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Mapping of marine key habitats and assessing their vulnerability to fishing activities

in Malta: available knowledge and gap analysis

United Nations Environment Programme
Mediterranean Action Plan
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Mapping of marine key habitats and assessing their vulnerability to fishing activities

in Malta: available knowledge and gap analysis

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FOREWORD

This document is the Phase I report of the Study "Mapping of marine key habitats and assessing their vulnerability to fishing activities in Malta". It consists of a desktop study. The Phase II and Phase III of the Study consist respectively of field work activities and data elaboration/reporting.

This Study is carried out as part of the MedKeyHabitats II Project - Mapping of marine Key habitats and assessing their vulnerability to fishing activities in the Mediterranean. The project is funded by the MAVA foundation within its strategy for the Mediterranean for the period 2017-2022 and it is implemented by the Specially Protected Areas Regional Activity Centre SPA/RAC. Its overall objective is to establish a cartographic inventory of key marine habitats and to assess their vulnerability to fishing activities in different Mediterranean countries.

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INTRODUCTION

Golder Associates S.r.l. (hereinafter referred as "Golder") has been appointed by the Specially Protected Areas Regional Activity Centre SPA/RAC to implement the project titled "Mapping of marine key habitats and assessing their vulnerability to fishing activities in Malta" (hereinafter referred as "Study") in five sites within the Maltese Archipelago. The Study is aimed at mapping marine habitats to establish distribution maps of key habitats in the selected pilot sites, provide concerned authorities with necessary measures for their conservation, and assess the impact that fishing activities have on these habitats. The scope of the Phase I Report is to collect useful available desktop data and perform a Gap Analysis to assess the state of knowledge and to better organize the field work of Phase II.

The 5 areas considered in the Study are the following:

- MT0000101 - Żona fil-Baħar bejn Rdum Majjiesa u Għar Lapsi, which includes the west coast of Malta;
- MT0000102 - Żona fil-Baħar fl-inħawi ta' Għar Lapsi u ta' Filfla, which is located in the south of Malta and comprises Finfla islet;
- MT0000103 - Żona fil-Baħar fl-inħawi tad-Dwejra (Għawdex), which is in the west coast of Gozo;
- MT0000104 - Żona fil-Baħar bejn Il-Ponta tal-Ħotba u Tal-Fessej (Għawdex), which is in the south of Gozo;
- MT0000105 - Żona fil-Baħar bejn il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet, which comprise a large portion of sea in the north and the north coast of Gozo and Malta and all the coastline of Comino.

The study areas are composed by all the portions above the 50 m isobath for all the sites apart from the MT0000105 where only some bays will be investigated (Figure 1).

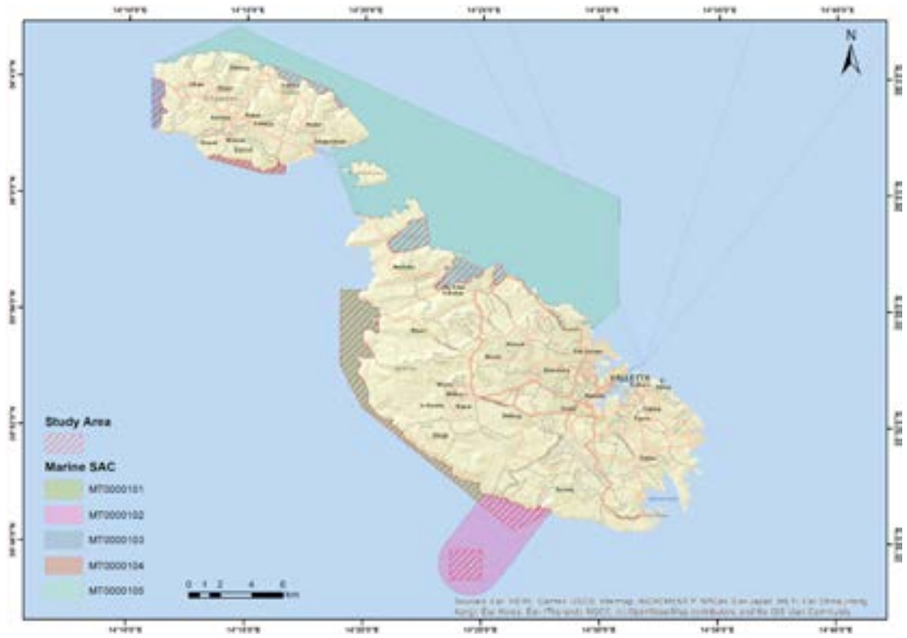

Figure 1
Study Areas.

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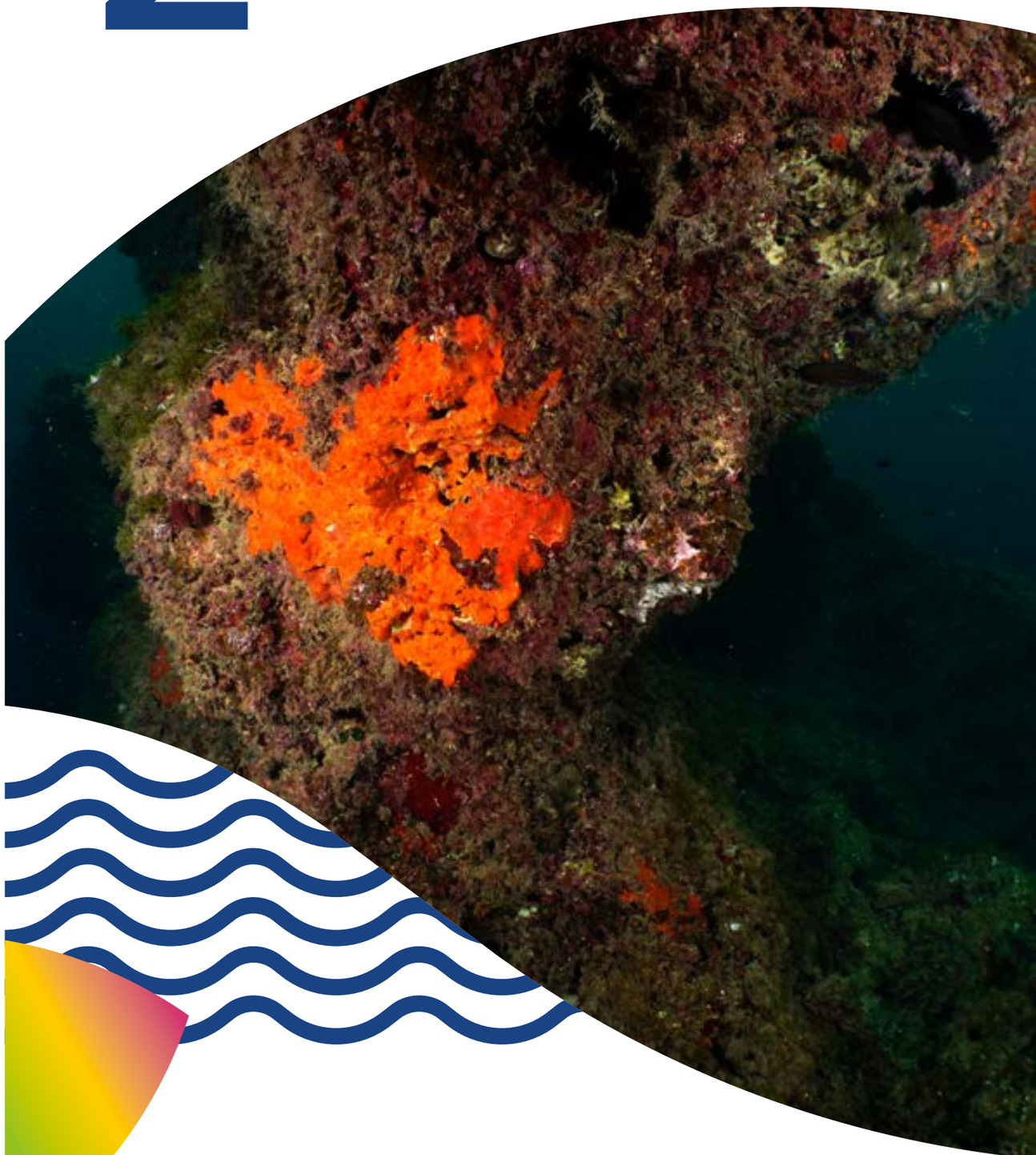

2 DESCRIPTION AND CHARACTERISTICS OF THE STUDY AREA

2.1. General description

The archipelago of Malta comprises three main islands (Malta, Gozo, and Comino) and several minor uninhabited islets (e.g., Cominotto, Filfla, St. Paul's Islands, Fungus Rock).

2.1.1. Geomorphology

In general, the coastline of Malta is characterized by high cliff with very few beaches (about 2.4% of the coastline; Schembri, 1990).

Magri (2006) summarized the main features of the coastline of Malta in the following five classes:

- Cliffs: they are the most abundant feature, and characterize half of the Maltese coastline, especially the southern and south-western portion of Malta (i.e., MT0000101 and MT0000102), eastern Comino and most of Gozo. Usually, they are steep cliffs with high greater than 50 m, sometimes even 200 m.
- *Rdum*: The *rdum* areas are a peculiarity of the Maltese coast and occur where Blue Clay crops out at sea level and is overlaid with the massive strata of Upper Coralline Limestone. The landforms are characterised by a boulder scree at sea level and larger landslides at the foot of the scarp face. *Rdum* areas are especially found north of the Victoria Lines Fault (i.e., in MT0000101) and in eastern Gozo.
- Low rocky coastline: they are low, rocky coastlines of corrosion found in north-east Malta and northern Gozo (i.e., MT0000105).
- Semi-circular coves and sinkholes: they originate from widely distributed typical karstic landforms inundated by the sea. The most famous are Qawra in western Gozo, the two creeks in western Comino and the Blue Grotto (MT0000102) on the southern coast of Malta.
- Drowned valleys: Malta and Gozo display inlets that are partially drowned valleys (also known as *calanques*) of subaerial erosion. Moreover, due to changes in sea level, mouths of drainage channels have been submerged. These features are located in southern Malta (Wied iz-Zurrieq, Marsascala bay), north-east Malta (Salina Bay, MT0000105), and in Gozo (Il-Bajda). Some inundated river valleys are the Marsamxett and the Grand Harbor, while in Gozo are Mgarr ix-Xini (MT0000104) and Xlendi Bay.

The southernmost Study Area is the MT0000102, which comprises the islet of Filfla. The islet lies about 5 km from the coast, it is a mesa that consists of a massive block of rock rising from the sea to about 60 m above the sea level. It was used as a target for military practice until 1980s, because of that the morphology of the islet (and of the small rocky islet nearby, Filfoletta) is currently changing (Borg et al., 1997; Furlani et al., 2019); in fact, several landslides have been spotted in the last decades (Furlani et al., 2019).

The areas along the north western coast of Malta are often subject to landslides; In Ghajn Tuffieha Bay and Il-Qarraba, which are located within the MT0000101 SAC, landslides can occur, and structures (e.g., an historical watchtower) on top of the cliff are at risk of being damaged (Magri et al., 2008).

2.1.2. Bathymetry

The Maltese Archipelago lies within the southernmost extremity of the south-eastern continental shelf of Sicily. It is very close to the shelf break and flanked by a very steep bathymetry in the south. The Malta Graben, in the southwest, reaches a depth of around 1650m. The shelf is characterized by a plateau (150 m deep) in its shallower part. Along the eastern and southern perimeter, the shelf is embraced by a submarine ridge, whose emerged part are the Maltese Islands. The Hurds bank represent a shallower area of the ridge (50 m) (Drago et al., 2003) (Figure 2).

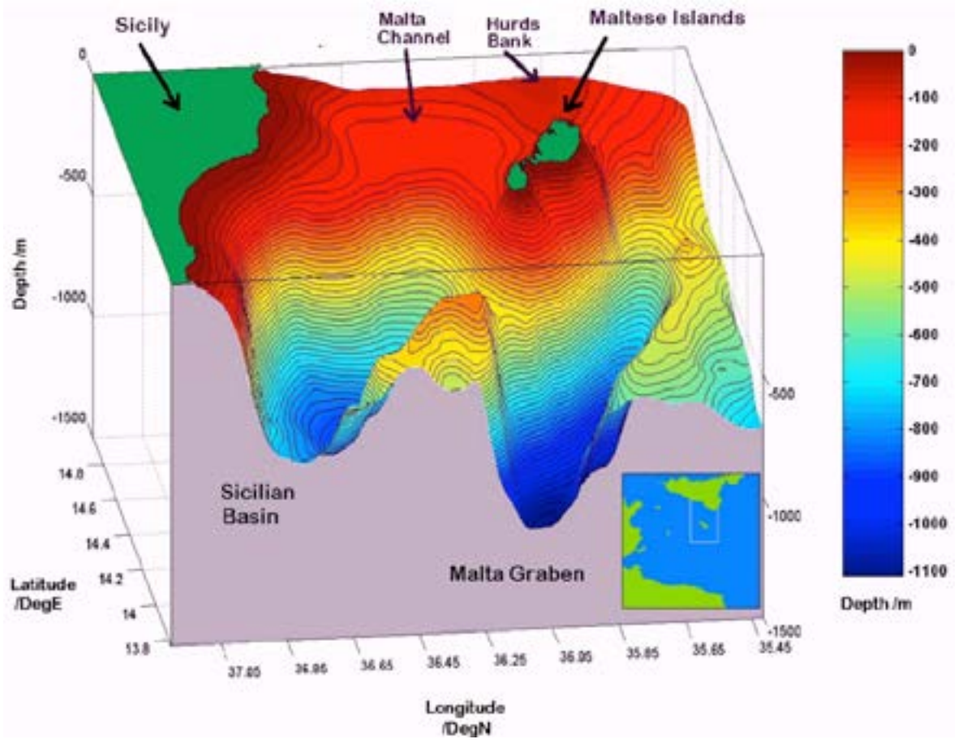

Figure 2

Three-dimensional view of the model bathymetry (source: Drago et al., 2003).

The general bathymetry of the Maltese Archipelago is shown in Figure 3.

