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REGIONAL PROJECT FOR THE DEVELOPMENT OF MARINE AND COASTAL PROTECTED AREAS IN THE MEDITERRANEAN REGION (MEDMPA)

**ACTIVITÉ PP1 : IDENTIFICATION OF SITES OF CONSERVATION INTEREST
WITH A VIEW TO ELABORATING NATIONAL PLANS FOR THE DEVELOPMENT
OF PROTECTED AREAS IN CYPRUS**

**REPORT ON FIELD SURVEYS FOR THE DEVELOPMENT OF
MARINE PROTECTED AREAS IN CYPRUS**

CY-PP1b-01



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1. INTRODUCTION

The Regional Project for the Development of Marine and Coastal Protected Areas in the Mediterranean Region (MedMPA) (ref.: ME8/AIDCO/2001/0132/SMAP) of the European Commission and coordinated by the Regional Activity Center for Special Protected Areas (RAC/SPA) of the Mediterranean Action Plan (UNEP) contemplate the identification of sites of conservation interest in Cyprus. This activity (PP1): 'Identification of sites of conservation interest with a view to elaborating national plans for the development of protected areas in the identified sites' have three parts: a) preliminary mission; b) the field survey; and c) drafting of the National Plan. The present report relates the field survey carried out in November 2002.

1.1 Background

After a preliminary mission (July 2002), where the RAC/SPA and the Unidad de Biología Marina de la Universidad de Alicante (UBM) have contacted with the Department of Fisheries and Marine Research (DFMR) of Cyprus; and a second meeting (October 2002) in the University of Alicante of the UBM with Marina Argyrou of the DFMR, where the detailed programme of the field survey (November 2002) was elaborated.

In these previous meetings, information about the proposed sites, logistics and sampling strategies have been considered. Summarising this information about:

- i) Collecting existing data relevant to the marine environment in the coastal zone of Cyprus:
 - Cartography and photography: maritime charts, satellite image, aerial photography.
 - Scientific publications (marine biology, oceanography).
 - Socio-economic data (artisanal fisheries, diving, boating, tourism).

- ii) Identification of the key sites to be studied:
 - Cape Gkreko.
 - Moulia Rocks.

- iii) The detailed programme of the field survey, which is presented here:
 - Strategy and sampling methodology.
 - Logistic.

Three sites have been selected which are fulfilling the criteria of the EU Habitat Directive (Special Areas of Conservation Natura 2000) and have been proposed by Cyprus Government to be included in the Natura 2000 network. Currently, the two of the sites (Cape Greko, Moulia Rocks) have been proposed to be declared as MPAs. A third site (Akamas Peninsula), which is characterized with scarcely human impacts, also has been considered into the research field since it has great ecological interest due to its natural features, which support highly diverse marine ecosystems and interesting species with significant ecological value.

1.2 Objectives

The main objective is preparing a zoning design, based on the biological mapping, interesting species and anthropic uses, to the elaboration of the management plan for some interesting marine areas in Cyprus. The specific objectives are:

- i) identification and classification of the marine biotopes occurring in the sites in question;

 - ii) collecting data on the sea-grass meadows and other assemblages (seascapes) of importance for the marine environment;
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- iii) inventory of sites of conservation interest using the Standard Data Form; and
 - iv) elaboration of photography library.

As expected results: a report of the field survey containing an inventory of marine biocenosis and interesting species of the proposed sites of conservation interest and compiled according to the Standard data Form.

2. MATERIAL AND METHODS

2.1 Habitats and species of protection interest

Based on the Barcelona Convention (1995), Annexes II and III of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean; and also, on the Berna Convention (1996), EU Habitat Directive (1992), and Mediterranean 'Red Book' of the thread marine vegetation, associations and seascapes of the Mediterranean Sea (PNUE, 1990). Inside the present report, we included some invasive species (*Caulerpa racemosa*)

2.2 Methodology

The methodological principle of the exploratory mission is to know the natural heritage of the selected zones, realising a bionomical mapping previous to the zoning proposition, and to consider two fundamental elements to be studied:

- Inventory and cartography of the marine biocenosis and seascapes.
- Inventory and distribution of the species, mainly those recommended for the protection and management.

The information about the sites is limited, and it is necessary a field survey. This field survey will based mainly on direct submarine observations and sampling by SCUBA and snorkellig (shallow water). The survey and sampling strategies will be:

2.2.1 Preliminary information

Based on the bibliography related to marine environment of Cyprus (mainly on the future protected areas): climatology, oceanography (Zodiatis et al., 1998^a, 1998^b, 2002),

geology, terrestrial (UTM) and maritime charts (Paphos), aerial photography and satellite images, marine biology/ecology (Demetropoulos, 1969, 1971; Demetropoulos & Hadjichristophorou, 1976^a, 1976b; Hadjichristophorou & Argyrou, 1993; Hadjichristophorou *et al.*, 1997; Argyrou *et al.*, 1999; Argyrou & Hadjichristophorou, 2000) and fisheries publications (Anonymous, 2002), Geographical Information System (of the interesting sites).

2.2.2 Survey methods

The field survey, observations and sampling will be realised with different strategies, according to the depth (shallow and deep communities).

- Zoning
 - Surface communities (0-5m): snorkelling and aerial photography.
 - Deep communities (5-50m): SCUBA diving; dredging and trawling
- Type of survey
 - Extensive: free diving transects, hydroplane transects, trawling
 - Intensive: spot dives (detailed study of communities, sampling of flora/fauna) to verify the limits). Mainly on rocky bottoms, seagrass meadows (*Posidonia*, *Cymodocea*, *Halophylla*), maerl beds; organic formations (*Dendropoma*); counts of fishes, *Pinna*, another spp.

2.2.3 Sampling methods

Mainly based on non destructive methods. However, it will be necessary to take some samples to classify the organisms and some trawls on the deep soft bottoms.

- Non destructive methods
 - Photography and video
 - Counts by metric tapes and quadrates
 - visual census (fishes, naces, another spp...)
 - *Posidonia* cover
 - iron quadrates (40 x 40 cm): *Posidonia* shoots density
 - Destructive methods (take of samples)
 - selected samples by diving (algae, invertebrata)
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- dredging and/or trawling

2.2.4 Bionomical work

It is carried out by spot (SCUBA and snorkelling) and transect dives. The tasks carried out have been:

- *Deep SCUBA diving*: on circalittoral hard bottoms (sciaphylic and coralligenous communities) and coastal detritic (maërl beds), 35-60m depth, with 2-3 divers persons on hard bottoms. Distribution of tasks
 - 1 or 2 diver/s : observation of habitats, species and sampling
 - 1 diver : U/W video, U/W photography
- *Shallow SCUBA diving*: on infralittoral hard bottoms and seagrass meadows (mainly *Posidonia* beds), < 30m depth: 2-3 persons (at the afternoon). The tasks carried out are the same as the deep dives.
- *Snorkelling*: on upper infralittoral bottoms, 0-10m depth, 1-2 persons. The tasks carried out are the same as the deep dives.
- *Hydroplane transects*: on infralittoral and circalittoral bottoms (mainly soft bottoms) with gentle slope, 5-45m depth, 1 SCUBA diver/transect. The hydroplane has been trawled by boat with a speed = 1.4-1.8 knots, and 15-30' diving time. The tasks distribution have been: i) 1 towed diver; ii) 1 person with the outboard engine and transect direction; iii) 1 person with the echosounder and time (the position was taken each 2'); and iv) 1 person with GPS and diver security.

Due to the security, only a deep SCUBA dive (in the morning) was carried out, and a shallower second dive in the afternoon, as well as snorkelling surveys.

2.2.5 Visual census (fishes and invertebrates)

The sampling of the ichthyofauna was carried out by means of visual census in SCUBA diving. This not destructive technique is extensively used around the world (Harmelin-Vivien *et al.*, 1985), mainly in marine protected areas. This method is necessary to get an good appreciation of the 'reserve effect' (Bayle & Ramos-Esplá, 1993).

We have used strip transects along 50 x 5 m (visual area), with five replicates/station between 5 to 25m depth. For each census, abundance of each observed species was recorded using classes of abundance (1, 2-5, 6-10, 11-30, 31-50, 51-100, 101-200, 201-300, 301-500, >500). With these data we calculate the biomass by means of length-weight relationships for each species. Strip transects were placed randomly over each selected site at each studied location (Cape Greco and Moulia Rocks). Sites were placed randomly too, mainly on rocky bottoms, carrying out four census in each site.

Also, observations about interesting invertebrate species (e.g. *Pinna nobilis*) have been taken along the transects.

2.2.6 *Posidonia oceanica* characterisation

Posidonia oceanica of Cape Greco and Moulia Rocks was sampled at shallow (5-10m) and deep (20-25m) meadows. It is analysed the shoots/density with a iron frame (30 x 30 cm) and three vertical (orthotropic) and three horizontal (plagiotropic) rhizomes were sampled in each *Posidonia* station.

Reconstruction techniques have been widely used to study seagrass dynamics. Lepidochronology was used as a reconstructive tool to analyse main characteristics of the plants (Pergent, 1987; Guidetti & Fabiano, 2000; Guidetti, 2001). The thickness of *Posidonia oceanica* sheaths has been shown to exhibit annual cycles, each cycle (i.e. the segment of rhizome comprised between two minims of sheath thickens) correspond to 1 year and the length of the rhizome segment comprised by each cycle. This annual cycles are only clearly appreciated in vertical shoots but not in the basal, horizontal stem. We used the age of vertical shoots to date indirectly horizontal rhizomes by ageing all their vertical ramifications: the difference in age of two consecutive vertical branches along the same horizontal rhizome correspond to the age of the segment for each horizontal rhizome and corresponding vertical ramifications, we measured elongation, leaf and rhizome production, ramification balance (new minus dead ramifications per year), the aborted ramifications (we considered aborted ramifications those that are not visible until dissection of the rhizome that are formed only by

few leaves) Rhizome production was estimated after drying rhizome until constant weight a during 24 h at 80°C.

For the data analysis a mixed design of analysis of variance (ANOVA) (Underwood, 1981) were employed in testing parameters from seagrass structure and rhizome growth, with respect to the main factors considered: Depth and Locality. The linear model for this analysis was:

$$X_{ijn} = \mu + D_i + L_j + D_i * L_j + \text{Residual}$$

where X_{ijn} is each dependent variable, μ is the overall mean, D_i is a the depth factor, L_j is the effect of the j th Locality, and $D_i * L_j$ is the effect of its interaction.

