TO BE INCLUDED AS PART OF THE IMPLEMENTATION PROGRAM

QA/QC ACTIVITY	DEFINITION
Field QA/QC	
Field replicates	Concurrent replicates will be collected for water analyses which are virtually identical in composition (in terms of depth, location and time). This is to assess sampling and analytical variability.
Laboratory replicates	Two additional replicates for each field replicate are collected in situ for laboratory analyses. This additional replicate acts as insurance in case of loss, damage or error with the first replicate.
Laboratory QA/QC	
Standard operating procedures	Use of standard operating procedures whenever possible, including MSA EN ISO/IEC-17025:2005 for all water quality analyses.
Detection limits	All detection limits are selected to ensure that the assessment of the environmental status based on seawater quality is not jeopardised.
Laboratory blank	Blank solutions will be used as part of general laboratory procedures for calibration of the equipment. This is to assess analytical bias.
Standard reference sample	Samples with known concentrations of the analytes shall be used by the laboratory to assess bias of the analytical procedure.

Commission Decision 2009/90/EC was also consulted to ensure all QA/QC requirements are reached, as outlined below. All required procedures are to be implemented.

1. *Member States shall ensure that laboratories or parties contracted by laboratories apply quality management system practices in accordance with EN ISO/IEC-17025 or other equivalent standards accepted at international level.*

[27] European Commission (2003). *Common Implementation Strategy for the Water Framework Directive (2000/60/EC): Guidance Document n. 7, Monitoring under the Water Framework Directive*. Luxembourg: Office for Official Publications of the European Communities.

[28] Francy, D., Jones, A., Myers, D., Rowe, G., Eberle, M. and Sarver, K. (1998). *Quality-Assurance/Quality-Control Manual for Collection and Analysis of Water-Quality Data in the Ohio District, U.S. Geological Survey.* Columbus, Ohio: U.S. Geological Survey. https://pubs.usgs.gov/wri/1998/4057/report.pdf.

2. *Member States shall ensure that laboratories or parties contracted by laboratories demonstrate their competences in analysing relevant physico-chemical or chemical measurands by:*
    a. *participation in proficiency testing programmes covering the methods of analysis referred to in Article 3 of this Directive of measurands at levels of concentrations that are representative of chemical monitoring programmes carried out under Directive 2000/60/EC, and*
    b. *analysis of available reference materials that are representative of collected samples which contain appropriate levels of concentrations in relation to relevant environmental quality standards referred to in Article 4(1).*
3. *The proficiency testing programmes referred to in paragraph 2(a) shall be organised by accredited organisations or internationally or nationally recognised organisations which meet the requirements of ISO/IEC guide 43-1 or of other equivalent standards accepted at international level.*
4. *The results of participation in those programmes shall be evaluated on the basis of the scoring systems set out in ISO/IEC guide 43-1 or in the ISO-13528 standard or in other equivalent standards accepted at international level.*

3.1.6 Data Interpretation

The following subsections outline the methodology to be used for the assessment of status for the primary producers trophic guild in line with MSFD Descriptor 4.

3.1.6.1 Primary production in terms of chlorophyll-a

Primary production in the pelagic region will be assessed in accordance with D4C4 of the MSFD. Primary production refers to the biomass generated by primary producers, in this case phytoplankton. Primary production depends on availability of light, water, carbon dioxide and chemical nutrients such as nitrogen, phosphorus, etc.). Primary production transfers energy up the food chain through consumption from primary producers, and therefore represents the basis of the marine ecosystem (i.e. trophic level 1). Chlorophyll-a will be used as a proxy index to estimate primary production. This indicator is directly and closely related to the biomass and therefore productivity of the phytoplankton trophic guild.[29]

Phytoplankton data from inshore, territorial and offshore waters will be used to calculate the 90th percentile chlorophyll-a concentration for each station. The principal pressure that affects this indicator is nutrient and organic matter enrichment, with eutrophic conditions indicating that the ecosystem is in bad ecological status in terms of Descriptor 4. Low primary production is also an indicator of bad ecological status, since little biomass is available for transfer to higher trophic levels. Consequently, the stability of this indicator (indicating good status) can be assessed through trend analysis. Thresholds for this parameter should be established

[29] Hinder, S., Hays, G., Edwards, M., Roberts, E., Walne, A., & Gravenor, M. (2012). *Changes in marine dinoflagellate and diatom abundance under climate change. Nature Climate Change, 4*(2), 271-275. https://doi.org/10.1038/nclimate1388.

through regional cooperation to enable quantitative assessment.

3.1.6.2 Phytoplankton abundance

The abundance of phytoplankton will be assessed in accordance with D4C2 of the MSFD. Firstly, the feeding by higher trophic groups on phytoplankton is generally non-discriminatory. Furthermore, selecting a single phytoplankton species as a keystone species is extensively difficult due to the limited knowledge on individual phytoplankton species.

Phytoplankton data from inshore, territorial and offshore waters will be used to calculate the abundance (cells/l) for each station. The principal pressure that affects this indicator is nutrient and organic matter enrichment, with eutrophic conditions indicating that the ecosystem is in bad ecological status in terms of Descriptor 4. Low phytoplankton abundance is also an indicator of bad ecological status, since little biomass is available for transfer to higher trophic levels. Consequently, the stability of this indicator (indicating good status) can be assessed through trend analysis. Thresholds for this parameter should be established through regional cooperation to enable quantitative assessment.

3.1.6.3 Diatom/dinoflagellate ratio

Diatoms and dinoflagellates have been selected as constituent groups for the assessment of primary producers in accordance with D4C1 of the MSFD. These organisms are the dominant phytoplankton taxonomic groups in the world's oceans, and therefore constitute the most important prey organisms for higher trophic levels. Furthermore, differences in diatom/dinoflagellate ratios (Dia/Dino index) may have ecosystem-wide consequences for energy transfer up the food web.[30] Differences in the dominance of these phytoplankton groups affects other trophic levels since their distribution in the water column, their quality as a food source for grazers and their period of occurrence generally differ.

Diatoms are r-strategists, growing and dying quickly. Consequently, diatom-dominated communities cause short bursts of large quantities of marine snow sinking to the bottom and becoming available to zoobenthos. Conversely, dinoflagellates are k-strategists, growing slower and taking longer to die. These organisms are more predominant in surface waters and are therefore more suitable prey for zooplankton. Furthermore, lower Dia/Dino indices may indicate low silicate availability due to eutrophication conditions.[30] Dinoflagellates prefer the water column to be stratified, therefore giving rise to lower Dia/Dino indices in the spring bloom, which occurs in Malta between March and May. Specifically within Maltese waters, the largest phytoplankton bloom, generally observed in January-February, is attributed almost exclusively to diatoms, whilst the smaller phytoplankton bloom in autumn is generally

[30] Wasmund, N., Kownacka, J., Göbel, J., Jaanus, A., Johansen, M., & Jurgensone, I. et al. (2017). The Diatom/Dinoflagellate Index as an Indicator of Ecosystem Changes in the Baltic Sea 1. Principle and Handling Instruction. *Frontiers In Marine Science*, *4*. https://doi.org/10.3389/fmars.2017.00022.

attributed to dinoflagellates.[31]

Phytoplankton data from inshore, territorial and offshore waters will be used to calculate the Dia/Dino index. The principal pressure that affects this indicator is nutrient and organic matter enrichment, with eutrophic conditions indicating that the ecosystem is in bad ecological status in terms of Descriptor 4. Consequently, the thresholds used by Malta in the latest MSFD Assessment in line with Descriptor 5 (Eutrophication) have been adopted, as described in Section 4.4.

3.1.6.4 Large microphytoplankton vs small micropytoplankton

Large microphytoplankton and small microphytoplankton have been selected as constituent groups for the assessment of primary producers in accordance with D4C1 and D4C3 of the MSFD. The ratio between these taxonomic groups serves as a size-based indicator of the efficiency of energy flow to higher trophic levels.[32] Microphytoplankton are classified into two groups as follows:

- Large microphytoplankton, >20 µm cells (not colonies)
- Small microphytoplankton (picoplankton & nanoplankton), <20 µm cells (not colonies)

The size structure of phytoplankton affects the trophic organisation of the trophic level and food web as a whole. In communities dominated by small phytoplankton, the dominant trophic pathway is the microbial food web, where most of the primary production is consumed by dinoflagellates, ciliates and heterotrophic nanoflagellates.[33] Little transfer to large organisms such as mesozooplankton or fish occurs. Conversely, primary production produced by plankton communities dominated by large phytoplankton is available for higher trophic guilds such as mesozooplankton, a proportion of which is transported to deeper waters and higher trophic guilds.[33]

Phytoplankton data from inshore, territorial and offshore waters will be queried to extract the ratio of large microphytoplankton to small microphytoplankton. As outlined in the 2018 OSPAR report describing plankton indicators, the large:small microphytoplankton indicator is not directly linked to pressures, since this is a state indicator.[32] No thresholds could be found for this indicator. Consequently, the stability of this indicator (indicating good status) can be assessed through trend analysis.

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[31] Farrugia, H., Deidun, A., Gauci, A., & Drago, A. (2016). Defining the Trophic Status of Maltese (Central Mediterranean) Coastal Waters through the Computation of Water Quality Indices Based on Satellite Data. *Journal of Coastal Research*, *75*(sp1), 632-636. doi: 10.2112/si75-127.1.

[32] OSPAR (2018). *Common indicator: PH1/FW5 Plankton lifeforms.* https://www.ospar.org/documents?v=39001.

[33] Marañón, E. (2009). Phytoplankton Size Structure. *Encyclopedia Of Ocean Sciences*, 445-452. https://doi.org/10.1016/b978-012374473-9.00661-5.

