PIPELINE RECONNAISSANCE SURVEY

Gas Pipeline Interconnection

Malta-Italy Project

REPORT

Posidonia oceanica / Sensitive Marine Habitat Study.

GAS PIPELINE INTERCONNECTION MALTA-ITALY

POST SURVEY ASSESSMENT

Produced by : Lighthouse S.p.A. - Bologna - Italy

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1.0.0 DEFINITIONS AND ABBREVIATIONS

1.1.0 Definitions

CLIENT: Maltese Ministry for Energy and Water Management

CONTRACTOR: LIGHTHOUSE S.p.A.

1.2.0 Abbreviations

AUV	Autonomous Underwater Vehicle
BMH	Beach Manhole
CM	Central Meridian
DGPS	Differential Global Positioning Systems
FEED	Front End Engineering Design
IDP	Identifier of Project
KP	Kilometre Post
LAT	Lowest Astronomical Tide
LGH	Lighthouse Spa
LP	Landing Point
m	Metre
m b.s.l.	Metres Below Sea Level
MAG	Magnetometer
MBES	MultiBeam EchoSounder
MPA	Marine Protected Area
PMRS	Preliminary Marine Route Survey
PSA	Post Survey Assessment
R/V	Research Vessel
RMS	Reconnaissance Marine Survey
ROV	Remote Operating Vehicle
SBP	Sub Bottom Profiler
SIN	Site of National Interest
SSS	Side Scan Sonar
UTM	Universal Transverse Mercator
w.d. / WD	Water Depth
WGS 84	World Geodetic System 1984

2.0.0 INTRODUCTION AND WORK AIMS

The company **Lighthouse S.p.A** of Bologna, Italy (LGH) – was entrusted by **Maltese Ministry for Energy and Water Management** to perform a Preliminary Reconnaissance Marine Survey (PRMS) in the Sicily Strait area, located between Italy and Malta. The PRMS included geophysical, geotechnical and environmental investigations. The scope of the project was to finalise the optimal pipeline route coordinates, including route turning and landing points of a 22" gas pipeline linking Italy (Gela) to Malta (Delimara) (Figure 1).

The objectives of the project were as follows:

- **Work Package 1**: execution of the Preliminary Reconnaissance Marine Survey (PRMS) on the offshore pipeline routing corridor;
- **Work Package 2**: execution of Post Survey Assessment (PSA).

This document is part of the **Post Survey Assessment**.

The results of the PSA are organized into eight (8) separate reports. This report focuses on studying the presence of *Posidonia Oceanica* and other Sensitive Marine Habitats.

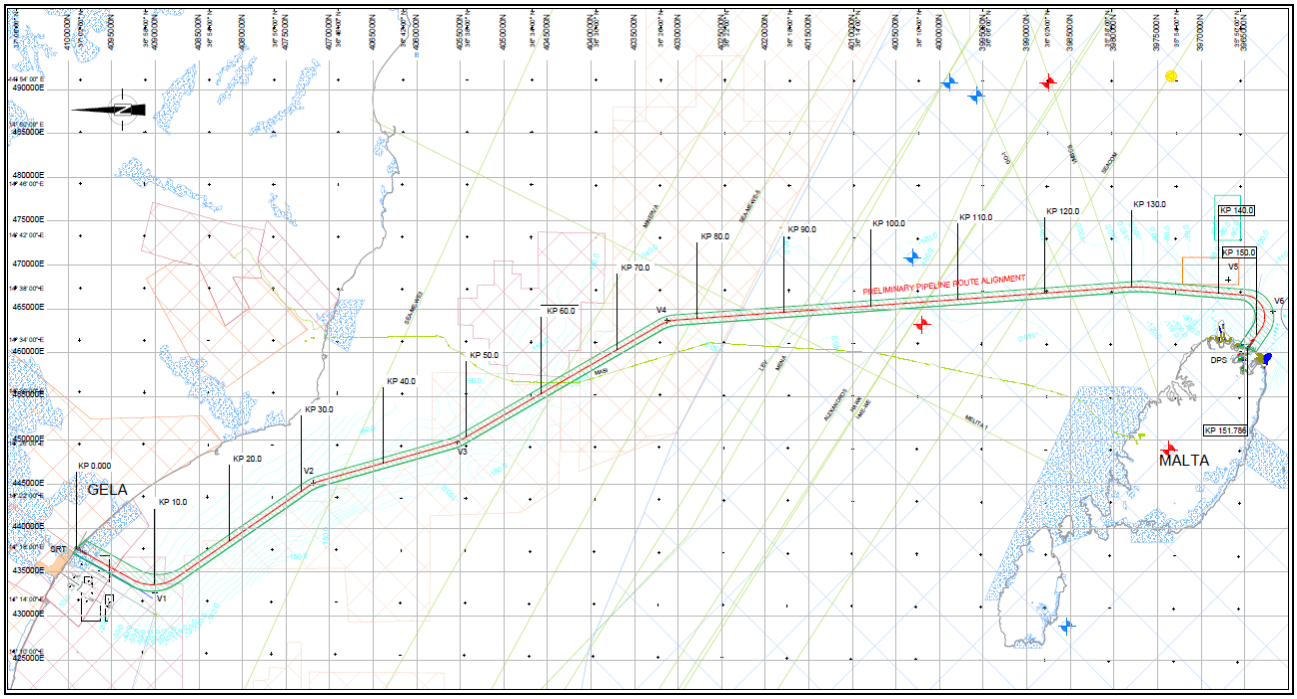


Figure 1 - Overview of reconnaissance survey route

2.1.0 Purpose of the report

Purpose of this report was to evaluate the presence of sensitive marine habitats in the coastal area of the two landfalls of the proposed 22" gas pipeline linking Italy (Gela) and Malta (Delimara). The **basic design route** was provided by the Client representative onboard R/V Odin Finder at the beginning of the marine survey, see §10.1.0 APPENDIX 1 GWF66 - PIPELINE LAYING THEORETICAL ROUTE of the report "MEW001_GEOPHY_FINAL_REPORT_REV02.doc" (hereinafter referred to as the "**route**"). The route provided by the Client on the base of the PMRS study is named as "FEED route". The images included in this report show the basic design route in black (unless otherwise stated in the images) and the FEED route in red.

The work included the research and check of updated available habitat information and maps from literature data and existing studies, cross-checked with the interpretation of PMRS data and the production of sensitive marine habitat maps of the two landfalls and in selected offshore pipeline sections.

Data research, interpretation and final report production have been carried out by LGH Marine Biodiversity Specialist Dr. Carlotta Pani.

This report should be read in conjunction with the followings working package reports, latest revisions:

- MEW001_GEOPHY – Geophysical Survey Results
- MEW001b_ENV_ – Environmental Survey Results
- MEW001_WP2_EBB – Environmental and Biodiversity Baseline
- MEW001_WP2_SOGECORA - Study of Oil and Gas exploration concessions and other restricted area

2.2.0 Geodetic System

All the positions and coordinates presented in this study are referred to the following Datum and projection (Table 1).

Table 1 – Geodetic data and projection parameters

GEODETIC PARAMETERS	
Datum	World Geodetic System 1984 (WGS84)
Reference Ellipsoid	World Geodetic System 1984 (WGS84)
Semi-major Axis (a)	6 378 137.000m
Semi-minor Axis (b)	6 356 752.314m
Inverse Flattening (1/f)	298.2572236
First eccentricity squared (e2)	6.69437999014x10−3
PROJECTION PARAMETERS	
Projection method	UTM 33N
Latitude Origin	0
Central Meridian (CM)	15°E
False East	500000m
False North	0m
Scale factor	0.9996

2.3.0 PRMS Coastal Areas Survey Definition and Methodology

For the purpose of this report the Italian and Maltese coastal areas are defined as follows:

- Italy landfall/coastal area – Gela: from the coastline (KP0) to 30m w.d. (KP8.682);
- Malta landfall/coastal area – Delimara: from the coastline (KP150.302) to 40m w.d. (KP150.836).

In order to map the sensitive marine habitats both the coastal areas have been surveyed using geological, geophysical and geotechnical methods together with visual inspection surveys. Bathymetric, morphologic and stratigraphic data have been acquired by means of MBES, SSS, SBP and Magnetometer, processed and interpreted. Geotechnical samples were collected (piston cores and boreholes) and cone penetration tests were carried out together with box corer samples collected during the environmental survey phase. Visual inspections have been carried out by means of ROV to characterize marine habitats and archaeological constraint and to ground-truth the geophysical survey results at Client defined positions. ROV transects have been performed also in spotted locations along the offshore pipeline section mainly where sonar contacts have been interpreted from the geophysical data (MBES/SSS/SBP), in order to verify the sonar targets, to confirm the geophysical interpretation and to detail the seabed characterisation. ROV inspection has been also performed at Client defined locations in the offshore section of the pipeline route, as shown in Figure 3, Figure 4 and Figure 5.

The results of these localised visual investigations have been extended, wherever possible, to nearby geophysical interpreted areas, in particular where the SSS acoustic response and water depths were similar to the sections investigated with ROV.

In the following pictures the ROV transects sketches are shown. In Chapter 4.0.0 the interpreted seabed sensitive habitats are detailed. Blue circles with ID MEW001b_S## and MEW001d_S## represent the box-corer sampling locations.

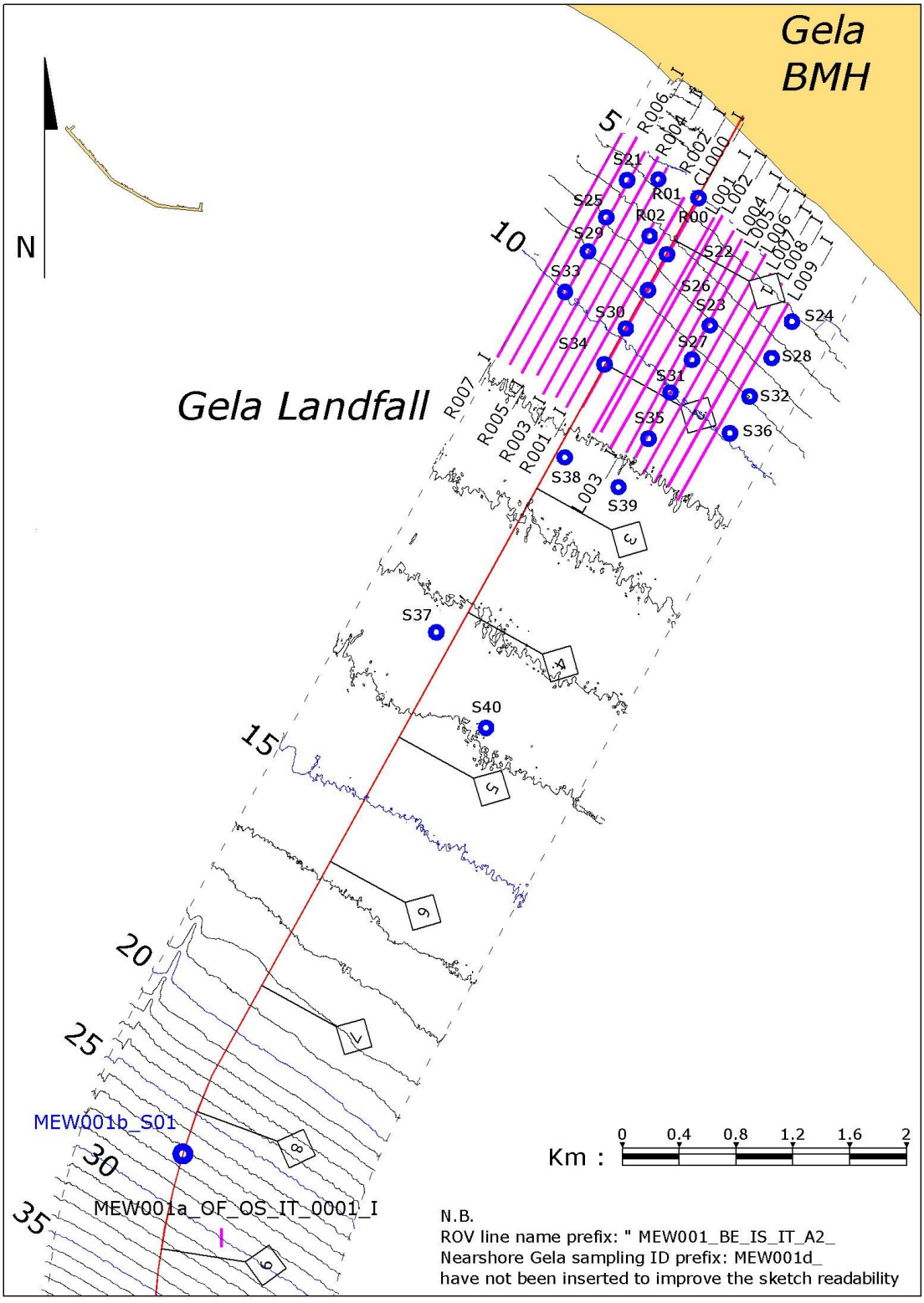


Figure 2 – ROV lines acquired at Gela landfall and at KP9

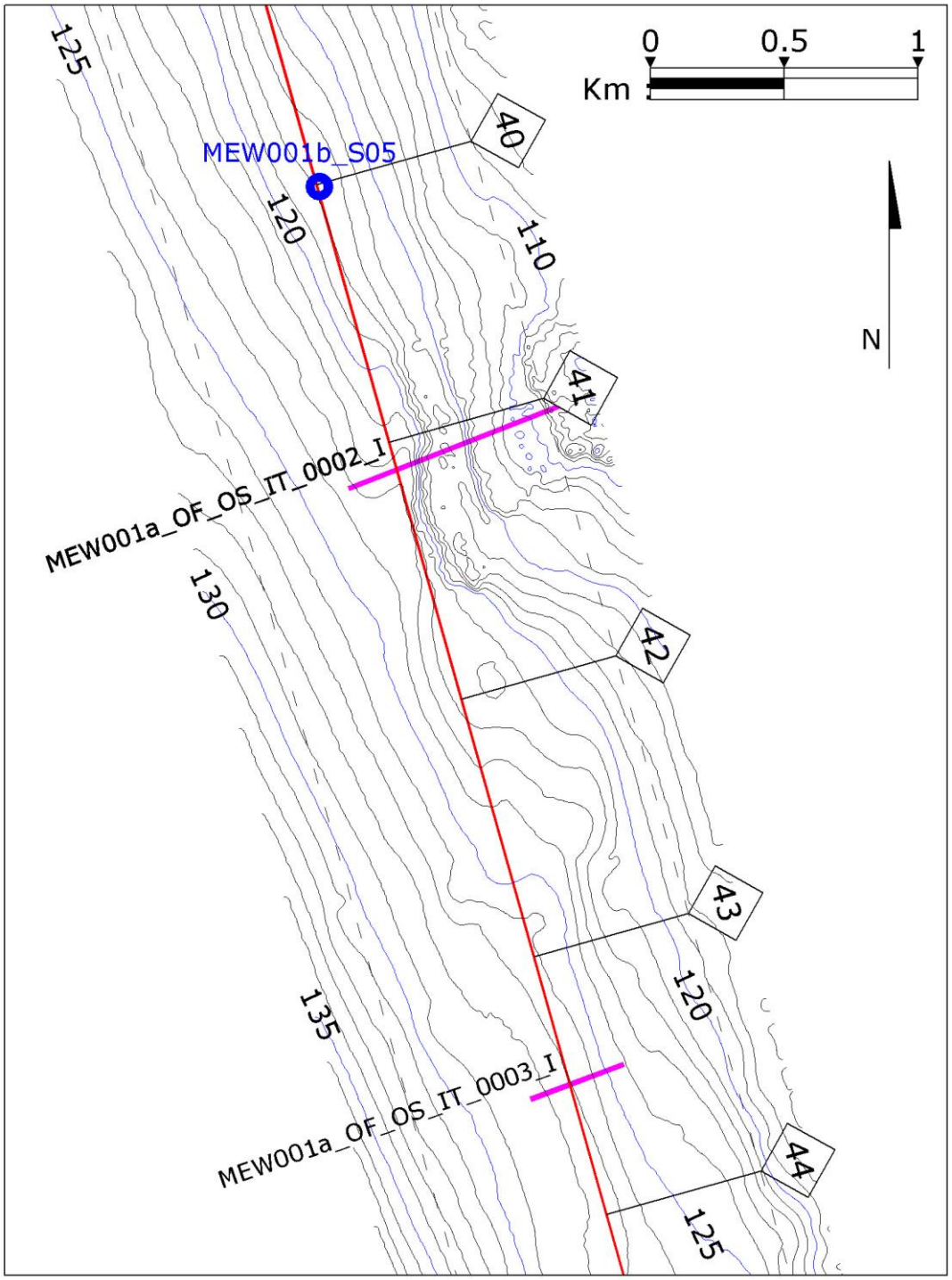


Figure 3 – ROV lines acquired at KP41 and KP43.5

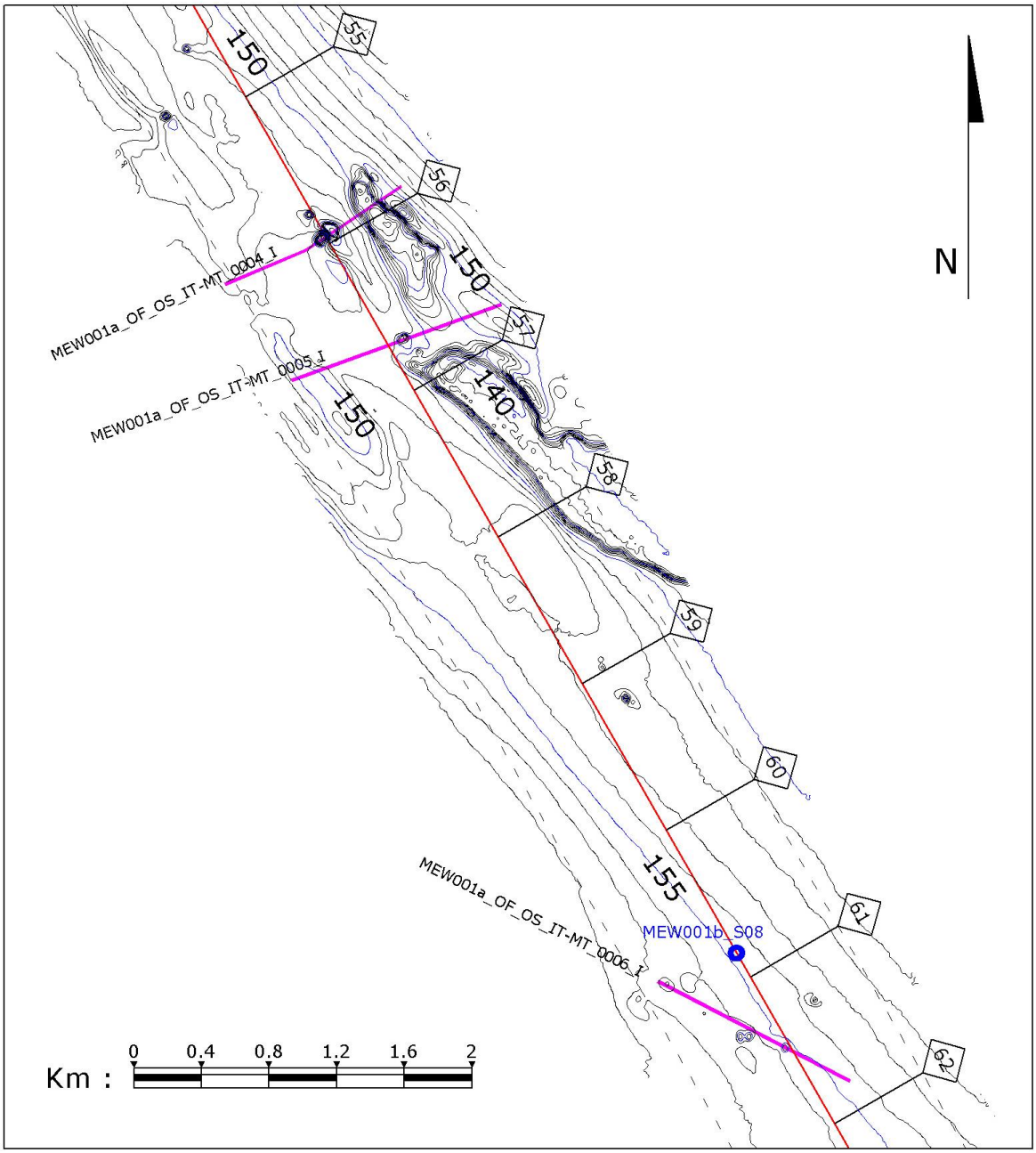


Figure 4 – ROV lines acquired at KP56-57 and KP61.5

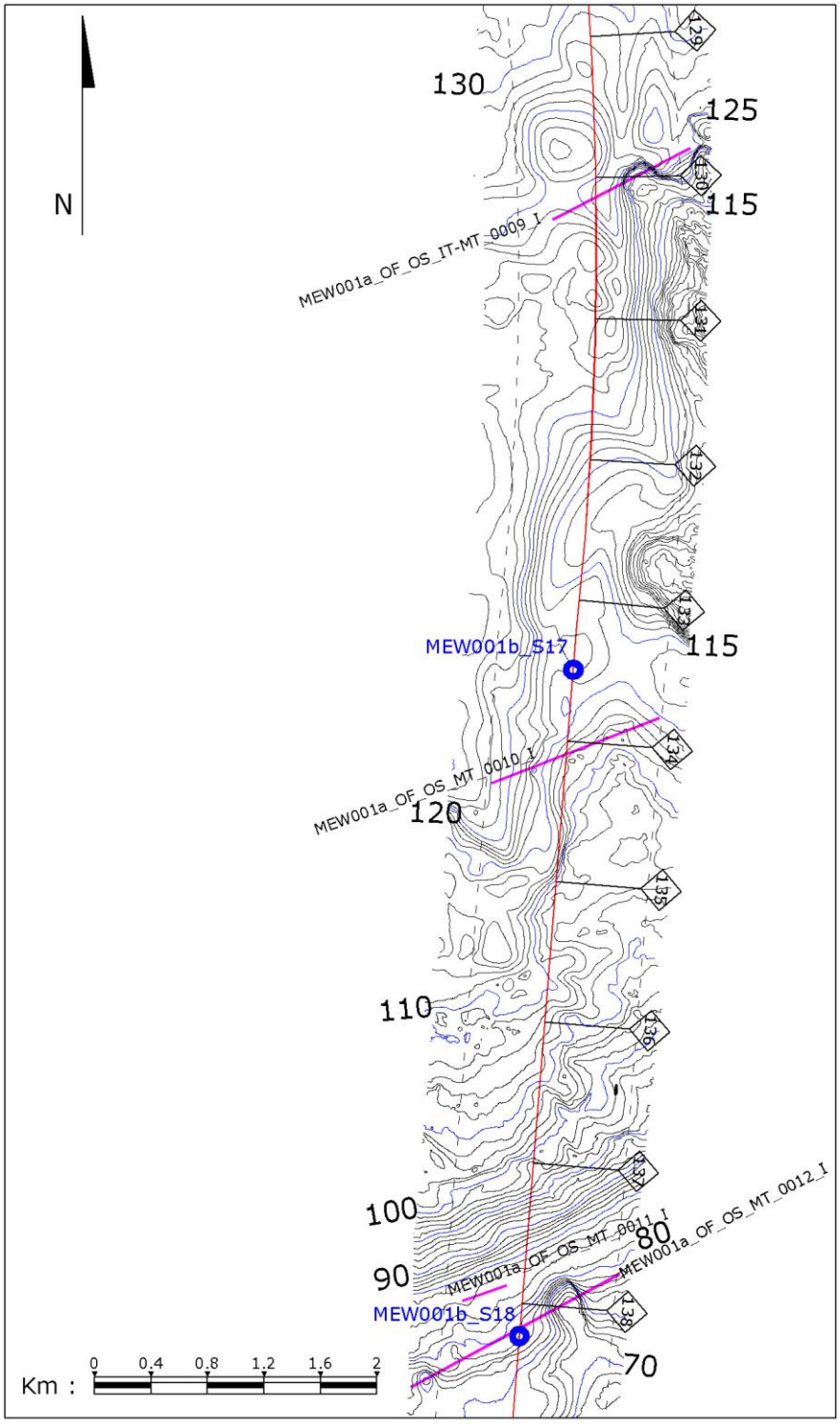


Figure 5 – ROV lines acquired at KP130, KP134 and KP138

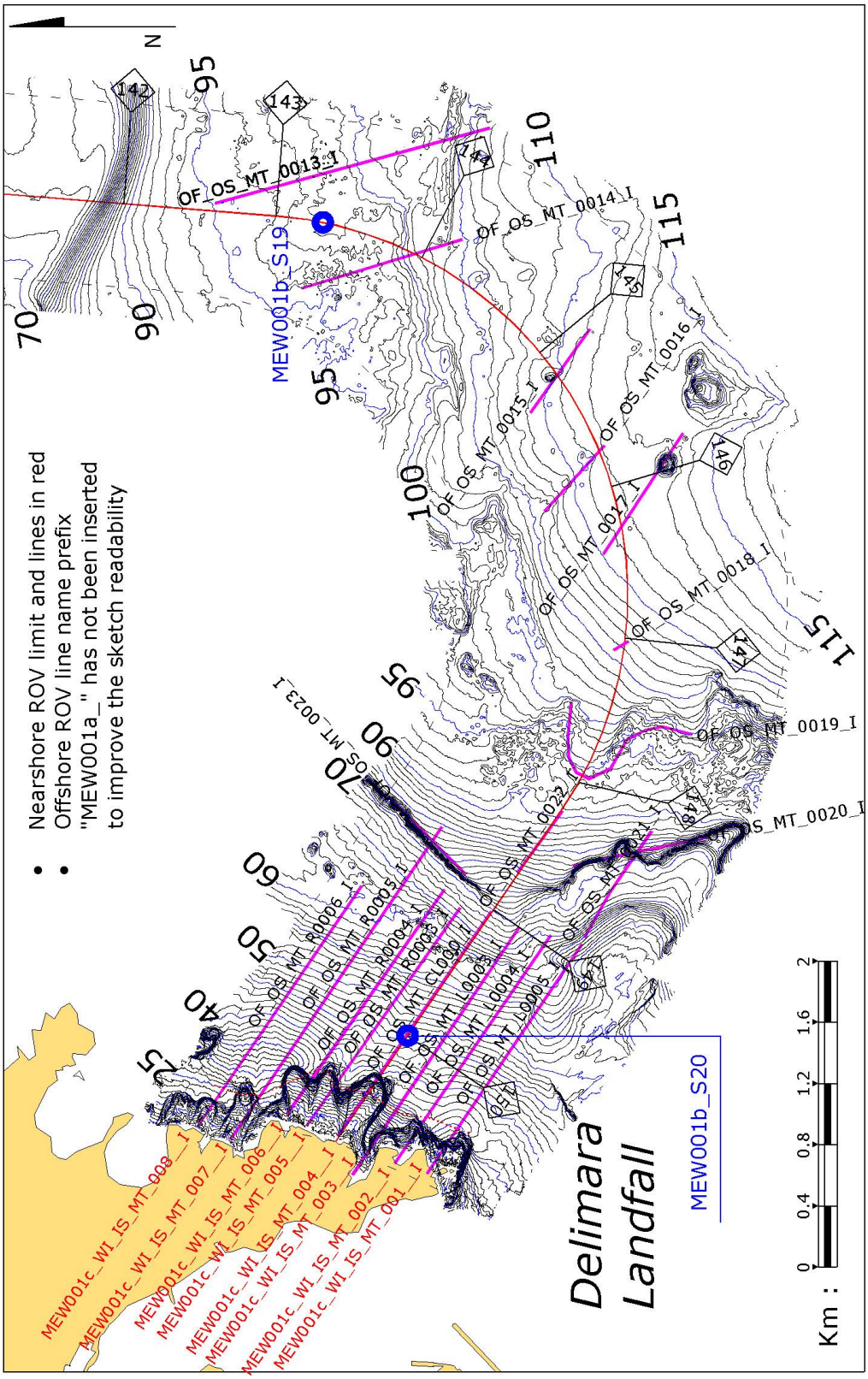


Figure 6 – ROV lines acquired from KP143 to KP149 and at Delimara landfall

3.0.0 SENSITIVE MARINE HABITATS DEFINITION

The scientific literature was studied to gather information relevant to the description, distribution, and definition of the sensitive marine benthic habitats featuring Gela (Italy) and Delimara (Malta) coastal areas and spotted offshore locations along the pipeline corridor. The literature investigation included published journal papers, published books and reports, as well as public GIS environmental data and LGH previous works. The analysed sensitive marine habitats occurring in Gela (Italy) and Delimara (Malta) marine waters include:

- *Posidonia oceanica* beds;
- *Cymodocea nodosa* beds;
- Biogenic reefs;
- Maërl beds.