2.2.7 Trawl sampling

To analyse the soft bottoms communities (> 50 depth) a trawling survey has carried out on board. The trawler was the 'Agios Sylianos II' (GRT: 56 mt, length: 24.0m; engine: 500 HP) of the Larnaka port. The fished area has been in the South-eastern part of Cyprus (Famagusta - Larnaka), between the 18h and 6h of the next day (12 hours on board), and the trawling depths between 35 to 85m. Also, it is important to know the fished sectors and depths to have an idea of the illegal trawling (quite near from de coast). The sampled sectors are been:

- 1) Famagusta-Maraliman (35-85m depth): coarse sand and muddy detritic bottoms with *Caulerpa prolifera* y *C. racemosa*.
- 2) Cape Greko (55-65m): *Peyssonnelia* with *Palmophyllum* beds, rare maërl and not *Caulerpa prolifera* y *C. racemosa*).
- 3) Front of Annabas (55-75m): muddy detritic bottoms with *C. racemosa*, *C. prolifera*, *C. bursa*; some stones with *Cystoseira* spp. and *Sargassum* spp.
- 4) Larnaka area (55-75m): Sandy mud bottoms with *Caulerpa prolifera* and *C. racemosa*.

2.3 Material

Mainly based on the dive surveys. Apart of the personal equipment, It is necessary SCUBA tanks and fill up them, small boats to access on the diving sites, and navigational and position facilities (GPS, echousounder, communication). The material to carry out by the different parties is:

- Unidad de Biología Marina (UBM)
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- Diving:
 - Personal equipment: diver suit, mask, snorkel, palms, knife, lead belt, regulator, jacket, dive computer, mesh bag, decompression balloon, U/W compass, plastic sheets.
 - Visual counts: 50 m metric tape (2)
 - U/W image: Nikon digital and video; Nikon + flash + 15mm
 - Position and bathymetry : GPS, echosounder
 - Portable computer
-
- Department of Fisheries and Marine Research of Cyprus (DFMR)
 - Diving:
 - SCUBA tanks (8-10 of 15 or 18 l), compressor, leads (8kg/diver).
 - Boats (1 or 2) with anchor, VHS radio, echosounder?)
 - Hydroplane (1) + 100m rope ($\varnothing = 5\text{mm}$)
 - Iron frames (2) of 40 x 40 cm (*Posidonia* studies)
 - Security: oxygen tank, hyperbaric chamber (location, telephone, means of displacement: by helicopter, car, boat)
 - Cartography, bathymetry and position
 - Mapping (marine charts, UTM maps), GPS, GIS mapping (?)
 - Aerial photography of the selected zones
 - Bathymetry: 1 Motorcycle battery (12 volts) to echosounder
 - Sampling and storage:
 - Possibility of dredge and/or trawl sampling
 - Samples storage (ascidians, macroalgae): formaline, plastic flasks (15l) and plastic bags

2.4 Working planning

2.4.1 Selected sites

The sites were selected by the Department of Fisheries and Marine Research of Cyprus. Three areas have been prospected (fig. 1): To see the possibility to have 3 representative sites on (fig. 1):

- 1st) Eastern part (Cape Greko), included in the Cyprus Natura 2000 sites (fig. 2).
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- 2nd) Western part (Moulia Rocks), included in the Cyprus Natura 2000 sites (fig. 3).
- 3rd) Northern part (Akamas Peninsula), included in the Natural Park of Akamas and Nature Reserve of Lara-Toxeftra (fig. 4)



Figure1. Location of the observed three areas: (1) Cape Greko; (2) Moulia Rocks; (3) Akamas.

The surface temperatures and salinities in Cyprus waters are (Zodiatis et al., 1998b): (-2m) 22 September-16 October (1995), upper mixed layer (at 20-30m depth) with extremely high salinity 39.4-39.55psi. and temperature 24-26.5°C; (-5m) 6-13 May (1996), 19.4°C and 39.18 and 39.10 psi.

2.4.2 Working time

The preliminary field mission in Cyprus has gone on for 16 days (16/11-01/12/02, table 1) and the second 8 days (26/10-02/11/03, table 2) .

Days (16/11-01/12/02)	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	01
Arrival / Departure	x															x
Mission preparation		x														
Cape Greco			x	x	x	x	x	x	x							
Moulia Rocks										x	x	x				
Akamas Cape													x	x		
Mission report															x	

Table 1. Working time distribution in the Cyprus'02 mission

Days (26/10-02/11/03)	26	27	28	29	30	31	1	2
Arrival / Departure	x							x
Mission preparation		x						
E-Akamas			x	x	x			
W-Akamas						x		

Mission report							x	
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Table 2. Working time distribution in the Cyprus'02 mission

2.4.3 Logistics

The main logistic facilities have been: i) lodgement and maintenance around the selected sites; ii) transport by DFMR cars and harbour facilities; iii) diving facilities (fill up SCUBA tanks) in Agia Napa and Pahos; iv) DFRM vessel (Cape Greco and Akamas Peninsula) and rent a artisanal fishing boat in Cape Greko, glass bottom boat in Paphos.

2.4.4 Stations

The figures 2-4 show the location 44 stations observed and/or sampled with the different methods (table 3). The characteristics of the stations (date, geographical coordinates, depth, method and substrates) appear in the Annex I.

The observed stations appear in the figures 2-4 indicating the spot dives (SCUBA, snorkelling) and hydroplane transects.



Figure 2. Stations in the Cape Greko area.



Figure 3. Stations in the Moulia Rocks area.



Figure 4. Stations in the Western Akamas area.

	Cape Greko	Moulia Rocks	Akamas Area
Type of main bottom	rocky, seagrass	rocky, sandy, seagrass	rocky, sandy

Bathymetry	0-55m	0-45m	0-60m
Slope	hard	gentle	hard
Hydroplane	+	+	+
Deep diving	+	-	+
Shallow diving	+	+	+
Snorkelling	+	+	+
Trawling	+	-	-

Table 3. Main features and tasks to be compiled on the proposed sites

3. RESULTS

3.1 BENTHIC COMMUNITIES

The habitats, communities and associations (with facies) have followed the classifications of UNEP/MAP (1998) and EUNIS (EEA, 2002), mainly based on the Pérès & Picard (1964) and Péres (1967) publications. We have included the more abundant species and/or characteristic of the observed macrobenthos with a subjective appreciation of the abundance: (cc) very common, (c) common, and (r) rare. The species observed in the different communities are included in the Annex II.

3.1.1 SUPRALITTORAL

1. 2 Sands

1.2.1 Biocenosis of the supralittoral sands

1.2.1.1 Facies of the sands without vegetation with dispersed detritus: This facies is well developed in the Lara area. It is important to point to the presence of the protected crab *Ocypode cursor*.

1.4 Hard beds and rocks

1.4.1 Biocenosis of supralittoral rock

1.4.1.1 Association with *Entophysalis deusta* and *Verrucaria* spp.: With the lichens *Caloplaca aurantia* and *Verrucaria adriatica* (com. Marina Argyrou) and the gastropod *Littorina neritoides* (cc). It no has observed *Nodilittorina* (= *Littorina*) *punctata*.

3.1.2 MEDIOLITTORAL

2.4 Hard beds and rocks

2.4.1 Biocenosis of the upper mediolittoral rock

2.4.1.4 Association with *Lithophyllum papillosum* and *Polysiphonia* spp.: The sessile fauna is represented by *Chthamalus depressus* (cc) and the vagil fauna by the gastropods *Littorina neritoides* (c) and *Patella rustica* (r) and the crab *Pachygrapsus marmoratus* (c).

2.4.2 Biocenosis of the lower mediolittoral rock

2.4.2.3 Association with *Tenarea undulosa* and *Lithophyllum trochanter* auct. (= *L. byssoides*). It is developed in exposed zones, mainly on Cape Greco.

2.4.2.4 Association with *Ceramium ciliatum* and *Corallina elongata* : In moderate exposed zones (Cape Greco, Moullia Rocks). With the cyanophyta *Rivularia atra* and the chlorophytes *Cladophora* spp.

2.4.2.8 *Spongites notarisii* (= *Neogoniolithon brassica-florida*) concretion : With the vermetid *Dedropoma petraeum*. Also, this important concretion is present at the littoral fringe. The vermetid formations appear well developed in the Cape Greco area (forming small cushion structures) and less developed structures (plates) in Moullia Rocks.

2.4.2.10 Pools and lagoons sometimes associated with vermetids (infralittoral enclave):

These infralittoral enclaves are frequent in the sandstones and limestones. The macroalgae are abundant: as chlorophytes (*Cladophora* spp., *Enteromorpha* spp., *Valonia utricularis*), phaeophytes (*Cystoseira compressa*, *Dictyota spiralis*) and rhodophytes (*Jania rubens*, *Laurencia obtusa*, *L. papillosa*, *Corallina elongata*, *Alsidium helminthochorton*)

The fauna in the lower mediolittoral rock is represented mainly by the gastropods *Patella ulyssiponensis* (cc) and *Osilinus* (= *Monodonta*) *turbinatus* (cc), and the crustaceans *Chthamalus depressus* (c) and *Pachygrapsus marmoratus* (c). The fauna of the pools (com. Marina Argyrou) is dominated by gastropods: *Patella coerulea*, *Diodora gibberula*, *Osilinus tuberculatus*, *Gibbula* spp., *Pisania stricta* (= *P. maculosa*), *Columbella rustica*, *Cerithium rupestris*, *Conus ventricosus* (= *C. mediterraneus*), *Pirenella conica*, *Vermetus* sp. Also, the

chiton *Chiton olivaceus*, the bivalve *Brachidontes variabilis*, the sedentary polychaete *Bispira volutacornis*, the anemone *Anemonia viridis* (= *A. sulcata*), and the shrimp *Palaemon serratus*.

3.1.3 INFRALITTORAL

3.2 Fine sands with more or less mud

3.2.2 Biocenosis of well sorted fine sand (fig. 5)

Between 0 to 25m with the bivalves (shells): *Callista chione* (c), *Macra stultorum* (cc), *Tellina planata* (cc), *Glycymeris insubrica* (cc), *Acanthocardia tuberculata* (c); the lessepsien gastropoda *Nassarius circumcinctus* (r); the hermit crab *Diogenes pugilator* (c); the echinoderms *Astropecten aranciacus* (c) and *Echinocardium mediterraneus* (shells) (cc); and fishes *Bothus podas* (c), *Lithognathus mormyrus* (cc), *Synodus saurus* (c), *Trachinus draco* (c), *Xyrichthys novacula* (cc). *Xyrichthys novacula* particularly abundant in the Cape Greco area.

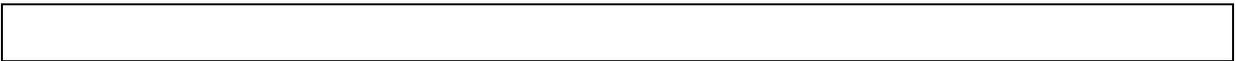


Figure 5. The flat fish *Bothus podas* on fine sand bottom. Lara beach, -2m (photo 9088)

3.2.2.1 Association with *Cymodocea nodosa* (fig. 6): Only present in very located stations (Eastern of Cape Greco, at 9-12 m depth, and Akamas, at 39-41 m depth) on sandy bottoms. The Akamas meadow is dense with *Caulerpa prolifera* (cc) and *C. racemosa* (c)



Figure 6. Sandy bottom with the fanerogame *Cymodocea nodosa* and *Caulerpa* spp. (*Caulerpa prolifera* and *C. racemosa*). Akamas, -41m (photo 8818)

3.2.2.2 Association with *Halophila stipulacea*: Only observed around the Cape Greco area in sandy coarse bottoms between 33-37m with *Caulerpa prolifera*; also observed in sparse *Posidonia oceanica* meadows at -23m.

