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An overview of the submerged sea caves of Sagres (South of Portugal-Algarve)

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CONTENTS

PREFACE

The submerged sea caves of Sagres are located within the “Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV)” Marine Protected Area (MPA). This MPA integrates the national network of protected areas, addressed by the National Institute for Nature Conservation and Forest (ICNF) and was declared Site of Community Importance (SCI) under the Habitats Directive. Under the Annex I from the Habitat Directive these habitat caves are included in “8330 Submerged or partially submerged sea caves”.

This conservation *status* should provide sufficient concern to have detailed information on biodiversity. However, among marine researcher, little is still known about these submerged sea caves and tunnels habitats. The only well-known study dealing with the Sagres sea caves was conducted in the late 80s and was only published in 2001.

For effective management of such specific habitats a clear understanding of their localization and extension, the assessment of the biological communities, its conservation importance, its monitoring options and their sensitivity to natural change and human disturbance need to be a relatively clear.

This report, produced under the MeshAtlantic Project, provides an overview of the available published and unpublished information relevant for the conservation management of the subtidal caves of Sagres. It mainly aims to be a base contribution for future studies.

SUMMARY

Submerged sea caves and deep-sea habitats share some common environmental conditions such as darkness and hydrodynamic. Due to their unique characteristics these two habitat types most often share the presence of similar species. In the Algarve (South coast of Portugal), the Sagres region is well known for its richness in submerged sea caves. Their main natural threat is related to the severe seasonal storms which could increase coastal erosion. Oil spills from offshore cargo ships could be the worse threat caused by human activity. Another important hazard to be considered is an increase in human recreational scuba diving that could cause a negative effect on these fragile habitats (especially in the most confined and smaller sea caves). With minor importance but worth reporting is coastal erosion caused by car movement and parking on cliff tops.

For a better assessment of this habitat surveys should be conducted for the Sagres submerged sea caves. To date about 245 species have already been documented between the entrance and the inside of these submerged caves. From the data set we have evidences that 14 species (6%) present cave habitat dependence while the majority of species can be also commonly found outside the cave vicinities.

Sponges were represented with 85 species, comprising more than 36% of the invertebrate richness. Other important groups of species were the Bryozoa (41; 17%), the Annelida (25; 11%) and Cnidaria (29; 12%). Six algae species were also registered from the entrance of the caves and among the assemblages of species about 65% are passive suspension feeders. Fifteen fish species were recorded but only one is a typical darkness habitant (Apogon imberbis). Important species in terms of commercial value were also registered, specifically crustacean species (Homarus gammarus, Maja squinado, Palinurus elephas, Scyllarus arctus) and some fish species (e.g. Conger conger, Phycis phycis, Plectorhinchus mediterraneus). The gorgonian species *Eunicella*

verrucosa is vulnerable for IUCN and is present on the caves. *Puellina saldanhai* n. Sp. is a bryozoa species firstly described from dark cave environment of southern Portugal.

One of the main biological survey techniques that should be used in these fragile caves environments is the underwater visual census method. Quantitative sampling on standard surfaces and depth above the bottom, as well as equal distance intervals along a longitudinal transect should be carried out. Additionally non destructive photography and video images can be used to backup the visual transect method. The use of equipments to measure currents, irradiance or Photosynthetically Active Radiation (PAR), temperature, depth and turbidity is equally important for consequent data analysis.

1 INTRODUCTION

1.1 Description and ecological characteristics

Submarine caves have frequently been considered as an interesting mesocosm of deep-sea habitat (Vacelet, 1996). Dark caves and deep-sea habitats share some environmental condition in terms of darkness and hydrodynamic condition and several species are therefore shared among them.

Caves could vary from merely a few meters to more complex structures of hundreds of meters and have one or more entrances. The biological communities may vary considerably depending on the level of submersion and exposure to waves and extension of the cave system and its geological structure (JNCC, 2004). Shallow sublitoral caves are commonly subject to strong wave action and therefore tend to have coarse sediment, cobbles and boulders on the bottom. On the other hand, caves which occur in deeper water are normally subject to less water movement from the surrounding sea, allowing muddy sediment to accumulate (JNCC, 2007).

Sea caves are mainly colonized on overhangs and on vertical surfaces by encrusting fauna species and shade tolerant algae close to their entrances. Physical conditions such as wave influence and darkness change rapidly along the cave leading to a shift and decrease of fauna richness (Fichez, 1990). Harmelin *et al*. (1985) noted the gradual decrease of species number and biological cover from the entrance to the inner parts of a cave, often dropping to zero in long caves (Balduzzi *et al*., 1989). According to Boury-Esnault (2001) three communities are normally recognized in marine caves: the entrance communities, the semi-dark and the dark cave communities. A progressive decline and disappearance of passive and subsequently of active suspension feeders occurs along caves with a complete gradient in biological cover (Harmelin *et al*., 1985).

The light availability and water movement are the most important factors for biological caves communities (Balduzzi *et al*., 1989). Water movement, together with several other factors more or less depending upon it (e.g. sedimentation, organic matter and live prey supply, water exchange, dispersion and supply of larval stocks) directly affects the distribution of many organisms. However, even for the sciaphilous fauna, the advantages of continuous darkness are balanced by the disadvantages due to the assumed decrease of water exchange. In fact, in caves with an active internal circulation, Harmelin (1969) found communities covering more than 100% even in total darkness.