3.1.0 Posidonia Oceanica

Posidonia seagrass beds are protected habitats which have a fundamental role for the health and productivity of Mediterranean marine ecosystems. Conservation of these areas is one of the most important priorities of Mediterranean Sea. The biological resources and ecological services provided by sea grasses are based on the physical structure of the plants themselves and the underwater meadows they form.

This species forms commonly monospecific meadows from the intertidal to maximum depths of 45m although can also be found forming mixed meadows. It is common on different substrates and habitats, from rocks to sandy bottoms (Bethoux and Copin-Motegut 1986), with the exception of estuaries where the input of fresh water and fine sediments is too high for its growth. *Posidonia oceanica* is a large, long-living but very slow-growing seagrass. Its shoots, which are able to live for at least 30 years, are produced at a slow rate from rhizomes which grow horizontally at a rate of a few centimetres each year. Over centuries, the rhizomes form mattes which rise up into reefs that help to trap sediment and mediate the motion of waves, thus clarifying water turbidity and protecting beaches from erosion (Boudouresque et al. 2012). The accumulation of *Posidonia oceanica* debris (berms) on the beaches provides also very effective protection against coastal erosion (Pergent et al. 2012).

Figure 7 – A dense meadow of *Posidonia oceanica* at a depth of 6m in Mellieha Bay (from Malta University website: https://www.um.edu.mt/science/biology/research/drjosephborg/posidonia)

It is an important habitat-forming species and provides habitat for many species. Nursery grounds for the juveniles of many commercially important fishes and vertebrates, such as for several species of the family Sparidae, Serranidae, Labridae and Scorpaenidae, as well as the sea urchin *Paracentrotus lividus*. *Posidonia oceanica* is also grazed by the green sea turtle (*Chelonia mydas*) and the fish *Sarpa salpa* (Thomas et al. 2005).

The resilience of *Posidonia oceanica* and the meadows it creates seems to be relatively high (Pergent et al. 2012). It is relatively strong to seawater temperature variations and the invasion by alien species, although it seems weaker to slightly salinity fluctuations, turbidity and the increase of sedimentation rate (Pergent et al. 2012).

Seagrass meadows have a fundamental importance for Mediterranean ecosystems and are hence protected by a large number of international conventions and the European legislation (UNEP, 2009b):

- Bern Convention, Annex I, P. oceanica: Extremely protected species of flora.
- EU Habitats Directive 92/43/CEE of 21/05/1992 and posterior adaptation at 97/62 CE of 27/11/1997 include *Posidonia oceanica*, habitat 1120 as a priority in conservation.
- Barcelona Convention for the Protection Of The Mediterranean Sea Against Pollution, protects in Annex II *Posidonia oceanica* as an endangered species.
- EU Fishing legislation: According to council regulation 1626/94 of 27/6/94, defining technical measures for the conservation of fishery resources in the Mediterranean, it is forbidden to fish with bottom trawls, seines or similar nets above *Posidonia oceanica* beds.

While seagrass is recognized as a priority habitat for conservation, there is evidence that it is experiencing significant widespread decline. *Posidonia oceanica* is a long-living plant with a slow growth rate (<10cm/year) and is highly vulnerable to pressures from the human populations which live disproportionately along the coasts. Direct human impacts such as fish farming, trawl fishing, as well as the uncontrolled anchorage on seagrass beds, cause irreversible damage to these habitats. Trawl fishing and anchoring cause a direct physical impact on the floor bottom and the organisms living in it, while at the same time giving opportunistic algae the chance to colonize new patches (Boudouresque et al, 2012).

Posidonia oceanica is present in the entire Mediterranean basin with the exception of large estuaries, and colder parts of the Mediterranean such as most of the Gulf of Lion, the northern part of the Adriatic and the westernmost part of the Alboran Sea close to the Gibraltar Strait. Moreover, its absence in the extreme southeast part of the basin seems to be directly related to the environmental conditions with very high water temperature during summer time (Celebi et al. 2006).

The most extensive *Posidonia oceanica* meadows in the western Mediterranean can be found in France (Hyères and Giens bays and off the eastern coast of Corsica), Italy (western Sardinia and Sicily, especially) and several sites in Spain, though less extensive meadows can be found scattered across the region. Around Malta, the Malta-Comino Channel particularly, supports extensive meadows of *Posidonia oceanica* that in some places extend to a depth of around 43m (Borg et al.2006).

A bibliographic research has been conducted to evaluate the presence of *Posidonia oceanica* at both the landfalls. In particular the following official websites have been consulted:

IUCN Red List of threatened Species	https://www.iucnredlist.org/species/153534/135156882
Italy – Università degli Studi di Palermo; Agenzia Regionale per lo Sudio dell'Ambiente, Sicilia	http://www.osservatorioacque.it/documenti/pta/allegati/02/volume%20iii.pdf
Italy – Ministero dell'Ambiente e della Tutela del territorio e del mare	https://www.naturaitalia.it/cartografiaPrateriePosidonia.do
Malta – ERA Environment and Resources Authority	https://era.org.mt/en/Search/Pages/results.aspx?k=POSIDONIA&s=Search%20this%20site%7Chttp%3A%2F%2Feraadmin.ecms.local
Malta Information Technology Agency (MITA)	https://msdi.data.gov.mt/geoportal.html
Malta Spatial Data Infrastructure - MSDI	https://msdi.data.gov.mt

The following picture shows the distribution of the *Posidonia ocenica* along the Italian coasts.; *P. oceanica* meadows only marginally affect the project landing area (meadows detected near Punta Braccetto; see Figure 9).

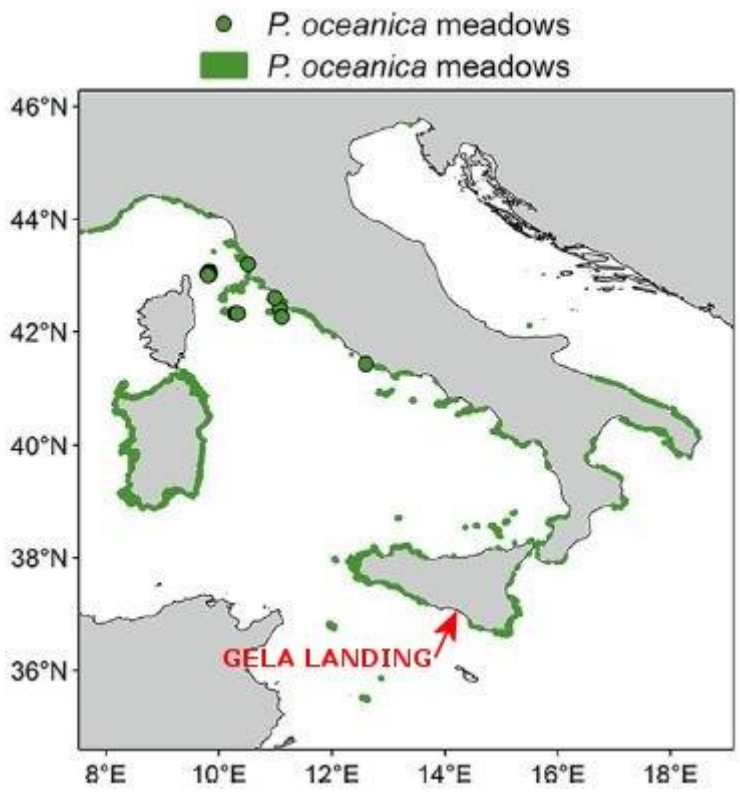


Figure 8 – Distribution of *Posidonia oceanica* along the Italian coast (modif. from Ingrosso et al., 2018)

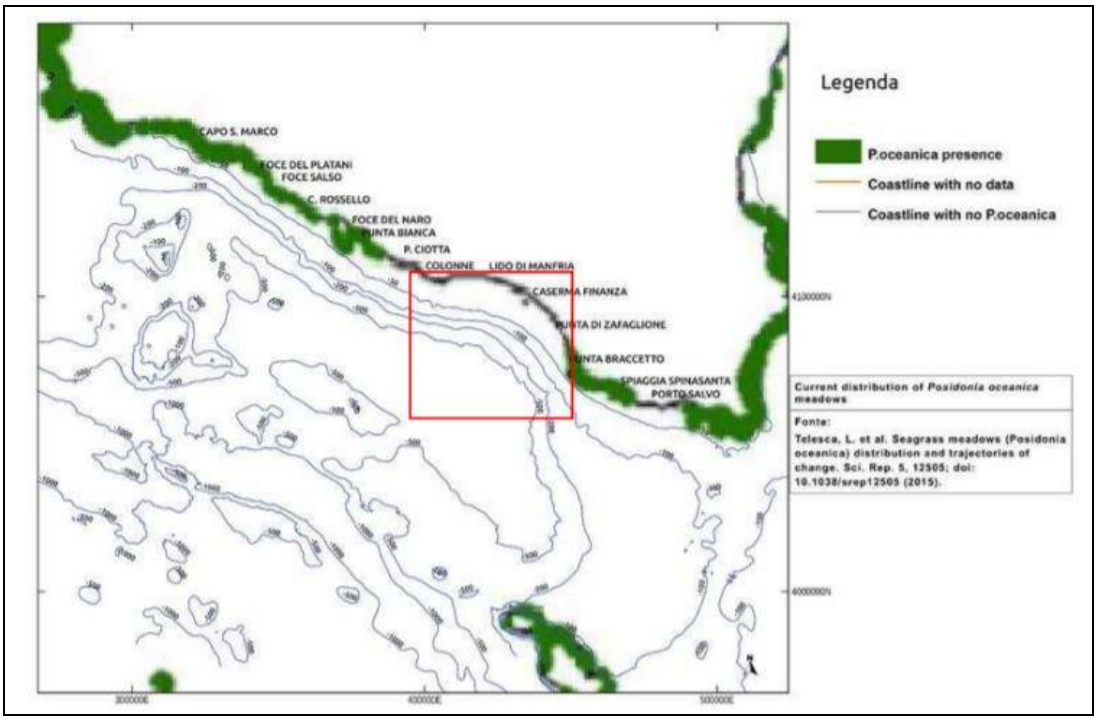


Figure 9 - Detail of the current distribution of *Posidonia oceanica* meadows in Sicily (Telesca et al., 2015). Red Square identifies the studied area.

Following the bibliographic data analysis no evidences of *Posidonia oceanica* prairies have been detected at Gela landfall while at Malta approach (Delimara) scattered meadows of *Posidonia oceanica* have been found (Borg et al, 2009).

Figure 10 – Distribution of *Posidonia oceanica* along the Maltese coast (modif from Borg et al., 2009)

3.2.0 Cymodocea nodosa

Cymodocea nodosa is a marine phanerogam endemic to the Mediterranean, colonizing movable bottoms in sheltered coastal areas. Where a regression of the *Posidonia oceanica* meadows occurs, *Cymodocea nodosa* can form mixed meadows. The inability of the rhizomes to grow in an orthotropic sense (= vertical), prevents the building of a real "matte" so that the meadows consist of a superficial layer of sediment containing a dense plant development, including a complex and compact root named "turf" (http://www.isprambiente.gov.it; Mazzella et al, 1993). "Turf" reaches a height of about 20cm in very sheltered conditions and it is not as persistent as the *Posidonia oceanica* "matte" being more affected by physical disturbances (i.e. water movements) because *Cymodocea* rhizomes are not so strongly lignified as in *Posidonia (*Mazzella et al, 1993). *Cymodocea nodosa* forms large and dense patches with green leaves than can reach 100cm long and 8mm wide in well shorted fine sands or on superficial muddy sands in sheltered waters and depths of 1-30 meters (OSPAR, 2010).Because the buried origin of the seeds, usually germinate in the vicinity of the plant "mother", favouring the maintenance of the seagrass itself, but only under certain conditions of disturbance of the sediment, this seed can reach greater distances and give rise colonization of new spaces (OSPAR, 2010). Frequently is mixed with other habitat forming phanerogams (*Zostera noltii* and *Zostera marina*) at muddy sands rich in organic nutrients.

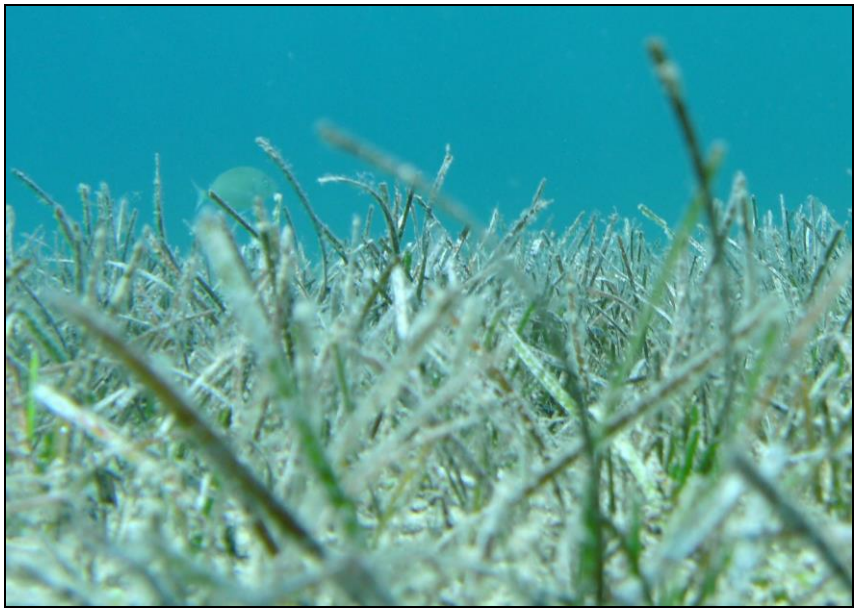


Figure 11 – *Cymodocea nodosa* (from Pergent-Martini et al., 2015)

Cymodocea nodosa is found throughout the Mediterranean Sea and extends into the Atlantic Ocean north to mid-Portugal and south to Madeira and to the Canary and Cape Verde Islands, as well as to Mauritania and Senegal on the coast of Africa (Short et al, 2010).

In the western Mediterranean, *Cymodocea nodosa* commonly occurs in shallow water (from a few cm to a depth of 2.5m) but can reach a depth of 30-40m, usually found in sandy substrate and sheltered sites. This species is a common seagrass in the eastern Mediterranean, frequently occurs in small sandy pockets that accumulate in crevices or small depressions on rocky flats. In beds, occasionally it is accompanied by *Caulerpa prolifera*, which may reach 20% of the plant cover. This species forms single species meadows in the Mediterranean Bioregion (Short et al. 2007) but also occurs in meadows with *P. oceanica* (it is out-competed by this species). *Cymodocea nodosa* provides important habitat for seahorses.

Cymodocea nodosa is threatened locally by mechanical damage from trawling and anchoring from boats and coastal development. Eutrophication is also a problem. This species is found in coastal

regions where there is a high level of human disturbance. It is however, a relatively resistant species. In the Mediterranean, this species is threatened due to competition from seaweed species like *Caulerpa taxifolia* and *Caulerpa racemosa*. In the eastern Mediterranean and the Red Sea, increased amounts of domestic and industrial pollutants are impacting the species (Green and Short 2003).

From literature data and from previous survey in both the pipeline landfalls, it results that meadows of *Cymodocea nodosa* are present in the Gulf of Gela possibly due to the predominantly muddy nature of substrates continuously reworked by waves (Calvo et al., 2010; see Figure 12); available data on the distribution of *Cymodocea nodosa* around Maltese coast is limited, but data from AIS Environmental Ltd. 2010. Alternative Assessment Report for the Disposal of Cooling Water – Delimara Power Station indicates a a regression in the extent of *Posidonia* and the replacement of the seagrass with *Cymodocea nodosa* and photophilic algal assemblage, possibly due to cooling water discharges from the main power plant on the Maltese Islands.

Figure 12 – *Cymodocea nodosa* distribution in Sicily (modif from Calvo et al., 2010)

3.3.0 Sabellaria alveolata reefs ("Honeycomb Reef Worms")

Biogenic structures built by ecosystem engineers such as corals, molluscs and polychaetes provide favourable habitats for other benthic invertebrates and vertebrates; moreover, these structures can play an important role as nurseries for certain species of commercial interest and also represent an essential source of food for birds and fishes. In Europe, 'reefs' are recognized as marine habitats to be protected and are listed under Annex I of the EU Habitats Council Directive 92/43/EEC under the Habitat Code 1170 (Reefs). *Sabellaria alveolata* (also known as the honeycomb worm, see Figure 13) is a reef-forming polychaete, about 30-40mm long, living in small tubes it constructs from cemented coarse sand and/or shell material, forming reefs. The tubes are arranged in close proximity and have a distinctive honeycomb-like appearance reefs. These reefs range from 30cm to 2m thick and take the form of hummocks, sheets or more massive formations. It is distributed around the Mediterranean Sea and from the north Atlantic Ocean to south Morocco. It is also found in the British Isles at its northern limit in the northeast Atlantic.

Figure 13 – *Sabellaria alveolata* (Sandulli, 2012)

The *Sabellaria alveolata* reefs are known to be present in Gela Natura 2000 SIC/ZPS "Torre Manfria, Biviere di Gela, Piana di Gela e area marina antistante" (ITA050012; see Figure 14), located in front of the mouth of the Dirillo river at a depth of 4 meters and at a distance of about 200 meters from the coast. It is a colony with living specimens, very stratified (and therefore quite old), which extends for about a meter from the substrate and for a total area of about 500m^2. These biogenic submerged reefs can have important effects on the physical and chemical environment, giving stability to the substrate and creating natural barriers that attenuate wave motion and reduce erosion. They also provide a solid substrate for the colonization of many sessile animal and plant organisms and can directly or indirectly represent an important source of food for other organisms.

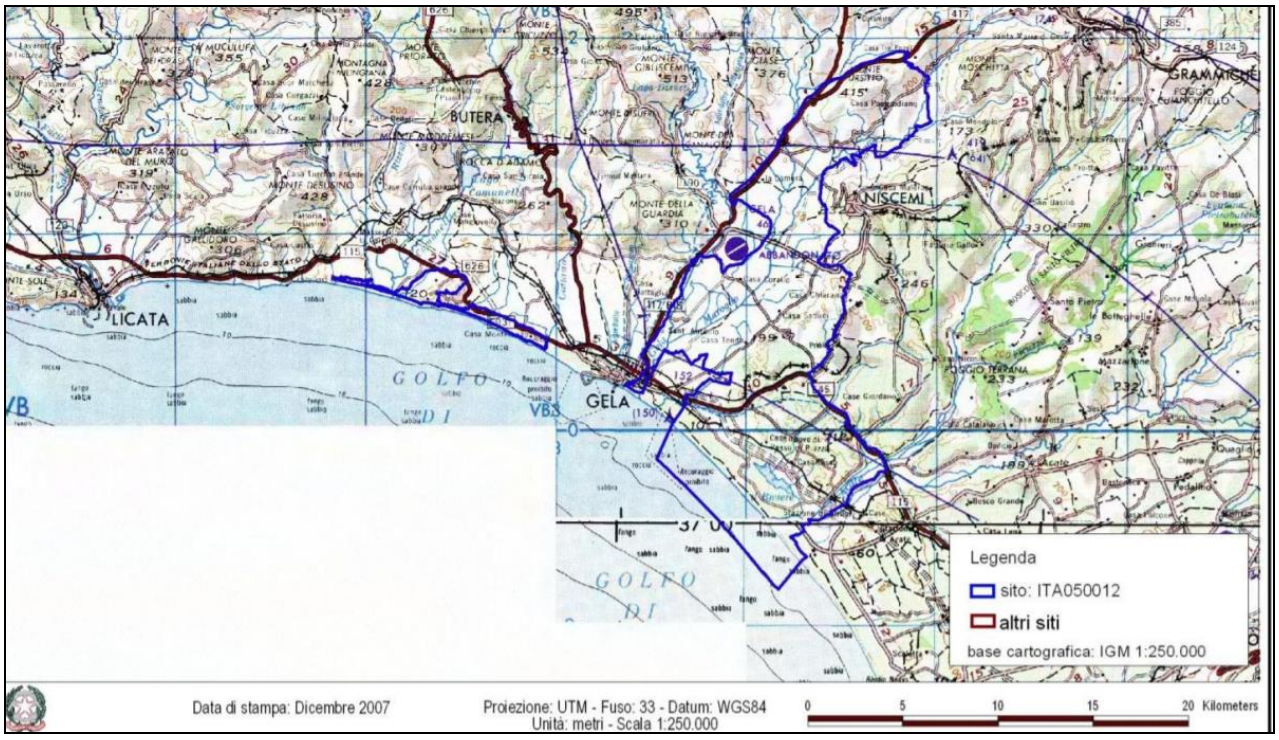


Figure 14 – Gela Natura 2000 SIC/ZPS "Torre Manfria, Biviere di Gela, Piana di Gela e area marina antistante" (ITA050012)

3.4.0 Bioconstructions: coralligenous outcrops and maërl beds

Bioconstructions such as coralligenous outcrops and maërl beds are typical Mediterranean underwater seascapes, comprising coralline algal frameworks that grow in dim light conditions. They are the result of the building activities of algal and animal constructors, counterbalanced by physical, as well as biological, eroding processes. Because of their extent, biodiversity and production, coralligenous and maërl habitats rank among the most important ecosystems in the Mediterranean Sea. Mechanical disturbance and re-suspension of nearby sediments, particularly by bottom trawling, is probably the most destructive human activity currently affecting coralligenous outcrops and maërl beds (from: https://www.nature.com/articles/srep05073#f1).