3.2.3 Biocenosis of superficial muddy sand in sheltered waters

3.2.3.6 Association with *Caulerpa prolifera* (figs. 6 and 7): This chlorophyte is very abundant in all of the observed sectors (on rocky and soft bottoms, *Posidonia* meadows), at depths (between 5 to 70m depth in trawling samples). Mainly *C. prolifera* forms grasses on soft

bottoms, normally with *C. racemosa*, well developed in the Eastern Cape Greco and Moulia areas in the sparse *Posidonia* meadows (between 10-30m depth) and on coastal detritic bottoms (> 40m depth).



Figure 7. *Caulerpa prolifera* grass on dead matte of *Posidonia*. Moulia Rocks, -16m (photo 8480)

3.3. Coarse sands with more or less mud

3.2.2 Biocenosis of coarse sands and fine gravels under the influence of bottom currents (figs. 8 and 9)

This community appears from 10m depth around and inside of *Posidonia* meadows and continue to 35m depth. The bottom is formed by debris (sand and gravel) of calcareous tests of molluscs, madreporarian, bryozoan, serpulids, echinoderms, etc. Also it appears



Figure 8. Biocenosis of coarse sand and fine gravel with bottom currents (molluscan shells and calcareous algae and echinoderm tests). Moulia Rocks, -23m (photo 8483)

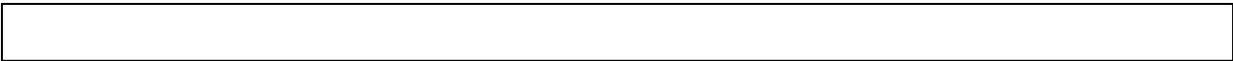


Figure 9. The sedentary polychaete *Sabella pavonina* in coarse sand bottoms. Moulia Rocks, -23m (photo 8530).

The sessile fauna is scarce, only the sedentary polychaete *Sabella pavonina* (c) has been observed. The vagile fauna is scattered, mainly the echinoderms: *Astropecten aranciacus* (c), *Spatangus purpureus* (r) and *Brissus unicolor* (r); also the fish *Gobius bucchichi* (c).

3.5 *Posidonia oceanica* meadows

3.5.1 *Posidonia oceanica* meadows (= Association with *Posidonia oceanica*) (figs. 10 and 11)

This community is well developed in the Cape Greco and Moulia Rocks areas, on coarse sand bottoms as well as on rocky substratum, between -38m depth (Western part of Cape Greco) to -4m. In the Moulia Rocks area the *Posidonia* matte forms terraces with 1-2m high (15-25m depth).

The rhizome stratum is colonised by the sciaphylic algae association with *Flabellia petiolata* (cc), *Peyssonnelia* spp. (cc), *Caulerpa prolifera* (c), *Lithophyllum stictaeforme* (c), *Mesophyllum alternans* (c) and *Cladophora patentiramea* (c). The sessile fauna is diverse, mainly the sponges: *Sarcotragus muscaria* (c), *Ircinia* sp. (cc), *Calyx nicaeensis* (r); the sedentary polychaete *Sabella spallanzani* (c); the bivalve *Pinna nobilis* (c); the bryozoan *Schizomavella* sp. (c); and ascidians of the family Didemnidae (cc) in both rhizomes and leaflets.

With regards of the vagile fauna, the more common species are the sea urchin *Sphaerechinus granularis* (c) and the fishes *Spicara smaris* (cc), *Chromis chromis* (cc), *Coris julis* (cc), *Scarus cretensis* (cc), *Siganus luridus* (cc), *Diplodus vulgaris* (c), *D. annularis* (c), *Sarpa salpa* (c) and *Symphodus tinca* (c).



Figure 10. *Posidonia oceanica* on rocky bottoms with the echinoid *Sphaerechinus granularis*. Moullia Rocks, -9m (photo: 8597).



Figure 11. Front of *Posidonia* with plagiothrope rhizomes. Moullia Rocks, -18m (photo 8922).

3.6 Hard beds and rocks

3.6.1 Biocenosis of infralittoral algae

The biocenosis of the infralittoral algae are divided by numerous associations, mainly relative to illumination (photophylic, hemiphotophylic and sciaphylic habitats, fig. 12) and wave intensities (very exposed, exposed, calm horizons).



Figure 12. Biocenosis of the infralittoral algae with the associations with the photophilic algae (behind *Cystoseira barbata* and the sponge *Sarcotragus muscaria*), hemiphotophilic algae (right side *Dictyopteris polypodioides*) and sciaphylic algae (*Flabellia petiolata* and *Peyssonnelia squamaria*). Moullia Rocks, -14m (photo 8709)

a) Communities of infralittoral algae exposed to wave action

3.6.1.2 Overgrazing facies with incrustant algae and sea urchins (fig. 13): This facies is rare in the observed zones and very localised and in shallow waters (0-5m depth). The bare bottom is covered by incrustant calcareous rhodophytes (*Neogoniolithon* sp., *Lithophyllum*

sp.) and sea urchins (*Arbacia lixula* and *Paracentrotus lividus*). Another incrustant species can be present, as the red sponge *Crambe crambe* and the bryozoan *Reptadeonella violacea*.



Figure 13. Overgrazing facies with incrustant algae and sea urchins (*Paracentrotus lividus*). Moullia Rocks, -8m (photo 8668).

Another possible bare bottom facies could be with the endolithic sponge *Cliona celata* (fig. 14). This sponge can extend over some square meters and dominate the substrate in shallow waters (0-5m). Only some incrustant algae have been observed in this facies.

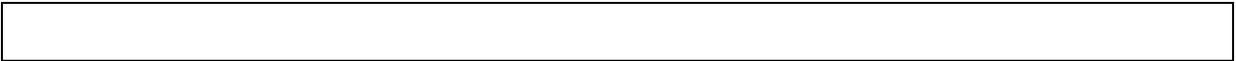


Figure 14. Bare rock with the drilled sponge *Cliona celata*, *Lithothamnion* sp (rose plots) and the sponge *Crambe crambe* (red plots) on infralittoral bottoms. W-Cape Greco, -10m (photo 8002)

3.6.1.2 Association with *Cystoseira amentacea* : This association has been rare, only on some very exposed sites in Cape Greco (0-1m depth), with the macroalgae *Laurencia obtusa*, *L. papillosa* *Anadyomene stellata*, *Dyctiota fasciola*, *Corallina elongata*, *Jania rubens*, *Spongites notarisii* and *Valonia utricularis*

3.6.1.3 Facies with vermetids : This facies is developed in Cape Greco, between 0-1m depth, with the vermetid *Dendropoma petraeum* and the corallinacea algae *Spongites notarisii* and *Lithophyllum trochanter*. With the erect algae *Laurencia obtusa* (cc), *Anadyomene stellata* (cc) and *Dictyota spiralis* (cc). The hydrozoan *Eudendrium* sp. is very common.

b) Communities of infralittoral algae moderately exposed to wave action

b.1) Photophilic algae

3.6.1.8 Association with *Dasycladus vermicularis* (fig. 15): More frequent in the Moullia Rocks, in shallow waters (0-10m depth).



Figure 15. The chorophyte *Dasycladus vermicularis*. Moullia Rocks, -8m (photo 8624).

3.6.1.9 Association with *Alsidion helmintochorton* . Particularly on the littoral fringe and littoral pools.

3.6.1.16 Association with *Cystoseira barbata* (= *Cystoseiretum barbatae* Pignatti 1962) (fig. 16): This association correspond in Cyprus waters to the *Cystoseira crinita* one, replaced by *C. barbata* f. *barbata*. It is well developed in Cape Greco and Moullia Rock areas, between 1 to 14m depth. The *Cystoseira* spp. (*C. barbata*, *C. cf. sedoides*, *C. compressa*) dominate the photophilic community. It seem some bathymetric separation between *C. barbata* (more superficial) and *C. cf. sedoides* (fig. 17)

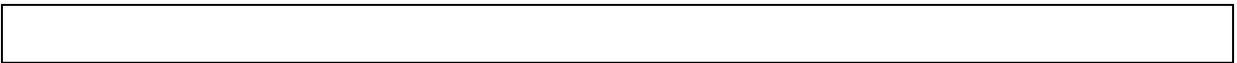


Figure 16. *Cystoseira barbata* 'forest' with the scarid fish *Sparisoma cretense*. W-Cape Greco, -15m (photo 8117).

The main macroalgae in the medium and lower strata are: *Anadyomene stellata* (cc), *Dasycladus vermicularis* (cc), *Jania rubens* (cc), *Amphiroa rigida* (cc), *Dictyota fasciola* (cc), *Laurencia obtusa* (c) and *Padina pavonica* (r). In some locations (Moullia Rocks) there is also *Caulerpa prolifera* (cc). The sessile fauna is represented by the sponges *Sarcotragus muscaria* (c), *Crambe crambe* (cc) and *Ircinia fasciculata* (c).



Figure 13. Association with *Cystoseira cf. sedoides* (cylindrical thales). W-Cape Greco, -12m (photo 8001)

The main vagile invertebrates: gastropods *Cerithium rupestre* (cc), *Columbella rustica* (cc), *Strombus decorus* (cc) and *Fasciolaria lignaria* (c); the polychaete *Hermodice carunculata* (cc); the decapod *Clibanarius erythropus*; and the echinoidea *Paracentrotus lividus* (cc) and *Arbacia lixula* (c). It is deserved to signalise the presence of *Charonia tritonis variegata* in Moullia Rocks. Among the fishes: *Chromis chromis* (cc), *Coris julis* (cc), *Scarus cretensis* (cc), *Thalassoma pavo* (cc), *Siganus luridus* (cc), *Diplodus vulgaris* (cc), *Diplodus sargus* (c), *Symphodus roissali* (c) and *Serranus scriba* (c). There is noteworthy the abundance of juveniles of *Epinephelus marginatus* (<20cm) in the point of the Cape Greco.

In some extended zones (Cape Greco area), between 15 to 30m there is and association with herbaceous (*Jania rubens*, Ceramiales, Cyanophyta?) and incrustant

macroalgae (*Neogoniolithon* sp. *Lithophyllum* sp.) without upper and medium strata (fig. 17), only some exemplars of *Codium bursa*. Some invertebrates species are common in this association: the gastropod *Strombus decorus* and the holothurian *Synaptidae* sp. (fig.



