REBUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE, NATURAL RESOURCES AND THE ENVIRONMENT
DEPARTMENT OF FISHERIES AND MARINE RESEARCH

Revision of Reports prepared in 2012 for the implementation of Articles 8, 9 and 10 of the Marine Strategy Framework-Directive (2008/56/EC)

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1 Introduction

1.1 The Marine Strategy Framework-Directive MSFD, 2008/56/EC)

The MSFD (2008/56/EC) is one of the seven thematic strategies proposed by the Sixth Community Environment Action Programme (1600/2002/EC). It is often considered the environmental pillar of the Integrated Maritime Policy of the EU (COM (2006) 275, COM (2007) 575). According to Article 1 of the MSFD, a framework is established within which the member-states (and, to a large degree, the candidate member-states) take all necessary measures to achieve and/or to maintain the good environmental status (GES) of their marine waters the latest by 2020. This framework consists of marine strategies, which aim towards the achievement and/or maintainance of GES. GES is defined by Article 3 of the MSFD as the environmental condition of marine waters in which these waters provide an ecologically diverse and dynamic marine environment which is clean, healthy and productive within its intrinsic conditions, and where the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations.

According to Article 5 of the MSFD, marine strategies are implemented in three phases:

(1) Preparation:

a) Assessment of the environmental status,
b) Determination of GES,
c) Establishment of environmental targets,
d) Establishment of a marine environment monitoring programme,

(2) Programme of measures:

e) Programme of measures designed to achieve and/or maintain good environmental status,

(3) Revision:

f) The periodic (every 6 years) revision of the above actions.

In the Republic of Cyprus, the Department of Fisheries and Marine Research (DFMR) is the Competent Authority for the implementation of the MSFD, and it participates in all the activities for the implementation of the MSFD at the EU level (committees, working groups, etc.). The DFMR transposed the MSFD into the National Legislation with the Marine Strategy Law of 2011 (Law 18(I)/2011), and immediately initiated the process of implementing the MSFD.

1.2 Implementation of the provisions of Articles 8, 9 and 10 – 2012

The DFMR implemented Phase I, parts (a)-(c), that concern MSFD Articles 8, 9 and 10, respectively, in 2011-2012. The process was completed with the submission of the relevant reports to the EC in 2012. A total of three reports were submitted:

- An Initial Assessment report of the marine environment of Cyprus (DFMR, 2012c), consisting of Part I (Characteristics), Part II (Pressures and Impacts) and Part III (Economic and Social Parameters),
- A report on the determination of Good Environmental Status (DFMR, 2012a),
- A report on environmental targets and associated indicators (DFMR, 2012b).

Subsequently, the information contained in the reports was submitted to the EC using typified reporting sheets.

1.3 Evaluation of the 2012 reports

In February 2014, the European Commission concluded a review (EC, 2014a, 2014d) of the reports submitted by Cyprus (and other member-states) in 2012 after the implementation of Articles 8, 9, and 10 of the MSFD. This review was based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014).

An analysis of the technical evaluation indicates that there are topics common to all descriptors that require attention, in addition to small details specific to each aspect. The major topics requiring revisions or improvements are the following:

- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing the significant knowledge gaps will be specified.

1.4 Revision of the 2012 reports

The present report includes the revisions deemed necessary in 2014 in view of the preparation of the monitoring programmes and programmes of measures. These revisions are not meant to be exchaustive, but are as detailed as time allows, and their purpose is to resolve critical issues that affect several aspects of the monitoring programmes and to lay the groundwork for the 2018-2020 revision of the implementation phases.

The most important of these aspects are the development of indicators (especially when they were not established in 2012) and the revision of the definition of GES for Cyprus waters based on these indicators.

1.4.1 Knowledge base

To simplify the task at hand, all indicators were developed based on the status of knowledge included in the 2012 reports. More recent information was only taken into account if it proved critical for the task at hand.

1.4.2 Indicators

All relevant indicators of the MSFD, as these were defined in CD477, as well as any indicators that were adopted by the 18th Meeting of the Contracting Parties to UNEP/MAP (2013) were taken into consideration when developing Cyprus indicators. To avoid confusion all Cyprus indicators are preceded by the prefix “CY”.

It should be noted that these indicators are not formally established since there is no official time step for such a revision, but it is certainly possible to implement them, especially if this will facilitate preparations for the development of more appropriate monitoring programmes, than based on the 2012 reports alone.

Finally, it should be noted that indicators were prepared using the SMART principles (Table 1.1) to ensure that the resulting targets comply with these principles.

Table 1.1 Description of SMART characteristics of objectives, goals or targets (modified from UNDP, 2009).

Specific	Avoid generalizations and vague terminology (e.g., “adverse”); Aim for a specific description of a future condition
Measurable	Associate with (semi-)quantitative indicator(s)
Achievable	Establish a realistic goal or target; Definitely avoid an idealized and (most likely) untenable condition
Relevant	Identify a clear relationship and contribution to the overarching objective(s) of the implemented programme
Time- bound	Define the time frame in which the goal or target must be achieved

1.4.3 Targets

As a rule, targets have not been proposed at this stage (with minor exceptions). However, attention should be focused on implementing as many of the indicators in time for the official 2017-2018 revision of the Phase I, (a)-(c), to allow for the definition of quantitative or semi-quantitative targets.

2 Biodiversity (D01), Food Webs (D04), Seafloor Integrity (D06)

2.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The Descriptors 01 (Biodiversity), 04 (Food Webs), and 06 (Seafloor Integrity) were evaluated jointly and the following revisions were identified as necessary:

- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Environmental targets and relevant indicators set in 2012 will be redefined with as many references as possible to semi-quantitative reference conditions;
- The GES definition and environmental targets and relevant indicators will be redefined to include the main functional/species groups, e.g., birds, mammals, reptiles, fish and cephalopods (Descriptors 01 and 04), as well as impacts on biogenic substrstes (Descriptor 06);
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- Pressures and impacts will be analyzed further, where necessary;
- Plans for addressing the significant knowledge gaps will be specified.

The general approach used in revising the 2012 reporting elements is as follows:

- The main characteristics and impacts identified and discussed during the 2012 Initial Assessment (DFMR, 2012c) were summarized;
- Definitions of descriptors, criteria and indicators for Descriptors 01, 04 and 06, and relevant UNEP/MAP Ecological Objectives (UNEP/MAP, 2013) were briefly reviewed;
- Cyprus indicators were redefined and/or developed for all three descriptors, and organized by function/species group and/or habitat group in the scheme used in the monitoring programmes guidelines (EC, 2014c);
- The above were incorporated in a GES definition in Cyprus waters for each of the above groups;
- The pending work towards the acquisition of missing data and information, primarily in relation to environmental targets, and the completion of the revision, was identified and elaborated.

2.2 Analysis of characteristics and impacts

2.2.1 Current sources of information

Numerous on-going monitoring programmes and studies inform various aspects of the three descriptors in question. These were extensively discussed during the Initial Assessment in 2012 (DFMR, 2012c) and are summarized in Table 2.1.

Table 2.1 Current sources of information, data-collecting mechanisms and monitoring programmes (DFMR, 2012c).

Element	Monitoring activities, other sources of information
Birds	○ Monthly waterbird counts by the Game Fund of the Republic of Cyprus,

	○ Monitoring of selected coastal species by the Game Fund and the Forestry Department of the Republic of Cyprus.
Cetaceans	○ Cetacean and turtle strandings programme of the DFMR
Monk seal	○ National Action Plan for the Conservation of the Mediterranean Monk Seal in Cyprus (UNEP/MAP, DFMR)
Turtles	○ Cyprus Turtle Conservation Project (DFMR, Cyprus Wildlife Society) ○ Cetacean and turtle strandings programme of the DFMR ○ Habitats Directive (92/43/EEC), specifically the Site of Community Importance of Polis-Gialia (CY4000001; terrestrial and marine) for the protection of the turtle *Caretta caretta*
Fish and cephalopods	○ Mediterranean International Trawling Survey (MedITS) ○ Data Collection Framework (DCF)
Water column physicochemical parameters	○ Water Framework-Directive (2000/60/EC), including the Nitrates Directive ○ MedPOL programme (UNEP/MAP)
Phytoplankton	○ Water Framework-Directive (2000/60/EC) ○ MedPOL programme (UNEP/MAP)
Zooplankton	○ Mediterranean International Trawling Survey (MedITS) ○
Macroalgae	○ Water Framework-Directive (2000/60/EC)
Zoobenthos	○ Water Framework-Directive (2000/60/EC)
Angiosperms	○ Water Framework-Directive (WFD, 2000/60/EC) ○ Habitats Directive (92/43/EEC) – *Posidonia* meadows mapping

2.2.2 Components of biodiversity

The tables that follow summarize the species and functional/species groups of interest and relevant spatial information for birds (Table 2.2), marine mammals and reptiles (Table 2.3), fish and cephalopods (Table 2.4) and benthic species groups (Table 2.5).

Table 2.2 Analysis of significant bird groups for the purposes of the implementation of the MSFD in Cyprus.

Bird habitat	**Important species**
Cyprus wetlands, i.e., the Larnaca Salt Lakes and the Akrotiri Peninsula, are considered the most important wetlands for birds in Cyprus and were designated Ramsar sites (in 2001 and 2003 respectively), Natura 2000 Sites of Community Importance (Larnaca Salt Lakes in 2004) and Special Protection Areas (in 2004 and 2011, respectively). These wetlands are important staging areas during spring and autumn passage for hundreds to thousands of waterbirds, and support internationally important numbers of several species of overwintering wetland birds. It is hereby noted that the Akrotiri Peninsula area falls under the jurisdiction of the Sovereign British Base Areas (SBBA) of Cyprus and, as such, it is governed	Larnaca Salt Lakes host more than 100 species of wetland birds, 31 of which are listed in Annex I of the Birds Directive (2009/147/EC), the most important being: *Phoenicopterus ruber*, *Grus grus*, *Charadrius alexandrinus*, *Larus ridibundus*, *Himantopus himantopus*, *Burhinus oedicnemus*, and *Vanellus spinosus*.

by the Game and Wild Birds Ordinance of the SBBA.	
The coasts of Cyprus serve as migration stop-over sites and staging points, as well as wintering and breeding sites. While monitoring doesn't cover the full extent of the coastline, it is sufficiently observed to allow distributional ranges of the main species to be estimated from existing efforts focused on selected species. Key special protected areas (SPAs) are: Kavo Gkreko, Agia Thekla-Liopetri, Akrotirio Aspro-Petra tou Romiou, Kato Pafos Lighthouse, and the Akamas Peninsula.	Each one of five SPAs hosts 20 or more bird species that are listed in Annex I of the Birds Directive (2009/147/EC. Specific species are listed in DFMR (2012c).
Offshore bird species in Cyprus waters tend to be overlooked. Given the size of the assessment area (approximately 6 times the terrestrial part of Cyprus), strong efforts must be made to quantitatively assess the presence of, at least, the main offshore bird species.	While information on any offshore birds will be pursued, special effort will be made to collect information on *Calonectris diomedea*, *Chroicocephalus genei*, *Puffinus yelkouan*, and *Hydrobates pelagicus*, since they have been designated as bird species of important consideration by UNEP/MAP (2013).

Table 2.3 Overview of marine mammals and reptiles for the purposes of the implementation of the MSFD in Cyprus.

Important species	**Habitat/area**
Tursiops truncatus	Coastal waters
Delphinus delphis and *Stenella coeruleoalba*. Rarer and vagrant species: *Grampus griseus*, *Steno bredanensis*, *Ziphius cavirostris*, *Physeter macrocephalus*, and *Balaenoptera physalus*	Open waters (mostly territorial waters)
Monachus monachus	Breeding and resting/shelter caves, coastal waters
Chelonia mydas and *Caretta caretta*. Rarely seen: *Dermochelys coriacea*	Coastal waters which serve as breeding grounds and nurseries, Nesting beaches

Table 2.4 Overview of fish and cephalopods for the purposes of the implementation of the MSFD in Cyprus.

Habitat	**Important species groups**
Seabed habitats: Shallow to bathyal. MedITS monitors 25 trawling stations at depths of 10-800 m	Demersal fish (All): MedITS records numbers of species, diversity and abundance indices for all caught species. Moreover, sex ratios, body size structure, and maturity stage are recorded for a selected sub-group of 41 species, while otoliths are collected for age structure of *Merluccius merluccius*, *Mullus barbatus*, and *Mullus surmuletus*
	Cephalopods (All): Numbers of species, diversity and abundance

	indices are calculated for all caught species.

Table 2.5 Overview of significant benthic species groups for the purposes of the implementation of the MSFD in Cyprus.

Habitats	**Important species groups**
Littoral-Shallow rock and biogenic reef	Macroalgae
Shallow sediment	Zoobenthos (benthic macrofauna)
Shallow-Shelf: All	Angiosperms

2.2.3 Activities, pressures and impacts

Human activities, pressures and impacts affecting all biodiversity elements were discussed during the Initial Assessment in 2012 (DFMR, 2012c) and are summarized in Table 2.6.

Table 2.6 Human activities and their pressures and impacts on important species and functional/species groups (DFMR, 2012c).

Species/group	**Activities**	**Pressures**	**Impacts**
Birds	Modification of land and coastlines (e.g., construction, tourism infrastructure, golf courses, marinas) within or near habitats, Collision with energy and transportation infrastructure (e.g., low-flying aircraft, power lines, wind turbines), Disturbances by escorted or ferile domesticated animals (e.g., dogs, cats), Illegal trapping, hunting and killing.	Other biological disturbance	Depletion of habitat, population reduction
Cetaceans	(Illegal) intentional or incidental killing during fishing activities	Biological disturbance: Selective extraction of species, including non-target catches	Population reduction
Monk seal	Modification of land and coastlines (e.g., construction, tourism infrastructure, human activities) within or near habitats and nesting beaches	Other biological disturbance	Depletion of habitat
Turtles	Modification of land and	Other biological	Depletion of habitat,

	coastlines (e.g., construction, tourism infrastructure, human activities) within or near habitats and nesting beaches, (Illegal) intentional or incidental killing during fishing activities	disturbance	population reduction
Demersal fish, cephalopods	Fisheries, including recreational fishing	Selective extraction of species, including non-target catches	Population reduction
Water column habitats	See Eutrophication (D05), section 5.		
Zoobenthos	Dredge material disposal	Smothering, siltation and enhanced organic matter inputs	Depletion of habitat, population reduction
	Aquaculture		
	Fisheries (trawling)	Abrasion	
	Man-made structures	Abrasion, siltation and smothering during installation, and sealing upon completion of the work	
Demersal fish, macroalgae, zoobenthos, angiosperms	Man-made structures, fisheries, aquaculture, recreation, shipping	Introduction of non-indigenous species (NIS) results in predation/herbivory and competition for space and resources	Population reduction and displacement

2.3 Analysis of MSFD D01, D04 and D06 criteria and indicator definitions

In this section, the definitions of the descriptor, criteria and indicator definitions for Descriptors 01, 04 and 06 (as these appear in CD477) are briefly discussed in view of the development of indicators for Cyprus waters.

Descriptor 01: 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 climate conditions.

Species distribution (1.1)
- Distributional range (1.1.1)
- Distributional pattern within the latter, where appropriate (1.1.2)
- Area covered by the species (for sessile/benthic species) (1.1.3)

Population size (1.2)

Population abundance and/or biomass, as appropriate (1.2.1)
Population condition (1.3)
Population demographic characteristics (1.3.1)
Population genetic structure, where appropriate (1.3.2)
Habitat distribution (1.4)
Distributional range (1.4.1)
Distributional pattern (1.4.2)
Habitat extent (1.5)
Habitat area (1.5.1)
Habitat volume, where relevant (1.5.2)
Habitat condition (1.6)
Condition of the typical species and communities (1.6.1)
Relative abundance and/or biomass, as appropriate (1.6.2)
Physical, hydrological and chemical conditions (1.6.3).
Ecosystem structure (1.7)
Composition and relative proportions of ecosystem components (1.7.1).

Descriptor 01 addresses the geographic presence, extent, characteristics and condition of the main species, groups of species, functional groups, and habitats. The effects of impacts, in particular, are addressed by two criteria, 1.3 and 1.6, while they are implicit in several other indicators.

Descriptor 04: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

Productivity (production per unit biomass) of key species or trophic groups (4.1)
Performance of key predator species using their production per unit biomass (4.1.1).
Proportion of selected species at the top of food webs (4.2)
Large fish (by weight) (4.2.1)
Abundance/distribution of key trophic groups/species (4.3)
Abundance trends of functionally important selected groups/species (4.3.1)

Descriptor 04 highlights the productivity of the top tiers of the food web, i.e., predatory fish, birds, mammals, etc. (4.1 and 4.2).