Among the activities undertaken by ISPRA within the Regional Biodiversity Observatory of Sicily, two research campaigns were conducted in the Strait of Sicily, in order to fill the knowledge gaps on the biodiversity of these particular environments. The research campaigns were carried out from 18 to 29 July 2014 and from 15 to 23 June 2015 (http://www.isprambiente.gov.it). Among the identified species 18 are protected by international agreements, conventions and directives, such as Washington Convention (CITES), Berne Convention, Directive 92/43 / EEC (Habitat Directive), and the SPA / BD protocol of the Convention of Barcelona. In details:

- superficial waters: are characterized by sandy and rocky seafloor where *Posidonia oceanica* is the most common species associated with a lot of green, red and brown algae, some of which are protected, such as sargasso and laminaria (*Laminaria rodriguezii*), whose presence is ascertained only in a few Mediterranean sites. In some cases these environments are densely populated by a species of gorgonian, *Eunicella singularis* (Figure 15).

- waters deeper than 70 meters depth ,the *Eunicella cavolini* species is more widespread. Beyond the 80m of depth, up to around 300m, the seabed is characterized, in the rocky parts, by isolated branches or entire banks of living red coral (*Corallium rubrum*) (Figure 16) and, diffusely , by different species of black coral, such as *Antipathes dichotoma*, *Antipathella subpinnata, Parantipathes larix* and *Leiopathes glaberrima*, the false coral (*Savalia savaglia*), white corals and other calcified corals - such as *Dendrophyllia ramea* and *Dendrophyllia cornigera* (Figure 17). At these depths the seabed are colonized by other species of soft corals, such as *Veretillum cynomorium, Funiculina quadrangularis* and *Viminella flagellum*.

Other hard bottom habitats have been monitored by ISPRA at different depths: the coralligenous dominated by various species of coralline algae, bryozoans, such as *Pentapora fascialis*, sponges, such as *Axinella polypoides*, and gorgonians, such as *Paramuricea clavata*. Maërl and rhodolithic seabeds, made of coral red algae, have also been observed.

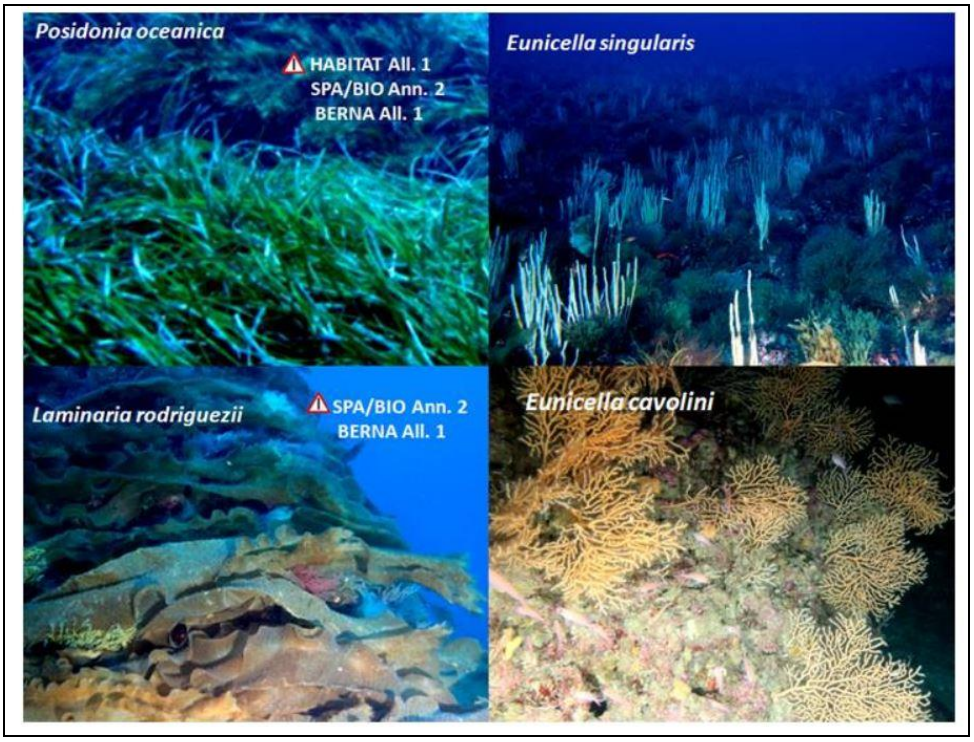


Figure 15 – Superficial waters: *Posidonia oceanica, Eunicella singularis, Laminaria rodriguezii, Eunicella cavolini*

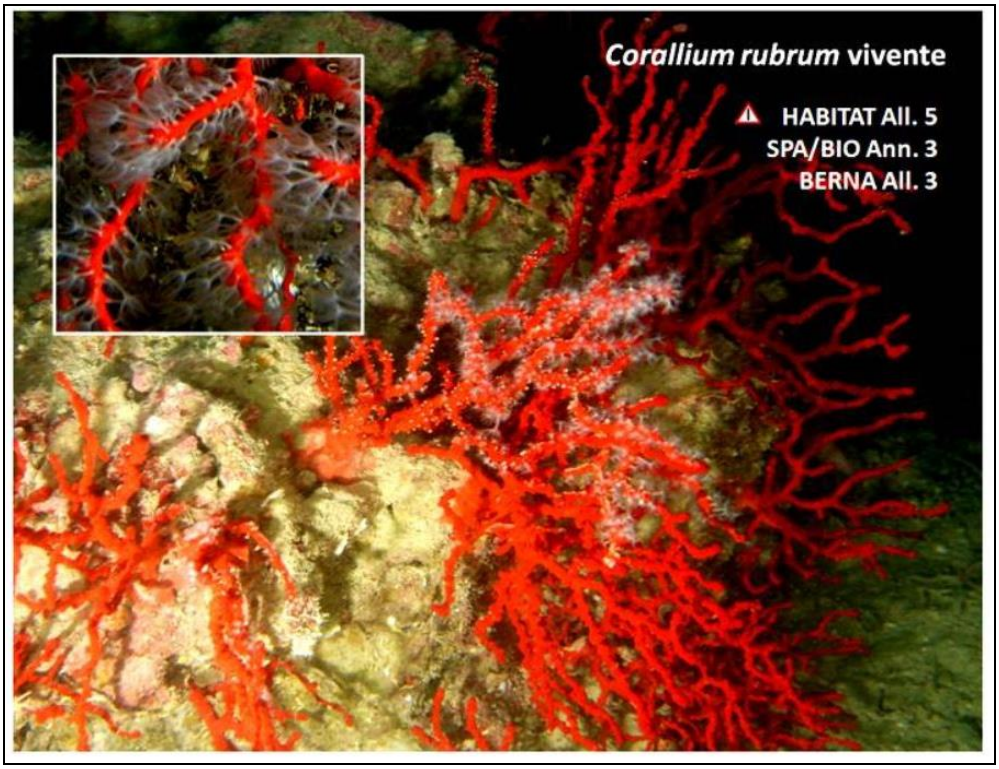


Figure 16 – Bank of *Corallium rubrum*

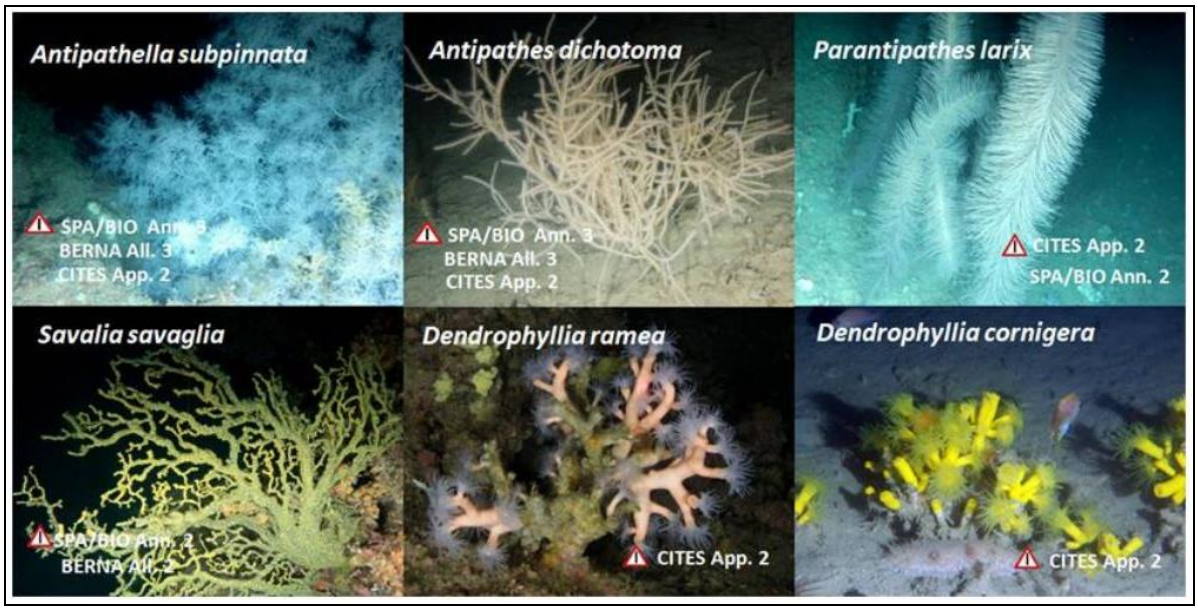


Figure 17 – Common species of corals in the Strait of Sicily

Knowledge on maërl beds was somewhat limited compared to what was available for coralligenous outcrops; a significant update was nevertheless achieved. Previously unknown spatial information on maërl distribution was brought to light for Greece, France (Corsica), Cyprus, Turkey, Spain and Italy. Malta and Corsica, in particular, had significant datasets for this habitat as highlighted by fine-scale surveys in targeted areas (Martin et al., 2014). Scientific information on these two habitats remained unevenly distributed, essentially because the majority of systematic studies have taken place in the western Mediterranean. However, the areas for which information was previously unavailable were much better covered by Martin et al., 2014, particularly the eastern Mediterranean Sea.

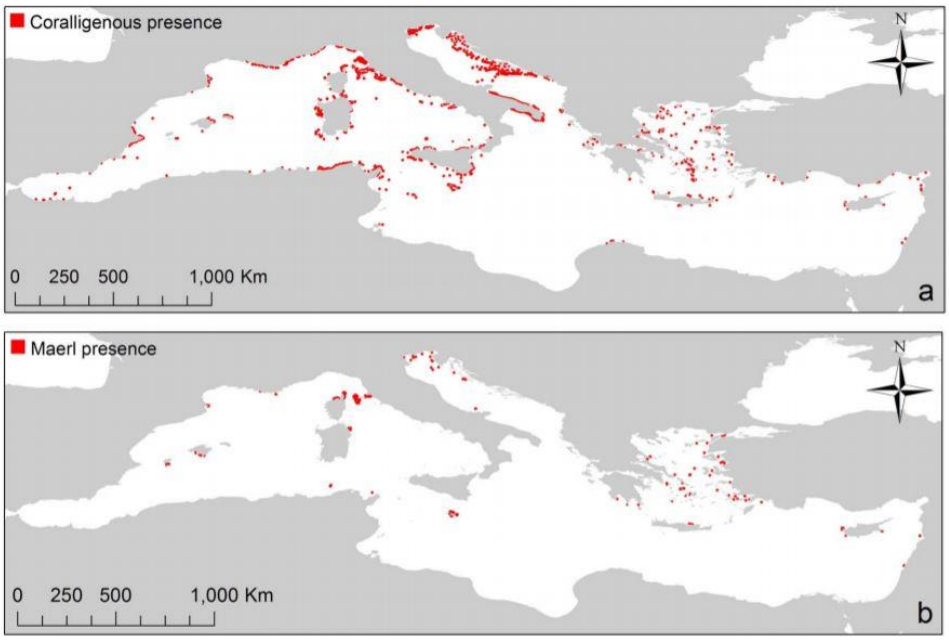


Figure 18 – Distribution of (a) coralligenous outcrops and (b) maërl beds across the Mediterranean Sea (Martin et al., 2014).

Benthic communities associated with shelf sublittoral rock are poorly known in Malta. Some data originates from localised surveys including a description of an expanse of barren rock at a depth of about 120m in the marine area of the islet of Filfla, off the south-western coast of Malta (Figure 19). This stretch of seabed supports tall hydroids possibly of the species *Nemertesia ramosa*. However, there are relatively few studies which describe this type of habitat and such data scenario precludes the possibility for assessing the extent of the communities associated with shelf sublittoral rock.

This substrate type in the Mediterranean is known to support coralligenous biocoenosis described as two main types of assemblages: *Lithophyllo-Halimedetum tunae* and *Rodriguezelletum straforelloi* (Ballesteros, 2006). The presence of these assemblages has not been specifically reported for Malta, although they are known to occur at depths between 90-120m in the Siculo-Tunisian region (Ballesteros, 2006). The depth at which such assemblages occur depend on the light intensity. The closest description of a benthic habitat which may fit within the definition of coralligenous communities originates from localised marine surveys within shallow caves and on shaded vertical rock faces at relatively shallow depths not exceeding 42m.

Records of the occurrence of species which are typical of such communities in Malta do exist, albeit the data available is very scant. *Corallium rubrum* is one such species which has been identified in Malta and has been recently observed at depths between 585m and 819m (Taviani et al., 2010). Very little is known about the distribution and status of *Corallium rubrum* at intermediate depths (60-300m; Costantini et al., 2010). *Corallium rubrum* has been commercially harvested since ancient times for its red axial calcitic skeleton. Historical data indicates that this species was fished between the period 1984-1987 at around depths of 170 – 200m, however such exploitation has now ceased. This species is strictly protected and trade of this species is illegal (ERA, MSDF 2016).

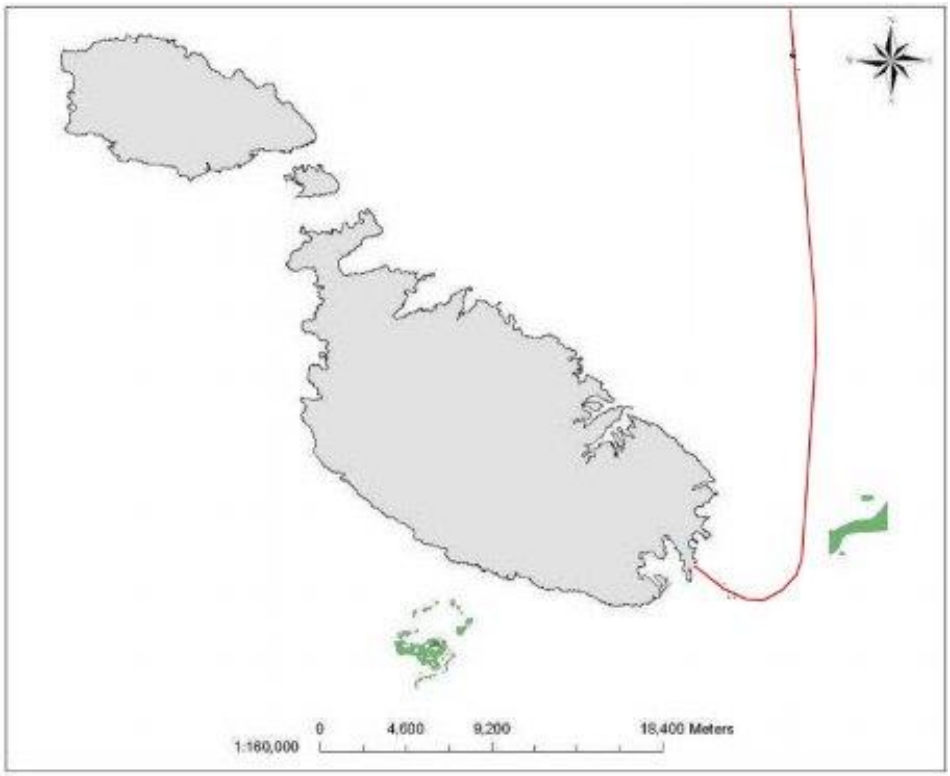


Figure 19 - Distribution of known assemblages belonging to the Shelf Sublittoral Rock and Biogenic Reef Category; in red the project pipeline route (ERA, 2016; Dimech *et al*., 2004)

Associations of coarse sediments with rhodoliths and maërl beds constitute better known benthic communities of the shelf sublittoral. These associations are characterized by accumulations of unattached coralline algae or rhodoliths (Corallinales, Rhodophyta) and occasionally calcified

peysonneliacean algae. The term 'maërl beds' is used when rhodoliths constitute a dominant proportion of the sediment layer. All grades ranging from sparse rhodoliths to full maërl beds occur in Malta.

In the Mediterranean, maërl beds occur in the transition zone between the lower infralittoral and upper circalittoral, although sparse rhodoliths occur at other depths. The depth limit depends primarily on the degree of light penetration and the high degree of light penetration in the Mediterranean can explain the common occurrence of live coralline algae at a water depth of 51-90m (Sciberras et al., 2009). In Malta maërl beds are characterized by five species of maërl forming algae: *Lithothamnion minervae, Phymatolithon calcareum, Lithothamnion corallioides, Lithophyllum racemus* and *Mesophyllum alternans. Lithothamnion minervae* was the most abundant rhodolith-forming species present at the maërl bed off the Northeastern coast of Malta. Neogoniolithon brassica-florida and Peysonnelia species may also occur at lower quantities (Sciberras et al., 2009). Maërl beds provide a substratum which is exploited by a wide variety of species typical of both hard and soft substrata (MSFD, 2015). Faunal assemblages associated with maërl beds include: burrowing and interstitial forms that utilize the sediment underlying the rhodoliths and the interstices between the rhodolith thalli; sessile epifaunal organisms that utilise the rhodoliths and the stabilised upper layer of sediment and vagile epifauna. The dominant faunal groups associated with maërl beds are annelids, crustaceans and molluscs, however most animal species within these taxonomic groups occur in other infralittoral and circalittoral habitats and are not restricted to maërl beds (Sciberras et al., 2009).

The major maërl bed in Malta covers an extent of circa 20km^2 of the seabed off the North-eastern coast of Malta at 30-100m depth (Sciberras et al., 2009; Micallef et al., 2013; ERA - MSDF, 2016; see Figure 20). However accumulations of rhodoliths or unattached coralline algae were recorded from other areas:

- off the South-eastern coast of Malta up to a maximum depth of 85m recorded through a video survey as part of the Environmental Impact Assessment process. This study area was characterised by a sparse maërl bed in association with different types of substrata such as sand, cobbles and pebbles. Rhodoliths were mainly restricted to the relatively shallower areas (ca. 56-69m) on a submarine plateau. In deeper areas (ca. 90-103m), rhodolith associations were replaced by muddy sand without rhodoliths
- Off the North-eastern coast of Malta at depths 45-50m recorded through a survey of two marine areas along the coast aimed at assessing the feasibility for land reclamation projects within these areas. This area was characterised by both maërl beds and associations with rhodoliths, with the former supporting the gorgonian *Eunicella singularis* in some places
- Off the Southwestern coast of Malta on a raised bank between mainland Malta and the islet of Filfla.

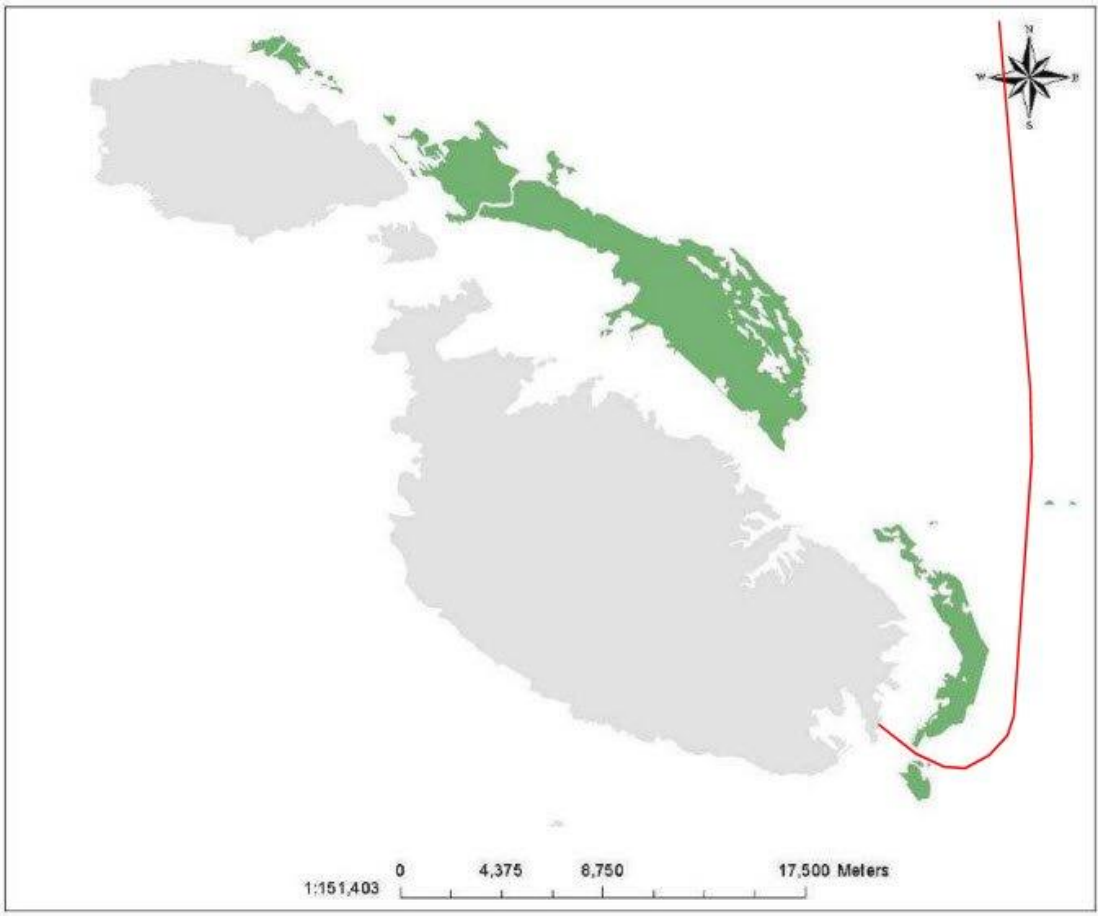


Figure 20 – Maërl, sand and gravel habitats category; in red the pipeline route (mod. from ERA - MSDF, 2016)

4.0.0 SENSITIVE MARINE HABITAT IDENTIFIED IN PROJECT AREA

The visual inspection for the Environmental and biodiversity analysis has been done along the corridor for the nearshore Gela, the offshore Gela-Malta and for the nearshore Maltese waters (see pictures from Figure 2 to Figure 6). Details about the biodiversity please refer to MEW001_WP2_EBB, latest revision.

The combined interpretation of geophysical data (SSS, SBP and MBES), seabed samplings and ROV visual inspection analyses allowed the mapping the following sensitive marine habitats:

- *Cymodocea nodosa* prairies at Gela coastal area;
- biogenic constructions at spotted areas along the design pipeline offshore section;
- biogenic constructions at Malta shallow water and Delimara coastal area;
- *Posidonia oceanica* prairies in association with green and brown algae and biogenic reef at Delimara coastal area.

The sensitive marine habitats mapping from the PMRS results are detailed in the following paragraphs and shown on the enclosures in Chapter 7.0.0.

4.1.0 Sensitive Marine Habitats at Gela (Italy) Landfall

Charts reference: MEW001_NU_PSMH_5K_FINAL_00-1

MEW001_NU_PSMH_5K_FINAL_00-2

MEW001_NU_PSMH_5K_FINAL_00-3

The Italian nearshore section of the basic design pipeline route - from KP0.097 to KP9.705 - is featured by a gently sloping seafloor (main gradient <2°; Figure 21) where water depths range from 0.6m to 38m; the seabed is covered by fine sediments and by an alternation of dense and scattered marine Phanerogam prairies (*Cymodocea nodosa;* see Figure 22 and Figure 23) down to KP7.273 at 19.4m w.d., as confirmed by the visual inspection (see Figure 25). It has to be underlined that the reef-forming polychaete *Sabellaria alveolata* has not been found based on SSS / MBES and ROV data.