Figure 17. The association with filamentous algae (Ceramiales, Cyanophyta?). Cape Greco, -20m (photo 8453)

b.2) Hemiphotophilic algae

3.6.1.21 Association with *Dictyopteris polypodioides* (fig. 18): Less developed association with the macroalgae: *Codium bursa* (cc), *Cladophora patentiramea*. (cc), *Stypodium shimperii* (cc), *Dictyopteris polypodioides* (c), *Halopteris filicina* (r) and particularly *Neogoniolithon* sp. (cc).



Figure 18. The hemisciaphilic brown alga *Dictyopteris polypodioides* with *Peyssonnelia squamaria* (red). Moullia Rocks, -15m (photo 8770).

The sponge *Chondrosia reniformis*, and the asteroid *Echinaster sepositus* are common in this association.

b.3) Sciaphilic algae

3.6.1.32 Association with *Flabellia petiolata* and *Peyssonnelia squamaria* (fig. 19): Well developed in the sciaphilic rock and lower strata in the *Posidonia* meadows with the macroalgae: *Flabellia petiolata* (cc) and *Peyssonnelia* spp. (cc) (*Peyssonnelia squamaria*, *P. rosa-marina*, *P. rubra*).

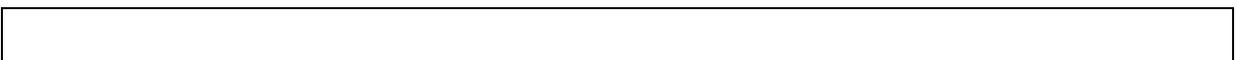


Figure 19. Association with the sciaphilic algae: *Peyssonnelia squamaria* (garnet spots), *Mesopyllum alternans* (rose plates). *Peyssonnelia coriacea?* (brown plates) and *Flabellia petiolata* (dark green spots). Moullia Rocks, -9m (photo 8648)

The main associated algae have been: *Styopodium shimperi* (c), *Cladophora patentiramea* (c), *Palmophyllum crassum* (c), *Jania corniculata* (c), *Osmundaria volubilis* (r), *Sphaerococcus coropifolius* (r) and incrustant corallinacea (cc) (*Lithophyllum stictaeforma*, *Mesophyllum alternans*, *Neogoniolithon* sp.). In some places, as Moullia Rocks and Akamas the chlorophytes *Caulerpa prolifera* (cc) and *C. racemosa* (c) are present.

The main sessile fauna are the poriferans: *Agelas oroides* (c), *Chondrosia reniformis* (c), *Petrosia ficiformis* (c). The echinoderms represent the more frequent vagile fauna with *Echinaster sepositus* (c), *Sphaerechinus granularis* (c), and *Marthasterias glacialis* (r)

3.6.1.35 Facies and association of coralligenous and semi-dark biocenosis (infralittoral enclaves) (fig. 20).

In the infralittoral enclaves of this community (overhangs, cave entries, crevices) there is the littoral rocky coralligenous community with the calcareous algae: *Lithophyllum stictaeforme*, *Mesophyllum alternans*, *Neogoniolithon* sp. and *Peyssonnelia rosa-marina* . The sessile fauna: sponges *Agelas oroides* (cc), *Spirasterella cunctatrix* (c); the madreporarian *Madracis phaerensis*; the serpulid *Protula intestinum* (cc); and the ascidians *Halocynthia papillosa* (c), *Pyura dura* (r). The main vagile fauna are the fishes: *Tripterygion tripteronotus* (cc), *Apogon imberbis* (c), *Pempheris vanicolensis* (c), and *Sargocentrum ruber* (c), these two lessepsian species only have been observed in Cape Greco.



Figure 20. Coralligenous enclave in the infralittoral stage with the incrustant red algae *Mesophyllum alternans* (rose) and *Peyssonnelia rosa-marina* (garnet), and the sponges *Agelas oroides* (orange) and *Crambe crambe* (red). Moullia Rocks, -13m (photo 8707).

3.1.4 CIRCALITTORAL

The circalittoral communities in horizontal surfaces start about the 40-45m. Also, they appear in enclaves (overhangs, caves, crevices) near of the surface see paragraph 3.6.1.35).

4.2 Sands

4.2.1 Biocenosis of the muddy detritic bottom

Between 45-80m depth, with *Caulerpa prolifera* (cc) and *C. racemosa* (cc). The sessile fauna are composed mainly by solitary ascidians: *Ascidia mentula* (cc), *Ascidia virginea* (r), *Microcosmus* sp. (r), *Molgula* sp. (r), and *Phallusia mammillata* (c). Among the

vagile fauna the polychaete *Hermione hystrix* (cc), the hermit crab *Paguristes eremita* (c), and the echinoderms *Antedon mediterranea* (r), *Echinaster sepositus* (r), and *Opiura* sp.

4.2.2 Biocenosis of the coastal detritic bottom

4.2.2.2 Maërl facies: located community (fig. 21): Very locates community (fig. 21), from 35m depth appears some sparse rhodoliths of the calcareous corallinaceae *Lithophyllum coralioides* (c), *Phymatolithon calcareum* (r) and *Mesophyllum alternans* (r) forming a facies of the coastal detritic bottoms. In some places the detritic bottom is covered by the chlorophytes *Caulerpa prolifera* (cc) and *C. racemosa* (cc), mainly in Eastern Cape Greco area (fig. 22) with *Flabellia petiolata* (r), and some rhodophytes as *Osmundaria volubilis*, *Rhodymenia ardissoni*, and *Botryocladia botryoides*. In some places with stones the fucaceans *Cystoseira spinosa* and *Sargassum hornschurchii* are present.



Figure 21. Test of *Spatangus purpureus* on maërl facies. It is observed some rhodoliths (right side) (photo 8087).

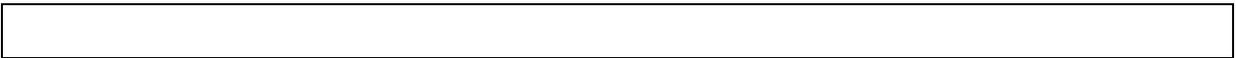


Figure 22. Coarse sand bottom with *Caulerpa prolifera* and *C. racemosa*. Cape Greco (NE area), - 55m (photo 8058)

The sessile fauna with the poriferans *Cliona viridis* (r), *Ircinia* spp. (r), *Suberites* sp. (c); the ascidians *Phallusia mammillata* (c), *Ciona edwardsi* (cc), and *Pyura dura* (r). The observed vagile fauna has been: the crustacean decapods *Paguristes eremita* (c), *Lissa chiragra* (r), and *Parthenope massena* (c); the echinoderms *Ophioderma longicaudum* (r), *Centrostephanus longispinus* (r), *Sphaerechinus granularis* (c), *Stylocydaris affinis* (r), *Spatangus purpureus* (c), and *Antedon mediterranea* (c).

4.2.2.3 Association with *Peyssonnelia rosa-marina* : This association has been observed by trawling front of the Cape Greco (55-65m depth) with *Peyssonnelia rosa-marina* (cc), *Peyssonnelia* spp. (c) and the chlorophyte *Palmophyllum crassum* (cc).

4.3. Hard beds and rocks

With the biocenosis of the coralligene (on littoral rocky bottoms) and the semi-dark caves. Both appear in enclaves in shallow waters (overhangs, caves entries, crevices), and the coralligenous community at 41m in horizontal surfaces.

4.3.1 Coralligenous biocenosis (fig. 23)

This important community forms enclaves in the infralittoral stage (see paragraph 3.6.1.35) and colonise horizontal surfaces from 41-45m depth. The chlorophytes *Caulerpa prolifera* (cc) and *C. racemosa* (cc) colonise these horizontal surfaces between 45-55m depth (it is observed in Cape Greco, Moulia Rocks and Akamas). The main macroalgae are calcareous (*Lithophyllum stictaeforme*, *Mesophyllum alternans*, *Peyssonnelia* spp.) and form an incrustant substratum.



Figure 23. Biocenosis of coralligenous with incrustant rhodophytes (*Mesophyllum alternans*, *Peyssonnelia* spp.) and the sponges *Agelas oroides* (orange) and *Crambe crambe* (red), with *Caulerpa* spp. (*C. prolifera* and *C. racemosa*). NE-Cape Greco (-51m) (photo 8048).

The more frequent algae are: *Mesophyllum alternans* (cc), *Lithophyllum stictaeforme* (cc), *Peyssonnelia* spp. (cc) (*P. rubra*, *P. rosa-marina*, *P. coriacea*), *Botryocladia botryoides* (cc),), *Rhodymenia ardissonnei* (cc), *Valonia macrophysa* (c), *Fauchea repens* (c), and *Osmundaria volubilis* (c). Among the sessile fauna: the poriferans are the most abundant with *Agelas oroides* (cc), *Clathrina clathrus* (cc), *Axinella polypodioides* (cc), *Axinella damicornis* (cc), *Ircinia* spp. (c), *Ircinia oros* (c), *Phorbas tenacior* (c), *Dysidea avara* (c), *Calyx nicaensis* (r), *Sarcotragus spinosula* (c), *Hamigera hamigera* (r); the cnidarian *Madracis phaerensis* (c); the polychaetes: *Protula intestinum* (cc), *Serpula vermicularis* (cc), *Filograna implexa* (r) (only observed in Akamas area); the bryozoans *Schizomavella* sp. (cc), *Retepora septentrionalis* (c), *Adeonella calveti* (c); and the ascidians *Halocynthia papillosa* (cc), *Pyura dura* (c).

Among the vagile fauna: the polychaete *Hermodice carunculata* (cc); the hermit crab *Calcinus tubularis* (cc); and the fishes *Anthias anthias* (cc), *Chromis chromis* (cc), *Serranus cabrilla* (c), *Coris julis* (c). It is noteworthy signal the presence of *Thalossoma pavo* in this depths.

4.3.1.1 Association with *Cystoseira zosteroides* (fig. 24): More or less developed in Eastern cape Greco area on horizontal surfaces with *C. spinosa* and *Sargassum cf. horschuchii*, from 41m depth.



Figure 24: Association with the brown algae *Cystoseira* spp. (*C. zosteroides* and *C. spinosa*) and the sponge *Axinella polypoides*, with *Caulerpa prolifera*, of the Coralligenous community. Cape Greco, -51m (photo 8084)

It is noteworthy the abundance of the yellow and branched sponge *Axinella polypoides*. This protected species forms a characteristic facies of the coralligenous community in the North-eastern part of Cape Greco (fig. 24)

4.3.1.5 Association with *Sargassum* spp. (fig. 25): This association is frequent on top of the deep rocky reefs (from -40m). The associated algae is the same of the coralligenous community.