1.2 Conservation status

The submerged sea caves and tunnels of Sagres are under the "Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV)" MPA conservation rules. This MPA integrates the national network of protected areas addressed by the national Institute for Nature Conservation and Forest (ICNF) and was declared a Special Area of Conservation (SACs) (Natura 2000) of natural habitats and of wild fauna and flora (Habitats Directive). Under the Annex I of the EC Habitats Directive submerged sea caves are also included in "8330 Submerged or partially submerged sea caves" special area for conservation. They are characteristically associated with "1170 Reefs" habitat. This habitat is under the EUNIS hierarchical classification associated with the following code: A3.74: Caves and overhangs in infralittoral rock (EUNIS, 2013).

1.3 Objectives

This report provides an overview and displays the status of the submerged sea caves from the south coast of Sagres and corresponding biocenoses. The purpose is to summarize the available information on submerged and partial submerged caves, focused on the environmental and biological habitat attributes, list their localization and extension, assess their global biological communities, enhance its conservation importance, its sensitivity to natural and anthropogenic changes and list survey and monitoring options. This information might be useful to carry out future studies to support management decisions on the marine SAC of Sagres and also on related initiatives such as the “Oslo and Paris Convention” (OSPAR).

2 SITES LOCATIONS AND CHARACTERIZATION

The Sagres region is a hotspot for underwater sea caves. Several tunnels and at least two caves are located in the Martinhal Islets (“Chaminé” and the cave of “Ilhéu de fora”). A complex of tunnels is also recognized at the East side of “Baía da Baleeira” (“Ponta dos caminhos”) which has numerous biological similarities with submerged caves (Figure 2). Most of the complex of tunnel and caves are distributed at the promontory of Sagres, between “Ponta da Baleeira” and “Ponta da Atalaia” (Figure 2). According to our best knowledge 7 submerged caves or tunnels are recognized in this area (*e.g*. “Falésia”, “Queijo Suiço”, “Donzela”, “Segredo ou Túnel”, "Velas", "Nossa Senhora or Catedral"). At the same location two very exposed partially submerged caves exist in the intertidal zone and consequently are very difficult to be explored (anecdotal information). Additionally between the Cape of São Vicente and Sagres there are no less than seven other recognized caves but much less explored by recreational scuba divers.

Explored caves and tunnels differ in length and on the opening of the vault (2 to15 meters depth and maximum length of 180 meters). Their opening/mouth during low tide occurs in shallow water between 6 and 18 meters depth and is mostly exposed to the swell and tidal movements. The maximum depth within the caves may vary between 5 and 15 meters (anecdotal information).

Figure 1. Sagres promontory where most of the complex of caves are distributed.

The action of the swell and tidal movements occurs in most of the partial and submerged cave of Sagres. According to Boury-Esnault *et al*. (2001) these actions can be directly or indirectly observed by signs of low muddy deposits, presence of ripple-marks on sandy bottoms and frequency of invertebrates that prefer to live in fast moving water (rheophilic species) (e.g. gorgonian species).

Some of the caves have an air compartment which can communicate with the outside environment which tends to accentuate the inner hydrological dynamic conditions (*pump effect*). However, in the majority of the caves the percentage of outside light decreased rapidly. Three of the caves ("Nossa Senhora", "Velas" and "Donzela") offer small annex rooms where darkness is complete and water movement is particularly attenuated compared to the main chambers (Boury-Esnault *et al*., 2001).