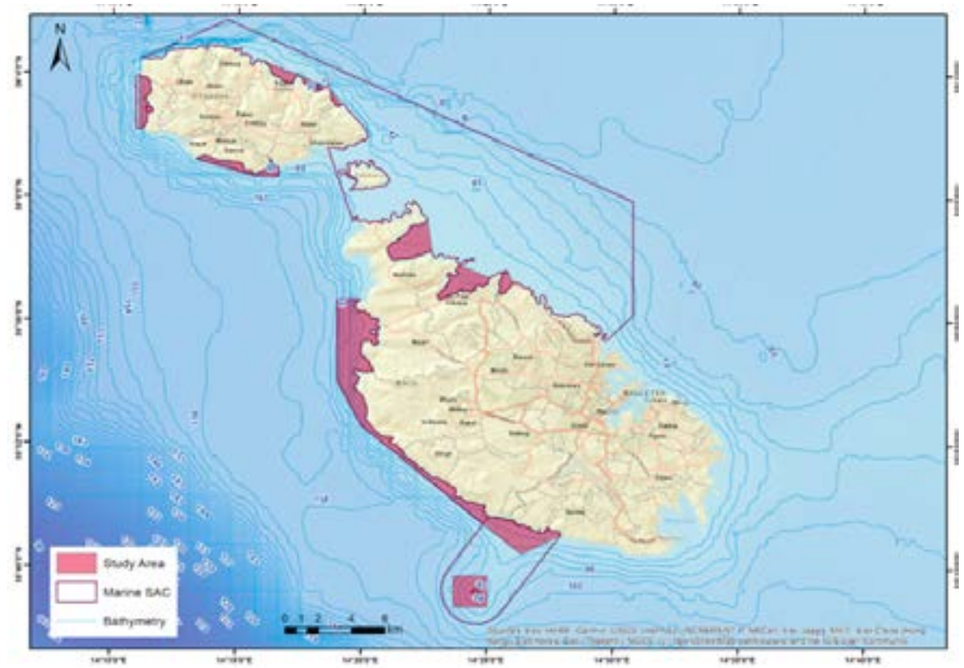

Figure 3

Bathymetry of the Maltese Archipelago (source: EMODnet).

General bathymetric data are available in the Nautical Charts. In addition, some bathymetric surveys were carried out during recent decades.

During 2012 and 2013 a bathymetric survey was conducted around the Maltese islands for an ERDF project. A total of 415 Km^2 were covered between the depths of 15 m and 200 m. The total area covered during the campaign is reported in Figure 4. The survey was done using a side pole-mounted SEA Swathplus-L interferometric sonar system (117 KHz) (Espinal & Hunter, 2014).

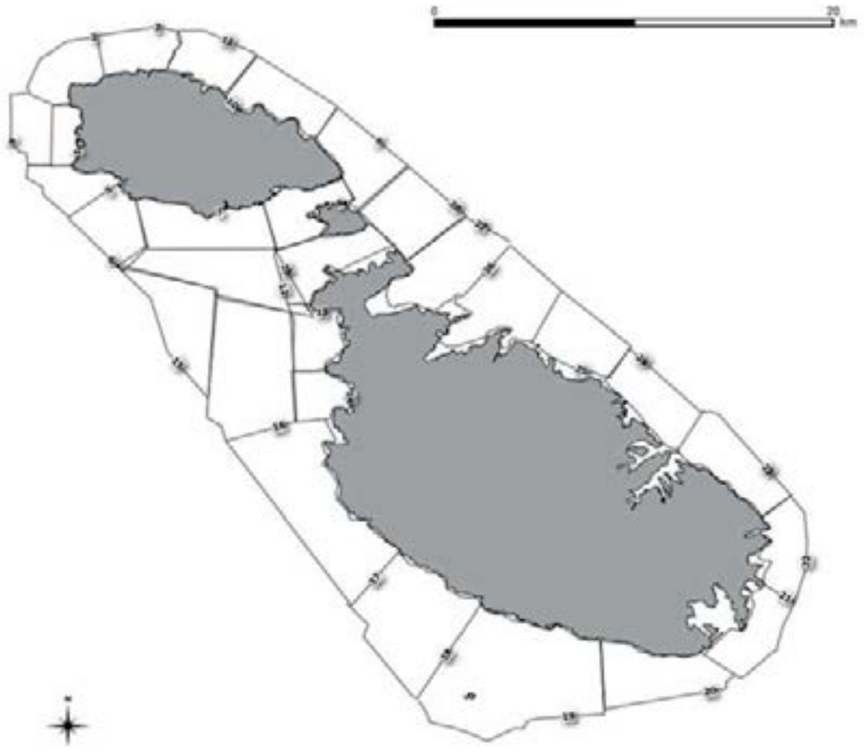

Figure 4

Areas surveyed during the 2012-13 campaign (source Espinal & Hunter, 2014).

The data seems to be not available for consultation with the exclusion of the Figure 5 as reported in Espinal & Hunter (2014).

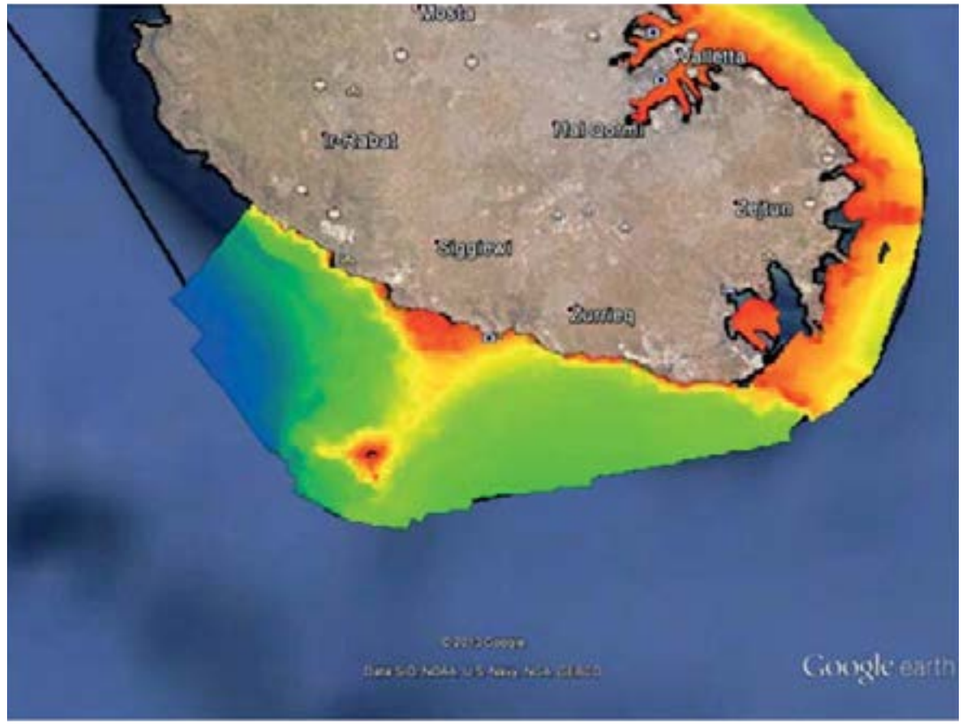

Figure 5

Low resolution raster mosaic of East Malta (September 2012) (source: Espinal & Hunter, 2014).

In 2006 a European Regional Development Fund (ERDF) project was conducted around Filfla Island. During the surveys a detailed bathymetry was produced (Figure 6). Digital data of this survey are not available.

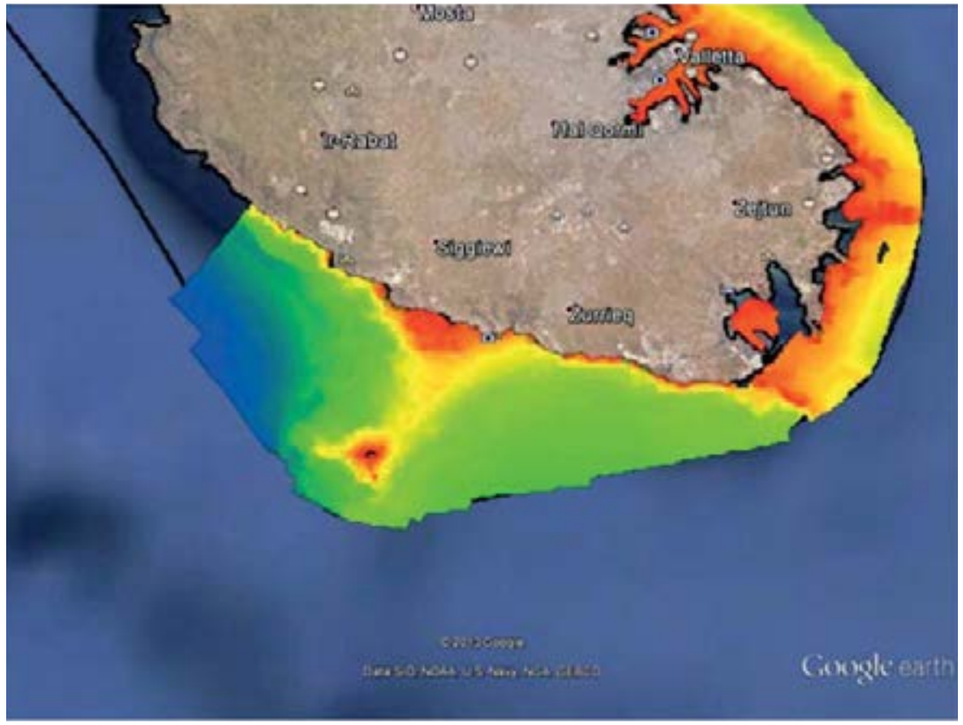

Figure 6
Filfla Bathymetry (AIS Environmental Limited, 2006).

2.1.3. Currents (Oceanography)

The area of sea north of Malta is comprised in what is called the Malta-Sicily channel (MSC) which is located in the broader Sicily Channel. This area is characterized by the currents that flow from the Atlantic Ocean to the Levantine Mediterranean Basin (the Atlantic Water, AW) and the other way around (the Levantine Intermediate Water, LIW). In particular the area north of Gozo Island is dominated by the flow of Atlantic Water towards east, the Atlantic-Ionian Stream. Moreover, in the Malta plateau, intense (10 cm/s) diurnal-period currents have been observed. Besides, in the MSC weak tidal currents have been observed, concentrated in the diurnal and semidiurnal range. Usually their speed is below 3 cm/s during the semidiurnal band and below 6 cm/s during the diurnal one (Cosoli et al., 2015; MSFD).

2.2. History and protection of the areas

The five areas identified for this Study are listed in the G.N. 682 of 2018 as Special Areas of Conservation (SAC) – Sites of International Importance in accordance with the Flora, Fauna and Natural Habitats protection Regulation, 2006 (S.L. 549.44) and the EU Habitat Directive (92/43/EEC). The first one designed is the MT0000101 - Żona fil-Baħar bejn Rdum Majjiesa u Għar Lapsi that has been a recognized SIC since 2008 (Deidun, 2009).

The islet of Filfla, which is part of the site MT0000102 - Żona fil-Baħar fl-inħawi ta' Għar Lapsi u ta' Filfla was a target practice for the US and English Navy until the '80s. Since 1987 the area around the islet has experienced some degree of protection due to the G.N. 473 of 1987 and the Local Notice to Mariners 16 of 1987 which prohibited the berthing and navigation of any craft within an area of one nautical mile radius off Filfla and swimming, underwater activities, and any other activities connected with fishing and trawling (Borg et al., 1997). The G.N. 473 of 1987 has been revoked by the Local Notice to Mariners 173 of 1990 which prohibits the berthing in a radius of 1 nm around the islet, but not the fishing activities.

Another type of zones of conservation are the ones created by the Transport Malta Authority around wrecks. The areas are defined as Conservation Areas in the Notice to Mariners No. 41 of 2019. In the Study Area of MT0000102 there is one wreck (Figure 7). In this zones anchoring is allowed only to divers' vessels, surface fishing (i.e., trolling lines and angling for pelagic fish) is the only way of fishing permitted, while spearfishing and the use of fishing gear such as set bottom lines, trammel nets, gill nets and entangling nets, encircling nets, demersal pots and traps are prohibited.

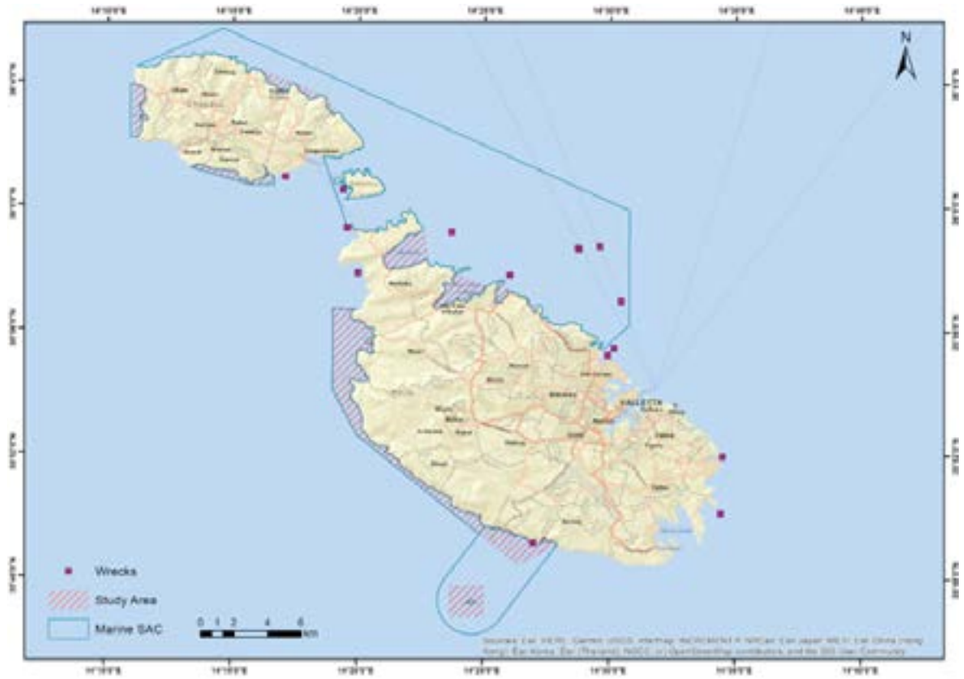

Figure 7
Wrecks (Conservation Areas) around Malta, according to the Notice to Mariners No. 41 of 2019.

3

3 MARINE BIODIVERSITY

The study of the marine Biodiversity around the Maltese Island has greatly increased during the last years. Among the most significant source of data for the present study, one Life Project (LIFE BaĦAR), focused on marine habitats mapping, was conducted from 2013 to 2018.

The aims of the LIFE BaĦAR project were to extend existing marine Sites of Community Importance (SCIs), and to designate new marine areas as SCIs to form part of the Natura 2000 network. The project collected data primarily regarding the following habitats:

- Sandbanks which are slightly covered by sea water all the time (code 1110);
- Reefs (code 1170);
- Submerged or partially submerged sea caves (code 8330).

The project output comprised the proposal for new SCIs and the designation of new MPAs.

In addition, Borg and Schembri (2002) focused on marine habitat of interest to provide an alignment to conform to the EU Habitats Directive. Due to the importance of sandbanks, listed in Annex I of the EU's Habitats Directive, Knittweis et al. (2017) focused the attention on this habitat around Malta.

Finally, some of the data were retrieved from the Marine Strategy Framework Directive (MSFD) Initial Assessment (https://era.org.mt/en/Pages/MSFD-IAs-GES-Targets.aspx) and from the Maltese Geoportal (https://msdi.data.gov.mt/geonetwork/srv/eng/catalog.search#/home).

3.1. Benthic bionomy

The cliffs and low **rocky coastline** are the most abundant feature and characterize half of the Maltese coastline. They are characterized by benthic assemblages which varies according to the bathymetry.

Associations with *Lithophyllum byssoides* and associations with *Ceramium ciliatum* and *Corallina elongata* occur in mediolittoral rock (Borg and Schembri, 2002). *C. elongata* prefers gently sloping shores in shaded places. In well-lit places of gently sloping shores, instead, generally belts of *Cystoseira* spp. occurs.