Moreover, it addresses the need to identify the trends in abundance of the main species, groups of species, and/or functional groups (4.3.1). These trends can be calculated, for instance, from time-series of data used to quantify indicators 1.2.1 and 1.6.2. Apart from top predators, CD477 identifies the following as groups of interest with regards to this indicator:

- Groups with fast turnover rates (e.g. phytoplankton, zooplankton, jellyfish, bivalve molluscs, short-living pelagic fish) that respond quickly to ecosystem change and are useful as early warning indicators,
- Groups/species that are targeted by human activities or that are indirectly affected by them (in particular, by-catch and discards),
- Habitat-defining groups/species,
- Groups/species at the top of the food web,
- Long-distance anadromous and catadromous migrating species,
- Groups/species that are tightly linked to specific groups/species at another trophic level.

Descriptor 06: 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.

Physical damage, having regard to substrate characteristics (6.1)
Type, abundance, biomass and areal extent of relevant biogenic substrate (6.1.1)
Extent of the seabed significantly affected by human activities for the different substrate types (6.1.2)
Condition of benthic community (6.2)
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)
Proportion of biomass or number of individuals in the macrobenthos above some specified length/size (6.2.3)
Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community (6.2.4).

Descriptor 06 addresses the need to protect specific biogenic substrates (6.1) and to maintain a diverse and resilient benthic community (6.2). It requires the selection of important biogenic substrates, the determination of their extent and volume/biomass (6.1.1), and their proportion affected by human activities. Moreover, it requires a measure of the presence of sensitive species, especially relative to opportunistic species (6.2.1 and 6.2.2) as an indicator of conditions that prevent the dominance of opportunists and, instead, foster a diverse – and consequently more resilient – assemblage.

2.4 UNEP/MAP Ecological Objective 01

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 5.1), in relation to Ecological Objective 01: Biodiversity (UNEP/MAP, 2013), with the intention that they will be incorporated in the upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a). Moreover, they defined significant marine mammal, bird and reptile species (Table 2.8), and habitats (Table 2.9) that should be considered when implementing this ecological objective (UNEP/MAP, 2013).

Table 2.7 Elements of Biodiversity adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
Species distribution is maintained (1.1)	Distributional range (1.1.1)	Monk Seal is present along recorded Mediterranean coasts with suitable habitats for the species.	The distribution of Monk Seal remains stable or expanding and the species is recolonizing areas with suitable habitats. Pressure/Response Human activities having the potential to exclude marine mammals from their natural habitat within their range area or to damage their habitat are regulated and controlled.

			Conservation measures implemented for the zones of importance for cetaceans Fisheries management measures that strongly mitigate the risk of incidental taking of monk seals and cetaceans during fishing operations are implemented.
		The bird species continue to occur in all their Mediterranean natural habitat	State No significant shrinkage in the bird population distribution in the Mediterranean in all indicator species, and for colonial-breeding seabirds (i.e., most species in the Mediterranean): New colonies are established and the population is encouraged to spread among several alternative breeding sites.
		The reptile species continue to occur in all their natural range in the Mediterranean, including nesting, mating, feeding and wintering and developmental (where different to those of adults) sites	State Turtle distribution is not significantly affected by human activities Turtles continue to nest in all known nesting sites Pressure/Response Protection of known nesting, mating, foraging, wintering and developmental turtle sites. Human activities having the potential to exclude marine turtles from their range area are regulated and controlled.

			The potential impact of climate change is assessed
Population size of selected species is maintained (1.2)	Population abundance (1.2.1)	The marine mammal species populations have abundance levels allowing to qualify to Least Concern Category of IUCN	State Marine mammal opulations recover towards natural levels
		The bird species populations have abundance levels allowing to qualify to Least Concern Category of IUCN	No human induced decrease in bird population abundance. Population recovers towards natural levels where depleted. The total number of individuals is sparse enough in different spots.
		The reptile species population size allows to achieve and maintain a favourable conservation status taking into account all life stages of the population	State No human induced decrease in reptile population abundance Population recovers towards natural levels where depleted
	Population density (1.2.2)	Number of monk seal individuals by colony allows to achieve and maintain a favourable conservation status	State Continual recovery of monk seal population density
		Bird population density allows to achieve and maintain a favourable conservation status	State Continual recovery or maintenance of bird population density in enough different spots to allow resilience No decrease in population density in new/ recolonized critical habitat (for recovered populations)
Population condition of selected species is maintained (1.3)	Population demographic characteristics (e.g.	Cetacean species populations are in good condition: Low	State Decreasing trends in human induced

	body size or age class structure, sex ratio, fecundity rates, survival/ mortality rates) (1.3.1)	human induced mortality, balanced sex ratio and no decline in calf production Monk Seal species populations are in good condition: Low human induced mortality, appropriate pupping seasonality, high annual pup production, balanced reproductive rate and sex ratio	mortality Pressure/Response Cetaceans: Appropriate measure implemented to mitigate incidental catch, prey depletion and other human induced mortality Monk Seal: Appropriate measures implemented to mitigate direct killing and incidental catches and to preclude habitat destruction.
		Bird species populations are in good conditions: Natural levels of breeding success & acceptable levels of survival of young and adult birds.	Populations of all bird taxa, particularly those with IUCN threatened status are maintained in long term following the indication of population models. Incidental catch mortality is at negligible levels, particularly for species with IUCN threatened status.
		Low reptile mortality induced by incidental catch Favourable sex ratio and no decline in hatching rates	Response Measures to mitigate incidental catches in turtles implemented
Key coastal and marine habitats are not being lost (1.4)	Potential/ observed distributional range of certain coastal and marine habitats listed under SPA protocol (1.4.1)	The habitat is present in all its natural distributional range.	State The ratio Natural/ observed distributional range tends to 1 Pressure Decrease in the main human causes of the habitat decline
	Distributional pattern of certain coastal and marine habitats listed under SPA protocol (1.4.2)	The distributional extent is in line with prevailing physiographic, hydrographic,	State Decline in habitat extension is reversed and the extension of recovering habitats

		geographic and climatic conditions.	shows a positive trend.
		Increasing distribution of turtle nesting sites	Turtle species recover historical nesting sites
	Condition of the habitat-defining species and communities (1.4.3)	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	State No human induced significant deviation of population abundance and density from reference conditions The species composition shows a positive trends towards reference condition over an increasing proportion of the habitat (for recovering habitats)

Table 2.8 Significant Mediterranean marine mammal, bird and reptile species that should be considered when implementing UNEP/MAP Ecological Objective 1 (UNEP/MAP, 2013).

Marine mammals	**Birds**	**Reptiles**
Balaenoptera physalus *Delphinus delphis* *Globicephala melas* *Monachus monachus* *Physeter macrocephalus* *Stenella coeruleoalba* *Tursiops truncatus*	*Calonectris diomedea* *Chroicocephalus genei* *Hydrobates pelagicus* *Larus audouinii* *Phalacrocorax aristotelis* *Puffinus mauretanicus* *Puffinus yelkouan* *Sterna bengalensis* *Sterna nilotica* *Sterna sandvicensis*	*Caretta caretta* *Chelonia mydas* *Trionyx triunguis* *Dermochelys coriacea*

Table 2.9 Indicative list of habitats that should be considered when implementing UNEP/MAP Ecological Objective 1 (UNEP/MAP, 2013).

Key coastal/marine habitats
Biocoenosis of infralittoral algae (facies with vermetids or trottoir), Hard beds associated with photophilic algae, Meadows of the sea grass *Posidonia oceanica*, Hard beds associated with Coralligenous biocenosis and semi dark caves, Biocoenosis of shelf-edge detritic bottoms (facies with *Leptometra phalangium*), Biocoenosis of deep-sea corals, Seeps and biocoenosis of bathyal muds (facies with *Isidella elongata*). Natural monuments listed by the Marine Vegetation Action Plan31: Barrier reefs of *Posidonia*, organogenic surface formations, terraces (platforms with vermitids covered by

soft algae) and certain *Cystoseira* belts. Upwelling areas, fronts and gyres

2.5 D01, D04 and D06 indicators and targets for Cyprus

Based on the analysis above a number of Biodiversity, Food Web and Seafloor Integrity indicators can be established to guide the planning of monitoring programmes and programmes of measures and lay the groundwork for the revision of Phase I in 2018.

2.5.1 Organization of elements

The organization of the elements (GES definition, criteria and indicators) is dictated by the grouping that has been established by both the implementation of the MSFD (EC, 2014c) as well as by the UNEP/MAP (2013) planning. Namely, the elements are developed by major functional group and type of marine habitat as shown in Table 2.10.

Table 2.10 Monitoring programmes anticipated by MSFD Article 11 implementation (EC, 2014c).

Descriptor	**MSFD Monitoring Programme**
D01, D04	Biodiversity – birds
D01, D04	Biodiversity – mammals and reptiles
D01, D04	Biodiversity – fish and cephalopods
D01, D04	Biodiversity – water column habitats
D01, D04, D06	Biodiversity – seabed habitats

2.5.2 Indicators

The developed Cyprus bird species indicators determined for coastal, wetland and offshore species, based on existing information reported in the Initial Assessment (DFMR, 2012c) as well as the guidance by UNEP/MAP (2013) and are shown in Table 2.11. They address in whole or in part the Biodiversity and Food WebMSFD indicators defined in CD477, as well as the indicators of Ecological Objective 1 adopted by the Contracting Parties of UNEP/MAP (2013). It is noted that no GES definition for birds was included during the 2012 GES determination.

Table 2.11 Cyprus birds indicators and corresponding MSFD criteria/indicators and UNEP/MAP indicators they address (X represents a number ID assigned to each monitored species).

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY0141.1.X	Distributional range	1.1.1	1.1.1
CY0141.2.X	Distributional pattern within range, where appropriate	1.1.2	-
CY0141.3.X	Population abundance	1.2.1	1.2.1
CY0141.4.X	Population density within distributional range	-	1.2.2

CY0141.5.X	Population sex ratio	1.3.1	1.3.1
CY0141.6.X	Fecundity rate	1.3.1	1.3.1
CY0141.7.X	Mortality rate	1.3.1	1.3.1

The developed Cyprus mammals and reptiles indicators with corresponding MSFD and UNEP/MAP indicators are shown in Table 2.12. It is noted that indicators for mammals and reptiles were not established during the 2012 reporting cycle, and the ones listed here are meant to act as guidelines for the next reporting cycle during which they will be formally established and implemented, along with associated targets.

Key species are the Mediterranean monk seal, *Monachus monachus*, and the marine turtles *Chelonia mydas* and *Caretta caretta* (the rarer *Dermochelys coriacea* should also be recorded if observed). Regarding cetaceans, focus should be placed on *Tursiops truncatus*, *Delphinus delphis*, and *Stenella coeruleoalba*, but the rarer and vagrant *Grampus griseus*, *Steno bredanensis*, *Ziphius cavirostris*, *Physeter macrocephalus*, *Balaenoptera physalus* should also be recorded when present.

Table 2.12 Cyprus mammals and reptiles indicators and corresponding MSFD criteria/indicators and UNEP/MAP indicators they address (X represents a number ID assigned to each monitored species).

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY0142.1.X	Distributional range	1.1.1	1.1.1
CY0142.2.X	Distributional pattern within range, where appropriate	1.1.2	-
CY0142.3.X	Population abundance	1.2.1	1.2.1
CY0142.4.X	Population sex ratio	1.3.1	1.3.1
CY0142.5.X	Mortality rate	1.3.1	1.3.1
CY0142.6.X	Fecundity rate	1.3.1	1.3.1
CY0142.7.X	Distribution of nesting sites	-	1.4.2

The developed Cyprus fish and cephalopod indicators with corresponding MSFD and UNEP/MAP indicators are shown in Table 2.13. It is noted that indicators for cephalopods were not established during the 2012 reporting cycle. All species collected during MedITS, as well as in the framework of the DCF should be monitored.

Table 2.13 Cyprus fish and cephalopod indicators and corresponding MSFD biodiversity and food-web criteria/indicators.

Cyprus indicator	**Description**	**MSFD**
CY0143.1.X	Species number	1.1.1
CY0143.2.X	Species diversity – Pielou's Evenness-J'	1.1.2
CY0143.3.X	Species diversity – Shannon-Weaver- H'	1.1.2
CY0143.4.X	Population abundance	1.2.1

CY0143.5.X	Population biomass	1.2.1
CY0143.6.X	Population sex ratio	1.3.1
CY0143.7.X	Body size structure	1.3.1
CY0143.8.X	Maturity stage	1.3.1
CY0143.9.X	Age structure	1.3.1

The Cyprus water column habitat indicators listed in Table 2.14 have been developed in response to the technical evaluation of the 2012 reports (EC, 2014a, 2014d; Milieu Ltd. Consortium, 2014), and are meant to act as guidelines for the next reporting cycle during which they will be formally established and implemented, along with associated targets.

Table 2.14 Cyprus water column habitats indicators and corresponding MSFD criteria/indicators and UNEP/MAP indicators they address.

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY0144.1.1	Water column temperature (^{o}C)	1.6.3	7.1.1
CY0144.1.2	Water column salinity (g/kg, TEOS-10)		
CY0144.1.3	Water column pH		
CY05.1	Water column total N concentration ($\mu mol\ L^{-1}$)	1.6.3, 5.1.1	5.1.1
CY05.2	Water column NO_3^- concentration ($\mu mol\ L^{-1}$)		
CY05.3	Water column NO_2^- concentration ($\mu mol\ L^{-1}$)		
CY05.4	Water column NH_4^+ concentration ($\mu mol\ L^{-1}$)		
CY05.5	Water column total P concentration ($\mu mol\ L^{-1}$)		
CY05.6	Water column PO_4^{3-} concentration ($\mu mol\ L^{-1}$)		
CY05.7	Water column Si_4^{4-} concentration ($\mu mol\ L^{-1}$)		
CY05.8	Water column N:P	1.6.3, 5.1.2	5.1.2
CY05.9	Water column N:Si		
CY05.13	Water column photosynthetically available radiation (PAR) depth at 1 % of surface value (m)	1.6.3, 5.2.2	5.2.2
CY05.14	Water column turbidity (NTU)		
CY05.15	Water column dissolved oxygen ($mg\ L^{-1}$)	1.6.3, 5.3.2	5.3.1
CY05.16	Water column dissolved oxygen (% saturation)		
CY0144.2.1	Phytoplankton abundance (individuals L^{-1})	1.2.1	-
CY0144.2.2	Phytoplankton biomass ($g\ L^{-1}$)		
CY05.10	Water column Chlorophyll *a* concentration ($\mu g\ L^{-1}$)	5.2.1	5.2.1
CY05.11	Water column Chlorophyll *a* fluorescence (FU)		

CY0144.2.3	Trend in phytoplankton abundance (individuals L^{-1} y^{-1})	4.3.1	-
CY0144.2.4	Trend in phytoplankton biomass (g L^{-1} y^{-1})		
CY0144.2.5	Trend in water column Chlorophyll *a* concentration (μg L^{-1} y^{-1})		
CY0144.2.6	Trend in water column Chlorophyll *a* fluorescence (FU y^{-1})		
CY0144.3.1	Zooplankton abundance (individuals L^{-1})	1.2.1	-
CY0144.3.2	Zooplankton biomass (g L^{-1})		
CY0144.3.3	Trend in zooplankton abundance (individuals L^{-1} y^{-1})	4.3.1	-

The developed Cyprus seabed habitats for macroalgae, zoobenthos and angiosperm indicators with corresponding MSFD and UNEP/MAP indicators are shown in Table 2.15. It is noted that indicators for habitat distribution (MSFD criterion 1.4 and UNEP/MAP indicators 1.4.1-3) were not established during the 2012 reporting cycle, and the ones listed here are meant to act as guidelines for the next reporting cycle during which they will be formally established and implemented, along with associated targets. As indicated in several of the indicator descriptions, the Cyprus seabed indicators will be developed for macroalgae, zoobenthos (benthic macrofauna), and *Posidonia* (angiosperms).

Table 2.15 Cyprus seabed habitats indicators and corresponding MSFD criteria/indicators and UNEP/MAP indicators they address (X represents a number ID assigned to each monitored species/group).