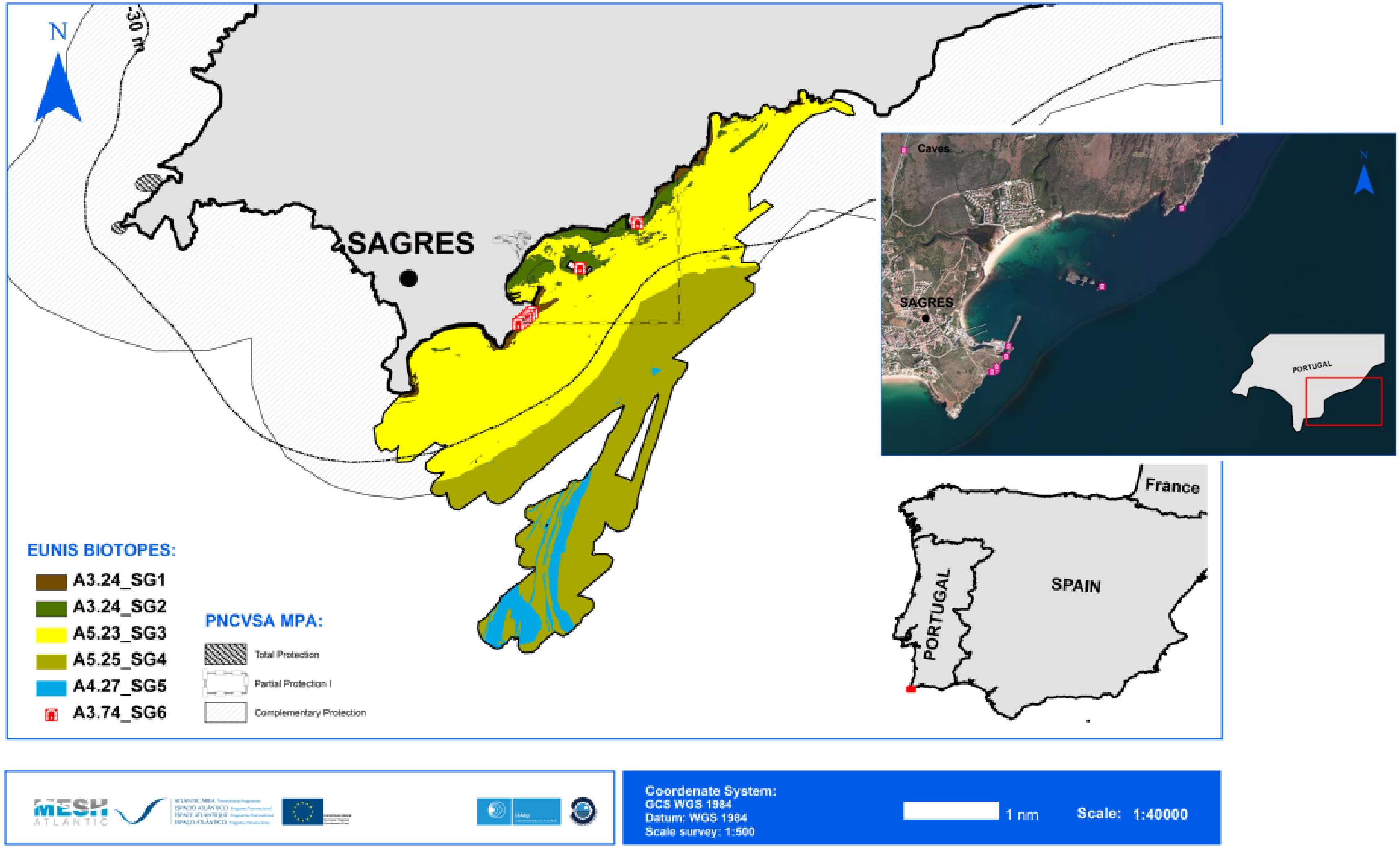

Figure 2. Biotopes at Sagres zone according to the EUNIS habitat Classification where the main areas of submerged sea caves can be seen (A3.74_SG6)

3 SENSITIVITY TO NATURAL AND HUMAN ACTIVITIES

Sagres region is subject to severe seasonal storms which can increase coastal erosion and cause negative impact on the cliff structure and consequently on local caves and tunnels. This **natural action** could be very significant as the swell and tidal movements occurs within most of the cave area as previously mentioned. On a short-term scale (hours to days), **extreme storms** are one of the most important agents of coastal erosion (Almeida *et al.*, 2012). According to different authors (e.g. Parravicini *et al.*, 2009) submarine caves are poorly resilient ecosystems and understanding their capacity of recovery after major disturbances is mandatory for their proper management and conservation. However, there is no evidence that intensive coastal erosion is taking place on the cliffs of Sagres.

There are few **human activities** that can directly affect caves' structure and/or biodiversity:

- ***Organic pollution and eutrophication*** - input of organic matter (*e.g.* from aquaculture waste or sewage) could favour the communities of suspension feeders (e.g. sponges and cup corals) by increasing the supply of suspended food. However, the absence of photosynthesis in this almost totally lightless environment and the presence of a highly stratified water column and sometimes long residence times for cave waters, characteristically results in depleted dissolved oxygen levels. Under such circumstances, organic pollution, even at low levels, can produce anoxic conditions and may consequently result in the extinction of entire species of cavernicolous fauna (Lliffe *et al.*, 1984). However this fact alone is unlikely to take place in the Sagres region;

- **Oil spills** - The potential effects of oil spills on benthic communities can be one of the most important threats. Chronic oil pollution in the marine food web is an important issue. The coast of Sagres is a known sea corridor for oil tankers and cargo ships between the Mediterranean and Northern Europe. A large oil spill could endanger the entire diversity of the caves and nearby areas, particularly harming unique and rare species that are mainly present at greater water depths;
- **Coastal alteration and erosion** – human change of the coastal environment may affect benthic communities of the caves and tunnels, mostly if this involves changes on the current regime and sedimentation rate. The erosion of the coast, potentially aggravated by cars movement and parking on the cliff tops, might also be an important issue to be considered;
- Another important threat to be considered is an increase in recreational **scuba diving** that could cause a negative effect on these fragile habitats. This activity should be regulated in the future, especially when considering the most confined and smaller sea caves.

4 SURVEY TECHNIQUES

Scuba diving has been considered as the appropriate method for surveying/exploring underwater caves. However, diving expertise, good floatability and equipment (e.g. guide line, lights) are highly required for this type of technical scuba diving. Expertise on decompression and equipment such as diver propulsion vehicles, re-breathers and numerous scuba cylinders for both the dives and the decompressions are also required for extremely long caves. The standard survey technique for mapping underwater cave consists of the measurement of azimuth and distance between consecutive survey stations and register of notable features, depth and sea bottom characteristic (Kincaid, 2000). For intertidal caves, one solution for measuring height might be laser or ultrasound measuring devices (JNCC, 2007)

The biological survey techniques depend on the type of data required and expertise on cave diving. However, for a faunal characterization it is important to use a set of procedures on specific distance interval that depend on the cave dimensions and characteristics. The characterization should have into account at least three main sectors of the cave i.e. entrance, semi-obscure and obscure zones (Boury-Esnault *et al*., 2001), depth and existent features (e.g. crevices).

