



Mediterranean
Action Plan
Barcelona
Convention



National Action Plan for the conservation of marine vegetation in Cyprus





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For bibliographic purposes, this document may be cited as

UNEP/MAP-SPA/RAC, 2019. National Action Plan for the conservation of marine vegetation in Cyprus. By Pergent G. & Pergent-Martini C., Ed. SPA/RAC, Tunis: 49 pp.

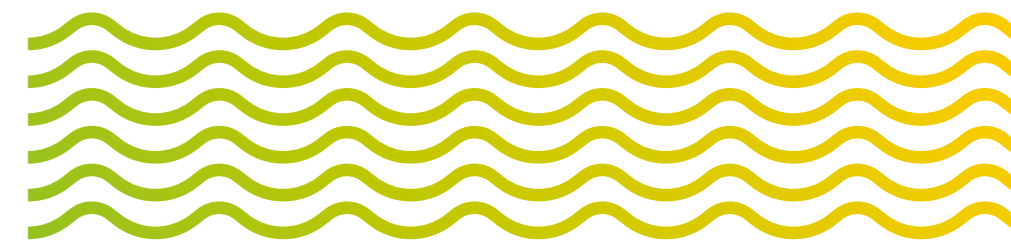
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The present report has been prepared in the framework of the projet **MedKeyHabitats II** project financed by the **MAVA** foundation.

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National Action Plan for the conservation of marine vegetation in Cyprus



LIST OF FIGURES	9
LIST OF TABLES	9
1. CONTEXT AND OBJECTIVES	11
1.1. Importance of Mediterranean Marine Vegetation	13
1.2. Action Plan for the conservation of marine vegetation in the Mediterranean Sea	13
1.3. Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast (IMAP)	16
1.4. Objectives of the National Action Plan	16
2. STATE OF KNOWLEDGE ON CONSERVATION OF MARINE VEGETATION IN THE REPUBLIC OF CYPRUS	17
2.1. State of the legislation	19
2.2.1. At international level	19
2.2.1.1. Barcelona Convention	19
2.2.1.2. Bern Convention	19
2.2.1.3. Habitat, Fauna and Flora Directive	20
2.2.1.4. Convention on Biological Diversity	20
2.2.2. At national level	20
2.2. Species and habitats	21
2.3. Threats to marine vegetation	26
2.4. Marine Protected Areas	29
2.5. Actions completed and in progress	30
3. ACTIONS TO BE IMPLEMENTED TO MEET THE OBJECTIVES OF THE NATIONAL ACTION PLAN	33
3.1. Legislation and management measures	35
3.2. Synthesis of existing data and identification of gaps	36
3.3. Case studies to implement	36
3.4. Awareness and capacity building	37

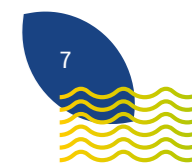
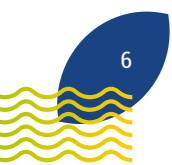


**4. ACTION PLAN IMPLEMENTATION TABLE
AND PRIORITIES**

39

REFERENCES

43



LIST OF FIGURES AND LIST OF TABLES

Figure 1 _____ 22	Figure 10 _____ 30
Distribution of <i>Posidonia oceanica</i> in the Mediterranean Sea (Pergent et al., 2012). Green dots: limit of extension; White dot: Relic population.	Location of NATURA 2000 sites in Cyprus (https://natura2000.eea.europa.eu/). 1: Kavo Gkreko, 2: Thalassia Periochi Nisia, 3: Periochi Polis – Gialia, 4: Thalassia Periochi Moulia, 5: Akrotirio Aspro - Petra Romiou, 6: Chersonisos Akama.
Figure 2 _____ 23	Figure 11 _____ 35
Percentage of cover of <i>Posidonia oceanica</i> beds (1 km ² square) around the island of Cyprus (from Kremmer, 2012).	Locations of <i>Posidonia oceanica</i> monitoring systems and coastal areas occupied by decommissioned and active fish farms (from Kletou et al., 2018b).
Figure 3 _____ 24	Table 1 _____ 14
Distribution in % of each ecotope (between 0 and -50 m), at the six Natura 2000 sites and the impacted site of Limassol-Basilikos (from Pergent-Martini et al., 2013).	Species taken into account, as having priority, in the context of the Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea.
Figure 4 _____ 25	Table 2 _____ 15
Main habitats and bottom types in the area close to Thalassia Periochi Moulia NATURA 2000 site (Pergent et al., 2016).	Work programme and timetable for the period 2019-2024
Figure 5 _____ 25	Table 3 _____ 16
Continuous belt of <i>Cystoseira</i> (forest) at the Kavo Gkreko Natura 2000 site (photo G. Pergent).	IMAP Biodiversity Ecological Objectives (EO 1) and related indicators
Figure 6 _____ 26	Table 4 _____ 21
Association with <i>Sargassum trichocarpum</i> at Akamas Peninsula (photo G. Pergent).	List of marine vegetation species listed in international conventions and directives reported along the Cyprus coast. Green: Present, Yellow: Possible, Orange: Absent. (1) As <i>Caulerpa prolifera</i> , (2) Or <i>Cystoseira montagnei</i> , (3) As <i>Lithophyllum byssoides</i> , (4) As <i>Felicinia spathulate</i> , (5) As <i>Beckerella dentata</i> ; * 13 <i>Cystoseira</i> species identified (Argyrou et al., 2002 ; Tsiamis et al., 2014 ; Verlaque et al., 2019).
Figure 7 _____ 27	Table 5 _____ 41
Natural and anthropogenic factors that influence <i>Posidonia oceanica</i> beds. The scale on the left indicates water depth. (from A. Abadie, 2016).	Action plan implementation table, proposed priorities and time table.
Figure 8 _____ 28	
Beach nourishment and coastal management in Pernera area (photo G. Pergent).	
Figure 9 _____ 29	
Yachting development in Latsi harbor (photo G. Pergent).	



1



1

CONTEXT AND OBJECTIVES

1.1. Importance of Mediterranean Marine Vegetation

Marine vegetation is the basis of the functioning of Mediterranean coastal ecosystems. It constitutes a whole set of habitats, characterized by an exceptional range of biodiversity. The ecosystem services associated with this marine vegetation are particularly numerous (food source, spawning and nursery grounds, oxygenation of water, reduction of water movements and protection of beaches, mitigation of climate change – Boudouresque *et al.*, 2012; Pergent *et al.*, 2014; Thibault *et al.*, 2017). Among these habitats, special structures, rare and threatened, are built, they are designated as 'natural monuments', the protection of which is of particular importance (UNEP *et al.*, 1990; Langar *et al.*, 2011; UNEP/MAP – SPA/RAC, 2012). The conservation of this marine vegetation is essential for maintaining the coastal equilibrium of the Mediterranean.

With more than one thousand macroscopic marine vegetation species, including a high percentage of rare and / or endemic species, the Mediterranean Sea has a special responsibility. Although *Posidonia oceanica*, and its seagrass beds, play a major role in this marine vegetation, and receive special attention, many other species contribute significantly to coastal biodiversity, provide many ecosystem services (eg *Cystoseira* forests) and build remarkable habitats. The regression of this marine vegetation, observed in many parts of the Mediterranean Sea, often in relation with the increase of anthropic pressures, has reached such a level that it is imperative to implement effective measures and to define conservation strategies at basin scale (Telesca *et al.*, 2015; UNEP/MAP – SPA/RAC, 2019a). The adoption of appropriate measures could drive a deceleration and even reversal of declining trends, bringing back the services these ecosystems provide.

1.2. Action Plan for the conservation of marine vegetation in the Mediterranean Sea

The Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea (Vegetation AP) was adopted in 1999 at the 11th Meeting of the Contracting Parties to the Barcelona Convention (Malta, 27-30 October 1999).