3.2 SUB-APEX DEMERSAL PREDATORS

3.2.1 Monitoring Parameters

Table 8 provides the criteria, indicators and taxonomic groups/species applicable for the assessment of sub-apex demersal predators. Further detail on how the data for each of these parameters will be used to assess the status of the Descriptor 4 criteria is provided in Section 4.

TABLE 8: CRITERIA, INDICATORS AND TAXONOMIC GROUPS/SPECIES APPLICABLE TO SUB-APEX DEMERSAL PREDATORS

CRITERIA	INDICATOR	TAXONOMIC GROUPS/SPECIES	PARAMETERS	UNIT
D4C1: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures	Abundance trends of functionally important selected groups/species within the trophic guild	*Illex coindetii, Octopus vulgaris, Mullus barbatus, Trachurus trachurus*	Species abundance	Catch per haul
	Marine Trophic Index (MTI)	All SDP species	Species abundance	Catch per haul
			Species TROPH	None
D4C2: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures[25]	Abundance trends of functionally important selected groups/species between the trophic guilds	All SDP fish and cephalopods	Species abundance	Catch per haul
	Marine Trophic Index (MTI)	All SDP species	Species abundance	Catch per haul
			Species TROPH	None
D4C3: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures	Proportion of large fish (large fish indicator, LFI)	All SDP fish species larger than 30cm, all SDP fish larger than 40cm	Species abundance	Catch per haul
			Individual length	mm
			Individual biomass	g
	Mean weights-at-age of predatory fish	All SDP fish species	Individual maturity	None
			Individual biomass	g
	Mean length of the surveyed community	All SDP species, all SDP fish and cephalopods	Individual length	mm
D4C4: Productivity of the trophic guild is not adversely affected due to anthropogenic pressures	Biomass of important trophic guilds	*Illex coindetii, Octopus vulgaris, Mullus barbatus, Trachurus trachurus*	Individual biomass	g

3.2.2 Monitoring Methodologies

Trawl surveys are carried out following the MEDITS protocol in GSA 15 where 45 stations are sampled using the IFREMER GOC 73 bottom trawl net: width 22m; height of vertical opening: 2m; length: 40m; stretched mesh size at cod-end: 20mm.

3.2.3 Monitoring Area

While MEDITS is carried out within GSA 15, the data generated by MEDITS for stations within the 25 nautical mile Fisheries Management Zone will be used for assessment purpose, as mapped in Figure 4. Table 9 provides the coordinates for the monitoring stations.

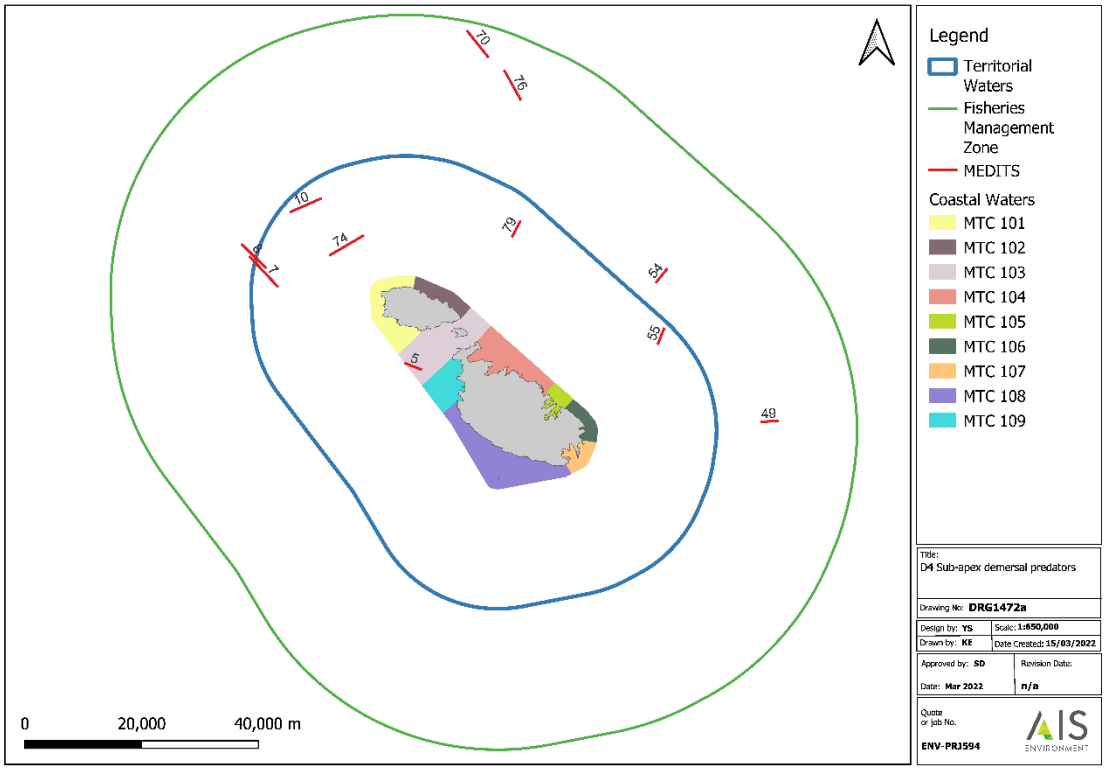

FIGURE 4: SUB-APEX DEMERSAL PREDATORS: MEDITS MONITORING STATIONS AND MRUS

TABLE 9: SUB-APEX DEMERSAL PREDATORS: COORDINATES OF MEDITS MONITORING STATIONS

MEDITS HAUL	START		END	
	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
5	35.9543	14.2607	35.9632	14.2318
7	36.0805	13.9863	36.1242	13.9343
8	36.109	13.9632	36.1433	13.919
10	36.1948	14.011	36.2155	14.0675
49	35.877	14.9377	35.8755	14.9078

MEDITS HAUL	START		END	
	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
54	36.1097	14.7272	36.0903	14.7078
55	35.9958	14.7113	36.0183	14.7222
70	36.475	14.3452	36.436	14.3847
74	36.1288	14.0868	36.1587	14.148
76	36.414	14.4165	36.3707	14.447
79	36.1602	14.4338	36.1828	14.4478

3.2.4 Monitoring Frequency

Table 6 provides the monitoring frequency for each of the sub-apex demersal predator parameters.

TABLE 10: MONITORING FREQUENCY FOR PARAMETERS OF SUB-APEX DEMERSAL PREDATORS

PARAMETERS	MONITORING STATIONS	MONITORING FREQUENCY
Catch by MEDITS haul	All stations in the FMZ	Yearly
Marine Trophic Index (MTI)	All stations in the FMZ	Yearly
Proportion of large fish (LFI)	All stations in the FMZ	Yearly
Mean weights-at-age of predatory fish	All stations in the FMZ	Yearly
Mean length of the surveyed community	All stations in the FMZ	Yearly
Biomass of important trophic guilds	All stations in the FMZ	Yearly

3.2.5 Data Interpretation

The following subsections outline the methodology to be used for the assessment of status for the sub-apex demersal predators trophic guild in line with MSFD Descriptor 4.

3.2.5.1 Abundance trends of sub-apex demersal predators

Abundance trends of sub-apex demersal predators will be assessed in accordance with D4C1 and D4C2 of the MSFD. One of the primary pressures which give rise to cascading changes in food webs, visible throughout the trophic guilds, is fishing. The removal of commercial species from the food web would directly reduce the abundance of the respective trophic level, and indirectly affect the abundances of higher and lower trophic levels. This anthropogenic pressure directly affects target

species, while indirectly affecting non-target components of food webs. Prey of exploited species tend to increase in numbers, while their predators tend to decrease.

MEDITS data from all hauls in the FMZ will be used to calculate the abundances of all representative species and two representative taxonomic groups (fish and cephalopods) over the study time period. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

D4C2 of the MSFD assesses the ecological status of food webs based on the relationship between the different trophic guilds. Considering the cascading nature of effects through trophic levels, issues in a particular guild may be visible in one/both other guilds. The abundance trends between the trophic guilds will be compared on a qualitative basis.

3.2.5.2 Marine Trophic Index

The marine trophic index (MTI) will be assessed in accordance with D4C1 and D4C2 of the MSFD. The MTI is an indicator representative of the ecological state of the trophic guild. The index is a product of the TROPH of a group/species (i.e. the position of the organism in the food chain) and its abundance.[34] The TROPH represents the number of energy transfer steps to that level and ranges between 1 for primary producers and 5.5 for apex predators. Herbivores (i.e. primary consumers) have a TROPH of about 2, while carnivores range in TROPH between 3 and 5. For the purposes of this assessment, sub-apex demersal predators constitute all demersal consumers with a TROPH of 4 or less.[35] This threshold is being drawn along arbitrary lines, taking into consideration the existing range of TROPHs for the Mediterranean Sea. Ideally, once data from other methodologies emerges (e.g. stable isotope analysis, fatty acid analysis), the recommended threshold should be reassessed for possible revision. These thresholds should also be discussed and agreed on a regional basis.

TROPHs are closely related to organism size, meaning changes in MTI mirror changes in food chain position and size composition. Since overfishing primarily targets large high-trophic level species, it leads to a deterioration in the ecosystem structure, reflected as a declining MTI.

MEDITS data from all hauls in the FMZ will be used to calculate the MTI for all sub-apex demersal species in the catch over the time period. The principal pressure that

[34] UNEP (2004). *Indicators for Assessing Progress Towards the 2010 Target: Marine Trophic Index.* https://www.cbd.int/doc/meetings/sbstta/sbstta-10/information/sbstta-10-inf-18-en.pdf.