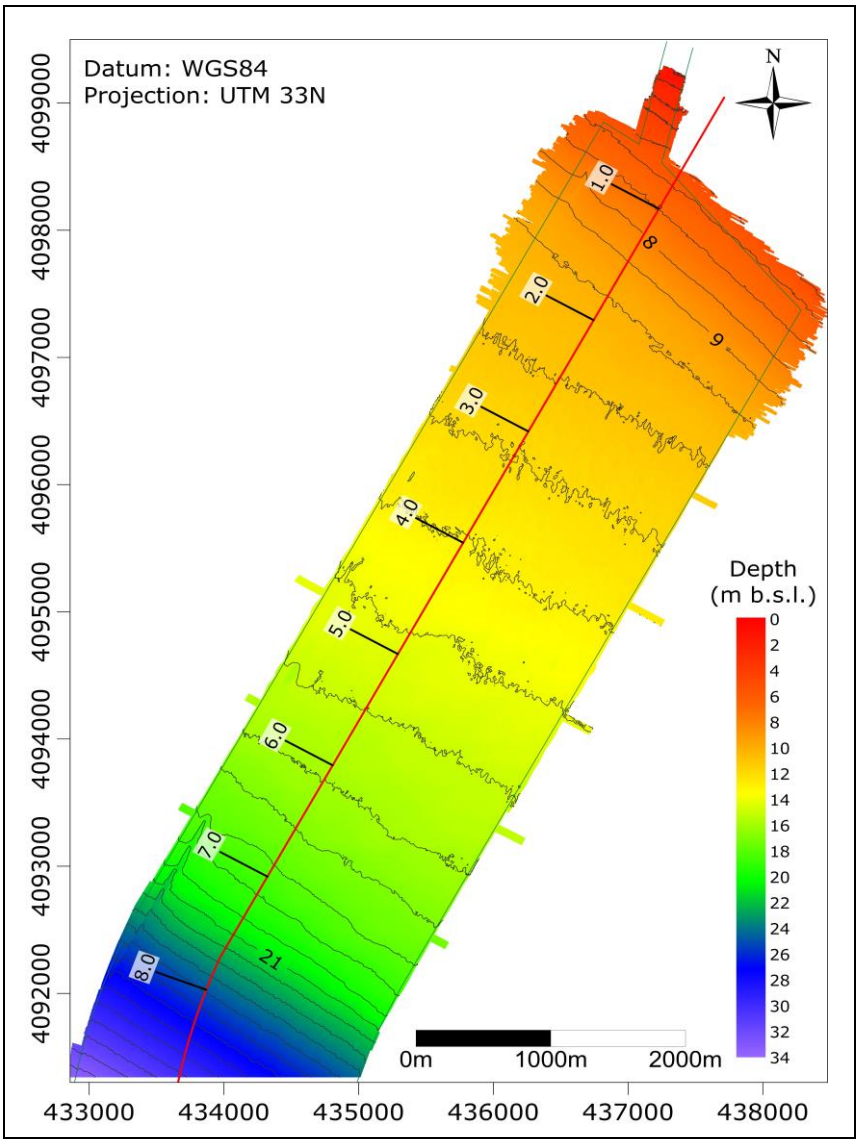


Figure 21 – 2D Bathymetric map of the Italy inshore area

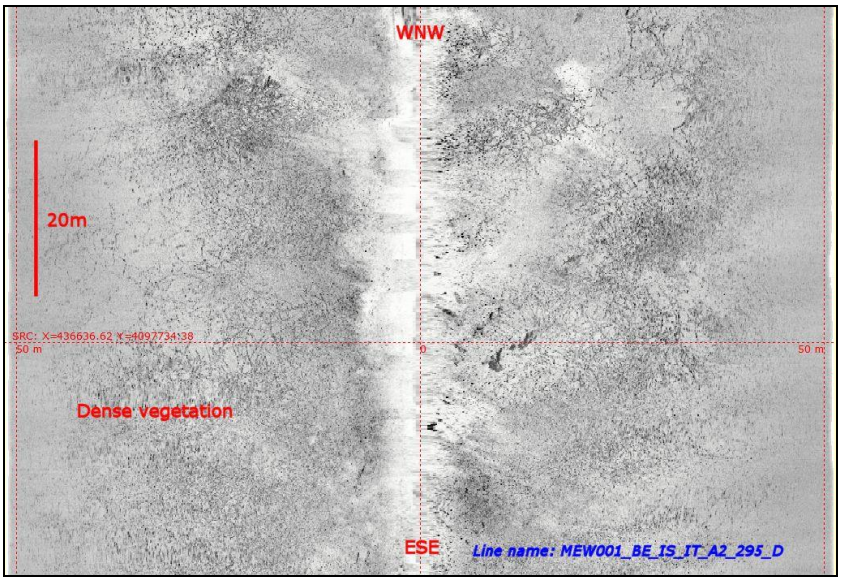


Figure 22 – SSS data example: dense vegetation

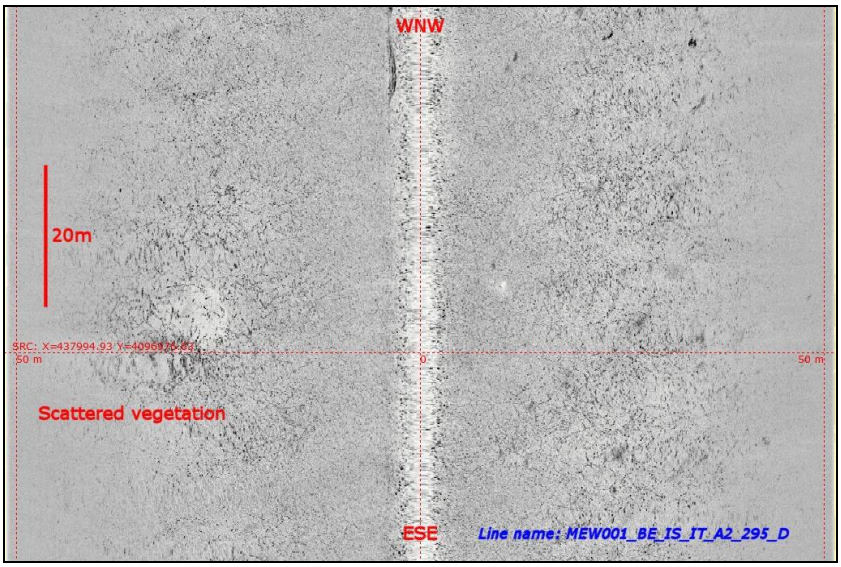


Figure 23 – SSS data example: scattered vegetation

Proceeding from Gela landfall towards SW along the design pipeline route, the alternation of dense and scattered *Cymodocea nodosa* prairie has been detected at the following intervals (see Figure 24): dense prairie from KP0.643 (about 5m, landfall limit of the survey) to KP1.019 (7.0m), scattered prairie from KP1.019 (7.0m) to KP1.500 (9.2m), dense prairie from KP1.500 (9.2m) to KP2.762 (11.4m), scattered prairie from KP2.762 (11.4m) to KP3.263 (12.0m), dense prairie from KP3.263 (12.0m) to KP4.839 (14.0m) and *Cymodocea nodosa* scattered prairie from KP4.839 (14.0m) to KP7.273 (19.4m, outer limit of *Cymodocea nodosa* prairie). Seabed samples have been collected by means of a Van Veen grab at 23 different locations during the Environmental Survey (see MEW001b_ENV, latest revision): they confirmed the presence of *Cymodocea nodosa*; furthermore a detailed visual inspection has been performed in the seabed samples collected for the benthos anayses revealing the presence of individuals of the green alga *Caulerpa* (possibly *Calulerpa taxifolia*).

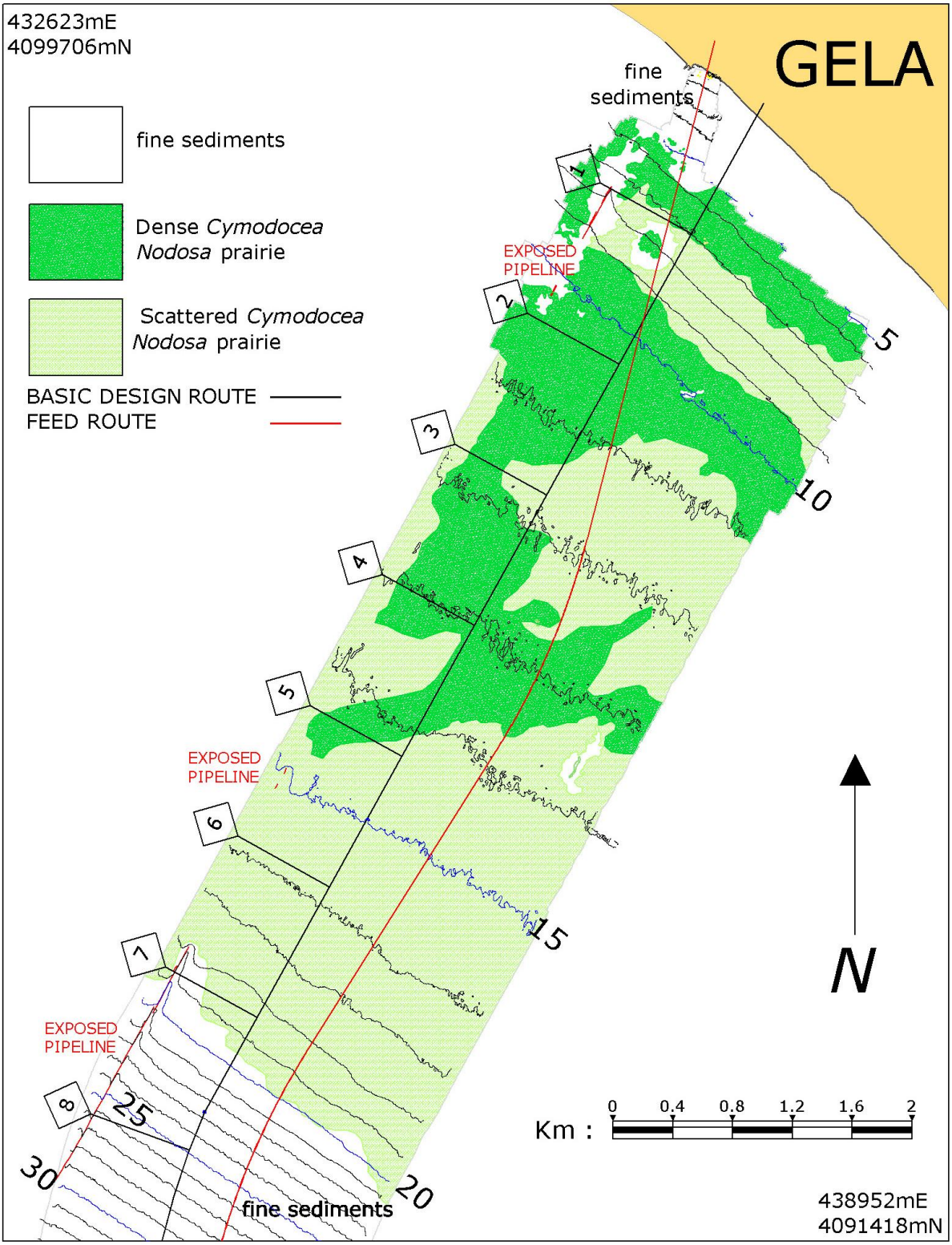


Figure 24 - Nearshore Gela: sensitive marine habitats (bathymetric contours every 1m; in blue every 5m)

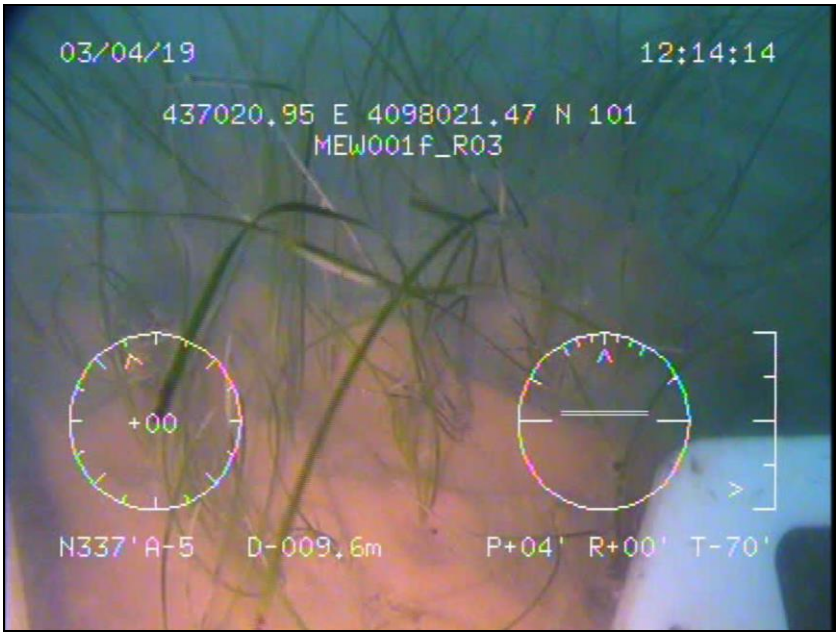


Figure 25 – Dense *Cymodocea nodosa* prairie (Gela Nearshore area)

Poor visibility conditions affected the ROV survey at Gela landfall. Nevertheless, several pictures have been taken at a later stage (i.e. during UXO Survey), in order to better verify the seabed within the area planned to be sampled during the environmental and geotechnical campaign. Location of the pictures are reported in Figure 26. The pictures taken, reported in Figure 27, Figure 28 and Figure 29 allowed a further confirmation of the interpretation provided, as well as aiding the permitting process associated with sampling nearshore Gela. It is to be noted that all ROV and/or other visual checks have been carried out prior to sampling operations.

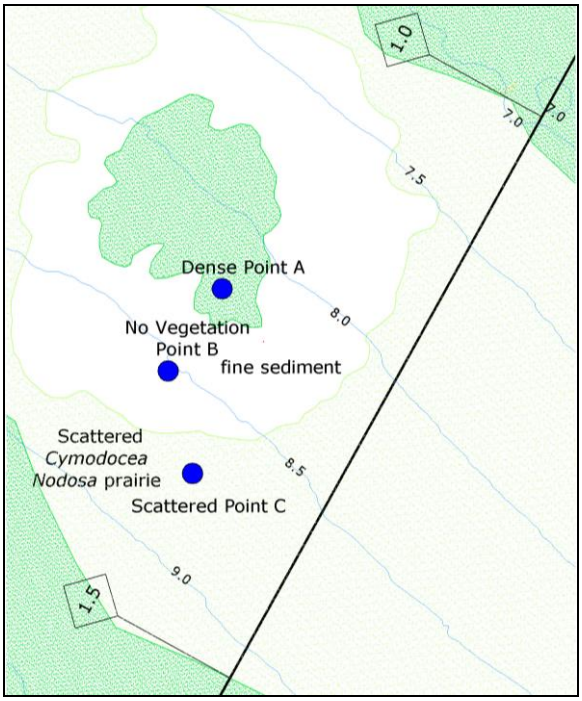


Figure 26 - Nearshore Gela: sketch of the pictures locations (UXO survey)

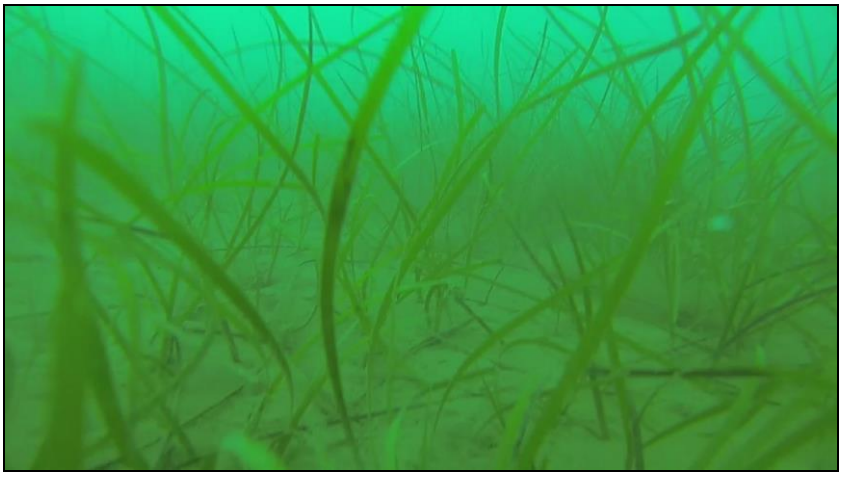


Figure 27 – Nearshore Gela: dense *Cymodocea nodosa* prairie at point A

Figure 28 – Nearshore Gela: fine sediment at point B

Figure 29 – Nearshore Gela: scattered *Cymodocea nodosa* prairie at point C

4.2.0 Sensitive Marine Habitats in the pipeline offshore section

4.2.1 Biogenic concretions / bioconstructions from KP40.5 (118.5m w.d.) to KP62 (156m w.d.)

Charts reference: MEW001_NU_PSMH_5K_FINAL_00-4

MEW001_NU_PSMH_5K_FINAL_00-5

MEW001_NU_PSMH_5K_FINAL_00-6

From KP40.500 (118.5m w.d.) to KP41.600 (122m w.d.), at the whole eastern portion of the surveyed corridor, the combined SSS/SBP/MBES data interpretation allowed the detection of wide structural relief surrounded by some scattered rocky outcrops with slopes up to 9°. The basic design pipeline route is at a minimum distance of 39.6m from this relief (see Figure 30 and Figure 31).

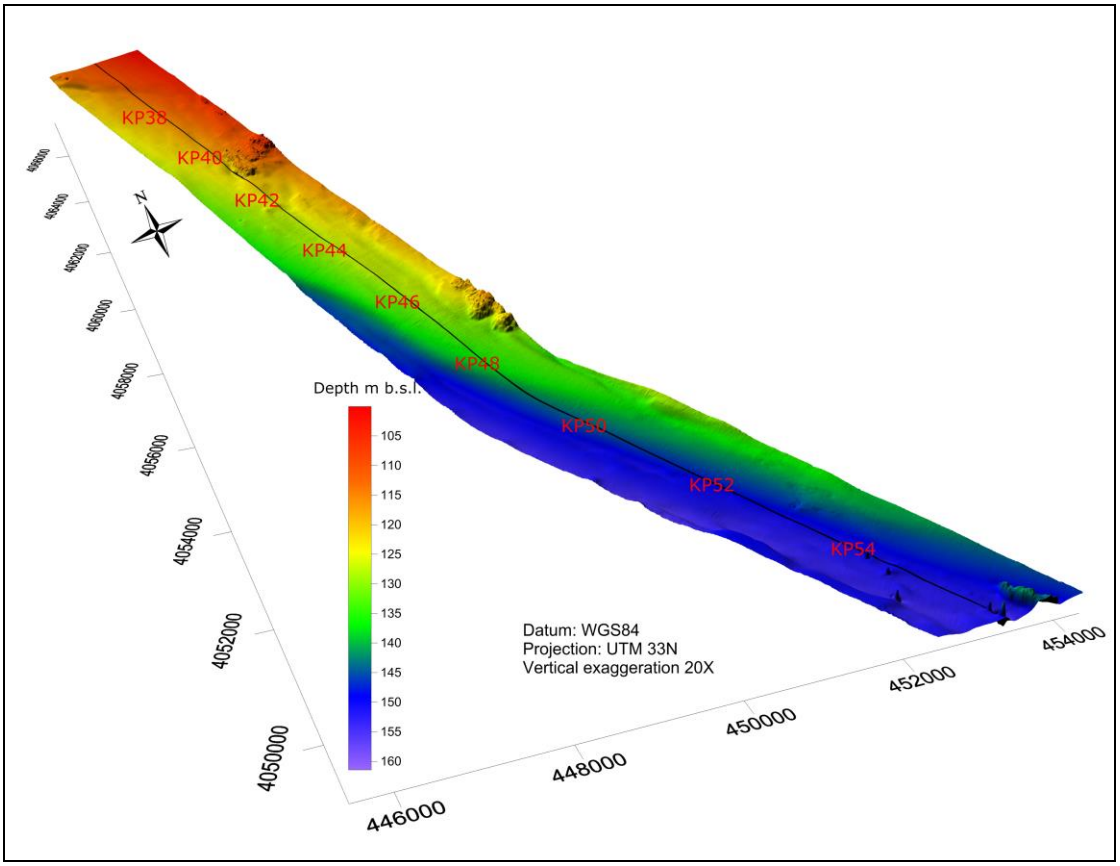


Figure 30 - 3D Bathymetry from KP36.129 to KP56.056

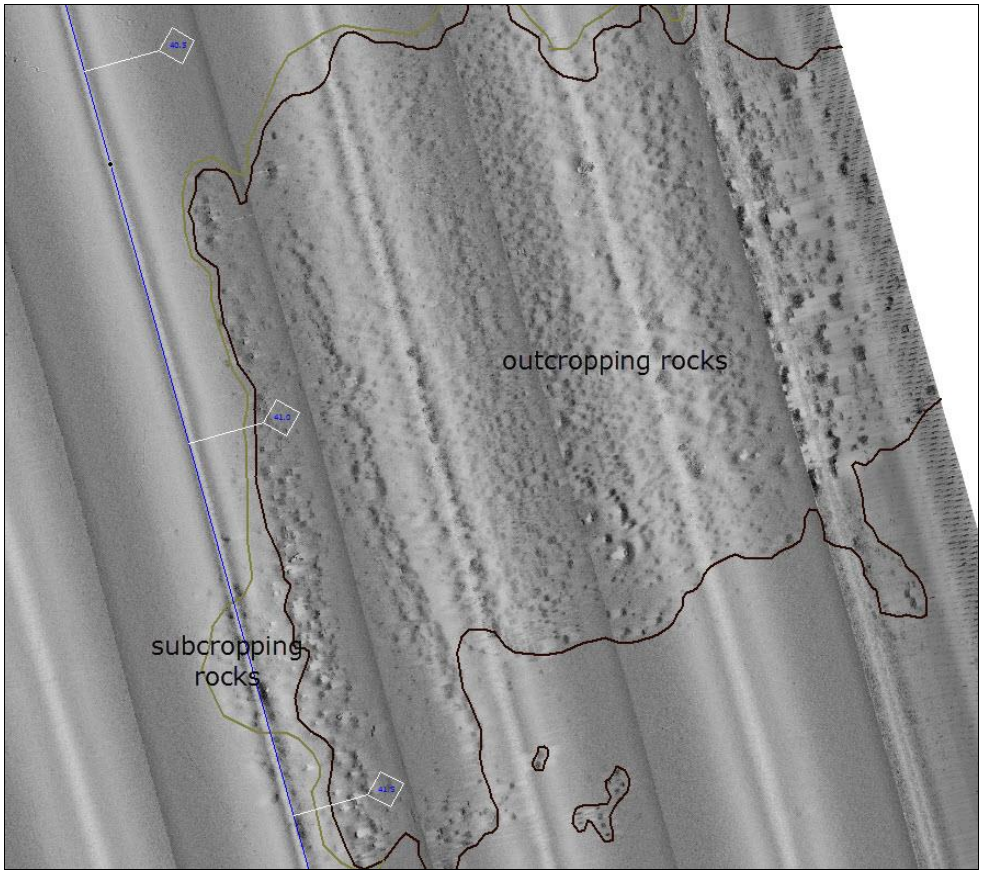


Figure 31 - SSS mosaic: outcrop at about KP40.5-KP41.5

ROV data across this feature show circalittoral bedrock biocoenosis (i.e. probable *Scleractinia* examples; Figure 32), roughly from KP40.5 to KP41.6, in water depths ranging from about 105m to 120m; this biogenic concretions is surrounded by fine sediments (very soft SILT with clay, as for MEW001b_K15; Figure 33). Sketch of this route section is presented in Figure 34.