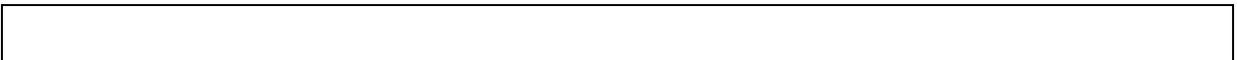


Figure 25. Biocenosis of coralligenous with *Sargassum cf. horschuchii* (large alga), *Caulerpa racemosa* (green alga), *Styopodium shimperii* (violet-brown algae) and incrustant algae *Mesophyllum* and *Peyssonnelia* spp. (rose and red algae), and the sponge *Agelas oroides* (orange). Also a piece of long-line. NE-Cape Greco, -42m (photo 8350).

4.3.2 Biocenosis of the semi-dark caves (also in enclave in upper stages) (fig. 26)

The entry of the caves is colonised by the coralligenous community with incrustant algae (*Mesophyllum alternans* (cc), *Lithophyllum stictaeforme* (cc), *Peyssonnelia*, *P. rosamarina*, *P. coriacea*). In more sciaphylic surfaces the cnidarian *Madracis phaerensis* (cc), characterise this habitat; the poriferans are abundant with *Spirastrella cunctatrix* (cc), *Phorbas tenacior* (c), *Hamigera hamigera* (c), *Agelas oroides* (c), *Petrosia ficiformis* (c), *Chondrosia reniformis* (c); also the polychaete *Protula intestinum* (cc) is frequent.

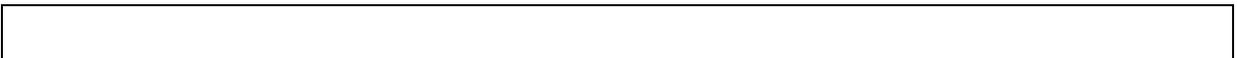


Figure 26. The madreporarian *Madracis phaerensis* and the red sponge *Spirastrella cunctatrix* of biocenosis of the semi-dark caves. Moullia Rocks, -9m (photo 8579)

The facies with madreporarians (*Leptopsammia pruvoti*, *Polycyathus muelleriae*, *Caryophyllia inornata...*), observed in another parts of the Mediterranean (Spain, Italy, Tunisia), in Cyprus only is represented by the species *Madracis phaerensis* (in some places with *Hoplangia durotrix*).

3.2 POSIDONIA MEADOWS

3.2.1 Phenology

The shoot densities in Moulia Rocks have been 625.0 ± 103.0 (at 15m depth) and 710.4 ± 62.9 (at 9m depth) shoots/m². The densities are very high compared with another places of the Mediterranean (Pergent & Pergent-Martini, 1995).

Number of leaves produced by vertical shoots range between 7 and 9 (figure 27). Its is possible to observe a decreasing trend with depth but this trend is not significant. The same trend is observed for the growth of vertical shoots (figure 28) but also in this case results are not significant. Branching rate of vertical shoots is very low (Figure 29). It is needed between 10 to 20 years for a new shoot to be produced. There is no significant trend between localities or depths.

3.2.2 Lepidochronology

Rhizome production of vertical rhizomes is around $80 \text{ mg DW sh}^{-1} \text{ y}^{-1}$ at all the localities and depths (figure 30). Rhizome production of horizontal rhizomes is much higher, around $1.4 \text{ g DW sh}^{-1} \text{ y}^{-1}$ in most of the studied meadows but in the the shallow meadow of Capo Greco less than half of this production is obtained (Figure 31). Elongation of horizontal rhizomes is about 6 cm per year (Figure 32). Also in this case the lower values were obtained for the shallow meadow of Capo Greco with only 4 cm/year.

Maximum number of leaves per year produced by horizontal rhizomes is 17.7 in the deep meadow of Capo Greco while the lowest, 13.7, is observed in the deep meadow of Pafos (Figure 33). Shallow stations have intermediate values. This differences are not significant. Branching rate of horizontal shoots is very high, with more than 2 new shoots produced by year (Figure 34).

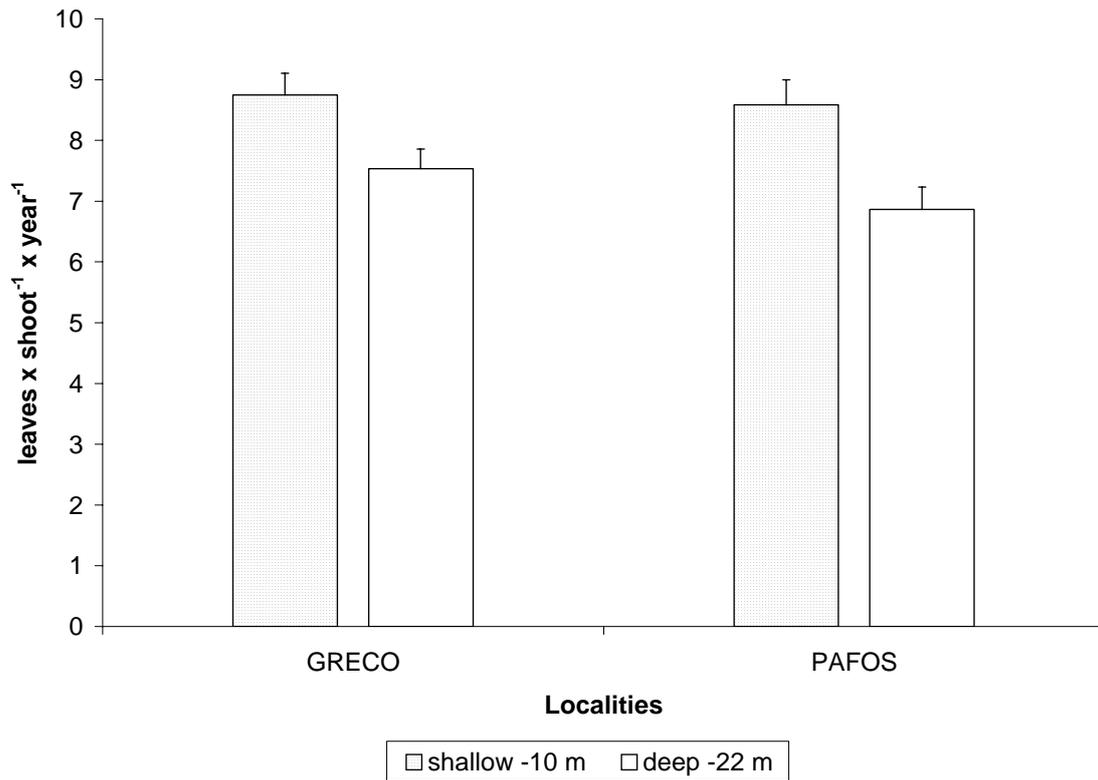


Figure 27: Number of leaves produced by vertical shoot and year.

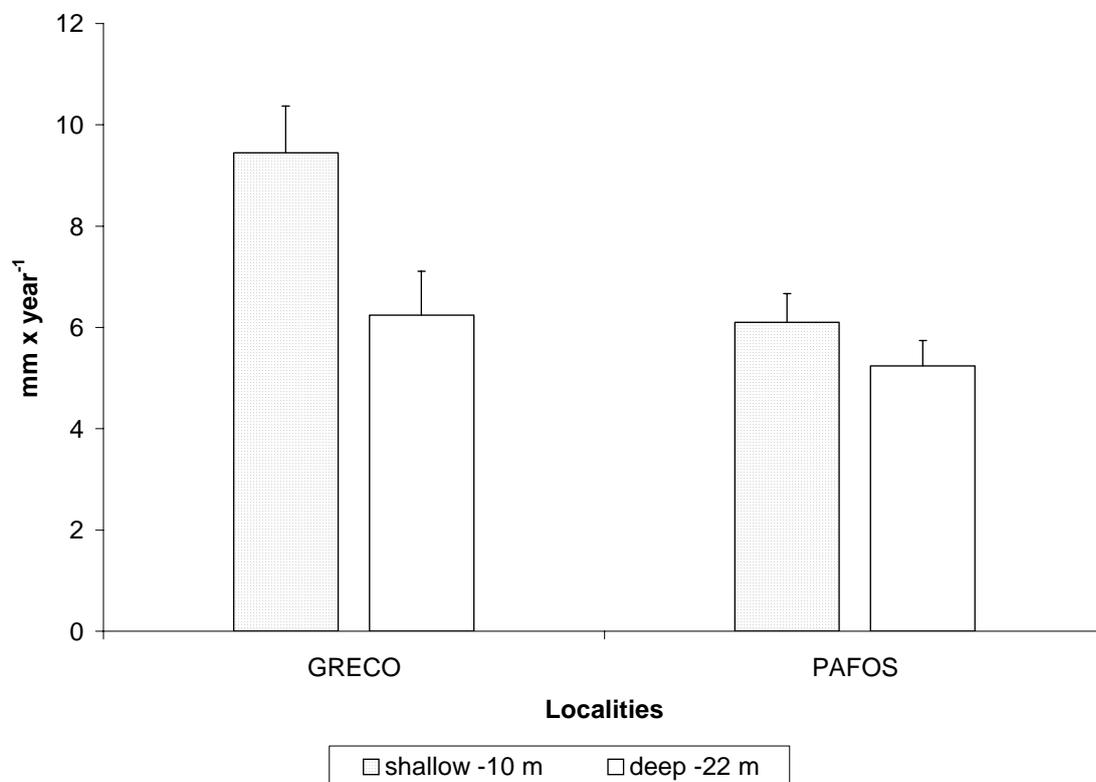


Figure 28: Growth of vertical rhizomes

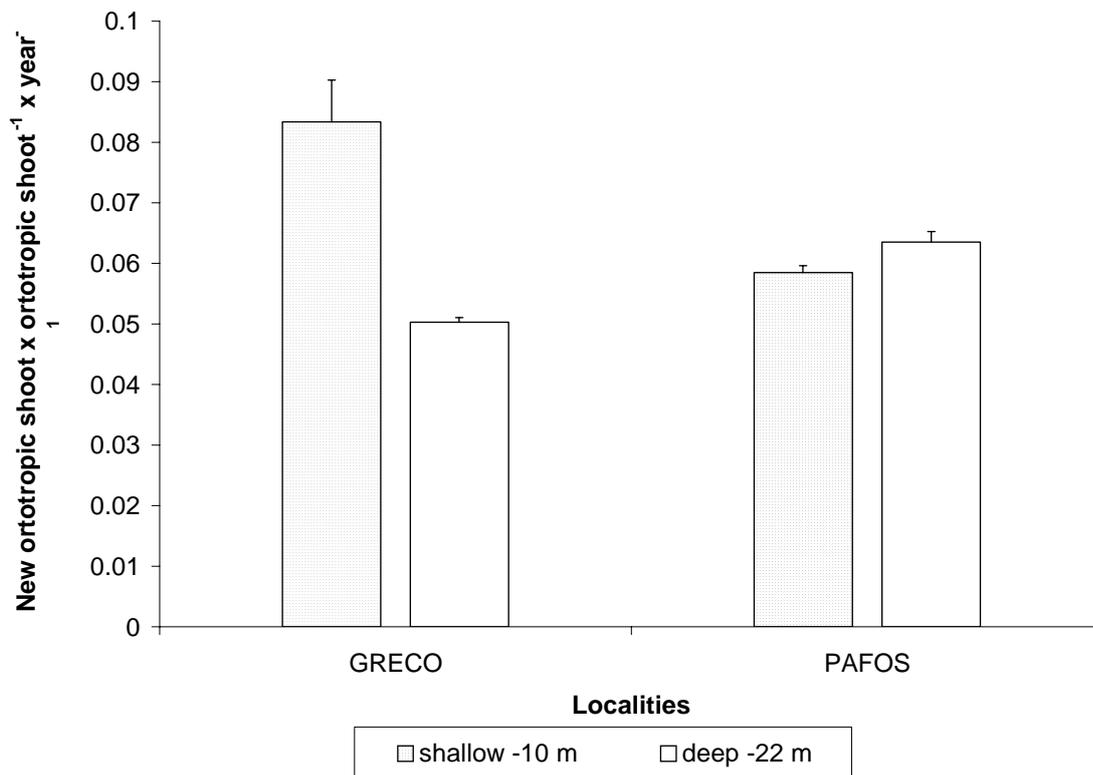


Figure 29: Production of new shoots by vertical rhizomes.