This Action Plan mainly aimed at:

- Ensuring the conservation of macroscopic marine vegetation species and vegetal assemblages in the Mediterranean by implementing management and legal protection measures
- Avoiding loss and degradation of seagrass meadows and other vegetal assemblages of importance for the marine environment, as marine habitats that are essential to the survival of many Mediterranean species, and keeping them in favourable conservation status
- Ensuring the conservation of marine vegetal assemblages that could be considered natural monuments, such as barrier reefs of *Posidonia oceanica* and organogenic surface formations, terraces (platforms with vermitids covered by soft algae) and *Cystoseira* belts.

Although the present Action Plan's provisions are to be implemented for all the macrophyta species inhabiting the Mediterranean, particular attention must however be paid to the species appearing in Annex 2 to the SPA Protocol as amended in 2009 (Decision IG.19/12 of the 16th Meeting of Contracting Parties, Marrakesh, Morocco, 2009; Table 1).

Table 1

Species taken into account, as having priority, in the context of the Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea.

Magnoliophyta	<i>Cymodocea nodosa</i> , <i>Posidonia oceanica</i> , <i>Zostera marina</i> , <i>Zostera noltei</i>
Chlorophyta	<i>Caulerpa ollivieri</i>
Heterokontophyta	Genus <i>Cystoseira</i> (with the exemption of <i>Cystoseira compressa</i>), <i>Fucus virsoides</i> , <i>Laminaria rodriguezii</i> , <i>Sargassum acinarium</i> , <i>Sargassum flavifolium</i> , <i>Sargassum hornschurchii</i> and <i>Sargassum trichocarpum</i>
Rhodophyta	<i>Gymnogongrus crenulatus</i> , <i>Kallymenia spathulata</i> , <i>Lithophyllum byssoides</i> , <i>Ptilophora mediterranea</i> , <i>Schimmelmannia schousboei</i> , <i>Sphaerococcus rhizophylloides</i> , <i>Tenarea tortuosa</i> , <i>Titanoderma ramosissimum</i> and <i>Titanoderma trochanter</i>

Given the particular importance of Posidonia meadows and other vegetal assemblages of importance for the marine environment in the Mediterranean, their conservation is to be considered one of the main priorities of the present Action Plan. National and regional priority must be accorded to:

- inventory of species and distribution mapping
- identification of threats, including watershed
- elaboration and implementation of appropriate legislation
- establishment of protected areas to protect Posidonia meadows and other vegetal assemblages of importance for the marine environment
- reinforced protection of the Posidonia reefs and organogenic surface formations and Cystoseira belts
- promote and support the setting up of marine vegetation monitoring networks
- At regional level:
 - develop cooperation, exchange of experience and training

To ensure greater effectiveness in the measures envisaged in the implementation of this Action Plan, Mediterranean countries are invited to establish national plans for the conservation of marine vegetation. Each national plan should take into account the specific features of the countries or even areas concerned. It must suggest appropriate legislative measures, particularly with regard to the environmental impact assessment of coastal infrastructure and to control activities which could affect marine vegetation.

During the Fourteenth Meeting of SPA/BD Thematic Focal Points (Portorož, Slovenia, 18-21 June 2019), an update of the work programme and timetable for the period 2019-2024 of the Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea was adopted (Table II).

Table 2

Species taken into account, as having priority, in the context of the Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea.

Activities for implementation of Action Plan	Deadline
Regulatory activities	
▪ Encourage the Parties to better integrate all the plant species in Annex II in the Party's regulatory tools (e.g. protected species, impact study procedures, etc)	As soon as possible
▪ Assist the Parties who have not already done so, to create MPAs for the conservation of Annex II plant species	As soon as possible
▪ Assist the Parties to create MPAs to strengthen the conservation of blue carbon ecosystems and the services they provide in particular to attenuate climate change impacts (carbon sinks)	As soon as possible
Inventory activities and mapping	
▪ Initiate a systematic inventory of natural monuments so that they can be included in future MPAs to ensure their sustainability	As soon as possible
▪ Establish a first inventory of plant formations considered as carbon sinks and generalize mapping them	As soon as possible
▪ Assist the countries in identifying the main pressures which could degrade the marine vegetation and devise strategies to develop better practices (e.g. restoration, strengthening of population)	Ongoing
Surveillance and monitoring activities	
▪ Promote the setting up of monitoring networks of the main marine vegetation assemblages in conformity with the principles and common indicators of the integrated monitoring and assessment programme (IMAP)	As soon as possible
▪ Assist the countries so that the monitoring networks of the main marine plant formations can be rendered sustainable so as to obtain long chronological series	Ongoing
Capacity and knowledge building activities	
▪ Organize a symposium every 3 years and disseminate as widely as possible the conclusions and propositions formulated by the participants	From 2021
▪ Update and make accessible the data pertaining to the mapping of priority habitats and natural monuments	As soon as possible
▪ Complete and regularly revise the list of specialists, laboratories and institutions and encourage exchanges between them	At symposiums
▪ Set up communication actions on Annex II plant species by targeting the least well-known ones	As soon as possible
▪ Continue with capacity building activities and align them with the expectations of the Parties	Ongoing
▪ Test the setting up of training of national trainers (professional staff – relays) and assess its efficacy	As soon as possible
▪ Assist the countries in setting up regular national training sessions	Ongoing

In the context of Specially Protected Areas and Biological Diversity in the Mediterranean (SPA-BD), a reference list of 27 major types of benthic habitat was adopted in 2002, and revised recently (UNEP-MAP SPA/RAC, 2019b). It was compiled to help the Mediterranean countries in drawing up inventories of natural sites of conservation interest (UNEP-MAP RAC/SPA, 2002). The most typical Mediterranean habitats, based on marine vegetation species, are i) *Lithophyllum byssoides* (e.g. *L. lichenoides*) rims; ii) Vermetid platforms with *Neogoniolithon brassica-florida* concretion, (iii) *Posidonia oceanica* meadows, (iv) Fucale forests (including *Cystoseira* sp.), v) Rhodolith association and (vi) Coralligenous.

1.3. Integrated Monitoring and Assessment Program of the Mediterranean Sea and Coast (IMAP)

The adoption in 2016 of the Integrated Monitoring and Assessment Program (IMAP) was a key milestone towards achieving an integrated monitoring program for the Mediterranean Sea. The IMAP is based on the ecosystem approach, its Ecological Objectives for the Mediterranean, and its indicators. Among these objectives, the Ecological Objective (EO1 – Biodiversity) and two associated indicators are particularly relevant in the context of the conservation of marine vegetation (Table III).

Table 3
IMAP Biodiversity Ecological Objectives (EO 1) and related indicators.

Ecological Objective (EO)	IMAP Indicators
Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions.	<u>Common Indicator 1: Habitat distributional range (EO1)</u> to also consider habitat extent as a relevant attribute. <u>Common Indicator 2: Condition of the habitat's typical species and communities (EO1)</u>

The IMAP complies with the European Union's Marine Strategy Directive (MSFD) aimed at achieving the good ecological status of EU marine waters by 2020. The IMAP contains in its Appendix 1 a reference list of species and habitats to be monitored. Most of these species are common to the species assemblages and natural monuments considered in the Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea, in the Action Plan for the Conservation of the Coralligenous and Other Calcareous Bio-concretions in the Mediterranean Sea or in the Dark Habitats Action Plan (Action Plan for the Conservation of Habitats and Species associated with Seamounts, Underwater Caves and Canyons, Aphotic hard beds and Chemo-synthetic phenomena in the Mediterranean Sea).

1.4. Objectives of the National Action Plan

According to the Action Plan for the conservation of marine vegetation in the Mediterranean Sea, the national plan shall be based on the available scientific data and will include programs for (i) collection and regular updating of data, (ii) training and refresher courses for specialists, (iii) awareness-raising and education for the general public, actors and decision-makers and (iv) the conservation of seagrass meadows and other vegetal assemblages of importance for the Mediterranean marine environment.

The main goal of this National Action Plan is to propose strategy to conserve marine vegetation along Cyprus coasts in good condition in terms of distribution, biodiversity and vitality in order to continue providing the associated ecosystem services.

The Republic of Cyprus has for many years initiated a series of actions that are fully integrated within this strategy. The objectives of the National Action Plan presented in this document are (i) to summarize all these actions (knowledge acquisition, regulatory activities, capacity-building and knowledge-building activities), (ii) to identify activities for which it appears necessary to develop new actions, and (iii) to propose a timetable for the implementation of these actions associated with suggested guidelines.