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY0146.1.1	Macroalgal species number	1.1.2	-
CY0146.1.2	Macroalgal species diversity – Pielou's Evenness, J'		-
CY0146.1.3	Macroalgal species diversity – Shannon-Weaver, H'		-
CY0146.1.4	Macroalgal abundance (%)	1.2.1	-
CY0146.1.5	Macroalgal biomass (g m^{-2})		-
CY0146.1.6	Abundance of perennial macroalgae (ESG IA) (% areal coverage)	1.6.2, 6.2.1	-
CY0146.1.7	Biomass of perennial macroalgae (g m^{-2})		
CY0146.1.8	Abundance of shade-adapted, slow growing calcareous macroalgae (ESG IC) (% areal coverage)		-
CY0146.1.9	Biomass of shade-adapted, slow growing calcareous macroalgae (g m^{-2})		
CY0146.1.10	Abundance of opportunistic macroalgae (ESG IIA) (% areal coverage)		-
CY0146.1.11	Biomass of opportunistic macroalgae (g m^{-2})		-
CY0146.1.12	EEI-c (Macroalgae)	1.7.1, 6.2.2	1.4.3

CY0146.2.1	Zoobenthos species number	1.1.2	-
CY0146.2.2	Zoobenthos species diversity – Pielou's Evenness, J'		-
CY0146.2.3	Zoobenthos species diversity – Shannon-Weaver, H'		-
CY0146.2.4	Zoobenthos abundance (individuals m^{-2})	1.2.1	-
CY0146.2.5	Zoobenthos biomass (g m^{-2})	1.2.1	-
CY0146.2.6	BENTIX (zoobenthos)	1.7.1, 6.2.2	1.4.3
CY0146.3.1	Distributional range of *P. oceanica*	1.4.1	1.4.1
CY0146.3.2	Distributional pattern of *P. oceanica*	1.4.2	1.4.2
CY0146.3.3	Habitat area of *P. oceanica* (m^2)	1.1.3, 1.5.1	-
CY0146.3.4	*P. oceanica* abundance (shoots m^{-2})	1.2.1, 1.6.2	1.4.3
CY0146.3.5	*P. oceanica* biomass (dry leaf mass, g m^{-2})		1.4.3
CY0146.3.6	PREI (*Posidonia*)	1.7.1, 6.2.2	1.4.3

2.5.3 Targets

Targets (along with indicators) for bird, mammal and reptile populations were not established during the Phase I implementation of the MSFD in 2012. Targets will be set in 2018. Targets (along with indicators) were only established for selected fish indicators during the 2012 reporting period (DFMR, 2012b) and are shown in Table 2.16 (it should be noted that values for these targets can be explicitely calculated based on the analysis reported in 2012). Targets for the remaining indicators for fish and cephalopods will be set in 2018.

Table 2.16 Targets for Cyprus fish indicators.

Cyprus indicator ID and description	**Target**
CY0143.2.X Species diversity – Pielou's Evenness-J'	Coefficient of Variance < 0.50
CY0143.3.X Species diversity – Shannon-Weaver- H'	Coefficient of Variance < 0.50
CY0143.4.X Population abundance	Coefficient of Variance < 0.50

Targets (along with indicators) were established for most of the seabed habitat indicators during the 2012 reporting period (DFMR, 2012b) and are shown in Table 2.17 (it should be noted that values for these targets can be explicitely calculated based on the analysis reported in 2012).

Table 2.17 Targets for Cyprus seabed habitat elements.

Cyprus indicator ID and description	**Target**
CY0146.1.2 Macroalgal species diversity – Pielou's Evenness, J'	Divergence $\leq$ 50 % from reference conditions
CY0146.1.3 Macroalgal species diversity – Shannon-Weaver, H'	
CY0146.1.4 Macroalgal abundance (%)	

CY0146.1.5 Macroalgal biomass (g m^{-2})	
CY0146.1.6 Abundance of perennial macroalgae (ESG IA) (% areal coverage)	
CY0146.1.7 Biomass of perennial macroalgae (g m^{-2})	
CY0146.1.8 Abundance of shade-adapted, slow growing calcareous macroalgae (ESG IC) (% areal coverage)	
CY0146.1.9 Biomass of shade-adapted, slow growing calcareous macroalgae (g m^{-2})	
CY0146.1.10 Abundance of opportunistic macroalgae (ESG IIA) (% areal coverage)	
CY0146.1.11 Biomass of opportunistic macroalgae (g m^{-2})	
CY0146.1.12 EEI-c (Macroalgae)	Divergence $\leq$ 25 % from reference conditions
CY0146.2.2 Zoobenthos species diversity – Pielou's Evenness, J'	Divergence $\leq$ 50 % from reference conditions
CY0146.2.3 Zoobenthos species diversity – Shannon-Weaver, H'	
CY0146.2.4 Zoobenthos abundance (individuals m^{-2})	
CY0146.2.5 Zoobenthos biomass (g m^{-2})	
CY0146.2.6 BENTIX (zoobenthos)	Divergence $\leq$ 25 % from reference conditions
CY0146.3.3 Habitat area of *P. oceanica* (m^2)	Divergence $\leq$ 50 % from reference conditions, expert judgment
CY0146.3.6 PREI (*Posidonia*)	Divergence $\leq$ 25 % from reference conditions

2.6 Good Environmental Status of Cyprus with regards to Biodiversity, Food Webs and Seafloor Integrity

Based on the brief revised assessment and the development of Biodiversity, Food Webs, and Seafloor Integrity indicators for Cyprus waters, a preliminary description of GES can be developed, as seen in the box below.

The marine environment of Cyprus is considered to be in good environmental status if:

- Bird species continue to occur in all their natural habitats, in line with prevailing physiographic, geographic and climate conditions,
- Their populations are at abundance and density levels that ensure the long-term abundance of the species and the retention of their full reproductive capacity, and that allow them to achieve and maintain a favourable conservation status,
- Their populations are in good condition, as indicated by breeding success and survival levels,
- Marine mammal and reptile species continue to occur in all their natural habitats, including suitable breeding and nesting sites,
- Their populations are at abundance and density levels that ensure the long-term abundance of the species and the retention of their full reproductive capacity, and that allow them to achieve and maintain a favourable conservation status,

- Their populations are in good condition, as indicated by breeding success and survival levels,
- Fish and cephalopod species continue to occur in all their natural habitats, in line with prevailing physiographic, geographic and climate conditions,
- Their populations are at abundance and density levels that ensure the long-term abundance of the species and the retention of their full reproductive capacity,
- Their populations are in good condition, as indicated by sex ratios, population size and age structure, and diversity indices,
- Temperature, salinity, pH, water transparency, nutrient concentrations and ratios, and oxygen are in line with prevailing physiographic, geographic and climate conditions throughout the water column,
- The abundance and biomass of phytoplankton and zooplankton are normal and in line with prevailing physiographic, geographic and climate conditions, and at levels capable of ensuring their long-term abundance.
- Macroalgal, zoobenthos and angiosperm species continue to occur in all their natural habitats, in line with prevailing physiographic, geographic and climate conditions,
- Their populations are at abundance and density levels that ensure the long-term presence of the species, and are in good condition, as indicated by diversity indices,
- Seabed habitat integrity is at a level that ensures that the structure and function of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

2.7 Work needed and gaps in knowledge

The issue of aggregation of values from different sampling stations in the case of most indicators must be investigated and addressed, preferably before the submission of the monitoring programmes, in part depending on the adoption of the recommendations to the EC on this topic (Prins et al., 2014). It is unknown whether there is official guidance at this point regarding aggregation within or between assessment areas, sub-regions and regional seas.

3 Non-Indigenous Species (D02)

3.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). Consequently, the following revisions were identified as necessary for Descriptor 2, Non-Indigenous Species (NIS):

- The table of species that appears in the written report will be replaced with a more detailed table, based in part on the format presented in the reporting sheets of Phase I (8Aa-Eco_Analysis), including details, where these are available, relevant to Phase II;
- Criteria, pressures and impacts will be discussed further;
- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing the significant knowledge gaps will be specified;
- The above will be achieved while distinguishing between the species that are actively introduced by human activities and the species that enter “passively” through the Suez canal and the Gibraltar straits (also referred to as secondary introduction).

The JRC/ICES Task Group (TG) Report on NIS (Olenin et al., 2010) identified the following components of an initial assessment on NIS for the evaluation of GES (p. 26):

- Inventory of all NIS and preferably also all cryptogenic species known in an area;
- Ratio between NIS and native species, at least in well studied taxonomic groups;
- Abundance and distribution range of invasive alien species (IAS) taking into account the phase of invasion;
- A summary of IAS impacts on native communities, habitats and ecosystem functioning, using a standardized bioinvasion impact measure;
- A vector account as measure of anthropogenic pressure.

Moreover, the TG report identifies elements of future assessments, which should be taken into account in the planning of monitoring programmes (p. 26):

- Inventory of newly arrived NIS and areas of their origin;
- Vectors associated with new introductions;
- Changes in power of pathways and their vectors;
- Account of newly colonized localities as a result of primary introduction and secondary spread;
- Impacts of newly established IAS;
- changes in bioinvasion impacts of previously established IAS.

All of the above topics are addressed in the sections below. The general approach used in revising the 2012 reporting elements is as follows:

- The description of the current status of NIS and their impacts in Cyprus waters was revised (using the existing literature) by supplementing it with additional components for

each NIS that facilitate the quantitative definition of criteria and indicators, especially with regards to baseline/reference conditions;
- Definitions of criteria and indicators, as they appear in CD477, were analyzed, based in part on the definitions and analysis contained in the TG report on NIS (Olenin et al., 2010), and assessed for feasibility when applied to Cyprus;
- Based on these definitions, semi-quantitative environmental targets were developed for Cyprus marine waters, and assigned to specific indicators and criteria;
- The above were incorporated in a GES definition for NIS in Cyprus marine waters;
- The pending work both towards completion of the revision, as well as contributions to the development of monitoring programmes and programmes of measures was identified and elaborated.

3.2 Revision of NIS inventory and classification

Table 3.27 of the Initial Assessment, Part I (Characteristics) written report was updated and supplemented to generate a more complete inventory of non-indigenous species (NIS), their characteristics, pressures and impacts. Specifically, the original references in the written report were consulted, in part to facilitate the revision process, but also to fill in the fields required by the reporting sheet (8Aa-Eco_Analysis), but not addressed by the written report. To aid in this task the review by Katsanevakis et al. (2009) used in the Initial Assessment report (DFMR, 2012c) was supplemented by information in Zenetos et al. (2010) for the Eastern Mediterranean region.

Subsequently, the MSFD, CD477, the JRC/ICES Task Group Report on NIS (Olenin et al., 2010), and the structure of the 2012 reporting sheets highlight a number of key classification components that are both essential in addressing D02, as well as in prioritizing the work involved. The sections that follow describe the patterns in these components (based on the revised NIS characterization) that will influence the determination of GES, associated criteria and indicators and their targets.

Taxonomic composition

The vast majority of the NIS in Cyprus waters, 119 of 129 (or 92 %), fall under 5 major taxa: molluscs (42), fish (28, all except one are Osteichthyes), annelids (21), macrophytobenthos (16, all except one are macroalgae) and crustaceans (13).

Predominant habitats and functional groups

Correspondingly to the taxonomic composition, the vast majority of NIS in Cyprus waters, 116 of 129 (or 90 %), are either wholly (106) or partially (10) associated with seabed habitats, with another 10 associated with water column habitats (2 NIS are unclassified). In turn, all of the seabed-associated NIS that can be classified in one or more seabed habitat types are found in the littoral and/or the sublittoral, which includes the continental shelf (down to 200 m depth). This is probably an artifact of a bias towards shallower waters in the studies and data collection efforts that contribute to NIS identifications. Similar results, presumably for the same reason, are obtained for water column-associated NIS.

Fish are the only official functional group (for the purposes of the implementation of the MSFD) that is represented in the NIS inventory in Cyprus waters. Their assignment into official functional group classes reflects both the importance of seabed habitats as the main locus of NIS in Cyprus waters, as well as the methodological bias in locating them and indentifying them: 20 of 28 fish NIS, are classified as wholly or partially demersal.

Drivers of introduction: Means of arrival and key human activities

In the case of Cyprus marine waters, means of arrival is a key characteristic in prioritizing or determining the measures that can be taken regarding management of NIS introduction in the future. The vast majority of NIS (and IAS) in Cyprus waters, 103 of 129, may have arrived through the Suez canal as Lessepsian migrants. Dispersal from the Mediterranean gateway of the Suez canal is considered secondary introduction, and this also applies in the case of the 2 NIS that have entered through the Gibraltar Straits, as well as the well-studied *Caulerpa racemosa* var. *cylindracea* (Verlaque et al., 2000). By far the most important human activity in terms of direct (primary) NIS introduction is shipping, referring to both hull (epibiotic) and ballast transport (Galil, 2009), and accounting for 36 introductions (23 of which, or 36 %, could have also entered through the Suez canal). Four of these 36 NIS are identified as having arrived as epibiotics (fouling).

First year of record

The first year of record ideally approximates the first year of arrival, assuming a continuous and consistently thorough monitoring programme. However, the first year of record in Cyprus waters reflects not so much the rate of invasion and occurrence, but more than likely the effort in NIS tracking and identification (Galil, 2009; Argyro Zenetos, 2010). The high uncertainty with which this effort during the past 50 years can be quantitatively evaluated renders the approximation to the first year of arrival impossible.

Establishment success

The persistence of the presence of an NIS is indicated by the establishment of a viable reproducing population. NIS whose presence is described as “questionable” may be relegated to low priority, unless they have been shown to be invasive in the broader region, i.e., the eastern Mediterranean, and especially the Levantine.

The majority of NIS in Cyprus waters (63 %) are established, while 23 % are casually found. An analysis of the main means of arrival indicates that NIS introduced by shipping, aquaculture and the aquarium trade are more likely to be established than those entering through the Suez canal.

Invasive Alien Species (IAS)

Invasive Alien Species (IAS) are a subset of NIS that have a demonstrated potential to spread extensively and can have an adverse effect on many environmental components as well as socio-economic indicators. It is noted that a NIS need not be established or well-established to be identified as an IAS, while cryptogenic NIS, i.e., those that cannot be conclusively classified as native or alien, should also be considered as IAS, if applicable (Olenin et al., 2010).

Monitoring of status and impacts of IAS should be prioritized. In Cyprus marine waters, there are 16 NIS characterized as IAS for Cyprus, all of which are established. Moreover, following a precautionary approach, another 43 Cyprus NIS are also characterized as IAS or potential IAS (39 and 4 respectively) for the Eastern Mediterranean (EMed) region (A. Zenetos et al., 2010; All 16 of the Cyprus IAS are also considered Eastern Mediterranean IAS). Not surpisingly, the majority of the IAS (50 of 59, or 85 %) are established, while the presence of 8 IAS is either casual or questionable. It is noteworthy that, assessing the relative proportion of IAS in every arrival pathway, the majority of NIS introduced by human activities other than Lessepsian migrants (25 of 41, or 61 %) are IAS.

Out of the 59 (potential) IAS, 38 appear in the 100 worst Mediterranean IAS list, 16 of which also appear in the IUCN/GISP list of the world's 100 worst IAS (Streftaris & Zenetos, 2006). In addition, another 5 NIS not classified as IAS appear in the above lists (1 in both, and 4 only in the Mediterranean) prompting a re-examination of their classification as IAS in Cyprus.

Abundance

Abundances of the vast majority of NIS in Cyprus waters, e.g., in terms of individuals/biomass per unit area or volume, are unknown. At present, they have been qualitatively stated ranging from negligible in the case of questionable NIS, to fair-high in the case of established NIS. Quantification for some NIS, especially the IAS that have been shown to have detrimental impacts, is essential, especially in areas of special interest, such as marine protected areas (MPAs).

Spatial distribution

Spatial distribution, as requested by the reporting mechanism of 2012, refers to the coverage of the assessment area for MFSD purpose, and then only in some broad-scale categories. Therefore, it doesn't address the need to record specific parts of an assessment area, e.g., a section of coastal waters, where a specific NIS concentrates, or in an area of special interest such as an MPA. This separate category may need to be developed as part of the monitoring programmes for this descriptor.

At present, the limited bibliography allows for a definitive assessment of the spread for some key NIS that are commonly found in shallow waters within a few nautical miles from shore, i.e., in the 1-5 % range of the assessment area (see references and discussion in DFMR, 2012c):

- *Caulerpa racemosa* var. *cylindracea*,
- *Cladophora* cf *patentiramea*,
- *Fistularia commersonii*,
- *Lagocephalus sceleratus*, *L. spadiceus*, and *L. suezensis*,
- *Siganus rivulatus* and *S. luridus*.

Impacts

The reporting of impacts for the purposes of the MSFD is not as typified as for other aspects, leaving room for open-ended reporting. The list of impacts at different organizational levels included in the TG report (Olenin et al., 2010) and the discussion in the 2012 Initial Assessment (DFMR, 2012c) and relevant references were used to identify several environmental and/or socioeconomic impacts of NIS in Cyprus waters (Table 3.1).