The main biological survey techniques that have been used in caves are the **Underwater Visual Census** – this technique consists on the qualitative and quantitative *in situ* description of the biological communities (Harmelin-Vivien *et al*., 1985). Quantitative sampling on standard surfaces (e.g. 400 cm) and depth above the bottom (e.g. 1 m), as well as equal distance intervals along a longitudinal transect (e.g. 5 m) should be carried out (Balduzzi *et al*., 1989). Although **faunal collection** might be carried out for latter identification at laboratory, the rarity and scarcity of some species in some sites combined with the MPA *status* for this area recommended that only the necessary specimens should be sampled from each cave. Thus *in situ* non-destructive methods such as photography and video images are highly recommended for complementary descriptions:

- **Photo quadrates** – photographic record at each station for latter identification and complement visual transect; Balduzzi *et al*. (1989) used photographic surveys along transects at 5 m intervals in a Mediterranean Sea cave (Figure 3).
- **Video transect** – video transect could be recorded to complement the visual transect and photo quadrates on qualitative *in situ* description.

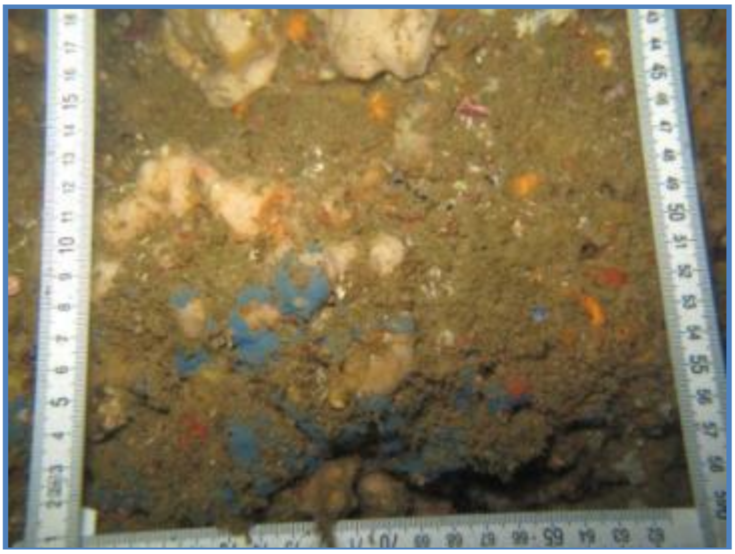

Figure 3. Photo quadrate inside a sea cave.

Some important variables for the analysis of the communities' zonation should be obtained. To measure those variables some equipment can be deployed at each surveying station along the caves:

- **Currents** - Current measuring equipment such as an ADCP (Acoustic Doppler Current Profiler); A method of gradual consumption of plaster balls was used as an alternative water movement measure technique by some authors (Balduzzi *et al.*,1989; Corriero *et al.*, 2000);
- **Irradiance** or **PAR** (Photosynthetically Active Radiation) – photometers sensor that measures the intensity of light (one major factor on biological zonation); Visibility within submerged caves can vary from nearly unlimited to low or even non-existent;
- **Temperatures and depth** – Measurement equipment such as CTDS (Conductivity, Temperatures and Depth);
- **Turbidity** – turbidity is also an important factor for the biological zonation. Direct measurement of turbidity can be obtained with specific sensors or using sediment traps as commonly carried out in caves (Fishez, 1990).

5 ASSOCIATED SPECIES

At least 245 species have been documented between the entrance and inside the submerged caves of Sagres (Figure 4; Table 1). This number of species was obtained from the two published articles on these caves diversity (Boury-Esnault *et al*. 2001 and Harmelin, 2001) and our own research experience (Monteiro *et al*., 2012; unpublished data). From this data set we have evidences that 14 species (6%) present cave habitat dependence while the majority of species can be also commonly found outside the cave vicinities.

Sponges were represented with 85 species, comprising more than 36% of the invertebrate richness. Other important groups of species were the Bryozoa (41; 17%), the Annelida (25; 11%) and Cnidaria (29; 12%). Six algae species were also registered from the entrance of the caves. Among the assemblages of species about 65% are passive suspension feeders.

Fifteen fish species were recorded but only one is a typical darkness habitant (*Apogon imberbis*). Important species in terms of commercial value were also registered, specifically crustacean species (*Homarus gammarus, Maja squinado, Palinurus elephas, Scyllarus arctus*) and some fish species (e.g. *Conger conger, Phycis phycis, Plectorhinchus mediterraneus*). The gorgonian species *Eunicella verrucosa* is vulnerable for the International Union for Conservation of Nature and Natural (IUCN, 2013) and is present on the caves.

Puellina saldanhai n. Sp. is a bryozoa species firstly discribed from dark cave environment of southern Portugal (Harmelin, 2001). Table I highlights the entire list of species that have been documented from the submerged caves of Sagres.