[35] Essington, T., Beaudreau, A., & Wiedenmann, J. (2006). Fishing through marine food webs. *Proceedings of the National Academy of Sciences*, *103*(9), 3171-3175. https://doi.org/10.1073/pnas.0510964103.

affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

D4C2 of the MSFD assesses the ecological status of food webs based on the relationship between the different trophic guilds. Considering the cascading nature of effects through trophic levels, issues in a particular guild may be visible in one/both other guilds. The abundance trends between the trophic guilds will be compared on a qualitative basis.

3.2.5.3 Proportion of large fish (large fish indicator, LFI)

The Large Fish Indicator (LFI) will be assessed in accordance with D4C3 of the MSFD. The LFI is defined as the proportion by weight of large fish in the sample of a specified survey, irrespective of species.[36] Generally, the threshold between small and large fish (L_{th}) is determined on a regional basis, and is chosen to optimise responsiveness of the indicator to fishing pressure.[37] Considering that fishing is generally size-selective, larger individuals are targeted to a greater extent than smaller individuals, and therefore suffer higher rates of mortality.[38] The LFI is therefore sensitive to the fishing pressure. Furthermore, the proportions of the indicator are based on weight not by numbers, making it less likely to be affected by the tendency of smaller fish to be found in higher numbers than larger fish. This indicator is very useful for studying fish taxonomic groups and has been selected as a common foodweb indicator by HELCOM and OSPAR.[39]

MEDITS data from all hauls in the FMZ will be used to calculate the LFI for all sub-apex demersal species in the catch over the time period. Since no regional length thresholds have been established,[40] the assessment will make use of two cut-off points to distinguish large fish: 30cm and 40cm. These cut-off points are being drawn on an arbitrary basis, but would allow the assessment of this indicator on multiple levels. Member States have made use of one or both these values to classify large fish. Using both at such an early stage in the process is useful to identify which is the

[36] Greenstreet, S. P. R., Rogers, S. I., Rice, J. C., Piet, G. J., Guirey, E. J., Fraser, H. M. & Fryer, R. J. (2011). Development of the EcoQO for the North Sea fish community. *ICES Journal of Marine Science 68*, 1–11

[37] Shephard, S., Reid, D. G. & Greenstreet, S. P. R. (2011). Interpreting the large fish indicator for the Celtic Sea. *ICES Journal of Marine Science 68*, 1963–1972.

[38] Rogers, S., Casini, M., Cury, P., Heath, M., Irigoien, X., Kuosa, H., Scheidat, M., Skov, H., Stergiou, K., Trenkel, V., Wilkner, J. & Yunev, O. (2010). *Marine Strategy Framework Directive Task Group 4 Report: Food Webs.* doi: 10.2788/87659.

[39] ICES (2014). *Report of the Workshop to develop recommendations for potentially useful Food Web Indicators (WKFooWI)*, 31 March–3 April 2014, ICES Headquarters, Copenhagen, Denmark. ICES CM 2014\ACOM:48. 75 pp.

[40] ICES (2014). EU request on proposal on indicators for MSFD Descriptor 4 (foodwebs).

most suitable in the local context.

The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

3.2.5.4 Mean weights-at-age of predatory fish

The mean weights-at-age of predatory fish will be assessed in accordance with D4C3 of the MSFD. As outlined above, fishing pressure is higher on large individuals than smaller ones. Consequently, the mean weights-at-age indicator serves to provide the average "weight anomaly" for the fish community in a particular year, i.e. the deviation around an observed long-term mean.[39] The youngest and oldest groups of fish are excluded to avoid sampling bias, and the weights of the remaining fish are averaged for all ages of each stock to obtain a mean annual anomaly for that stock. Stock anomalies are then averaged by year to obtain the stock average weight for the whole predatory fish community, where indicator values fluctuate around this norm. This indicator can be applied to different species or whole communities.

MEDITS data from all hauls in the FMZ will be used to calculate the mean weights-at-age for all sub-apex demersal fish species in the catch over the time period. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

3.2.5.5 Mean length of the surveyed community

The mean length (ML) of the surveyed community will be assessed in accordance with D4C3 of the MSFD. This indicator again takes into consideration the fishing pressure which is higher on larger individuals. ML of all species caught in a survey (ML) can be a useful and simple indicator to study the overall effects of fishing on an ecosystem.[39] This indicator quantifies relative abundances of large and small individuals, thereby describing the size distribution of the community.[41] Although this is a useful indicator, the direction of the response to fishing pressures could be an indication of increasing/decreasing large fish or decreasing/increasing small fish.

MEDITS data from all hauls in the FMZ will be used to calculate the ML for all sub-apex demersal species in the catch over the time period. The assessment will also be carried out for sub-apex demersal fish and cephalopods separately, to assess the contributions of each of the taxonomic groups towards any patterns observed in the ML. The principal pressure that affects this indicator is fishing, with declining values

[41] Shin, Y. J., Rochet, M. J., Jennings, S., Field, J. G., & Gislason, H. (2005). Using size-based indicators to evaluate the ecosystem effects of fishing. *ICES Journal of Marine Science: Journal du Conseil, 62*(3), 384–396.

over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

3.2.5.6 Biomass of important trophic guilds

The biomass will be assessed in accordance with D4C4 of the MSFD. One of the primary pressures which give rise to cascading changes in food webs, visible throughout the trophic guilds, is fishing. The removal of commercial species from the food web would directly reduce the biomass of the respective trophic level, and indirectly affect the biomasses of higher and lower trophic levels. This anthropogenic pressure directly affects target species, while indirectly affecting non-target components of food webs. Prey of exploited species tend to increase in biomass, while predators tend to decrease.

Exploited populations would therefore show decreasing trends in biomass than healthy populations. Consequently, trends in biomass are good measures of ecosystem structure, particularly at trophic levels which are targeted by commercial fishing.[39] The pressure of fishing on non-target species can also be investigated through the assessment of trends in biomass.

MEDITS data from all hauls in the FMZ will be used to calculate the biomasses of all representative sub-apex demersal predator species over the study time period. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

3.3 APEX PREDATORS

3.3.1 Monitoring Parameters

Table 11 provides the criteria, indicators and taxonomic groups/species applicable for the assessment of apex predators. Further detail on how the data for each of these parameters will be used to assess the status of the Descriptor 4 criteria is provided in Section 4.4.

TABLE 11: CRITERIA, INDICATORS AND TAXONOMIC GROUPS/SPECIES APPLICABLE TO APEX PREDATORS

CRITERIA	INDICATOR	TAXONOMIC GROUPS/SPECIES	PARAMETER	UNIT
D4C1: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures	Abundance trends of demersal predators	*Squalus blainville, Heptranchias perlo, Lophius piscatorius*	Species abundance	Catch per haul
	Abundance trends of pelagic predators	*Coryphaena hippurus*	Species abundance	Catch per landing
	Marine Trophic Index (MTI)	All AP species	Species abundance	Catch per haul
			Species TROPH	None
D4C2: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures[25]	Abundance trends of functionally important selected groups/species between the trophic guilds	*Squalus blainville, Heptranchias perlo, Lophius piscatorius*	Species abundance	Catch per haul
		Coryphaena hippurus	Species abundance	Catch per landing
	Marine Trophic Index (MTI)	All AP species	Species abundance	Catch per haul
			Species TROPH	None
D4C3: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures	Proportion of large fish (large fish indicator, LFI)	All AP fish species larger than 30cm, all AP fish larger than 40cm	Species abundance	Catch per haul
			Individual length	mm
			Individual biomass	g
	Mean weights-at-age of predatory fish	All AP fish species	Individual maturity	None

CRITERIA	INDICATOR	TAXONOMIC GROUPS/SPECIES	PARAMETER	UNIT
			Individual biomass	g
	Mean length of the surveyed community	All AP species, all AP fish and cephalopods	Individual length	mm
D4C4: Productivity of the trophic guild is not adversely affected due to anthropogenic pressures	Biomass of representative demersal species	*Squalus blainville, Heptranchias perlo, Lophius piscatorius*	Individual biomass	g
	Biomass of representative pelagic species	*Coryphaena hippurus*	Individual biomass	g

3.3.2 Monitoring Methodologies

MEDITS

Trawl surveys are carried out following the MEDITS protocol in GSA 15 where 45 stations are sampled using the IFREMER GOC 73 bottom trawl net: width 22m; height of vertical opening: 2m; length: 40m; stretched mesh size at cod-end: 20mm.

Landings

Data on landings will be obtained from the DFA. It is assumed that the indicator status at GSA15 reflects the status at FMZ level. Ideally, data should also include coordinates for the catches, which is currently missing.

3.3.3 Monitoring Area

MEDITS

While MEDITS is carried out within GSA 15, the data generated by MEDITS for stations within the 25 nautical mile Fisheries Management Zone will be used for assessment purpose, as mapped in Figure 5. Table 12 provides the coordinates for the monitoring stations.