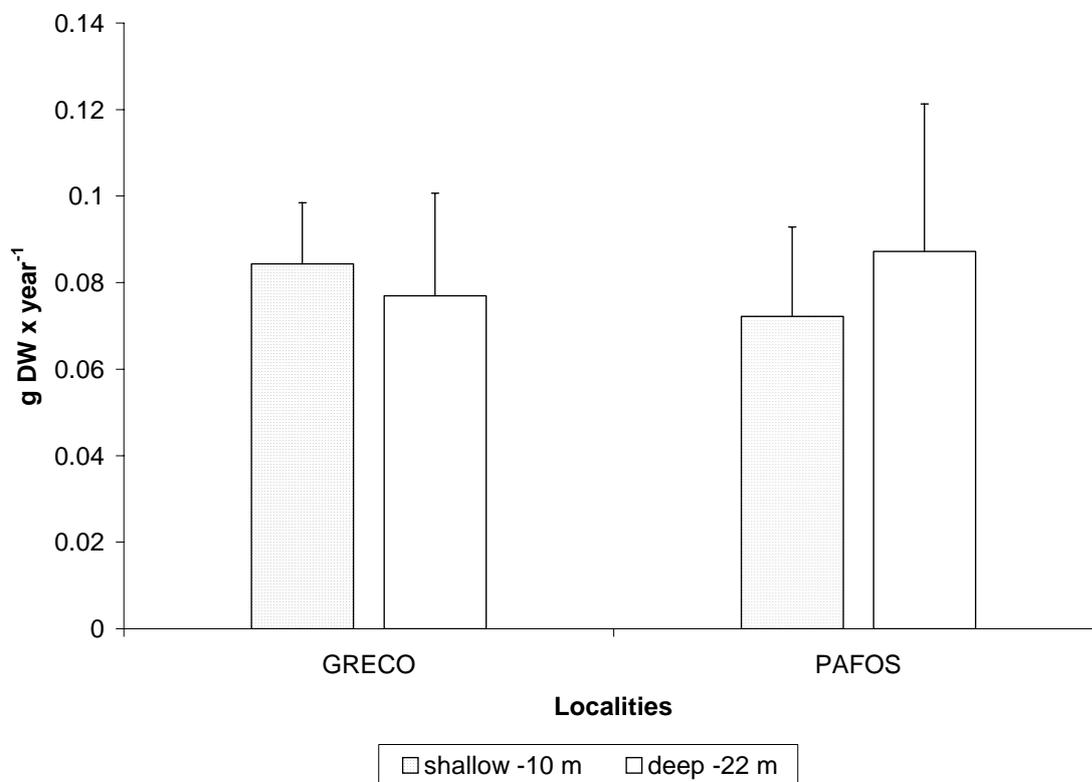


Figure 30: Rhizome production of vertical shoots

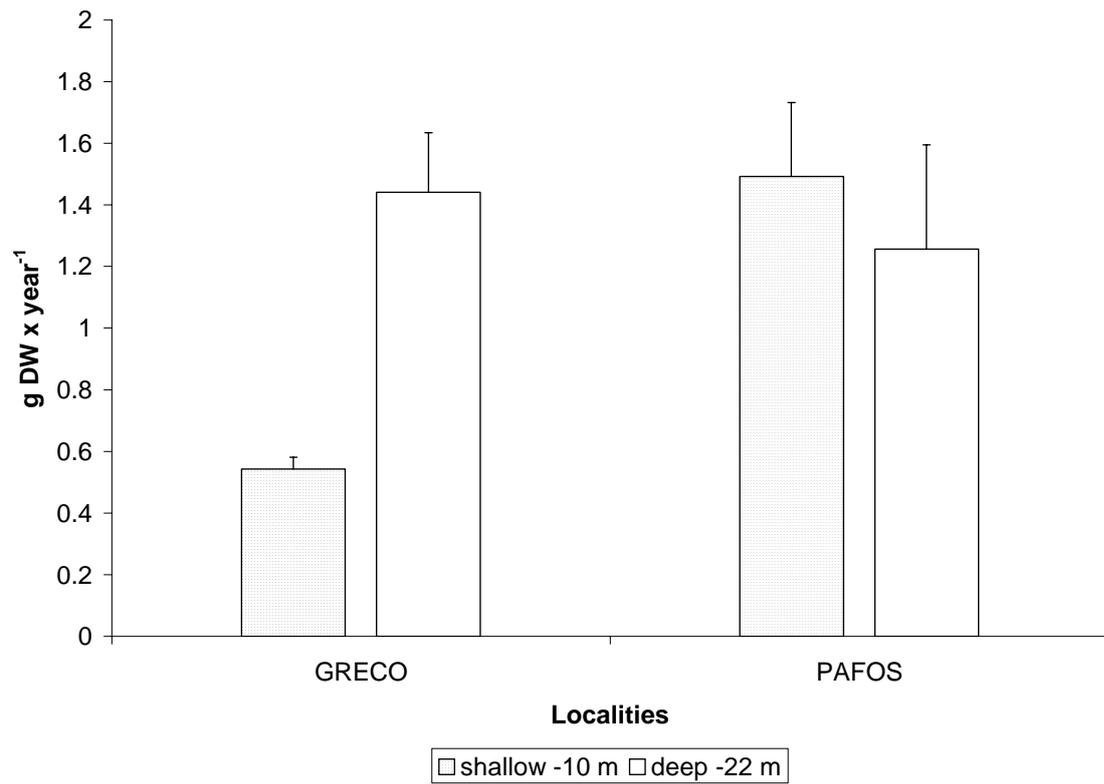


Figure 31: Rhizome production of horizontal shoots.

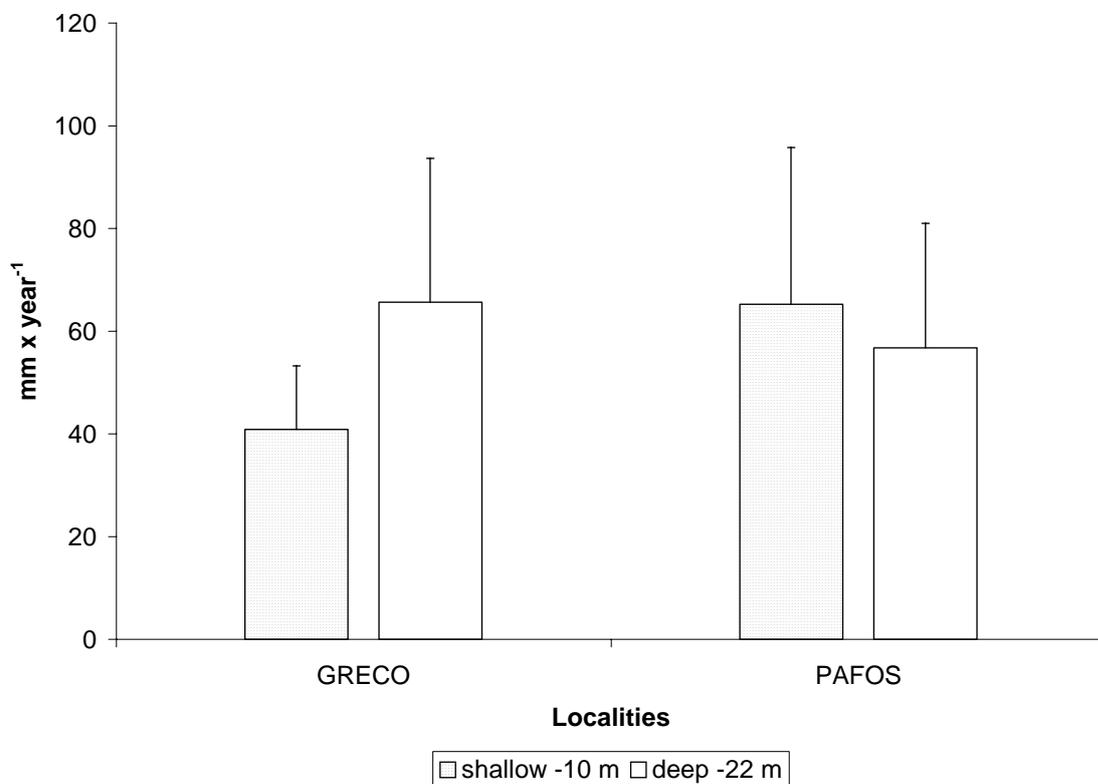


Figure 32: Elongation of horizontal shoots.