Neogoniolithon brassica-florida concretion occurs in the lower mediolittoral-upper infralittoral of local rocky shores, especially in shallow depressions where it forms a crust on the rock.

The upper infralittoral on hard substrata, in well-lighted situations wherever seagrasses are absent, is dominated principally by photophilic algae, mostly phaeophytes. Further, in infralittoral rocks, associations with encrusting algae and sea urchins, associations with *Cystoseira amentacea* and facies with *Mytilus galloprovincialis* occur (Borg and Schembri, 2002). Sea urchins (*Centrostephanus longispinus*) are important grazers controlling algae growth on shallow water reefs and is protected by law (listed as threatened species in IUCN Red List and listed in the Annex IV of the Habitat Directive, in the Annex II of the SPA/BD Protocol, and in the Annex II of Bern Convention as strictly protected fauna species) (LIFE BaĦAR, 2018). *Corallina elongata* also occurs in this infralittoral zone (Borg and Schembri, 2002).

Faunal species characteristic of the infralittoral zone include the sponge *Chondrilla nucula* associated with well-lit conditions, *Astroides calycularis* common in shady conditions,

Dendropoma/Neogoniolithon trottoirs occurring at sea level and the uppermost reaches of the infralittoral, *Serpulorbis arenaria* occurring on exposed rock in shallow water. *Cladocora caespitosa* is also present and forms small colonies not more than 15 cm in diameter (Borg and Schembri, 2002).

Coralligenous formations comprise various benthic assemblages, which form typical underwater seascapes in the infralittoral zone (UNEP-MAP-RAC/SPA, 2008).

In Maltese islands, these coralligenous formations were recorded within shallow caves and on shaded vertical rock faces at relatively shallow depths not exceeding 42 m (Borg et al., 2004; AIS Environmental Ltd. & Malta Environment and Planning Authority, 2006). This habitat type is characterized by encrusting algae (including *Peyssonnelia squamaria* recorded in the Filfla area and *Lithophyllum frondosum* in association with *Zonaria tournefortii* recorded at the mouth of caves in the Dwejra area), encrusting and erect bryozoans (including *Myriapora truncata, Caberea boryi, Smittina cervicornis* and possibly *Celleporina caminata* and Schizoporella species), corals (*Leptosammia pruvoti*), several species of sponges (including *Agelas oroides, Petrosia ficiformis, Faciospongia cavernosa, Buskea dichotoma* and *Chondrosia reniformis*), the ascidian (*Halocynthia papillosa*) and hydroids of the genus Eudendrium sp. (Ballesteros, 2006).

Only some 2.5% of the Maltese coastline consists of **mobile sediments** (the rest is rocky) (Borg and Schembri, 2002). The mobile substrates are mainly sandbanks, bathyal muds and shallow mixed sediment. In the Maltese Islands sandbanks tend to be present in very shallow waters with the highest part of the surveyed sandbanks at depths ranging from surface to 2 m, and the depth of the surrounding seabed from 0.2 to 2.6 m (Knittweis et al., 2017).

Mobile substrata within 50 m depth are dominated by presence of several ecologically important species such as *Posidonia oceanica* and *Cymodocea nodosa* meadows.

Special attention must be deserved to the endemic marine gastropod *Gibbula nivosa*. Although the main habitat of the Maltese top-shell has been considered to be the leaves of the seagrass *P. oceanica*, it has also been reported from under stones in shallow water, as recently discovered by Evans and Schembri (2014). *G. nivosa* was rediscovered in cobble beds in 2006, after some 25 years during which no living specimens had been found. It is still quite rare within the Maltese Islands. This, together with its very narrow geographical range (endemic of Maltese archipelago), renders it highly vulnerable to extinction (Evans and Schembri, 2014). It is listed in the Annexes II and IV of the Habitat Directive, in the Annex II of the Bern Convention, and in the Annex II of the SPA/BD Protocol.

On sandy beaches in the littoral zone the polychaete *Ophelia bicornis* and the isopods *Tylos europaeus* thrive. However, research efforts on sandy or shingle beaches undertaken to date are not deemed adequate enough to provide a clear picture of the actual distribution of these species on Maltese beaches, also in view of the rarity of such species.

Proceeding in deeper zones, in shallow sublittoral sands, Facies with *Loripes lactus* and *Tapes spp* occur. Species typical of this shallow sublittoral sediment are the noble pen shell *Pinna nobilis* which is listed in Annex IV of the Habitats Directive and in the Annex II of the SPA/BD Protocol. Other typical species include the echinoderm *Paracentrotus lividus* which is listed in the Bern Convention and in the Annex III of the SPA/BD Protocol (MSFD, 2012).

Another habitat of conservation interest is characterized by **rhodoliths.** Accumulations of rhodoliths were recorded in several sites off southeastern Malta at depths of 50 m to 100 m (LIFE BaĦAR, 2018). The rhodolith-forming coralline algae are formed by *Lithothamnium coralloides* and *Phymatholithon calcareum* and are listed in the Annex V of the Habitats Directive (Council Directive 92/43/EEC). Rhodoliths may interest the 5 study areas only partially especially in their deeper sections.

The main results of the LIFE BaĦAR on the distribution of key habitats are presented in Figure 8.

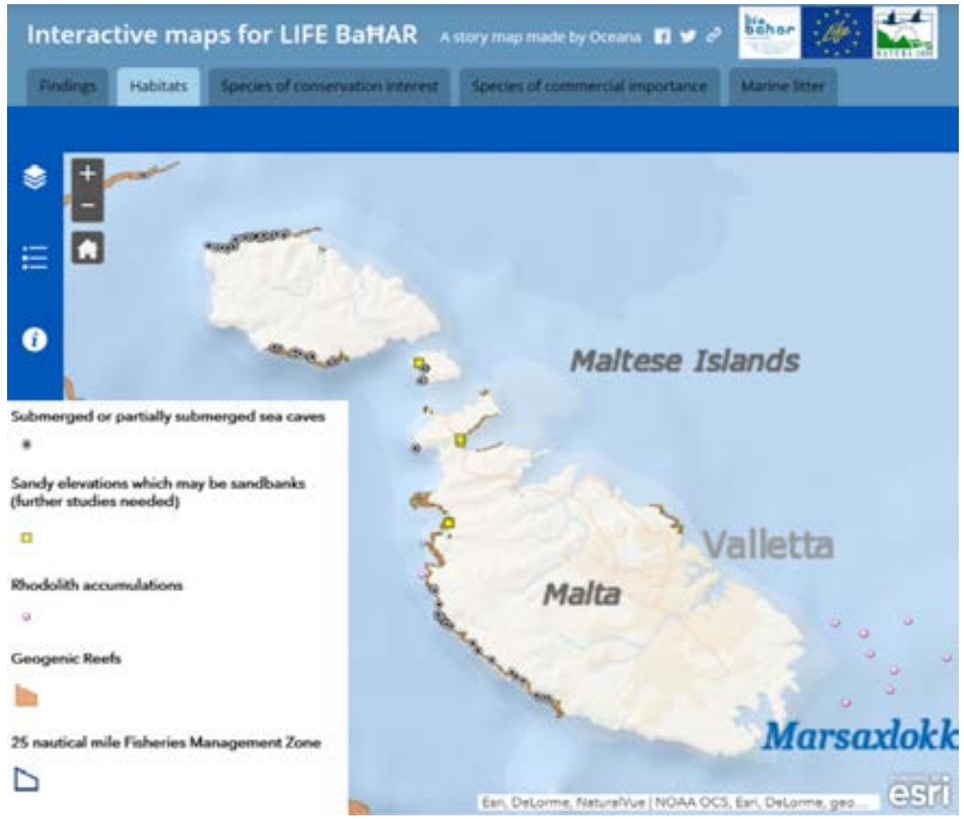

Figure 8

Key habitats distribution (source: LIFE BaĦAR, 2018).

A general cartography for the habitats listed in the Habitat Directive has been done. Its coverage is shown in Figure 9.

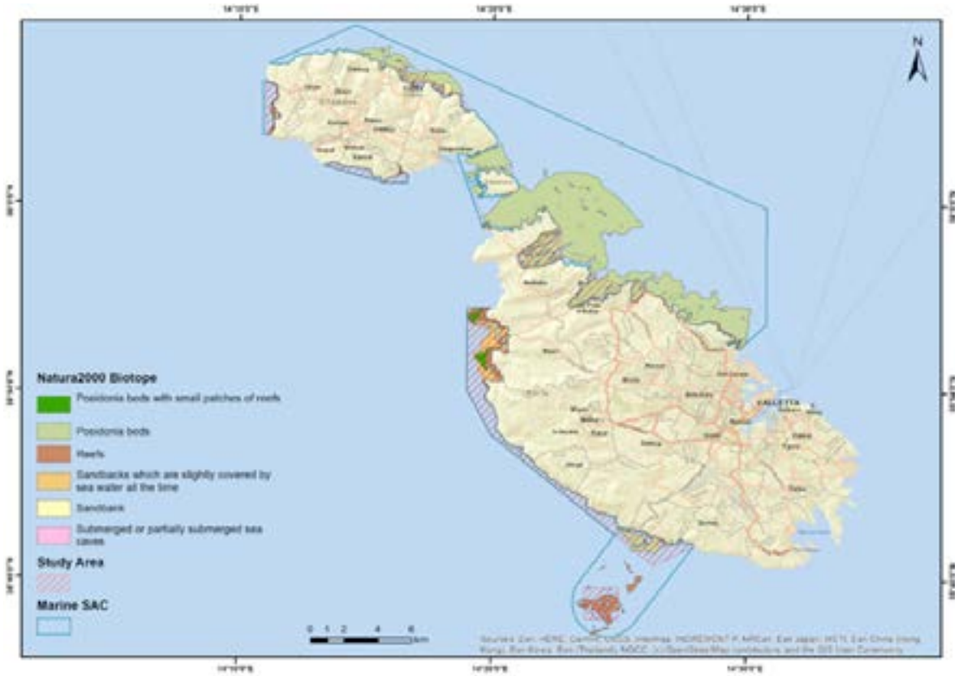

Figure 9

Distribution map of the habitat listed in the Habitat Directive (source: Malta Geoportal).

A detailed habitat cartography is available from the MSFD Initial Assessment, which collected data from 2002 to 2011. An example of the level of detail is provided in Figure 10, and the non-categorized distributions for each site is presented below.

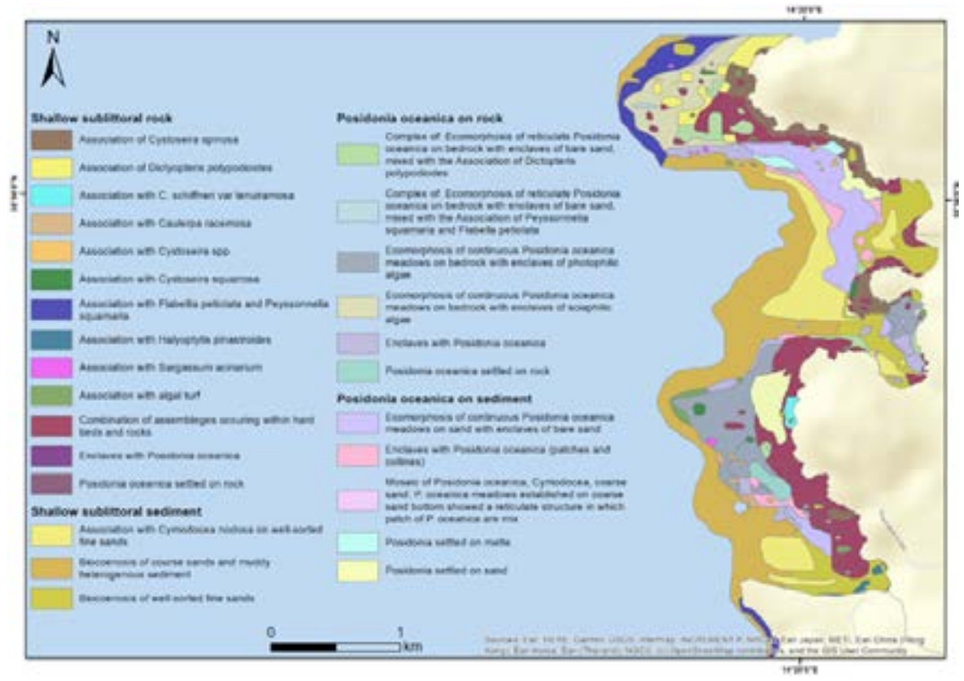

Figure 10

Example of the level of detail within the MT0000101 SAC for the cartography done for the MSFD Initial Assessment (source: Malta Geoportal).

Focusing on the 5 study areas the following data are available:

MT0000101

Main habitats

- *Posidonia oceanica* meadows, with isolated stands of brown and green algae
- *Cymodocea* nodosa
- Photophilic algae
- Sciaphilic and encrusting algae, mainly rhodophytes
- Coastal biogenic reefs
- Presence of the gastropod *Gibbula nivosa* (LIFE BaħAR, 2018)

Other relevant features

- Presence of collapsed cliffs (*rdum*) in the areas of Ramla tal-Mixquqa and Ir-Ramla ta' Ghajn Tuffieha

Below (Figure 11, Figure 12 and Table 1) are provided the main GIS data available on the benthic cartography of this Study Area.

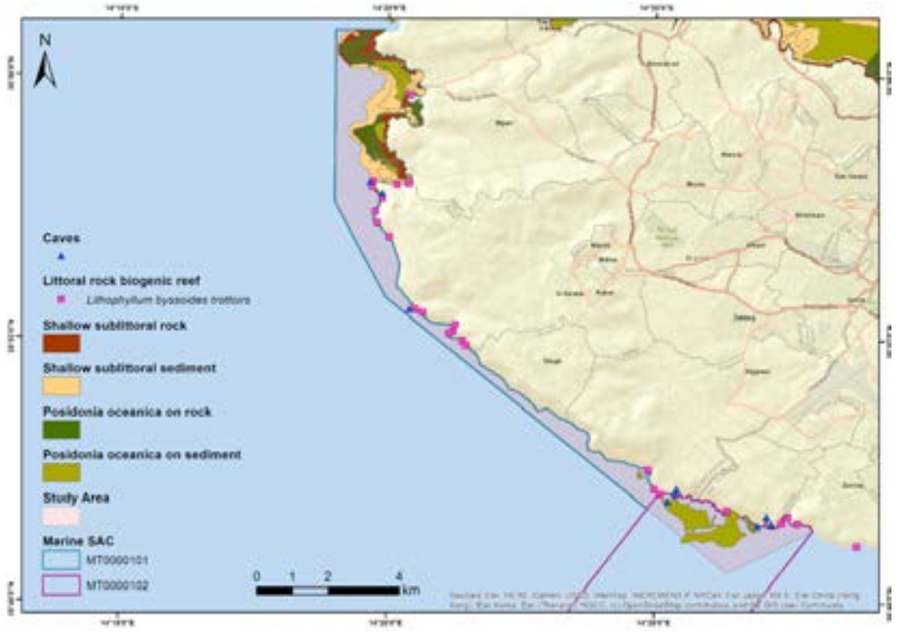

Figure 11

Main benthic cartography data available for the MT0000101 SAC (source Malta Geoportal).

