

Monitoring Factsheet: Seabed Habitats

October 2015

1. Subject: Seabed Habitats

Seabed or benthic habitats are defined on the basis of the physical substrate, hydrological characteristics (e.g. temperature, salinity and water movement) and composition of species communities associated with the seabed, including benthic species living on the seabed, attached to it as epibiota or living in the sediment as infauna¹. The combination of an abiotic habitat (constituting of the physical and environmental conditions supporting a biological community) and its associated community of species is termed a 'biotope'.

Benthic habitats are subject to various classification systems. For the purpose of this monitoring factsheet, the broad categories of benthic habitats based on depth and substratum characteristics, as adopted by the Marine Strategy Framework Directive's (MSFD) Commission Staff Working Paper² on the basis of the European Nature Information System (EUNIS) habitat classification, are used, whilst taking into consideration the habitat types listed in the EU Habitats Directive and those identified for the purpose of the Protocol for Specially Protected Areas and Biological Diversity in the Mediterranean within the framework of the Barcelona Convention.

Table 1 identifies the depth zones for the broad habitat types. Annex I to this monitoring factsheet lists benthic habitats occurring in Maltese waters, highlighting those that are directly covered through this monitoring factsheet.

¹ Definition adapted from: Cochrane, S.K.J., Connor, D.W., Nilsson, P., Mitchell, I., Reker, J., Franco, J., Valavanis, V., Moncheva, S., Ekebom, J., Nygaard, K., Serrao Santos, R., Naberhaus, I., Packeiser, T., van de Bund, W., Cardoso, A.C. 2010. *Marine Strategy Framework Directive Task Group 1 Report – Biological diversity*. Publications Office of the European Union, Luxembourg. EUR 24337 EN - 2010

² Commission Staff Working Paper: Relationship between the initial assessment of marine waters and the criteria for good environmental status. SEC(2011)1255 final

Table 1: Broad habitat types and associated depth zones

MSFD habitat classification	Depth	Topography
Littoral	0m	Coastal Waters
Shallow sublittoral	0m – 50m ³	
Shelf sublittoral	50m – 200m	Continental Shelf ⁴
Upper Bathyal	200m and 1100m ⁵	Continental slope

2. Monitoring Requirements

2.1. Marine Strategy Framework Directive – MSFD (2008/56/EC)

2.1.1. Annex III characteristics/pressures/impacts

The MSFD calls for an assessment of the environmental status based on a list of characteristics listed in Table 1 of Annex III to the Directive, and pressures and impacts listed in Table 2 of the same Annex.

Implementation of this monitoring factsheet will enable a description of predominant seabed habitat type(s) and biological communities, including information on angiosperms, macroalgae and invertebrate bottom fauna as per Table 1 of Annex III. The monitoring programme also addresses ‘physical loss’ and ‘physical damage’ as pressures listed in Table 2 of Annex III.

2.1.2. Annex I Good Environmental Status Descriptors

MSFD Annex I descriptors of Good Environmental Status and the associated criteria and indicators established by MSFD Commission Decision 2010/477/EU for assessment of progress towards the achievement of GES in terms of seabed habitats

³ The boundary between the shallow sublittoral and shelf sublittoral MSFD habitat types was set at 50m, based on the vertical extent of occurrence of marine phanerogams, namely *Posidonia oceanica* in Malta. In the Maltese Islands, the maximum depth at which stands of this species have been recorded is 44m (Borg J. A., Micallef M. A, & Schembri P. J., 2006. Spatio-temporal variation in the structure of a deep water *Posidonia oceanica* meadow assessed using non-destructive techniques. Marine Ecology 27: 320 - 327.)

⁴ Definition of continental shelf by the Continental Shelf Act 2014: *the “continental shelf” means the seabed and subsoil of the submarine areas that extend beyond the territorial waters of Malta to a limit established in accordance with international law, measured from the baselines from which the breadth of the territorial waters is measured; so however that where in relation to States of which the coast is opposite that of Malta it is necessary to determine the boundaries of the respective continental shelves, the boundary of the continental shelf shall be that determined by agreement between Malta and such other State or States or, in the absence of agreement, the median line, namely a line every point of which is equidistant from the nearest points of the baselines from which the breadth of the territorial waters of Malta and such other State or States is measured: Provided that until the agreement mentioned in the preceding paragraph comes into force, any licences issued under this Act or any regulations made thereunder for the exploration and exploitation of natural resources of the continental shelf of Malta shall only apply to the area lying on the Maltese side of the median line between the coast of Malta and coast belonging to the opposite State or States: Provided further that nothing shall preclude the Government of Malta from entering into any cooperative arrangements, such as joint development agreements, revenue sharing agreements and international unitisation agreements, with other States for the purpose of exploring and exploiting the natural resources on the continental shelf: Provided further that the Government of Malta may extend the continental shelf boundary beyond the median line in accordance with international law;*

⁵ Howell (2010) in https://webgate.ec.europa.eu/maritimeforum/system/files/all_annexes.pdf

(or associated species), and which will be addressed by this monitoring factsheet, are listed hereunder:

Descriptor 1: *Biological Diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions*

- 1.4 Habitat Distribution
 - Distributional Range (1.4.1)
- 1.5 Habitat Extent
 - Habitat Area (1.5.1)
- 1.6 Habitat Condition
 - Condition of the typical species and communities (1.6.1)
 - Relative abundance and/or biomass, as appropriate (1.6.2)

Descriptor 6: *Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.*

- 6.1 Physical damage, having regard to substrate characteristics
 - Type, abundance, biomass and areal extent of relevant biogenic substrate (6.1.1)
- 6.2 Condition of benthic community
 - Presence of particularly sensitive and/or tolerant species (6.2.1)
 - Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (6.2.2)

2.2. EU Nature Directives

The EU Nature Directives comprise the Habitats Directive (92/43/EEC) locally transposed to national law through the Flora, Fauna and Natural Habitats Protection Regulations, 2006 (Legal Notice 311 of 2006 as amended). The main aim of the Habitats Directive is to maintain or restore natural habitats and species listed in the Directive at a 'Favourable Conservation Status'. Monitoring of conservation status is an obligation arising from Article 11 of the Habitats Directive for all habitats listed in Annex I to the Directive, and species listed in Annexes II, IV and V. Monitoring results in relation to conservation status have to be reported to the Commission every six years in accordance with Article 17 of the Directive.

The reporting format set out by the Commission requires information on the different parameters defining conservation status:

- Range (12 year trends);
- Area (habitats only) (12 year trends);
- Population (species only);
- Structure and function (habitats only), and
- future prospects⁶.

Habitats listed in Annex I to the Habitats Directive and occurring in Malta's marine waters include:

- Sandbanks which are slightly covered by seawater all the time (1110)
- *Posidonia* beds (1120) - assigned a 'Priority' status in the Habitats Directive
- Reefs (1170)
- Submerged or partially submerged sea caves (8330)

Structure and function for some of these habitats as defined in the Explanatory Notes & Guidelines for the period 2007-2012 on Assessments and reporting under Article 17 of the Habitats Directive are listed in Table 2.

Protected areas designated within the framework of the Habitats Directive are known as Special Areas of Conservation (SAC) and form part of the EU Natura 2000 network of protected areas. Designation of marine SACs in Malta to date was primarily based on the presence of *Posidonia* beds, mainly as a result of data limitations in relation to the other habitat types. The ongoing project LIFE Baħar for Natura 2000 aims to collect data on the location, range and conservation status of Habitats Directive Annex I habitats, specifically seacaves, sandbanks and reefs, for the further designation, or extension of existing, of marine Natura 2000 sites on the basis of listed benthic habitats other than *Posidonia* beds.

⁶ The Explanatory Notes & Guidelines for the period 2007-2012 on Assessments and reporting under Article 17 of the Habitats Directive recommends that future prospects are evaluated by considering the future trends and likely future status of the 3 other parameters.

Table 2: Structure and Functions associated with specific marine habitat types listed in the Habitats Directive as extracted from 'Assessment and reporting under Article 17 of the Habitats Directive: Explanatory Notes & Guidelines for the period 2007-2012. Final Draft. April 2011'

Habitat	Structure	Typical Species	Functions
Sandbanks which are slightly covered by seawater all the time (1110)	<ul style="list-style-type: none"> - Elevation and topographic contour of the habitat feature - Species composition animal and vegetal: density of dominant species, general biodiversity index 	<i>Ammodytes</i> sp.; <i>Callionymus</i> sp., <i>Pomatoschistus</i> sp., birds; marine mammals; polychaetes, bivalves; crustaceans; free-living Corallinacea, <i>Zostera</i> sp.	<ul style="list-style-type: none"> - Spawning and nursery area for fish; - Sediment movement
<i>Posidonia</i> beds (1120)	<ul style="list-style-type: none"> - Typology of meadow lower limit: progressive (meadow lower limit distribution is influenced only by decreasing light levels), sharp, erosive, regressive - Conservation index (% live <i>Posidonia</i>: dead matte) - Conservation status (defined on the basis of leaf density according to depth. Note: taking into account variations known to occur in subregions) - Rhizome growth (orthotropic and plagiotropic) 	<i>Posidonia oceanica</i>	<ul style="list-style-type: none"> - Protection from coastal erosion processes - Source of primary productivity to the benefit of species living within the habitat as well as distal from it; - Spawning and nursery area for fish - Biodiversity hotspot - Maintenance of water quality and transparency to the benefit of tourist activities - Source of water oxygenation.
Reefs (1170)	<ul style="list-style-type: none"> - Conservation evaluation based on vitality of the platforms (percentage of dead organisms) - Erosion/abrasion/damage signs - Patchiness (patch size/distance between patches) - Density of specimens (stratified at 	<ul style="list-style-type: none"> - Dendropoma, vermetid & Lithophyllum rims: <i>Dendropoma petraeum</i>, <i>Neogoniolithon brassica-florida</i>, <i>Lithophyllum byssoides</i>, <i>Corallina elongata</i>; <i>Lithophyllum papillosum</i>, <i>Rissoella verruculosa</i>; <i>Nemalion helminthoides</i> 	<ul style="list-style-type: none"> - Biodiversity hotspot (often to the benefit of landscape value and tourism activities).

	selected sampling stations)	<ul style="list-style-type: none"> - Structuring algal infralittoral associations: <i>Cystoseira amentacea</i>, <i>C. tamariscifolia</i>, <i>C. brachycarpa</i>, <i>C. crinita</i>, <i>C. crinitophylla</i>, <i>C. sauvageauana</i>, <i>C. spinosa</i>, <i>C. compressa</i>, <i>Sargassum vulgare</i> - Coralligenous communities: <i>Lithophyllum stictaeforme</i>, <i>Peyssonnelia rosa-marina</i>, <i>Mesophyllum lichenoides</i>, Gorgoniana, Bryozoans and sponges - Corals: <i>Lophelia pertusa</i>, <i>Dendrophyllia</i> spp., <i>Madrepora oculata</i> - Mussel beds: <i>Ostrea edulis</i>, <i>Modiolus modiolus</i>, <i>Mytilus edulis</i> - Encrusting communities: <i>Sabellaria spinosula</i> 	
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2.3. EU Biodiversity Strategy to 2020

The EU Biodiversity Strategy, which calls for the halting of biodiversity and the degradation of ecosystem services by 2020, includes six targets and 20 associated actions targeted at setting the EU on the right track to meet its biodiversity objectives and the global commitments under the Convention on Biological Diversity.

Action 5 of the strategy requires Member States, with the assistance of the EU Commission, to map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services and promote the integration of these values into accounting and reporting systems at EU and National level by 2020.

The monitoring regimes to be undertaken as part of European directives can fit within the broader ecosystem service oriented framework of the EU Biodiversity Strategy.

2.4. Water Framework Directive – WFD (2000/60/EC)

The EU Water Framework Directive (WFD) 2000/60/EC calls for the protection of all water resources, including coastal waters. The main objective of the WFD for coastal water bodies is the achievement, by 2015, of ‘good ecological status’ up to one nautical mile from the coast; ‘good chemical status’ for all territorial waters (12 nautical miles) and ‘good ecological potential’⁷ for heavily modified water bodies⁸. ‘Good ecological status’ is determined by combining assessment of status of the biological elements, including seagrasses, macroalgae and benthic invertebrates, hydromorphological and physicochemical quality elements. The quality element most severely affected by human activity determines the overall ecological status (i.e. the ‘*one out - all out principle*’)

2.5. Barcelona Convention and the Ecosystem Approach

The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) was adopted in 1976 and came into force in 1978. The principal aim of the Barcelona Convention and its protocols is to reduce pollution in the Mediterranean Sea and to protect and improve the marine environment

⁷ ‘Good Ecological Potential’ is less stringent objective than good ecological status, making allowances for ecological impacts resulting from alterations to the physical environment that are necessary to either support a specific use, or must be maintained in order to avoid effects on the wider environment.

⁸ Heavily Modified Water Bodies are substantially changed in character as a result of physical alterations by human activity, and cannot therefore, meet ‘good ecological status’

in the area, thereby contributing to its sustainable development. The Barcelona Convention/MAP are working towards an Integrated Monitoring Programme and an Integrated Policy of Assessments to be established by 2015. The Integrated Monitoring Programme should be able to provide all the data needed to assess whether 'Good Environmental Status' defined through the EcAp process⁹ has been achieved or maintained.