2



2

STATE OF KNOWLEDGE ON CONSERVATION OF MARINE VEGETATION IN THE REPUBLIC OF CYPRUS

2.1. State of the legislation

2.2.1. At international level

In the Republic of Cyprus, the protection of species is implemented through the provisions of EU Directive (92/43/EEC) for the Conservation of Natural Habitats and Wild Fauna and Flora (Habitat, Fauna and Flora Directive), as well as the Barcelona Convention (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean) and in particular the Protocol concerning Specially Protected Areas and Biodiversity in the Mediterranean (SPA/BD Protocol). Complementary to these are the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), the Convention on the International Trade in Wild Fauna and Flora (CITES) and the Convention on Biological Diversity (CBD). In particular, protected marine species and habitats are those listed in the aforementioned Conventions and Agreements. Moreover, the EU Marine Strategy Framework Directive (2008/56/EC), which aims to protect the marine ecosystem and biodiversity, incorporates monitoring programs based on seaweeds and seagrass, while the EU water Framework Directive ((2000/60/CE), which aims to assess the ecological status of waterbodies, uses *Posidonia oceanica* as an element of biological quality (bioindicator)

2.2.1.1. Barcelona Convention

The Barcelona Convention, initially referred as the Convention for the Protection of the Mediterranean Sea Against Pollution, was adopted, by the Mediterranean countries on 16 February, 1976, and amended and renamed as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, on 10 June, 1995. Twenty-one countries and the European Union have already signed up to the Convention. Seven Protocols addressing specific aspects of Mediterranean environmental protection complete the Mediterranean Action Plan legal framework. Among them, the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (adopted in 1995, and replacing the related protocol of 1982), and Annexes (adopted in 1996, amended in 2009, 2012 and 2013), are dedicated to the conservation of marine species and habitats. Endangered or threatened species are listed in the Appendix II of the SPA/BD protocol (Appendix A).

The Republic of Cyprus signed the Barcelona Convention on 16/02/1976 and ratified it on 19/11/1979, and the SPA/BD Protocol on 10/06/1995 (signature) and 18/07/2003 (ratification).

In order to help the Mediterranean countries to implement the SPA/BD Protocol and to manage endangered and threatened species, a specific Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea was adopted in 1999, and regularly updated.

2.2.1.2. Bern Convention

The Bern Convention was the first international treaty to protect both species and habitats and to bring countries together to decide how to act on nature conservation. Fifty countries and the European Union have already signed up to the Convention and committed to promoting national conservation policies, considering the impact of planning and development on the natural environment, promoting education and information on conservation, and coordinating research. Strictly protected floral species are listed in Appendix 1 of the Convention

(Appendix B). The Republic of Cyprus signed the Bern Convention on 21/10/1981 and ratified it on 16/05/1988.

2.2.1.3. Habitat, Fauna and Flora Directive

The Habitat, Fauna and Flora Directive, known as the Conservation of Natural Habitats and of Wild Fauna and Flora Directive, is a European Council Directive, adopted on 21 May 1992 (Directive 92/43/EEC). This Directive aims to contribute to the maintenance of biodiversity by defining a common framework for the conservation of natural habitats - terrestrial or aquatic - and ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Some 220 rare and characteristic habitat types, and approximately 1 000 species of community interest, are targeted for conservation and referenced in appendices. Appendix I mentions the natural habitat types of community interest for which conservation requires the designation of Special Areas of Conservation (SACs), and listed only *Posidonia oceanica* beds as a priority habitat based on marine vegetation (Habitat type 1120). All the lists of SACs, drawn up by each Member State, constitute the Natura 2000 European network. The Directive requires that Member States identify Sites of Community Importance which contribute significantly to the maintenance or restoration at a favorable conservation status of a natural habitat type or of a species, and may also contribute significantly to the effectiveness of Natura 2000, and/or contribute significantly to the maintenance of biological diversity within the biogeographic region concerned. Once approved by the European Commission, these sites can be designated as SACs by the Member State.

To date, 40 Sites of Community Importance have been identified by the Republic of Cyprus, from which four of them concern both terrestrial and marine habitats and species and two only marine habitats and species.

2.2.1.4. Convention on Biological Diversity

The Convention on Biological Diversity is a UNEP Convention, signed in 1992, with the aims of the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Cyprus has been party to the CBD since 1996 and formulated the National Biodiversity Strategy (NBS) during 2013, which was updated in 2019, as a reference document in order to fulfill the commitments accepted with the ratification of the Convention on Biological Diversity (Republic of Cyprus, 2014). The implementation of this action plan was planned for 2015.

2.2.2. At national level

The EU Directive on the conservation of natural habitats and of wild fauna and flora was transposed into Cyprus law in 2003 (153(I)/2003). This law was introduced with a view to harmonizing the current Cypriot legislation with the European standards and constitutes the principal national legislation for the protection of habitats and wildlife in Cyprus. The law also provides for the designation and management of protected areas for both habitats and species. The Party, in accordance with Article 14 of the Barcelona Convention, has adopted legislation implementing the provisions of the SPA and Biodiversity Protocol concerning the protection and management of endangered or threatened plant and animal species (CAP 135-Law 20(III)/2001, Law 153(I)/2003-Act 273/90 and Law 2(III)/2013; Ministry of Agriculture, Natural Resources and Environment, 2015). *Posidonia oceanica* beds are listed as natural habitat but no other marine vegetation habitat/species is specifically mentioned.

2.2. Species and habitats

The Republic of Cyprus has a very diverse range of marine vegetation including species, habitats and natural monuments of major interest for conservation. Several of the species present are specifically named in the Action Plan for the Conservation of Marine Vegetation in the Mediterranean and the SPA/BD protocol of the Barcelona Convention, the Bern Convention and the Habitat Fauna and Flora Directive (Table IV). Even though some species are of low interest for marine vegetation conservation (e.g. *Caulerpa ollivieri* = *Caulerpa prolifera*), more than 20 species of marine flora listed in the various conventions are present. In addition, the Sargassum species must be precisely identified and the record of *Zostera marina*, by "seagrassspotter", probably corresponds to an identification error.

Table IV: List of marine vegetation species listed in international conventions and directives reported along the Cyprus coast. Green: Present, Yellow: Possible, Orange: Absent. (1) As *Caulerpa prolifera*, (2) Or *Cystoseira montagnei*, (3), As *Lithophyllum byssoides*, (4) As *Felicinia spathulate*, (5) As *Beckerella dentata*; * 13 *Cystoseira* species identified (Argyrou et al., 2002; Tsiamis et al., 2014; Verlaque et al., 2019).

Table 4
List of marine vegetation species listed in international conventions and directives reported along the Cyprus coast. Green: Present, Yellow: Possible, Orange: Absent. (1) As *Caulerpa prolifera*, (2) Or *Cystoseira montagnei*, (3), As *Lithophyllum byssoides*, (4) As *Felicinia spathulate*, (5) As *Beckerella dentata*; * 13 *Cystoseira* species identified (Argyrou et al., 2002; Tsiamis et al., 2014; Verlaque et al., 2019).