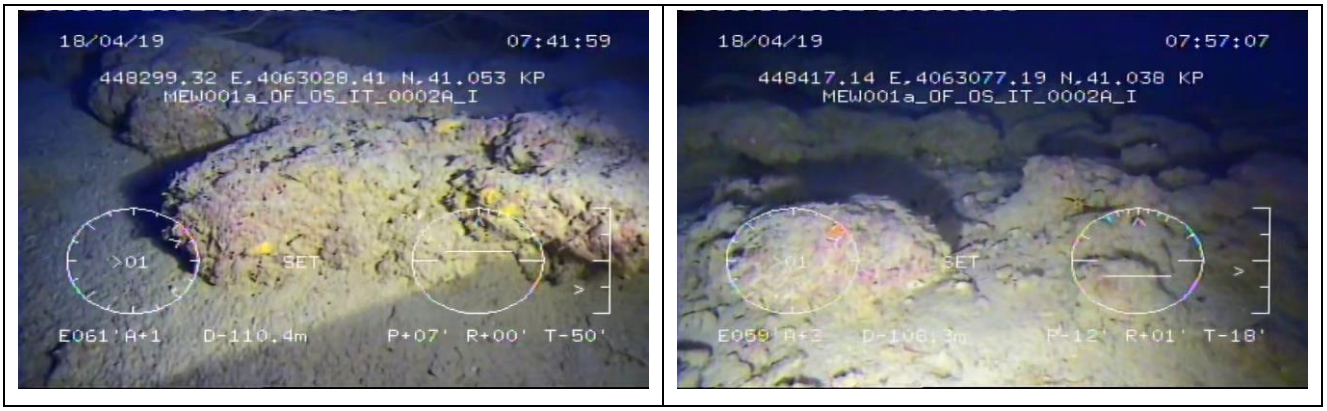
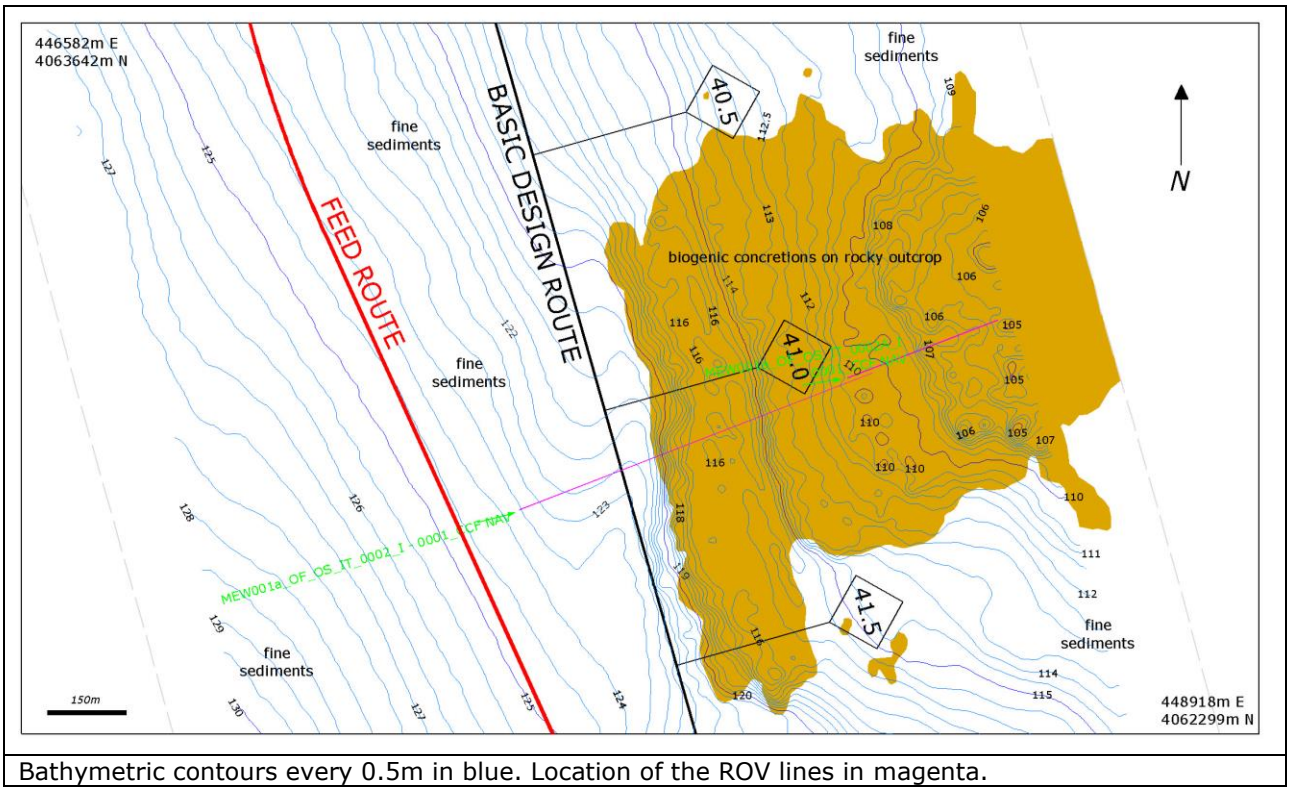


Figure 32 – ROV data example at about KP41 – biogenic concretions (probable *Scleractinia)*

Figure 33 – ROV data example at about KP41 – fine sediments surrounding the outcrop



Bathymetric contours every 0.5m in blue. Location of the ROV lines in magenta.

Figure 34 – Pipeline offshore section: sensitive marine habitats from KP40.5 to KP41.6

Roughly from KP54 (151m w.d.) to KP 62 (156m w.d.) some scattered small sub-conical, dome-like features have been detected during the geophysical survey (Figure 35, Figure 36, Figure 37), and from KP55.6 to KP58.8 two wide tabular NW-SE elongated flat-top ridges characterise the eastern sector of the survey corridor, located at a minimum distance of 15m from the route in water depths ranging from about 140m to 155m (Figure 35, Figure 37, Figure 38). The ridges rise up to 10m from the surrounding seafloor, while the dome-like outcrops show an height ranging from 2m to 10m and an average diamater of 65m.

The nature of these features have been investigated by a total of three ROV transects performed across KP55.95, KP56.70 and KP61.5 with the main aim to verify the nature of SSS and magnetometric contacts during the geophysical survey (see Figure 4; see MEW001_GEOPHY, latest

revision). The rocky nature of the elongated ridges and the dome-like featurs, surrounded by soft fine sediments, has been confirmed by the ROV inspection. The northern elongated ridge area is covered by carbonates, with a rich occurrence of benthic fauna in hard-substrata (in particular the abundance of the gorgonian *Callogorgia verticillata*, see Figure 40); similar images have been recorded on the dome-shaped features (Figure 42). It has to be underlined that no ROV transects have been performed across the sourthern and longest elongated ridge detected East of the design route roughly from KP56.8 to KP58.5, but the same area has been investigated during three cruises in 2006 and 2007 by INGV and Milano-Bicocca University by means of MBES/SBES, SBP/Sparker, SSS, ROV and gravity cores (Savini et al., 2009): images from the ROV were acquired at the top of the seaward steep flank of the largest ridge and clearly showed that most of the ridge area was covered by carbonates and by the same rich occurrence of benthic fauna detected during LGH survey. The small scale mounds and the presence of caves found along the flat top of all the ridges and well mapped on the SSS mosaics (Figure 37, Figure 38) correspond to hard carbonate build-ups that host living fauna dominated by the presence of the gorgonian *Callogorgia verticillata* (Figure 40, Figure 41 from Savini et al., 2009). From literature data (Savini et al., 2009) the domes of the Malta plateau, their seismic path, the muddy nature of the sediment and the occurrence of nannofossil assemblages in core samples with significant age mixing indicate that they are fine-grained sediment extrusions like those forming mud volcanoes: the domes found within the survey area may have formed as mud volcanoes, but at present they may be characterized by a dormant stage with a slow flux that leads to the formation of carbonate crusts at their tops (Savini et al., 2009).

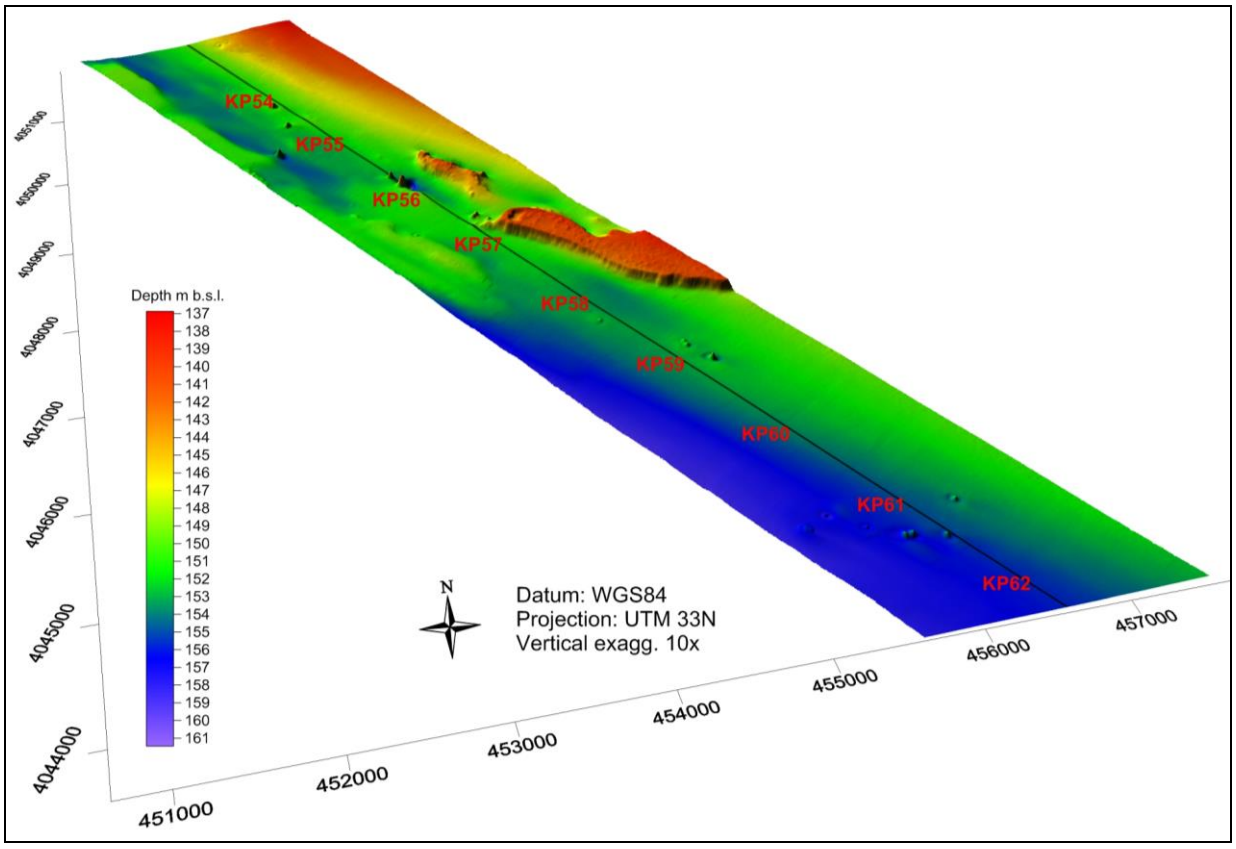


Figure 35 – 3D Bathymetry: detail between KP54.000 and KP62.000

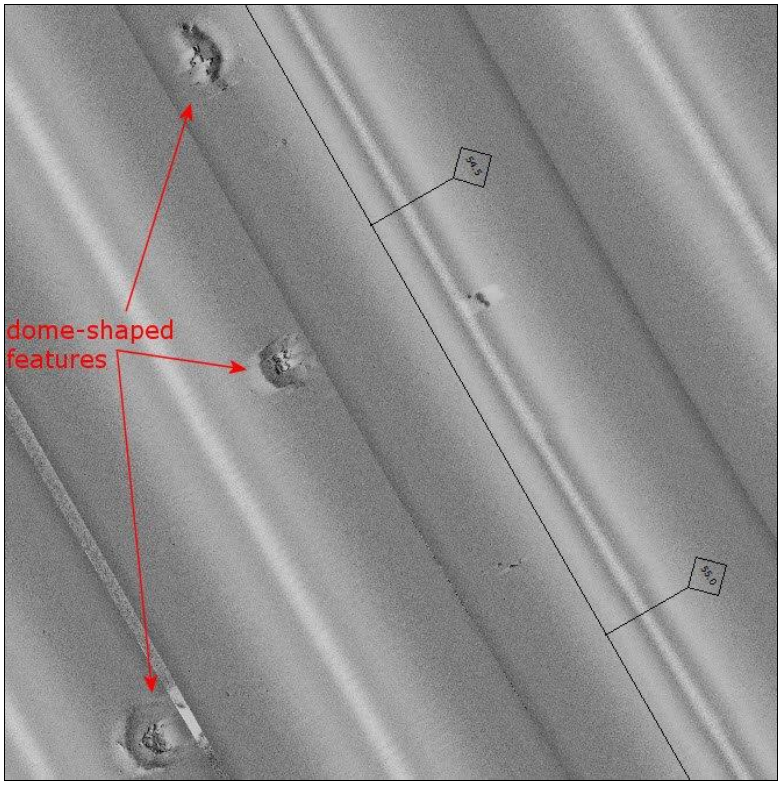


Figure 36 – SSS mosaic at about KP54.5: dome-shaped features

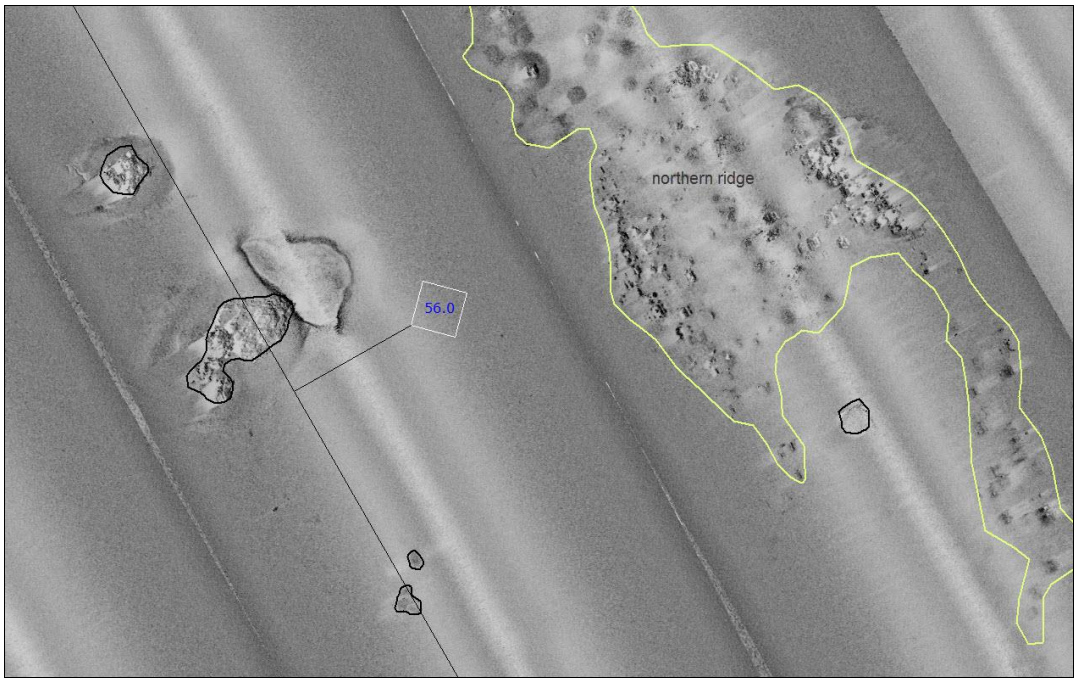


Figure 37 – SSS mosaic at about KP56: dome-shaped features and northern ridge

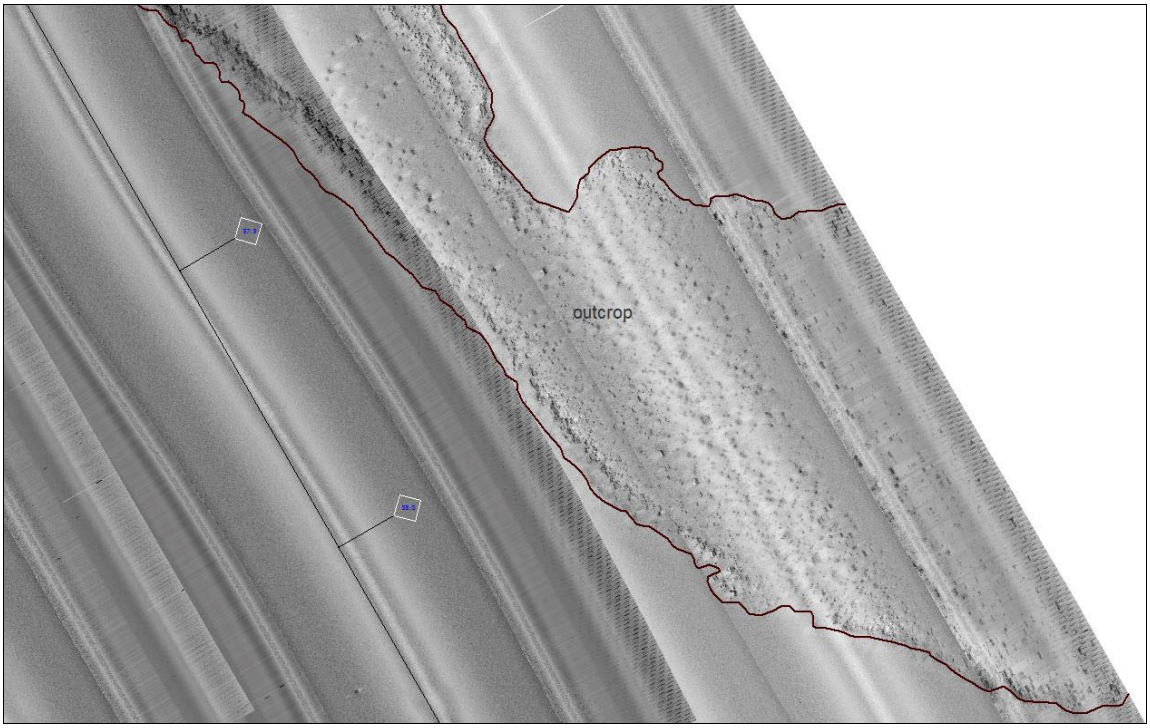


Figure 38 – SSS mosaic at about KP58: section of the southern largest ridge

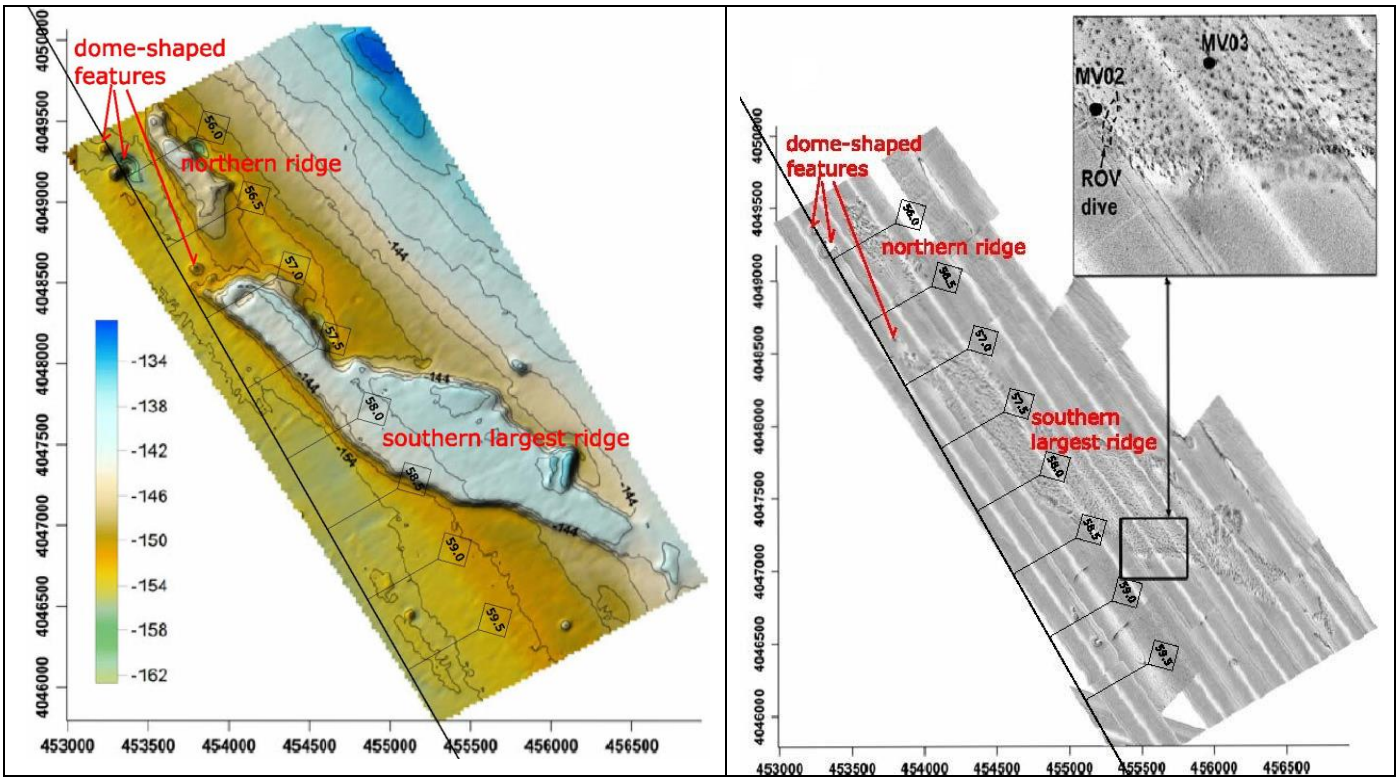
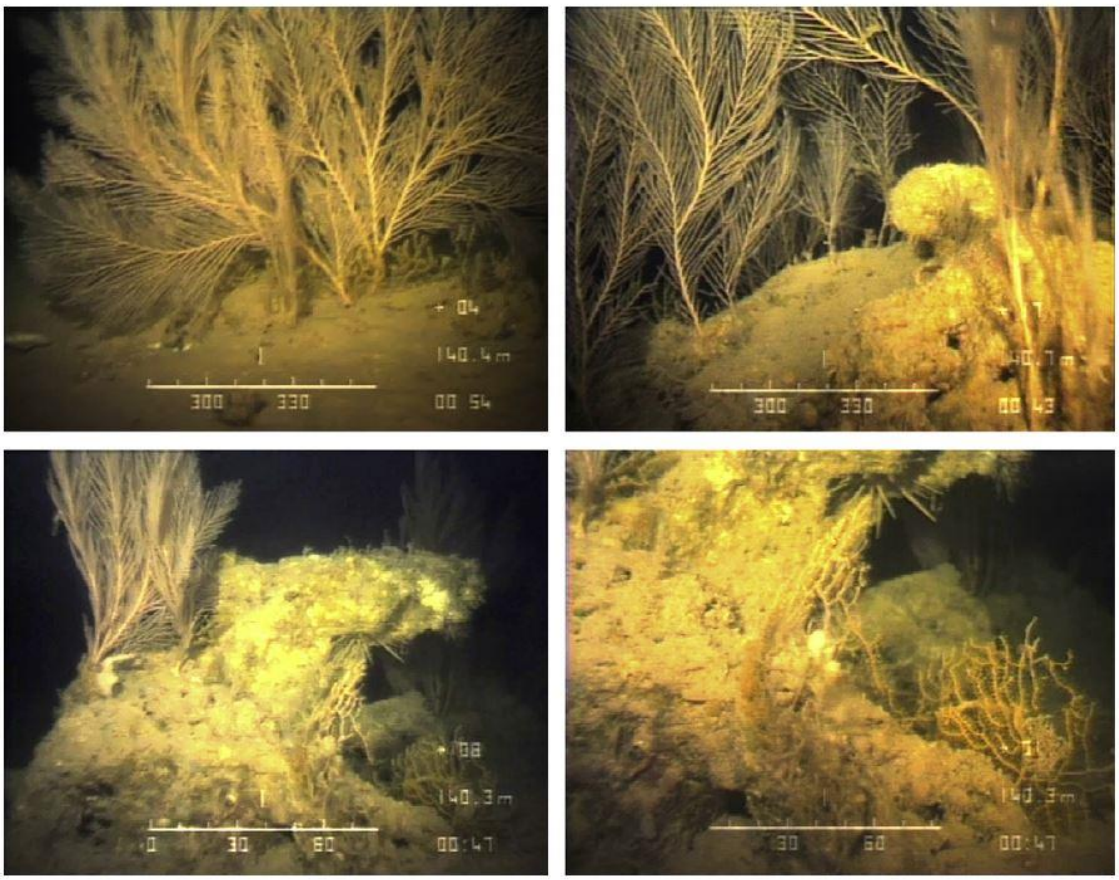


Figure 39 – Literature data: bathymetric map and SSS mosaic map (mod. From Savini et al., 2009)

Figure 40 – *Callogorgia verticillata* observed at the top of the northern elongated ridge at KP55.921



ROV images taken along the southern largest ridge, roughly 1km East of KP58.5

Figure 41 – ROV images from literature data (Savini et al., 2009; ROV location in Figure 39)

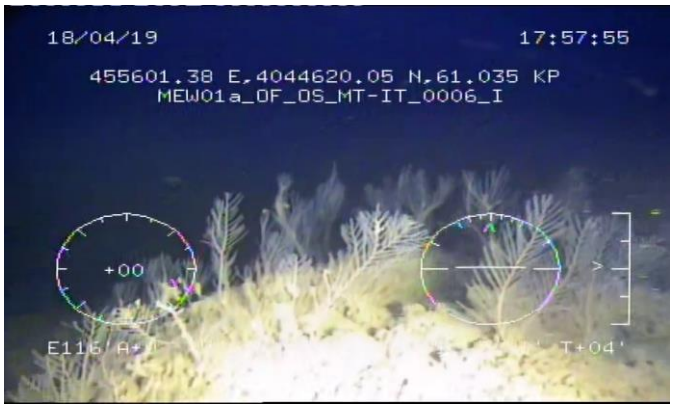
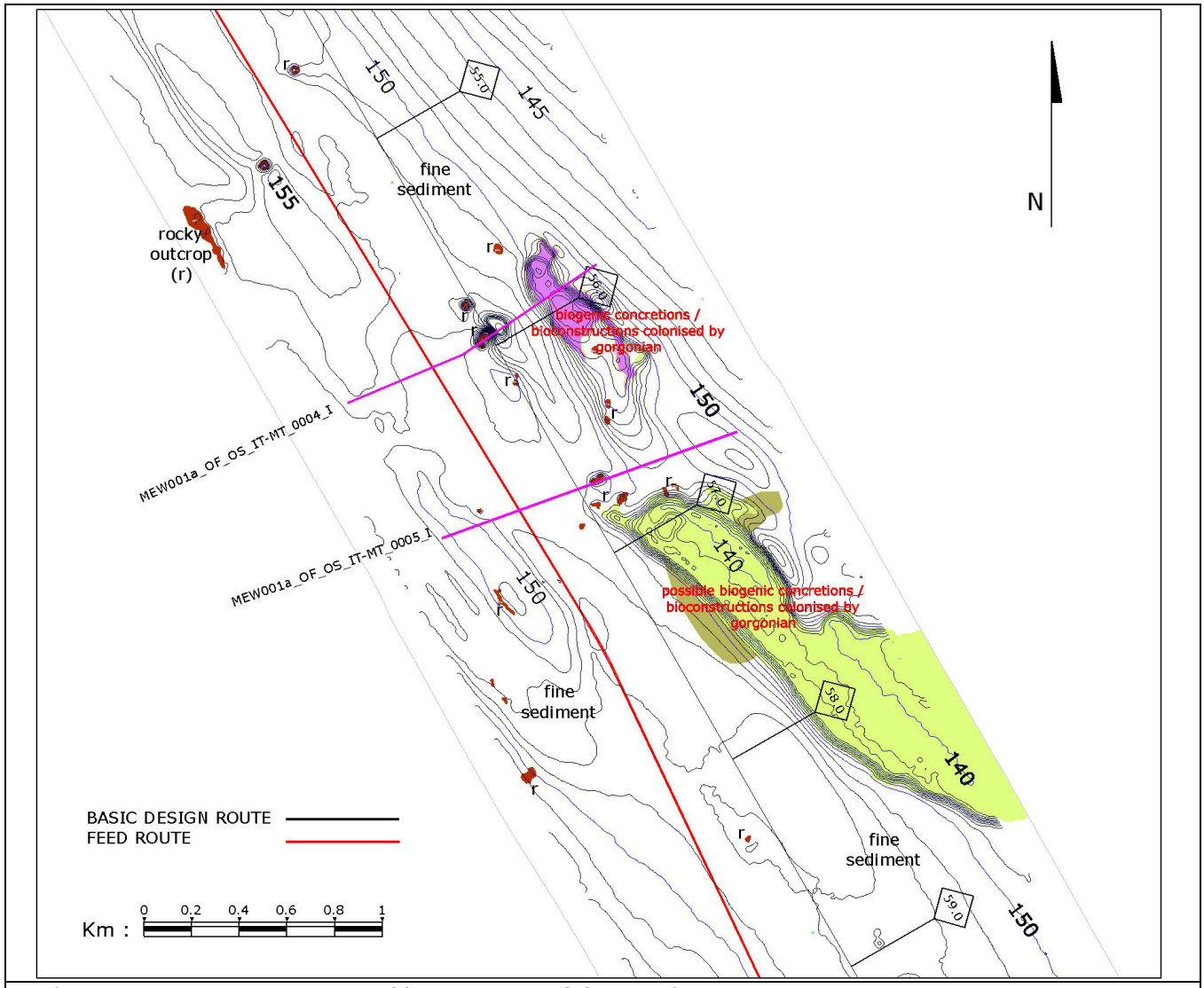


Figure 42 – *Callogorgia verticillata* at the top of the dome-shaped feature at KP61.035



Bathymetric contours every 1m in blue. Location of the ROV lines in magenta.