Table 3.1 Summary of potential environmental attributes and socioeconomic effects of NIS found in Cyprus marine waters.

Environment/Biodiversity	**Socioeconomics**
○ Habitat alteration/reduction ○ Reduction and/or displacement of species, species groups and functional groups ○ Bioengineering ○ Outcompeting ○ Predation/Herbivory	Fisheries and aquaculture ○ Damage to fishing and farming gear and catch ○ Burden as invaluable by-catch ○ Displacement and consumption of commercially important species ○ Marketable value Health and sanitation

	○ Poisonous/toxic/venomous ○ Risk to swimmers Infrastructure and buildings ○ Impedence ○ Nuisance

3.3 Analysis of MSFD D02 criteria and indicator definitions

In this section, the definitions of the descriptor, criteria and indicator definitions for Descriptor 02 (as these appear in CD477) are discussed in view of the preceeding analysis on NIS in the marine waters of Cyprus and of the discussion and recommendations of the TG report on D02 (Olenin et al., 2010).

Descriptor 02: Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem

Abundance and state characterisation of non-indigenous species, in particular invasive species (2.1)

Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species (2.1.1)

Environmental impact of invasive non-indigenous species (2.2)

Ratio between invasive non-indigenous species and native species in some well studied taxonomic groups (e.g. fish, macroalgae, molluscs) that may provide a measure of change in species composition (e.g. further to the displacement of native species) (2.2.1)

Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible (2.2.2).

A pivotal component of the D02 definition as it applies In the case of Cyprus marine waters, is “human activities”. The TG report on the descriptor (Olenin et al., 2010) states that:

“It is important that the transfer of these species over the environmental barriers, e.g. land masses or vast open ocean spaces, separating the source and recipient regions took place as the result of human activities. Natural shifts in distribution ranges (e.g. due to climate change or dispersal by ocean currents) do not qualify a species as a NIS. However, secondary introductions of NIS from the area(s) of their first arrival could occur without human involvement due to spread by natural means.” (p. 6)

The interpretation above suggests that two NIS thought to have arrived through the Straits of Gibraltar, *Sphoeroides pachygaster* and *Enchelycore anatina*, are outside the purview of this Descriptor, since their sread took place by natural means.

Moreover, this interpretation suggests that arrival through the Suez canal qualifies is a result of human activity, since the canal was man-made and it eliminated an intervening land mass that was acting as an environmental barrier. Therefore, all Lessepsian migrants, i.e., NIS thought to have arrived through the Suez canal, must be considered as introduced through human activities.

Furthermore, the wording of criteria 2.1 and 2.2. prioritizes IAS over other NIS. The inherent assumption is that IAS are more likely to bring about considerable, and possibly adverse, impacts than the rest, and therefore their assessment is more urgent.

Trends in abundance, temporal occurrence and spatial distribution (indicator 2.1.1) can only be reliably estimated from a long, consistent record of observations at a broad-enough spatial scale. Abundance was defined in the 2012 reporting sheets as a quantitative indicator of individuals or biomass per unit area (or volume), depending on the habitat of each NIS. The analysis of the status of all known NIS in Cyprus waters identified 38 NIS (8 of which are IAS) whose establishment is either casual or questionable. It is not evident how trends in abundance will be possible in their case. Locating and consistently monitoring them to acquire a continuous record for trend estimation may require disproportionate effort, a factor that should be taken into account according to the DPSIR model (Agu, 2007; Smeets & Weterings, 1999). Therefore, abundances for these 38 NIS need not be determined at present, unless their establishment status changes, as this is determined by the monitoring programmes in place. Moreover, the definition of indicator 2.1.1 reinforces the urgency with which assessment of IAS, over other NIS, should take place.

Therefore, in aid of the implementation of this indicator, the 129 NIS in Cyprus waters were prioritized for management and monitoring purposes, based on the following successive criteria, in increasing order of importance:

- Arrival through human-mediated pathways,
- Establishment success,
- Invasive attributes in the Eastern Mediterranean region, and
- Invasive attributes in Cyprus waters.

The resulting prioritization highlights 89 established NIS, 39 of which are non-IAS and 50 NIS that are demonstrably IAS in the broader region. Out of these 50 IAS, 15 are IAS in Cyprus waters in particular, and that have been shown to bear broad environmental and socioeconomic impacts in the Eastern Mediterranean. Therefore, with regards to Indicator 2.2.1, it is argued that focus should be placed on the 89 established NIS.

Moreover, the unwritten implication of D02 is that member-states should minimize or eliminate IAS introductions. Therefore, a distinction must and can be made between Lessepsian migrants and other NIS, when it comes to managing the pathways/means of arrival. Lessepsian migration cannot be expected to be controlled and/or managed within reason, while shipping and aquaculture are, by comparison, more manageable, at least in principle. Therefore, IAS can be further subdivided into secondarily-introduced (Lessepsian) and primarily introduced IAS (PIIAS) via shipping, aquaculture, etc., or other direct human activities. The breakdown of the 89 established NIS is shown in Table 3.2.

Criterion 2.2 focuses on the environmental impacts of IAS. It is implied that “environmental” mainly refers to “ecological.” However, it should probably be stressed here that socio-economic impacts, such as on human health, quality of life, commercial activities, etc., are of considerable interest and perhaps equal importance, and, moreover, these are incorporated in the definition of IAS in the TG report (Olenin et al., 2010). Therefore, both types of impacts should be taken into account when evaluating Cyprus NIS.

Indicator 2.2.1 permits the selection of “some well studied taxonomic groups” in calculating NIS to native ratios, thus relying, and correctly so, on robust data records that are currently generated in the framework of other projects, and implicitly requiring the maintenance of an inventory of native species (NAS) in these well-studied taxonomic groups. The vast majority of the established NIS in Cyprus waters, 79 of 89, fall under 5 major taxa, that are monitored (to a certain extent) in coastal and territorial waters: 22 fish, 22 molluscs, 13 annelids, 12 crustaceans, and 10 macroalgae.

The impacts of IAS (Indicator 2.2.2) are clearly the most difficult indicator to address, due to the widespread lack of data on many aspects of NIS invasions for most of the European

seas (Olenin et al., 2010). This difficulty is reflected in the use of the phrase “where feasible”, allowing focus at any of the biological organizational levels. The environmental/ecological and socioeconomic impacts identified in the analysis (Table 3.1) are typically determined at the basin level (Eastern Mediterranean) based on very localized studies, and are not expected to lead to realistic and measureable impact indicators in the near future. Instead, abundance and biomass ratios are proposed as preliminary indicators to address dominance of IAS due to competition, predation, etc., resulting in reduction or displacement of native species (Table 3.1). Regarding other impacts, such as habitat alteration, bioengineering, etc., data may be collected by the MSFD monitoring programmes to provide enough data to aid with a definition of Indicator 2.2.2 and appropriate targets during their revision phase in 2018. At this point, a comparison of ratios of NIS to native species in terms of abundances/biomasses, may provide a proxy of ecosystem function impacts by discerning a dominance in function, e.g., primary productivity in the case of macrophytobenthos.

Table 3.2 Classification of the 89 established NIS in Cyprus waters based on invasive attributes in the broader region and Cyprus in particular and human-meditated introduction pathway. It is noted that classification of individual species into these categories as well as the introduction and elimination of species will constantly be revised as new information is collected and published.

NIS	Definition
19	Established PIIAS (a subdivision of established IAS): Established primarily introduced IAS, i.e., IAS directly introduced to Cyprus waters by shipping (ballast water or surface-fouling), aquaculture, the aquarium trade and any other human activity that may result in the direct introduction of NIS to Cyprus waters. In accordance with the precautionary principle, this number includes NIS that may have either spread through the Suez canal but also could have been introduced by shipping or aquaculture.
50	Established IAS: NIS in Cyprus waters that have demonstrated the potential to spread extensively and to have adverse effects either in Cyprus waters or elsewhere in the Eastern Mediterranean
39	Established non-invasive NIS: NIS established in Cyprus waters in the wild with free-living, self-maintaining and self-perpetuating populations unsupported by and independent of humans

3.4 UNEP/MAP Ecological Objective 02

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 3.3), in relation to Ecological Objective 02: Non-indigenous species (UNEP/MAP, 2013), with the intention that they will be incorporated in the upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a).

Table 3.3 Elements of NIS adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	Indicator	GES	Proposed Targets
Invasive non-	Spatial distribution,	Introduction and	State

indigenous species introductions are minimized (2.1)	origin and population status (established vs. vagrant) of non-indigenous species (2.1.1)	spread of NIS linked to human activities are minimised, in particular for potential IAS	The number of species and abundance of IAS introduced as a result of human activities is reduced. <u>Pressure/Response</u> - Improved management of the main human related pathways and vectors of NIS introduction (Mediterranean Strategy for the management of ballast waters, Aquaculture early warning systems, etc.) - Action plans developed to address high risk NIS, should they appear in the Mediterranean.
	Trends in the abundance of introduced species, notably in risk areas (2.1.2)	Decreasing abundance of introduced NIS in risk areas	<u>State</u> Abundance of NIS introduced by human activities reduced to levels giving no detectable impact
The impact of non-indigenous particularly invasive species on ecosystems is limited (2.2)	Ecosystem impacts of particularly invasive species (2.2.1)	No decrease in native species abundance, no decline of habitats and no change in community structure that have been generated by IAS via competition, predation or any other direct or indirect effect.	<u>Pressure/Response</u> Impacts of NIS reduced to the feasible minimum
	Ratio between non-indigenous invasive species and native species in some well-studied taxonomic groups (2.2.2)	Stable or decreasing proportion of NIS in the different habitats	<u>State</u> To be set upon species choice and their related impact degree of the invasive upon the indigenous ones, taking into account the role of Climate Change in accelerating the establishment of NIS populations.

3.5 NIS indicators and targets for Cyprus

3.5.1 Indicators

During the 2012 GES determination process, no GES definition and indicators were established for NIS. Based on the analysis of existing data on NIS in Cyprus waters in the Initial Assessment (DFMR, 2012c) and in previous sections, as well as the guidance by UNEP/MAP (2013), a number of NIS indicators have been developed to guide the planning of monitoring programmes and programmes of measures and to lay the groundwork for the revision of Phase I in 2018 (Table 3.4). They address in whole or in part the NIS MSFD indicators defined in CD477, as well as the indicators of Ecological Objective 02 adopted by the Contracting Parties of UNEP/MAP (2013). It is noted that no NIS indicators were included during the 2012 GES determination (DFMR, 2012a). Furthermore, the catalogue of IAS in Cyprus waters (from which CY2.4 is calculated) may contribute directly to the requirements of the proposed Regulation on the Prevention and Management of IAS (EC, 2013).

Table 3.4 NIS indicators for Cyprus waters. Species indicators will be implemented for the 89 established NIS, while taxonomic indicators will be evaluated for the predominant, well-studied taxonomic groups (fish, crustaceans, benthic macroinvertebrates, and macroalgae).

		Related Indicators	
Code	**Description**	**MSFD**	**UNEP/MAP**
CY2.1	Established NIS abundance (number m^{-2} or km^{-2} or m^{-3}) and/or biomass (g m^{-2} or km^{-2} or m^{-3})	2.1.1	2.1.1
CY2.2	Trend in established NIS abundance/biomass (CY2.1 y^{-1})		2.1.2
CY2.3	Number of NIS introduced in Cyprus waters via human-mediated pathways	2.2.1	2.2.2
CY2.4	Number of established IAS in Cyprus waters		
CY2.5	Number of established PIIAS in Cyprus waters		
CY2.6	Number of established IAS in Cyprus waters (per taxonomic group)		
CY2.7	Number of established PIIAS in Cyprus waters (per taxonomic group)		
CY2.8	Number of NAS in Cyprus waters (per taxonomic group)		
CY2.9	Ratio of established IAS (CY2.4) to NAS (CY2.8) in Cyprus waters (per taxonomic group)		
CY2.10	Ratio of established PIIAS (CY2.7to NAS (CY2.8) in Cyprus waters (per taxonomic group)		
CY2.11	Abundance (number m^{-2} or km^{-2} or m^{-3}) and/or biomass (g m^{-2} or km^{-2} or m^{-3}) of established IAS (per taxonomic group)	2.2.2	2.2.1
CY2.12	Abundance (number m^{-2} or km^{-2} or m^{-3}) and/or biomass (g m^{-2} or km^{-2} or m^{-3}) of established PIIAS (per taxonomic group)		
CY2.13	Abundance (number m^{-2} or km^{-2} or m^{-3}) and/or biomass (g m^{-2} or km^{-2} or m^{-3}) of NAS (per taxonomic group)		

CY2.14	Trend in abundance/biomass (CY2.11 y^{-1}) of established IAS (per taxonomic group)		
CY2.15	Trend in abundance/biomass (CY2.12 y^{-1}) of established PIIAS (per taxonomic group)		
CY2.16	Trend in abundance/biomass (CY2.13 y^{-1}) of NAS (per taxonomic group)		
CY2.17	Ratio of abundance and/or biomass of established IAS (CY2.11) to NAS (CY2.13) (per taxonomic group)		
CY2.18	Ratio of abundance and/or biomass of established PIIAS (CY2.12) to NAS (CY2.13) (per taxonomic group)		
CY2.19	Trend in the ratio of abundance and/or biomass of established IAS to NAS (CY2.11 to CY2.13 y^{-1}) (per taxonomic group)		
CY2.20	Trend in the ratio of abundance and/or biomass of established PIIAS to NAS (CY2.12 to CY2.13 y^{-1}) (per taxonomic group)		

3.5.2 Targets

No specific targets are proposed at this point. However, preliminary determination of values of the developed indicators prior to the 2017-2018 revision (and formal establishment of these indicators) will allow the definition of specific targets associated with these indicators.

3.6 Good Environmental Status of Cyprus with regards to NIS

Based on the revised assessment and the development of NIS indicators for Cyprus waters, a preliminary description of GES with regards to NIS is developed.

The marine environment of Cyprus is considered to be in good environmental status if:

- Invasive non-indigenous species (IAS) do not dominate the abundance/biomass of their taxonomic group/functional group within a predominant habitat type, and especially in Marine Protected Areas (including Sites of Community Importance),
- The introduction of primarily-introduced invasive non-indigenous species (PIIAS), i.e. species introduced directly into Cyprus waters (and excluding secondary dispersal) by human activities such as shipping, aquaculture, and the aquarium trade, is minimized and, if possible, is effectively eliminated,
- PIIAS are not established outside high-risk areas of impact, such as harbors, marinas, aquaculture facilities etc., while their abundances in high-risk areas are minimized.

3.7 Work needed and gaps in knowledge

The proposed indicators developed for NIS in Cyprus waters address all MSFD and UNEP/MAP indicators. Trends in abundance, temporal occurrence and distribution can only be reliably estimated from a long, consistent record of observations at a broad-enough spatial scale. It is argued that such a spatial scale is potentially achieved at present for a significant percentage of established NIS (64 %) with the combined monitoring networks in the framework of the Habitats Directive and the Water Framework Directive. One major unknown factor is the spread of surface-fouling epibiotics (e.g., serpulids, bivalves), many of which have caused infrastructure issues (e.g., in harbors and marinas, intakes and outlets of

facilities, etc.) elsewhere in the Eastern Mediterranean.. Future monitoring programmes should address this gap by introducing an appropriate plan to evaluate and monitor any populations of these species and their impacts.

Even though the MSFD criteria and indicators generally permit the use of indicators broadly defined at the assessment area level, the proposed indicators often refer to specific stations. Moreover, due to the specificity of predominant habitat(s) each established NIS can be found, some of these proposed indicators can be recalculated for specific predominant habitats for the major taxonomic groups represented in the NIS record. It should be evident, however, that special mention will be made of high-risk areas such as harbors/marinas and aquaculture facilities, as well as MPAs (Natura 2000 areas, Akamas, etc.), per the TG report's suggestions.

Targets have not been proposed, but it is deemed feasible to do so, as long as indicators are implemented in time for the official 2017-2018 revision of the assessment, GES determination, targets and associated indicators.

As already mentioned, in order to correctly evaluate the presence and impact of NIS, baseline information on NAS is also needed, at least for the main taxonomic groups represented in the NIS inventory. Even though compiling an NAS database will not be a trivial task, it should be considered a necessary one for an overall assessment of the marine biodiversity of Cyprus.

4 Commercially important stocks (D03)

4.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The following revisions were identified as necessary for Descriptor 3, commercially important stocks (CIS):

- GES will be revised to identify the CIS that MSFD provisions will apply on, and any temporal limits will be removed;
- Environmental targets and relevant indicators will be redefined to ensure that CIS are within safe limits and not merely approaching them;
- Cephalopods, pelagics and shellfish will also be discussed (where applicable);
- Fisheries impacts on the marine environment will be discussed further.