	Bern Convention Appendix I	Barcelona Convention & Action Plan Vegetation	Habitats directive
Chlorophyta			
	<i>Caulerpa ollivieri</i> (1)	<i>Caulerpa ollivieri</i> (1)	
Fucophyceae			
	<i>Cystoseira amentacea</i>	<i>Cystoseira</i> sp. (except <i>C. compressa</i>) *	
	<i>Cystoseira mediterranea</i>		
	<i>Cystoseira sedoides</i>		
	<i>Cystoseira spinosa</i> (2)		
	<i>Cystoseira zosteroides</i>		
		<i>Fucus virsoides</i>	
	<i>Laminaria rodriguezii</i>	<i>Laminaria rodriguezii</i>	
	<i>Laminaria ochroleuca</i>		
		<i>Sargassum acinarium</i>	
		<i>Sargassum flavifolium</i>	
		<i>Sargassum hornschurchii</i>	
		<i>Sargassum trichocarpum</i>	
Rhodophyta			
	<i>Goniolithon byssoides</i> (3)		
		<i>Gymnogongrus crenulatus</i>	
		<i>Kallymenia spathulata</i> (4)	

Bern Convention Appendix I	Barcelona Convention & Action Plan Vegetation	Habitats directive
<i>Lithophllum lichenoides</i> (3)	<i>Lithophyllum byssoides</i>	
<i>Ptilophora mediterranea</i> (5)	<i>Ptilophora mediterranea</i> (5)	
<i>Schimmelmannia schousboei</i>	<i>Schimmelmannia schousboei</i>	
	<i>Sphaerococcus rhizophylloides</i>	
	<i>Tenarea tortuosa</i>	
	<i>Titanoderma ramosissimum</i>	
	<i>Titanoderma trochanter</i>	
Magnoliophyta		
<i>Posidonia oceanica</i>	<i>Posidonia oceanica</i>	<i>Posidonia oceanica</i>
<i>Cymodocea nodosa</i>	<i>Cymodocea nodosa</i>	
<i>Zostera marina</i>	<i>Zostera marina</i>	
	<i>Zostera noltei</i>	

Among natural habitat types of interest, the priority habitat type *Posidonia oceanica* beds is of particular importance along the coast of Cyprus as it corresponds to the limit of extension of this habitat in the south-eastern part of the Mediterranean Sea (Figure 1). Moreover, *Posidonia oceanica* beds constitute a continuous belt all along the coasts of the Republic of Cyprus (Figure 2) and this habitat presents a particular extension in the six NATURA 2000 sites of Cyprus (Republic of Cyprus, 2010; Kremmer, 2012).



Figure 1 Distribution of *Posidonia oceanica* in the Mediterranean Sea (Pergent et al., 2012). Green dots: limit of extension; White dot: Relic population.

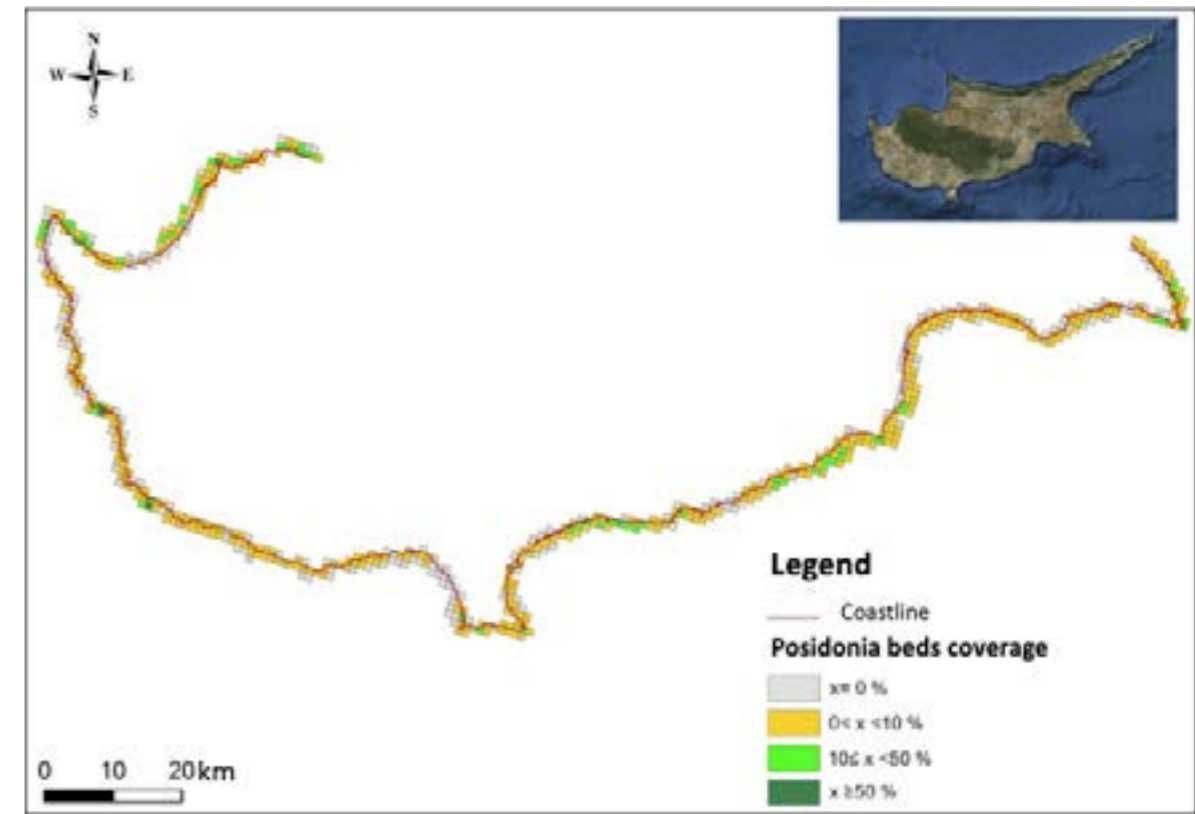


Figure 2 Percentage of cover of *Posidonia oceanica* beds (1 km² square) around the island of Cyprus (from Kremmer, 2012).

In the Natura 2000 sites of the Republic of Cyprus, the distribution of main habitats (between 0 and -50 m) shows a percentage of *Posidonia oceanica* beds that varies between 2 % (Akrotirio Aspro - Petra Romiou) and nearly 40 % (Thalassia Periochi Moulia) (Figure 3). The very low values observed at the Akrotirio Aspro - Petra Romiou site seem to be related with a regression of the *Posidonia oceanica* beds, attested by numerous examples of dead *matte* observed on the side-scan sonar images (Pergent-Martini et al., 2013). The overall coverage of *Posidonia oceanica* in Natura 2000 sites is estimated at 22 %; even if this value is weak in comparison with other sites in the Mediterranean Sea, it corresponds to the overall trend observed along a north-west / south-east axis and is comparable to coverage observed in Crete (22.3% in Valette et al., 2019). In the impacted site of Limassol-Basilikos, the coverage of *Posidonia oceanica* is lower (7%).

The bathymetric extension of the *Posidonia oceanica* beds along the Cyprus coastline ranges from a minimum depth of -1 m (Kavo Gkreko, Akrotirio Aspro - Petra Romiou, Thalassia Periochi Moulia, Chersonisos Akama) to a maximum depth of more than -40 m (Kavo Gkreko, Thalassia Periochi Moulia). The vitality of the *Posidonia oceanica* meadow is 'high' to 'good' for all the NATURA 2000 sites (Pergent-Martini et al., 2013).



Figure 3
Distribution in % of each ecotope (between 0 and -50 m), at the six Natura 2000 sites and the impacted site of Limassol-Basilikos (from Pergent-Martini et al., 2013).

The healthiest *Posidonia oceanica* bed along the Cyprus coastline seems to be the one growing in the area close to the Thalassia Periochi Moullia NATURA 2000 site, where it covers around 35% of the bottom between 0 and 50 m depth, and the lower limit reaches 42 m depth. *Posidonia oceanica* exhibits extensive meadows on rocky and sandy substrates, forming well-developed *matte* in the deep part, and it constitutes patches, especially on rocks, near the coast (Figure 4; Pergent et al., 2016; Petrou et al., 2016). The associated flora and fauna show high biodiversity.

Several other habitats of importance have also been identified along the Cyprus coastline, mainly:

- The *Cystoseira* forests with high ecological assessments, at least in pristine locations where they constitute a continuous belt along the coast (Stavrou & Orfanidis, 2012; Figure 5). To date, 13 species of *Cystoseira* have been reported (Tsiamis et al., 2014), from the surface to nearly 50 m depth (DFMR, 2012a). These *Cystoseira* forests support a diverse range of associated species and can host richer and more abundant juvenile fish assemblages compared to turf algae or barren reefs (Cheminée et al., 2013).
- The association with *Sargassum* spp is frequent in deep waters (from 30 m depth) on rocky substrate associated with *Cystoseira* species (DFMR, 2012a ; Figure 6).