Figure 43 – Pipeline offshore section: sensitive marine habitats from KP55 to KP59

4.2.2 Bioconstructions (coralligenous) from KP129.5 (126m w.d.) to KP134.5 (112m w.d.)

Charts reference: MEW001_NU_PSMH_5K_FINAL_00-7

MEW001_NU_PSMH_5K_FINAL_00-8

The offshore pipeline section from KP129.5 (126m w.d.) to KP134.5 (112m w.d.) is featured by a very rough seafloor: a structural high rising up to about 12m from the surrounding seabed and featured by moderate slopes up to 10° has been detected East of the route up to about KP133 (Figure 44, Figure 45); it crosses the whole surveyed corridor from about KP134 going southward (Figure 44).

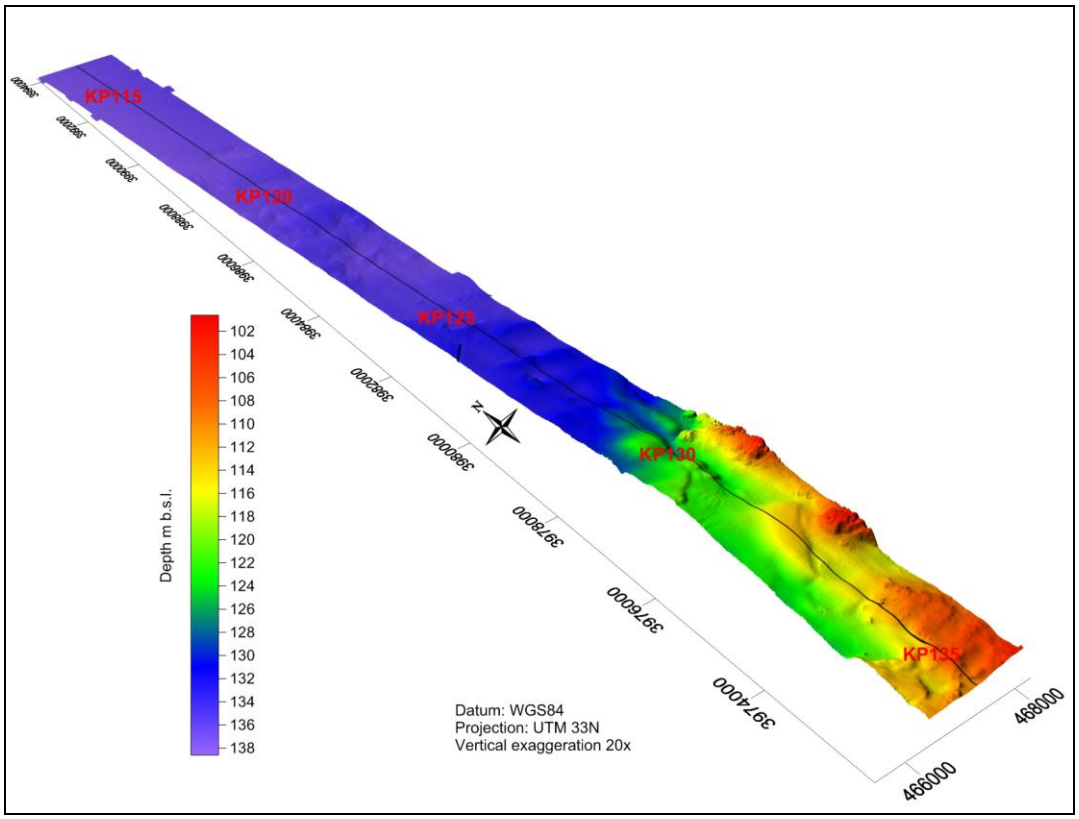


Figure 44 – 3D Bathymetry from KP113.127 to KP135.803

SSS data analyses combined wit the SBP interpretation allowed defining rocky outcrops areas and subcropping areas within a fine sediment with coarser sediment patches domain (Figure 45, Figure 46).

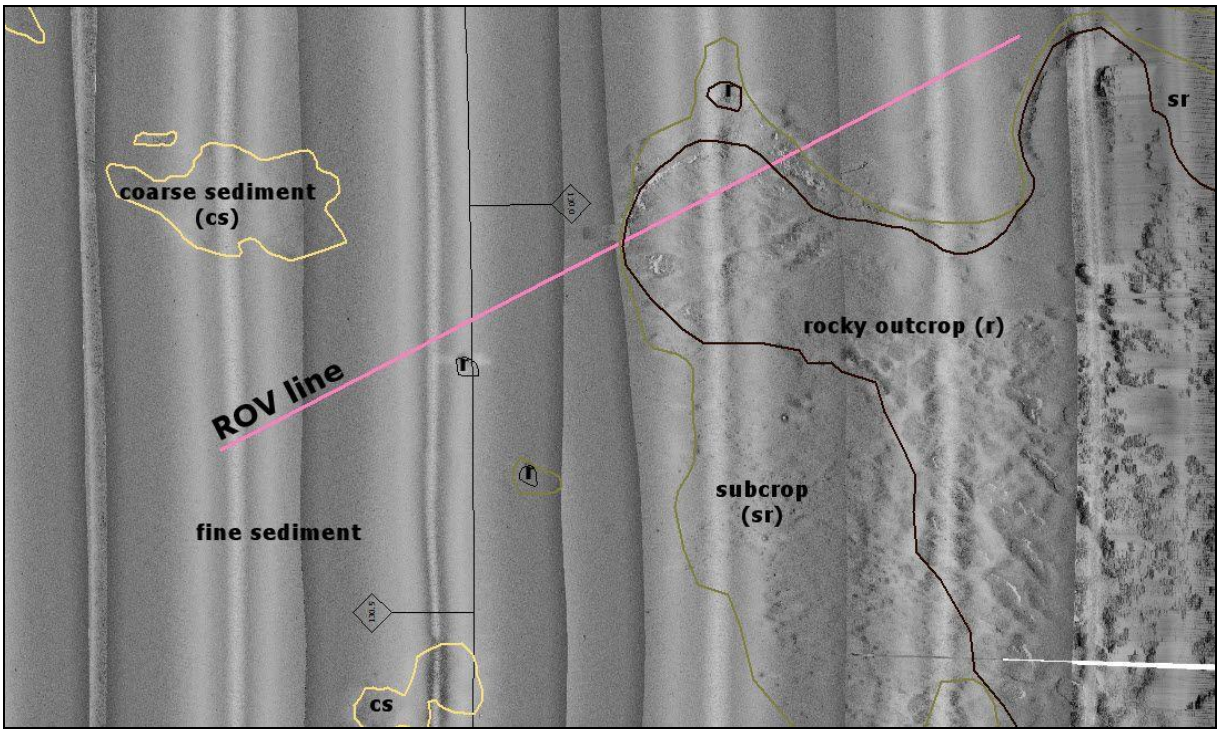


Figure 45 – SSS mosaic at KP130-KP130.5

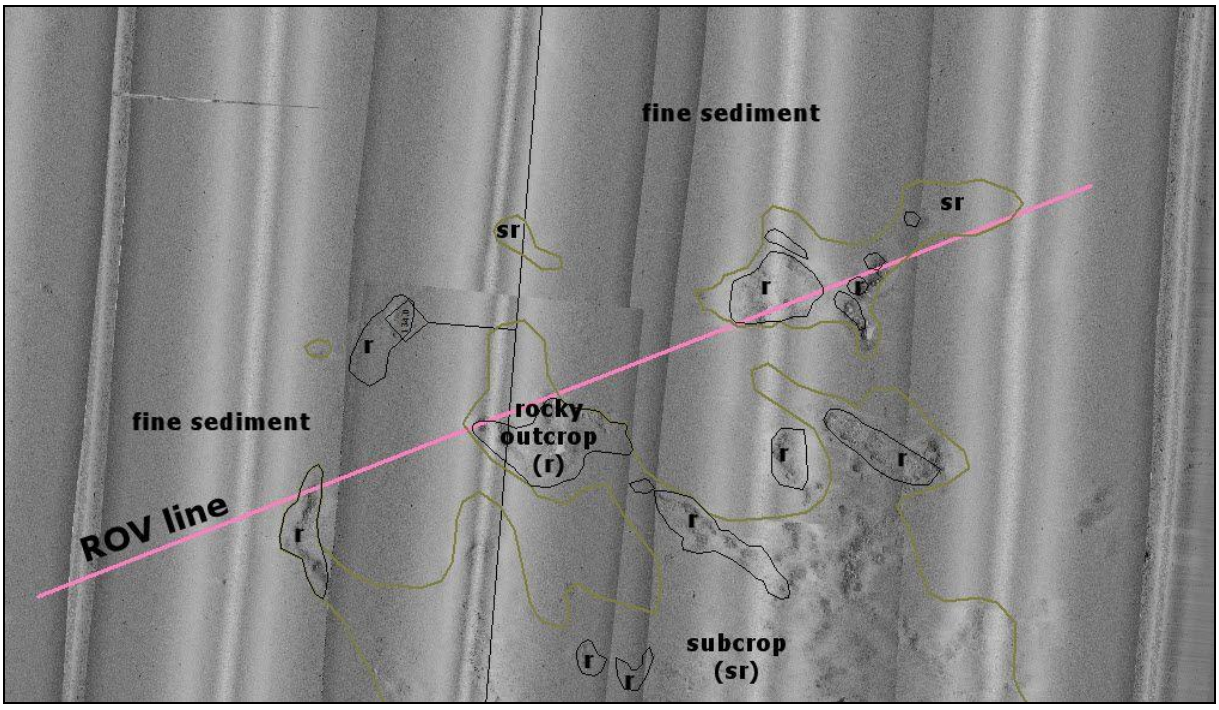
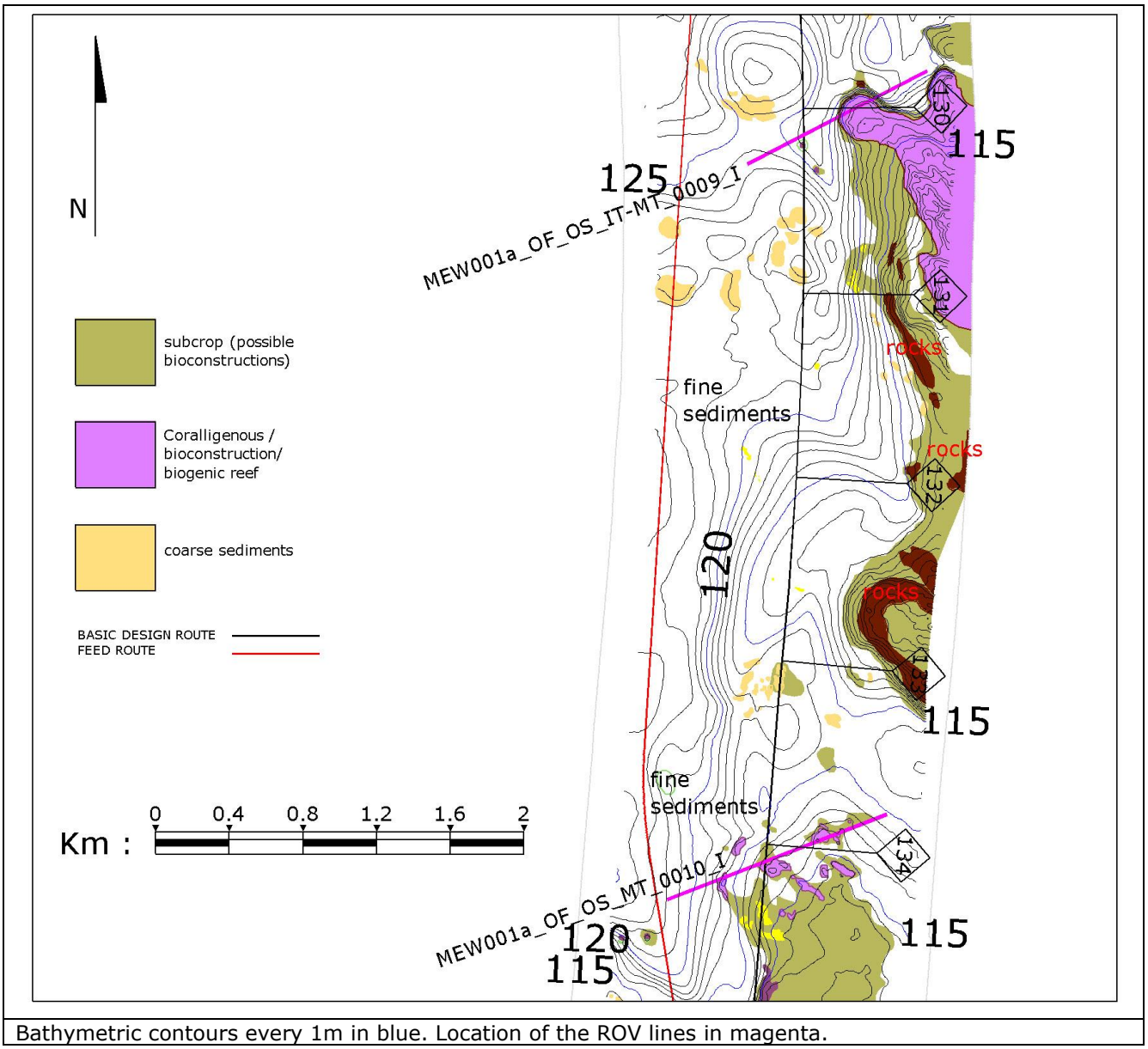


Figure 46 – SSS mosaic at about KP134.1



Bathymetric contours every 1m in blue. Location of the ROV lines in magenta.

Figure 47 – Pipeline offshore section: sensitive marine habitats from KP130 to KP134.5

Within this route section two ROV transects have been acquired, respectively at about KP130.2 (Figure 45; about 117m to 128m w.d. along the ROV transect) and at KP134.1 (Figure 46; about 110m to 120m w.d. along the ROV transect), crossing fine sediments, subcropping and outcropping areas: the fine sediment domain (soft silty SAND) is featured by the presence of many burrows (Figure 48-a, Figure 51-d) and it consists of circalittoral biocoenosis where sediments and shells form small aggregates with associated low biodiversity. These biocoenosis show limited coverage and they are characterized by few taxa. In the sandy seafloor few *Pennatuacea* organisms (Figure 48-a) and many individuals belonging to *Bonellia viridis* species (Figure 48-b) were found. Some organisms such as *Zeus faber* individuals and few belonging to Triglidae taxum (d) were recognised (Figure 51).

a) *Pennatuacea sp.*

b) *Bonellia viridis*

Figure 48 – Visual inspection at KP130: fine sediment domain

Figure 49 – Visual inspection at KP134.0 and 134.3: fine sediment domain

ROV inspection at the rocky domain shows the presence of possible Polychaeta, Porifera (probable *Axinellae sp.)*, Briozoa and organism belonging to Coralligenous biocoenosis (Figure 50, Figure 51).

Figure 50 – Visual inspection at KP130: rocky outcrop domain (coralligenous: possible Polychaeta, Porifera, probable *Axinellae sp*)

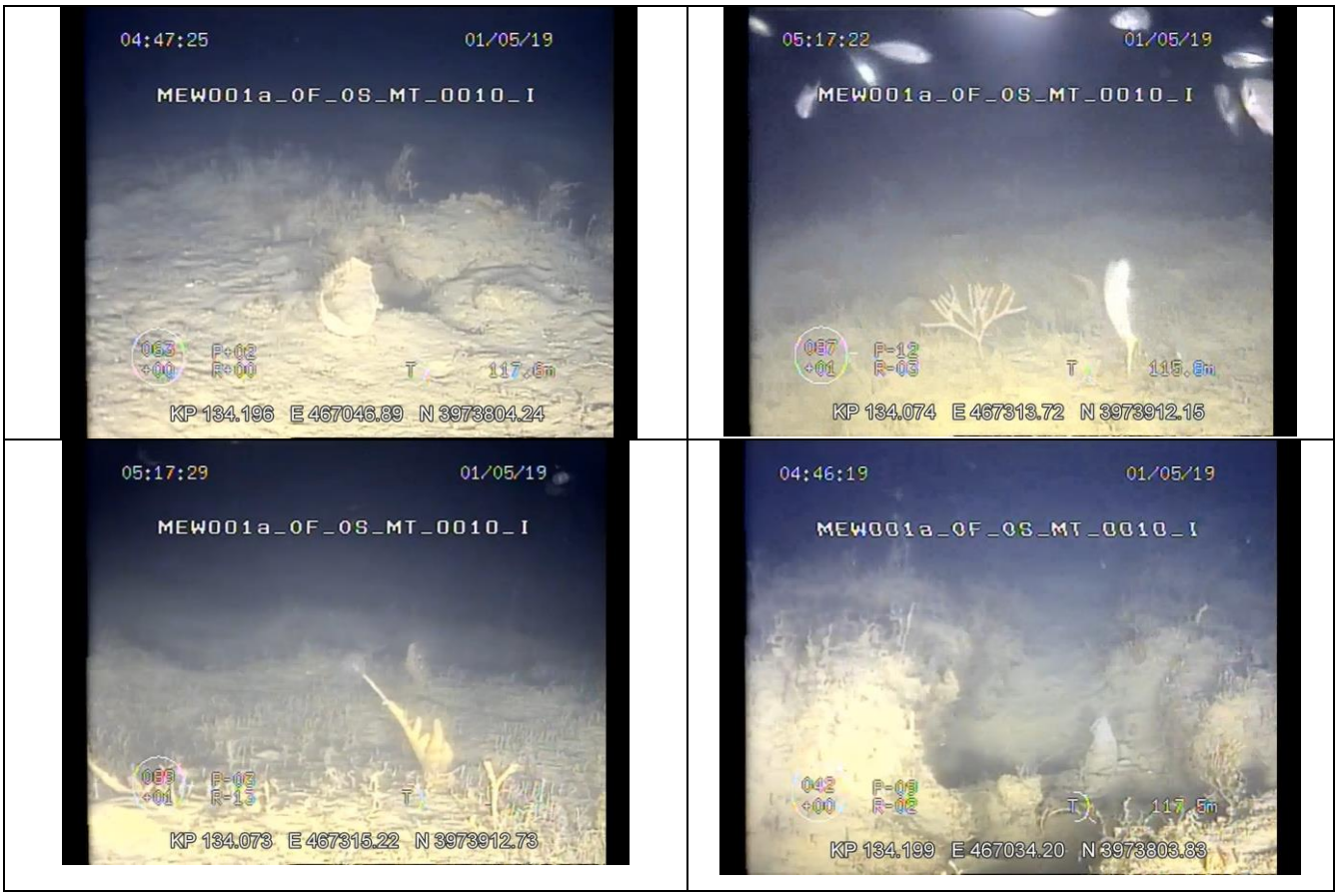


Figure 51 – Visual inspection at KP134 and KP134.2: rocky outcrop domain (coralligenous: possible Polychaeta, Porifera (probable *Axinellae sp*)

4.2.3 Maërl beds and coralligenous from KP137.8 (83m w.d.) to KP138.7 (74.5m w.d.)

Chart reference: MEW001_NU_PSMH_5K_FINAL_00-9

From KP136 to KP141.75 the basic design pipeline route crosses a structural high where water depths up to 69.6m have been detected (Figure 52). Maërl beds have been detected from ROV visual inspection between KP137.8 and KP138.7, in water depths ranging from about 75m to 83m (see Figure 5) across a fine sediment domain (silty fine SAND) with isolated subcropping areas detected by SSS/SBP at the high's tops. At the steepest flanks of the northern subcropping area coralligenous biocoenosis have been also found.