The list of habitats which would be subject to EcAp biodiversity monitoring through the Integrated Monitoring Programme is under discussion at the time of compiling this monitoring factsheet. At this stage, the list includes¹⁰:

- Benthic infralittoral (=photophilic, e.g. 0-50m)
 - Rocky
 - Hard beds associated with communities of photophilic algae, with special attention to certain *Cystoseira* belts.
 - Communities of infralittoral algae (organogenic trottoir with *Lithophyllum* spp), with special attention to facies with vermetids (trottoir with vermetids)
 - Sedimentary
 - Meadows of sea grass (*Posidonia oceanica*, *Cymodocea nodosa*, *Zostera* sp.), with special attention to Barrier reefs of *Posidonia* sp., Tiger meadows of *Posidonia* sp., *Cymodocea* sp.
 - Communities of infralittoral sands or muddy sands
- Benthic Circalittoral (=Sciaphilic, e.g. 50-200m)
 - Rocky
 - Hard beds associated with coralligenous communities and semi dark caves,
 - Sedimentary
 - Communities of the coastal detritic bottom
 - Communities of shelf-edge detritic bottoms (facies with *Leptometra phalangium*),
- Benthic Bathyal (=dark, e.g. >200 m)
 - Communities of deep-sea corals
 - Seeps and communities associated with bathyal muds (facies with *Isidella elongata*)
 - Communities associated with seamounts

⁹ Ecosystem-based approach undertaken as part of the Barcelona Convention.

¹⁰ UNEP(DEPI)/MED WG.400/4

2.5.1. Protocol for Specially Protected Areas and Biological Diversity in the Mediterranean

Parties to the Barcelona Convention's Protocol for Specially Protected Areas and Biological Diversity in the Mediterranean may establish protected areas and to undertake all actions necessary in order to protect these areas and, as appropriate, to restore them as rapidly as possible. The protocol lists habitat characteristics for the selection of sites to be included in National inventories of Natural Sites of Conservation Interest, which list was finalised by the 4th meeting of the National Focal Points for SAP and cleared by the meeting of MAP focal points on the 6 September 1999 in Athens.

Following the designation of protected areas, parties need to adopt monitoring measures for Specially Protected Areas, which measures should include the continuous monitoring of ecological processes, habitats, population dynamics, landscapes as well as the impact of human activities. Monitoring Programmes shall be coordinated across Parties. The Protocol also calls on Parties to encourage and develop scientific and technical research relating to the aims of the Protocol.

3. Targets

This section includes targets set by policies in relation to seabed habitats.

Implementation of this monitoring factsheet will enable assessment of progress towards the achievement of targets adopted by Malta as part of the EU Marine Strategy Framework Directive¹¹. Such monitoring may also apply in assessing progress towards targets articulated through other processes.

Policy	Status to be achieved	Targets
Marine Strategy Framework Directive	Good Environmental Status: The natural range and extent of marine habitats and species are stable, or otherwise in line with the physiographic and climatic conditions, taking into consideration the sustainable use of the marine environment	Efforts are undertaken, through implementation of conservation measures or existing permitting and licensing procedures, to ensure maintenance of the distributional range and extent of selected habitat types in selected areas. [applying to Littoral Sediment: Biocoenosis of mediolittoral sands; <i>Posidonia oceanica</i> meadows and Shelf sublittoral sediment: Maerl facies]

¹¹ Unless the targets are more adequately assessed through implementation of the MSFD Programme of Measures.

	<p>Good Environmental Status: The structure and function of marine habitats ensure their long-term viability</p>	<p>Species composition and/or abundance associated with selected marine habitats is stable over a period of time (to be identified) or is indicative of good status, based on definition of status through the implementation of the EU Water Framework Directive. [applying to Littoral Rock and Biogenic Reefs; Shallow Sublittoral Sediment; Shelf sublittoral Sediment and Upper Bathyal Sediment]</p> <p>Health status of seagrass meadows is maintained</p>
	<p>Good Environmental Status: The long-term viability of key marine habitats is not compromised by anthropogenic pressures and impacts.</p>	<p>Benthic habitats affected by currently regulated anthropogenic activities show signs of recovery. [applying to Littoral Rock and Biogenic Reefs; Shallow sublittoral rock and biogenic reefs]</p> <p>Maintaining and enforcing regulations governing fishing activities within the 25 nautical mile Fisheries Management Zone [applying to Shelf sublittoral rock and biogenic reefs; Shelf sublittoral sediment; <i>Posidonia oceanica</i> meadows (as relevant)]</p> <p>Localised or sensitive marine habitats are afforded legal protection by 2025 [applying to Upper Bathyal Rock]</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Habitats Directive</p>	<p>Achievement or maintenance of Favourable Conservation Status for habitat types of community interest:</p> <ul style="list-style-type: none"> ▪ Sandbanks which are slightly covered by seawater all the time (1110) ▪ <i>Posidonia</i> beds (1120) ▪ Reefs (1170) ▪ Submerged or partially submerged sea caves (8330) 	<p>The conservation status of a natural habitat will be taken as 'favourable' when:</p> <ul style="list-style-type: none"> - its natural range and areas it covers within that range are stable or increasing, and - the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and - the conservation status of its typical species is favourable

Water Framework Directive	Achievement, by 2015, of ‘good ecological status’ up to one nautical mile from the coast and ‘good ecological potential’ ¹² for heavily modified water bodies. ‘Good ecological status’ is defined by the ecological status of biological elements, including elements associated with benthic habitats such as seagrasses, macroalgae and benthic invertebrates.	
Barcelona Convention: ECAP Process	Operational Objective: Key coastal and marine habitats are not being lost <i>Common Indicator</i> ¹³ : ▪ <i>Habitat Distributional Range</i> Good Environmental Status defined as ‘The habitat is present in all its natural distributional range’	State Target: The ratio Natural/observed distributional range tends to 1 Pressure Target: Decrease in the main human causes of the habitat decline
	Operational Objective: Key coastal and marine habitats are not being lost <i>Indicator</i> : ▪ <i>Distributional pattern of certain coastal and marine habitats listed under SPA protocol</i> Good Environmental Status defined as ‘The distributional extent is in line with prevailing physiographic, hydrographic, geographic and climatic conditions’	State Target: Decline in habitat extension is reversed and the extension of recovering habitats shows a positive trend.
	Operational Objective: Key coastal and marine habitats are not being lost <i>Common Indicator</i> ¹⁴ :	State Targets: No human induced significant deviation of population abundance and density from reference conditions

¹² ‘Good Ecological Potential’ is less stringent objective than good ecological status, making allowances for ecological impacts resulting from alterations to the physical environment that are necessary to either support a specific use, or must be maintained in order to avoid effects on the wider environment.

¹³ UNEP/MAP 2014. Working document on Common Indicators for the Mediterranean. Integrated Correspondence Groups of GES and Targets Meeting, Athens (Greece), 17-19 February 2014 , UNEP(DEPI)/MED WG.390/3

	<ul style="list-style-type: none"> ▪ <i>Condition of the habitat's typical species and communities</i> ▪ <i>Population abundance of selected species (marine macroalgae, zoobenthos)</i> <p>Good Environmental Status defined as: The population size and density of the habitat-defining species, and species composition of the community, are within reference conditions ensuring the long term maintenance of the Habitat</p>	The species composition shows a positive trend towards reference condition over an increasing proportion of the habitat (for recovering habitats)
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4. Competent Authorities

Policy	Competent Authority
MSFD	Office of the Prime Minister (delegation of technical implementation to the Malta Environment and Planning Authority)
WFD (Coastal waters)	Malta Environment and Planning Authority
Habitats Directive	Malta Environment and Planning Authority
Barcelona Convention – SPA/BD Protocol	Malta Environment and Planning Authority

5. Spatial Extent of monitoring requirements

Policy	Extent of marine waters
MSFD	Extent of waters to be monitored depends on relevance and established GES and targets.
WFD (Coastal waters)	1 nautical mile
Habitats Directive	12 nautical miles
Barcelona Convention – SPA/BD Protocol	Regional

¹⁴ UNEP/MAP 2014. Working document on Common Indicators for the Mediterranean. Integrated Correspondence Groups of GES and Targets Meeting, Athens (Greece), 17-19 February 2014, UNEP(DEPI)/MED WG.390/3

6. Monitoring Approach

This monitoring factsheet includes four monitoring subprogrammes listed hereunder:

Monitoring sub-programme	Title	Monitoring Purpose
1	Seabed habitats – distribution and extent	State
2	Seabed habitats – community characteristics	State
3	Benthic species – abundance	State
4	Information on relevant anthropogenic activities	Activities

The monitoring programme focuses on assessment of status of relatively known seabed habitat types. Habitats to be monitored were selected on the basis of availability of baseline data and listings in policies described in Section 2.

Some pressures on seabed habitats will be assessed through other monitoring programmes, in particular those related to ‘eutrophication’, ‘contaminants’ and ‘hydrographical changes’. Other relevant pressures, particularly those associated with physical loss and physical damage, will be assessed in relation to specific activities.

Habitat types and parameters to be monitored are subject to revision as further knowledge and baseline data becomes available, on the basis of a risk-based approach.

7. Assessment of status

Determination of ecological status of the benthic habitats in question is based on a collective assessment of the habitat type in terms of its range and extent, where these two criteria are deemed applicable, habitat condition when assessment is deemed possible and future prospects. All four criteria need to be taken into consideration when determining overall status.

‘Future prospects’ for the habitat types in question are defined in accordance with the Explanatory Notes & Guidelines for the period 2007-2012 on Assessments and reporting under Article 17 of the Habitats Directive. Future prospects are described on the basis of ‘future trends’ and ‘future status’.

Future trends of habitats and species are dependent on threats which will have a negative influence and on the other hand, action plans, conservation measures and

other provisions which can have a positive influence. If the habitat type is subject to a number of threats of high or medium importance then the future trend of one or more parameters will very likely be decreasing. If there are only threats of low importance or even no threats indicated then the future trend can be evaluated as stable or even increasing.

Future status of each parameter can be evaluated by estimation via expert judgement. Favourable Reference Values should preferably be used to assess the long-term viability of the habitat type, when these are determined/estimated for specific habitat types.

Assessment of status is detailed for the monitoring sub-programmes as relevant.

8. Monitoring Sub-Programme 1: *Seabed habitats – distribution and extent*

8.1. Monitoring Parameters

The monitoring parameters in terms of distribution and extent for selected benthic habitats are listed in Table 3. Definitions of relevance to the implementation of this monitoring factsheet are listed hereunder:

- Distributional Range is defined as the outer limits of the overall area in which a habitat type is found¹⁵. Range should exclude major discontinuities that are natural i.e. caused by ecological factors. A discontinuity of at least 40–50 km is suggested to be considered as a gap in the range, but this value may be modified on the basis of an expert judgment;
- Habitat Extent refers to the area occupied by the selected habitat.

¹⁵ Assessment and reporting under Article 17 of the Habitats Directive: Explanatory Notes & Guidelines for the period 2007-2012. Final Draft. April 2011

Table 3: Indicators and parameters to be monitored per selected habitat

Habitat	Indicator	Parameter	Policy			
			HD	MSFD	WFD	EcAp
Littoral Sediment	Habitat Distributional Range and Habitat Extent	Length of coastline occupied by littoral sediment		✓		✓ ¹⁶
Littoral and shallow sublittoral rock: Hard beds associated with communities of photophilic algae (<i>Cystoseira</i> belts)	Habitat Distributional Range	Grid map outlining the lateral extent of habitat	✓	✓		✓
	Habitat Extent	Length of coastline occupied by habitat type (km)	✓	✓		✓
Organogenic trottoirs with <i>Lithophyllum</i> spp, including facies with vermetids (trottoir with vermetids)	Habitat Distributional Range	Grid map outlining the lateral extent of habitat	✓	✓		✓
	Habitat Extent	Length of coastline occupied by habitat type (km)	✓	✓		✓
<i>Posidonia</i> beds	Habitat Distributional Range	Grid map outlining the lateral extent of habitat in question	✓	✓		✓
	Habitat Extent	Area covered by habitat type (km ²)	✓	✓		✓
Shelf sublittoral sediment: Maerl	Areal extent of relevant biogenic substrate	Area covered by habitat (km ²)		✓		

¹⁶ The EcAp requirement is not specifically related to benthic habitats but is rather related to the natural dynamics of coastal areas.

8.2. Monitoring methodologies

8.2.1. Littoral Sediment

- For localised habitat types occurring in particular environmental conditions such as sandy or shingle beaches, the distributional range is equivalent to the habitat extent¹⁷.
- Range/extent of littoral sediment is determined as the length of shoreline occupied by selected sandy/shingle beaches as measured from aerial photographs¹⁸.
- Trends in extent of the selected sandy/shingle beaches are reported.

8.2.2. Littoral Rock: Hard beds associated with communities of photophilic algae (*Cystoseira* belts)

- The range and extent of macroalgal assemblages characterised by *Cystoseira* spp. are determined through the application of the CARLIT¹⁹ methodology as described in Ballesteros *et al.* 2007²⁰ and outlined in Section 9.2.1.
- The CARLIT is carried out using a small vessel navigated as close as possible to the rocky shoreline along the coast.
- For the purpose of determining range and extent of this habitat type, macroalgal assemblages dominated by *Cystoseira* spp. present in the littoral and upper-sublittoral zones are identified and recorded in line with the categories listed in Table 6, on appropriate maps.
- The length of coastline occupied by macroalgal assemblages dominated by *Cystoseira* spp. is recorded. Range and extent are also recorded on a 1kmX1km grid as per Assessment and reporting under Article 17 of the Habitats Directive: Explanatory notes & Guidelines for the period 2007-2012.