Figure 4
Main habitats and bottom types in the area close to Thalassia Periochi Moullia NATURA 2000 site (Pergent et al., 2016).



Figure 5
Continuous belt of *Cystoseira* (forest) at the Kavo Gkreko Natura 2000 site (photo G. Pergent).



Figure 6
Association with *Sargassum trichocarpum* at Akamas Peninsula (photo G. Pergent).

2.3. Threats to marine vegetation

Even if, the Fourth National Report to the United Nations Convention on Biological Diversity (Republic of Cyprus, 2010) noted that "the occurrence of endangered species and the presence of well-preserved important habitats along the coastal waters of Cyprus are evidence that the marine environment of Cyprus is still in a good state with minor environmental impacts consequent biological diversity of marine plants and animals", numerous impacts have been observed, mainly close to the main coastal cities and industrial plants (e.g. Limassol, Vasiliko Bay; Holmer *et al.*, 2008; DFMR, 2012b; Kletou *et al.*, 2018ab). For marine species, the impacts ranked first among threats, are fisheries and pollution followed by anthropogenic disturbance and changes in ecosystems (Republic of Cyprus, 2014). They are likely to jeopardize the vitality of the marine vegetation, leading to significant regressions and a decline in associated ecosystem services.

As in the whole Mediterranean basin, the main pressures on marine vegetation concern coastal development (urbanization and coastal management, sewage outfall, desalination plants), management of living resources (aquaculture, trawling), tourism development (coastal infrastructures, beach nourishment, anchoring), introduced species; but also, in a more global way, climate change impact (Thibaut *et al.*, 2005; Boudouresque *et al.*, 2009; Boudouresque & Verlaque, 2012; Pergent *et al.*, 2014; Blanfuné *et al.*, 2016; Figure 7).

It is important to keep in mind that the effects of climate change may have a stronger impact in Cyprus as this region is already characterized by higher temperatures and salinity than anywhere else in the whole of the Mediterranean basin. Moreover, because of its geographical location, the coast of Cyprus is particularly exposed to the arrival of species from the Red

Sea (via the Suez Canal), and especially herbivorous species that can induce overgrazing of marine vegetation, turning algal forests into 'barrens' (e.g. *Siganus* sp.; Katsanevakis, 2009; Vergès *et al.*, 2014).

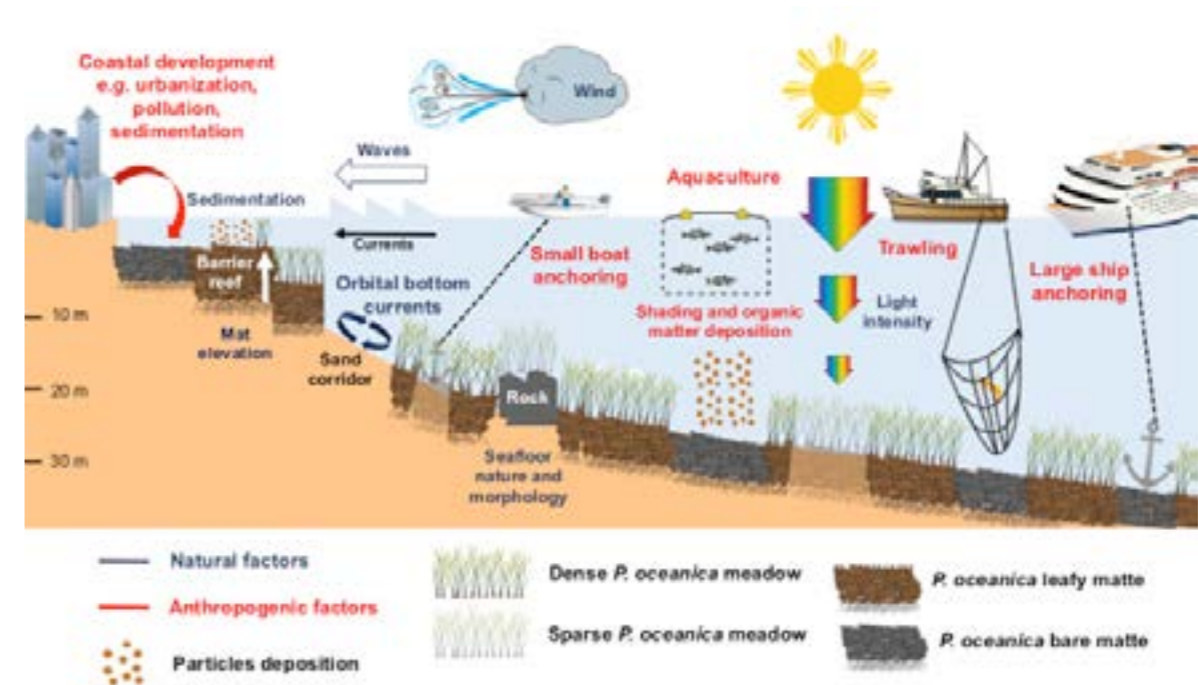


Figure 7
Natural and anthropogenic factors that influence *Posidonia oceanica* beds. The scale on the left indicates water depth. (from A. Abadie, 2016).

Several impacts on marine vegetation have been observed along the Cyprus coastline:

- i) The increase of nutrient inputs, in the vicinity of a fish hatchery (Liopetri Bay), along with other nutrient sources derived from surface run-off and ground water intrusion, acting in synergy with high water temperature, are likely inducing the proliferation of filamentous algae *Cladophora* sp., including the Red Sea migrant *Cladophora patentiramea*, in the 1990s (Argyrou, 2000). This proliferation was responsible for the regression of the *Cystoseira* forest in this area.
- ii) The impact of sea cage farming on *Posidonia oceanica* beds has been a particular focus of interest (Díaz-Almela *et al.*, 2008, Holmer *et al.*, 2008); the main finding was that various indicators of meadow health, such as shoot density, were negatively correlated with particulate sedimentation rates and nutrient supply. For instance, the development of fish farming in the Vasiliko-Moni area (southern Cyprus) using floating cages, starting at 22–28m depth, over seagrass beds, induced a severe regression of *Posidonia oceanica* coverage and promoted the installation of *Caulerpa* sp. (Holmer *et al.*, 2008; Kletou *et al.*, 2018b).
- iii) The expansion of *Caulerpa cylindracea* (another introduced species) in Moni Bay, adjacent to the city of Limassol, induced changes in the phytobenthic community and also in macrofaunal assemblages (Argyrou *et al.*, 1999). Moreover, from a more general point of view, the increase in alien marine species

with associated impacts constitutes a clear threat for the marine vegetation (Katsanevakis *et al.*, 2009).

- iv) The use of desalination to satisfy the needs for potable water in Cyprus results in current brine discharges with an adverse impact reported by Argyrou (1999) on forests of the macroalga *Cystoseira* sp., as well as significant shifts in macrofaunal community composition.
- v) The artificialization of the coastline with the construction of numerous coastal structures is likely to cover over shallow marine vegetation such as *Cystoseira* belts and/or shallow *Posidonia oceanica* meadows (DFMR, 2012b).
- vi) The coastal development of the eastern part of Vasiliko Bay (naval base, crude oil import terminal, main power station in the region, desalination plant and large cement plant) induced the disappearance of furoid forests; the *Cystoseira* canopy was replaced by opportunistic algae with lower biomass and biodiversity, providing reduced ecosystem services (Kletou *et al.*, 2018a).

The impact of other activities on marine vegetation has not yet been documented but can be observed along Cyprus coastline (Figures 8 and 9).



Figure 8
Beach nourishment and coastal management in Pernera area (photo G. Pergent).



Figure 9
Yachting development in Latsi harbor (photo G. Pergent).

2.4. Marine Protected Areas

The first Marine Protected Area established in Cyprus is the Lara – Toxeftra turtle reserve, set up in 1989, which includes the most important breeding biotope for the sea turtles, *Chelonia mydas* and *Caretta caretta*. The area covers 6.73 km² along 10 km of coastline and is protected by the Fisheries Law and related regulations. In 2013, Lara – Toxeftra was designated as one of the Specially Protected Areas of Mediterranean Importance (Barcelona Convention).