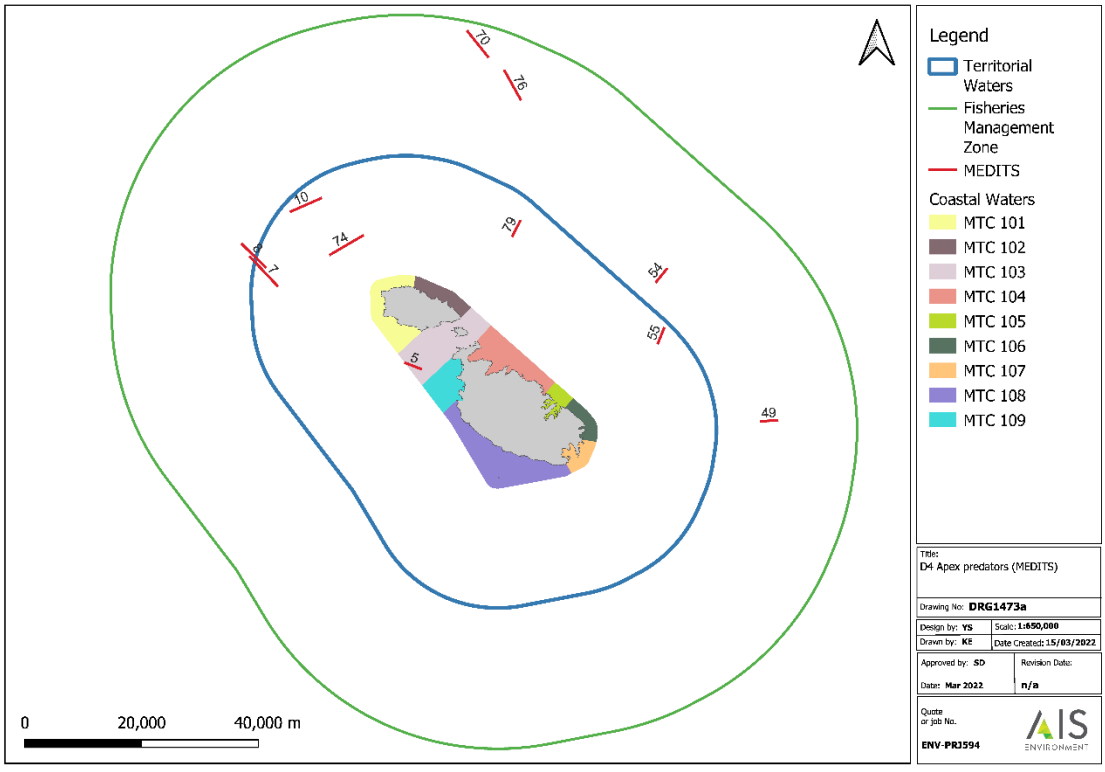

FIGURE 5: APEX PREDATORS: MEDITS MONITORING STATIONS AND MRUS

TABLE 12: APEX PREDATORS: COORDINATES OF MEDITS MONITORING STATIONS

MEDITS HAUL	START		END	
	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
5	35.9543	14.2607	35.9632	14.2318
7	36.0805	13.9863	36.1242	13.9343
8	36.109	13.9632	36.1433	13.919
10	36.1948	14.011	36.2155	14.0675
49	35.877	14.9377	35.8755	14.9078
54	36.1097	14.7272	36.0903	14.7078
55	35.9958	14.7113	36.0183	14.7222
70	36.475	14.3452	36.436	14.3847
74	36.1288	14.0868	36.1587	14.148
76	36.414	14.4165	36.3707	14.447
79	36.1602	14.4338	36.1828	14.4478

Landings

Data generated from the landings data is obtained from the GSA 15, as shown in Figure 6. The landings data does not include coordinates for the catches. Filtering of the data to the 25 nautical mile FMZ is therefore not possible, so all data will be used.

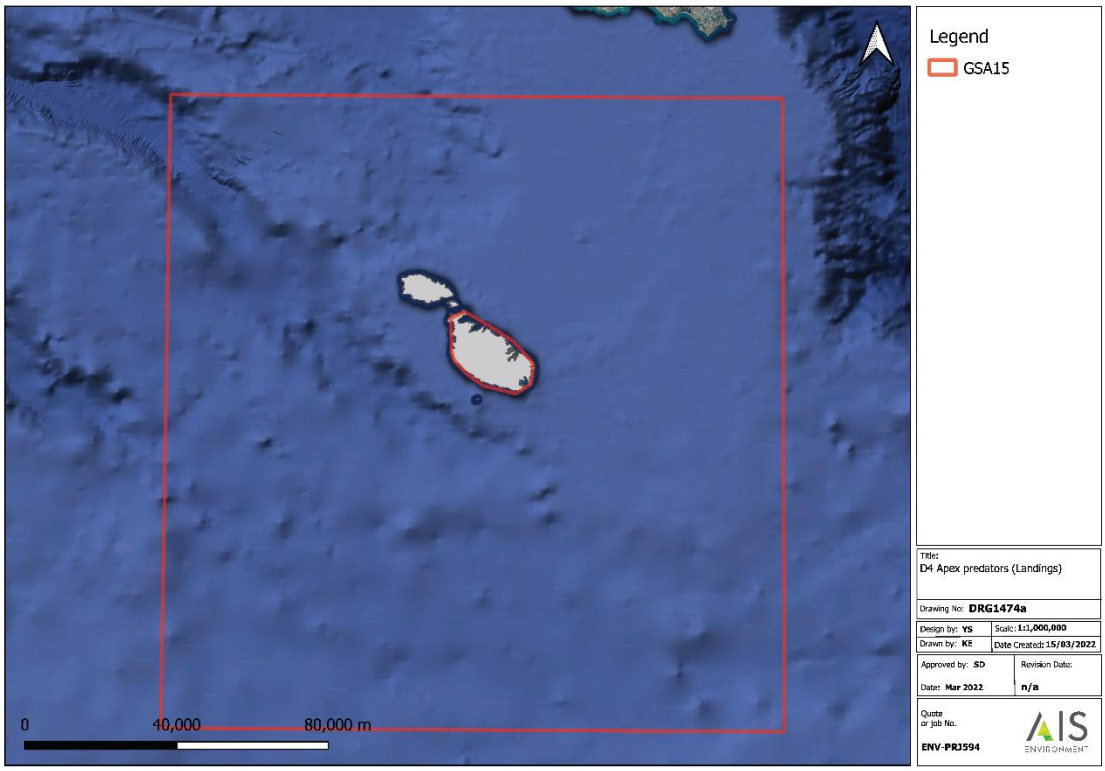

FIGURE 6: APEX PREDATORS: LANDINGS MRUS

3.3.4 Monitoring Frequency

Table 6 provides the monitoring frequency for each of the sub-apex demersal predator parameters.

TABLE 13: MONITORING FREQUENCY FOR PARAMETERS OF SUB-APEX DEMERSAL PREDATORS

PARAMETERS	MONITORING STATIONS	MONITORING FREQUENCY
MEDITS		
Catch by MEDITS haul	All stations in the FMZ	Yearly
Marine Trophic Index (MTI)	All stations in the FMZ	Yearly
Proportion of large fish (LFI)	All stations in the FMZ	Yearly
Mean weights-at-age of predatory fish	All stations in the FMZ	Yearly
Mean length of the surveyed community	All stations in the FMZ	Yearly
Biomass of important trophic guilds	All stations in the FMZ	Yearly
Landings		
Catch by landing	All stations in the FMZ	Yearly
Marine Trophic Index (MTI)	All stations in the FMZ	Yearly
Proportion of large fish (LFI)	All stations in the FMZ	Yearly

PARAMETERS	MONITORING STATIONS	MONITORING FREQUENCY
Mean weights-at-age of predatory fish	All stations in the FMZ	Yearly
Mean length of the surveyed community	All stations in the FMZ	Yearly
Biomass of important trophic guilds	All stations in the FMZ	Yearly

3.3.5 Data Interpretation

The following subsections outline the methodology to be used for the assessment of status for the apex predators trophic guild in line with MSFD Descriptor 4.

3.3.5.1 Abundance trends of apex predators

Abundance trends of apex predators will be assessed in accordance with D4C1 and D4C2 of the MSFD. One of the primary pressures which give rise to cascading changes in food webs, visible throughout the trophic guilds, is fishing. The removal of commercial species from the food web would directly reduce the abundance of the respective trophic level, and indirectly affect the abundances of higher and lower trophic levels. This anthropogenic pressure directly affects target species, while indirectly affecting non-target components of food webs. Prey of exploited species tend to increase in numbers, while their predators tend to decrease.

MEDITS data from all hauls in the FMZ will be used to calculate the abundances of *Squalus blainville*, *Heptranchias perlo*, and *Lophius piscatorius*. Landings data will be used to calculate the abundances of *Coryphaena hippurus* over the study time period. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

D4C2 of the MSFD assesses the ecological status of food webs based on the relationship between the different trophic guilds. Considering the cascading nature of effects through trophic levels, issues in a particular guild may be visible in one/both other guilds. The abundance trends between the trophic guilds will be compared on a qualitative basis.

3.3.5.2 Marine Trophic Index

The marine trophic index (MTI) will be assessed in accordance with D4C1 and D4C2 of the MSFD. The MTI is an indicator representative of the ecological state of the trophic guild. The index is a product of the TROPH of a group/species (i.e. the position of the organism in the food chain) and its abundance.[42] The TROPH represents the number of energy transfer steps to that level and ranges between 1

[42] UNEP (2004). *Indicators for Assessing Progress Towards the 2010 Target: Marine Trophic Index.* https://www.cbd.int/doc/meetings/sbstta/sbstta-10/information/sbstta-10-inf-18-en.pdf.

for primary producers and 5.5 for apex predators. Herbivores (i.e. primary consumers) have a TROPH of about 2, while carnivores range in TROPH between 3 and 5. For the purposes of this assessment, apex predators constitute all consumers with a TROPH above 4.[7] This threshold is being drawn along arbitrary lines, taking into consideration the existing range of TROPHs for the Mediterranean Sea. Ideally, once data from other methodologies emerges (e.g. stable isotope analysis, fatty acid analysis), the recommended threshold should be reassessed for possible revision. These thresholds should also be discussed and agreed on a regional basis.

TROPHs are closely related to organism size, meaning changes in MTI mirror changes in food chain position and size composition. Since overfishing primarily targets large high-trophic level species, it leads to a deterioration in the ecosystem structure, reflected as a declining MTI.