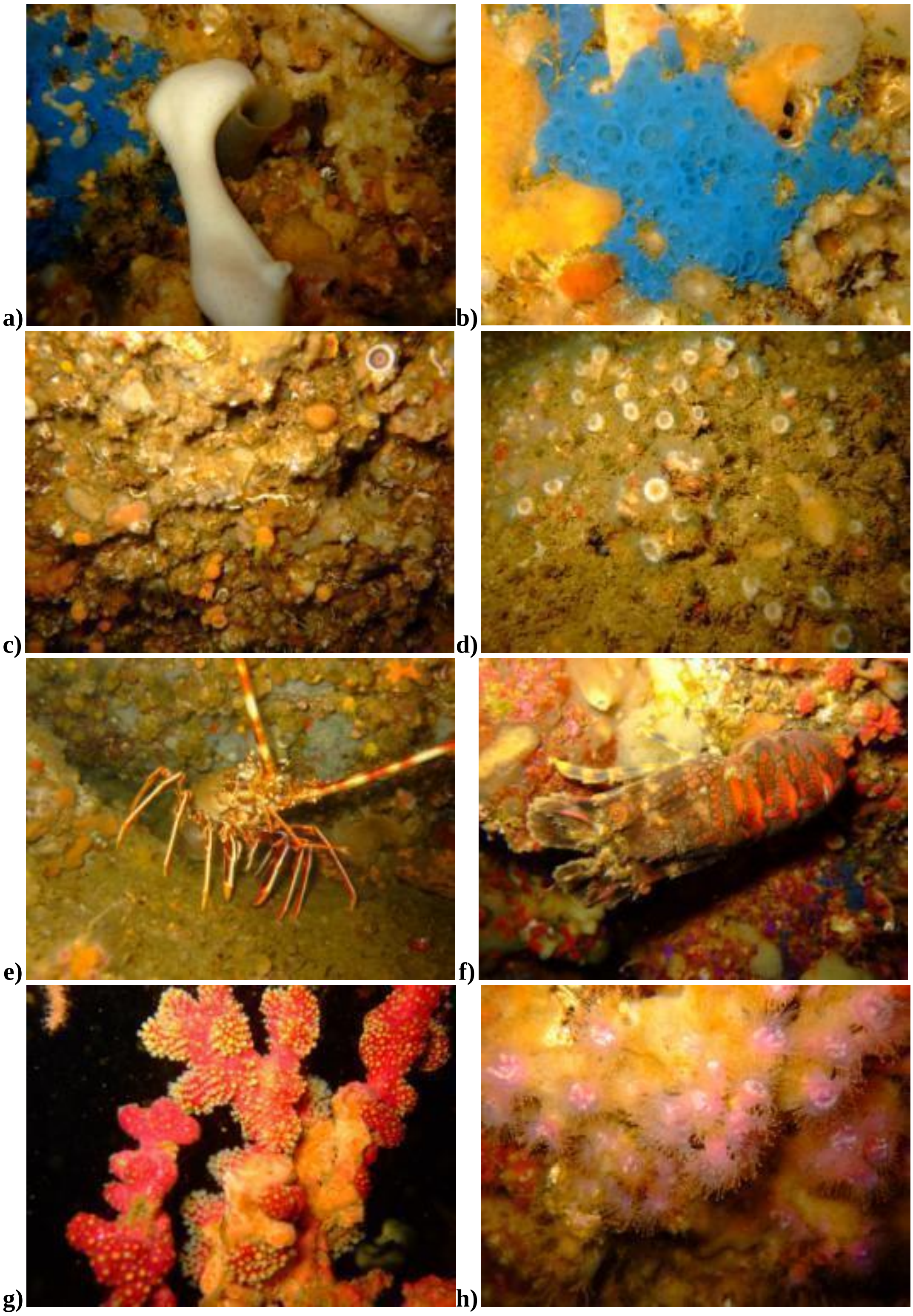

Figure 4: Photographs from the seabed environment in submerged sea caves of Sagres: a) *Terpios gelatinosa* and *Chondrosia reniformis*; b) *Hymedesmia versiculor*; c) *Astroides calycularis*; d) *Polycyathus muellerae*; e) *Palinurus elephas*; f) *Scyllarus arctus*; g) *Alcyonium coralloides;* h) *Corynactis viridis*.

Table 1. List of species that were identified within the submerged caves and tunnels of the cliffed coast of Sagres. A) cave dependency or deep species; * Boury-Esnault et al. 2001 and ** Monteiro _et al_., 2012; unpublished data.