8.2.3. Organogenic trottoirs with *Lithophyllum* spp, including facies with vermetids (trottoir with vermetids)

- Application of the CARLIT methodology as outlined in 9.2.1 for the purpose of determining range and extent of macroalgal assemblages is applied to determine the

¹⁷ Assessment and reporting under Article 17 of the Habitats Directive: Explanatory Notes & Guidelines for the period 2007-2012. Final Draft. April 2011

¹⁸ As per UNEP/MAP (2014) Draft Monitoring and Assessment Methodological Guidance, 4th meeting of the EcAp Coordination Group UNEP(DEPI)/MED WG.401/3: measuring length of sandy beaches using aerial photographs is subjective. Any improvements to this methodology will be assessed on the basis of the outcome of the proposed monitoring.

¹⁹ 'CARtography of LITtoral and upper-sublittoral rocky communities'

²⁰ Ballesteros E., Torras X., Pinedo S., Garcia M., Mangialajo L., de Torres M. (2007). A new methodology based on littoral community cartography dominated by macroalgae for the implementation of the European Water Framework Directive. Marine Pollution Bulletin 55: 172-180.

range and extent of organogenic trottoirs with *Lithophyllum* spp. and trottoirs with *Dendropoma* spp.

- The length of coastline occupied by organogenic trottoirs is recorded. Range and extent are also recorded on a 1kmX1km grid as per Assessment and reporting under Article 17 of the Habitats Directive: Explanatory notes & Guidelines for the period 2007-2012.

8.2.4. *Posidonia* beds

- Distributional range and (horizontal) extent of *P. oceanica* meadows are determined through the application of remote seabed mapping techniques.
- Range and extent are recorded on a 1kmX1km grid as per Assessment and reporting under Article 17 of the Habitats Directive: Explanatory notes & Guidelines for the period 2007-2012.
- The bathymetric range of this habitat type is determined through the application of the PREI index as per Section 9.2.4.

8.2.5. Shelf sublittoral sediment: Maerl²¹

- The monitoring protocol outlined hereunder will apply to the maerl bed located off the Northeastern coast of Malta in which rhodoliths are dense and cover the bottom with interlocking rhodoliths. Sparse accumulations of rhodoliths are not being considered by this monitoring factsheet.
- The spatial extent of this maerl bed is determined by mapping the presence of live maerl either on a grid or along a series of transects placed across the habitat through a combination of underwater video surveying using an ROV and collecting Van Veen grab samples as a means of calibrating ROV data.
- The bathymetric distribution of the key rhodolith-forming species²² can be determined by quantifying the composition of live rhodolith to sediment ratio along bathymetric transects²³.

²¹ Outlined methodology is based on the monitoring approach suggested by Borg et al. (2013): Borg, J.A., Knittweis, L. & Schembri, P.J. (2013) *Compilation of an interpretation manual for marine habitats within the 25 NM Fisheries Management Zone around the Republic of Malta*. [MEPA tender reference: T2/2013]. Mosta, Malta: Ecoserv Ltd; 218pp

²² In the Maltese Islands the main rhodolith forming species are *Lithothamnion minervae* and *Lithothamnion corallioides*, with other species including *Phymatolithon calcareum*, *Lithophyllum racemus*, *Mesophyllum alternans*, *Neogoniolithon brassica-florida* and *Peyssonnelia rosa-marina*.

²³ This is being included as an optional monitoring process which should only be sought if deemed cost-effective.

8.3. Monitoring areas

8.3.1. Littoral Sediment

- Extent of littoral sediment will be determined for sandy or shingle beaches as selected for the purpose of the MSFD Initial Assessment:
 - Ir-Ramla and il-Bajja ta' San Blas, on Gozo
 - Il-Qala ta' Santa Marija, on Comino
 - Il-Bajja tal-Ġnejna, Ir-Ramla tal-Mixquqa, Ir-Ramla ta' Ġhajn Tuffieħa and the shingle beach at Fomm ir-Riħ on the southwestern coast of mainland Malta;
 - Ir-Ramla tat-Torri, Ir-Ramla tal-Qortin, Ir-Ramla tal-Armier, Little Armier and il-Bajja tal-Mellieħa on the north-eastern coast of mainland Malta.

8.3.2. Littoral Rock: Hard beds associated with communities of photophilic algae (*Cystoseira* belts)

Distributional range and extent of macroalgal assemblages characterised by *Cystoseira* spp. is assessed at a National scale.

8.3.3. Organogenic trottoirs with *Lithophyllum* spp, including facies with vermetids (trottoir with vermetids)

Distributional range and extent of organogenic trottoirs are assessed at a National scale.

8.3.4. *Posidonia* beds

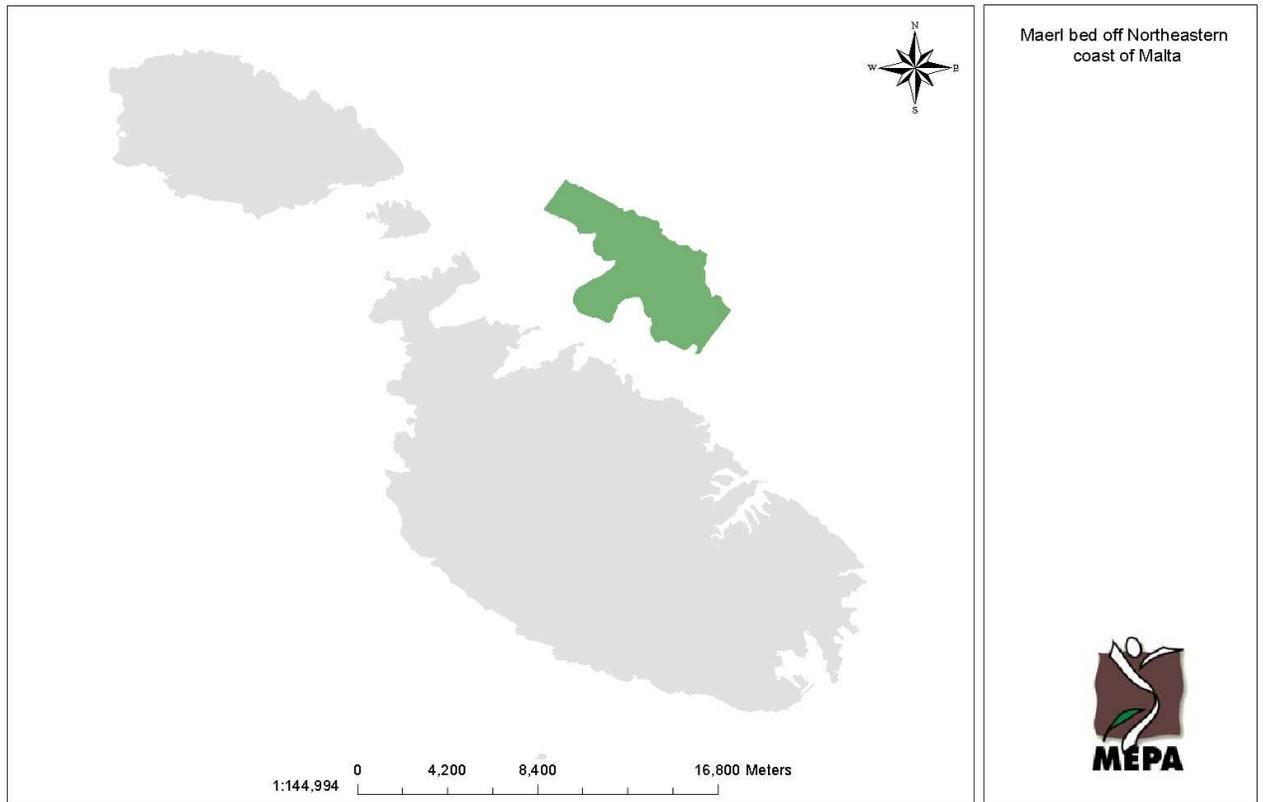
Distributional range and extent of *Posidonia* beds are assessed at a National scale.

8.3.5. Shelf sublittoral sediment: Maerl²⁴

The extent of the maerl bed known to occur off the Northeastern coast of Malta will be assessed (Figure 1).

²⁴ Outlined methodology is based on the monitoring approach suggested by Borg et al. (2013): Borg, J.A., Knittweis, L. & Schembri, P.J. (2013) *Compilation of an interpretation manual for marine habitats within the 25 NM Fisheries Management Zone around the Republic of Malta*. [MEPA tender reference: T2/2013]. Mosta, Malta: Ecoserv Ltd; 218pp

Figure 1: Location of maerl bed off the Northeastern coast of Malta



8.4. Monitoring frequency

Monitoring frequency for each habitat type is indicated below. The monitoring frequency however is subject to revisions following analysis of the initial monitoring results.

Habitat Type/species	Indicator	Frequency
Littoral Sediment	Distributional range and extent	6-yearly
Littoral Rock Hard beds associated with communities of photophilic algae (<i>Cystoseira</i> belts)	Distributional range and extent;	6-yearly
Organogenic trottoirs with <i>Lithophyllum</i> spp, including facies with vermetids	Distributional range and extent	6-yearly
<i>Posidonia</i> beds	Distributional range and extent	6-yearly
Shelf sublittoral sediment: Maerl	Areal extent of relevant biogenic substrate	6-yearly

8.5. Assessment of status

Status in terms of distributional range and extent is assessed on the basis of trends by comparison of the range/extent with baseline data through time. Expert judgement is used for interpretation of trends. Estimates of trend for changes are carried out over two assessment cycles i.e. 12 years. The recommended period for assessing longer term trends is four assessment cycles (24 years).

The baseline data and the area to be used for assessment of status in terms of range and extent are indicated in Table 4.

Table 4: Baseline data and assessment area to be used for assessing trends in range and/or extent.

Habitat Type	Baseline data	Assessment Area	Additional considerations for Interpretation of trends
Littoral Sediment	2008 aerial photographs	Selected beaches as per Section 8.3.1	Effects of development on the extent of sandy beaches take place gradually over a long period of time with effects of past developments still being observed and expected to continue in the future. Assessment of status should thus be coupled to information on the processes/mechanisms used to assess potential effects from anthropogenic activities.
Hard beds associated with communities of photophilic algae (<i>Cystoseira</i> belts)	Range and extent, in terms of length of coastline, of macroalgal assemblages characterised by <i>Cystoseira</i> spp. were established through a 2008 survey which applied the CARLIT index to the Maltese coastline ²⁵ .	National Scale	

²⁵ Thibaut, T. 2011. Ecological Status of the Rocky Coast of Malta, May 2008

Organogenic trochoids with <i>Lithophyllum</i> spp.	Range and extent established through a 2008 survey which applied the CARLIT index to the Maltese coastline ²⁶ .	National Scale	
<i>Posidonia</i> beds	Extent of <i>Posidonia</i> beds as reported for the 2013 Article 17 reporting (grid-based) and/or MSFD Initial Assessment (polygons)	National Scale	The data on <i>Posidonia</i> beds as reported to date is mainly based on 2002 side-scan sonar data as supplemented by more recent localised data. As indicated by the MSFD Initial Assessment, while this data provides a good indication of the distribution of <i>Posidonia</i> meadows, there are inaccuracies which any quantitative estimates should acknowledge.
Shelf sublittoral sediment: Maerl	Extent of maerl bed as determined through the first monitoring episode.	Maerl bed off the Northeastern coast of Malta	There is a discrepancy in the area of the maerl bed as calculated on the basis of the habitats data repository and that in published literature. Therefore it is being suggested that the extent is verified through implementation of this monitoring factsheet.

²⁶ Thibaut, T. 2011. Ecological Status of the Rocky Coast of Malta, May 2008

9. Monitoring Sub-Programme 2: *Seabed habitats – community characteristics*

9.1. Monitoring Parameters

The monitoring parameters in terms of community characteristics for selected benthic habitats are listed in Table 5. Definitions of relevance to the implementation of this monitoring sub-programme include the following:

- Typical species are selected to reflect favourable structure and functions of the habitat type. These species should be good indicators for favourable habitat quality, e.g. by indicating presence of a wider group of species with specific habitat requirements. They should be species only found in the habitat or which are present over a large part of the habitat’s range. They should be sensitive to changes in the condition of the habitat (“early warning indicator species”).