MEDITS data from all hauls in the FMZ and landings data will be used to calculate the MTI for all apex species in the catch. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

D4C2 of the MSFD assesses the ecological status of food webs based on the relationship between the different trophic guilds. Considering the cascading nature of effects through trophic levels, issues in a particular guild may be visible in one/both other guilds. The abundance trends between the trophic guilds will be compared on a qualitative basis.

3.3.5.3 Proportion of large fish (large fish indicator, LFI)

The Large Fish Indicator (LFI) will be assessed in accordance with D4C3 of the MSFD. The LFI is defined as the proportion by weight of large fish in the sample of a specified survey, irrespective of species.[36] Generally, the threshold between small and large fish (L_{th}) is determined on a regional basis, and is chosen to optimise responsiveness of the indicator to fishing pressure.[37] Considering that fishing is generally size-selective, larger individuals are targeted to a greater extent than smaller individuals, and therefore suffer higher rates of mortality.[38] The LFI is therefore sensitive to the fishing pressure. Furthermore, the proportions of the indicator are based on weight not by numbers, making it less likely to be affected by the tendency of smaller fish to be found in higher numbers than larger fish. This indicator is very useful for studying fish taxonomic groups and has been selected as a common foodweb indicator by HELCOM and OSPAR.[39]

MEDITS data from all hauls in the FMZ and landings data will be used to calculate the LFI for all apex species in the catch over the time period. Since no regional length thresholds have been established,[40] the assessment will make use of two cut-off points to distinguish large fish: 30cm and 40cm. These cut-off points are being drawn on an arbitrary basis, but would allow the assessment of this indicator on multiple

levels. Member States have made use of one or both these values to classify large fish. Using both at such an early stage in the process is useful to identify which is the most suitable in the local context.

The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

3.3.5.4 Mean weights-at-age of predatory fish

The mean weights-at-age of predatory fish will be assessed in accordance with D4C3 of the MSFD. As outlined above, fishing pressure is higher on large individuals than smaller ones. Consequently, the mean weights-at-age indicator serves to provide the average "weight anomaly" for the fish community in a particular year, i.e. the deviation around an observed long-term mean.[39] The youngest and oldest groups of fish are excluded to avoid sampling bias, and the weights of the remaining fish are averaged for all ages of each stock to obtain a mean annual anomaly for that stock. Stock anomalies are then averaged by year to obtain the stock average weight for the whole predatory fish community, where indicator values fluctuate around this norm. This indicator can be applied to different species or whole communities.

MEDITS data from all hauls in the FMZ and landings data will be used to calculate the mean weights-at-age for all apex fish species in the catch over the time period. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

3.3.5.5 Mean length of the surveyed community

The mean length (ML) of the surveyed community will be assessed in accordance with D4C3 of the MSFD. This indicator again takes into consideration the fishing pressure which is higher on larger individuals. ML of all species caught in a survey can be a useful and simple indicator to study the overall effects of fishing on an ecosystem.[39] This indicator quantifies relative abundances of large and small individuals, thereby describing the size distribution of the community.[41] Although this is a useful indicator, the direction of the response to fishing pressures could be an indication of increasing/decreasing large fish or decreasing/increasing small fish.

MEDITS data from all hauls in the FMZ and landings data will be used to calculate the ML for all apex species in the catch over the time period. The assessment will also be carried out for apex fish and cephalopods separately, to assess the contributions of each of the taxonomic groups towards any patterns observed in the ML. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be

used to assess the environmental status of Maltese waters.

3.3.5.6 Biomass of important trophic guilds

The biomass will be assessed in accordance with D4C4 of the MSFD. One of the primary pressures which give rise to cascading changes in food webs, visible throughout the trophic guilds, is fishing. The removal of commercial species from the food web would directly reduce the biomass of the respective trophic level, and indirectly affect the biomasses of higher and lower trophic levels. This anthropogenic pressure directly affects target species, while indirectly affecting non-target components of food webs. Prey of exploited species tend to increase in biomass, while predators tend to decrease.

Exploited populations would therefore show decreasing trends in biomass than healthy populations. Consequently, trends in biomass are good measures of ecosystem structure, particularly at trophic levels which are targeted by commercial fishing.[39] The pressure of fishing on non-target species can also be investigated through the assessment of trends in biomass.

MEDITS data from all hauls in the FMZ will be used to calculate the biomasses of *Squalus blainville*, *Heptranchias perlo*, and *Lophius piscatorius* individuals over the study time period. Landings data will be used to calculate the biomasses of *Coryphaena hippurus* individuals over the study time period. The principal pressure that affects this indicator is fishing, with declining values over the time period indicating that the stations are in bad ecological status in terms of Descriptor 4. Considering that this assessment will be undertaken in relation to time, no thresholds are applicable. Instead, the variation of this indicator over time will be used to assess the environmental status of Maltese waters.

4 ASSESSMENT METHODOLOGY

4.1 EUROPEAN COMMISSION GUIDELINES

Deliverable 3 of SPD8/2021/016 will comprise the following items:

- **A structured reporting of information, in Excel files:** These files serve to assess the environmental status for different indicators and descriptors, and should be provided as an annex to the assessment report. Such files contain information on how to aggregate indicators, depending on the descriptors and the criteria.

- **The national indicator assessments:** The indicators and thresholds to be used in this process are included in Section 4.4, and will be assessed on a pilot basis in Deliverable 3. We have made use of, wherever possible, indicators measured in the existing national monitoring network. We have also referred to indicators which should be integrated into the national monitoring network for future data collection exercises.

- **The supporting assessment datasets**: This exercise falls outside the scope of SPD8/2021/016.

- **Text-based national reports:** This exercise falls outside the scope of SPD8/2021/016. Nevertheless, the report prepared as part of Deliverable 3 can be included in the national reports.

4.2 MARINE REPORTING UNITS

The monitoring network for Maltese waters is a complex mixture of MRUs, as required by the MSFD, and sampling stations for different environments (water, sediment, biota) and ecosystem components (plankton, macroalgae, seagrasses, macroinvertebrates) as well as other elements (such as litter).

Figure 7 presents the MRUs applicable to the assessment of Maltese waters in line with MSFD Descriptor 4 as part of SPD8/2021/016. In total, we will be assessing eleven MRUs:

- Nine coastal water bodies within the WFD, with sizes between 13 and 98 km^2, which are aggregated into a unique WFD MRU, covering 399 km^2
- Territorial waters, covering approximately 3,830 km^2
- Fisheries Management Zone, covering approximately 11,480 km^2

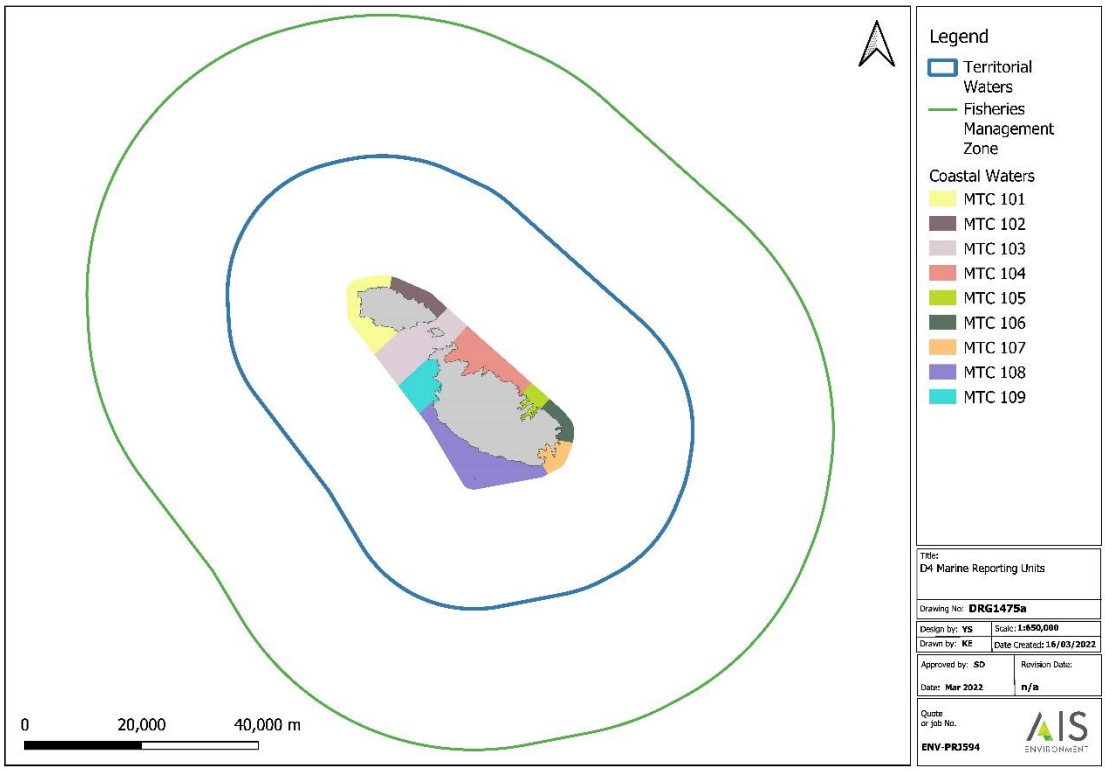

FIGURE 7: MAP SHOWING THE MALTESE MARINE REPORTING UNITS

4.3 ECOSYSTEM COMPONENTS

Since each indicator describes a specific ecosystem component, we have defined the following ecosystem components:

- Phytoplankton (chlorophyll, abundance, composition)
- Pelagic fish (abundance, MTI, LFI, weights-at-age, length, biomass)
- Demersal fish (abundance, MTI, LFI, weights-at-age, length, biomass)
- Demersal cephalopods (abundance, MTI, length, biomass)

4.4 INDICATORS & THRESHOLDS

To select the indicators, we have followed as far as possible the criteria of the European Commission (2017) decision.[43] In line with the guidance, primary criteria will be used to ensure consistency across the European Union. Proposals for assessment using secondary criteria have been put forward. Where necessary, implementation of these criteria should be decided by Member States. The purpose of implementing secondary criteria is to complement a primary criterion or when the marine environment is at risk of not achieving or not maintaining good environmental status for a particular criterion.