The general approach used in revising the 2012 reporting elements is as follows:

- A current list of CIS is drafted, ensuring that cephalopods, pelagics and shellfish are also addressed (if applicable);
- Definitions of criteria and indicators, as they appear in CD477, and relevant UNEP/MAP Ecological Objectives (UNEP/MAP, 2013) were were identified;
- Indicators for CIS are explicitely reiterated;
- Semi-quantitative environmental targets for CIS were re-defined and assigned to specific indicators and criteria;
- The above were incorporated in a GES definition for CIS in Cyprus marine waters;
- Fisheries impacts on the marine environment are discussed further.

4.2 CIS in Cyprus waters

During the Initial Assessment (DFMR, 2012c), CIS were defined as those stocks contributing to more than 1% of the total landings (based on official landings statistics between 2004 to 2008), and excluding mixed categories and large pelagics. The absence of cephalopods, tunas and swordfish from 2012 reporting was noted by the technical evaluation. Therefore, landings data were re-examined in order to address this gap and to supplement the CIS list that should be monitored for the purposes of the implementation of the MSFD. The following points are relevant:

- Mixed categories included significant contributors to the catch, such as cephalopods, which – for the period between 2004-2008 – accounted for more than 10 % of the cumulative catch,
- Mixed categories also included siganids (*Siganus luridus*, *Siganus rivulatus*) that are of interest as non-indigenous species of commercial importance and accounted for 1.8 % of the cumulative catch for the same period,
- Finally, the large pelagic predators *Thunnus alalunga*, *Thunnus thynnus*, and *Xiphias gladius* accounted for 21 % of the cumulative catch during the period 2001-2008. Assessment for these fisheries is conducted by ICCAT. However, the catch data is provided by the Republic of Cyprus. Therefore, indicators developed for the implementation of the MSFD can and should be calculated for these three CIS, and independently of the ICCAT assessment,
- No shellfish groups/species constitute an estimable part of the cumulative catch, therefore they are not considered in the CIS inventory.

Based on the above, the CIS inventory drafted in 2012 during the Initial Assesment is supplemented with additional species/groups (Table 4.1), in response to the technical evaluation of the 2012 reports, to guide the planning of monitoring programmes and programmes of measures and to lay the groundwork for the revision of Phase I in 2018.

Table 4.1 Revised CIS inventory for Cyprus waters to help guide the planning of monitoring programmes and programmes of measures and to lay the groundwork for the revision of Phase I in 2018.

Commercially important stocks for Cyprus waters (D03)	
Defined in 2012	Added by the present revision
Spicara smaris *Boops boops* *Mullus surmuletus* *Mullus barbatus* *Sparisoma cretense* *Spicara maena* *Pagrus pagrus* *Pagellus erythrinus* *Pagellus acarne* *Serranus cabrilla* *Dentex dentex*	*Thunnus alalunga* *Thunnus thynnus* *Xiphias gladius* Octopoda (multiple species) Sepiida (multiple species) Teuthiida (multiple species) *Siganus luridus* *Siganus rivulatus*

4.3 Analysis of MSFD D03 criteria and indicator definitions

The definitions of the descriptor, criteria and indicator definitions for D03 (as these appear in CD477) are listed and briefly discussed below.

Descriptor 03: Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.

Level of pressure of the fishing activity (3.1)
- Fishing mortality (F) (3.1.1)
- Ratio between catch and biomass index (hereinafter 'catch/biomass ratio') (3.1.2).

Reproductive capacity of the stock (3.2)
- Spawning Stock Biomass (3.2.1)
- Biomass indices (3.2.2)

Population age and size distribution (3.3)
- Proportion of fish larger than the mean size of first sexual maturation (3.3.1)
- Mean maximum length across all species found in research vessel surveys (3.3.2)
- 95 % percentile of the fish length distribution observed in research vessel surveys (3.3.3)
- Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation (3.3.4)

The following are noted as part of the present revision:

a) The definition refers to "fish and shellfish" but it should be considered that they do include cephalopods, other molluscs, etc. (the term will be most likely updated during the forthcoming revision of CD477);

b) Commercially exploited species must be “within” safe biological limits, and not approaching them, as was apparently inadvertently stated on occasion in the Phase I reports;
c) “All” commercially exploited species must be “within” these limits, severely restricting the ability to justify any deviation from the limits in even a small number of species.

4.4 UNEP/MAP Ecological Objective 03

The 18th Meeting of the Contracting Parties to UNEP/MAP did not adopt any operational objectives, indicators, a GES definition or targets in relation to Ecological Objective 03: Commercially Exploited Fish and Shellfish (UNEP/MAP, 2013).

4.5 CIS indicators and targets for Cyprus waters

4.5.1 Indicators

The CIS indicators for Cyprus waters (Table 4.2) defined in DFMR (2012a) apply as such, but now apply to the expanded list of CIS (Table 4.1).

Table 4.2 Cyprus CIS indicators.

Code	Description	Related MSFD indicators
CY3.1	Fishing mortality (F)	3.1.1
CY3.2	Spawning Stock Biomass (SSB)	3.2.1
CY3.3	Total biomass	3.2.2
CY3.4	Biomass index	3.2.2
CY3.5	Proportion of fish larger than the mean size of first sexual maturation	3.3.1
CY3.6	95th percentile fish length observed in research vessel surveys	3.3.3
CY3.7	BOI Index (fish from research survey)	-
CY3.8	Proportion of fish larger than the mean size of first sexual maturation (target fish from research survey)	-
CY3.9	95th percentile fish length observed in research vessel surveys (target fish from research survey)	-

4.6 Targets

Table 4.3 Targets associated with the Cyprus CIS indicators. Thresholds identify fractions of a maximum value of 1.0 used in the Initial Assessment of the status of Cyprus marine waters in relation to CIS (DFMR, 2012a).

Indicator	Threshold	Limit or Target	Baseline
CY3.1	If F is below $F_{0.1}$ or F_{msy} is always 1 (no matter the divergence). If the distance between F and $F_{0.1}$ is from 1 to 33% of the $F_{0.1}$ or F_{msy} of 1	Target: $F_{0.1}$ and F_{msy} Limit: F_{max}	Reference conditions ($F_{0.1}$ or F_{msy})

	the status value is 0.8, if is above of 33% to 66% = 0.5, if is above of more than 67% = 0.2.		
CY3.2	SSB calculated from stock assessment does not have any reference value. Lower than 67% = 0.2.	Target: Stable or positive trend	Trend-based baseline
CY3.3	Total Biomass (as a proxy of SSB) has a Reference value (B_{msy}) and if it is above the B_{msy} the status value is always 1. If B is below B_{msy} by 33%, then = 0.8, if below between 33% to 66%, then 0.5, if below 66 %, then 0.2.	Limit: B_{msy}	Reference B_{msy}
CY3.4	-	Target: Stable or positive trend	Trend-based baseline
CY3.5	-	Target: Stable or positive trend	Trend-based baseline
CY3.6	-	Target: Stable or positive trend	Trend-based baseline
CY3.7	Value comprised between 15% and 50% indicates a low impact (0.8). Value below 20% indicates a moderate status of impact (0.5). Value below 10% indicate a high status of impact (0.2).	Limit	Reference conditions
CY3.8	-	Target: Stable or positive trend	Trend-based baseline
CY3.9	-	Target: Stable or positive trend	Trend-based baseline

4.7 Good Environmental Status of Cyprus with regards to CIS

Based on the comments in the technical evaluation (Milieu Ltd. Consortium, 2014), the brief revised assessment, above and the re-evaluation of CIS indicators for Cyprus waters, the definition of GES with regards to CIS in Cyprus is revised as seen in the box below.

The marine environment of Cyprus is considered to be in good environmental status if:

- All CIS are exploited below F_{msy} (or its proxy $F_{0.1}$),
- All CIS have a total biomass below B_{msy},
- All CIS have a spawning stock biomass (SSB) at a level capable of providing MSY,
- All CIS have a biomass index that exhibits a stable or positive trend,

- All CIS contain a high percentage of adult fish, as indicated by the proportion of fish larger than the mean size of first sexual maturation and the 95th percentile fish length, and these indicators exhibit stable or positive trends.

4.8 Impacts of fisheries on the marine environment of Cyprus

Commercial fisheries in Cyprus principally target a multispecies catch using bottom longlines. Gill and trammel nets and bottom longline. Selective extraction of species is limited to large pelagics and some cephalopods. Therefore the impact of commercial fishing activity is on a wide range of stocks and the idea of bycatch is perplexed since there are very few fishing activities that target a specific species. The impacts of the activity therefore cover a wide range of predominantly demersal species with the exception of the large pelagic fisheries. Small pelagic fisheries are non-existent in Cyprus.

The decrease of the trawler fleet between 2004 to 2013 as well as the decrease in the number of artisanal fishing licences in recent years was expected to have a substantial positive impact relating to fish stocks. This does not however seem to be the case since many stocks are still considered overexploited with low standing stock biomass and levels of removal surpassing the MSY. Recovery is assumed to be particularly slow. Stock assessment has been limited to few species (5) so far but it is evident that there is a need to use already collected data for many more CIS for management purposes.

The lack of recovery may be due to time lags in stock recovery as well as the associated impacts from other factors such as non-indigenous species (NIS) and climate change which affect Cyprus to a greater extent due to its proximity to the Suez Canal, a point source for NIS. NIS such as *Lagocephalus sceleratus* and *Fistularia commersonii* are invasive and clearly effect the fish stocks by voraciously feeding on juvenile and adult populations. *L. sceleratus* appears clearly to have an appetite for cephalopod species. Some NIS have become highly commercial such as the siganids which have been established and are now highly commercial. This fishery is both a problem (as it competes with the indigenous herbivore *Salpa salpa*) and a solution as it is also very abundant and highly desirable.

Fishing impacts are possiblt enhanced due to the intensity of activity carried out in a confined area. The coastal water of Cyprus deepen at a short distance from shore due to a relatively narrow continental shelf and steep slope. Consequently, the fishing fleet is predominantly coastal artisanal and confined to the near shore fishing grounds. Particular effort is carried out in the depths between 10 and 170 m due to these being the most productive grounds. To this end, overfishing is caused by the effort of too many vessels in too small an area. Even with the removal of a substantial number of fishing vessels, this may not be enough to help stocks recover.

4.9 Work needed and gaps in knowledge

The definition of GES, as revised, is more extensive than the previous one and incorporates more indicators and their targets. It has to be examined further (as will the indicators and targets) for feasibility for each CIS individually (Table 4.1). Particular issues may arise with the application of many of the indicators to cephalopods, and it is possible that alternative indicators may need to be developed.

5 Eutrophication (D05)

5.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). Descriptor 5 was one of two elements of the Initial Assessment to have been judged adequate, primarily due to long-term monitoring time-series that provide adequate data. However, the following revisions were identified as necessary for other aspects regarding Descriptor 5, Eutrophication:

- The relevant indicators and associated environmental targets focused on impacts rather than pressures, since nutrient indicators and targets (MSFD criterion 5.1) were not established. Nutrient-asociated indicators should be defined;
- While the relevant indicators and associated environmental targets were judged specific and measureable, it wasn't clear that they are achievable, mainly due to the lack of reporting on reference values. Reference values should be calculated and incorporated in the target definitions explicitely. The resulting targets will be evaluated as to whether they are achievable and realistic;
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits, and will incorporate the criteria, indicators and associated targets (in their new form);
- Impacts will be re-stated specifically addressing riverine inputs (or, more precisely, the lack thereof).

The general approach used in revising the 2012 reporting elements is as follows:

- Definitions of criteria and indicators, as they appear in CD477, and UNEP/MAP Ecological Objectives (UNEP/MAP, 2013) were listed and briefly discussed, as needed;
- Cyprus indicators were re-defined, and in the case of nutrients were established, based in part on the common eutrophication indicators agreed upon in the third MED CAM meeting (MED CAM, 2014a);
- The above were incorporated in a GES definition for eutrophication in Cyprus waters;
- Impacts were briefly discussed to address the role (or lack thereof) of riverine inputs.

5.2 Analysis of MSFD D05, criteria and indicator definitions

In this section, the definitions of the descriptor, criteria and indicator definitions for Descriptor 5 (as these appear in CD477) are discussed in view of the development of indicators for Cyprus and the recommendations of the.

Descriptor 05: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters

Nutrient levels (5.1)
- Nutrients concentration in the water column (5.1.1)
- Nutrient ratios (silica, nitrogen and phosphorus), where appropriate (5.1.2)

Direct effects of nutrient enrichment (5.2)
- Chlorophyll concentration in the water column (5.2.1)
- Water transparency related to increase in suspended algae, where relevant (5.2.2)
- Abundance of opportunistic macroalgae (5.2.3)

Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacteria) caused by human activities (5.2.4)

Indirect effects of nutrient enrichment (5.3)

Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency (5.3.1)

Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned (5.3.2).

Criterion 5.1 and its indicators quantify nutrient levels as absolute values (5.1.1) and as ratios to each other (5.1.2). While they represent characteristics (state) of the marine environment, they also the only elements that approximate pressure in this descriptor (perhaps with the exception of dissolved oxygen, 5.3.2), since the other two criteria attempt to quantify impacts. It should be noted that whether or not elevated levels of nutrients are observed, the monitoring authority cannot directly demonstrate the presence or absence of a pressure using this criterion and indicators. In a sense, CD477 failed to propose appropriate pressure indicators.

5.3 UNEP/MAP Ecological Objective 05

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 5.1), in relation to Ecological Objective 5: Human-induced eutrophication (UNEP/MAP, 2013), with the intention that they will be incorporated in the upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a).

Table 5.1 Elements of eutrophication adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
5.1 Human introduction of nutrients in the marine environment is not conducive to eutrophication	5.1.1 Concentration of key nutrients in the water column	Concentrations of nutrients in the euphotic layer are in line with prevailing physiographic, geographic and climate conditions	<u>State</u> 1. Reference nutrients concentrations according to the local hydrological, chemical and morphological characteristics of the un-impacted marine region 2. Decreasing trend of nutrients concentrations in water column of human impacted areas, statistically defined <u>Pressure</u> 1. Reduction of BOD emissions from land

			based sources 2. Reduction of nutrients emissions from land based sources
	5.1.2. Nutrient ratios (silica, nitrogen and phosphorus) where appropriate	Natural ratios of nutrients are kept	
5.2 Direct effects of nutrient over-enrichment are prevented	5.2.1 Chlorophyll-a concentration in the water column	Natural levels of algal biomass in line with prevailing physiographic, geographic and weather conditions[18]	State 1. Chl-a concentrations in high-risk areas below thresholds 2. Decreasing trend in chl-a
	5.2.2 Water transparency where relevant	Water transparency in line with prevailing physiographic, geographic and climate conditions.	State 1. Index of turbidity behind threshold in high risk areas 2. Increasing trend of transparency in areas impacted by human activities
5.3 Indirect effects of nutrient over-enrichment are prevented	5.3.1 Dissolved oxygen near the bottom, i.e. changes due to increased organic matter decomposition, and size of the area concerned[20]	Bottom water fully oxygenated in line with prevailing physiographic, geographic and climate conditions	State 1. Dissolved oxygen concentrations in high-risk areas above local threshold[21] 2. Increasing trend in dissolved oxygen concentrations in areas impacted by human activities

5.4 Eutrophication indicators and targets for Cyprus waters

5.4.1 Indicators

The Cyprus eutrophication indicators (Table 5.2) were determined in agreement with other Mediterranean EU member-states (MED CAM, 2014b). They address in whole or in part the MSFD indicators defined in CD477, as well as the indicators of Ecological Objective 05 adopted by the Contracting Parties of UNEP/MAP (2013).

During the 2012 reporting phase, nutrient-related indicators (5.1) were not established and focus was placed on direct and indirect effects of eutrophication (5.2 and 5.3). The “effects” indicators are listed below and are preceeded by physicochemical and nutrient-related indicators as agreed with other Mediterranean EU member-states (MED CAM, 2014a, 2014b). It is noted that several of these indicators have already been established for the biodiversity monitoring programmes.

Table 5.2 Cyprus eutrophication indicators and corresponding MSFD eutrophication criteria/indicators and UNEP/MAP indicators they address.