Table 5: Indicators and parameters to be monitored per selected habitat

Habitat	Indicator	Parameter	Policy			
			HD	MSFD	WFD	EcAp
Littoral and shallow sublittoral rock: Hard beds associated with communities of photophilic algae (<i>Cystoseira</i> belts)	Habitat condition: Condition of the typical species and communities	List of habitat-typical species	✓			✓
		Density of <i>Cystoseira</i> spp. per length of coastline	✓			
	Habitat condition: Relative abundance & Presence of particularly sensitive and/or tolerant species	CARLIT index (based on assigned sensitivity of macroalgal community and length of coastline occupied by the community)	✓	✓	✓	✓
Organogenic trottoir with <i>Lithophyllum</i> sp.	Habitat Condition: Condition of the typical species and communities	% cover of live <i>Lithophyllum</i> species	✓	✓		✓
<i>Posidonia</i> beds	Habitat condition: Condition of the typical species and communities	Shoot Density [PREI index]	✓	✓	✓	✓
		Shoot Surface Area				

Habitat	Indicator	Parameter	Policy			
			HD	MSFD	WFD	EcAp
		[PREI index]	✓	✓	✓	✓
		Ratio between epiphytic biomass and leaf biomass [PREI index]	✓	✓	✓	✓
		depth of the lower limit [PREI index]	✓	✓	✓	✓
		type of this limit (regressive, progressive or stable) [PREI index]	✓	✓	✓	✓
		% live <i>Posidonia</i> : dead matte	✓			
Shallow sublittoral sediment	Habitat Condition: Multi-metric indexes assessing benthic community condition	Number of species		✓	✓	
		Species Richness (S)		✓	✓	
		Abundance (Individuals/m ²)		✓	✓	
		Diversity index (H') (Shannon Wiener)		✓	✓	
		BENTIX index ²⁷		✓	✓	
Shelf sublittoral and upper bathyal sediment.	Habitat condition: Condition of the typical species and communities	List of habitat-typical species		✓		

²⁷ Simboura.N and Zenetos. A. 2002. Benthic indicators to use in Ecological Quality classification of Mediterranean soft bottom marine ecosystems, including a new Biotic Index., In: Mediterranean Marine Science Vol.3/2, 2002, 77-111

9.2. Monitoring methodologies

9.2.1. Littoral Rock: Hard beds associated with communities of photophilic algae (*Cystoseira* belts)

- The CARLIT²⁸ methodology as described in Ballesteros *et al.* 2007²⁹ is applied by means of a small boat, navigated as close as possible to the rocky shoreline.
- Macroalgae present in the littoral and upper-sublittoral zones (0m – 3m) along the Maltese coastline are identified and recorded as per categories in Table 6 on appropriate maps. The rocky shoreline is partitioned into sections of habitat categories which are assigned sensitivity levels reflecting the vulnerability/resistance of communities to environmental stress related to water quality, also included in Table 6.
- Geomorphological factors which are likely to influence the presence / abundance of macroalgae communities are defined and classified as per Table 7.
- The data gathered on habitat distribution as well as geomorphological variables is mapped using Geographic Information System (GIS) techniques. Each sector of the coast is thus characterized by the community category and the different geomorphological features.
- The following indicators are calculated from the data obtained:
 - Length of coastline occupied macroalgal assemblages characterised by *Cystoseira* species.
 - List of habitat-typical species
 - Density of *Cystoseira* species (derived from % algal cover)
 - CARLIT index calculated as $EQ = \frac{\sum SLi * li}{\sum li}$

Where:

EQ: environmental quality of a particular stretch of coastline,
li: length of the coastline occupied by the community category i,
SLi: sensitivity level of the community category i.

²⁸ 'CARtography of LITtoral and upper-sublittoral rocky communities'

²⁹ Ballesteros E., Torras X., Pinedo S., Garcia M., Mangialajo L., de Torres M. (2007). A new methodology based on littoral community cartography dominated by macroalgae for the implementation of the European Water Framework Directive. *Marine Pollution Bulletin* 55: 172-180.

Table 6: Macroalgal assemblages and sensitivity levels as per Ballesteros *et al* (2007)^{30,31}

Category	Description	Sensitivity Level
<i>Cystoseira amentacea</i> 5	Continuous belt of <i>C. amentacea</i>	20
<i>Cystoseira crinita</i>	Populations of <i>C. crinita</i>	20
<i>Cystoseira balearica</i>	Populations of <i>C. balearica</i>	20
<i>Cystoseira</i> sheltered	Populations of <i>Cystoseira foeniculacea/barbata/spinosa</i> v. <i>tenuior/ v.pustulata</i>	20
<i>Posidonia</i> reef	Barrier and fringing reefs of <i>Posidonia oceanica</i>	20
<i>Cymodocea nodosa</i>	<i>Cymodocea nodosa</i> meadows	20
<i>Zostera noltii</i>	<i>Zostera noltii</i> meadows	20
Trottoir	Build-ups of <i>Lithophyllum byssoides</i>	20
<i>Cystoseira amentacea</i> 4	Almost continuous belt of <i>C. amentacea</i>	19
<i>Cystoseira amentacea</i> 3	Abundant patches of dense stands of <i>C. amentacea</i>	15
<i>Cystoseira amentacea</i> 2	Abundant scattered plants of <i>C. amentacea</i>	12
<i>Cystoseira compressa</i>	Populations of <i>C. compressa</i> v. <i>compressa</i>	12
<i>Cystoseira amentacea</i> 1	Rare scattered plants of <i>C. amentacea</i>	10
<i>Corallina elongata</i>	Belt of <i>Corallina elongata</i> without <i>Cystoseira</i>	8
<i>Haliptilon</i>	Belt of <i>Haliptilon virgatum</i> , without <i>Cystoseira</i>	8
Encrusting corallines	Belt of <i>Lithophyllum incrustans</i> , <i>Neogoniolithon brassica-florida</i> & other encrusting corallines	6
Green algae	Upper sublittoral belts of <i>Ulva</i> and <i>Cladophora</i>	3
Blue greens	Communities dominated by Cyanobacteria and <i>Derbesia tenuissima</i>	1

Table 7: Geomorphological features

Geomorphological factors	Levels
Coastline morphology	High continuous coast Low continuous coast Metric blocks Decimetric blocks
Substrate constitution	Calcareous Metamorphic rock Granite Sandstone Conglomerate
Coastline slope	Horizontal Sub-vertical Vertical Overhanging
Coastline orientation	North Northeast East

³⁰ Ballesteros E., Torras X., Pinedo S., Garcia M., Mangialajo L., de Torres M. (2007). A new methodology based on littoral community cartography dominated by macroalgae for the implementation of the European Water Framework Directive. *Marine Pollution Bulletin* 55: 172-180.

³¹ In addition to the categories as listed by Ballesteros *et al.* (2007) the identification of the extents occupied by *Dendropoma* species in Malta is deemed pertinent.

	Southeast South Southwest West Northwest
Natural or artificial Degree of wave exposure (perpendicular distance to the nearest coast)	0–500 m 500–1000 m >1000 m Island

9.2.2. Shallow sublittoral rock affected by anthropogenic activities

- Monitoring in shallow sublittoral rock is linked to MSFD target '*Benthic habitats affected by currently regulated anthropogenic activities show signs of recovery*'.
- The outcome of the CARLIT methodology as outlined in Section 9.2.1 at specific coastal stretches is used to assess achievement of the MSFD target.
- Lists of habitat-typical species of the community and CARLIT index measured at these stations are recorded over time.

9.2.3. Organogenic trottoirs with *Lithophyllum* spp, including facies with vermetids (trottoir with vermetids)

- Location of *Lithophyllum* spp. concretions along the Maltese coast was determined through a 2008 survey³².
- 0.2mX0.2m quadrats are randomly deployed along stretches of coastline identified to host *Lithophyllum* spp. concretions.
- Percentage cover of live and dead *Lithophyllum* spp. is determined through visual estimations.

9.2.4. *Posidonia* beds

- The PREI (*Posidonia oceanica* Rapid Easy Index) method described in Gobert *et al.* (2009)³³ is applied at specific monitoring stations. This technique requires SCUBA divers working on monitoring stations at constant depths (at 15 ± 1m depth) and on fixed points at the lower limit of the meadow. At each station, three 400m² areas each being 10m apart are investigated as replicates.
- Measurements to be collected *in situ* include:
 - shoot density: by counting shoots present in three replicate samples. Values are expressed as number of shoots/m²;
 - depth of the lower limit;

³² Thibaut, T. 2011. Ecological Status of the Rocky Coast of Malta, May 2008

³³ Gobert, S., Sartoretto, S., Rico-Raimondino, V., Andral, B., Chery, A., Lejeune, P., & Boissery, P. (2009). Assessment of the ecological status of Mediterranean French coastal waters as required by the Water Framework Directive using the *Posidonia oceanica* Rapid Easy Index: PREI. Marine Pollution Bulletin, 58(11), 1727-1733.

- type of this limit (regressive, progressive or stable).
- Estimates on the percentage cover of *P. oceanica*, typology of substratum, continuity of the meadow, percentage of dead matter, percentage of *Caulerpa racemosa* and percentage of *Cymodocea nodosa* are estimated at each monitoring stations.
- Six orthotropic shoots of *P. oceanica*, randomly chosen, are uprooted for laboratory analyses. Measurements to be obtained by processing samples in the laboratory include:
 - shoot leaf surface area: length and width of each leaf have to be measured and the leaf surface area per shoot calculated
 - E/L (ratio between epiphytic biomass and leaf biomass) measured on shoots: Epiphytes are to be scratched off with a blade to estimate their epiphyte biomass as dry weight after 48 hours at 60°C. Leaf (adult and intermediate) biomass will be calculated as dry weight after 48 hours at 60°C in order to calculate the E/L ratio.
- At the lower limit of the meadow for each monitoring station, another 6 randomly selected shoot density measures have to be carried out and a further 6 orthotropic shoots have to be uprooted for subsequent laboratory analyses.

9.2.5. Shallow Sublittoral Sediment

- Two replicate samples are collected from monitoring stations on shallow sublittoral sediment by means of a 0.025m² Van Veen grab. Samples are washed through a 0.5mm mesh sieve and then fixed in buffered formalin-seawater solution (8%).
- Sediment grain size is determined through granulometric analysis; Total Organic Carbon is also measured for the sediment samples.
- Organisms are sorted out and classified to the lowest taxonomic level possible. The abundance of each taxon is expressed as number of individuals.
- For each monitoring station, the following indicators are calculated:
 - Number of species
 - Species Richness (S)
 - Abundance (Individuals/m², N)
 - Diversity index (Shannon Wiener, H')
- BENTIX index is determined in line with methodologies outlined in Simboura and Zenetos (2002)³⁴.

³⁴ Simboura.N and Zenetos. A. 2002. Benthic indicators to use in Ecological Quality classification of Mediterranean soft bottom marine ecosystems, including a new Biotic Index., In: Mediterranean Marine Science Vol.3/2, 2002, 77-111

9.2.6. Shelf sublittoral and Upper Bathyal sediment

- Samples collected by the Mediterranean International Bottom Trawl Surveys (MEDITS)³⁵ will be used.
- Sampling using the MEDITS standard gear is performed at 45 selected stations within Geographical sub-area 15. For each fish, crustacean and cephalopod species collected in the hauls, the total weight and number of individuals is recorded.
- Habitat-typical species are identified for this particular habitat type

9.3. Monitoring areas

9.3.1. Littoral Rock: Hard beds associated with communities of photophilic algae (*Cystoseira* belts)

The CARLIT methodology is applied at a National scale i.e. along the whole stretch of Malta's coastline. Data interpretation for the purpose of status assessment is carried out on the basis of WFD water bodies. Therefore CARLIT indices for the stretches of coastlines within WFD water bodies will be calculated.

9.3.2. Organogenic trottoirs with *Lithophyllum* spp, including facies with vermetids (trottoir with vermetids)

Monitoring of bioconcretions of *Lithophyllum* spp. to take place in sites known to host this community on the basis of the 2008 survey³⁶. Such sites are included in Table 8 and shown on

Figure 2. Stations will be subject to revision following the initial monitoring episodes.

Table 8: Monitoring Stations for *Lithophyllum* spp. concretions

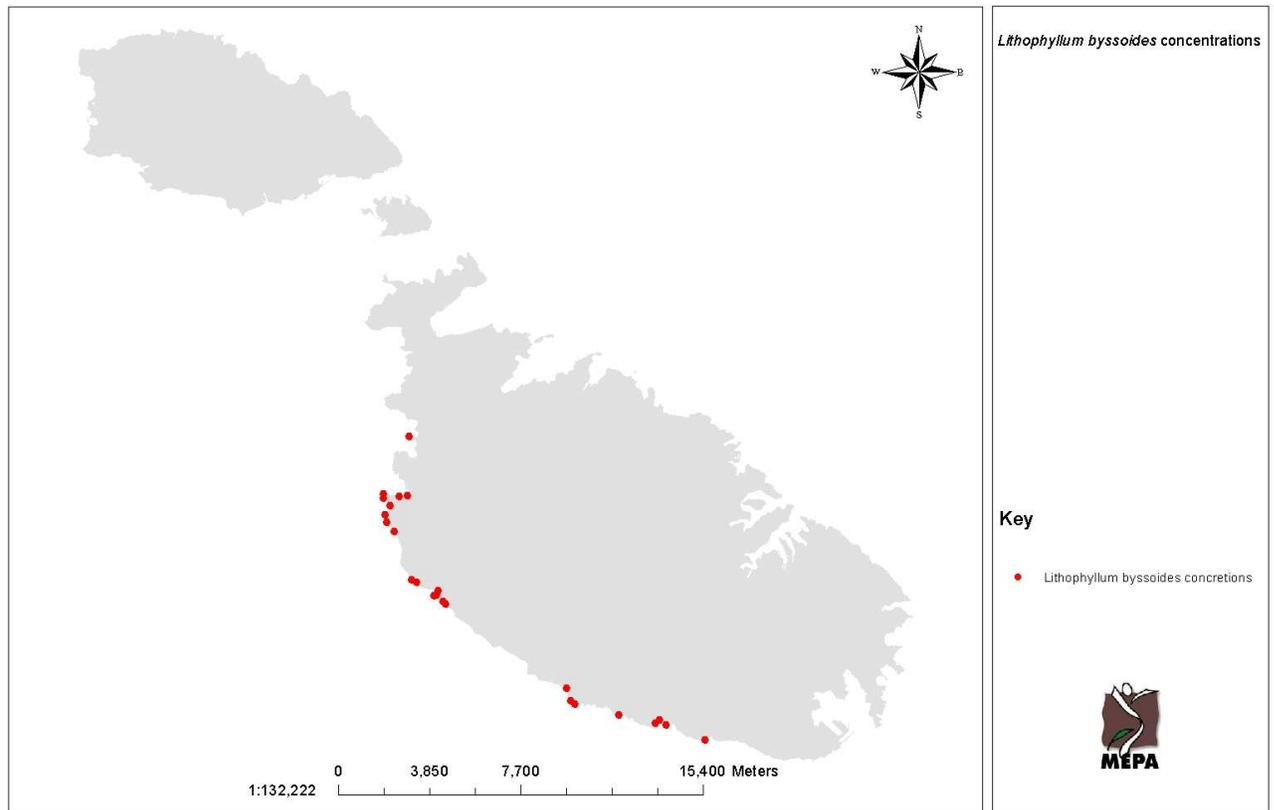
Coordinates (Full UTM ED50)	
Longitude	Latitude
451395.60	3964327.15
451127.85	3964531.89
453052.69	3963688.72
450949.56	3964364.84
449411.87	3964718.32

³⁵ MEDITS is a bottom trawl survey carried out on a regional basis which aims to collect data on benthic and demersal species, targeting species which have an existing or potential commercial value.