Six sites of Community Importance Natura 2000, including marine habitats, have been identified by the Republic of Cyprus (Figure 9):

- Kavos Gkreko (CY3000002), identified as SIC in 2008 – Area: 1 897.26 ha
- Thalassia Periochi Nisia (CY3000006), identified as SIC in 2008 – Area: 265.31 ha
- Periochi Polis - Gialia (CY4000001), identified as SIC in 2008 – Area: 1 751.38 ha
- Thalassia Periochi Moulia (CY4000006), identified as SIC in 2008 – Area: 200.15 ha
- Akrotirio Aspro - Petra Romiou (CY5000005), identified as SIC in 2008 – Area: 2 490.58 ha
- Chersonisos Akama (CY4000010) identified as SIC in 2010 – Area: 17 926.94 ha

In addition, another Cyprus area can be considered as an MPA: the Eratosthenes Seamount, located in the Eastern Mediterranean between the Levantine Platform to the south and the Cyprus margin to the north, near the subduction zone of the African plate. This area was recognized as a Fisheries Restricted Area by the General Fishery Commission for the Mediterranean Sea (GFCM), in 2006, in order to protect the deep-sea sensitive habitat over an area of 10 306 km². Legal recognition of FRAs at national level is then undertaken by the

concerned country. This specific site allows Cyprus to achieve the 10 % of its MPA but, due to its significant depth, it does not integrate any species or habitat from the Action Plan for the Conservation of Marine Vegetation in the Mediterranean.

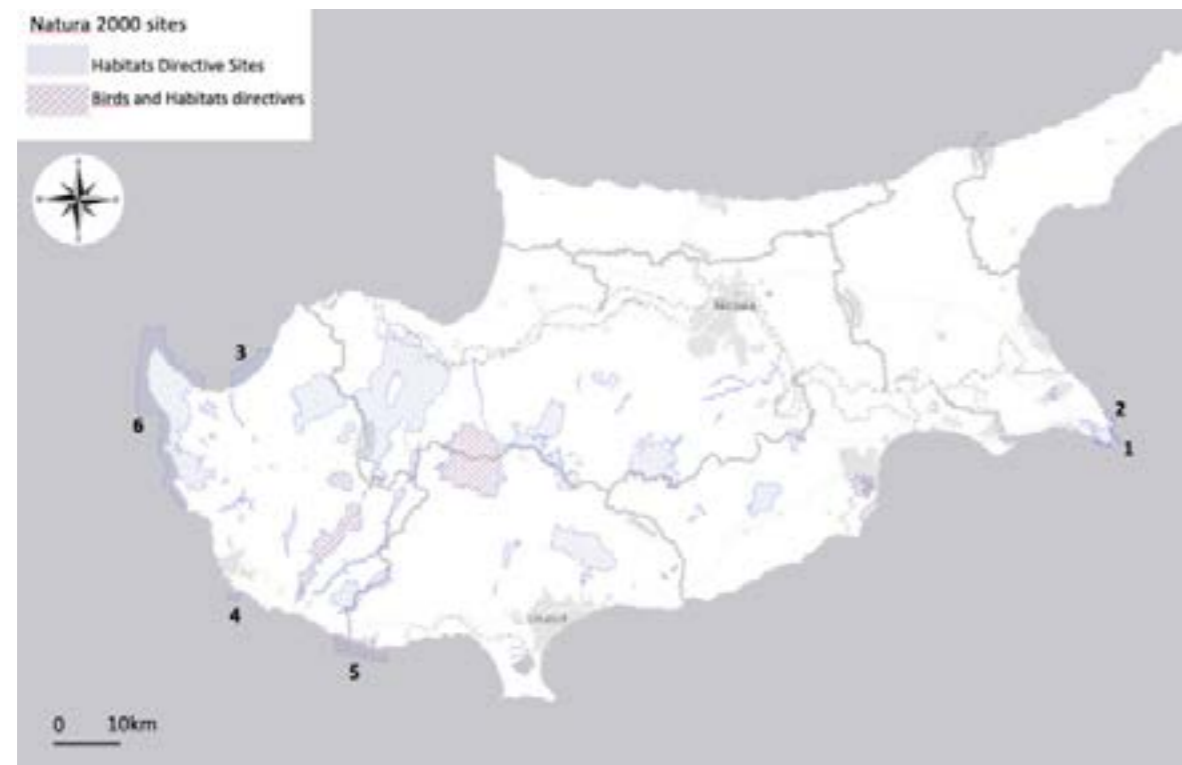


Figure 10
Location of NATURA 2000 sites in Cyprus (<https://natura2000.eea.europa.eu/>). 1: Kavo Gkreko, 2: Thalassia Periochi Nisia, 3: Periochi Polis – Gialia, 4: Thalassia Periochi Moulia, 5: Akrotirio Aspro - Petra Romiou, 6: Chersonisos Akama.

2.5. Actions completed and in progress

The Republic of Cyprus, and more specifically the Ministry of Agriculture, Natural Resources and the Environment - Department of Fisheries and Marine Research, has initiated and/or participated in several programmes aimed at enhancing knowledge of marine vegetation along the coasts of Cyprus with the objective of ensuring the conservation of species and habitats.

In 2011, the Department of Fisheries and Marine Research (Ministry of Agriculture, Natural Resources and Environment) published call for tenders N° 11/2010.

The overall objective of the project was “Services for mapping the meadows of the marine phanerogam *Posidonia oceanica* in the coastal waters of Cyprus, within the operational programme for fisheries 2007-2013”.

The main objectives of this programme concern:

- i) Mapping of *Posidonia oceanica* meadows in all the coastal waters under the effective control of the Republic of Cyprus.
- ii) Descriptive mapping of *Posidonia oceanica* meadows in Natura 2000 areas

for purposes of management and long-term surveillance of fluctuations in the distribution and extent of *Posidonia oceanica* meadows in these areas.

- iii) Descriptive mapping of *Posidonia oceanica* meadows in areas with intense anthropogenic activity (general marine area of Limassol-Basilikos), in order to ensure more effective management measures with the objective of the protection and monitoring of the state of health of the *Posidonia oceanica* meadows, and assessment of the ecological situation.
- iv) Localization of other major ecotopes potentially occurring in the mapping areas (eg *Cymodocea nodosa* meadows)
- v) Bathymetric and morphological study of the mapping areas and specification of substrate type.

The results, available since 2013, offer a basis for precise description of the distribution of each ecotope (between 0 and -50 m), at the six Natura 2000 sites and the impacted site of Limassol-Basilikos (Figure 3; Pergent-Martini *et al.*, 2013; Republic of Cyprus, 2013). Moreover, for each site, the coverage of *Posidonia oceanica* meadow, as well as its vitality is given (Appendix C & D; Tables V & VI from Pergent-Martini *et al.*, 2013).

In 2018, the Department of Fisheries and Marine Research published call for tenders N° 19/2018.

The overall objective of the project is “the mapping and evaluation of *Posidonia oceanica* meadows and other important marine habitats under the European Habitats Directive (92/43/EEC) in the coastal waters of Cyprus”.

This will be achieved by carrying out a 30-month project divided into 2 distinct Phases, which will last 18 and 12 months, respectively. Various technologies, methodologies, field, laboratory, digital and statistical techniques will be employed to collect, analyze and present the data as requested in the tender documents

Phase A will include detailed mapping of *Posidonia oceanica* meadows (Habitat 1120), Sandbanks (Habitat 1110) in coastal waters (comprising mainly *Cymodocea nodosa* meadows), Reefs (Habitat 1170) and Sea Caves (Habitat 8330). In addition, based on the new mapping results, a comparison will be made of the Natura 2000 marine areas and the Limassol – Vassilikos bay, based on the 2013 mapping results, by describing variations in the distribution and coverage of the *Posidonia oceanica* meadows. In order to map all habitats successfully, determination of the nature of the seabed / substrate will be a critical step in order to interpret the mapped data correctly.