ANNELIDA

1 _Apomatus_ sp. Philippi, 1844 *
2 _Filograna_ sp. Berkeley, 1835 *
3 _Filogranula annulata_ (O. G. Costa, 1861) *
4 _Filogranula calyculata_ (O. G. Costa, 1861) *
5 _Hydroides pseudouncinatus_ Zibrowius, 1968 *
6 _Janita fimbriata_ (Delle Chiaje, 1822) *
7 _Josephella merenzelleri_ Caullery & Mesnil, 1896 *
8 _Metavermilia taenia_ Zibrowius, 1971 *
9 _Placostegus crystallinus sensu_ (non Scacchi, 1836) sensu Zibrowius, 1968 *
10 _Pomatoceros lamarckii_ (Quatrefages, 1866) *
11 _Pomatoceros triqueter_ (Linnaeus, 1758) *
12 _Protolaeospira striata_ (Quievreux, 1963) *
13 _Protula_ sp. Risso, 1826 *
14 _Salmacina_ sp. Claparède, 1870 *
15 _Semivermilia crenata_ (O. G. Costa, 1861) *
16 _Semivermilia torulosa_ (Delle Chiaje, 1822) *
17 _Serpula cavernicola_ Fassari & Mollica, 1991 *
18 _Serpula concharum_ Langerhans, 1880 *
19 _Serpula lobiancoi_ Rioja, 1917 *
20 _Serpula vermicularis_ Linnaeus, 1767 *
21 _Spiraserpula massiliensis_ (Zibrowius, 1968) *
22 _Spirobranchus lima_ (Grube, 1862) *
23 _Spirobranchus polytrema_ (Philippi, 1844) *
24 _Vermiliopsis labiata_ (O. G. Costa, 1861) *
25 _Vermiliopsis monodiscus_ Zibrowius, 1968 *

BRACHIOPODA

26 _Argyrotheca cistellala_ (Searles-Wood, 1841) *a
27 _Argyrotheca cordata_ (Risso, 1826) *a
28 _Argyrotheca cuneata_ (Risso, 1826) *a
29 _Megathiris detruncata_ (Gmelin, 1789) *a
30 _Megerlia truncata_ (Linnaeus, 1767) *a
31 _Novocrania anomala_ (Müller, 1776) *a
32 _Tethyrhynchia mediterranea_ Logan in Logan & Zibrowius, 1994 *a

BRYOZOA

33 _Adeonella calveti_ (Canu & Bassler, 1930) *
34 Bryozoa n. Sp.1 *
35 Bryozoa n. Sp.10 *
36 Bryozoa n. Sp.11 *
37 Bryozoa n. Sp.12 *
38 Bryozoa n. Sp.13 *
39 Bryozoa n. Sp.2 *
40 Bryozoa n. Sp.3 *
41 Bryozoa n. Sp.4 *
42 Bryozoa n. Sp.5 *
43 Bryozoa n. Sp.6 *
44 Bryozoa n. Sp.7 *
45 Bryozoa n. Sp.8 *
46 Bryozoa n. Sp.9 *
47 _Bugula n. Sp. Oken, 1815_ *
48 _Celleporina caminata_ (Waters, 1879) *a
49 _Chartella papyracea_ (Ellis & Solander, 1786) *
50 _Chorizopora brongniartii_ (Audouin, 1826) *
51 _Coronellina fagei_ Gautier, 1962 *
52 _Crassimarginatella crassimarginata_ (Hincks, 1880) *
53 _Crassimarginatella maderensis_ (Waters, 1898) *
54 _Ellisina gautieri_ Fernandez Pulpeiro & Reverter Gil, 1993 *
55 _Escharina dutertrei_ (Audouin, 1826) *
56 _Escharina hynmanni_ (Johnston, 1847) *
57 _Escharina vulgaris_ (Moll, 1803) *
58 _Escharoides coccinea_ (Abildgaard, 1806) *
59 _Haplopoma sciaphilum_ Silén & Harmelin, 1976 *
60 _Myriapora truncata_ (Pallas, 1766) *
61 _Pentapora foliacea_ (Pallas, 1766) *
62 _Porella minuta_ (Norman, 1868) *
63 _Puellina cassidainsis_ (Harmelin, 1984) *
64 _Puellina pedunculata_ Gautier, 1956 *
65 _Puellina radiata_ (Moll, 1803) *a
66 _Puellina saldanhai_ n. Sp. Harmelin, 2001 *a
67 _Puellina setosa_ (Waters, 1899) *a
68 _Puellina venusta_ (Canu & Bassler, 1925) *
69 _Reteporella_ Busk, 1884 *
70 _Schizomavella_ spp. Canu & Bassler, 1917 *
71 Scrupocellaria n. sp. van Beneden, 1845 *
72 _Setosella cavernicola_ Harmelin, 1977 *
73 _Smittina cercornis_ (Pallas, 1766) *

CHORDATA

74 _Apogon imberbis_ (Linnaeus, 1758) *
75 _Centrolabrus exoletus_ (Linnaeus, 1758) **
76 _Chromis chromis_ (Linnaeus, 1758) *
77 _Conger conger_ (Linnaeus, 1758) *
78 _Coris julis_ (Linnaeus, 1758) **
79 _Ctenolabrus rupestris_ (Linnaeus, 1758) **
80 _Diplodus vulgaris_ (Geoffroy Saint-Hilaire, 1817) **
81 Gobiidae n. Id. **
82 _Labrus bergylta_ Ascanius, 1767 **
83 _Phycis phycis_ (Linnaeus, 1766) *
84 _Plectorhinchus mediterraneus_ (Guichenot, 1850) *
85 _Serranus atricauda_ Günther, 1874 *
86 _Serranus cabrilla_ (Linnaeus, 1758) *
87 _Thorogobius ephippiatus_ (Lowe, 1839) *
88 _Trisopterus luscus_ (Linnaeus, 1758) *
89 _Zeugopterus punctatus_ (Bloch, 1787) *