Figure 12

Result of LIFE BaĦAR project for the MT0000101 SAC (source LIFE BaĦAR).

Table 1

Biocoenosis and Associations in the Study Area of MT0000101.

Biocoenosis	Associations
Biocoenosis of coarse sands and muddy heterogeneous sediment	Biocoenosis of coarse sands and muddy heterogenous sediment
Biocoenosis of infralittoral algae	Association of *Dictyopteris polypodioides*
Biocoenosis of infralittoral algae	Combination of assembleges occuring within hard beds and rocks
Biocoenosis of infralittoral algae	Association with algal turf
Biocoenosis of infralittoral algae	Association with *Cystoseira squarrosa*
Biocoenosis of infralittoral algae	Association with *Halyoptytis pinastroides*
Biocoenosis of infralittoral algae	Association with *Caulerpa racemosa*
Biocoenosis of infralittoral algae	Association with *Cystoseira* spp.
Biocoenosis of infralittoral algae	Association with *Sargassum acinarium*
Biocoenosis of infralittoral algae	Association with *Flabellia petiolata* and *Peyssonnelia squamaria*
Biocoenosis of infralittoral algae	Association of *Cystoseira spinosa*
Biocoenosis of infralittoral algae	Association with *C. schiffneri var tenuiramosa*
Biocoenosis of infralittoral algae	Enclaves with *Posidonia oceanica*
Biocoenosis of Posidonia oceanica meadows	Ecomorphosis of continuous *Posidonia oceanica* meadows on sand with enclaves of bare sand
Biocoenosis of Posidonia oceanica meadows	Complex of: Ecomorphosis of reticulate *Posidonia oceanica* on bedrock with enclaves of bare sand, mixed with the Association of *Dictopteris polypodiodes*
Biocoenosis of Posidonia oceanica meadows	Ecomorphosis of continuous *Posidonia oceanica* meadows on bedrock with enclaves of sciaphilic algae
Biocoenosis of Posidonia oceanica meadows	Complex of: Ecomorphosis of reticulate *Posidonia oceanica* on bedrock with enclaves of bare sand, mixed with the Association of *Peyssonnelia squamaria* and *Flabella petiolata*
Biocoenosis of Posidonia oceanica meadows	Ecomorphosis of continuous *Posidonia oceanica* meadows on bedrock with enclaves of photophilic algae
Biocoenosis of well-sorted fine sands	Enclaves with *Posidonia oceanica* (patches and collines)
Biocoenosis of well-sorted fine sands	Biocoenosis of well-sorted fine sands
Biocoenosis of well-sorted fine sands	Association with *Cymodocea nodosa* on well-sorted fine sands
NA	Posidonia settled on sand
NA	Posidonia settled on matte
NA	Mosaic of *Posidonia oceanica, Cymodocea*, coarse sand: *P. oceanica* meadows established on coarse sand bottom showed a reticulate structure in which patch of *P. oceanica* are mix
NA	*Posidonia oceanica* settled on rock

MT0000102

Main habitats

- *Posidonia oceanica* meadows: in the Għar Lapsi area the posidonia meadow's rhizome primary production values are amongst the higher values for the Mediterranean Sea
- Presence of *Cystoseira spinosa* (LIFE BaĦAR, 2018)

Below (Figure 13) are provided the main GIS data available on the benthic cartography of this Study Area.

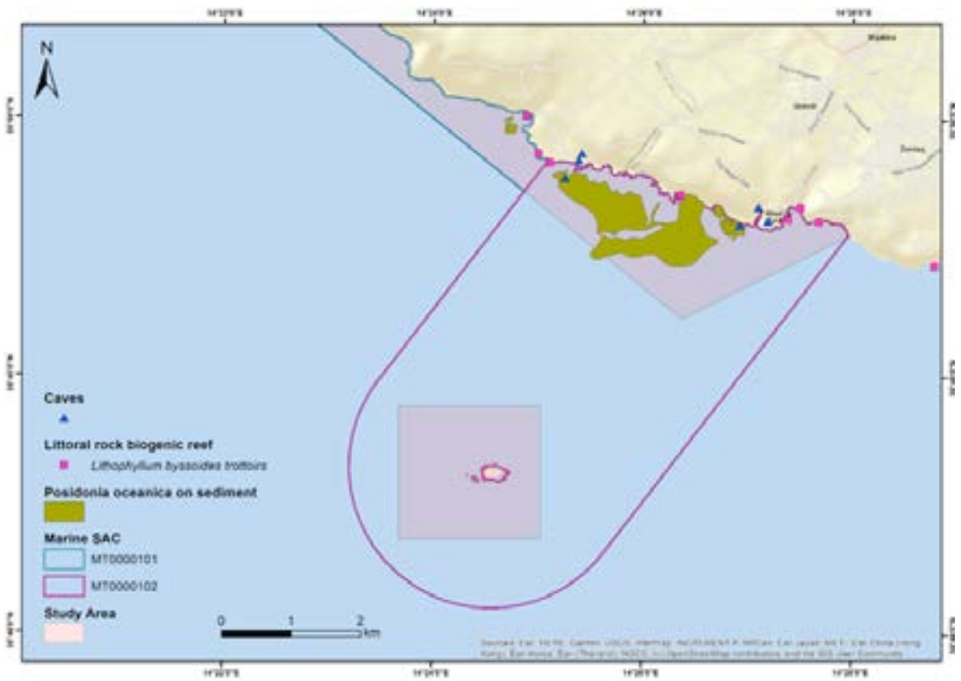

Figure 13

Main benthic cartography data available for the MT0000102 SAC (source Malta Geoportal).

Main habitats around Filfla islet are described in the following figure (**Figure 14**).

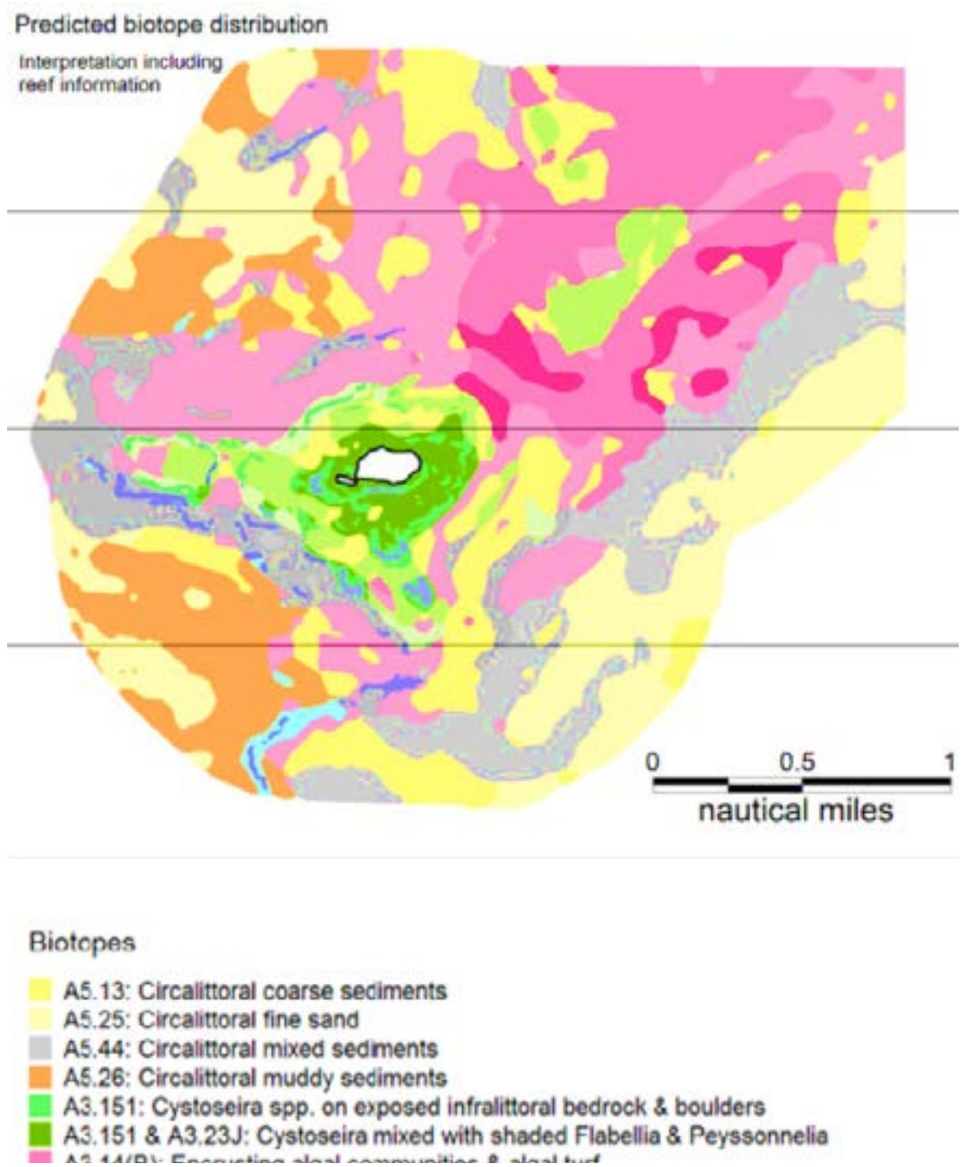

Figure 14

Biotope distribution around Filfla islet (source: AIS Environmental Limited, 2006).

MT0000103

Main habitats

- *Posidonia oceanica* meadows (non-continuous bed)
- Coastal reef characterized by associations with *Flabellia petiolata* and *Peyssonnelia squamaria* (LIFE BaHAR, 2018)
- Infralittoral stones and pebble characterized by thin algal felt, supporting a rich macrofauna such as the gastropods *Gibbula* spp. and *Osilinus articulates*. *Clibanarius erythropus, Xantho poressa* and *Xantho incises* and *Pisidia* sp. occur (MSFD, 2012).

Below (Figure 13) are provided the main GIS data available on the benthic cartography of this Study Area.

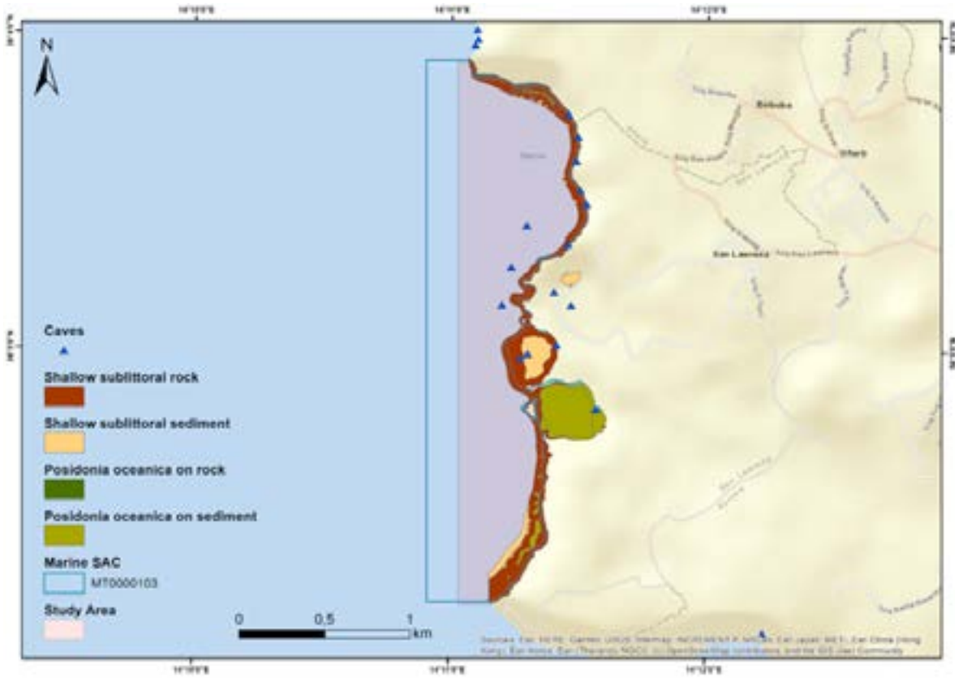

Figure 15
Main benthic cartography data available for the MT0000103 SAC (source Malta Geoportal).

Table 2
Biocoenosis and Associations in the Study Area of MT0000103.

Biocoenosis	Associations
Biocoenosis of coarse sands and muddy heterogeneous sediment	Biocoenosis of course sands and muddy heterogenous sediment
Biocoenosis of infralittoral algae	Association of *Corallina elongata*
Biocoenosis of infralittoral algae	Combination of assemblages occurring within hard beds and rocks
Biocoenosis of infralittoral algae	Association with *Cystoseira* spp.
Biocoenosis of infralittoral algae	Association of *Dictyopteris polypodioides*
Biocoenosis of infralittoral algae	Association with *Flabellia petiolata* and *Peyssonnelia squamaria*
Biocoenosis of infralittoral algae	Association with *Caulerpa racemosa*
Biocoenosis of infralittoral algae	Association of *Cystoseira spinosa*
Biocoenosis of *Posidonia oceanica* meadows	Complex of: Ecomorphosis of reticulate Posidonia *oceanica* on bedrock with enclaves of bare sand, mixed with the associations of *Cystoseira* spp.
NA	A community of bare sand which appears to be rather impoverished. Biota includes holothurian species and some burrowing polychaetas and bivalves.
NA	Community of the alga *Caulerpa racemosa*
NA	Assemblages of photophilic algae dominated by *Cystoseira* species
NA	Sciaphilic algal community characterised by *Flabellia petiolata, Halimeda* tuna and *Peysonnelia squamaria*
NA	A discontinuous meadow of Posidonia *oceanica* with patches of rock, gravel, sand and clay.
NA	Posidonia settled on matte
NA	Sparse Posidonia oceanica prairies

MT0000104

Main habitats

- *Posidonia oceanica* meadows
- *Cymodocea nodosa*
- Coralligenous formations formed by red algae, such as *Lithophyllum incrustans* and *Peysonnelia squamaria* (LIFE BaHAR, 2018)
- Hard substrata characterized by assemblages of sciaphilic algae such as *Palmophyllum crassum*, *Cladophora prolifera*, *Flabellia petiolata*, *Halopteris filicina* and *Zonaria tourneforti*

Data on distribution of habitats in this area are scarce. In fact, the SAC was extended in 2018 while the MSFD initial assessment was conducted before the extension.

Below (Figure 16, Figure 17 and Table 3) are provided the main GIS data available on the benthic cartography of this Study Area.