In Phase B, a detailed monitoring plan will be drawn up and applied to the six marine areas of the Natura 2000 network. Monitoring protocols for each marine habitat (1110, 1120, 1170, 8330) will be created and implemented after acceptance and discussion with the contracting authority. Following the monitoring, as appropriate, the programme will be evaluated in line with the obligations of the implementation of the EU Habitats Directive (92/43/EEC) and Water Framework Directive (2000/60/EC). Further to this, Art 17 Reference Forms of Directive 92/43/EEC for the next reporting and update Standard Data Forms (SDFs) of the six marine Natura 2000 sites, with the required data for each marine habitat present, will be completed.

In 2019, the Specially Protected Areas Regional Activity Centre (SPA/RAC), in collaboration with the Department of Fisheries and Marine Research, published call for tenders N° 13/2019 for "Assessing the vulnerability of marine key habitats to fishing activities in Cape Greco MPA-Cyprus".

The action consists in:

- i) Setting up monitoring systems for *Posidonia oceanica* meadows in the Cape Greco MPA
- ii) Conducting a fisheries study on the importance, frequency and extent of professional fishing practices and illegal fishing practices in and around in the Cape Greco MPA and their impact on marine habitats, and assessing the socio-economic impact of invasive fish species in the MPA, as a pilot study
- iii) Assessing the sensitivity of marine habitats and in particular *Posidonia oceanica* meadows to regulated and/or non-regulated fishing activities identified in the Cape Greco MPA;
- iv) Filling in the SDF (Standard Data-Entry Form)

All these actions/projects are of major importance for the implementation of the Action Plan for the conservation of marine vegetation in the Mediterranean Sea, and more especially the National Action Plan for the conservation of marine vegetation in Cyprus.

3



3

ACTIONS TO BE IMPLEMENTED TO MEET THE OBJECTIVES OF THE NATIONAL ACTION PLAN

3.1. Legislation and management measures

The Republic of Cyprus transposed, into Cyprus law, the EU Directive on the conservation of natural habitats and of wild fauna and flora in 2003. An additional step, the transposition into Cyprus law of the Barcelona Convention, particularly its SPA/BD Protocol requirements and provisions, as well as other ratified conventions, integrating the conservation of marine vegetation (e.g. Bern Convention, CBD Convention), would be an important step in the strategy to protect marine vegetation.

In terms of environmental impact assessment, *Posidonia oceanica* beds are taken into account on the basis of Cyprus law 153(I)/2003 and relevant modifications. The relocation of floating fish farms away from the meadows is part of this approach and appears to be very effective (Kletou *et al.*, 2018b; Figure 10). The 'No Net Loss of Biodiversity' EU initiative and the 'Avoid, Reduce Compensate' sequence should be considered in the future in order to better assess the impact and threats to the marine vegetation and to reduce them. Several documents and guidelines could be used: Guidelines for the assessment of environmental impact on seagrass meadows, drawn up by SPA/RAC (UNEP-MAP-RAC/SPA, 2007a); the EU Initiative on 'No Net Loss of Biodiversity and Ecosystem Services' (Tucker *et al.*, 2016) and the 'Avoid, reduce, offset' sequence from the French Minister of Environment (MEDDE, 2012).

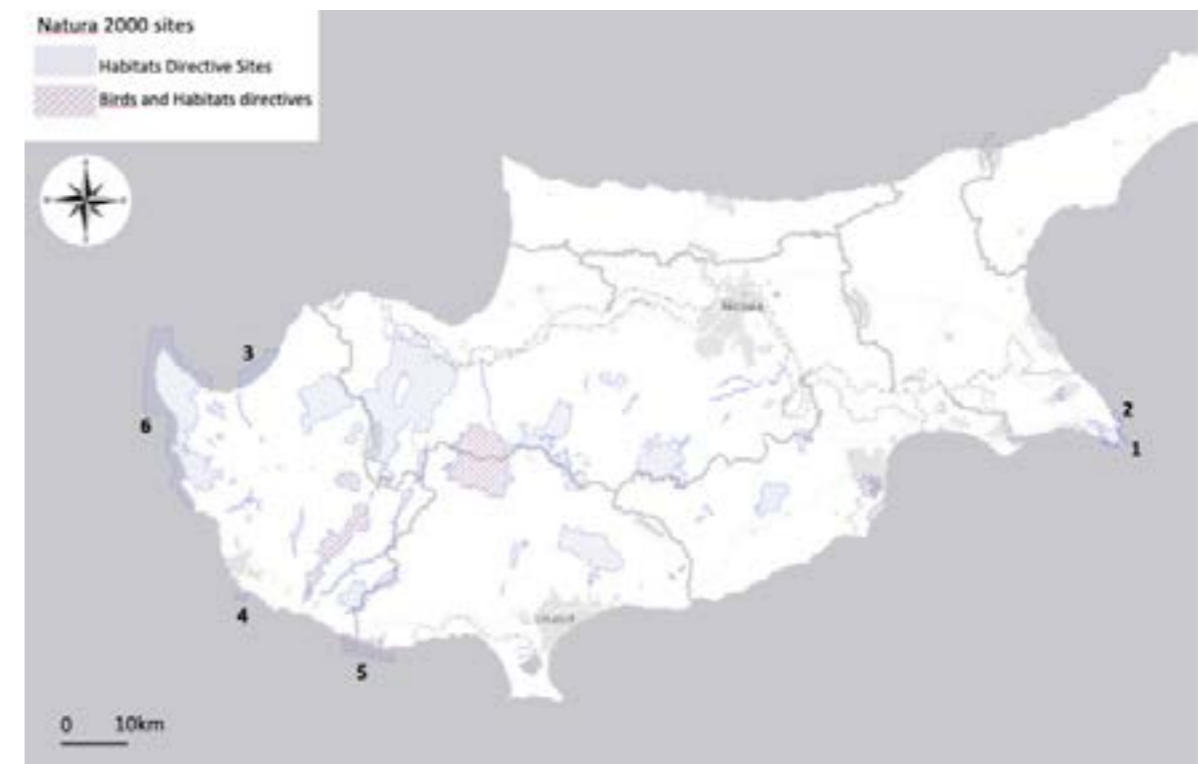


Figure 11
Locations of *Posidonia oceanica* monitoring systems and coastal areas occupied by decommissioned and active fish farms (from Kletou *et al.*, 2018b).

The Republic of Cyprus is particularly involved in the protection of the marine environment with more than 10% of its Exclusive Economic Zone (EEZ) under protection. In the future, I think that in order to strengthen the protection of coastal vegetation, new coastal MPAs integrating more specifically natural monuments (to be identified beforehand) and blue carbon ecosystems (e.g. seagrass meadows), should be considered. However, this initiative is the responsibility of the Republic of Cyprus

3.2. Summary of existing data and identification of gaps

According to available data and programmes in progress, the distribution of *Posidonia oceanica* meadows is well known. However, the patterns of change over time of this habitat have been poorly studied (trajectories of change); a reference state, based on a representative network of sites along the Cyprus coastline, and its monitoring over long periods of time, would be of particular interest. In parallel, a better assessment of specific threats to *Posidonia oceanica* meadows in relation with different human activities must be undertaken as a planning aid for reducing harmful activities / developing better practices.

Distribution of main Fucale forests (e.g. *Cystoseira* belt, deep forest, etc.), associated or not with platforms with vermitids, requires specific investigation in order to determine their biological diversity, their distribution and to identify certain 'natural monuments' representative of the Cyprus coastline.

All available information should be consolidated in a geodatabase managed by the Department of Fisheries and Marine Research. This geographic information system, regularly updated, will serve as a reference during coastal management programmes; it will make it possible to precisely assess the potential impacts and possibly to propose alternative solutions to mitigate them. It will also enable monitoring of changes in the vitality of the marine vegetation along the coasts of the Republic of Cyprus. In addition, these information could be of particular interest in line with the implementation of the EU Marine Strategy Framework Directive and the IMAP Process of the Barcelona Convention, to fulfil the descriptor "sea-floor integrity".

3.3. Case studies to implement

Several studies concerning marine vegetation have been undertaken by the Republic of Cyprus (Cf. 2e – Actions completed and in progress). However, certain new actions might be envisaged regarding (i) the monitoring of *Posidonia oceanica* meadows, and (ii) the inventory and protection of natural monuments listed in the Action Plan for the Conservation of Marine Vegetation in the Mediterranean Sea.