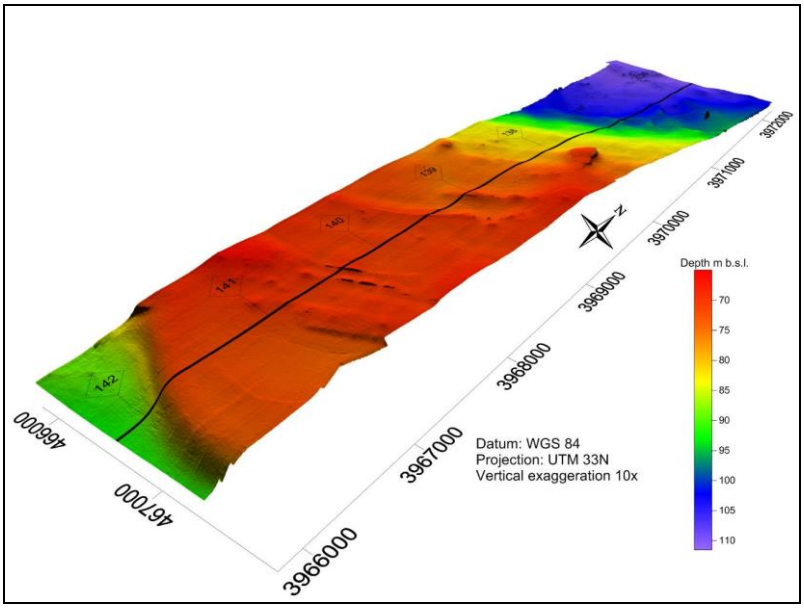


Figure 52 – 3D Bathymetry from KP135.803 to KP142.200

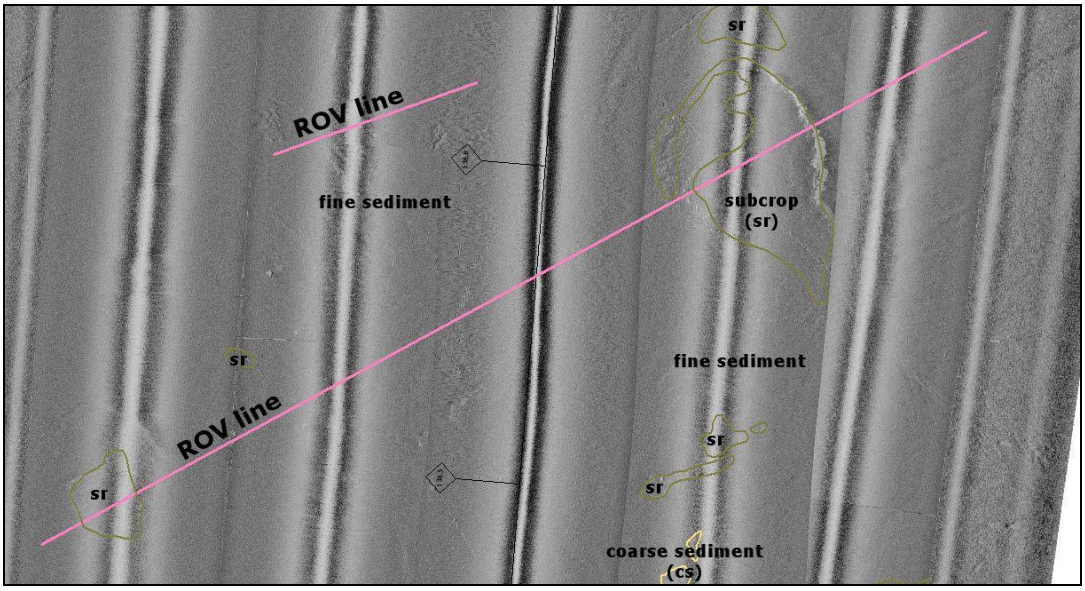
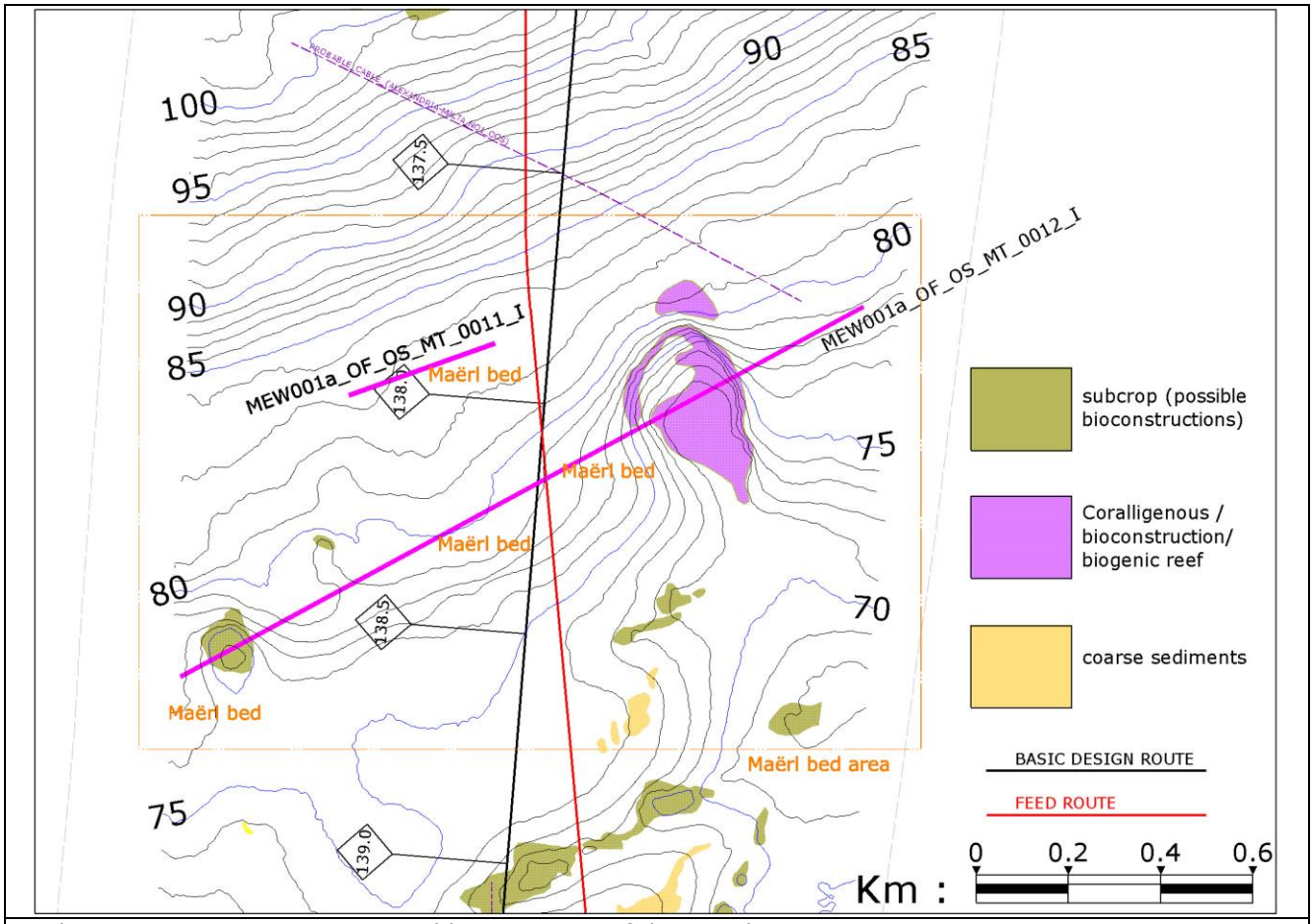


Figure 53 – SSS mosaic at KP137.5-KP138.7

Biocoenosis assemblages was recognized as belonging to the 'nullipore facies' of the coastal detritic biocoenosis of Pérès and Picard (1964). Such bottoms and the assemblages are better known as "maërl". Maërl is characterized by accumulations of unattached, calcareous rhodophytes which take the form of either twig-like thalli, or ones encrusting some solid but mobile granule, usually a stone or shell (Borg *et al.,* 1998). Maërl biocoenosis were recognized across the surveyed corridor only along the ROV lines MEW001a_OF_OS_0011_I and MEW001a_OF_OS_0012_I (see Figure 5 and Figure 53 for lines location; see Figure 54) as reported in the following Figure 55. SSS data at the aforementioned ROV lines did not show a variation of the response so it did not allow any definition of boundaries of Maerl Beds outside of the ROV lines. From MEW001a_OF_OS_0012_I ROV line interpretation the basic design pipeline route is affected by maërl bed at KP138.150.



Bathymetric contours every 1m in blue. Location of the ROV lines in magenta.

Figure 54 – Pipeline offshore section: sensitive marine habitats from at KP137.5-KP139

Figure 55 – Visual inspection at KP137.9, KP138.1 and KP138.7: maërl beds (possible *Lithothamnion corallioides* and *Phymatolithon calcareum*)

The moderate to steep flanks of the northern subcropping area are featured by coralligenous biocoenosis as shown in the following Figure 56.

Echinoidea (probable Cidaris cidaris), Asteroidea — *Echinoidea (probable Cidaris cidaris), Asteroidea*

Figure 56 – Visual inspection at KP138: coralligenous at the northern subcrop flanks

The associated biodiversity (benthic, demersal and pelagic organisms) is various and abundant, as expected for coralligenous and maërl biocoenosis. In the following Figure 57 some examples of ROV images are reported. It was possible to see many individuals belonging to Echinoidea (probable *Cidaris cidaris,* Figure 56), Asteroidea (Figure 56), Sparidae (es: *Dentex dentex* (Figure 57-a), *Diplotus.vulgaris* (Figure 57-c), Octopodidae (Figure 57-d) and Triglidae (Figure 57-b) taxa.

Figure 57 – Visual inspection at KP138: coralligenous at the northern subcrop flanks

4.2.4 Shelf sublittoral rock biogenic reef from KP143 (96m w.d.) to about KP149 (70m w.d.)

Chart reference: MEW001_NU_PSMH_5K_FINAL_00-10

From KP143 (96m w.d.) to KP149 (70m w.d.) the offshore route corridor approaching Malta Landfall is featured by a very rough seabed, where wide areas of pinnacles and scattered pinnacles, mounds and a main E-W oriented lineament have been detected (Figure 58).

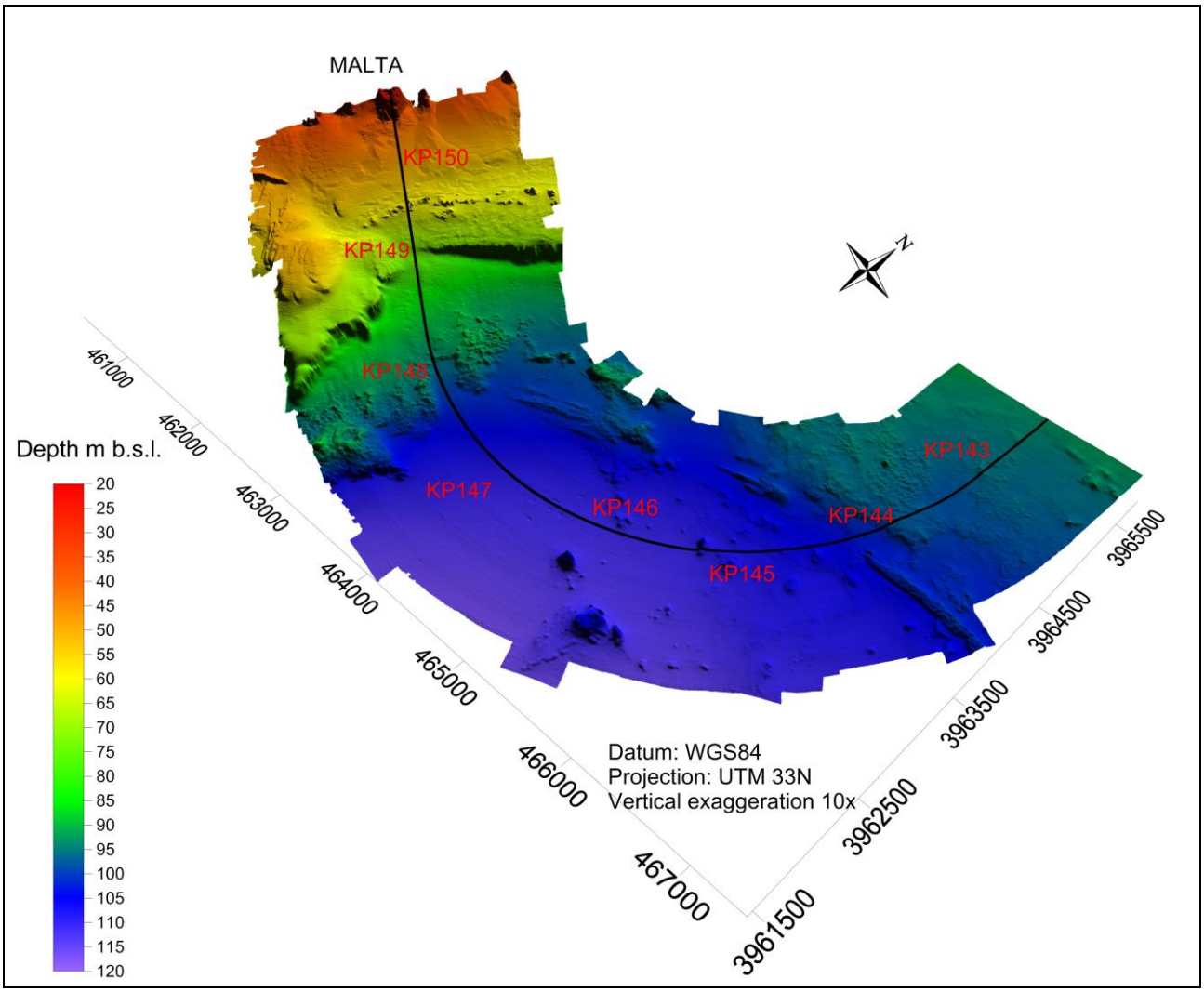


Figure 58 – 3D Bathymetry from KP142.2 to Malta landfall

The pinnacle outcrops have been mainly found West of route from approx. KP143.1 to KP144.3 and South of the route from KP145 to KP146. They characterise the whole surveyed corridor from KP147.3 to KP148.3. Their average height is about 2m in water depths ranging from 90m to 105m. Furthermore from KP145.500 to KP147.500, some outcrops and subcrops located on the northern side of the survey corridor show W-E oriented lineaments, likely associated to tilted layers. The following pictures show the SSS mosaic of this area. In the next chapter §4.2.4, Figure 72 is a skecth of the interpreted sensitive marine habitats.

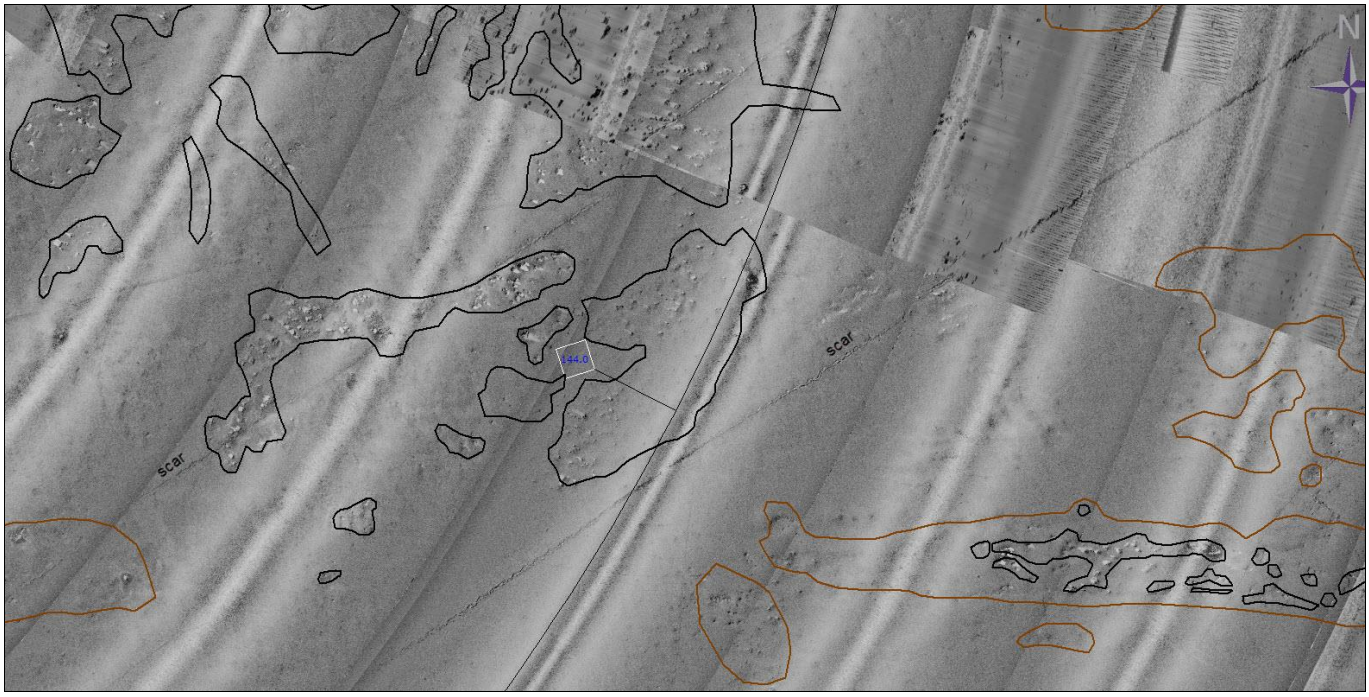
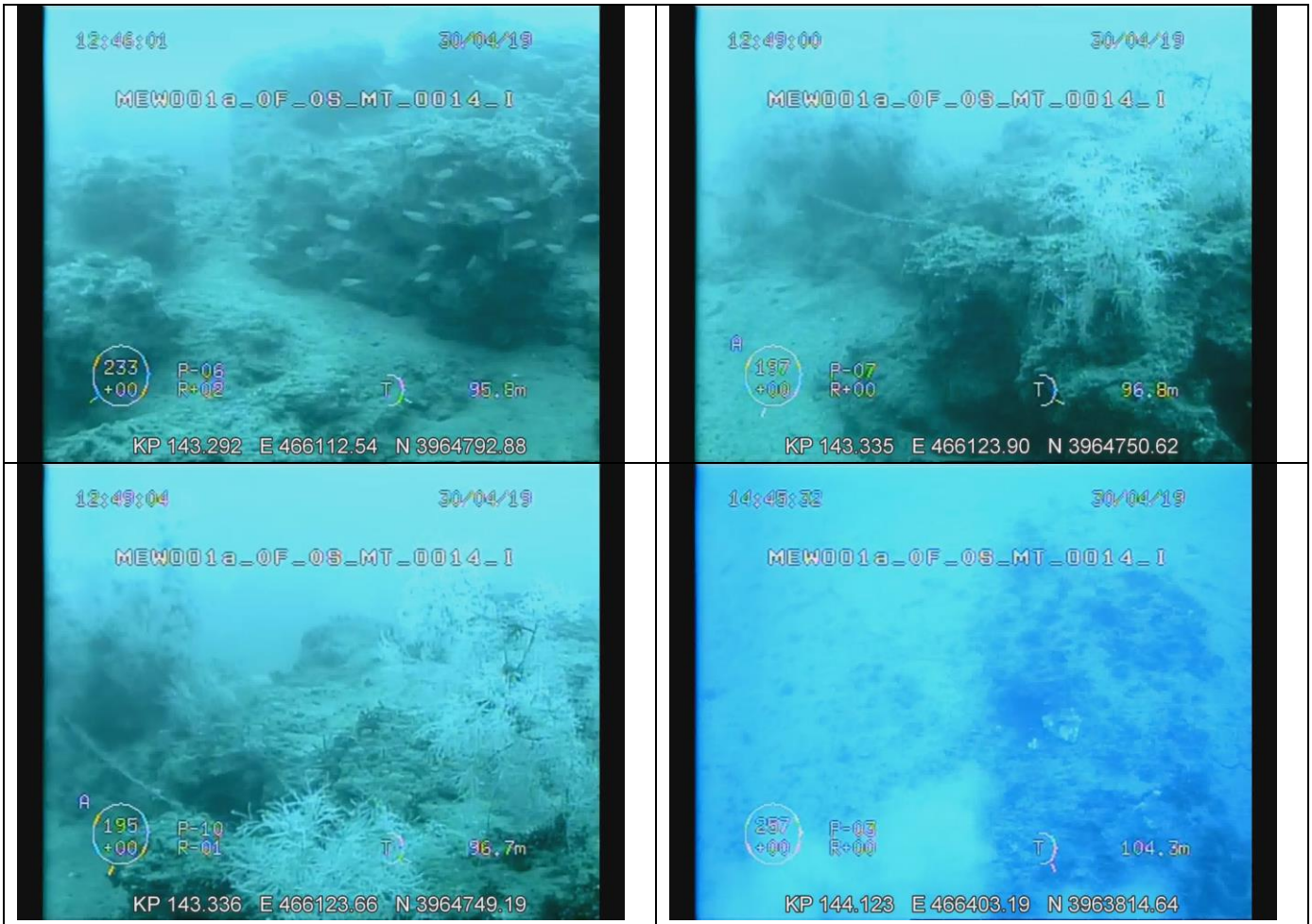


Figure 59 – SSS mosaic data at KP144: rocky pinnacles areas (in black), subcropping rocks (in brown) and scars

ROV transects have been acquired at the following KP locations: East of the route approximately from about KP142.5 to KP144 and at about KP144; at about KP145.2, KP145.75, KP146.3; between KP147.5 and KP148 and South of KP148.5 (Figure 6). As better detailed in the following paragraph, a set of ROV transects perpendicular to the shelf cover most of the landfall corridor from about KP149 to the inshore limit of the survey.

ROV analyses confirmed the rocky nature of the outcrops ascribable to coralligenous biocoenosis. The following Figure 60 shows the biogenic rock at KP144 (102m w.d.).



Possible *Antipathella subpinnata*

Figure 60 – Visual inspection at KP143.3 and KP144: coralligenous

From KP145 to KP146.5 (100-115m w.d.) the ROV transects highlight the dominance of a sandy seafloor with many burrows and bioturbations (a) with isolated outcrops. Associated with outcrops many *Bonellia viridis* individuals (d) were detected, as well as benthic organisms belonging to Echinoidea taxum (c) and one individual of probable *Palinurus elephas* (f). Regarding pelagic fauna, some organisms belonging to Sepiidae [i.e.: probable *Sepia officinalis* I], Labridae [i.e.: probable *Symphodus tinca* (h)] and probable Anthozoa taxa (g) were detected with ROV inspection as in Figure 61 below.

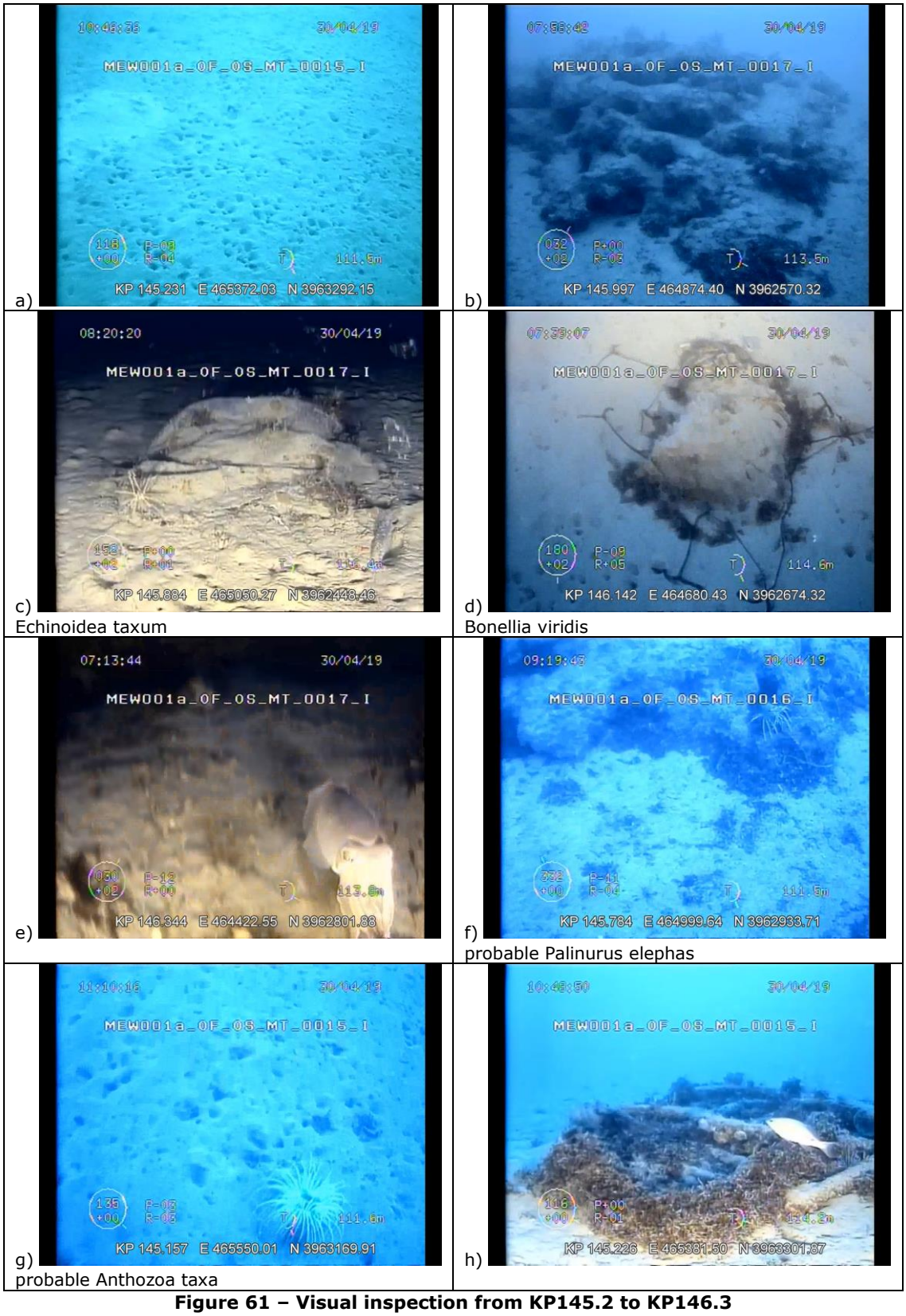
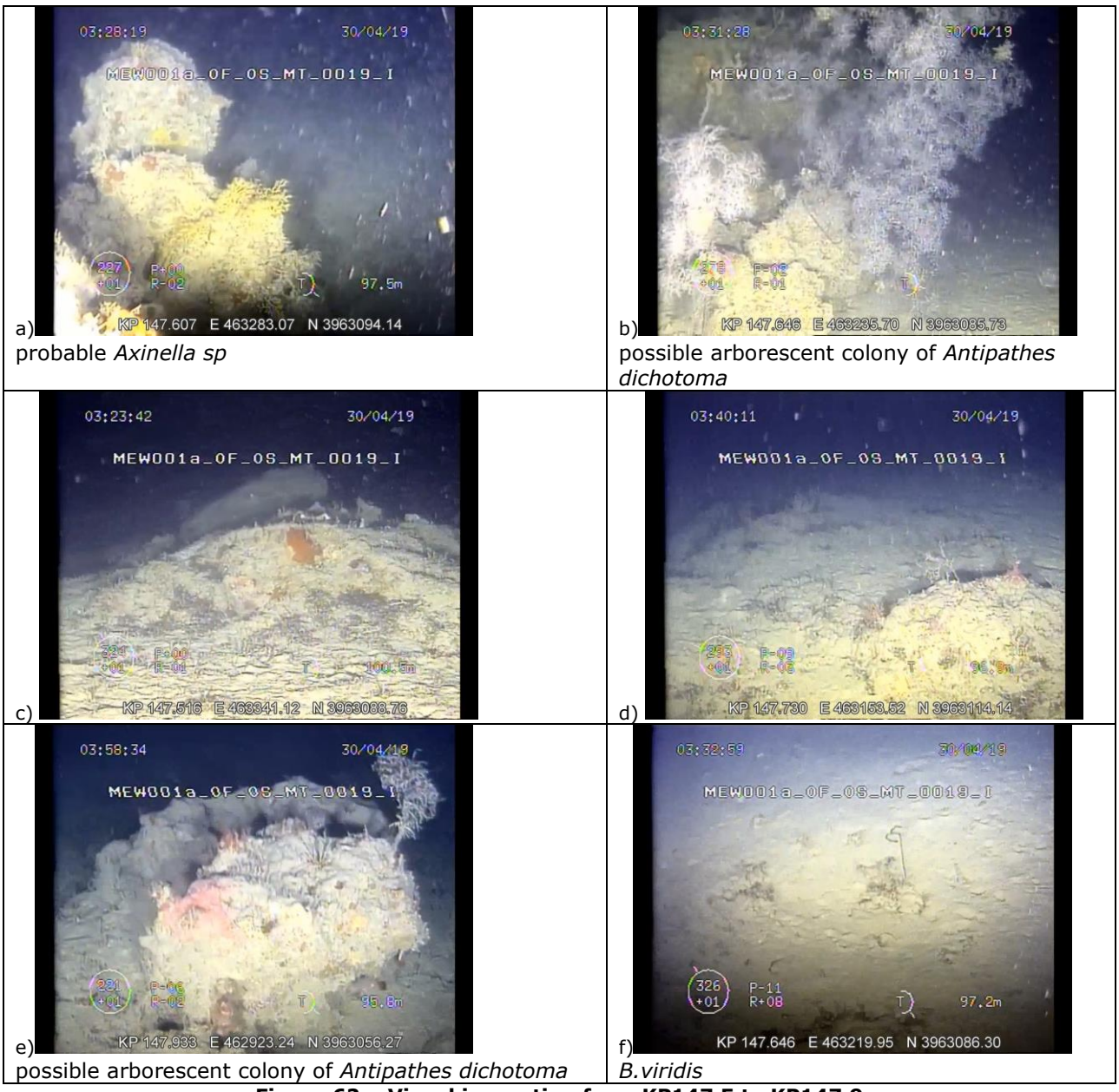