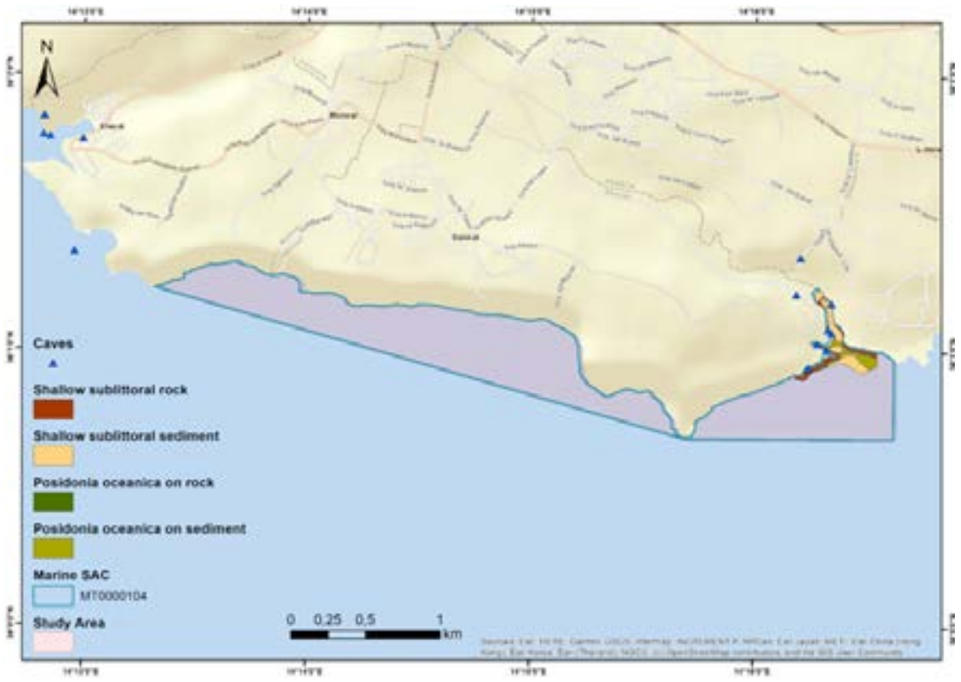

Figure 16

Main benthic cartography data available for the MT0000104 SAC (source Malta Geoportal).

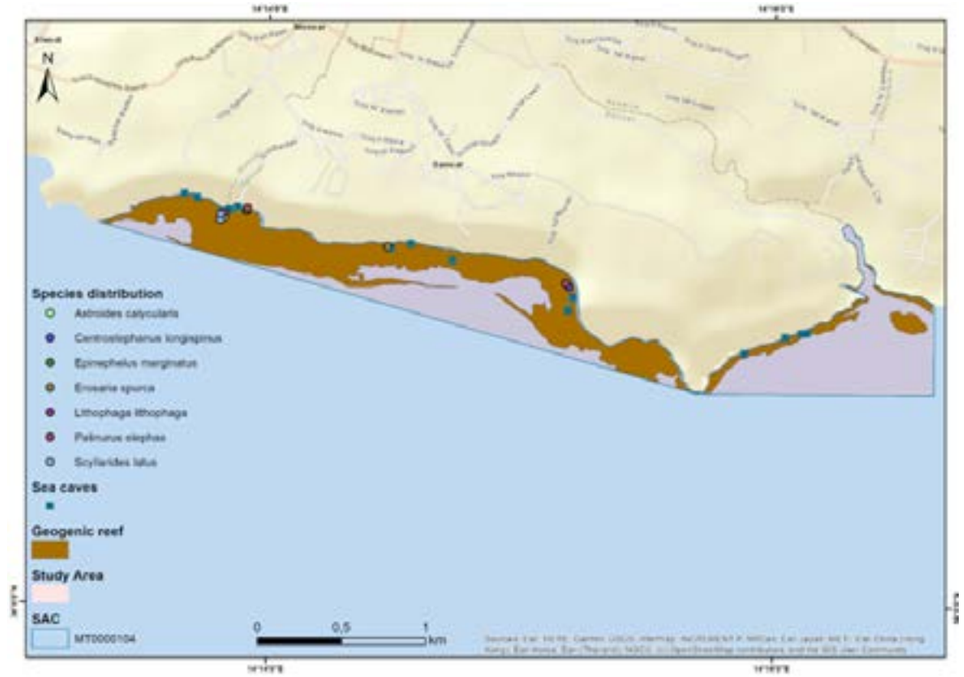

Figure 17

Result of LIFE BaHAR project for the MT0000104 SAC (source LIFE BaHAR).

Table 3

Biocoenosis and Associations in the Study Area of MT0000104.

Biocoenosis	Associations
Biocoenosis of coarse sands and muddy heterogeneous sediment	Biocoenosis of course sands and muddy heterogenous sediment
Biocoenosis of coarse sands and muddy heterogeneous sediment	Enclaves with sciaphilic algae on patches of bedrock and/or boulders
Biocoenosis of coarse sands and muddy heterogeneous sediment	Enclaves with *Posidonia oceanica* and sciaphilic algae on patches of bedrock and/or boulders
Biocoenosis of infralittoral algae	Association with *Cystoseira* spp.
Biocoenosis of infralittoral algae	Association of *Corallina elongata*
Biocoenosis of infralittoral algae	Association of *Dictyopteris polypodioides*
Biocoenosis of infralittoral algae	Association with *Zonaria tourneforti*
Biocoenosis of infralittoral algae	Association with *Flabellia petiolata* and *Peyssonnelia squamaria*
Biocoenosis of infralittoral algae	Association of *Halopteris scoparia and Padina pavonica*
Biocoenosis of infralittoral algae	Enclaves with *Posidonia oceanica*
Biocoenosis of infralittoral stones and pebbles	Biocoenosis of infralittoral stones and pebbles
Biocoenosis of Posidonia oceanica meadows	Ecomorphosis of continuous *Posidonia oceanica* meadows on sand with enclaves of bare sand
Biocoenosis of well-sorted fine sands	*Biocoenosis* of well-sorted fine sands

Biocoenosis	Associations
Biocoenosis of well-sorted fine sands	Association with *Cymodocea* nodosa on well-sorted fine sands
Biocoenosis of well-sorted fine sands	Enclaves with photophilic algae on patches of bedrock and/ or boulders
Biocoenosis of well-sorted fine sands	Enclaves with *Posidonia oceanica* (patches and collines)

MT0000105

Main habitats

- *Posidonia oceanica* meadows: this area hosts the largest variety of Posidonia sub-types when considering the marine sites selected to form part of the Natura 2000 Network.
- Coastal biogenic reef
- Maërl bed
- *Cymodocea nodosa* meadows
- Gastropod *Gibbula nivosa* (Borg and Schembri, 2002).

Below (Figure 18,Figure 19 and Table 4) are provided the main GIS data available on the benthic cartography of this Study Area.

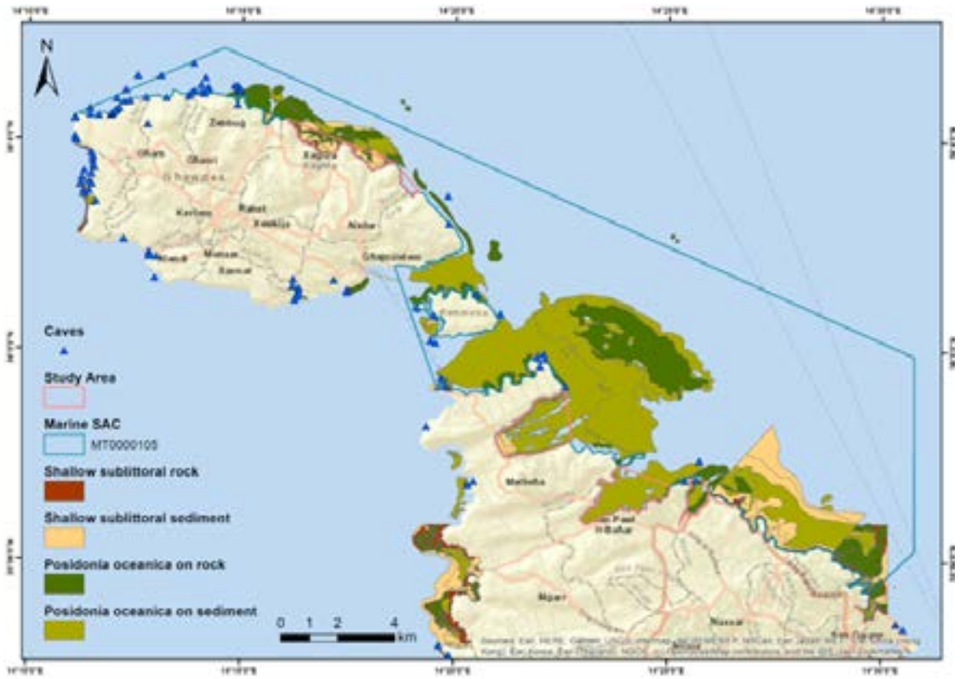

Figure 18

Main benthic cartography data available for the MT0000105 SAC (source Malta Geoportal).

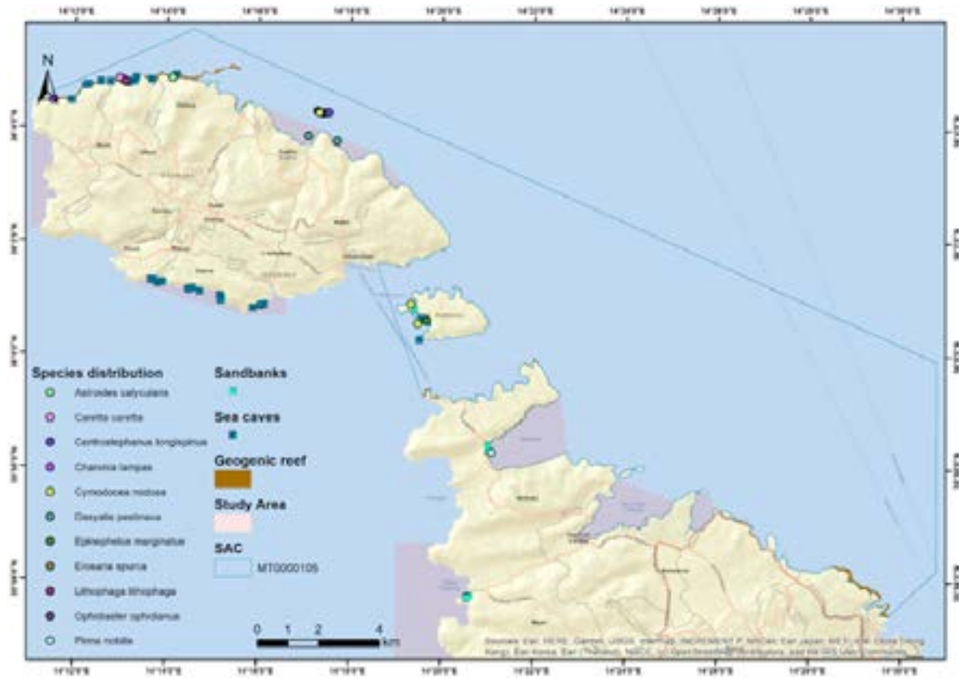

Figure 19

Result of LIFE BaHAR project for the MT0000105 SAC (source LIFE BaHAR).

Table 4

Biocoenosis and Associations in the Study Area of MT0000105.

Biocoenosis	Associations
Biocoenosis of coarse sands and muddy heterogeneous sediment	Enclaves with Posidonia *oceanica* and *sciaphilic* algae on patches of bedrock and/or boulders
Biocoenosis of fine sands in very shallow waters	Biocoenosis of fine sands in very shallow waters
Biocoenosis of infralittoral algae	Enclaves with *Posidonia oceanica*
Biocoenosis of infralittoral algae	Enclaves with *Posidonia oceanica*
Biocoenosis of infralittoral algae	Association of *Dictyopteris polypodioides*
Biocoenosis of infralittoral algae	Association of *Halopteris scoparia* and *Padina pavonica*
Biocoenosis of infralittoral algae	Association with *Cladophora prolifera*
Biocoenosis of infralittoral algae	Association with *Acetabularia acetabulum*
Biocoenosis of infralittoral stones and pebbles	Biocoenosis of infralittoral stones and pebbles
Biocoenosis of infralittoral stones and pebbles	Combination of assemblages occuring within stones and pebbles
Biocoenosis of *Posidonia oceanica* meadows	Ecomorphosis of continuous *Posidonia oceanica* meadows on bedrock with enclaves of photophilic algae
Biocoenosis of *Posidonia oceanica* meadows	Complex of: Ecomorphosis of reticulate *Posidonia oceanica* on bedrock with enclaves of bare sand, mixed with the Association of *Dictopteris polypodiodes*

Biocoenosis	Associations
Biocoenosis of *Posidonia oceanica* meadows	Ecomorphosis of reticulate *Posidonia oceanica* meadows on sand with enclaves of bare sand
Biocoenosis of *Posidonia oceanica* meadows	Ecomorphosis of 'barrier reef' meadows
Biocoenosis of well-sorted fine sands	Enclaves with mixed Posidonia *oceanica* (patches) and photophilic algae on patches of bedrock and/or boulders
Biocoenosis of well-sorted fine sands	Enclaves with mixed *Posidonia oceanica*/*Cymodocea nodosa* (patches)
Biocoenosis of well-sorted fine sands	Combination of assemblages occuring within fine sands with more or less mud
Biocoenosis of well-sorted fine sands	Association with *Cymodocea* nodosa on well-sorted fine sands
Biocoenosis of well-sorted fine sands	Biocoenosis of well-sorted fine sands
Euryhaline and eurythermal biocoenoses	Association with Ulva *laetevirens* and *Enteromorpha linza*
NA	*Posidonia oceanica* settled on rock
NA	Posidonia settled on matte
NA	Posidonia settled on sand
NA	Mosaic of *Posidonia oceanica*, *Cymodocea*, coarse sand: *P. oceanica* meadows established on coarse sand bottom showed a reticulate structure in which patch of *P. oceanica* are mix
NA	Photophilic algae on hard substrata, with patches of *Posidonia oceanica* in places

3.2. Ichthyofauna

During the LIFE BaHAR project (LIFE BaHAR, 2018) a distribution map of the species of conservation interest recorded in the surveyed SACs was created. Amongst these species the following ones were recorded inside the five Areas of Study:

- *Dasyatis pastinaca*, the common stingray, recorded north of Gozo (MT0000105);
- *Mobula mobular*, spotted once off the coast of Gozo (MT0000105);
- *Myliobatis aquila*, the common eagle ray, recorded in the south-west of Malta (MT0000101);
- *Epinephelus marginatus*, the dusky grouper, seen north of Gozo and east of Comino (MT0000105), south of Gozo (MT0000104) and south-west of Malta (MT0000101);
- *Labrus viridis*, the green wrasse, spotted in the south-west of Malta (MT0000104).

Around Filfla (MT0000102) a dated preliminary study (Borg et al., 1997) reported an impoverishment of the demersal fish fauna, when compared to other areas of the Maltese Archipelago. The species recorded during that survey are reported in the Table 5, but in general the abundance of species such as *E. marginatus*, *Sciaena umbra*, *Umbrina cirrosa*, and *Diplodus* spp. were low. This fact can be due to the methodology of illegal fish practiced in this area (explosive and spearfishing using SCUBA).

Table 5
Fish species presented in the area around Fifla (Source: Borg et al, 1997).