CNIDARIA

90 _Aglaophenia pluma_ (Linnaeus, 1758) **
91 _Alcyonium coralloides_ (Pallas, 1766) **
92 _Alicia mirabilis_ Johnson, 1861 **
93 _Astroides calycularis_ (Pallas, 1766) *
94 _Balanophyllia (Balanophyllia) regia_ Gosse, 1853 *
95 _Caryophyllia (Caryophyllia) inornata_ (Duncan, 1878) *
96 _Caryophyllia (Caryophyllia) smithii_ Stokes & Broderip, 1828 *
97 _Cerianthus membranaceus_ (Spallanzani, 1784) **
98 _Coenocyathus anthophyllites_ Milne Edwards & Haime, 1848 *
99 _Coenocyathus cylindricus_ Milne Edwards & Haime, 1848 *
100 _Corynactis viridis_ Allman, 1846 *
101 _Dendrophyllia ramea_ (Linnaeus, 1758) *
102 _Eunicella gazella_ Studer, 1878 **
103 _Eunicella labiata_ Thomson, 1927 **
104 _Eunicella verrucosa_ (Pallas, 1766) **
105 _Guynia annulata_ Duncan, 1872 *
106 _Haplangia durotrix_ Gosse, 1860 *
107 _Leptogorgia lusitanica_ Stiasny,1937**
108 _Leptogorgia sarmentosa_ (Esper, 1789) **
109 _Leptopsammia pruvoti_ Lacaze-Duthiers, 1897 *a
110 _Madracis pharensis_ (Heller, 1868) *
111 _monomyces pygmaea_ (Risso, 1826) *
112 _Paracyathus pulchellus_ (Philippi, 1842) *
113 _Paramuricea clavata_ (Risso, 1826) **
114 _Parazoanthus axinellae_ (Schmidt, 1862) **
115 _Phyllangia mouchezii_ (Lacaze-Duthiers, 1897) *
116 _Polycyathus muellerae_ (Abel, 1959) *
117 _Pourtalosmilia anthophyllites_ (Ellis & Solander, 1786) *

DECAPODA

118 _Dromia personata_ (Linnaeus, 1758) *
119 _Euchirograpsus liguricus_ H. Milne Edwards, 1853 *
120 _Galathea strigosa_ (Linnaeus, 1761) *
121 _Herbstia condyliata_ (Fabricius, 1787) *
122 _Homarus gammarus_ (Linnaeus, 1758) **
123 _Lysmata seticaudata_ (Risso, 1816) **
124 _Maja squinado_ (Herbst, 1788) **
125 Paguridae n. Id. **
126 _Palinurus elephas_ (Fabricius, 1787) **
127 _Scyllarus arctus_ (Linnaeus, 1758) *
128 _Stenopus spinosus_ Risso, 1827 *

MYSIDA

129 _Hemimysis margalefi_ Alcaraz, Riera & Gili, 1986 *
130 _Hemimysis sophiae_ Ledoyer, 1989 *
131 _Hemimysis speluncola_ Ledoyer, 1963 *
132 _Hemimysis spinifera_ Ledoyer, 1989 *a
133 Mysidacea n. id. **

HETEROKONTOPHYTA

134 _Dyctiota dicotoma_ (Hudson) J.V.Lamouroux, 1809 **
135 _Halopteris_ sp. Allman, 1877 **

RHODOPHYTA

136 _Asparagopsis armata_ Harvey, 1855 **
137 _Lithophillum incrustans_ R.A.Philippi, 1837 **
138 _Mesophyllum lichenoides_ (J.Ellis) Me.Lemoine, 1928 **
139 _Peyssonnelia rubra_ (Greville) J.Agardh, 1851 **

ECHINODERMATA

140 _Antedon_ sp. de Fréminville, 1811 *
141 _Holothuria arguinensis_ Jaeger, 1833 **
142 _Holothuria forskalii_ Delle Chiaje, 1823 *
143 _Marthasterias glacialis_ (Linnaeus, 1758) *
144 _Ophiocomina nigra_ (Abildgaard, in O.F. Müller, 1789) *
145 _Ophioderma longicauda_ (Bruzelius, 1805) **
146 _Ophiopsila_ sp. Forbes, 1843 *
147 _Ophiothrix_ cf. _fragilis_ (Abildgaard, in O.F. Müller, 1789) **
148 _Ophiura_ sp. Lamarck, 1801 **
149 _Paracentrotus lividus_ (Lamarck, 1816) **

ECHIURA

150 _Bonellia viridis_ Rolando, 1821 **

UROCHORDATA

151 _Aplidium proliferum_ (Milne-Edwards, 1841) **
152 cf. _Ciona_ sp. Fleming, 1822 **
153 _Didemnum_ sp.2 Savigny, 1816 **
154 _Phalusia fumigata_ (Grube, 1864) **
155 _Pycnoclavella taurensis_ Brunetti, 1991 **

MOLLUSCA

156 Berthellina edwardsi _(Vayssière, 1896)_ **
157 Calliostoma zizyphinum _(Linnaeus, 1758)_ **
158 hypselodoris villafranca _(Risso, 1818)_ **
159 Octopus vulgaris _Cuvier, 1797_ **
160 Sepia officinalis _Linnaeus, 1758_ **