At this stage, we are proposing the use of total of 21 indicators for assessment of

[43] European Commission (2017). *Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU Official Journal of the European Communities*, L125: 43-74.

Descriptor 4, corresponding to two priority and two secondary criteria. Their feasibility will be assessed on a pilot basis as part of SPD8/2021/016, and the list will be confirmed/updated as part of Deliverable 3 of this project.

- D4C1 [Diversity within trophic guilds] – 2 indicators for primary producers; 2 indicators for sub-apex demersal predators; 3 indicators for apex predators
- D4C2 [Total abundance between trophic guilds] – 1 indicator for primary producers; 2 indicators for sub-apex demersal predators; 3 indicators for apex predators
- D4C3 [Size distribution within trophic guilds] – 1 indicator for primary producers; 3 indicators for sub-apex demersal predators; 3 indicators for apex predators
- D4C4 [Productivity within trophic guilds] – 1 indicator for primary producers; 1 indicator for sub-apex demersal predators; 2 indicators for apex predators

To make use of the indicators for the assessment of status, the results will be analysed, wherever possible, by comparing them to a threshold between good/not good environmental status. However, since assessment of EU Member States in relation to Descriptor 4 is still in the initial stages, thresholds for Descriptor 4 indicators are scarce. Consequently, scientific papers have been used to set thresholds. Wherever thresholds for good/not good environmental status were not available, trend analyses over a given time period will be performed to determine whether the conditions of the trophic guild vary over time.

The indicators will show a range of variation (from worst to best values, i.e. reference conditions). These results will be compared against a threshold between good/not good status, as shown in Table 14.

TABLE 14: INDICATORS, THRESHOLDS AND PRESSURES FOR THE ASSESSMENT OF DESCRIPTOR 4

INDICATORS	TROPHIC GUILD	UNITS	THRESHOLDS	PRESSURES
D4C1: Diversity within trophic guilds				
Dia/Dino index	PP	Ratio	0.5 [30]	Aquaculture, bunkering, sewage outfalls, agriculture, harbours, industrial areas
Large microphytoplankton vs small microphytoplankton	PP	Ratio	None (trend analysis)	None, since this is a state indicator which does not provide a direct link to pressures
Abundance of *Illex coindetii, Octopus vulgaris, Mullus barbatus, Trachurus trachurus*	SDP	Catch by MEDITS haul	None (trend analysis)	Trawling, fishing
Abundance of *Squalus blainville, Heptranchias perlo, Lophius piscatorius*	AP	Catch by MEDITS haul	None (trend analysis)	Trawling, fishing
Abundance of *Coryphaena hippurus*	AP	Catch by landing	None (trend analysis)	Trawling, fishing
Marine Trophic Index (MTI) of all sub-apex demersal predators	SDP	None	None (trend analysis)	Trawling, fishing
Marine Trophic Index (MTI) of all apex predators	AP	None	None (trend analysis)	Trawling, fishing
D4C2: Total abundance between trophic guilds[44]				
Phytoplankton abundance	PP	Cells/l	None (trend analysis)	Aquaculture, bunkering, sewage outfalls,

[44] Comparison between the trophic guilds will be done on a qualitative basis.

INDICATORS	TROPHIC GUILD	UNITS	THRESHOLDS	PRESSURES
				agriculture
Abundance of *Illex coindetii, Octopus vulgaris, Mullus barbatus, Trachurus trachurus*	SDP	Catch by MEDITS haul	None (trend analysis)	Trawling, fishing
Abundance of *Squalus blainville, Heptranchias perlo, Lophius piscatorius*	AP	Catch by MEDITS haul	None (trend analysis)	Trawling, fishing
Abundance of *Coryphaena hippurus*	AP	Catch by landing	None (trend analysis)	Trawling, fishing
Marine Trophic Index (MTI) of all sub-apex demersal predators	SDP	None	None (trend analysis)	Trawling, fishing
Marine Trophic Index (MTI) of all apex predators	AP	None	None (trend analysis)	Trawling, fishing
D4C3: Size distribution within trophic guilds				
Large microphytoplankton vs small microphytoplankton	PP	Ratio	None (trend analysis)	None, since this is a state indicator which does not provide a direct link to pressures
Proportion of large fish (large fish indicator, LFI) of all sub-apex demersal predators	SDP	g	None (trend analysis) of all fish species larger than 30cm and 40cm	Trawling, fishing
Proportion of large fish (large fish indicator, LFI) of all apex predators	AP	g	None (trend analysis) of all fish species larger than 30cm and 40cm	Trawling, fishing
Mean weights-at-age of all sub-	SDP	g	None (trend analysis) of the representative	Trawling, fishing

INDICATORS	TROPHIC GUILD	UNITS	THRESHOLDS	PRESSURES
apex demersal predatory fish			species at maturity stage 2/3	
Mean weights-at-age of all apex predatory fish	AP	g	None (trend analysis) of the representative species at maturity stage 2/3	Trawling, fishing
Mean length of the surveyed community of all sub-apex demersal predators	SDP	mm	None (trend analysis)	Trawling, fishing
Mean length of the surveyed community of all apex predators	AP	mm	None (trend analysis)	Trawling, fishing
D4C4: Productivity within trophic guilds				
90th percentile chlorophyll-a	PP	µg/l	None (trend analysis)	Aquaculture, bunkering, sewage outfalls, agriculture
Biomass of *Illex coindetii, Octopus vulgaris, Mullus barbatus, Trachurus trachurus*	SDP	g	None (trend analysis)	Trawling, fishing
Biomass of *Squalus blainville, Heptranchias perlo, Lophius piscatorius*	AP	g	None (trend analysis)	Trawling, fishing
Biomass of *Coryphaena hippurus*	AP	g	None (trend analysis)	Trawling, fishing

4.5 ASSESSMENT OF ENVIRONMENTAL STATUS

The assessment will be done, as far as possible, in accordance with Annex III of the MSFD and with the criteria and methodological standards by the European Commission.[43,47] The method which will be used to assess the status of Maltese waters in line with Descriptor 4 (food webs) is outlined in Section 2.1.1. Steps 1 to 5 have already been completed as part of Deliverable 1 and 2 of SPD8/2021/016. Steps 6 and 7 will be performed as part of this project on a pilot basis.

The first step of the assessment exercise will involve the computation of the indicators, as outlined in Section 4.4 and shown in Figure 8. The mean, minimum and maximum values for each indicator from all stations associated to each MRU will then be extracted. These values will then be aggregated to MRU-level, as outlined in Section 2.1.1. Results from individual stations will be aggregated by calculating the mean value, or the percentage of areas achieving good status. This step will produce an MRU-level assessment for each indicator. In line with the draft ICES guidance for assessment of MSFD D3 and D4, each trophic guild will be assessed separately, and integration of the MRU-level assessments for each indicator will not be carried out.[48]

In line with MSFD Guidance Document 14, the assessment of Maltese waters in line with MSFD Descriptor 4 will include the comparison to pressures where possible.[47] The draft ICES guidance for assessment of MSFD D4 states that "*link to direct human pressure and hence direct management actions can be difficult to identify.*" Links to suspected pressures will be discussed wherever possible. The predominant pressure on phytoplankton is nutrient and organic matter enrichment. The indicators for the assessment of primary producers in line with Descriptor 4 will be compared to thresholds which reflect this pressure-impact relationship. The thresholds used by Malta in the latest MSFD Assessment in line with Descriptor 5 (Eutrophication) have therefore been adopted. These pressures have been obtained from the 2nd Water Catchment Management Plan, as mapped in Figure 9.[49]

Conversely, the predominant pressure on higher marine trophic guilds is fishing. The indicators for sub-apex demersal predators and apex predators will be compared across the data time period to observe variation in the pelagic and demersal communities with time. An indicator which is stable or improving over time will constitute GES for that particular indicator.

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[47] European Commission (2018). *Reporting on the 2018 update of articles 8, 9 & 10 for the Marine Strategy Framework Directive.* DG Environment, Brussels. pp 72 (MSFD Guidance Document 14).

[48] ICES (2021). *EU request for a Technical Service on MSFD Article 8 guidance on undertaking assessments for Descriptor 3 (commercially exploited fish and shellfish) and Descriptor 4 (marine foodwebs).* [DRAFT Provided to AIS Environment by the ERA].