Family	Species
Serranidae	*Epinephelus marginatus*
Serranidae	*Serranus scriba*
Mullidae	*Mullus surmuletus*
Mullidae	*Mullus sp.*
Sparidae	*Diplodus spp.*
Sparidae	*Dentex dentex*
Labridae	*Labrus sp.*
Labridae	*Coris julis*
Labridae	*Symphodus spp.*
Labridae	*Thalassoma pavo*
Scaridae	*Sparisoma cretense*
Gobidae	*Gobius sp.*
Blenniidae	*Blennius sp.*

In the last years, a few observations of species from the Atlantic Ocean has been reported. For examples *Sphoeroides pachygaster* (Visentin and Borg, 2014), *Seriola fasciata* and *Cephalopholis taeniops* (Deidun et al., 2011), and *Pontinus Kuhlii* (Castriota and Deidun, 2014).

Malta is an important area for Chondrichthyes, as witnessed by the numerous sightings of both sharks (Selachii) and Batoidea. 37 species of sharks and 26 species of rays were recorded from Malta, although subsequent researches have confirmed 26 sharks and 14 rays for Malta (Schembri et al., 2003) and 23 sharks for the Sicilian Channel (Ragonese et al., 2013).

3.3. Alien species

A detailed list of invasive species in Malta has been created within the MSFD Initial Assessment (MSFD, 2012); Table 6 presents the marine species identified within the Study Areas.

Table 6
Alien species recorded in the Study Areas (MSFD, 2012).

Taxonomic Group		Species	Status	Abundance	Distribution
Macrophyta	Chlorophyta	*Caulerpa racemosa* var. *cylindracea*	Established, Invasive	High	MT0000102 MT0000103 MT0000105
	Magnoliophyta	*Halophila stipulacea*	Established	Moderate	MT0000105
	Rhodophyta	*Asparagopsis* sp.	Established	Moderate	MT0000101 MT0000102 MT0000103 MT0000104 MT0000105
		Botryocladia madagascariensis	Established	Low	MT0000101 MT0000102 MT0000105
		Chondria pygmaea	Established?	Not Known	MT0000102 MT0000105
		Lophocladia lallemandii	Established, Invasive	High	MT0000101 MT0000102 MT0000103 MT0000105
		Womersleyella setacea	Established, Invasive	High	MT0000101 MT0000102 MT0000103 MT0000104 MT0000105
Foraminifera		*Amphistegina lobifera*	Established	Moderate	MT0000101 MT0000103 MT0000105
Cnidaria	Scyphozoa	*Rhopilema nomadica*	Casual	Low	MT0000103 MT0000105
Crustacea	Decapoda	*Percnon gibbesi*	Established, Invasive	High	MT0000101 MT0000102 MT0000104 MT0000105
	Maxillopoda	*Dosima fascicularis*	Casual	Not Known	MT0000101
Mollusca	Gastropoda	*Aplysia dactylomela*	Casual	Not Known	MT0000105
		Atys macandrewi	Casual	Low	MT0000105
		Chelidonura fulvipunctata	Casual	Low	MT0000102 MT0000105
		Gibbula cineraria	Casual	Low	MT0000105
	Bivalvia	*Brachidontes pharaonis*	Established, Invasive	High	MT0000101 MT0000102 MT0000103 MT0000105
		Crassostrea gigas	Established	Low	MT0000105
		Pinctada radiata	Established	Moderate	MT0000101 MT0000105
Fish	Perciformes	*Cephalopholis taeniops*	Casual	Low	MT0000105
		Siganus luridus	Established, Invasive	Low	MT0000102
	Syngnathiformes	*Fistularia commersonii*	Established, Invasive	Moderate	MT0000104 MT0000105

4

4

FISHING ACTIVITIES

4.1. Overview

Fisheries in Malta are a relatively small industry where its socio-cultural significance far outweighs its economic importance. The economic contribution of capture fisheries to the national economy is negligible, accounting for approximately 0.10 percent of the Malta's Gross Domestic Product (GDP). It is in fact a traditional activity which however operates on a small scale, producing small volumes of a very valuable product. The industry is mainly artisanal and fairly typical of the fisheries found in many Mediterranean countries (Dimech at al., 2009).

The proportion of the working population dependant, to varying extents, on this industry for its livelihood, is around 1.0 per cent. From an international perspective, the value of the annual fish catch in Malta is around 0.07 percent that of the European Union (EU), while total employment, including full-time, part-time and seasonal employment, is around 0.4 percent of the EU total in the sector (Dimech et al., 2009).

Fishing is mostly conducted within the Maltese fisheries management zone, which is a 25 nautical mile Fisheries Management Zone (FMZ), in which fishing effort and capacity are restricted by size and engine power. In particular, only vessels smaller than 12 m are allowed to practice fishing in the zone since these are considered as boats which practice small scale coastal fishing and which therefore have minimal impacts on the marine environment. The number of vessels that can fish in this zone has been set by the Treaty of Accession and is reflected in Council Regulation (EC) 813/2004 and Council Regulation (EC) 1967/2006.

For the areas under study the limit access rights are in general the same as the ones detailed by the Council Regulation (EC) 1967/2006, for the Fisheries Management zone.

Malta carries out an annual National Fisheries Data Collection Programme according to EC 2016/1701, and has been collecting such data on a regular basis since 2006. The catch data include data on commercial landings by weight and value for each fishing segment by species, by quarter and by geographical origin of the catch. The data is derived from exhaustive data reported in logbooks (for the over 10 metre fleet), by sampling landings (for the under 10 metre fleet). Landing values will also be based by data derived from the official fish market and direct sales notes data (>10m and <10m). For the small-scale fleet, face to face interviews are conducted with the vessel owners every fortnight. Information on catches, effort in fishing days, by type of gear, fishing areas and activity are obtained. This methodology of obtaining data overcomes the difficulty of acquiring data from the fish market and other official sources for the small scale fishery which can have many errors due to various reasons such as the underestimation in information on landings declared in the invoices for fiscal reasons and erroneous names attributed to fish species which are difficult to identify. Furthermore, data on effort is not reported in sales vouchers.

4.2. Fishing fleet

On the 31st December 2018 the Maltese fishing vessel population consisted of 3,355 registered fishing vessels (Department of Fisheries and Aquaculture, 2019) of which about 20 % are based in the picturesque fishing village of Marsaxlokk while about 15% are based in the island of Gozo. Out of these vessels 938 are considered as professional vessels of which 380 (~41%) were professional full-time (MFA) and 558 (~59%) were professional part-time vessels (MFB). The rest which amount to 2,037 vessels hold a recreational fishing license (MFC). The recreational category operated recreational fishing gear only and fish caught by such vessels are not commercialised.

The absolute majority (93%) of the professional vessels are less than 12 m in length overall and more than half of them are of a traditional design, and these operate mainly in coastal waters. Out of the 938 Professional Full-time vessels, only 43 are considered as industrial vessels (i.e. over 18 m in length). These industrial vessels are trawlers, longliners and netters. All the vessels except the bottom otterboard trawlers are considered as multipurpose since they undertake all types of fishing with changes of gear from one season to the next. At the end of 2018, there were a total of 15 trawlers registered on a full-time basis, with a total power and tonnage of 5,561.51 kW and 2,007.42 GT respectively. These ranged between 19.08 to 35 m in overall length (Department of Fisheries and Aquaculture, 2019).

Professional Full-time (MFA) is the term used for fishermen whose main income is derived solely from fishing. Most fishing vessel owners own more than one vessel. It must be pointed out that fishing in the Maltese Islands is mainly seasonal and as a consequence some of the fulltime fishermen own at least one small and one large vessel which enable them to practice off-shore fishing during the milder seasons and coastal activities during the winter months. The average number of fishermen employed on each fulltime boat is around three persons per unit during winter, whilst when undertaking trips of more than two days, extra hands are sometimes recruited for the tuna, swordfish and lampuki seasons (Dimech et al., 2009)

4.3. Fishing production

In 2018 landings from marine capture fisheries are dominated by mackerel (*Scomber* spp., 32%), dolphinfish "lampuki" (*Coryphaena hippurus*, 16%), swordfish (*Xiphias gladius*, 12%), and bluefin tuna (*Thunnus thynnus*, 4.5%), in decreasing order of importance (Fishery Statistics, 2018). About 65 percent of the annual landings originate from these species. The actual percentage attributed to any one of these three species depends on the actual volume of landings and market price for each particular species in a given period. The price of lampuki and swordfish varies enormously, and the percentage importance attributed to them will therefore change in different time periods.

These fisheries are operated on a seasonal basis, according to the particular targeted species' migratory or biological behaviour (Table 7).

Table 7
Seasonal pattern of fishing activity in the Maltese islands

Fishery	Period	Location	Fishing Gear	Species
Tuna fishery	April – June	Offshore	Drifting Surface Longline	Bluefin Tuna, Swordfish
Trawl fishery	All year	FMZ	Bottom Otter Board Trawl Nets	Red Shrimp, White Shrimps, Red Mullet, Hake
		Offshore		
Demersal fishery	January – July	FMZ	Bottom Set Longlines	Wreck fish Bream
		Offshore		
Small Pelagic fishery	March – August	FMZ	Lampara/Purseseine, Cane Pots	Bogue, Mackerel
FAD fishery	August – December	FMZ	FADs and Surrounding Nets	Lampuki, Pilot fish, Amberjack
		Offshore		
Swordfish fishery	All year	FMZ	Drifting Longlines	Swordfish, Spearfish, Lampuki
		Offshore		

4.4. Species of halieutic interest

The most important fisheries in Maltese waters are those for bluefin tuna, dolphinfish, swordfish, demersal and small pelagics. In recent years there has been an increase in fishing for mackerel, mainly not for human consumption, but as fresh feed for the tuna penning operations. For the areas under study the most important species are demersal, the pelagic species dolphinfish and coastal pelagic species. Large pelagics including, Bluefin tuna and swordfish are usually fished in offshore waters outside of the study areas.

4.4.1. Demersal Fish

Fishing for Demersal species is undertaken with different types of gears: gillnets and entangling nets, bottom trawlers, bottom longlines and traps (Dimech et al., 2009). Different types of bottom gillnet and entangling nets are used in the Maltese Islands. These are a) trammel net locally known as 'Parit'; b) the 'Xkitt' which is a gillnet; c) 'Xkatlar', a single mesh bottom gillnet. They are mainly used during the winter months when the weather does not allow long term fishing on the high seas but their use is extended over the whole year. These gears are used both by day and night depending on the particular species being targeted, e.g. demersal species late evening and night, pelagic species during the day. The product is commercialized fresh and is for local consumption. The main fishing area is along the coast, at 10-40 m depth. These activities are undertaken by a large amount of vessels of the smaller categories, such as 'Luzzijiet', 'Kajjiki' and MPVs which are less than 12 m in length. These boats are usually manned by 1 or 2 fishermen. The 2 largest vessels lay around 2.5 km of nets whereas all the others normally lay less than 1 km per vessel.

Bottom longlining targets several species of Bream (Sparidae spp.), dentex (*Dentex dentex*), wreckfish (*Polyprion americanus*), groupers (*Epinephelus* spp.) and common red porgy (*Pagrus pagrus*). Usually these longlines are set in deep rocky areas near the slope, at depths of 200 m to 700 m. This fishing activity is conducted out of the 5 coastal areas of interest for this Study.

Pots and Traps are used to catch a wide range of demersal species and are constructed in different shapes and sizes according to the species being targeted. The material used to construct these traps also varies according to species. For species such as moray eel (*Muraena helena*) and octopus (*Octopus vulgaris*) the material used is chicken wire netting, whilst for bogue (*Boops boops*), picarel (*Spicara* spp.) and similar species the material used is cane cut into fine strips or special reeds. Shapes vary according to the habitats of the targeted species, meaning that for demersal species the shape would be rectangular, whilst bell or pear shaped traps are used for mid-water species. Approximately there are 180-200 vessels using traps. These vessels are normally the 'kajjik' and small 'luzzu' type, with lengths under 10 m. The number of fishermen per boat varies from 1 to 2 fishers. The product is always consumed locally and sold as fresh fish.

4.4.2. Dolphin fish fishery

The dolphinfish (*Coryhaena hippurus*) or 'lampuka' in Maltese is one of the most important species for the economy of the Maltese fishing industry (Gatt et al., 2015). In fact up to a few years ago it was actually the most important fishery due to its appeal to the public and the abundance of catches which regularly occur each year. Due to its traditional appeal a consistent number of boat owners participate in this seasonal activity. The authorities have been involved in the management of this fishery in the last 100 years. Lampuki are captured using 'fish aggregating devices' (FAD's). These FAD's are small rafts made of floating material, which are then anchored to the bottom. They were introduced after it was noticed that lampuki along with other species such as the pilot fish (*Naucrates ductor*) and the amberjack (*Seriola dumerilii*) tend to aggregate within the canopy of shadow that these floats make (Gatt et al., 2015). To further augment the number of fish, palm fronds are attached underneath each float. Once the lampuki are aggregated, they are caught by surrounding nets without a purse-line. When the boat is near an FAD various trolls made out of feathers or artificial bait are set and one fish is caught, a decoy dolphinfish is thrown into the sea to attract any others that may be present under the FAD. When the number of fish present makes it worthwhile, the surrounding operation is then undertaken. A variation to this original day fishery is the surrounding of the FAD's at night with the use of a strong search light to keep the fish aggregated during the surrounding operation.

4.4.3. Small Pelagics

Coastal pelagic fishing in the Maltese Islands has been practised for a very long time and at least from 1930 when 'lampara' fishing was first introduced locally and from the 60's to the 80's it was very important part of the total national fishing effort when landings of chub mackerel (*Scomber japonicus*), Atlantic mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*), bogue (*Boops boops*), allice shad (*Alosa alosa*), sardines (*Sardina pilchardus*) and anchovy (*Engraulis encrasicholus*) were quite abundant and in fact use to constitute 30% of the total fish landings, but since the 60's the effort became minimal and catches have reduced considerably (Dimech et al., 2009). Interestingly this fishery has regained importance in recent years due to the demand for fresh fish feed for tuna penning operations, and hence fishing for mackerel has increased considerably. The main targeted species using lampara is chub mackerel. The term 'lampara' is used because fishermen use strong lights to attract fish, which are then caught by purse seining. The boats used for this fishery are in the 10-15 m length category. The purse seine is between 400 to 450 m long and about 105 m high. Fishing takes place all along the North side of the island but the main zone is around a shallow area covering about 5 square miles, known as Hurd bank to the South East. The depth is between 45 and 55 m with the intermediate area descending to a maximum of 100 m. 'Lampara' fishing is undertaken throughout the year except for the period from September to December when these boats target the lampuki. Considering its bathymetric range, this fishing activity can deal only with the deeper sectors of the 5 areas of interest for this Study.

4.5. Fisheries Management Plans

Currently there are three management plans in place within the 25 nautical mile Maltese Fisheries Management Zone (FMZ). These were developed in line with Article 19 of Council Regulation (EC) No 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea and include: lampara purse seine fishery, bottom otter trawler fishery and lampuki FAD fisheries. The two main objectives of management plans are to ensure the sustainability of stocks through better monitoring and to ensure financial stability for fishers (Fisheries Control Directorate, 2013).