PORIFERA

161 _Aaptos aaptos_ (Schmidt, 1864) *
162 _Acanthella acuta_ Schmidt, 1862 *
163 _Agelas oroides_ (Schmidt, 1864) *
164 _Aplysina cavernicola_ (Vacelet, 1959) *
165 _Aplysina_ n. sp. Nardo, 1834 *
166 _Axinella polypoides_ Schmidt, 1862 *
167 _Axinella vaceleti_ Pansini, 1984 *
168 _Axinella verrucosa_ (Esper, 1794) *
169 _Axinyssa digitata_ (Cabioch, 1968) *
170 Calcarea n. Sp.1 *
171 Calcarea n. Sp.2 *
172 Calcarea n. Sp.3 *
173 Calcarea n. Sp.4 *
174 Calcarea n. Sp.5 *
175 _Caminella intuta_ (Topsent, 1892) *
176 _Chondrosia reniformis_ Nardo, 1847 *
177 _Ciocalypta penicillus_ Bowerbank, 1862 *
178 _Clathrina clathrus_ (Schmidt, 1864) *
179 _Clathrina coriacea_ (Montagu, 1818) **
180 _Cliona celata_ Grant, 1826 **
181 _Corticium candelabrum_ Schmidt, 1862 *
182 _Crambe crambe_ (Schmidt, 1862) *
183 Demospongiae n. Sp.1 *
184 Demospongiae n. Sp.10 *
185 Demospongiae n. Sp.11 *
186 Demospongiae n. Sp.12 *
187 Demospongiae n. Sp.13 *
188 Demospongiae n. Sp.14 *
189 Demospongiae n. Sp.15 *
190 Demospongiae n. Sp.16 *
191 Demospongiae n. Sp.17 *
192 Demospongiae n. Sp.18 *
193 Demospongiae n. Sp.19 *
194 Demospongiae n. Sp.2 *
195 Demospongiae n. Sp.20 *
196 Demospongiae n. Sp.21 *
197 Demospongiae n. Sp.22 *
198 Demospongiae n. Sp.23 *
199 Demospongiae n. Sp.3 *
200 Demospongiae n. Sp.4 *
201 Demospongiae n. Sp.5 *
202 Demospongiae n. Sp.6 *
203 Demospongiae n. Sp.7 *
204 Demospongiae n. Sp.8 *
205 Demospongiae n. Sp.9 *
206 Dendroxea lenis (Topsent, 1892) *
207 _Dercitus bucklandi_ (Bowerbank, 1858) *
208 _Dictyonella marsilii_ (Topsent, 1893) **
209 _Diplastrella bistellata_ (Schmidt, 1862) *
210 _Discodermia polydiscus_ (Bowerbank, 1869) *
211 _Dysidea avara_ (Schmidt, 1862) **
212 _Dysidea fragilis_ (Montagu, 1818) *
213 _Erylus euastrum_ (Schmidt, 1868) *
214 _Geodia cydonium_ (Jameson, 1811) *
215 _Grantia compressa_ (Fabricius, 1780) **
216 _Guancha lacunosa_ (Johnston, 1842) **
217 _Guancha_ n. sp. Miklucho-Maclay, 1868 *
218 _Hemimycale columella_ (Bowerbank, 1874) **
219 _Hymedesmia versiculor_ (Topsent, 1893) *a
220 _Ircinia dendroides_ (Schmidt, 1862) **
221 _Ircinia fascilculata_ (Pallas, 1766) *
222 _Leucosolenia_ cf. _botryoides_ (Ellis & Solander, 1786) **
223 _Mycale massa_ (Schmidt, 1862) *
224 _Oscarella lobularis_ (Schmidt, 1862) *
225 _Pachastrissa pathologica_ (Schmidt, 1868) *
226 _Petrobiona massiliana_ Vacelet & Lévi, 1958 *
227 _Petrosia ficiformis_ (Poiret, 1789) *
228 _Phorbas fictitius_ (Bowerbank, 1866) *
229 _Phorbas tenacior_ (Topsent, 1925) *
230 _Pleraplysilla spinifera_ (Schulze, 1879) *
231 _Raspaciona aculeata_ (Johnston, 1842) *
232 _Raspailia hispida_ (Montagu, 1818) **
233 _Reniera fulva_ (Topsent, 1893) *
234 _Reniera mucosa_ (Griessinger, 1971) *
235 _Rhabderemia_ n. sp. Topsent, 1890 *
236 _Sarcotragus_ sp. Schmidt, 1862 **
237 _Scopalina lophyropoda_ Schmidt, 1862 *
238 _Spirastrella_ n. sp. Schmidt, 1868 *
239 _spongia agaricina_ Pallas, 1766 *
240 _Spongia virgultosa_ (Schmidt, 1868) *
241 _Spongionella pulchella_ (Sowerby, 1804) *
242 _Stryphnus mucronatus_ (Schmidt, 1868) *
243 _Terpios gelatinosa_ (Bowerbank, 1866) **
244 _Thethya citrina_ Sarà & Melone, 1965 *
245 _Thymosia guernei_ Topsent, 1895 *

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