[49] Environment & Resources Authority (2015). *The 2nd Water Catchment Management Plan for the Malta Water Catchment District 2015 – 2021.*

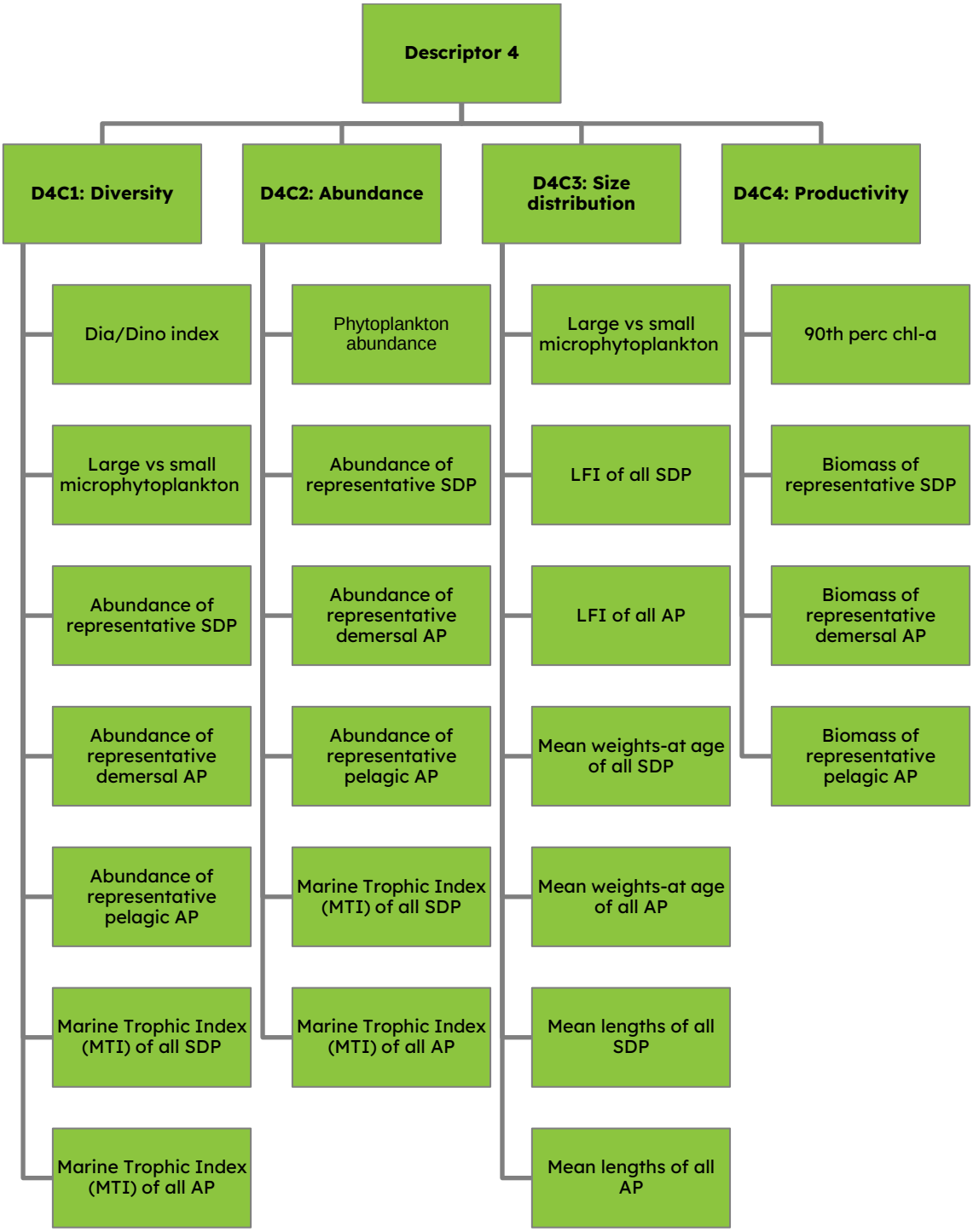

FIGURE 8: AGGREGATION OF INDICATORS AND CRITERIA FOR DESCRIPTOR 4 ASSESSMENT

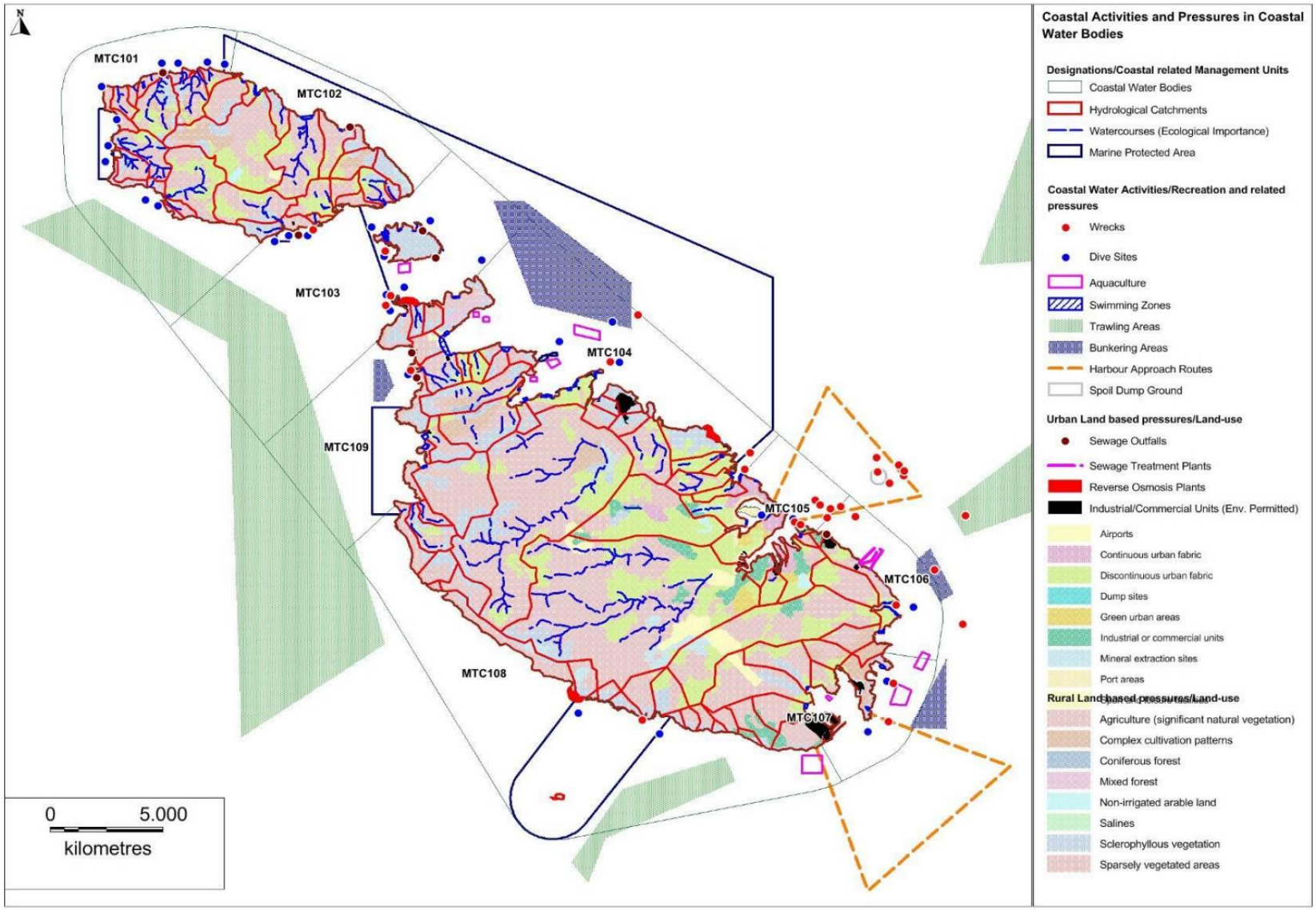

FIGURE 9: HUMAN PRESSURES IN THE MALTESE WATERS[49]

TABLE 15: TEMPLATE FOR ASSESSMENT OF ENVIRONMENTAL STATUS ON A PILOT BASIS

SCHEMA CLASS	SCHEMA FIELD	DESCRIPTION	PROPERTY	GUIDANCE	D4: FOOD WEBS			
MarineUnit	MarineReportingUnit	Area where the assessment applies and the 'extent to which GES has been achieved' is reported for the descriptor (where relevant).	Required	Enter one from List: Marine Reporting Unit (MarineUnitID) as reported by MS in 4geo.xml file, or select one from the Marine Reporting Units vocabulary				
OverallStatus	GEScomponent	Descriptor for which the assessment is reported	Required	Enter corresponding 'Descriptor' from List: GEScomponent_Enum				
OverallStatus	Feature	Feature(s) to which the assessment applies	Required	Enter all 'Ecosystem component' or 'Pressure' features (from List: Feature_Enum), that are relevant for this Descriptor and MRU. These should be included in the related GES determination (Art9_GES)				
ElementStatus	Element	Specific element of the Feature which is assessed (species, habitat, contaminant…)	Required (where applicable)	Enter the name of the species (D1, D2, D3, D5, D8, D10), habitat (D1, D2, D6, D7, D8), ecosystem/trophic guild (D4), nutrient/contaminant (D5, D8, D9), litter category (D10) or other type of element (D5, D6, D7, D8, D11) (max. 250 characters)				
ElementStatus	ElementCode	Code of Element	Conditional (when Element is provided)	Enter the corresponding code or ID, as described in Reporting Guidance section 3.2 (max. 50 characters)				
ElementStatus	ElementCodeSource	Source of Element Code	Conditional (when the ElementCode is provided)	Enter code from List: ElementCodeSource_Enum. When 'Other' is selected, provide details in field 'DescriptionElement'.				
ElementStatus	Element2	Associated element of the feature that is assessed	Conditional: when GEScomponent is 'D3' (stocks), 'D9' (species), 'D10' (species) OR 'D11' (time period).	Enter the name of the stock for the commercial species assessed (D3), the species of seafood used to assess the contaminant level (D9), the species used for litter ingestion assessment (D10C3) and the time period used for acute noise events (D11C1) (max. 250 characters).				
ElementStatus	Element2Code	Code of Element2	Conditional (when Element2 is provided)	Enter the corresponding code or ID, as described in Reporting Guidance section 3.2 (max. 50 characters)				
ElementStatus	Element2CodeSource	Source of ElementCode2	Conditional (when the ElementCode2 is provided)	Enter code from List: ElementCodeSource_Enum. When 'Other' is selected, provide details in field 'DescriptionElement'.				
ElementStatus	ElementSource	Source of the agreed list of elements used in the assessment	Conditional (when the Element is provided)	Enter: 'EU', 'HELCOM', 'OSPAR', 'BARCON', 'BSC', 'MS in (sub)region', 'CFP', 'ICES', 'National' OR 'Other'. When 'Other' is selected, provide details in field 'DescriptionElement'.				
CriteriaStatus	Criteria	Criterion for which the assessment is reported	Required	Enter corresponding 'Criteria' code from List: GEScomponent_Enum	D4C1	D4C2	D4C3	D4C4
CriteriaValues	Parameter	Parameter assessed	Required	Enter code from List: Parameters_Enum. If 'Other' is selected, provide details in field 'ParameterOther'.				