4.6. Aquaculture

Aquaculture in Malta is marine-based. It consists of the capture-based aquaculture of the Atlantic bluefin tuna (*Thunnus thynnus thynnus*), as well as the culture of European sea bass (*Dicentrarchus labrax*) and Gilthead sea bream (*Sparus aurata*) with a small production of Meagre (*Argyrosomus regius*) and amberjack (*Seriola dumerili*). Atlantic bluefin tuna is exported mainly to Japan, whereas European seabass and Gilthead seabream are exported to Europe, mainly Italy. Aquaculture of seabass, seabream and meagre takes place in floating cages, approximately one kilometer offshore (STECF, 2014). In the case of Bluefin tuna, an Aquaculture Zone 6 km off the southeastern coast is utilized by 5 farms to fatten up the captured tunas. Another Aquaculture Zone towards the north of Malta is being planned. In 2015, European seabass and Gilthead seabream production was 2 364 tonnes whilst the Atlantic bluefin tuna production was 8 051 tonnes (Aquaculture Statistics, 2015).

The national body for aquaculture research is the Malta Aquaculture Research Centre (MAR).

There is strong competition for space and resources due to the small size of Malta. Environmental issues take priority and an environmental impact assessment is required before aquaculture development is initiated in line with the Aquaculture Strategy set from (2014-2025).

Inside the Study Area within the SAC MT0000105 there are 4 aquaculture farms and 1 or 2 are within the SAC but outside the Study Area. Inside Melieħa Bay, along the northern coast, there is an intensive aquaculture farm with *Sparus aurata, Dicentrarchus labrax*, and *Argyrosomus regius* in floating cage and a smaller one, for which no information of the species bred was retrieved. In Xemxija Bay there are two intensive aquaculture farms with *Sparus aurata, Dicentrarchus labrax*, and *Argyrosomus regius* in floating cage. About 1.5 km offshore the bay, a blue tuna farm was also registered, but, according to the most recent satellite photo, the farm has relocated. However, a blue tuna farm is still present outside the areas to be surveyed in this study but inside this SAC, about 0.5 km south of Comino (Figure 20) (Malta Geoportal, 2016).

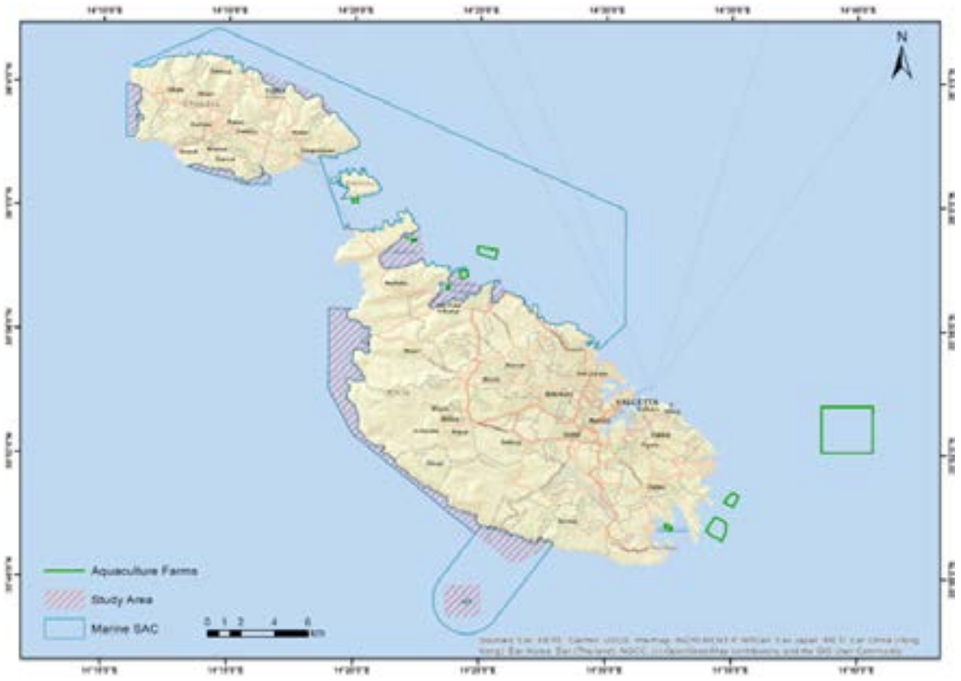

Figure 20

Aquaculture farms around Malta (source: LIFE BaĦAR, 2018).

5

5

TOURISTIC ACTIVITIES

Malta together with the other two main islands of the Maltese archipelago, Gozo and Comino, and a number of smaller islands, is located in a strategic position in the middle of the Mediterranean.

With over 1 million annual tourists, the Maltese Islands experience one of the highest tourist arrival densities in the world (Deidun, 2010). Total inbound visitors for August were estimated at 338,758 in 2019, an increase of 6.7 per cent when compared to the corresponding month in 2018 (National Statistics Office [NSO], 2019). Growth of tourism during the years increased after the Government launched a scheme to attract airlines to introduce new routes to improve the accessibility of Malta (Ministry of Tourism, 2019). Most of the tourism pressure on small islands is exerted along the narrow coastal fringe. Statistics from the Maltese Islands amply testify to this statement. 96% of the accessible coastline in the Maltese Islands is developed, dominated by tourism, shipping or other industries (Anderson and Schembri, 1989), whilst 21% of the total coastline of the islands no longer retains its natural features (MEPA, 2006b).

In 2017, it is estimated that around 117,300 tourists, 5.2% of total inbound tourists were motivated to visit Malta by scuba diving (Research Unit Malta Tourism Authority, 2018).

Another popular activity in the small islands is recreational fisheries. It plays an important social and economic role. It is a growing activity in the Mediterranean area due to the development of tourism (Gaudin and De Young, 2007). Marine recreational fisheries, however, are not monitored as commercial fisheries are (Font and Lloret, 2010).

In detail, the Maltese Islands competitive shore-based sport fishing is a popular recreational activity. Darmanin and Vella (2018) monitored 79 sport fishing competitions, lasting between 4 and 5 hr, each took place between July 2012 and December 2015 at 30 sites, located mainly along the west coast of Malta (Figure 21). Of the sites, 2 are located within the SAC number MT0000101 and 8 within the MT0000105. The area of La Valletta is the most popular site for fishing competitions and it is located very close to the study area number MT0000105. Sport fishing activities, when carried out on boats, can damage benthic habitats due to the physical damage of anchors and lines.

Many anthropic activities, such as fishing, have negative effects particularly on hard bottom benthic communities (Collie et al., 2000).

Figure 21

Map of the Maltese islands showing where fishing competition were documented (source: Darmanin and Vella, 2018).

Over the past two decades, there has been a focus on diversifying the economy of the Maltese Islands, focusing to inbound tourism. Nautical tourism forms such a market (Carlton, 2018).

Nautical tourism is a dynamic type of tourism of particular interest in Mediterranean countries and small island nations, including Malta. Here it is a niche to develop in order to maintain and grow tourism revenues while limiting undesirable effects of mass tourism (Rogan and Antonopoulos, 1995).

There are several marinas which can accommodate more than 100 boats within the study areas and numerous bays of touristic value for their beauty and their natural characteristics, especially within the Żona fil-Baħar bejn il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet (MT0000105). Therefore, it is likely that nautical tourism will be particularly developed in the SACs such as MT0000105 where the concentration of marinas is higher.

The following pictures, taken in the summer of 2017, show two main bays of Maltese islands within the MT0000105 and MT0000103 SACs. It is possible to see the presence of numerous pleasure boats especially in the Xemxija Bay (Figure 22).

Figure 22

Satellite images of Xemxija Bay (Malta) and Azure Window (Gozo) respectively (source: Google Earth).

The Figure 23 shows the Coastal and Marine Infrastructure as per SPED (Strategic plan for environment and development) and Harbour Approach routes and Communication infrastructure in Maltese islands.

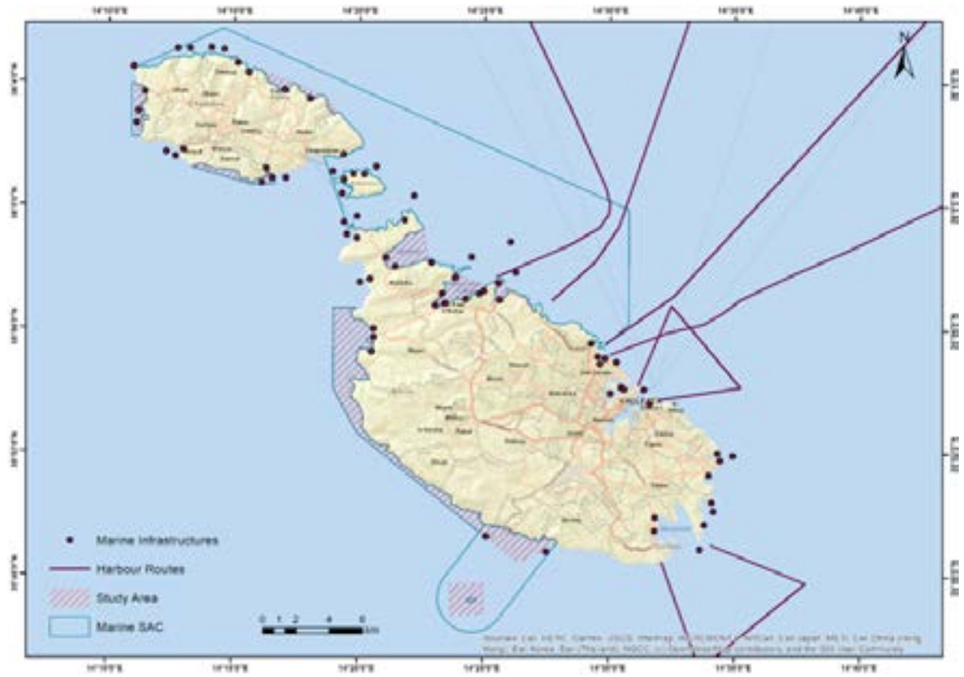

Figure 23

Coastal and Marine Infrastructure and Harbour approach routes (source: Malta Geoportal).

Most of these infrastructures are located on the east coast of Malta, on Gozo and Comino islands. Several infrastructures are included in MT0000103, MT0000104 and MT0000105 zones.

6

6

ASSESSMENT OF THE INTERACTION BETWEEN FISHING ACTIVITIES AND MARINE KEY HABITATS IN THE STUDY AREAS

Fisheries are amongst the activities most threatening marine life and ecosystems, both by causing changes and shifts in the food web (Reitz, 2004) and physically affecting key habitats, such as seagrass meadows and coralligenous assemblages (UNEP, 2004).

Fishing by trawlers is known to impact seagrass beds by both suspending sediments and directly damaging vegetal mass. Increases in sediment suspension, in fact, can affect photosynthesis by decreasing light intensity (UNEP, 2004). As regarding the physical damage to the meadows, trawling was reported as the main agent causing the degradation of deep seagrasses (Sánchez Lizaso, Guillén Nieto and Ramos Esplá, 1990). However, despite this, the highest threat for seagrass meadows remain anchorage and mooring, change in the sedimentation rate and, mostly, climate change (Diaz-Almela et al, 2006)).

Coralligenous bioconstructions are considered among the most threatened Mediterranean habitats by fishing activities (Ferrigno et al., 2018). Within coralligenous assemblages, in fact, erect and branched organisms with calcareous skeletons, such as bryozoans and fan corals are often damaged, broken and upturned (Hall-Spencer et al., 2002; UNEP, 2009; Angiolillo et al., 2015). In addition, over the past decade, an increase in the amount and distribution of lost fishing gears was recorded, due to the rapid expansion of fishing effort and fishing grounds (Gilman, 2015). Lost fishing gears, in fact, can alter the benthic environment, by introducing synthetic material into the marine food web and passively entangling marine organisms (Macfadyenet al., 2009).

According to the data collection carried out within this Study the impact of fishing activities on marine habitats in the 5 study areas is not documented.

7

7

GAP ANALYSIS

A gap analysis was conducted in order to identify the main knowledge gaps and potential areas of special interest to be investigated more in-depth during the surveys (Phase II of the Study). The gap analysis has been conducted taking into consideration the Scope of Work, which is mapping and setting up a monitoring system for key benthic habitats and assessing the impact of fishing activities on key habitats in the study areas.

Each main feature described above is analyzed and assessed under two aspects ("Available information typology and sources" and "Deficiency / Gap Analysis and Required Studies") as detailed in the following paragraphs:

1. Available information typology and sources

   This section describes all the available information typology on environmental and social data.

2. Deficiency / Gap analysis and required studies

   Available information is evaluated by typology and analyzed in order to identify what additional information (further data, details and studies) is required. Then, the identified gaps are classified with the following rating system associated to a potential risk gap, to assess the most significant gaps that need to be filled-in (Table 8).

Table 8
Classification of gaps.

Type of gap	Classification
Very significant – must be filled with specific survey/data collection	High Gap
Moderately significant – recommended to be filled with specific survey/ data collection	Medium Gap
Low significant – a gap that may not be important in this context, and likely is not critical or does not require specific survey/data collection	Low Gap

Table 9
Gap Analysis.