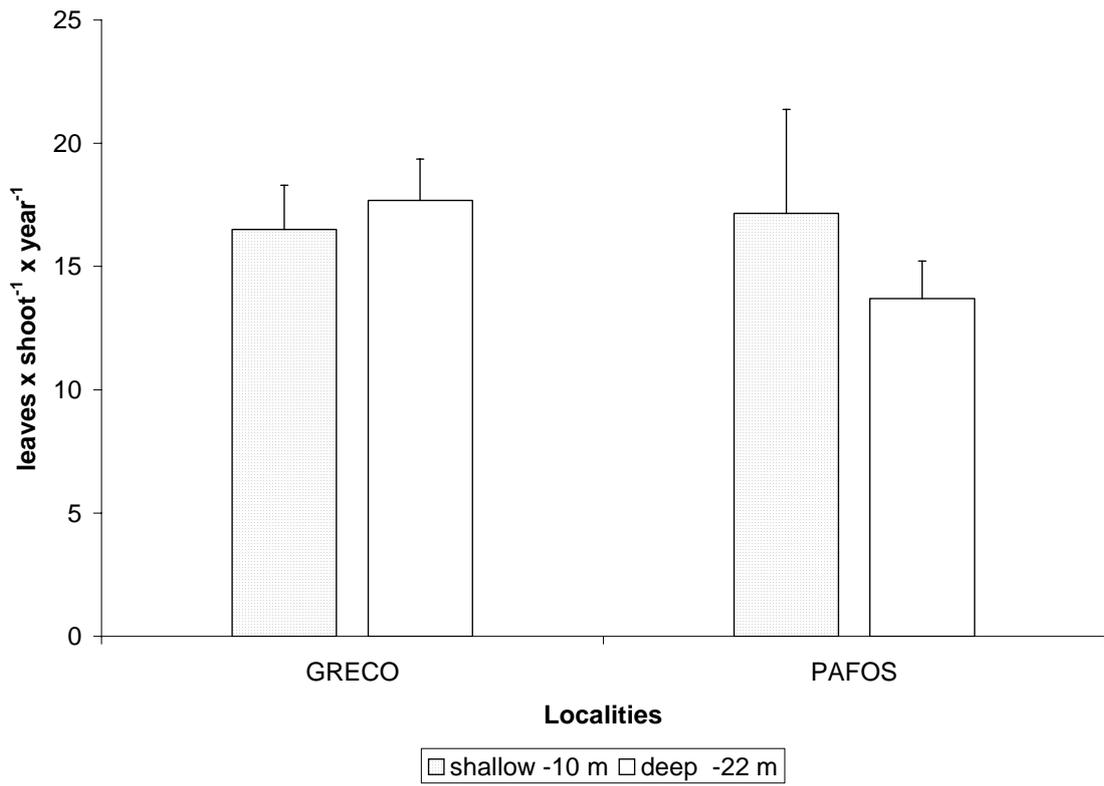


Figure 33: Leaf production of horizontal shoots.

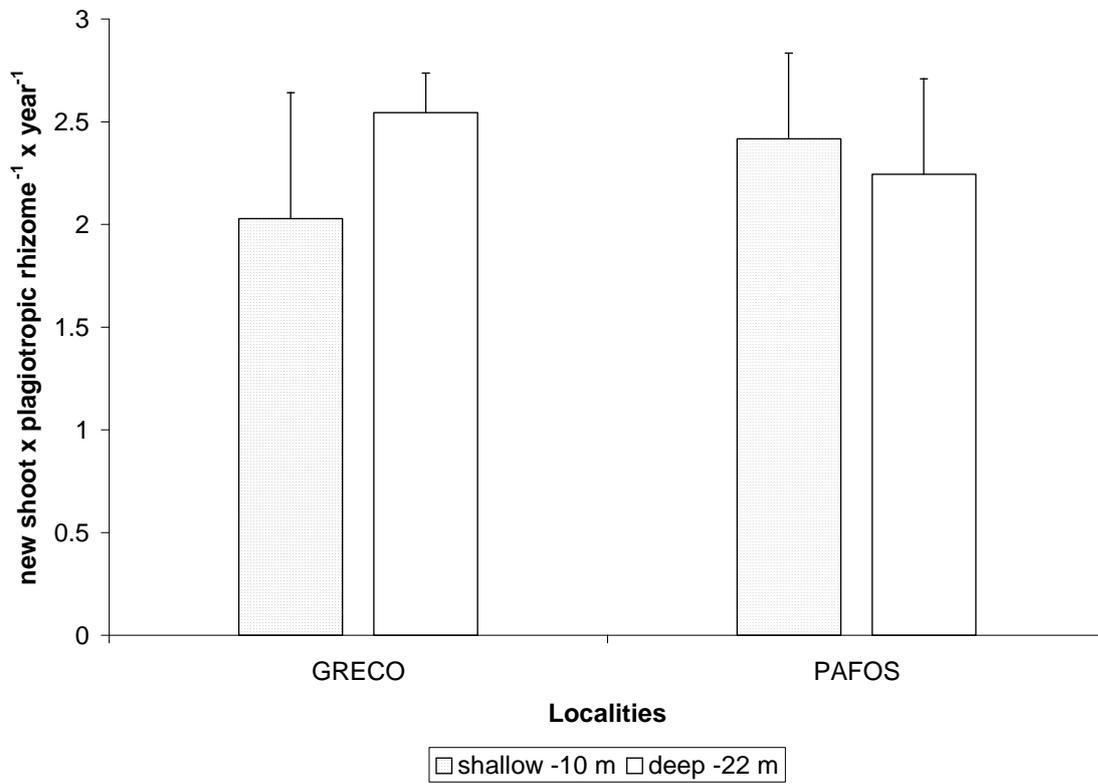


Figure 34: Branching rate of horizontal shoots.

3.3 FISH ASSOCIATIONS

3.3.1 Results

Fourteen sites were sampled, 8 in Capo Greco and 6 in Mouilla Rocks and 56 census were collected in the study. Mean number of species was greater in Capo Greco (Table I, Figure 1 and 2) but the difference with Mouilla Rocks was slight. Total mean abundance was two folder higher in Capo Greco and the biomass was greater too in this location. The total number of species recorded in the quantitative assessment was 42.

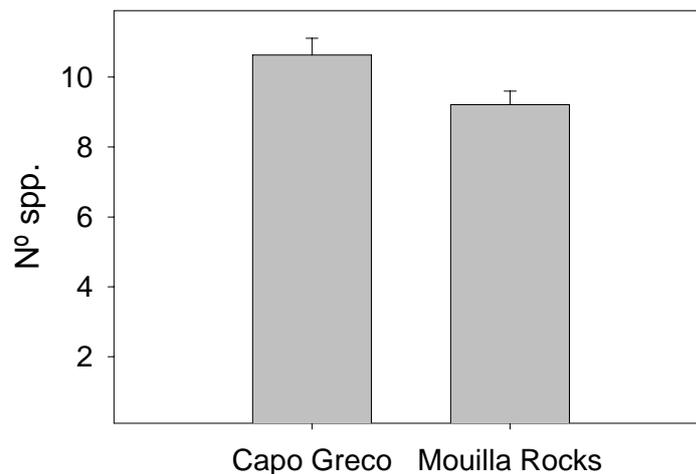


Figure 1. Number of species in the stuiied locations

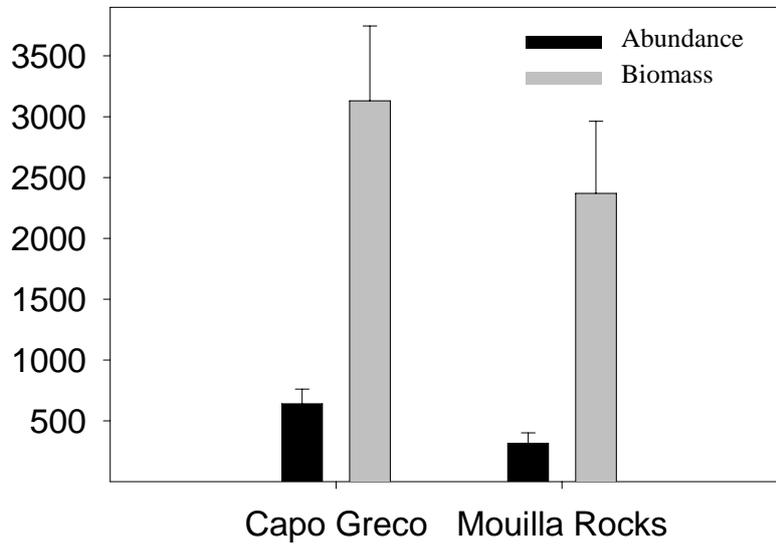


Figure 2. Values of mean abundance and biomass in the studied locations

Table I

	N° spp	Abundance	Biomass
Capo Greco	10.63 ± 0.48	639.78	± 3130.76 ±
		121.00	616.07
Mouilla Rocks	9.21 ± 0.39	315.25 ± 86.87	2369.17 ±
			593.05

The most abundant size class was size 2 both at Capo Greco and Mouilla Rocks (Table II, Figure 3) but in Capo Greco number of individuals of this size class was two-fold greater than in Mouilla Rocks.

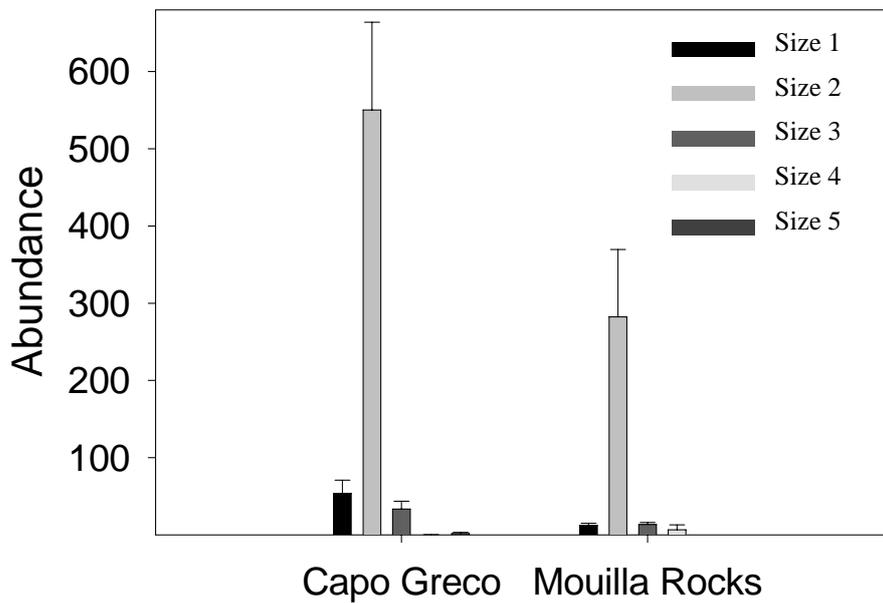
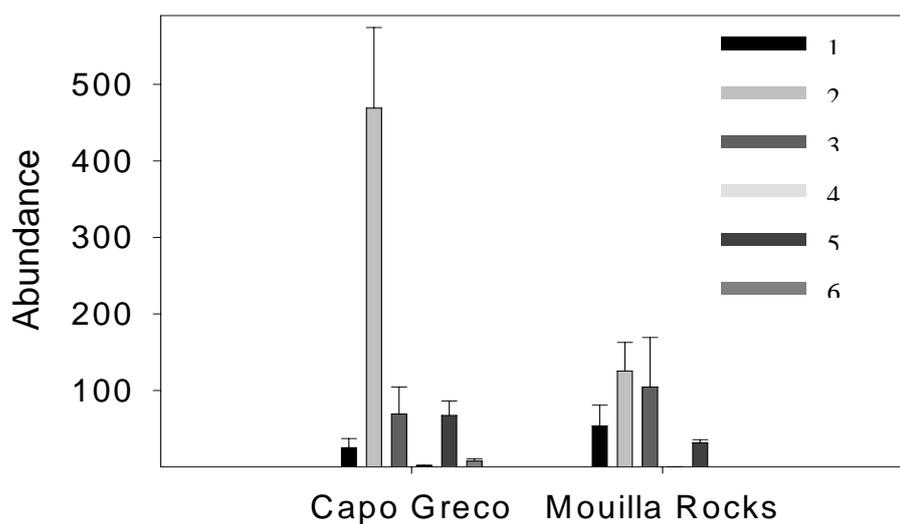


Figure 3. Size class structure in terms of abundance on individuals

Table II

	Size 1	Size 2	Size 3	Size 4	Size 5
Capo Greco	53.72 ± 17.20	550.34 ± 113.64	33.62 ± 10.11	0.41 ± 0.13	1.69 ± 1.56
Mouilla Rocks	12.29 ± 2.89	282.54 ± 87.14	13.54 ± 2.80	6.83 ± 6.23	0.04 ± 0.04

The spatial structure of the fish assemblage was dominated numerically by the



planktivorous and relatively sedentary species -COE₂- like *Chromis chromis* followed by the demersal species with relatively short horizontal movements like most of the serranidae or sparidae species (Table III, Figure 4).