The first action concerns the setting up of a *Posidonia oceanica* Monitoring Network for the whole of the Cyprus coastline. This network, based on the guidelines established by the SPA/RAC (UNEP/MAP-RAC/SPA, 2015) must take into consideration the different environmental situations and threats identified along the Cyprus coastline; that is to say, 'reference sites' where human impact is low (e.g. MPAs), and 'impacted sites' where specific pressures have been observed; these pressures may be always active, increasing or decreasing. Special attention must be paid to natural monuments constructed by *Posidonia oceanica* (e.g. *Posidonia oceanica* reef; Rouanet *et al.*, 2019). On the basis of the length of coastline of the Republic of Cyprus, a number of 10 to 12 sites seems appropriate. The objective of *Posidonia* Monitoring network is to take into consideration the main environmental situations and

not only the global situation of a water body. Thus, two types of sites are monitored 1 – Reference sites with low human impact (e.g. MPA) and 2 – Sites where human pressure are identified (e.g. aquaculture farms, sewage outfall, coastal management, trawling,...). This strategy makes it possible to differentiate the global evolution (e.g. climate change) from the local anthropogenic impacts. Each site is relatively small but this strategy allows to precisely follow the *Posidonia* vitality and the evolution of environmental situation. This monitoring system would offer the means (i) to monitor the state of conservation of the *Posidonia oceanica* meadows, and (ii) to use the *Posidonia oceanica* meadows as an indicator of the quality of the environment, in addition to the sites already studied under the EU WFD. It would give managers and stakeholders precise information for the assessment of government policy regarding actions undertaken to improve the quality of the environment (Pergent *et al.*, 2015).

The second action concerns the Fucale forests (e.g. *Cystoseira* belt, deep forest, etc.) and associated natural monuments. Most of the *Cystoseira* species are large macroalgae constituting a tree stratum with stands referred to as 'marine forests'. The *Cystoseira* forests are distributed from the surf zone (midlittoral zone and infralittoral fringe) down to 50 to 60 m deep in Cyprus. These forests are home to a very rich flora and fauna and have an important functional role, especially for juveniles of many species (nurseries in Cheminée *et al.*, 2013). However, these habitats, often reported for the Cyprus coasts, are particularly threatened due to coastal development (Argyrou *et al.*, 2003; UNEP-MAP RAC/SPA, 2007b; Republic of Cyprus, 2010; DFMR, 2012a; Kletou *et al.*, 2018a). To date, there is no map of their distribution along the coast and this gap precludes monitoring of their vitality or their patterns of change over time. On the other hand, these habitats can feature several natural monuments to be protected (*Cystoseira* belts). Furthermore, a general mapping of their distribution with the location of possible natural monuments should be considered.

3.4. Awareness and capacity building

Most of the information concerning marine vegetation in Cyprus is the work of a small number of particularly committed people, often linked to the Department of Fisheries and Marine Research (Ministry of Agriculture), private organisations (Marine & Environmental Research – MER, AP Marine Environmental Consultancy) or researchers from universities abroad. The Cypriot academic institutions (e.g. Oceanography Center of the University of Cyprus) seem to be poorly involved in this issue. The involvement of research and education organisations is important; it could be achieved by establishing an agreement with the Department of Fisheries and Marine Research. This agreement should facilitate the inclusion in curricula of course topics relevant to marine environmental conservation, with a special reference to marine vegetation, and would encourage local students and young researchers interested in this field (e.g. internships in Cyprus or abroad).

Given the small number of specialists available in this field, the establishment of a list of national competencies, completed by researchers regularly working in Cyprus but belonging to institutions abroad, would offer useful support for the competent authorities.

Capacity building measures, including decision makers, stakeholders and sea users, are poorly developed in Cyprus, even if there have been several opportunities to increase knowledge on marine vegetation through several calls for tender since 2012 (c.f. 2e – Actions completed and in progress).

In addition, a particular effort must be devoted to devising a strategy for the transmission of knowledge and awareness. This strategy might be based on various actions:

- The organization of specific training courses on marine vegetation carried out with the SPA/RAC associating national and international experts. They would make it possible to train 'people-bridges' to transmit the knowledge acquired in collaboration with Mediterranean experts in the field. This training could be carried out in the form of a field study (case study) combining theoretical training and practical work, and target public administrators in central or local authorities, and bodies in charge of the management of MPAs and NGOs.
- Involving the Republic of Cyprus through the organization of media events related to the conservation of marine vegetation (symposia, workshops, debates, photo competitions, awareness-raising campaigns, etc.).
- Producing an awareness-raising video on the marine vegetation of Cyprus to be broadcast on social networks. NGOs should be encouraged to participate in such programmes to promote effective advocacy and act as relays and observers in the field.

4



4

ACTION PLAN IMPLEMENTATION TABLE AND PRIORITIES

The order of priority must be discussed with Cyprus authorities according to the various actions identified in the National Action Plan, and of course the feasibilities and goals at national level.

So in this first step, we propose a first list of actions (Table V). The implementation table might be discussed in Cyprus through internal consultation with the Department of Fisheries and Marine Research, and updated in the final version of the document. Certain actions may be already in progress, and some may have been missed out with regard to national strategy (e.g. interaction with fisheries activities).

Table 5
Action plan implementation table, proposed priorities and time table.

Activities for implementation of Action Plan	Deadline
Regulatory activities <ul style="list-style-type: none">Encourage the Republic of Cyprus to better transpose into national law the Barcelona convention, particularly its SPA/BD Protocol obligations and provisions, and others ratified conventions.Strengthen legislation on environmental impact assessments by better taking into account marine vegetation and integrated the EU Initiative on "No Net Loss of Biodiversity and Ecosystem Services" and the "Avoid, reduce, offset" sequence.Create MPAs to strengthen the conservation of blue carbon ecosystems and the services they provide in particular mitigation of climate change impacts (carbon sinks) and conservation of natural monuments (e.g. Cystoseira belt)	
Inventory activities and mapping <ul style="list-style-type: none">Initiate a systematic inventory of main Fucale forests and related natural monuments to be included in future MPAs to ensure their sustainabilityBetter evaluate specific threats on Posidonia oceanica meadows in relation with different activities in order to devise strategies to develop better practicesImplementation of a geodatabase managed by the Department of Fisheries and Marine Research	
Surveillance and monitoring activities <ul style="list-style-type: none">Promote the setting up of monitoring networks of the main marine vegetation assemblages in conformity with the principles and common indicators of the integrated monitoring and assessment programme (IMAP) and the recommendations of the Action Plan for the conservation of marine vegetation in the Mediterranean Sea:<ul style="list-style-type: none">(i) Setting up of a Posidonia Monitoring Network all around the Cyprus coastline(ii) Setting up a monitoring network of Fucale forests (diversity, distribution, vitality and trajectories of change over time) in representative sites of Cyprus and natural monuments	
Capacity and knowledge building activities <ul style="list-style-type: none">Implementation of an agreement with academic institutionsEstablishment of a list of national competencies, drawn up by researchers working on Cyprus marine vegetationOrganization of specific training course on marine vegetation with "people-bridges"Production an awareness-raising video on the marine vegetation of Cyprus	

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SPA/RAC WORKING AREAS

SPA/ RAC, the UNEP/ MAP **Specially Protected Areas Regional Activity Centre**, was created in 1985 to assist the Contracting Parties to the Barcelona Convention (21 Mediterranean countries and the European Union) in implementing the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol).



Marine turtles



Cetaceans



Mediterranean Monk Seal



Cartilaginous fishes
(Chondrichthyans)



Marine and coastal bird species

Listed in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean



Specially Protected Areas



Monitoring



Coralligenous and other calcareous bio-concretions



Marine vegetation



Dark Habitats

Habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena



Species introduction and invasive species





Mediterranean
Action Plan
Barcelona
Convention



*The Mediterranean
Biodiversity
Centre*

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This publication
has been prepared
with the financial support
of the MAVA foundation