Features	Area	Available Information Typology and Sources	Deficiency / Gap Analysis and Required Studies
Geophysical, geomorphological and oceanographic features	MT0000101	Few precise information was retrieved regarding this area, the main geomorphological features are cliffs and rdum. Bathymetric data should exist from the ERDF project conducted between 2012 and 2013 with an interferometric system. Data are not available. Main sources: ▪ Espinal & Hunter, 2014; ▪ Magri et al., 2008; ▪ Magri, 2006.	Specific bathymetric data are not available for this study area. This gap could be partially filled-in during the Phase II of the Study (single beam or Multibeam survey) and conducting further research to obtain 2012 ERDF data. **Medium Gap**
	MT0000102	Some data were retrieved for the area around the islet of Filfla, but not for the coastal area. Sinkholes are present along the coast (the Blue Grotto) which is characterized by high cliffs. Bathymetric data should exist from the ERDF project conducted between 2012 and 2013 with an interferometric system for all the Study Area (data not available) and from an older ERDF project conducted in 2006 around Filfla (data available but not in digital format). Main sources: ▪ Furlani et al 2019; ▪ Espinal & Hunter, 2014; ▪ Magri, 2006; ▪ Borg et al., 1997.	An interferometric survey was already conducted in Filfla (2006) and a bathymetric map around the island is available (only paper format). Further research should be conducted to obtain 2012 ERDF data and the digital version of the 2006 Filfla data. If the digital bathymetric data were available and its resolution were sufficient, multibeam surveys (initially planned around Filfla), could focus on other coastal areas. **Medium Gap**
	MT0000103	No precise information was retrieved regarding this area, bathymetric data should exist from the ERDF project conducted between 2012 and 2013 with an interferometric system. Main sources: ▪ Espinal & Hunter, 2014; ▪ Magri, 2006.	Specific bathymetric data are not available for this study area, this gap could be partially filled-in during the Phase II of the Study (single beam or Multibeam survey) and conducting further research to obtain 2012 ERDF data. **Medium Gap**
	MT0000104	Very few precise information was retrieved regarding this area, the main geomorphological features are the drowned valleys. Bathymetric data should exist from the ERDF project conducted between 2012 and 2013 with an interferometric system. Main sources: ▪ Espinal & Hunter, 2014; ▪ Magri, 2006.	Specific bathymetric data are not available for this study area, this gap could be partially filled-in during the Phase II of the Study (single beam or Multibeam survey) and with further research to obtain 2012 ERDF data. **Medium Gap**
	MT0000105	Very few precise information was retrieved regarding this area, the main geomorphological featured are the drowned valleys. Bathymetric data should exist from the ERDF project conducted between 2012 and 2013 with an interferometric system. Main sources: ▪ Espinal & Hunter, 2014; ▪ Magri, 2006.	Specific bathymetric data are not available for this study area, this gap could be partially filled-in during the Phase II of the Study (single beam or Multibeam survey) and with further research to obtain 2012 ERDF data. **Medium Gap**
Marine biodiversity: Benthic bionomy	MT0000101	The Posidonia oceanica distribution should have been done in the early 2000s. Malta Geoportal collects available data and reports information about main habitats distribution (P. oceanica, hard bottom and soft bottom). LIFE BaĦAR project (2018) adds some information about key species presences and some key habitats (rhodoliths, sandbanks, geogenic reefs and caves). A few scientific papers give further details on specific features and species. Main sources: ▪ LIFE BaĦAR project, 2018; ▪ Evans and Shembri, 2014; ▪ Borg and Schembri, 2002; ▪ Knittweis et al., 2017; ▪ Malta Geoportal.	The benthic cartography retrieved (about 10 years old or more) should be updated or counterchecked. A more detailed survey on the distribution of key habitats is recommended. **Medium Gap**
	MT0000102	The Posidonia oceanica distribution should have been done in the early 2000s. Malta Geoportal collects available data and reports information about main habitats distribution (P. oceanica, hard bottom and soft bottom). A bionomic map of the area around Filfla has already been done in 2006. LIFE BaĦAR project (2018) adds some information about key species presences and some key habitats (rhodoliths, sandbanks, geogenic reefs and caves). A few scientific papers give further details on specific features and species. Main sources: ▪ LIFE BaĦAR project, 2018; ▪ Evans and Shembri, 2014; ▪ Knittweis et al., 2017; ▪ Malta Geoportal.	The benthic cartography retrieved (about 10 years old or more) should be updated or counterchecked. A more detailed survey on the distribution of key habitats is recommended. **Medium Gap**

Features	Area	Available Information Typology and Sources	Deficiency / Gap Analysis and Required Studies
	MT0000103	The Posidonia oceanica distribution should have been done in the early 2000s. Malta Geoportal collects available data and reports information about main habitats distribution (P. oceanica, hard bottom and soft bottom). A bionomic map of the area around Filfla has already been done in 2006. LIFE BaĦAR project (2018) adds some information about key species presences and some key habitats (rhodoliths, sandbanks, geogenic reefs and caves). A few scientific papers give further details on specific features and species. Main sources: ▪ LIFE BaĦAR project, 2018; ▪ Evans and Shembri, 2014; ▪ Knittweis et al., 2017; ▪ Malta Geoportal.	The benthic cartography retrieved (about 10 years old or more) should be updated or counterchecked. A more detailed survey on the distribution of key habitats is recommended. **Medium Gap**
	MT0000104	The Posidonia oceanica distribution should have been done in the early 2000s. Malta Geoportal collects available data and reports information about main habitats distribution (P. oceanica, hard bottom and soft bottom). LIFE BaĦAR project (2018) adds some information about key species presences and some key habitats (rhodoliths, sandbanks, geogenic reefs and caves). A few scientific papers give further details on specific features and species. This area has less information regarding habitats distribution, since it was extended after the submission of the MSFD Initial Assessment, which is the main source of data on this topic. Main sources: ▪ LIFE BaĦAR project; ▪ Evans and Shembri, 2014; ▪ Knittweis et al., 2017; ▪ Malta Geoportal.	The benthic cartography retrieved (about 10 years old or more) should be updated or counterchecked. A more detailed survey on the distribution of key habitats is recommended, since the existing information covers only a small portion of the study area. **Medium Gap**
	MT0000105	The Posidonia oceanica distribution should have been done in the early 2000s. Malta Geoportal collects available data and reports information about main habitats distribution (P. oceanica, hard bottom and soft bottom). LIFE BaĦAR project (2018) adds some information about key species presences and some key habitats (rhodoliths, sandbanks, geogenic reefs and caves). A few scientific papers give further details on specific features and species. Main sources: ▪ LIFE BaĦAR project ▪ Evans and Shembri, 2014 ▪ Knittweis et al., 2017 ▪ Borg and Schembri, 2002 ▪ Malta Geoportal	The benthic cartography retrieved (about 10 years old or more) should be updated or counterchecked. A more detailed survey on the distribution of key habitats is recommended. **Medium Gap**

Features	Area	Available Information Typology and Sources	Deficiency / Gap Analysis and Required Studies
Marine biodiversity: Ichthyofauna	MT0000101	The following species of interest have been reported in this SAC: ▪ *Myliobatis aquila* ▪ *Epinephelus marginatus* Other data are referred to all the Maltese Archipelago. Main sources: ▪ LIFE BaĦAR project ▪ Castriota and Deidun, 2014 ▪ Schembri et al., 2003 ▪ Ragonese et al., 2013 ▪ MSFD Initial Assessment;	Data are generally scarce or outdated, and referred to all the Maltese Archipelago. Visual surveys are recommended to assess the presence of key species. **Medium Gap**
	MT0000102	The area around Fiflla has been object of few studies in the past years. An impoverishment of the fish fauna was observed in this area. Data for the coastal area are scarce. Main sources: ▪ LIFE BaĦAR project; ▪ Castriota and Deidun, 2014; ▪ Schembri et al., 2003; ▪ Ragonese et al., 2013; ▪ MSFD Initial Assessment; ▪ Borg et al., 1997	Data around Filfla are outdated. Other available data are referred to all the Maltese Archipelago. Visual surveys are recommended to assess the presence of key species. **Medium Gap**
	MT0000103	No detailed information on the distribution of fish inside this study area was retrieved, only data regarding all the Maltese Archipelago are available. Main sources: ▪ LIFE BaĦAR project; ▪ Castriota and Deidun, 2014; ▪ Schembri et al., 2003; ▪ Ragonese et al., 2013; ▪ MSFD Initial Assessment;	Site specific data are not available. Only generic data dealing with all the Maltese Archipelago are available. Visual surveys are recommended to assess the presence of key species. **Medium Gap**
	MT0000104	The following species of interest have been reported in this SAC: ▪ *Epinephelus marginatus* ▪ *Labrus viridis* Other data are referred to all the Maltese Archipelago. Main sources: ▪ LIFE BaĦAR project; ▪ Castriota and Deidun, 2014; ▪ Schembri et al., 2003; ▪ Ragonese et al., 2013; ▪ MSFD Initial Assessment;	Data are generally scarce or outdated, and referred to all the Maltese Archipelago. Visual surveys are recommended to assess the presence of key species. **Medium Gap**
	MT0000105	The following species of interest have been reported in this SAC: ▪ *Dasyatis pastinaca* ▪ *Mobula mobular* ▪ *Epinephelus marginatus* Other data are referred to all the Maltese Archipelago. Primary sources of information are: ▪ LIFE BaĦAR project; ▪ Castriota and Deidun, 2014; ▪ Schembri et al., 2003; ▪ Ragonese et al., 2013; ▪ MSFD Initial Assessment;	Data are generally scarce or outdated, and referred to all the Maltese Archipelago. Visual surveys are recommended to assess the presence of key species. **Medium Gap**

Features	Area	Available Information Typology and Sources		Deficiency / Gap Analysis and Required Studies
Fishing activities	MT0000101	Data are available for the Maltese Fishery Management Zone, but they are not detailed for each study area. Main sources: ▪ Dimech at al., 2009 ▪ Department of Fisheries and Aquaculture, 2019 ▪ Gatt et al., 2015 ▪ Fisheries Control Directorate, 2013 ▪ STECF, 2014		There is a lack of precise data focused on the study areas. This gap will be filled-in during Phase II of the Study both consulting the "National Fisheries Data Collection Programme" and carrying out interviews with fishermen. **Medium Gap**
	MT0000102			
	MT0000103			
	MT0000104			
	MT0000105			
Aquaculture	MT0000101	Aquaculture in Malta is marine based. It consists of the capture-based aquaculture of the Atlantic bluefin tuna (*Thunnus thynnus thynnus*), as well as the culture of European sea bass (*Dicentrarchus labrax*) and Gilthead sea bream (*Sparus aurata*) with a small production of Meagre (*Argyrosomus regius*) and amberjack (*Seriola dumerili*).	Four aquaculture farms are present in the study area, while at least another one is present within the SAC.	More information regarding the aquaculture farms and the benthic habitats below and close to aquaculture plant is needed, to better assess the possible impact on benthic habitats. Some further data can be collected during the Phase II of the Study. **Low Gap**
	MT0000102	Main sources: ▪ Aquaculture Statistics, 2015 ▪ Malta Geoportal	No aquaculture farm is present.	It is necessary during the field work (Phase II) to confirm the absence of aquaculture systems. **Low Gap**
	MT0000103		No aquaculture farm is present.	It is necessary during the field work (Phase II) to confirm the absence of aquaculture systems. **Low Gap**
	MT0000104		No aquaculture farm is present.	It is necessary during the field work (Phase II) to confirm the absence of aquaculture systems. **Low Gap**
	MT0000105		No aquaculture farm is present.	It is necessary during the field work (Phase II) to confirm the absence of aquaculture systems. **Low Gap**

Features	Area	Available Information Typology and Sources	Deficiency / Gap Analysis and Required Studies
Impact of fishing activities in the 5 study areas	All	Several scientific papers describe the interactions and impacts of fishing activities on marine key habitats at Mediterranean level and in some specific sites. No data are available for the 5 study areas	No specific data are available for the 5 study areas. This gap can be partially filled-in during the Phase II of the Study. Special attention will be paid during the SSS survey and visual inspection to the identification of signs of impact in the Posidonia meadows and other key habitats. **High Gap**

METHODOLOGICAL NOTE AND TIMETABLE FOR THE PHASE II

Below is reported an update on the logistic and the methodology for Phase II. The validation meeting for the Phase I will be held in Malta on the 12th of November 2019. Table 10 presents an updated schedule for Phase II and Phase III. Bibliographic data collection will continue throughout the Phase II; further data will be integrated in the Phase II Report.

Logistic

- Requests for permit have been sent to the competent authorities the Environmental Resource Authority. Authorization is still pendent.
- The Authorization from Superintendence of Cultural Heritage (Ref: SCH 412/19) has arrived on the 30th October 2019.
- The Authorization from the Continental Shelf Department (Ref: CSD/11/2017/8) has arrived on the 11th November 2019.
- Transport Malta will issue the related Notice to Mariners within one week, once the permits are obtained.
- The two field campaigns (i.e., the biological and the geophysical campaigns) could be conducted as follows (if the authorization will be approved in time and weather permitting):
  - The geophysical survey will be performed between the 25th of November 2019 and the 10th of December 2019, for a total of 13 days, and it will be followed by a period of data analysis;
  - The biological survey will take place between the 15th and the 31st of January 2020, for a total of 7 days;
  - The preparation of Phase II deliverable, including maps, GIS and reports, will take place between December 2019 and the first fortnight of March 2020.
- The boat "SIMO" from the DiveSystems Diving Center will be used for both the biological and the geophysical campaign. Agreements with the owners Simon Sciberras are ongoing to be finalised.
- Local fishermen interviews and fishery surveys will be performed during Phase II. The interview will be conducted in December 2019 and January 2020. The proposed sheet for the interview is available in APPENDIX A.

Methodology and approach

We confirm that the georeferenced data will be collected using the reference system UTM - WGS 84 Zone 33 N. The positioning data collected in the field will be recorded with a Differential GPS (DGPS) that will acquire the differential correction (sub-metric precision) provided by the EGNOSS satellite system.

The georeferenced data analysed during the literature review were collected and organized within the structure of a GIS database. All the data collected during the field survey will also be inserted as layer in the geodatabase and made available on a GIS.

The following methodology already scheduled in the proposal can be confirmed:

- Van Veen grab for the sampling and the assessment of soft bottom communities;
- Underwater towed camera, MiniROV, and SCUBA diving for hard substrata (e.g. coralligenous associations) and posidonia meadows;
- High-resolution semi-quantitative analyses of photos taken within random quadrats to calculate the coverage of each identified taxonomic unit;
- Photographic documentation for qualitative habitat description;
- SCUBA dives for Underwater Visual Census (UVC) of the fish fauna and large vagile invertebrates;
- A surveillance network will be set up according to the method proposed by the RAC/SPA (Pergent, 2007) and Garrabou et al. (2014) for the key habitats present in the study areas (e.g., the seagrass meadows and the coralligenous biocoenoses). In addition, as improvement, a 3D photographic survey will be carried out in the selected area for the coralligenous monitoring.

Geophysical and bionomic mapping has already been performed in Filfla, but the data are not available yet. If they will be in high enough quality, the field effort could be diverted on the coastal area within the same SAC or in other study areas.

The final report will integrate the available information and data already present in literature from past studies with the new results of the surveys.

Table 10

Schedule for the Study.

Activity	November 2019		December 2019		January 2020		February 2020		March 2020		April 2020		May 2020	
	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
Validation meeting	*													
Geophysical mission on field (geophysical survey, SSS and multibeam)			**											
Elaboration of the first draft of maps														
Biological mission on field (towed camera, dives and miniROV)						***								
Fishery mission on field														
Training activities														
Preparation of Report of Phase II														
Submission of Report of Phase II														
Preparation of Report of Phase III														
Submission of Report of Phase III and validation meeting with SPA/RAC and ERA														

* The validation meeting will be held on the 11th of November 2019
** The geophysical survey will be performed between the 25th of November 2019 and the 10th of December 2019, for a total of 13 days.
*** The biological survey will take place between the 15th and the 31st of January 2020, for a total of 7 days.

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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 contries and the European Union) in implementing the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol).*

POST-2020 SAPBIO

Strategic Action Programme for the **Conservation** of **Biodiversity** and **Sustainable Management** of **Natural Resources** in the **Mediterranean Region**

SPAMI

Specially Protected Areas of **Mediterranean Importance**

Marine turtles

Cetaceans

Specially Protected Areas

Monitoring

Mediterranean Monk Seal

Cartilaginous fishes
(Chondrichtyans)

Coralligenous and other calcareous bio-concretions

Marine vegetation

Marine and coastal bird species

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

Dark Habitats

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

Species introduction and invasive species

UN environment programme

Mediterranean Action Plan
Barcelona Convention

SPA / RAC
The Mediterranean Biodiversity Centre

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