³⁶ Thibaut, T. 2011. Ecological Status of the Rocky Coast of Malta, May 2008

Coordinates (Full UTM ED50)	
Longitude	Latitude
447535.48	3965192.38
447370.77	3965312.68
447201.67	3965861.13
440650.12	3970398.50
440863.58	3970307.44
441713.93	3969787.79
441606.59	3969724.63
441783.84	3969961.99
441976.02	3969496.37
442075.89	3969384.69
440530.07	3976419.83
439450.62	3973838.57
439932.35	3972440.13
439587.13	3972827.82
439534.23	3973133.77
439737.88	3973509.56
439472.33	3974004.70
440141.35	3973892.95
440474.40	3973933.26

Figure 2: Location of *Lithophyllum* spp. communities



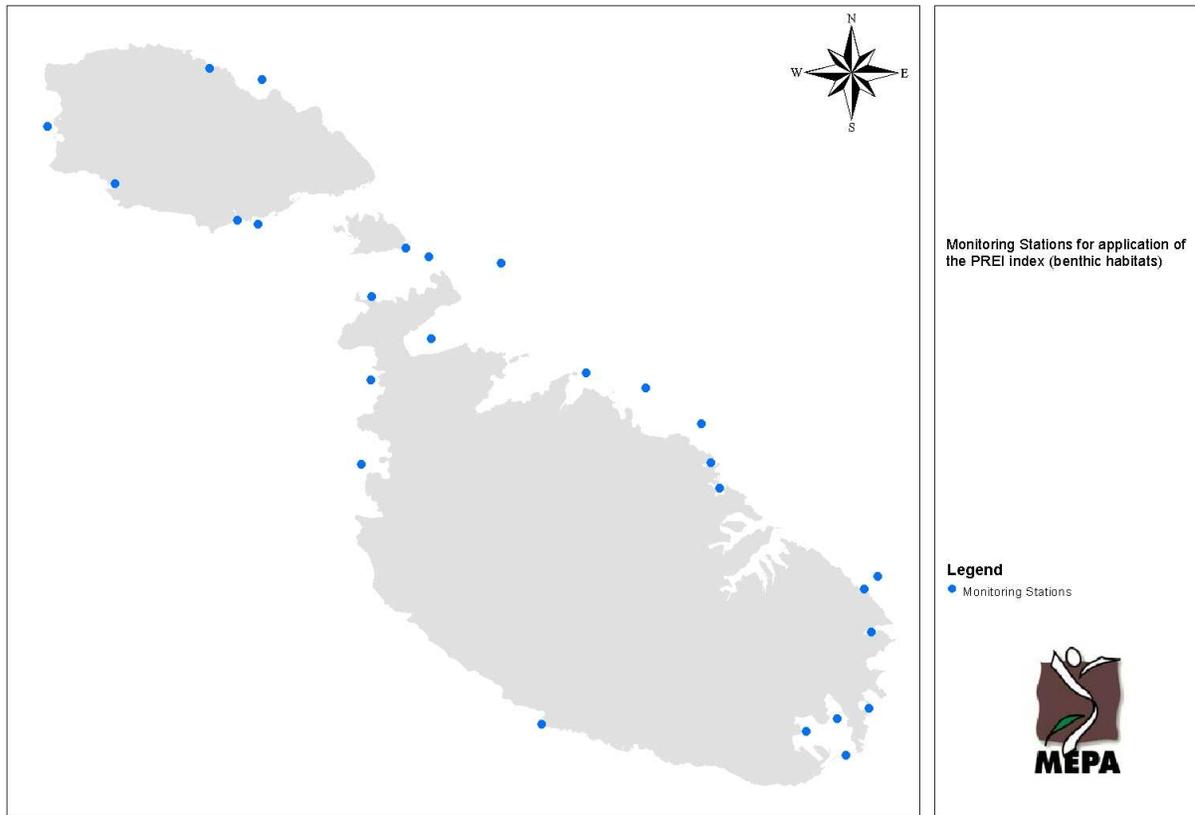
9.3.3. *Posidonia* beds

Assessment of the condition of *Posidonia* beds will be undertaken at monitoring stations listed in Table 9 and shown in Figure 3. These monitoring stations are subject to revision following the initial monitoring cycles.

Table 9: Monitoring Stations for assessment of the condition of *Posidonia* beds

Mon. Site Ref. Code	Monitoring Network	Coordinates (Full UTM ED50)	
		Longitude	Latitude
CP04-1	Operational	453769,71	3977836,62
CP04-2	Operational	449013,07	3979914,24
CP06-1	Operational	461078,41	3971492,15
CP06-2	Operational	460522,84	3970960,01
CP07	Operational - Harbour	459771,77	3964111,98
CS02	Sur + Reference Site	435571,14	3992063,13
CS03	Sur + Reference Site	442502,54	3984741,51
CS09	Sur + Protected area	439697,26	3976129,46
CN01-1	Protected Area	426700,89	3990134,58
CN01-2	Op – Diffuse Sources	429492,88	3987775,43
CN02-1	Op – Diffuse sources	433397,15	3992518,78
CN03-1	Op – Sewage Outfall	435420,03	3986084,12
CN03-3	Op - Harbour	440130,02	3983083,45
CN03-6	Op – Minor Sewage Outfall	441540,34	3985079,15
CN04-1	Op - diffuse sources	442596,44	3981355,59
CN04-3	Op - bunkering site	445500,41	3984462,78
CN04-4	Op - diffuse sources	444937,85	3978614,21
CN04-5	Nitrates Directive	454162,08	3976206,21
CN04-6	Nitrates Directive	454528,54	3975162,74
CN06-1	Op - diffuse sources	460815,92	3969206,43
CN07-1	Op - Thermal effluent	460712,08	3966044,50
CN07-2	Op – Harbour	459413,96	3965607,40
CN07-3	Op – Harbour	458110,28	3965070,20
CN08-1	Op – Desalination Plant	447163,40	3965389,58
CN09-1	Op – Sewage Outfall	440099,89	3979621,63
/	Mgarr ix-Xini MPA	434555,04	3986240,65

Figure 3: Monitoring stations for the application of the PREI index



9.3.4. Shallow Sublittoral Sediment

Monitoring stations for the purpose of assessing benthic invertebrates still need to be identified through a pilot survey. Stations³⁷ characterised by sediment within the 8-12m depth range are to be selected and georeferenced. Should stations within this depth range be mostly characterised by seagrasses or rocky bottoms, alternative stations are selected within the 6m – 15m depth range or at a maximum depth of 18m. The latter depth range should only be used as a last resort.

Implementation of the monitoring programme will be undertaken following completion of this exercise and identification of the monitoring stations.

³⁷ The WFD intercalibration exercise recommends sampling at 40 stations, however actual number of stations to be determined through the pilot survey.

9.3.5. Shelf sublittoral and Upper Bathyal sediment

Samples collected from selected MEDITS stations located within the specified depth ranges for shelf and upper bathyal within the Fisheries Management Zone are used for the purpose of assessing the condition of species and communities associated with the shelf sublittoral and upper bathyal sediments. The start and end points of the MEDITS trawl surveys are indicated in Figure 4.

Figure 4: Location of MEDITS trawl surveys



9.4. Monitoring frequency

Monitoring frequency for each habitat type is indicated below. The monitoring frequency however is subject to revision following analysis of the initial monitoring results. Monitoring frequency will also depend on the status of the marine environment under assessment³⁸, based on which a risk-based approach can be applied.

Habitat Type	Indicator	Frequency
Littoral Rock Hard beds associated with communities of photophilic algae (<i>Cystoseira</i> belts)	Condition of the typical species & communities; Relative abundance	Yearly (May - June) – monitoring frequency to be determined following first monitoring year.
<i>Posidonia</i> beds	Condition of the typical species & communities	Yearly (September-October) every 3 years
Shallow sublittoral sediment	Presence of particularly sensitive and/or tolerant species	6-monthly for the first monitoring year: monitoring frequency to be determined following the first monitoring year.
Shelf and Upper Bathyal	Condition of the typical species & communities	3-yearly

9.5. Assessment of Status

Assessment of status in terms of habitat condition is mainly based on:

- the determination of Ecological Quality Ratios (EQR) representing the relationship between the values observed for the biological elements and the values for the same elements in reference conditions; or
- the condition of the structures and functions of the habitat-types in terms of trends in presence/absence or abundance/biomass of habitat-typical species.

Malta has completed an intercalibration exercise with Spain whereby the boundaries corresponding to comparable levels of ecosystem alteration due to anthropogenic

³⁸ WFD stipulates that Surveillance monitoring for water bodies not at risk can be carried out once every six years or once every 18 years for water bodies which reached good status in previous monitoring exercises and for which the relevant review does not indicate any evidence of new pressures

disturbance were determined for *Posidonia* beds and macroalgae³⁹. Relevant EQRs are listed in below sections.

9.5.1. Hard beds associated with communities of photophilic algae (*Cystoseira* belts)

On the basis of the CARLIT index (Section 9.2.1), an environmental quality index representative of the ecological status of rocky coasts is calculated as a ratio between the observed values of each shore sector and the expected value in a reference condition zone with the same substratum and coastal morphology:

$$EQR = \frac{\sum EQ_i * l_i}{EQ_{ref} / \sum l_i}$$

Where:

EQR: Environmental Quality Ratio

EQ_i: Environmental Quality in the study site for the situation i

EQ_{ref}: Environmental Quality for the reference site in the situation i

l_i: length of the coastline occupied by the community category i

Definitions of high, good and moderate status as qualitatively agreed at the WFD Mediterranean Geographical Intercalibration (MEDGIG) group and are therefore specific to the Mediterranean Ecoregion, are listed in Table 10. Intercalibrated EQRs between Malta and Spain (Valencia) are listed in Table 11.

³⁹ Ecoserv & Universidad Catolica de Valencia. 2015. Intercalibration Report. Service Tender for the Provision for Scientific Expert/s Assistance in the Intercalibration Exercise of Biological Elements of Maltese Coastal Waters MEPA T03/2014.

Table 10: High, Good and Moderate Status definitions for macroalgae.

High Status	Good Status	Moderate Status
<p>All disturbance-sensitive macroalgal taxa associated with undisturbed conditions are present. The levels of macroalgal cover and abundance are consistent with undisturbed conditions. Using the CARLIT method in qualitative terms this means that rocky shores exposed to high irradiance levels and characterised by dense communities of several <i>Cystoseira</i> species: <i>C. mediterranea/amentacea var.stricta</i>, <i>C. crinita</i>, <i>C. brachyparpa var. balaerica</i>, <i>C. foeniculacea/ barbata/spinosa var. tenuior/compressa var. pustulata</i>. Alternatively, in shadow zones (steep vertical cliffs, high hydrodynamic conditions) <i>Lithophyllum byssoides</i> develops, forming important organogenic structures (trottoir).</p>	<p>Most disturbance-sensitive macroalgal taxa associated with undisturbed conditions are present. <i>Cystoseira</i> communities may start to be replaced by the red alga <i>Corallina elongata</i> and the mussel <i>Mytilus galloprovincialis</i>. The level of macroalgal cover show slight signs of disturbance.</p>	<p>A moderate number of the disturbance-sensitive macroalgal taxa associated with undisturbed conditions are absent. Macroalgal cover and abundance is moderately disturbed and may be such as to result in an undesirable disturbance to the balance of organisms present in the water body.</p> <p>Green ephemeral algae begin to dominate in disturbed environments and near freshwater discharges. <i>Ulva</i>, <i>Cladophora</i> or <i>Enteromorpha</i> also appear.</p>

Table 11: Intercalibrated EQRs for macroalgae

Country	National classification system	EQRs	
		High-Good boundary	Good-Moderate Boundary
Malta	CARLIT	0.75	0.60
Spain (Valencia)	CARLIT	0.75	0.60

In addition to the CARLIT index, a stable trend in the density of *Cystoseira* spp. and a stable list of “typical species” over medium- to long-term are indicative of good status.