Figure 4. Spatial structure of fish assemblage in each sampling location in terms of abundance

Table III

	COE ₁	COE ₂	COE ₃	COE ₄	COE ₅	COE ₆
Capo Greco	25.16	± 469.06	± 69.19	± 1.50 ± 0.75	67.22	± 7.66 ± 2.71
	11.89	105.12	35.30		18.84	
Mouilla	53.54	± 125.33	± 104.54	± 0.21 ± 0.08	31.54 ± 4.05	0.08 ± 0.06
Rocks	27.27	37.32	64.64			

About the trophic structure, it is dominated by microphagous carnivore species, corresponding mainly to *Chromis chromis* (Table IV, Figure 5). It is noted that the abundance of macrophagous species is extremadely low.

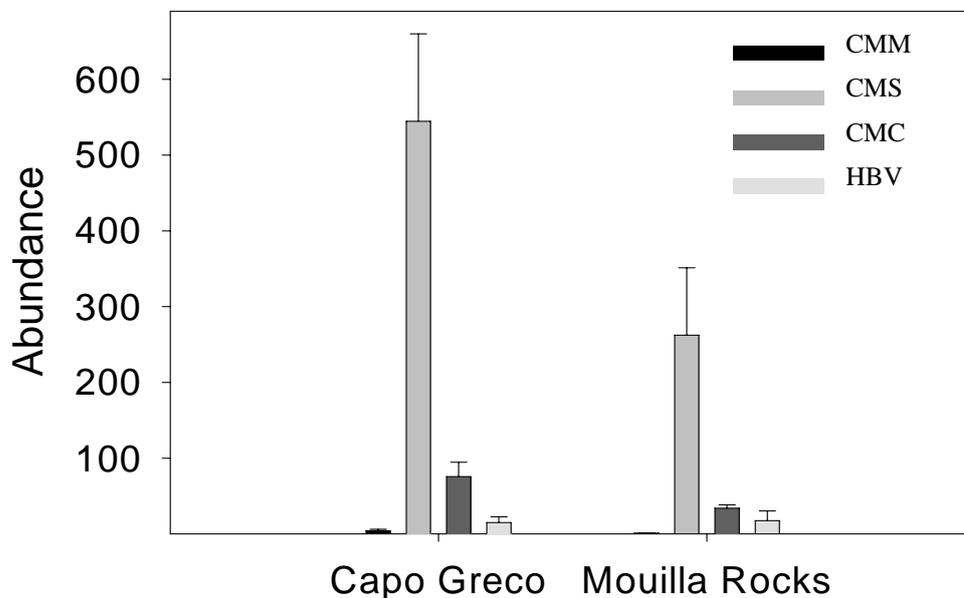


Figure 5. Trophic structure in the studied locations in terms of abundance

Table IV

	CMC	CMM	CMS	HBV
Capo Greco	4.41 ± 1.61	544.63 115.54	± 75.75 ± 18.94	15.00 ± 7.69
Moulia Rocks	1.17 ± 0.22	262.33 89.00	± 34.17 ± 4.21	17.58 ± 12.73

3.3.2 Discussion

The fish assemblage observed during this survey is characterized by the significant absence of great carnivorous species (e.g., *Epinephelus* spp, *Dentex* spp) and the very low abundance of other economically important species. The fish assemblage is totally skewed to those species with very low economic value like *Chromis chromis*.

Capo Greco showed higher number of species mainly due to the habitat characteristics, composed by mixed bottoms of rocky, sand and *P. Oceanica* seagrass beds. These characteristics determine a higher spatial complexity that favour a higher diversity of fishes. Correlatively, abundances and biomass reached higher values in Capo Greco due to this higher habitat complexity, but mainly due to the great abundance of *Chromis chromis* in this area. This structure is more equilibrated in Moulia Rocks where rocky habitat was less frequent and marine grounds were dominated by *P. Oceanica* seagrass beds, resulting in a more homogeneous habitats.

The main cause that structure the fish assemblage in the studied areas were the fishing pressure. It favour the low frequency of predatory and high valuable species and skew the assemblage to the dominance of prey species like *Chromis chromis*, and some small labrids. This effect is quite significant on the size structure of the fish assemblage, that cause the higher frequencies of the smaller size classes in both studied areas.

3.4 Interesting habitats and species for the conservation

3.4.1 Habitats

a) Midlittoral and littoral fringe

- *Lithophyllum trochanter* organogenous formations: Cape Greco (cc), Moulia Rocks (r)
 - *Dendropoma petraeum* organogenous formations: Cape Greco (cc), Moulia Rocks (r)
 - *Cystoseira* forests (exposed waters):
-

-
- *C. amentacea* forest: Cape Greco (c).

b) Infralittoral

- *Cystoseira* spp. shallow forests (sheltered waters)
 - *Cystoseira barbata*, *C. compressa*, *C. cf. sedoides*: Cape Greco (cc), Moulia Rocks (cc), Akamas (cc).
- *Cystoseira* spp. deep forests:
 - *C. spinosa* and *C. zosteroides*
- *Posidonia* meadows: Cape greco (cc), Moulia Rocks (cc), Akamas (cc).
- *Cymodocea* meadows: Cape Greco (c), Akamas (c).

c) Circalittoral

- Coralligenous community (associations with sponges): Cape Greco (cc), Moulia Rocks (c), Akamas (c).
- Semi-dark cave community: Cape Greco (cc), Moulia Rocks (c).
- Maërl beds: Cape Greco (c).

3.4.2 Interesting species

a) Macroalgae

- *Cystoseira amentacea*: Cape Greco (c), Moulia Rocks (r).
- *Cystoseira spinosa*: Cape Greco (c)
- *Cystoseira zosteroides*: Cape Greco (c)
- *Lithophyllum trochanter autor.* (= *L. byssoides*): Cape Greco (cc), Moulia Rocks (r).

b) Fanerogames

- *Posidonia oceanica*: Cape Greco (cc), Moulia Rocks (cc), Akamas (c).
-

c) Poriferans

- *Axinella polypoides*: Capo Greco (cc), Moulia Rocks (c).

d) Mollusca

- *Charonia tritonis variegata*: Capo Greco (r), Moulia Rocks (c).
- *Erosaria spurca* : Capo Greco (r), Moulia Rocks (r),
- *Lithophaga lithophaga*: capo Greco (c), Moulia Rocks (c).
- *Luria lurida*: Capo Greco (r), Moulia Rocks (r).
- *Pinna nobilis* : Capo Greco (c), Moulia Rocks: (c).
- *Tonna galea*: Capo Greco (r).

e) Crustacea

- *Ocypode cursor*: Lara beach (cc)

f) Bryozoa

- *Hornera* sp.: Capo Greco (r)

g) Echinodermata

- *Centrostephanus longispinus*: Capo Greco (r).
- *Paracentrotus lividus* : Capo Greco (cc), Moulia Rocks (cc), Akamas (c).

h) Fishes

- *Epinephelus marginatus*: Capo Greco (cc, juv.), Moulia Rocks (r).
 - *Epinephelus aeneus*: Capo Greco (r).
 - *Epinephelus costae*: Capo Greco (r), Moulia Rocks (r), Akamas (r).
 - *Hippocampus hippocampus*: Capo Greco (r).
-

3.4.3 Species reported from the literature and communications

a) Crustacea

During the field survey it has not been observed the large decapods *Scyllarides latus*, *Scyllarus arctus*, *Maja squinado* and *Palinurus elephas*. *Scyllarus arctus* and *Maja squinado* have been signalated by Hadjichristophorou et al. (1997). The former in the southern (Limassol and Episkopi areas) and northern (Morphou area) between 10-60m depth; the *Maia squinado* in the southern part of Cyprus (Moni, Limassol and Episkopi areas) between 10-40m depth. *Scyllarides latus* ('karavida') and *Palinurus elephas* (= *P. vulgaris*) ('astakos') figure in the annual report of Cyprus commercial catches (Anonymous, 2002) and fished around the island, mainly in the northern part (table 4).

b) Echinodermata

- *Ophidiaster ophidianus* : Signalised by Demetropoulos & Hadjichristophorou (1976) on rocky grounds (5-40m depth) with coralligenous growths, mainly from the North coast. signalled by Hadjichristophorou et al. (1997) in the North area

c) Fishes

- *Sciaena umbra* and *Umbrina cirhosa* (Sciaenidae spp.): These species are reported in the fishery statistics (table 1) in Cyprus, mainly caught in the Southern zone.

Vulnerable spp.	Eastern Area	Southern Area	Western Area	Northern Area	Total (kg)
Large Sparidae	3080	22330	4590	8140	38140
Sciaenidae spp.	170	1970	480	410	3030
Large Serranidae	1210	7400	3610	6970	19190
Large crustaceans	100	2220	1190	1570	5080
Total	4560	33920	9870	17090	65440

N° of boats	56	320	71	53	500
CPEU (kg/boat)	81.43	106.00	139.01	322.45	130.88

Table4. Catch by areas in Cyprus waters (Anonymous, 2001) of inshore demersal vulnerable species, and catch per effort unit (CPEU). Areas: Eastern (C. Andreas to C. Greco); Southern (C. Greco to C. Zevgari); Western (C. Zevgari to C. Arnaoudi); Northern (C. Arnaoudi to Pyrgos). Vulnerable species: large Sparidae (*Pagrus pagrus*, *Dentex dentex*); Sciaenidae spp. (*Umbrina cirrosa*, *Sciaena umbra*); large Serranidae (*Epinephelus* spp.); large crustaceans (*Palinurus elephas*, *Scyllarides latus*).

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