Cyprus indicator	Description	Related Indicators	
		MSFD	UNEP/MAP
CY0144.1.1	Water column temperature (^{o}C)	1.6.3	7.1.1
CY0144.1.2	Water column salinity (g/kg, TEOS-10)	1.6.3	7.1.1
CY0144.1.3	Water column pH	1.6.3	7.1.1
CY05.1	Water column total N concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.2	Water column NO_3^- concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.3	Water column NO_2^- concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.4	Water column NH_4^+ concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.5	Water column total P concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.6	Water column PO_4^{3-} concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.7	Water column Si_4^{4-} concentration (μmol L^{-1})	5.1.1	5.1.1
CY05.8	Water column N:P	5.1.2	5.1.2
CY05.9	Water column N:Si	5.1.2	5.1.2
CY05.10	Water column Chlorophyll *a* concentration (μg L^{-1})	5.2.1	5.2.1
CY05.11	Water column Chlorophyll *a* fluorescence (FU)	5.2.1	5.2.1
CY0144.2.1	Phytoplankton abundance (individuals L^{-1})	1.2.1	-
CY0144.2.6	Phytoplankton biomass (g L^{-1})	1.2.1	-
CY05.12	Water transparency depth (Secchi disc) (m)	5.2.2	5.2.2
CY05.13	Water column photosynthetically available radiation (PAR) depth at 1 % of surface value (m)	5.2.2	5.2.2
CY05.14	Turbidity (NTU)	5.2.2	5.2.2
CY0146.1.10	Abundance of opportunistic macroalgae (ESG IIA) (% areal coverage)	5.2.3	-
CY0146.1.11	Biomass of opportunistic macroalgae (g m^{-2})	5.2.3	-
CY0146.1.12	EEI-c (Macroalgae)	5.2.4	-
CY0146.1.6	Abundance of perennial macroalgae (ESG IA) (% areal coverage)	5.3.1	-
CY0146.1.7	Biomass of perennial macroalgae (g m^{-2})	5.3.1	-
CY0146.3.4	*P. oceanica* abundance (shoots m^{-2})	5.3.1	-
CY0146.3.5	*P. oceanica* biomass (dry leaf mass, g m^{-2})	5.3.1	-
CY0146.3.6	PREI (*Posidonia*)	5.3.1	-
CY05.15	Water column dissolved oxygen (mg L^{-1})	5.3.2	5.3.1

CY05.16	Water column dissolved oxygen (% saturation)		

5.4.2 Targets

Targets (along with indicators) were established for most of the indicators established during the 2012 reporting period (DFMR, 2012b) and are shown in Table 5.3 (it should be noted that values for these targets can be explicitely calculated based on the analysis reported in 2012). Targets for the remaining indicators will be set in 2018.

Targets and reference values for nutrients have not been defined yet. The extremely low concentrations commonly lead to a significant fraction of samples yielding values below the detection limit, thus rendering reference values and especially isotopic ratios unusable and perhaps misleading. Targets will be determined in time for the next revision (2017-2018) in light of all the new data that will be collected.

Table 5.3 Targets for Cyprus eutrophication indicators.

Cyprus indicator ID and description	**Target**
CY05.10 Water column Chlorophyll *a* concentration ($\mu g\ L^{-1}$)	Divergence $\leq$ 25 % from reference conditions
CY05.11 Water column Chlorophyll *a* fluorescence (FU)	
CY05.12 Water transparency depth (Secchi disc) (m)	
CY0146.1.6 Abundance of perennial macroalgae (ESG IA) (% areal coverage)	Divergence $\leq$ 50 % from reference conditions
CY0146.1.7 Biomass of perennial macroalgae ($g\ m^{-2}$)	
CY0146.1.10 Abundance of opportunistic macroalgae (ESG IIA) (% areal coverage)	
CY0146.1.11 Biomass of opportunistic macroalgae ($g\ m^{-2}$)	
CY0146.1.12 EEI-c (Macroalgae)	Divergence $\leq$ 25 % from reference conditions
CY0146.3.6 PREI (*Posidonia*)	Divergence $\leq$ 25 % from reference conditions
CY05.15 Water column dissolved oxygen ($mg\ L^{-1}$)	Divergence $\leq$ 25 % from reference conditions

5.5 Good Environmental Status of Cyprus with regards to marine litter

Based on the brief revised assessment and the redefinition of eutrophication indicators for Cyprus waters, a revised description of GES with regards to eutrophication is developed.

The marine environment of Cyprus is considered to be in good environmental status if:

- Human-induced eutrophication is minimized and/or eliminated,
- Physicochemical indicators that may be adversely affected by eutrophication, especially water transparency, nutrient concentrations and ratios, and oxygen concentrations, are in line with prevailing physiographic, geographic and climate conditions throughout the water column,
- Phytoplankton abundance and biomass and/or Chlorophyll *a* concentration are in line with prevailing physiographic, geographic and climate conditions,

- Macroalgal populations are at abundance and density levels that are in line with prevailing physiographic, geographic and climate conditions,
- Perennial macroalgae are not adversely affected by eutrophication-related effects, such as low water transparency, and in good proportion to opportunistic macroalgae, as indicated by EEI-c values,
- *P. oceanica* populations are at abundance and density levels that are in line with prevailing physiographic, geographic and climate conditions, are not adversely affected by eutrophication-related effects, such as low water transparency, and in good condition, as indicated by PREI values.

5.6 Impacts

The technical evaluation required the discussion of impacts with regards to riverine inputs. It is noted that riverine inputs were extensively discussed in section 1.3 (Spatial and temporal distribution of nutrients (DIN, TN, DIP, TP, TOC) and oxygen) of Part I (Characteristics) the Initial Assessment (DFMR, 2012c). Furthermore, all potential sources of eutrophication and their potential impacts were discussed in section 6 (Nutrient and organic matter enrichment) of Part II (Pressures and Impacts) of the Initial Assessment).

5.7 Work needed and gaps in knowledge

The issue of aggregation of values from different sampling stations in the case of most indicators must be investigated and addressed, preferably before the submission of the monitoring programmes, in part depending on the adoption of the recommendations to the EC on this topic (Prins et al., 2014). It is unknown whether there is official guidance at this point regarding aggregation within or between assessment areas, sub-regions and regional seas.

6 Hydrographical Conditions (07)

6.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The following revisions were identified as necessary for Descriptor 07, hydrographical conditions:

- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477), including characteristics and impacts;
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing the significant knowledge gaps will be specified.

The general approach used in revising the 2012 reporting elements is as follows:

- Any available information on hydrographic conditions in Cyprus marine waters was briefly compiled;
- Definitions of descriptors, criteria and indicators for Descriptor 07, as they appear in CD477, and relevant UNEP/MAP Ecological Objectives (UNEP/MAP, 2013) were briefly reviewed;
- Hydrographical conditions indicators were developed for Cyprus waters;
- The above were incorporated in a GES definition for hydrographical conditions in Cyprus waters;
- The pending work towards the acquisition of missing data and information, primarily in relation to environmental targets, and the completion of the revision, was identified and elaborated.

6.2 Analysis of activities/infrastructure, pressures and impacts

The main source of information regarding hydrographical conditions and how they are impacted by human activities is the discussion and calculations conducted during the Initial Assessment of the marine environment of Cyprus (DFMR, 2012c) and GES determination (DFMR, 2012a), namely:

- Initial Assessment, Part II – Pressures and Impacts:
  - Chapter 1, Physical loss,
  - Chapter 2, Physical damage,
  - Chapter 4, Interference with hydrographical processes,
- Determination of GES report:
  - Chapter 7, Permanent alteration of hydrographical conditions.

The activities (and corresponding infrastructure) contributing to permanent hydrographical alterations in Cyprus waters are summarized in

Table 6.1. The pressures they exert and the areal coverage these pressures affect are shown in Table 6.2.

Table 6.1 Activities, infrastructure and their status (as of 2012) that impact hydrographical processes in Cyprus marine waters. Activity categories were selected based on the typology used in 2012 reporting (EC, 2012). Infrastructure and status was reported in 2012 (DFMR, 2012a, 2012c).

Activities	**Infrastructure**	**Status in 2012**
Man-made structures: port operations	Harbours	3 major, 4 minor
Recreation: Tourism and recreation including yachting	Marinas	3 in operation
Extraction of living resources: fisheries	Fishing shelters	20
Man-made structures: Land claim, coastal defence	Breakwaters	136
	Groynes	67
Energy production – other	Power plants	3
Extraction of non-living resources: Desalination/water abstraction	Desalination plants	2 permanent, 1 temporary
Man-made structures: placement and operation of offshore structures (other than for energy production)	Offshore gas-and-oil-extraction platforms	1

Table 6.2 Pressures and impacts as they relate to infrastructure that affects hydrographical processes in Cyprus marine waters. Pressures categories were selected based on the typology used in 2012 reporting (EC, 2012). Infrastructure and areas of impact were reported in 2012 (DFMR, 2012a, 2012c). Percentages of impacted length of coastline and areas were calculated based on a Cyprus coastline and coastal water area (within 1 nm from shore) under the control of the Republic of 480 km and 455 km^2, respectively.

Pressures	**Infrastructure**	**Occupied coastline length (km, % of total coastaline)**	**Occupied area (km^2, % of coastal waters)**
Physical loss: sealing and siltation	Breakwaters, groynes, revetment, coastal walls	20.5, 4.27%	1.905, 0.42%
	Harbours, marinas, fishing shelters	18.1, 3.77%	1.143, 0.25%
	Offshore platforms	-	1.3, (not appl.)
Interference with hydrographical processes: Changes in thermal regime	Power plants	-	0.44, 0.10%
Interference with hydrographical processes: Changes in salinity regime	Desalination plants	-	0.039, 0.009%
	Total	38.6, 8.04%	3.527, 0.76%

6.3 Analysis of MSFD D07, criteria and indicator definitions

The definitions of D07, its criteria and indicators (as these appear in CD477) are as follows:

Descriptor 07: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.

Spatial characterisation of permanent alterations (7.1)
Extent of area affected by permanent alterations (7.1.1)
Impact of permanent hydrographical changes (7.2)
Spatial extent of habitats affected by the permanent alteration (7.2.1)
Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions (7.2.2)

The MSFD hydrographical changes indicators focus on the area "affected" by "permanent alterations. The area affected by a permanent alteration may shift seasonally or even in shorter time scales due to dynamic physical conditions. Therefore, it can only be determined on a case-by-case basis, most likely after a long-term study. It is more likely that a proxy for the affected area, probably based on the occupied area of the structure, will be used initially.

Moreover, the term "permanent alteration" presents an even bigger challenge in the case of discharges that, in addition to the aforementioned shifting physical conditions, are also subject to fluctuations in the discharged volumes. They are only truly permanent with respect to fixed points of discharge.

6.4 UNEP/MAP Ecological Objectives 07 and 08

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 5.1 and Table 6.4), in relation to Ecological Objectives 07 and 08, respectively (UNEP/MAP, 2013), with the intention that they will be incorporated in the upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a). Ecological Objective 07 states that alteration of hydrographic conditions does not adversely affect coastal and marine ecosystems, while 08 states that the natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved.

Table 6.3 Elements of Ecological Objective 07 adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
Alterations due to permanent constructions on the coast and watersheds, marine installations and seafloor anchored structures are minimized (7.2)	Impact on the circulation caused by the presence of structures (7.2.1)	With new structures in place, near shore wave- and current patterns maintain as natural as possible.	Marine and shore based new structures planned, constructed and operated in a way to maintain the natural wave and current pattern as much as possible
	Location and extent of the habitats impacted directly by	Negative impacts due to new structure are minimal with no	Planning of new structures takes into account all possible

	the alterations and/or the circulation changes induced by them: footprints of impacting structures (7.2.2)	influence on the larger scale coastal and marine system	mitigation measures in order to minimize the impact on coastal and marine ecosystem and its services integrity and cultural/historic assets. Where possible, promote ecosystem health.
Impacts of alterations due to changes in freshwater flow from watersheds, seawater inundation and coastal freatic intrusion, brine input from desalination plants and seawater intake and outlet are minimized (7.3)	Changes in key species distribution due to the effects of seawater intake and outlet (7.3.3)	Water circulation in coastal and marine habitats, and changes in the levels of salinity and temperature are within thresholds, to maintain natural/ecological processes	Site specific tolerable limits of key species in immediate proximity of seawater intake and outlet structures are considered while planning, constructing and operating such infrastructure

Table 6.4 Elements of Ecological Objective 08 adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
The natural dynamic nature of coastlines is respected and coastal areas are in good condition (8.1)	Areal extent of coastal erosion and coastline instability (8.1.1)	Coastal resilience maintained and improved; and coastal uses made adaptable to coastal erosion	Impacts of coastal erosion caused by man made factors anticipated and prevented through coastal erosion management allowing for natural fluctuation of the coast and minimizing coastal erosion risk
	Changes in sediment dynamics along the coastline (8.1.2)	Long term sediment dynamics is within natural patterns	Disturbance in sediment inflows reduced through improved Integrated River Basin Management and coastal sand management practices
	Length of coastline subject to physical disturbance due to the influence of manmade	Physical disturbance to sandy coastal areas induced by human activities should be minimized	Negative impacts of human activities on sandy coastal areas are minimized through appropriate

	structures (8.1.4)		management measures

6.5 Hydrographical indicators and targets for Cyprus waters

Based on the indicator definitions listed and described in the previous section, a number of Cyprus hydrographical indicators can be established to guide the planning of monitoring programmes and programmes of measures and lay the groundwork for the revision of Phase I, (a)-(c) in 2018.

6.5.1 Indicators

The Cyprus hydrographical indicators (Table 6.5) address in whole or in part the hydrographical MSFD indicators defined in CD477, as well as the indicators of Ecological Objectives 7 and 8 adopted by the Contracting Parties of UNEP/MAP (2013).

Table 6.5 Cyprus hydrographical indicators and corresponding MSFD criteria/indicators and UNEP/MAP indicators they address.

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY07.1	Marine area occupied by man-made structures (km^2)	7.1.1	-
CY07.2	Length of coastline occupied by man-made structures (km)	7.1.1	8.1.4
CY07.3	Area of habitat affected by man-made structures and/or discharges (km^2)	7.2.1	7.2.2, 8.1.1
CY07.4.1	Gradient in water column temperature (CY0144.1.1) with distance away from man-made structures and/or discharges ($^oC\ m^{-1}$)	7.2.2	7.2.2
CY07.4.2	Gradient in water column salinity (CY0144.1.2) with distance away from man-made structures and/or discharges ($g\ kg^{-1}\ m^{-1}$)	7.2.2	7.2.2
CY07.4.3	Gradient in water column dissolved oxygen (CY05.16) with distance away from man-made structures and/or discharges (% saturation m^{-1})	7.2.2	7.2.2
CY07.4.4	Gradient in water column turbidity (CY05.14) with distance away from man-made structures and/or discharges (NTU m^{-1})	7.2.2	7.2.2
CY07.4.5	Gradient in pore water salinity with distance away from man-made structures and/or discharges ($g\ kg^{-1}\ m^{-1}$)	7.2.2	7.2.2
CY07.4.6	Gradient in EEI-c (CY0146.1.12) with distance away from man-made structures and/or discharges (m^{-1})	7.2.2	7.3.3
CY07.4.7	Gradient in BENTIX (CY0146.2.6) with distance away from man-made structures and/or discharges (m^{-1})	7.2.2	7.3.3
CY07.4.8	Gradient in PREI (CY0146.3.6) with distance away from man-made structures and/or discharges (m^{-1})	7.2.2	7.3.3

Cyprus hydrographical indicators CY07.1 and CY07.2 quantify the section of the marine environment occupied by man-made structures from topographic data. The approaches for the calculation of these indicators are shown in Table 6.6. These indicators can serve as precautionary minimum estimates of the area/length affected by structures and discharges. All three indicators are evaluated at the level of the assessment area, i.e., the marine waters of Cyprus as a whole.

Table 6.6 Calculation of indicators CY07.1 and CY07.2 for each type of infrastructure, as described in the Initial Assessment (DFMR, 2012c).

Indicator	**Infrastructure**	**Calculation**
CY07.1 Marine area occupied by man-made structures	Breakwaters, groynes, revetment, coastal walls	Area covered by structures. In addition: ○ the area between breakwaters and the coastline ○ the area adjacent to groynes, with a coastline length equal to that of the groyne length
	Harbours, marinas, fishing shelters	Sum of area covered by structures themselves as well as the area enclosed by them
CY07.2 Length of coastline occupied by man-made structures	Harbours, marinas, fishing shelters, breakwaters, groynes, revetment, coastal walls	Along-shore distance covered by structures

Cyprus hydrographical indicators CY07.3 and CY07.4.1-CY07.4.8 assess the impact of the presence of permanent structures and discharges on physicochemical parameters, habitats, functional/species groups and species. Changes in selected characteristics at and away from structures and discharge outfalls (CY07.4.1-CY07.4.8) will allow the calculation of the area affected by these (CY07.3) when measured in an appropriate spatial network. These indicators should be assessed at selected locations that are considered representative of the assessment area, i.e., the marine waters of Cyprus as a whole.