For shallow sublittoral rock affected by anthropogenic activities in particular, shifts towards the predominance of sensitive, habitat-typical species are indicative of good status.

9.5.2. Organogenic trottoir with *Lithophyllum* sp.

Trends in the % cover of live and % cover of dead *Lithophyllum* spp. at specific monitoring stations to be assessed. A stable or increasing % cover of live *Lithophyllum* spp. would be indicative of good status.

9.5.3. *Posidonia* beds

On the basis of the measurements collected as per Section 9.2.4 (PREI index), Environmental Quality Ratio for *Posidonia* beds is calculated as:

$$\text{EQR}' = (\text{N density} + \text{N leaf surface area} + \text{N (E/L)} + \text{N lower limit})/3.5$$

Where:

N density = value measured-0/reference value-0⁴⁰;

N leaf surface area (per shoot) = value measured-0/reference value-0⁴¹;

N (E/L) = [1- (epiphyte biomass / *P. oceanica* leaf biomass)]x0.5

N lower limit = (value measured-17)/ (reference value -17⁴²),

N = depth noted on the field + λ , where $\lambda = 0$ (stable limit), $\lambda = 3$ (progressive limit) or $\lambda = -3$ (regressive limit).

The PREI value may vary from 0 to 1 and will give a corresponding value to the Ecological Quality Ratio (EQR). Hence, the EQR may either range from 0 to 1, 0 being considered as the worst value for the density and for the leaf surface area. The EQR is computed as follows:

$$\text{EQR} = (\text{EQR}' + 0.11)/(1 + 0.10)$$

Definitions of high, good and moderate status as qualitatively agreed at the WFD Mediterranean Geographical Intercalibration (MEDGIG) group and are therefore specific to the Mediterranean Ecoregion, are listed in Table 12. Intercalibrated EQRs between Malta and Spain (Valencia) are listed in Table 13.

⁴⁰ 0 being considered as the worst value for the density and for the leaf surface area

⁴¹ 0 being considered as the worst value for the density and for the leaf surface area

⁴² 17m being considered as the worst lower limit for *P. oceanica* meadows

Table 12: High, Good and Moderate Status definitions for *Posidonia* beds.

High Status	Good Status	Moderate Status
<p>Angiosperm taxa associated with undisturbed conditions are present. The levels of angiosperm cover and abundance is consistent with undisturbed conditions (as indicated by the reference boundaries of that particular site).</p> <p>In the case of the MEDGIG, High status within different regions can vary due to possible biogeographical differences and therefore high status is based on the results of the different methods applied within the various regions of the Mediterranean. For instance in the case of the PREI, the selected reference sites for this particular method reflect the highest status that can be achieved for the different matrices (i.e. shoot density, cover, depth limit, shoot length etc.)</p>	<p>Angiosperm taxa associated with undisturbed conditions are present. The level of angiosperm abundance shows slight signs of disturbance.</p> <p>Conditions between good and moderate – the seagrass communities are characterised by presenting in general a state of condition of some of the metrics (cover, density, shoot length, etc.) that is at least 30% worse than the high status for that area.</p>	<p>A moderate number of angiosperm taxa associated with undisturbed conditions are absent. Angiosperm abundance is moderately disturbed and may be such as to result in an undesirable disturbance to the balance of organisms present in the water body.</p>

Table 13: Intercalibrated EQRs for *Posidonia* beds.

Country	National classification system	EQRs	
		High-Good boundary	Good-Moderate Boundary
Malta	PREI	0.775	0.55
Spain (Valencia)	Valencian-CS	0.775	0.55

9.5.4. Shallow Sublittoral Sediment

Assessment of benthic invertebrates in shallow sublittoral sediment has not been intercalibrated at the time of compiling this document. Definitions of high, good and moderate status as qualitatively agreed at the WFD Mediterranean Geographical Intercalibration (MEDGIG) group and are therefore specific to the Mediterranean Ecoregion, are listed in Table 14.

Table 14: High, Good and Moderate Status definitions for benthic invertebrates.

High Status	Good Status	Moderate Status
The level of diversity and abundance of invertebrate taxa is within the range normally associated with undisturbed conditions. All the disturbance-sensitive taxa associated with undisturbed conditions are present.	The level of diversity and abundance of invertebrate taxa is slightly outside the range associated with the type-specific conditions. Most of the sensitive taxa of the type-specific communities are present.	The level of diversity and abundance of invertebrate taxa is moderately outside the range associated with the type-specific conditions. Taxa indicative of pollution are present. Many of the sensitive taxa of the type-specific communities are absent.

9.5.5. Shelf sublittoral and Upper Bathyal sediment

Stable trends in presence/absence of habitat-typical species are indicative of a stable community, hence indicative of good status.

10. Monitoring Sub-Programme 3: *Benthic species – abundance*

10.1. Monitoring Parameters

Table 15: Indicators and parameters to be monitored per selected benthic species

Benthic Species	Associated Benthic Habitat	Indicator	Parameter	Policy			
				HD	MSFD	WFD	EcAp
<i>Pinna nobilis</i>	<i>Posidonia</i> beds	Population density	Individuals/100m ²	✓			
<i>Gibbula nivos</i>	Shallow sublittoral sediment	Population Abundance	Individuals/m ²	✓			

10.2. Monitoring methodologies

10.2.1. *Pinna nobilis*

- Methodologies for assessing populations of *Pinna nobilis* will follow those employed in: Ecoserv Ltd. & Instituto de Ecología Litoral (2012): *Study on the Noble Pen Shell (Pinna nobilis) populations in Maltese Marine Protected Areas: Rdum Majjiesa to Ra sir-Raheb; in the limits of Mgarr ix-Xini (Gozo) and in the limits of Dwejra (Gozo)*. Report part-financed by the Malta Environment and Planning Authority's share in the MedPan North Project.
- Within each monitoring station, the density of individuals of *Pinna nobilis* is estimated within a circle of predetermined radius from a central position. The circular sampling area is systematically searched to locate individuals of *Pinna nobilis*, the location of which is determined as the distance from the centre of the circle.
- Number of individuals per 100m² is estimated.

10.2.2. *Gibbula nivos*

Methodologies for determining population abundance of *Gibbula nivos* will follow those outlined in: Evans, J., Borg, J.A. & Schembri, P.J. 2011. Distribution, habitat preferences and behaviour of the critically endangered Maltese top-shell *Gibbula nivos*. *Marine Biology* (2011) 158:603–611; DOI 10.1007/s00227-010-1584-4

10.3. Monitoring areas

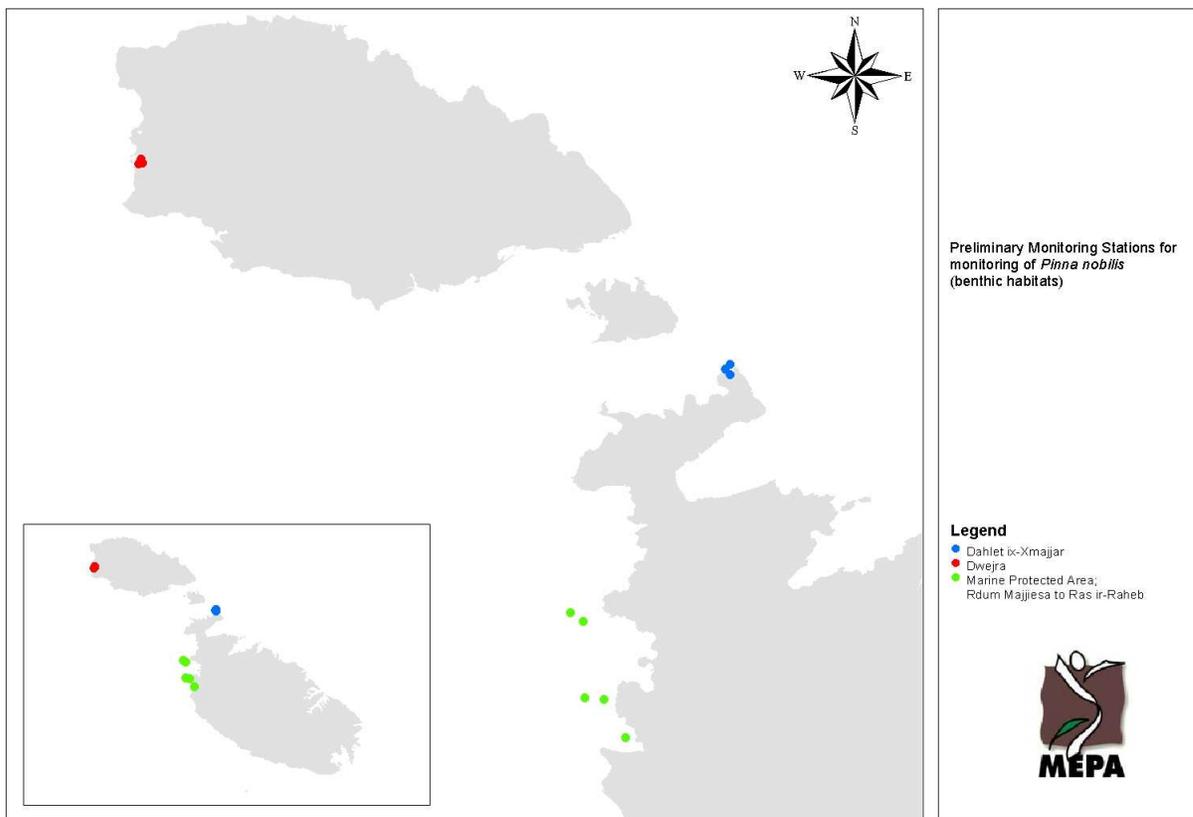
10.3.1. *Pinna nobilis*

The monitoring stations as listed in Table 16 and shown in Figure 5 are considered preliminary and are subject to revisions throughout the monitoring cycles with a view to ensure that sampling for *Pinna nobilis* is representative of the populations of this species at a National scale and to enable monitoring of distributional range in future monitoring cycles. Such revisions shall be proposed following the first monitoring year.

Table 16: Preliminary monitoring Stations for *Pinna nobilis*

Mon. Site Ref. Code	Coordinates	
	Longitude	Latitude
Marine Protected Area: Rdum Majjiesa to Ras ir-Raheb		
Station 1	439536	3975326
Station 2	440107	3974302
Station 8	438644	3977644
Station 9	439032	3975372
Station 10	438992	3977398
Dwejra		
Station G16	427179	3989586
Station G21	427231	3989677
Station G72	427283	3989619
Station G74	427242	3989725
Dahlet ix-Xmajjar		
Station NP1	442889	3983987
Station NP2	442748	3984130
Station NP5	442893	3984244

Figure 5: Preliminary monitoring stations for *Pinna nobilis*



10.3.2. *Gibbula nivos*a

Monitoring stations to be selected through the initial monitoring episode within areas known to support this species as identified in Evans, J., Borg, J.A. & Schembri, P.J. 2011. Distribution, habitat preferences and behaviour of the critically endangered Maltese top-shell *Gibbula nivos*a. *Marine Biology* (2011) 158:603–611; DOI 10.1007/s00227-010-1584-4, namely West Comino and Sliema creek.

10.4. Monitoring frequency

Monitoring frequency for each habitat type is indicated below. The monitoring frequency however is subject to revision following analysis of the initial monitoring results.

Species	Indicator	Frequency
<i>Pinna nobilis</i>	Population Density	6-yearly
<i>Gibbula nivos</i> a	Population abundance	6-yearly

10.5. Assessment of Status

A stable trend in the population density of *Pinna nobilis* and population abundance of *Gibbula nivos*a is indicative of 'good status'. Interpretation of such status should also be subject to expert judgement.

11. Monitoring Sub-Programme 4: *Information on relevant anthropogenic activities*

Activities with potential impacts on benthic habitats will be mapped as per Table 17. Collection of data for anthropogenic activities for the purposes of this monitoring factsheet will be mainly related to location and dates of operation where relevant. Assessment of impacts associated with these activities is considered a separate process which should be addressed through environmental assessment procedures. Any monitoring requested as part of such procedures is also being considered a separate process.