SCHEMA CLASS	SCHEMA FIELD	DESCRIPTION	PROPERTY	GUIDANCE	D4: FOOD WEBS			
CriteriaValues	ParameterOther	Parameter assessed	Conditional (if Parameter is 'Other')	Free text (max. 250 characters)				
CriteriaValues	ThresholdValueUpper	Value defined as threshold. Whenever the threshold has been defined as a range: upper value.	Conditional: required if a value is provided under ThresholdValueLower.	Number				
CriteriaValues	ThresholdValueLower	Whenever the threshold has been defined as a range: lower value.	Optional (where available)	Number (for use when the value to be achieved should be between the upper and lower threshold values entered)				
CriteriaValues	ThresholdQualitative	Definition of the threshold if ever it is not quantitative	Optional (where available)	Free text (max. 250 characters)				
CriteriaValues	ThresholdValueSource	Provide the source of the threshold value, e.g. taken from other legislation or policies, or defined through regional processes or nationally	Conditional (when ThresholdValueUpper is provided)	Enter one code from List: ThresholdSources_Enum (Annex IVg). When 'Other' is selected, provide details in field 'ThresholdValueSourceOther'. When 'Directional trends' or 'Pressure-based proxy' is selected, indicate if this is national or (sub)regionally agreed under 'ThresholdValueSourceOther'.				
CriteriaValues	ThresholdValue SourceOther	Whenever the threshold value has been taken from the application of other legislation or policies, source	Conditional (if ThresholdValueSource is 'Other')	Free text (max. 250 characters)				
CriteriaValues	ValueAchievedUpper	Value resulting from monitoring and assessment. Whenever the value has to be provided as a range: upper value.	Conditional: required if a value is provided under ValueAchievedLower.	Number. For multiple samples/sites in the MRU, provide the upper (this field) and lower (next field) values in the dataset. The proportion of values achieving the threshold value should be expressed in 'ProportionValueAcheived'.				
CriteriaValues	ValueAchievedLower	Whenever the value has to be provided as a range: lower value.	Optional (where available).	Number				
CriteriaValues	ValueUnit	Unit in which the value is expressed	Conditional: required when ValueAchievedLower is provided	Enter code from List: Units_Enum. When 'Other' is selected, provide details in field 'ValueUnitOther'.				
CriteriaValues	ValueUnitOther	Unit in which the value is expressed	Conditional (if ValueUnit is 'Other')	Free text (max. 20 characters)				
CriteriaValues	Proportion ThresholdValue	Proportion ofr MRU area over which the threshold value set is to be achieved	Conditional (where relevant)	Number				
CriteriaValues	ProportionValue Achieved	Proportion of MRU area, or of the species group or habitat type within the MRU, over which the threshold value set has been achieved, OR extent of adverse effect (not achieving threshold values)	Optional (where available)	Number				

SCHEMA CLASS	SCHEMA FIELD	DESCRIPTION	PROPERTY	GUIDANCE	D4: FOOD WEBS			
CriteriaValues	Proportion ThresholdValue Unit	Unit for proportion/extent	Conditional: required when Proportion ThresholdValue is provided	Select one from list: '% area of MRU achieving threshold value', '% of population achieving threshold value', '% of samples achieving threshold value', '% area of habitat achieving threshold value', '% of species group adversely affected', 'extent in km2 of MRU adversely affected', 'extent in km2 of habitat adversely affected', 'extent in km2 of pressure' OR 'Not relevant'. 'Adversely affected' indicates values are below the threshold value.				
CriteriaValues	Trend	Trend in status compared with previous 6-year reporting period	Required	Enter: 'Improving' (status improving, pressure or impact reducing), 'Stable', 'Deteriorating' (status deteriorating, pressure or impact increasing), 'Not Relevant', 'Unknown'				
CriteriaValues	ParameterAchieved	Indicate whether the threshold value has been achieved or not (over the required proportion of the assessment area)	Required	Enter: 'Yes' OR 'No', based on Threshold value AND, where appropriate, proportion value, OR 'Unknown', Not assessed' or 'Yes, based on low risk'.				
CriteriaValues	DescriptionParameter	Description of the parameter assessment outcomes, when needed	Optional	Free text (max. 2500 characters)				
CriteriaValues	RelatedIndicator	Indicator/s from which the assessment has been extracted	Required (where available)	Enter as many indicator codes as necessary (as reported by MS under the schema 'Indicators')				
CriteriaStatus	CriteriaStatus	Indicate the status of the criteria based on the outcomes of the parameters used	Required (where applicable)	Enter: 'Good', 'Good, based on low risk', 'Not good', 'Unknown' OR 'Not assessed'. If 'Good, based on low risk' is selected, provide a justification in 'DescriptionElement'.				
CriteriaStatus	DescriptionCriteria	Description of the criteria assessment outcomes, when needed	Optional	Free text (max. 2500 characters)				
ElementStatus	ElementStatus	Indicate the status of the specific element (species, habitat, contaminant) based on the outcomes of the criterion used	Required (where applicable)	Enter: 'Good', 'Good, based on low risk', 'Not good', 'Contributes to assessment of another criterion/element', 'Not assessed' OR 'Unknown'. If 'Good, based on low risk' is selected, provide a justification in 'DescriptionElement'.				
ElementStatus	DescriptionElement	Description of the element assessment outcomes, when needed	Optional	Free text (max. 2500 characters); provide details here if 'Other' is selected for 'ElementCodeSource', 'Element2CodeSource' or 'ElementSource'', when 'Directional trends' and 'Pressure-based proxy' has been used and when ElementStatus or CriteriaStatus is 'Good, based on low-risk'.				
OverallStatus	IntegrationRuleTypeParameter	Integration rule type applied when more than one parameter is used to assess the criterion	Required (when more than one parameter has been used per criterion)	Enter code from List: IntegrationRule_Enum. Enter 'Not relevant' in cases where there is only one parameter used per criterion.				
OverallStatus	IntegrationRuleDescriptionParameter	Description of the rule applied	Required (where applicable)	Free text (max. 1000 characters) or provide URL or attach file (to be uploaded to the same folder as the XML)				

SCHEMA CLASS	SCHEMA FIELD	DESCRIPTION	PROPERTY	GUIDANCE	D4: FOOD WEBS			
OverallStatus	IntegrationRuleTypeCriteria	Integration rule type applied when more than one criterion is used to assess the element	Required (when more than one criterion has been used per element)	Enter code from List: IntegrationRule_Enum (Annex IVd). Enter 'Not relevant' in cases where there is only one criterion used per element. Use also for D4 and D5 for the integration of elements to define overall status for a D4 ecosystem or for D5).				
OverallStatus	IntegrationRuleDescriptionCriteria	Description of the rule applied	Required (where applicable)	Free text (max. 1000 characters) or provide URL or attach file (to be uploaded to the same folder as the XML)				
OverallStatus	GESextentThreshold	Threshold defined for achievement of GES	Required (when GESextentAchieved is reported)	Percentage OR number (Number applicable only for D2)				
OverallStatus	GESextentAchieved	Indicate, where relevant, to what extent GES has been achieved for the Feature	Required (where applicable)	Percentage OR number (Number applicable only for D2)				
OverallStatus	GESextentUnit	Indicate the unit for GES extent	Required (when GESextentAchieved is reported)	Enter: 'Proportion of species in good status within species group', 'Proportion of area in good status', 'Proportion of populations in good status', 'Proportion of habitats in good status', 'Proportion of substances in good status', 'Proportion of litter categories in good status', 'Number of newly-introduced species' OR 'Not relevant'.				
OverallStatus	GESachieved	Indicate whether GES has been achieved or not	Required	Enter 'GES achieved', 'GES expected to be achieved by 2020', 'GES expected to be achieved later than 2020, no Article 14 exception reported', 'GES expected to be acheieved later than 2020, Article 14 exception reported', 'Not assessed', 'Not relevant' OR 'Unknown'.				
OverallStatus	DescriptionOverallStatus	Description of or comment on the Overall Status assessment.	Optional	Free text (max. 2500 characters). Whenever a schema prefilled with EU (WFD, CFP) or regional (RSC) information has been modified or not used, provide reasons here.				
OverallStatus	AssessmentPeriod	Start and end date for the 6-year assessment period	Required	YYYY—YYYY				
OverallStatus	RelatedPressures	Pressures that are or may have an impact on the feature assessed	Required	Enter as many 'Pressure' codes as necessary (as in Feature_Enum) whenever they are considered relevant (e.g. provide the top three pressures). In the case where there is no clear pressure relationships, enter 'Unknown'.				
OverallStatus	RelatedTargets	Target(s) defined under Article 10 which are relevant for the feature being assessed (i.e. addressing relevant pressures and impacts)	Required	Enter as many target codes (as reported in the schema ART10_Targets.xml) as are relevant OR 'No targets'.				