6.5.2 Targets

Targets (along with indicators) for were not established during the Phase I implementation of the MSFD in 2012. Targets will be set in 2018, after experience is obtained with the proposed Cyprus hydrographical indicators which will then be formally established.

6.6 Good Environmental Status of Cyprus with regards to hydrographical conditions

Based on the brief revised assessment and the development of hydrographical indicators for Cyprus waters, a preliminary description of GES can be developed, as seen in the box below. This definition is expected to be amended as the contents of this report are finalized.

The marine environment of Cyprus is considered to be in good environmental status if:
- Man-made permanent structures and thermal and saline discharges do not adversely affect marine ecosystems,

- Changes in habitats, functional/species groups, species, and physicochemical parameters due to such structures and discharges are limited to areas directly occupied by them.

6.7 Work needed and gaps in knowledge

The issue of aggregation of values from different sampling stations in the case of most indicators must be investigated and addressed, preferably before the submission of the monitoring programmes, in part depending on the adoption of the recommendations to the EC on this topic (Prins et al., 2014). It is unknown whether there is official guidance at this point regarding aggregation within or between assessment areas, sub-regions and regional seas.

The Cyprus hydrographical indicators do not address hydrographical changes themselves (e.g., changes in circulation) or siltation. Noteably, none of the MSFD indicators do so either. Instead, the existing indicators do so indirectly. Therefore, due consideration must be given for the future development and implementation of circulation indicators and a siltation indicator, e.g., as sedimentation rate, in areas of interest.

MSFD Descriptor 07 seems to address direct human activities. Climate change may also bring about hydrographical changes but they do not seem to fall under the purview of this descriptor. The 18th Meeting of the Contracting Parties to UNEP/MAP adopted Operational Objective 7.1 and related indicators, shown in Table 6.7. They should be given due consideration for future revisions of Phase I MSFD aspects.

Table 6.7 Elements of Operational Objective 7.1 adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
Impacts to the marine and coastal ecosystem induced by climate variability and/or climate change are minimized (7.1)	Large scale changes in circulation patterns, temperature, pH, and salinity distribution (7.1.1)	Ecosystems are resilient enough to adapt to climate change	Anthropogenic impacts which may alter ecosystems' adaptive capacity are reduced

7 Contaminants (D08)

7.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The following revisions were identified as necessary for Descriptor 08, Contaminants:

- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing any knowledge gaps will be specified.

The general approach used in revising the 2012 reporting elements is as follows:

- Definitions of criteria and indicators, as they appear in CD477, were briefly evaluated;
- Cyprus contaminants indicators were developed based on the common indicators described in the second MED CAM (2014b);
- The above were incorporated in a GES definition for contaminants in Cyprus waters;
- The pending work towards the acquisition of missing data and information, primarily in relation to environmental targets for contaminants and the completion of the revision, was identified and elaborated.

7.2 MSFD D08, criteria and indicator definitions

The definitions of the descriptor, criteria and indicator definitions for Descriptor 08 (as these appear in CD477) are as follows:

Concentrations of contaminants are at levels not giving rise to pollution effects Concentration of contaminants (8.1) Concentration of the contaminants mentioned above, measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC (8.1.1) Effects of contaminants (8.2) Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored (8.2.1) Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution (8.2.2)

7.3 UNEP/MAP Ecological Objective 09

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 5.1), in relation to Ecological Objective 09: Contaminants (UNEP/MAP, 2013), with the intention that they will be incorporated in the

upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a).

Table 7.1 Elements of contaminants adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
Concentration of priority contaminants is kept within acceptable limits and does not increase (9.1)	Concentration of key harmful contaminants[24] in biota, sediment or water (9.1.1)	Level of pollution is below a determined threshold defined for the area and species	State Concentrations of specific contaminants below EACs or below reference concentrations[25] No deterioration trend in contaminants concentrations in sediment and biota from human impacted areas, statistically defined. Pressure Reduction of contaminants emissions from land based sources
Effects of released contaminants are minimized (9.2)	Level of pollution effects of key contaminants where a cause and effect relationship has been established (9.2.1)	Concentrations of contaminants are not giving rise to acute pollution events	State Contaminants effects below threshold[27] Decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and off-shore activities.
Acute pollution events are prevented and their impacts are minimized (9.3)	Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution (9.3.1)	Occurrence of acute pollution events are reduced to the minimum.	Pressure 1. Decreasing trend in the occurrences of acute pollution events

7.3.1 Common indicators agreed during CAM

The following common contaminant indicators were agreed to by the Mediterranean EU member-states during the third CAM (MED CAM, 2014a), in connection with specific MSFD indicators:

- 8.1.1: Trace metals (Pb, Cd, Hg), PCB, aromatics, (PAH, TBT) in sediments and biota
- 8.2.2: number of spills, illegal discharges, amount of substances released

7.4 Contaminant indicators and targets for Cyprus waters

7.4.1 Indicators

During the 2012 reporting phase, contaminant indicators were briefly mentioned but not elaborated. Based on the agreement with other Mediterranean EU member-states during CAM (MED CAM, 2014a), several specific Cyprus contaminant indicators have been developed (Table 7.2).

Table 7.2 Cyprus contaminant indicators and corresponding MSFD and UNEP/MAP indicators they address. Indicators for specific polychlorinated biphenyls (PCB), polyaromatic hydrocarbons (PAH), and tributyltin (TBT) compounds can be further elaborated (hence the parentheses in indicator definitions). Similarly, indicators for specific contaminants spilled or illegally discharged can be further elaborated, as needed.

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY08.1	Concentration of Pb in sediment (mg kg^{-1})	8.1.1	9.1.1
CY08.2	Concentration of Cd in sediment (mg kg^{-1})		
CY08.3	Concentration of Hg in sediment (mg kg^{-1})		
CY08.4	Concentration of (PCB) in sediment (mg kg^{-1})		
CY08.5	Concentration of (PAH) in sediment (mg kg^{-1})		
CY08.6	Concentration of (TBT) in sediment (mg kg^{-1})		
CY08.7	.1 Concentration of Pb in *Mullus* sp. (mg kg^{-1}) .2 Concentration of Pb in *Boops boops* sp. (mg kg^{-1})		
CY08.8	.1 Concentration of Cd in *Mullus* sp. (mg kg^{-1}) .2 Concentration of Cd in *Boops boops* sp. (mg kg^{-1})		
CY08.9	.1 Concentration of Hg in *Mullus* sp. (mg kg^{-1}) .2 Concentration of Hg in *Boops boops* sp. (mg kg^{-1})		
CY08.10	.1 Concentration of (PCB) in *Mullus* sp. (mg kg^{-1}) .2 Concentration of (PCB) in *Boops boops* sp. (mg kg^{-1})		
CY08.11	.1 Concentration of (PAH) in *Mullus* sp. (mg kg^{-1}) .2 Concentration of (PAH) in *Boops boops* sp. (mg kg^{-1})		
CY08.12	.1 Concentration of (TBT) in *Mullus* sp. (mg kg^{-1}) .2 Concentration of (TBT) in *Boops boops* sp. (mg kg^{-1})		
CY08.13	Number of spills and illegal discharges (y^{-1})	8.2.2	9.3.1

7.4.2 Targets

Targets (along with indicators) were stated for “heavy metals” during the 2012 reporting period (DFMR, 2012b) without specifying which metals they refer to. Targets corresponding

to the new relevant indicators are shown in Table 7.3, while targets for the remaining indicators will be set in 2018.

Table 7.3 Targets for Cyprus contaminants indicators.

Cyprus indicator ID and description	**Target**
CY08.1 Concentration of Pb in sediment (mg kg^{-1})	Divergence $\leq$ 25 % from reference conditions
CY08.2 Concentration of Cd in sediment (mg kg^{-1})	
CY08.3 Concentration of Hg in sediment (mg kg^{-1})	
CY08.7.1 Concentration of Pb in *Mullus* sp. (mg kg^{-1}) CY08.7.2 Concentration of Pb in *Boops boops* sp. (mg kg^{-1})	
CY08.8.1 Concentration of Cd in *Mullus* sp. (mg kg^{-1}) CY08.8.2 Concentration of Cd in *Boops boops* sp. (mg kg^{-1})	
CY08.9.1 Concentration of Hg in *Mullus* sp. (mg kg^{-1}) CY08.9.2 Concentration of Hg in *Boops boops* sp. (mg kg^{-1})	

7.5 Good Environmental Status of Cyprus with regards to contaminants

Based on the brief revised assessment and the development of contaminant indicators for Cyprus waters, the following description of GES with regards to contaminants was developed:

The marine environment of Cyprus is considered to be in good environmental status if:

- The concentrations of contaminants in sediments and biota do not exceed levels for annual averages and/or maximum allowable concentrations that are either regulatory (legally defined) or, if not, based on reference values for Cyprus marine sediments and biota,
- The concentratrions of contaminants in sediments and biota do not result in acute pollution or contamination events and their subsequent effects,
- The number of spills and illegal discharges is minimized.

7.6 Work needed and gaps in knowledge

The issue of aggregation of values from different sampling stations in the case of most indicators must be investigated and addressed, preferably before the submission of the monitoring programmes, in part depending on the adoption of the recommendations to the EC on this topic (Prins et al., 2014). It is unknown whether there is official guidance at this point regarding aggregation within or between assessment areas, sub-regions and regional seas.

8 Contaminants in seafood (D09)

8.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The following revisions were identified as necessary for Descriptor 09, Contaminants in seafood:

- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing any knowledge gaps will be specified.

The general approach used in revising the 2012 reporting elements is as follows:

- Definitions of criteria and indicators, as they appear in CD477, were briefly evaluated;
- Cyprus contaminants indicators were developed based on the common indicators described in the second MED CAM (2014b);
- The above were incorporated in a GES definition for contaminants in seafood in Cyprus waters;
- The pending work towards the acquisition of missing data and information, primarily in relation to environmental targets for contaminants and the completion of the revision, was identified and elaborated.

8.2 MSFD D09, criteria and indicator definitions

The definitions of the descriptor, criteria and indicator definitions for Descriptor 08 (as these appear in CD477) are as follows:

Descriptor 09: Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards Levels, number and frequency of contaminants (9.1) Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels (9.1.1) Frequency of regulatory levels being exceeded (9.1.2)

8.3 UNEP/MAP Ecological Objective 09

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 8.1), in relation to Ecological Objective 09: Contaminants (UNEP/MAP, 2013), with the intention that they will be incorporated in the upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a).

Table 8.1 Elements of indicators relating to contaminants in seafood adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	Indicator	GES	Proposed Targets

Levels of known harmful contaminants in major types of seafood do not exceed established standards (9.4)	Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (9.4.1)	Concentrations of contaminants are within the regulatory limits for consumption by humans	State Concentrations of contaminants are within the regulatory limits set by legislation
	Frequency that regulatory levels of contaminants are exceeded (9.4.2)	No regulatory levels of contaminants in seafood are exceeded	State Decreasing trend in the frequency of cases of seafood samples above regulatory limits for contaminants
Water quality in bathing waters and other recreational areas does not undermine human health (9.5)	Percentage of intestinal enterococci concentration measurements within established standards (9.5.1)	Concentrations of intestinal enterococci are within established standards	State Increasing trend in the percentage of intestinal enterococci concentration measurements within established standards

8.4 Contaminant-in-seafood indicators and targets for Cyprus waters

8.4.1 Indicators

During the 2012 reporting phase, contaminant indicators in seafood were briefly mentioned but not elaborated. Based on the agreement with other Mediterranean EU member-states during CAM (MED CAM, 2014a) for common indicators, several specific Cyprus indicators have been developed (Table 8.2). In addition to the common indicators, Hg content in large pelagics was also included.

Table 8.2 Cyprus contaminant-in-seafood indicators and corresponding MSFD and UNEP/MAP indicators they address. Indicators for several contaminants in biota are already defined for the contaminants monitoring programme (Table 7.2). Indicators for specific polychlorinated biphenyls (PCB), polyaromatic hydrocarbons (PAH), and tributyltin (TBT) compounds can be further elaborated (hence the parentheses in indicator definitions).

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY08.7	.1 Concentration of Pb in *Mullus* sp. (mg kg^{-1}) .2 Concentration of Pb in *Boops boops* (mg kg^{-1})	9.1.1	9.4.1
CY08.8	.1 Concentration of Cd in *Mullus* sp. (mg kg^{-1}) .2 Concentration of Cd in *Boops boops* (mg kg^{-1})		
CY08.9	.1 Concentration of Hg in *Mullus* sp. (mg kg^{-1}) .2 Concentration of Hg in *Boops boops* (mg kg^{-1})		

	.3 Concentration of Hg in *Thunnus alalunga* (mg kg^{-1}) .4 Concentration of Hg in *Thunnus thynnus* (mg kg^{-1}) .5 Concentration of Hg in *Xiphias gladius* (mg kg^{-1})		
CY08.10	.1 Concentration of (PCB) in *Mullus* sp. (mg kg^{-1}) .2 Concentration of (PCB) in *Boops boops* (mg kg^{-1})		
CY08.11	.1 Concentration of (PAH) in *Mullus* sp. (mg kg^{-1}) .2 Concentration of (PAH) in *Boops boops* (mg kg^{-1})		
CY08.12	.1 Concentration of (TBT) in *Mullus* sp. (mg kg^{-1}) .2 Concentration of (TBT) in *Boops boops* (mg kg^{-1})		
CY09.1	.1 Concentration of ^{137}Cs in *Mullus* sp. (Bq kg^{-1}) .2 Concentration of ^{137}Cs in *Boops boops* (Bq kg^{-1})		
CY09.2	.1 Concentration of ^{40}K in *Mullus* sp. (Bq kg^{-1}) .2 Concentration of ^{40}K in *Boops boops* (Bq kg^{-1})		

8.4.2 Targets

Targets (along with indicators) were stated for “concentrations in fish” during the 2012 reporting period (DFMR, 2012b) without specifying which contaminants they refer to. Targets corresponding to the new relevant indicators are shown in Table 8.3, while targets for the remaining indicators will be set in 2018.

Table 8.3 Targets for Cyprus contaminants indicators.

Cyprus indicator ID and description	**Target**
CY08.1 Concentration of Pb in sediment (mg kg^{-1})	Divergence $\leq$ 25 % from reference conditions
CY08.2 Concentration of Cd in sediment (mg kg^{-1})	
CY08.3 Concentration of Hg in sediment (mg kg^{-1})	
CY08.7.1 Concentration of Pb in *Mullus* sp. (mg kg^{-1}) CY08.7.2 Concentration of Pb in *Boops boops* sp. (mg kg^{-1})	
CY08.8.1 Concentration of Cd in *Mullus* sp. (mg kg^{-1}) CY08.8.2 Concentration of Cd in *Boops boops* sp. (mg kg^{-1})	
CY08.9.1 Concentration of Hg in *Mullus* sp. (mg kg^{-1}) CY08.9.2 Concentration of Hg in *Boops boops* sp. (mg kg^{-1}) CY08.9.3 Concentration of Hg in *Thunnus alalunga* (mg kg^{-1}) CY08.9.4 Concentration of Hg in *Thunnus thynnus* (mg kg^{-1}) CY08.9.5 Concentration of Hg in *Xiphias gladius* (mg kg^{-1})	

8.5 Good Environmental Status of Cyprus with regards to contaminants

Based on the brief revised assessment and the development of contaminant-in-seafood indicators for Cyprus waters, the following description of GES with regards to contaminants was developed:

The marine environment of Cyprus is considered to be in good environmental status if:

- The concentrations of contaminants in seafood do not exceed levels for annual averages and/or maximum allowable concentrations that are regulatory (legally defined) or, if not, based on reference values for Cyprus seafood.

8.6 Work needed and gaps in knowledge

The issue of aggregation of values from different sampling stations in the case of most indicators must be investigated and addressed, preferably before the submission of the monitoring programmes, in part depending on the adoption of the recommendations to the EC on this topic (Prins et al., 2014). It is unknown whether there is official guidance at this point regarding aggregation within or between assessment areas, sub-regions and regional seas.

9 Marine Litter (D10)

9.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The following revisions were identified as necessary for Descriptor 10, marine litter:

- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing the significant knowledge gaps will be specified.

The general approach used in revising the 2012 reporting elements is as follows:

- Any available information on marine litter in Cyprus marine waters was briefly compiled;
- Definitions of criteria and indicators, as they appear in CD477, and UNEP/MAP Ecological Objectives (UNEP/MAP, 2013) were analyzed;
- Cyprus marine litter indicators were developed based on the common indicators for beach litter, seabed litter, and litter and biota described in the second MED CAM meeting (MED CAM, 2014b), and the detailed guidelines of the MSFD Technical Subgroup on marine litter (MSFD TSG-ML, 2011, 2013) and the UNEP/MAP Correspondence Group on Monitoring, Pollution and Litter (UNEP/MAP, 2014b);
- The above were incorporated in a GES definition for marine litter in Cyprus waters;
- The pending work towards the acquisition of missing data and information, primarily in relation to environmental targets for marine litter, and the completion of the revision, was identified and elaborated.