Table 17: Relevant Activities

Activity	Legislation/Mechanism	Monitoring requirements
Disposal at sea	Waste Regulations 2011 published by Legal Notice 184 of 2011	Amount and type of waste disposed; location of disposal at sea.
Construction at sea	The Environment and Development Planning Act regulating development and use of land and sea;	Data on nature of development taking place at sea and location of such development to be collated through the development permitting process.
Dredging	The Environment and Development Planning Act regulating development and use of land and sea;	Data on location of dredging activities and dates of operation to be collated through the development permitting process.
Aquaculture Installations	The Environment and Development Planning Act regulating development and use of land and sea	Data on location of new aquaculture installations to be collated through the development permitting process. Monitoring procedures requested through the development permitting process on aquaculture installations to reflect the monitoring indicators and methodologies stipulated through the monitoring factsheet.
Scuttling of vessels	The Environment and Development Planning Act regulating development and use of land and sea	Data on location of scuttled vessels to be collated through the development permitting process. Monitoring procedures requested

		through the development permitting process for scuttled vessels to reflect the monitoring indicators and methodologies stipulated through the monitoring factsheet.
Cables and pipelines	<p>The Environment and Development Planning Act regulating development and use of land and sea</p> <p>Continental Shelf Act 2014 – in accordance with Article 4 (1) (b) Regulating or prohibiting the construction, erection, placing, or use of artificial islands, installations, structures or devices in, on, or above the continental shelf:</p> <p>(i) in connection with the exploration of the continental shelf or that part thereof or the exploitation of its natural resources, or</p> <p>(ii) in places where they could cause interference with the rights of the Government of Malta to explore and exploit the natural resources of the said continental shelf, or</p> <p>(iii) in places where they could cause interference with the use of recognised sea lanes essential to international as well as coastwise navigation can be subject to regulations and require a license.</p>	Data on location of cables and pipelines to be collated through the development permitting and licensing processes accordingly.
Trawling	Fisheries Conservation and Management Act (Chapter 425);	Mapping of trawling activities and fishing effort.
Anchoring within bunkering area 1		Records/statistics of the number of vessels anchored within this area.

12. Supporting Parameters

Parameter	Unit	Related Monitoring Factsheet
Nutrients		Eutrophication
Dissolved Oxygen	% saturation	
Water Turbidity	Secchi depths, NTU	
Near bottom temperature	°C	
Salinity	psu	
Organic matter in sediment (in relation to assessment of benthic invertebrates only)	%	
pH		
Granulometric analysis of sediment (in relation to assessment of benthic invertebrates only)		N/A
Hydrodynamics Data including seabed structure, substrata, composition, topography, bathymetry, current direction/wave exposure		Hydrographical Changes

Additional Information:

- time of the day,
- weather conditions,
- sampling depth,
- an estimate of the volume of sediment collected and
- a visual description of the sediment collected (depth of oxygenated layer, smell and additional important observations).

13. Links to monitoring processes

Monitoring in terms of this factsheet is linked with monitoring or related processes as follows:

- Monitoring stations for assessment of *Posidonia* beds are shared with those proposed for 'eutrophication' and 'contaminants'.
- Monitoring for 'eutrophication' will provide the supporting parameters for monitoring 'benthic habitats'.
- Monitoring Stations for monitoring shelf and upper bathyal sediment are those of the Mediterranean International Bottom Trawl Surveys (MEDITS) pursuant to Council Regulation 199/2008 concerning the establishment of a '*Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy*' and Commission Decision 2008/949/EC outlining a multiannual Community programme pursuant to Council Regulation 199/2008.

14. Quality Assurance & Quality Control

Sampling methodologies and analysis of samples shall be carried out in line with standards and guidance documents listed in this section:

General:

- Malta Standards Authority EN ISO 16665:2005: Water Quality. Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna. 30pp.
- Malta Standards Authority EN ISO 19493:2007: Water Quality – Guidance on marine biological surveys of hard substrate communities. 21pp

Monitoring of benthic invertebrates:

- HELCOM (2013). Manual for marine monitoring in the COMBINE programme of HELCOM. Helsinki Commission, Baltic Marine Environment Protection Commission, 406 pp.

15. Data collection, storage and dissemination

All data should be collected and stored in accordance with the INSPIRE Technical Specifications listed in this section and/or any other relevant INSPIRE standard as identified through the Marine Pilot Project⁴³. Processed data to be uploaded in a geoportal.

- 'D2.8.II/III.7 INSPIRE Data Specification on Environmental Monitoring Facilities – Technical Guidelines'⁴⁴.
- 'D2.8.III.18 INSPIRE Data Specification on Habitats and Biotopes – Technical Guidelines'⁴⁵
- D2.8.III.19 Data Specification on Species Distribution – Technical Guidelines⁴⁶

⁴³ <https://circabc.europa.eu/w/browse/bc33dff1-0f8c-467a-8382-7724c5f79d45>

⁴⁴ <http://inspire.ec.europa.eu/index.cfm/pageid/2>

⁴⁵ <http://inspire.ec.europa.eu/index.cfm/pageid/2>

⁴⁶ <http://inspire.ec.europa.eu/index.cfm/pageid/2>

16. Responsible organisations

Habitat Type	Sub-themes	Responsible authorities
Littoral Sediment	All monitoring	MEPA
Littoral Rock	All monitoring	MEPA
<i>Posidonia</i> beds	All monitoring	MEPA
Shallow sublittoral Rock	All monitoring	MEPA
Shallow sublittoral sediment	All monitoring	MEPA
Shelf sublittoral sediment: maerl	All monitoring	MEPA
Shelf sublittoral sediment	Sampling	Fisheries
	Data Analysis	MEPA
Activities	Disposal at sea	MEPA
	Construction at sea	MEPA
	Dredging	MEPA
	Aquaculture Installations	MEPA
	Scuttling of vessels	MEPA
	Cables and pipelines	MEPA & Continental Shelf Department
	Trawling	Fisheries
	Anchoring	Transport Malta

17. Gaps and Research Needs

Gaps	Plans to address gaps
As a consequence of limited knowledge on specific benthic habitats such as 'reefs' (as defined for the purposes of the Habitats Directive) and coralligenous habitats, knowledge on benthic species listed in the Habitats Directive is also limited.	Pilot surveys within areas occupied by specific habitat types will be considered to improve knowledge on the distribution and population size of the following species: <i>Scyllarides latus</i> (on shallow sublittoral rock/reefs) <i>Lithophaga lithophaga</i> (on shallow sublittoral rock) <i>Corallium rubrum</i> (in coralligenous habitats if identified) Areas to be monitored for the purposes of such species are to be selected through such pilot surveys.
	Broad brush survey to be considered to identify extent of occurrence of <i>Centrostephanus longispinus</i> with a view to identify suitable monitoring areas for this particular species.
Links between pressures and benthic habitats are poorly known. Areas at	Pressures to be analysed in terms of location, intensity and duration with a view to identify high-risk areas on

risk are not clearly identified.	which monitoring efforts should be focused. Monitoring factsheet to be revised accordingly.
	Link state monitoring with pressures mapped as per Section 11 in future monitoring cycles to identify relationship between levels or pressures and biological responses, with a view to determine acceptable levels of pressures/impacts.
Caves: Data gaps related to the species communities and ecological status associated with this habitat type. Data on location is partly available.	Baseline survey on caves to be considered including measurements of the cave dimensions such as depth (relative to sea-level), floor width, wall height and wall bearings measured at different stations along the floor; percentage cover of selected dominant algae and sessile animals determined using quadrats along the transect.
Littoral Sediment: Information gaps are related to the abundance and/or biomass data of typical species. This gap is mainly attributed to the rarity of such species, of which monitoring would require a significant sampling effort.	Pilot monitoring to be considered targeting assessment of the presence and abundance of typical species on selected beaches.
<i>Posidonia</i> beds: <i>Posidonia</i> beds located on reef structures in Malta's coastal waters may not be adequately captured through the stations identified by this monitoring factsheet.	A pilot survey of the <i>Posidonia</i> reefs may be considered with a view to refine the ecological status assessment of this particular habitat that takes into account Malta's unique characteristics where the growth of these meadows is concerned.

18. Main Sources

- AAE Consortium (ADI Associates Ltd, Ecoserv Ltd and E Cubed Consultants). 2014. Long Term Monitoring Strategy for the Marine Environment of the Maltese Islands under the Marine Strategy Framework Directive. Service Contract for the development of a long-term monitoring strategy for the marine environment, a social and economic analysis of the use of marine waters and costs of degradation, and baseline sediment survey in inland waters (MEPA tender ref: CT3048/2012). ERDF156 - Developing national environmental monitoring infrastructure and capacity. Malta, unpublished report, 252 pp.
- AAE Consortium (ADI Associates Ltd, Ecoserv Ltd and E Cubed Consultants). 2014. Long Term Monitoring Programme for the Marine Environment of the Maltese Islands under the Marine Strategy Framework Directive. Service Contract for the development of a long-term monitoring strategy for the marine environment, a social and economic analysis of the use of marine waters and costs of degradation, and baseline sediment survey in inland waters (MEPA tender ref: CT3048/2012). ERDF156 - Developing national environmental monitoring infrastructure and capacity. Malta, unpublished report, 346 pp.
- Assessment and reporting under Article 17 of the Habitats Directive: Explanatory Notes & Guidelines for the period 2007-2012. Final Draft. April 2011
- CIBM & Ambiente SC. 2013. Development of Environmental Monitoring Strategy and Environmental Monitoring Baseline Surveys – Water Lot 1 – Long-term monitoring – September 2013. ERDF156 - Developing national environmental monitoring infrastructure and capacity
- UNEP/MAP (2014) Monitoring Guidance on Ecological Objective 01: Biodiversity. UNEP(DEPI)/MED WG.400/4

ANNEX I

Table 18: Benthic Habitat Types associated with hard beds of relevance to the Maltese Islands as adapted from AEE Consortium (2014), quoting Borg, J.A., Knittweis, L. & Schembri, P.J. (2013) *Compilation of an interpretation manual for marine habitats within the 25NM Fisheries Management Zone around the Republic of Malta [MEPA tender reference: T2/2013] Mosta, Malta: Ecoserv Ltd.; 218pp*

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Littoral rock and biogenic reef	n/a	A1.13 Mediterranean and Black Sea communities of upper mediolittoral rock	
Littoral rock and biogenic reef	n/a	A1.131 Association with [<i>Bangia atropurpurea</i>]	
Littoral rock and biogenic reef	n/a	A1.132 Association with [<i>Porphyra leucosticta</i>]	
Littoral rock and biogenic reef	1170 Reefs	A1.134 Association with [<i>Lithophyllum papillosum</i>] and [<i>Polysiphonia</i>] spp.	
Littoral rock and biogenic reef	n/a	A1.14 Mediterranean and Black Sea communities of lower mediolittoral rock very exposed to wave action	
Littoral rock and biogenic reef	1170 Reefs	A1.141 Association with [<i>Lithophyllum byssoides</i>]	II.4.2.1 Association with <i>Lithophyllum lichenoides</i>
	1170	A1.23	

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Littoral rock and biogenic reef	Reefs	Mediterranean communities of lower mediolittoral rock moderately exposed to wave action	
Littoral rock and biogenic reef	n/a	A1.231 Association with [<i>Ceramium ciliatum</i>] and [<i>Corallina elongata</i>]	
Littoral rock and biogenic reef	n/a	A1.232 [<i>Neogoniolithon brassica-florida</i>] concretion	II.4.2.8 <i>Neogoniolithon brassica-florida</i> concretion
Littoral rock and biogenic reef	n/a	A1.233 Association with [<i>Gelidium</i>] spp	
Littoral rock and biogenic reef	1170 Reefs	A1.234 Pools and lagoons sometimes associated with [<i>Vermetus</i>] spp. (infralittoral enclave)	II.4.2.10 Pools and lagoons sometimes associated with vermetids
Littoral rock and biogenic reef	n/a	A1.34 Mediterranean communities of lower mediolittoral rock sheltered from wave action	
Littoral rock and biogenic reef		A1.341 Association with [<i>Enteromorpha compressa</i>]	
Littoral rock and biogenic reef	8330 Submerged or partially submerged sea	A1.44 Communities of littoral caves and overhangs	

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
	caves		
Littoral rock and biogenic reef	8330 Submerged or partially submerged sea caves	A1.448 Faunal crusts on wave-surged littoral cave walls	
Shallow sublittoral rock and biogenic reef	n/a	A3.13 Mediterranean and Pontic communities of infralittoral algae very exposed to wave action	
Shallow sublittoral rock and biogenic reef	n/a	A3.131 Overgrazing facies with encrusting algae and sea urchins	
Shallow sublittoral rock and biogenic reef	n/a	A3.132 Association with [<i>Cystoseira amentacea</i>] (var. [amentacea], var. [stricta], var. [spicata])	III.6.1.2 Association with <i>Cystoseira amentacea</i>
Shallow sublittoral rock and biogenic reef	1170 Reefs	A3.133 Facies with [<i>Vermetus</i>] spp.	III.6.1.3 Facies with vermetids
Shallow sublittoral rock and biogenic reef	n/a	A3.134 Mediterranean and Pontic facies with [<i>Mytilus galloprovincialis</i>]	

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Shallow sublittoral rock and biogenic reef	n/a	A3.135 Association with [<i>Corallina elongata</i>] and [<i>Herposiphonia secunda</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.137 Association with [<i>Schottera nicaeensis</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.23 Mediterranean and Pontic communities of infralittoral algae moderately exposed to wave action	
Shallow sublittoral rock and biogenic reef	n/a	A3.231 Association with [<i>Codium vermilara</i>] and [<i>Rhodomenia ardissoni</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.232 Association with [<i>Dasycladus vermicularis</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.237 Mediterranean and Pontic Association with [<i>Ceramium rubrum</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.238 Facies with [<i>Cladocora caespitosa</i>]	III.6.1.14 Facies with <i>Cladocora caespitosa</i>
		A3.239	III.6.1.15