9.2 Analysis of marine litter characteristics and impacts

The main sources of existing information on marine litter in Cyprus are largely summarized in UNEP/MAP (2011), and are briefly listed below, along with supplementary information where available.

As is the case in many countries, the most informative record of marine litter characteristics on Cyprus beaches, including abundance and weight of different categories, is from volunteer cleanup efforts, namely the International Coastal Cleanup (ICC) campaign organized by the Ocean Conservancy, and “Cleanup the Med/Cleanup the World” campaigns led by the NGO Legambiente. As noted in the report, these data constitute a snapshot in time, and, similarly to the ICC data, they are largely effort-dependent (i.e., on the number of participating volunteers).

Additional information on beach litter is included in the UNEP/MAP pilot study conducted in 1988-1989 in 5 signatory states including Cyprus, and whose results were published by Gabrielides et al. (1991).

Finally, regarding non-coastal marine litter, UNEP/MAP (2011) describes a study coordinated by HELMEPA that enumerated floating litter off south Cyprus, among other Mediterranean locations, in 2008 (p. 16-21, Annex 3). In total, 16 items were observed

belonging to three categories (fishing nets, buoys, and plastic containers) weighing 29.6 kg. The resulting weight normalized to sea surface, 1.5 kg km^{-2}, was one of the lowest recorded.

The main decision on marine litter reached by the support mechanism of the EU in implementing the MSFD in the Mediterranean was the focus on beach litter, seafloor litter, and strandings of *Caretta caretta* individuals entangled in fishing gear (MED CAM, 2014b). The MSFD TSG on marine litter drafted guidelines for beach and seafloor surveys, among others, as well as a master list of categories/objects to be monitored (Annex 8.1 in MSFD TSG-ML, 2013), and its findings were echoed by the report of the UNEP/MAP Correspondence Group on Monitoring, Pollution and Litter (UNEP/MAP, 2014b). The master list is reproduced in the enclosed MS Excel table (see below to open) and the categories relevant to beach and seafloor surveys are summarized in Table 9.1. The two surveys, between them, cover 181 of the 217 categories and 44 of the 45 core categories, while 36 categories are monitored by both.

Table 9.1 Summary of marine litter categories as they appear in the master list drafted by the MSFD TSG-ML (2013) for beach and seafloor surveys. The main litter categories are identified as “Core” categories.

			Beach surveys		Seafloor surveys	
Level 1 - Materials	**All**	**Core**	**All**	**Core**	**All**	**Core**
Artificial polymer materials	124	22	92	19	20	6
Rubber	10	3	10	3	6	2
Cloth/textile	11	2	9	2	5	1
Paper/Cardboard	13	4	10	4	3	1
Processed/worked wood	15	5	11	4	3	2
Metal	26	5	21	5	10	2
Glass/ceramics	11	4	10	4	5	2
Chemicals	2	-	1	-	-	-
Food waste	1	-	-	-	-	-
Unidentified	4	-	1	-	-	-
TOTAL	217	45	165	41	52	16

Sources of and activities contributing to marine litter in the wider Eastern Mediterranean region are predomintantly attributed to tourism and recreation (UNEP/MAP, 2011). More specifically, the vast majority (92 %) of litter recorded in Mediterranean beaches for the period 2000-2006 was associated to shoreline recreational activities and smoking-related activities. As such, UNEP/MAP (2011) emphasized the need to address shore-based tourism and recreation as a priority area regarding marine litter.

Ocean/waterway activities including shipping, recreational boating and fishing, were assigned to a minor amount (5 %) of marine litter recorded in Mediterranean beaches for the period 2000-2006 (UNEP/MAP, 2011). While this contribution is minor, fisheries (both professional and recreational) must be formally considered in view of potential impacts of discarded and abandoned gear on protected species, such as *Caretta caretta*.

There are two major marine litter agents whose impacts on biota are of concern (UNEP/MAP, 2011):

a) Direct impedence, either from large items, such as fishing gear, packaging, etc., that may entangle and/or suffocate nekton (e.g., Galil, 2006), or from plastic nanoparticles, that may enter all levels of the food web more readily due to their size, with inestimable but undoubtedly broad-reaching impacts at present (e.g., Thompson et al., 2004),
b) Secondary pollution from chemical substances, such as metals or organopollutants, distributed either through metal marine litter objects or on the surfaces of nanoparticles.

9.3 Analysis of MSFD D10, criteria and indicator definitions

In this section, the definitions of the descriptor, criteria and indicator definitions for Descriptor 10 (as these appear in CD477) are discussed in view of the development of indicators for Cyprus and the recommendations of the second Mediterranean CAM (MED CAM, 2014b).

Descriptor 10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment Characteristics of litter in the marine and coastal environment (10.1) Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1) Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seafloor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2) Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro- plastics) (10.1.3) Impacts of litter on marine life (10.2) Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1)

The first part of the definition of Descriptor 10 identifies the aspects of marine litter that should be quantified, namely properties and quantities. Properties can be easily inferred by the identity of litter. Litter collection initiatives identify numerous categories. For instance, the MSFD TSG-ML (2013) lists 217 types of litter. Quantities are typically defined by two parameters: (a) the number of items, and (b) their weights.

The second part of the definition states that marine litter shall cause no harm, thus implying zero impacts.

Finally, the definition delineates the spatial regime over which the descriptor applies, by extending the marine environment onto the coast and the terrestrial margin with the sea. This extension into land is supported by the consistent findings that shoreline recreational activities constitute the vast majority of marine litter and that priority should be placed on this source.

Criterion 10.1 concerns characteristics of litter in the coastal (including the terrestrial margin, i.e., beaches) and the marine environment. Characteristics include:

a) An indication of the type of litter that is usually defined based on the material, size, and use,

b) A measure of its amount, usually the number of pieces/items and/or its weight, and more rarely its volume, per unit distance or area of coastline/beach seafloor or per unit volume of seawater,
c) The spatial distribution of litter, not only across the type of environmental category, e.g., coastline, seafloor, etc., but also across the whole assessment area,
d) The sources and activities that may contribute to it. This is typically the most difficult aspect to identify, but inference may limit the list of sources/activities to the most likely ones to contribute.

Indicators 10.1.1-3 quantify trends in litter characteristics on the coastline (beaches) and in the sea (both water column and seafloor). It is evident that in order to calculate these indicators, the characteristics themselves must be quantified at regular time intervals at a sufficient spatial scale to generate indicators that will be used for the calculation of trends.

Characteristics include the type of litter, but micro-plastics are the only type explicitely isolated and identified by name in the MSFD (in Indicator 10.1.3). While our understanding on their role and impact is constantly improving, it is not clear whether this identification is symbolic of their preponderance and political demonstration of sensitivity to their impacts compared to those of other types or literally a consequence of the current knowledge of their significance and detrimental effects on the marine environment.

Indicator 10.2.1 is broad in scope and encompasses all impacts of all types of litter on any group of marine life, thus permiting flexibility in identifying suitable indicators.

This indicator needs to be developed further in all EU marine regions, based on the experience in some sub-regions, such as the North Sea, largely constrained due to the technical complexities of sample collection and analysis (MED CAM, 2014b).

9.4 Analysis of Ecological Objective 10

The 18th Meeting of the Contracting Parties to UNEP/MAP adopted operational objectives, indicators, a GES definition and targets (Table 5.1), in relation to Ecological Objective 10: Marine Litter (UNEP/MAP, 2013), with the intention that they will be incorporated in the upcoming UNEP/MAP integrated Mediterranean Monitoring and Assessment Programme, planning for which is expected to be concluded by 2015 (UNEP/MAP, 2014a).

Table 9.2 Elements of marine litter adopted by the Contracting Parties to UNEP/MAP (UNEP/MAP, 2013).

Operational objective	**Indicator**	**GES**	**Proposed Targets**
The impacts related to properties and quantities of marine litter in the marine and coastal environment are minimized (10.1)	Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)	Number/amount of marine litter items on the coastline do not have negative impacts on human health, marine life and ecosystem services	Decreasing trend in the number of/amount of marine litter (items) deposited on the coast

	Trends in amounts of litter in the water column, including micro-plastics, and on the seafloor (10.1.2)	Number/amount of marine litter items in the water surface and the seafloor do not have negative impacts on human health, marine life, ecosystem services and do not create risk to navigation	Decreasing trend in the number/amount of marine litter items in the water surface and the seafloor
Impacts of litter on marine life are controlled to the maximum extent practicable (10.2)	Trends in the amount of litter ingested by or entangling marine organisms, especially mammals, marine birds and turtles (10.2.1)		Decreasing trend in the cases of entanglement or/and a decreasing trend in the stomach content of the sentinel species

9.5 Marine litter indicators and targets for Cyprus waters

9.5.1 Indicators

Based on the analysis above and the decisions of the second MED CAM (2014b) a number of marine litter indicators can be established to guide the planning of monitoring programmes and programmes of measures and lay the groundwork for the revision of Phase I in 2018. The Cyprus marine litter indicators were determined in agreement with other Mediterranean EU member-states (MED CAM, 2014b). They address in whole or in part the marine litter MSFD indicators defined in CD477, as well as the indicators of Ecological Objective 10 adopted by the Contracting Parties of UNEP/MAP (2013).

Table 9.3 Cyprus marine litter indicators and corresponding MSFD marine litter criteria/indicators and UNEP/MAP indicators they address.

Cyprus indicator	**Description**	**Related Indicators**	
		MSFD	**UNEP/MAP**
CY10.1.X	Number of items of [X=type of beach litter] larger than > 2.5 cm per 100 m of coastline	10.1.1	-
CY10.2.X	Trend in the number of items of [X=type of beach litter] larger than > 2.5 cm per 100 m per y	10.1.1	10.1.1
CY10.3.X	Number of items of [X=type of seafloor litter] per km^2 of seafloor	10.1.2	-
CY10.4.X	Weight (kg) of items of [X=type of seafloor litter] per km^2 of seafloor	10.1.2	-
CY10.5.X	Trend in the number of items of [X=type of seafloor litter] per km^2 of seafloor per y	10.1.2	10.1.2
CY10.6.X	Trend in weight (kg) of items of [X=type of seafloor	10.1.2	10.1.2

	litter] per km^2 of seafloor per y		
CY10.7	Number of stranded *Caretta caretta* individuals that are entangled in fishing gear in a calendar year	10.2	-
CY10.8	Trend in number of stranded *Caretta caretta* individuals that are entangled in fishing gear per y	10.2	10.2.1

9.5.2 Targets

Targets are proposed for the four (4) "trend" indicators in accordance with the recommendations adopted by the Contracting Parties of UNEP/MAP (2013), and pending any decisions regarding the aggregation or not of values for individual stations. Decreasing trend must be explicitely defined, e.g., a Pearson product-moment correlation coefficient value < 0 at p <0.05.

Table 9.4 Targets for Cyprus marine litter "trend" indicators.

Cyprus indicator ID and description	**Target**
CY10.2.X Trend in the number of items of [X=type of beach litter] larger than > 2.5 cm per 100 m per y	Decreasing trend
CY10.5.X Trend in the number of items of [X=type of seafloor litter] per km^2 of seafloor per y	Decreasing trend
CY10.6.X Trend in weight (kg) of items of [X=type of seafloor litter] per km^2 of seafloor per y	Decreasing trend
CY10.8 Trend in number of stranded *Caretta caretta* individuals that are entangled in fishing gear per y	Decreasing trend

9.6 Good Environmental Status of Cyprus with regards to marine litter

Based on the brief revised assessment and the development of marine litter indicators for Cyprus waters, a preliminary description of GES with regards to marine litter can be developed, as seen in the box below. This definition is expected to be amended as the contents of this report are finalized.

The marine environment of Cyprus is considered to be in good environmental status if:
- The amount of marine litter on beaches and on the seafloor is minimized and, if possible, is effectively eliminated,
- Mortality of *Caretta caretta* individuals due to entanglement and impedence by marine litter, and subsequent stranding is minimized and, if possible, is effectively eliminated.

9.7 Work needed and gaps in knowledge

The issue of aggregation of values from different sampling stations in the case of the "Characteristics" indicators must be investigated and addressed, preferably before the submission of the monitoring programmes, in part depending on the adoption of the recommendations to the EC on this topic (Prins et al., 2014).

Regarding monitoring, the policy framework and measures, the answers to the questionnaire summarized in UNEP/MAP (2011) as well as the Arcadis report on Public consultation on marine litter (EC, 2014b) should also be explored for any information relevant to the implementation of the MSFD in Cyprus at the current stage.

10 Introduction of energy, including underwater noise (D11)

10.1 Revision requirements and approach

In February 2014, the European Commission concluded a review of the reports submitted by Cyprus on Phase I of the implementation of the MSFD (EC, 2014a, 2014d), based on an extensive technical evaluation by a group of experts (Milieu Ltd. Consortium, 2014). The following revisions were identified as necessary for Descriptor 11, introduction of energy, including underwater noise:

- Environmental targets and relevant indicators will be set (they were not identified in 2012), with as many references as possible to semi-quantitative reference conditions;
- Trends will be evaluated based on the relevant criteria defined in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU; from hereon referred to as CD477);
- GES will be redefined without the verbatim reproduction of the MSFD definition and without any temporal limits;
- Plans for addressing the significant knowledge gaps will be specified.

The general approach used in revising the 2012 reporting elements is as follows:

- Definitions of criteria and indicators, as they appear in CD477, and UNEP/MAP Ecological Objectives (UNEP/MAP, 2013) were analyzed;
- Cyprus underwater noise indicators were developed based on the common indicators for underwater noise described in the second MED CAM (2014b);
- The above were considered for incorporation in a GES definition for underwater noise in Cyprus waters, in view of the conclusions of the second MED CAM (2014b);
- The pending work towards the acquisition of missing data and information, primarily in relation to environmental targets for underwater noise, and the completion of the revision, was identified and elaborated.

10.2 MSFD D11, criteria and indicator definitions

The definitions of D11, its criteria and indicators (as these appear in CD477) are as follows:

Descriptor 11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

Distribution in time and place of loud, low and mid frequency impulsive sounds (11.1)
Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1μPa^2.s) or as peak sound pressure level (in dB re 1μPa peak) at one metre, measured over the frequency band 10 Hz to 10 kHz (11.1.1)

Continuous low frequency sound (11.2)
Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1μPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1)

The indicators agreed to by the Mediterranean EU member-states at the second MED CAM (2014b) are identical to the above.

10.3 UNEP/MAP Ecological Objective 11

The 18th Meeting of the Contracting Parties to UNEP/MAP did not adopt any operational objectives, indicators, a GES definition or targets in relation to Ecological Objective 11: Noise from human activities (UNEP/MAP, 2013).

10.4 Underwater noise indicators and targets for Cyprus waters

10.4.1 Indicators

As mentioned above, the Cyprus underwater noise indicators were determined in agreement with other Mediterranean EU member-states (MED CAM, 2014b), and they are identical to the MSFD indicators defined in CD477. Indicators for Ecological Objective 11 have not been adopted yet by the Contracting Parties of UNEP/MAP (2013).

Table 10.1 Cyprus underwater noise indicators and corresponding MSFD marine litter criteria/indicators and UNEP/MAP indicators they address.

Code	Description	Related MSFD indicators
CY11.1	Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1μPa^2.s) or as peak sound pressure level (in dB re 1μPa peak) at one metre, measured over the frequency band 10 Hz to 10 kHz	11.1.1
CY11.2	Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1μPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1)	11.2.1

10.4.2 Targets

At this stage, there is insufficient information available about the effects of increased ambient noise levels and it is not clear what the type of approach for target setting and description of GES will be chosen, in common with the other Mediterranean EU member-states (MED CAM, 2014b).

10.5 Good Environmental Status of Cyprus with regards to underwater noise

As mentioned above, there is insufficient information available to address GES conditions with respect to the two underwater noise indicators in the area. Therefore, GES is not defined at present. Information and data collected by the next revision cycle (2017-2018) will enable the definition of GES with respect to underwater noise.

10.6 Work needed and gaps in knowledge

Collection of underwater noise fields between now and 2018 (the year the next revision is due) is imperative. The recommendation of the second MED CAM (2014b) is to monitor environmental pressure (expressed as ambient noise level) as well as trends in ambient

noise levels within 63 and 125 Hz, retaining sound pressure levels as a function of time, along with a specified averaging time.

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