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Shallow sublittoral rock and biogenic reef	n/a	Association with [<i>Cystoseira brachycarpa</i>]	Association with <i>Cystoseira brachycarpa</i>
Shallow sublittoral rock and biogenic reef	n/a	A3.23A Mediterranean and Pontic Association with [<i>Cystoseira crinita</i>]	III.6.1.16
			Association with <i>Cystoseira crinita</i>
Shallow sublittoral rock and biogenic reef	n/a	A3.23B Association with [<i>Cystoseira crinitophylla</i>]	III.6.1.17 Association with <i>Cystoseira crinitophylla</i>
Shallow sublittoral rock and biogenic reef	n/a	A3.23D Association with [<i>Cystoseira spinosa</i>]	III.6.1.19 Association with <i>Cystoseira spinosa</i>
Shallow sublittoral rock and biogenic reef	n/a	A3.23E Association with [<i>Sargassum vulgare</i>]	III.6.1.19 Association with <i>Sargassum vulgare</i>
Shallow sublittoral rock and biogenic reef	n/a	A3.23F Association with [<i>Dictyopteris polypodioides</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.23G Association with [<i>Calpomenia sinuosa</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.23H Association with [<i>Rhodymenia ardissonae</i>] and [<i>Rhodophyllis divaricata</i>]	

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Shallow sublittoral rock and biogenic reef	n/a	A3.23I Facies with [<i>Astroides calycularis</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.23J Association with [<i>Flabellia petiolata</i>] and [<i>Peyssonnelia squamaria</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.23K Association with [<i>Halymenia floresia</i>] and [<i>Halarachnion ligatum</i>]	
Shallow sublittoral rock and biogenic reef	n/a	A3.23L Association with [<i>Peyssonnelia rubra</i>] and [<i>Peyssonnelia</i>] spp.	
Shallow sublittoral rock and biogenic reef	n/a	A3.331 Association with [<i>Stypocaulon scoparium</i>] (= [<i>Halopteris scoparia</i>])	
Shallow sublittoral rock and biogenic reef	n/a	A3.333 Association with [<i>Cystoseira compressa</i>]	
Shallow sublittoral rock and biogenic reef		A3.334 Association with [<i>Pterocladia capillacea</i>] and [<i>Ulva laetevirens</i>]	
		A3.335	

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Shallow sublittoral rock and biogenic reef	n/a	Facies with large Hydrozoa	
Shallow sublittoral rock and biogenic reef	n/a	A3.336 Association with [<i>Pterothamnion crispum</i>] and [<i>Compsothamnion thuyoides</i>]	
Shelf sublittoral rock and biogenic reef	1170 Reefs	A4.26 Mediterranean coralligenous communities moderately exposed to hydrodynamic action	
Shelf sublittoral rock and biogenic reef	n/a	A4.261 Association with [<i>Cystoseira zosteroides</i>]	IV.3.1.1 Association with <i>Cystoseira zosteroides</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.263 Association with [<i>Cystoseira dubia</i>]	IV.3.1.3 Association with <i>Cystoseira dubia</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.264 Association with [<i>Cystoseira corniculata</i>]	IV.3.1.4 Association with <i>Cystoseira corniculata</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.265 Association with [<i>Sargassum</i>] spp.	IV.3.1.5 Association with <i>Sargassum</i> sp.
	1170	A4.266	

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Shelf sublittoral rock and biogenic reef	Reefs	Association with [<i>Mesophyllum lichenoides</i>]	
Shelf sublittoral rock and biogenic reef	1170 Reefs	A4.267 Algal bioconcretion with [<i>Lithophyllum frondosum</i>] and [<i>Halimeda tuna</i>]	
Shelf sublittoral rock and biogenic reef		A4.268 Association with [<i>Laminaria ochroleuca</i>]	IV.3.1.8 Association with <i>Laminaria ochroleuca</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.269 Facies with [<i>Eunicella cavolinii</i>]	IV.3.1.10 Facies with <i>Eunicella cavolinii</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.26A Facies with [<i>Eunicella singularis</i>]	IV.3.1.11 Facies with <i>Eunicella singularis</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.26B Facies with [<i>Paramuricea clavata</i>]	IV.3.1.13 Facies with <i>Paramuricea clavata</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.26C Facies with [<i>Parazoanthus axinellae</i>]	
Shelf sublittoral rock and biogenic reef	1170 Reefs	A4.26D Coralligenous platforms	IV.3.1.15 Coralligenous platforms

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Shelf sublittoral rock and biogenic reef	n/a	A4.27 Faunal communities on deep moderate energy circalittoral rock	
Shelf sublittoral rock and biogenic reef	1170 Reefs	A4.32 Mediterranean coralligenous communities sheltered from hydrodynamic action	
Shelf sublittoral rock and biogenic reef	n/a	A4.321 Association with [<i>Rodriguezella strafforelli</i>]	IV.3.1.9 Association with <i>Rodriguezella strafforelli</i>
Shelf sublittoral rock and biogenic reef	n/a	A4.322 Facies with [<i>Lophogorgia sarmentosa</i>]	IV.3.1.12 Facies with <i>Lophogorgia sarmentosa</i>
Semi dark caves (also in enclave in upper stages)	8330 Submerged or partially submerged sea caves	A4.71 Communities of circalittoral caves and overhangs	
Semi dark caves (also in enclave in upper stages)	8330 Submerged or partially submerged sea caves	A4.712 Caves and overhangs with [<i>Parazoanthus axinellae</i>]	
Semi dark caves (also in enclave in upper stages)	8330 Submerged or partially submerged sea	A4.713 Caves and overhangs with [<i>Corallium rubrum</i>]	IV.3.2.2 Facies with <i>Corallium rubrum</i>

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
	caves		
Semi dark caves (also in enclave in upper stages)	8330 Submerged or partially submerged sea caves	A4.714 Caves and overhangs with [<i>Leptopsammia pruvoti</i>]	
Semi dark caves (also in enclave in upper stages)	8330 Submerged or partially submerged sea caves	A4.715	
Upper / lower bathyal rock and biogenic reef	1170 Reefs	A6.61 Communities of deep-sea corals	V.3.1 Biocoenosis of deep-sea corals
Lower bathyal rock and biogenic reef	n/a	A6.621 Facies with [<i>Pheronema grayi</i>]	

Table 19: Benthic Habitat Types associated with soft substrata of relevance to the Maltese Islands as adapted from AEE Consortium (2014) quoting Borg, J.A., Knittweis, L. & Schembri, P.J. (2013) *Compilation of an interpretation manual for marine habitats within the 25NM Fisheries Management Zone around the Republic of Malta [MEPA tender reference: T2/2013] Mosta, Malta: Ecoserv Ltd.; 218pp*

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Littoral sediment	n/a	A2.13 Mediterranean communities of mediolittoral coarse detritic bottoms	
Littoral sediment	n/a	A2.131 Facies of banks of dead leaves of [<i>Posidonia oceanica</i>] and other phanerogams	Facies of dead leaves of <i>Posidonia oceanica</i> and other phanerogams
Littoral sediment	n/a	A2.2 Littoral sand and muddy sand	
Littoral sediment	n/a	A2.25 Mediterranean and Pontic communities of mediolittoral sands	
Littoral sediment	n/a	A2.251 Facies with [<i>Ophelia bicornis</i>]	
Shallow sublittoral coarse sediment	n/a	A5.13 Infralittoral coarse sediment	
Shallow sublittoral coarse sediment	n/a	A5.139 Facies with [<i>Gouania wildenowi</i>]	
Shallow sublittoral sand	n/a	A5.235 Mediterranean communities of fine sands in very shallow waters	
		A5.2351	

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Shallow sublittoral sand	n/a	Facies with [<i>Lentidium mediterraneum</i>]	
Shallow sublittoral sand	n/a	A5.236 Mediterranean communities of well sorted fine sands	
Shallow sublittoral mixed sediment	n/a	A5.28 Mediterranean communities of superficial muddy sands in sheltered waters	
Shallow sublittoral mixed sediment	n/a	A5.283 Facies with [<i>Loripes lacteus</i>], [<i>Tapes</i>] spp.	III.2.3.3 Facies with <i>Loripes lacteus</i> and <i>Tapes</i> spp.
Shallow sublittoral mixed sediment	n/a	A5.284 Association with [<i>Caulerpa prolifera</i>] on superficial muddy sands in sheltered waters	
Shallow sublittoral mixed sediment	n/a	A5.515 Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents	
Shallow sublittoral mixed sediment	n/a	A5.52A Association with [<i>Gracilaria</i>] spp.	
Shallow sublittoral mixed sediment	n/a	A5.52D Association with [<i>Ulva laetevirens</i>] and [<i>Enteromorpha linza</i>]	
Shallow sublittoral sand	1110 Sandbanks*	A5.53131 Association with [<i>Cymodocea nodosa</i>] on well sorted fine sands	

MSFD Habitat Classification (stipulated by the Commission Staff Working Paper)	Habitats Directive	EUNIS	Habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest – as finalised by the 4th meeting of the National Focal Points for Specially Protected Areas
Shallow sublittoral mixed sediment	1110 Sandbanks*	A5.53132 Association with [<i>Cymodocea nodosa</i>] on superficial muddy sands in sheltered waters	
Shallow sublittoral sand	n/a	A5.5322 Mediterranean [<i>Halophila</i>] beds	III.2.2.2 Association with <i>Halophila stipulacea</i>
Shallow sublittoral mixed sediment	n/a	A5.5342 Tethyan marine [<i>Ruppia</i>] communities	III.1.1.1 Association with <i>Ruppia cirrhosa</i> and/or <i>Ruppia elongata</i>
Shallow sublittoral sand	1120 <i>Posidonia</i> beds (<i>Posidonia oceanica</i>)	A5.535 [<i>Posidonia</i>] beds	
Shallow sublittoral sand	1120 <i>Posidonia</i> beds (<i>Posidonia oceanica</i>)	A5.5352 Ecomorphosis of "barrier-reef" [<i>Posidonia oceanica</i>] meadows	Ecomorphosis of 'barrier reef' meadows
Shallow sublittoral sand	1120 <i>Posidonia</i> beds (<i>Posidonia oceanica</i>)	A5.5353 Facies of dead "mattes" of [<i>Posidonia oceanica</i>] without much epiflora	
Shallow sublittoral sand	1120 <i>Posidonia</i> beds (<i>Posidonia oceanica</i>)	A5.5354 Association with [<i>Caulerpa prolifera</i>] on [<i>Posidonia</i>] beds	
Shelf sublittoral coarse sediment	n/a	A5.14 Circalittoral coarse sediment	
		A5.38	

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Shelf sublittoral mud	n/a	Mediterranean communities of muddy detritic bottoms	
Shelf sublittoral mud	n/a	A5.39 Mediterranean communities of coastal terrigenous muds	
Shelf sublittoral mud	n/a	A5.391 Facies of soft muds with [<i>Turritella tricarinata communis</i>]	
Shelf sublittoral mud	n/a	A5.392 Facies of sticky muds with [<i>Virgularia mirabilis</i>] and [<i>Pennatula phosphorea</i>]	
Shelf sublittoral mud	n/a	A5.393 Facies of sticky muds with [<i>Alcyonium palmatum</i>] and [<i>Stichopus regalis</i>]	
Shelf sublittoral mixed sediment	n/a	A5.46 Mediterranean animal communities of coastal detritic bottoms	
Shelf sublittoral mixed sediment	n/a	A5.461 Facies with [<i>Ophiura texturata</i>]	
Shelf sublittoral mixed sediment	n/a	A5.462 Facies with Synascidies	
Shelf sublittoral mixed sediment	n/a	A5.463 Facies with large Bryozoa	IV.2.2.10 Facies with large bryozoa

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Shelf sublittoral mixed sediment	n/a	A5.47 Mediterranean communities of shelf-edge detritic bottoms	
Shelf sublittoral mixed sediment	n/a	A5.471 Facies with [<i>Neolampas rostellata</i>]	
Shelf sublittoral mixed sediment	n/a	A5.472 Facies with [<i>Leptometra phalangium</i>]	
Shelf sublittoral coarse sediment	n/a	A5.51 Maerl beds	III.3.2.1 Maerl facies (= Association with <i>Lithothamnion corallioides</i> and <i>Phymatolithon calcareum</i>)
Shelf sublittoral mixed sediment		A5.516 Association with rhodolithes on coastal detritic bottoms	III.3.2.2 Association with rhodoliths
Shelf sublittoral mixed sediment	n/a	A5.52H Association with [<i>Peyssonnelia rosa-marina</i>]	
Shelf sublittoral mixed sediment	n/a	A5.52I Association with [<i>Arthrocladia villosa</i>]	
Shelf sublittoral mixed sediment	n/a	A5.52J Association with [<i>Osmundaria volubilis</i>]	
Upper bathyal sediment	n/a	A6.31 Communities of bathyal detritic sands with [<i>Grypheus vitreus</i>]	
		A6.51	

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Upper bathyal sediment	n/a	Mediterranean communities of bathyal muds	
Upper bathyal sediment	n/a	A6.511 Facies of sandy muds with [<i>Thenia muricata</i>]	
Upper bathyal sediment	n/a	A6.512 Facies of fluid muds with [<i>Brissopsis lyrifera</i>]	
Upper bathyal sediment	n/a	A6.513 Facies of soft muds with [<i>Funiculina quadrangularis</i>] and [<i>Apporhais seressianus</i>]	V.1.1.3 Facies of soft muds with <i>Funiculina quadrangularis</i> and <i>Apporhais seressianus</i>

* *Cymodocea nodosa* may be found on sandbanks, however on many sandbanks macrophytes do not seem to occur.