Figure 61 – Visual inspection from KP145.2 to KP146.3

Between KP147.5 and KP148 depth ranges from about 101m to 92m and the detected outcrops and rocky pinnacles areas are featured by coralligenous biocoenosis with probable Polichaeta, Cnidaria (es: Scleractinia), Briozoa and Porifera organisms [es: probable *Axinella sp.*(a)]. In figures (b, e) of Figure 63 a possible arborescent colony of *Antipathes dichotoma* was also detected. It is possible to observe also the presence of other organisms such as *B.viridis* (f), probable *Ophidiaster ophidianus* (g) *and Cidaris cidaris* organisms (g). Also some individuals belonging to Rajidae [probable *Raja clavata* (i)], Loliginidae [probable *Loligo vulgaris* (l)] and Triglidae taxa (h) were noticed. In the following Figure 62 and Figure 63 some ROV examples are presented.



a) probable *Axinella sp*

b) possible arborescent colony of *Antipathes dichotoma*

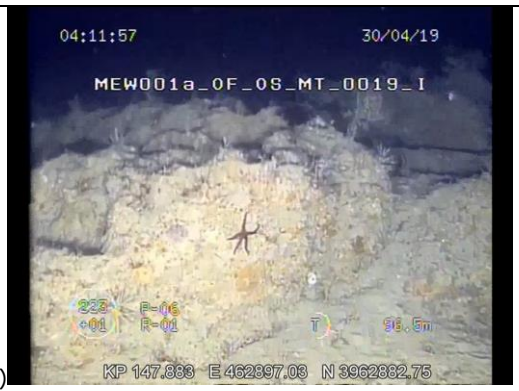
c)

d)

e) possible arborescent colony of *Antipathes dichotoma*

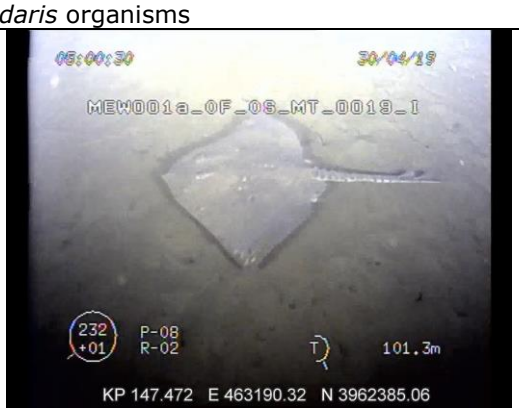
f) *B.viridis*

Figure 62 – Visual inspection from KP147.5 to KP147.9



g) probable *Ophidiaster ophidianus and Cidaris cidaris* organisms

h)



i) Rajidae

l) Loliginidae

Figure 63 – Visual inspection from KP147.5 to KP147.9

From about KP148 to KP149 two ROV transects have been acquired North and South of the route along two NE-SW and NW-SE oriented rocky escarpments featured by moderate to steep slopes and w.d. ranging from 70m to 80m and identified by ROV as coralligenous outcrops (Figure 64, Figure 65) The biodiversity is quite similar to the KP147.5 – KP148 section described above, but it's interesting to note the presence of the green alga [probable *Flabellia petiolate* (e, f, h), see Figure 64] which is an evidence of the environmental change approaching the coastal area. Together with *Cidaris cidaris* (h-Figure 64), another Echinidae specie is present [probable *Centrostephanus longispinus* (b, d); Figure 64], together with Porifera [i.e.: possible *Axinella sp.* I- Figure 65], some speciments of *Diplodus vulgaris* (a-Figure 65) and some individuals belonging to Triglidae taxus (b-Figure 65).

One more ROV transect has been acquired along the route approximately from KP148.2 and KP148.7 with the main aim to check the origin of 6 magnetic contacts (see also MEW001_GEOPHY_FINAL_REPORT_REV01 for details). Some examples of the detected contacts are shown in Figure 66; organisms belonging to Echinoidea [i.e.: probable *Cidaris cidaris* (b)], Loliginidae [i.e.: probable *Loligo vulgaris* (a)], Paguridae (f) and Malacostraca (f) have been recognized.

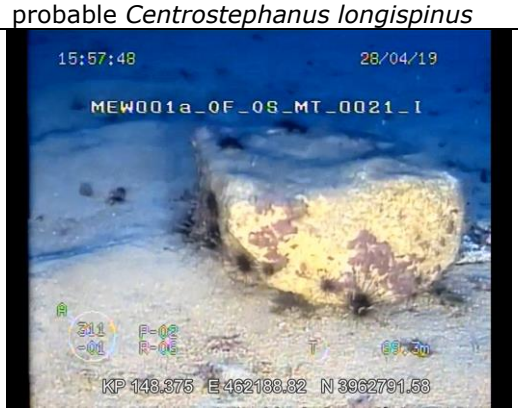
a)

b)

probable *Centrostephanus longispinus*

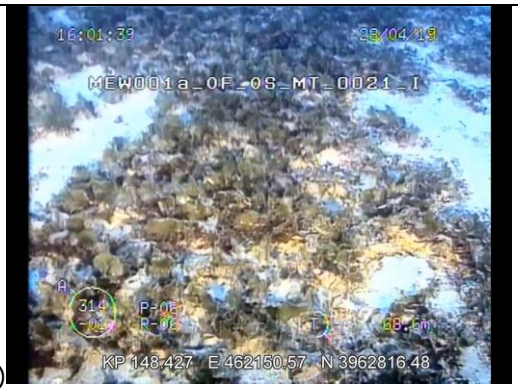
c)

d)



probable *Centrostephanus longispinus*

e)

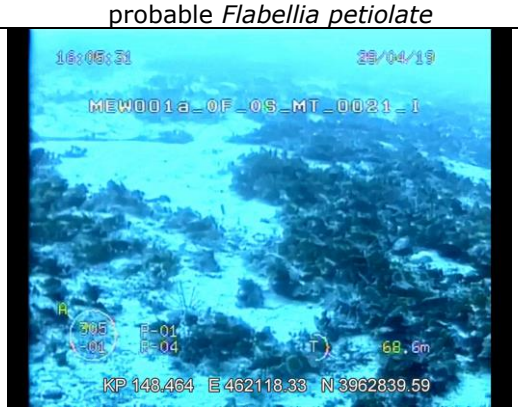


probable *Flabellia petiolate*

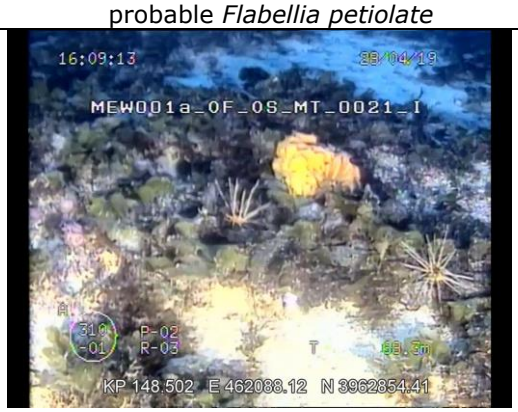
f)

probable *Flabellia petiolate*

g)



h)



probable *Flabellia petiolate; Cidaris cidaris*

Figure 64 – Visual inspection at KP148.1 to KP148.5, along the southern escarpment

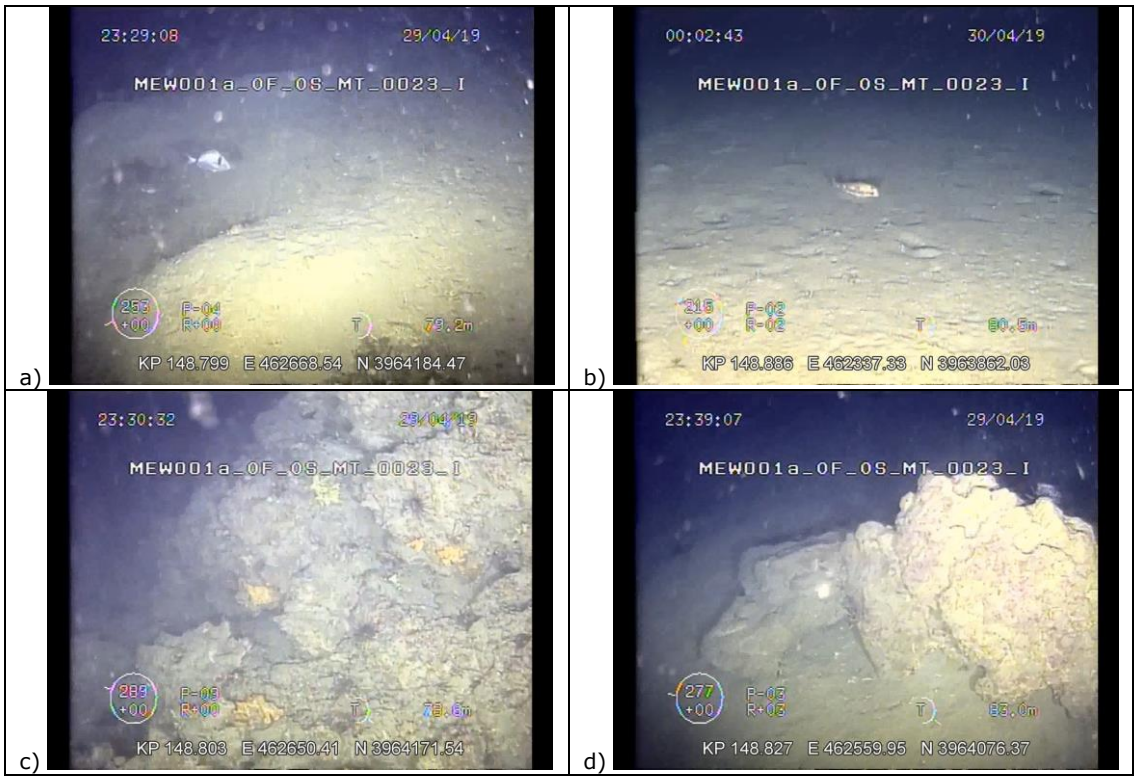


Figure 65 – Visual inspection at KP148.9, along the northern escarpment

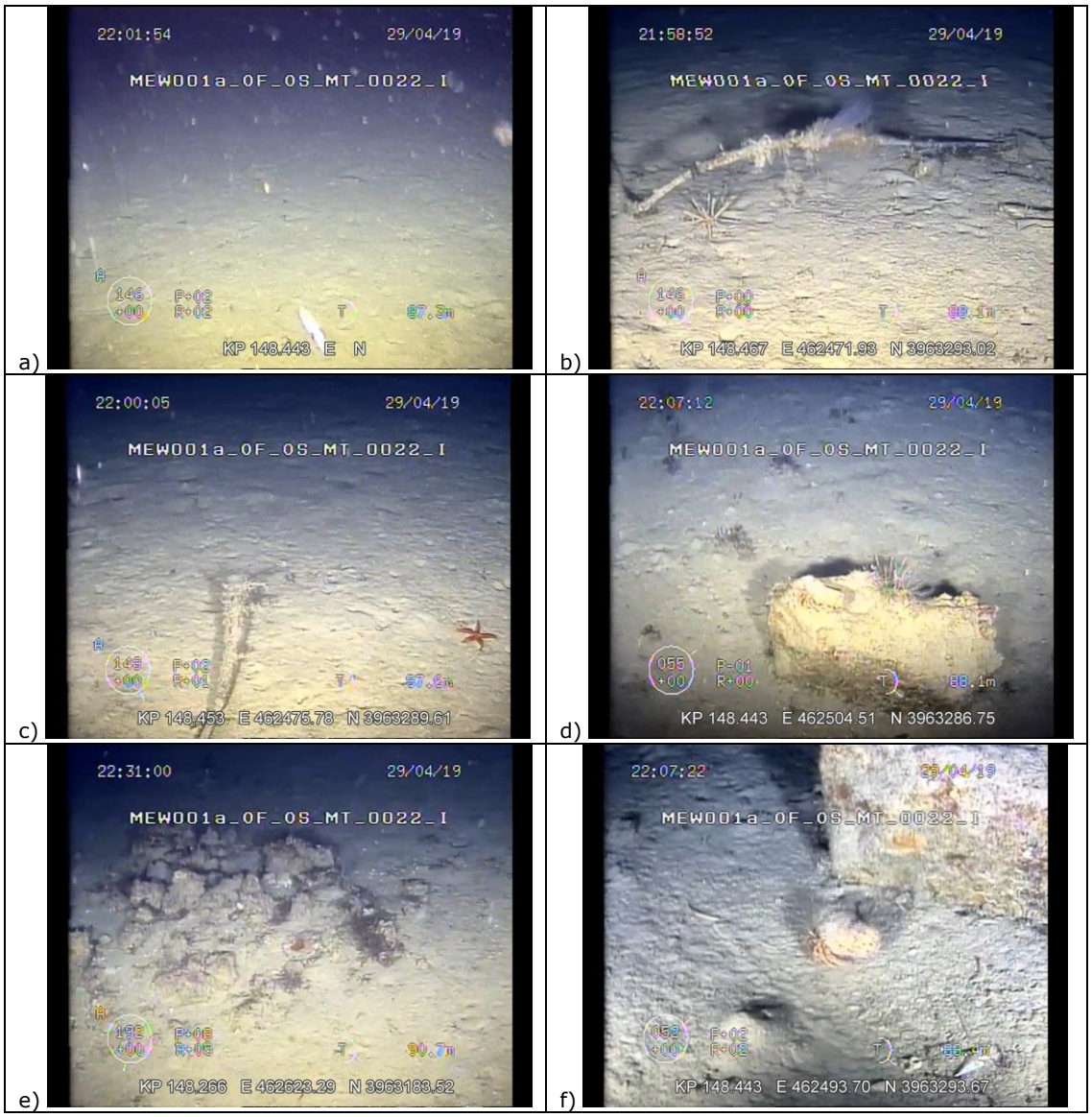


Figure 66 – Visual inspection from KP148.2 to KP148.7

4.3.0 Sensitive Marine Habitats at Delimara (Malta) Landfall

Chart reference: MEW001_NU_PSMH_5K_FINAL_00-11

Delimara landfall area (Malta), approximately from KP149 to KP150.836, water depths along the route ranges from 70.2m to 7.5m (at a distance from the shore of about 25m; see Figure 67). Two significant bathymorphological structures feature the surveyed corridor:

- from KP149.408 to KP149.442 a NNE-SSW aligned and scattered rocky area mainly detected North of the route, with rock tops rising 3-4m from the sourrounding seabed (Figure 67, Figure 69, Figure 70) and slopes up to 20° (Figure 68).
- Approaching the coast, the marine landform is featured by a prominent and irregularly shaped escarpment representing the offshore extension of the coastal cliff (Figure 67; Globigerina Limestone Formation, Government of Malta, 1993). Gradients up to 70° have been detected (Figure 68). The rocky outcrops featuring the nearshore section of the Maltese landfall are covered by patches of seagrass (mainly *Posidonia Oceanica* meadows), which become progressively sparse passing to the deeper subcropping areas, as confirmed by ROV visual inspections.

SSS data examples are shown in the following Figure 69, Figure 70 and Figure 71.

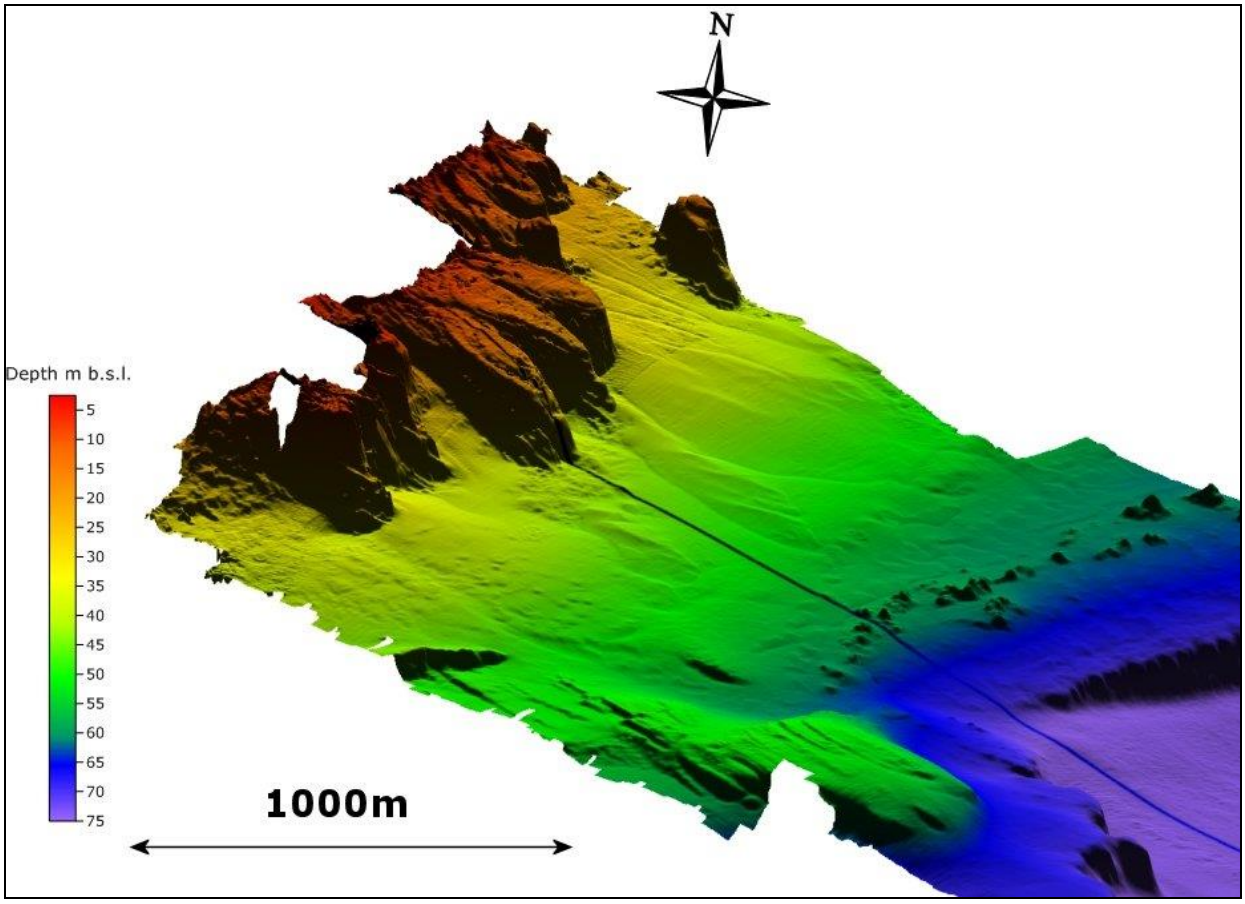


Figure 67 – Malta landfall 3D Bathymetric map

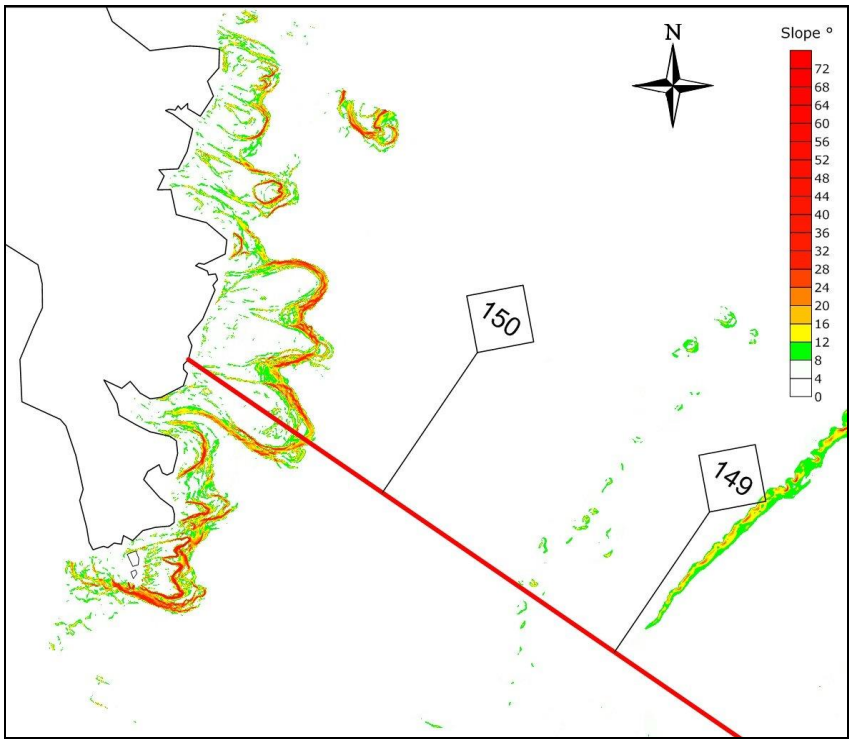


Figure 68 – Malta landfall Slope map

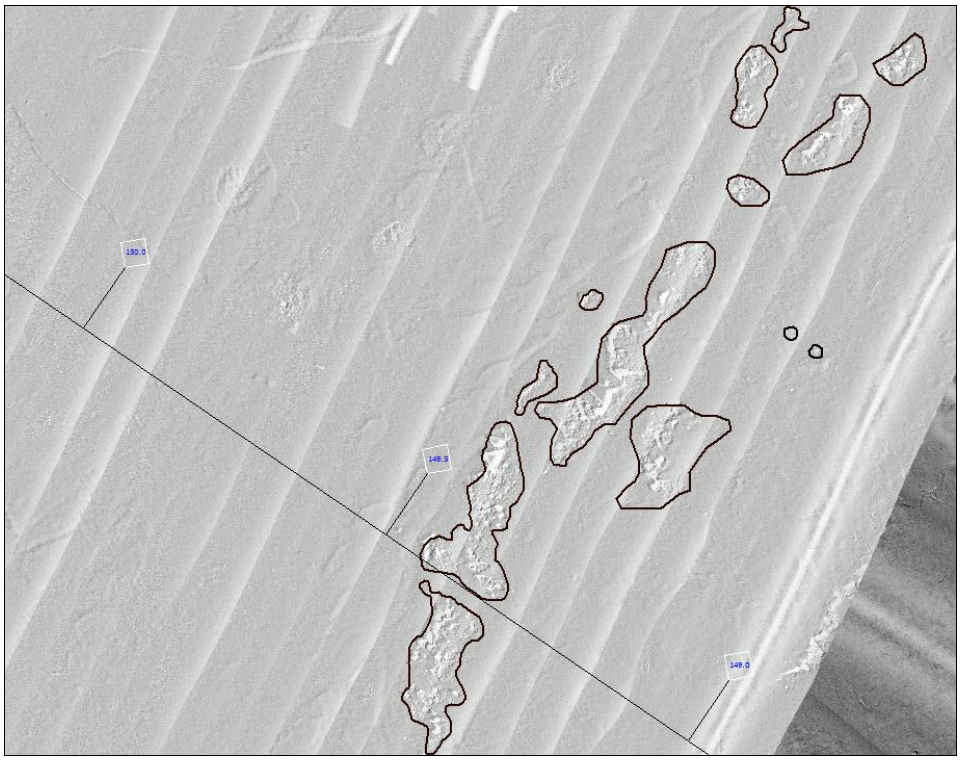


Figure 69 – SSS mosaic: NNE-SSW aligned and scattered rocky area at Malta landfall

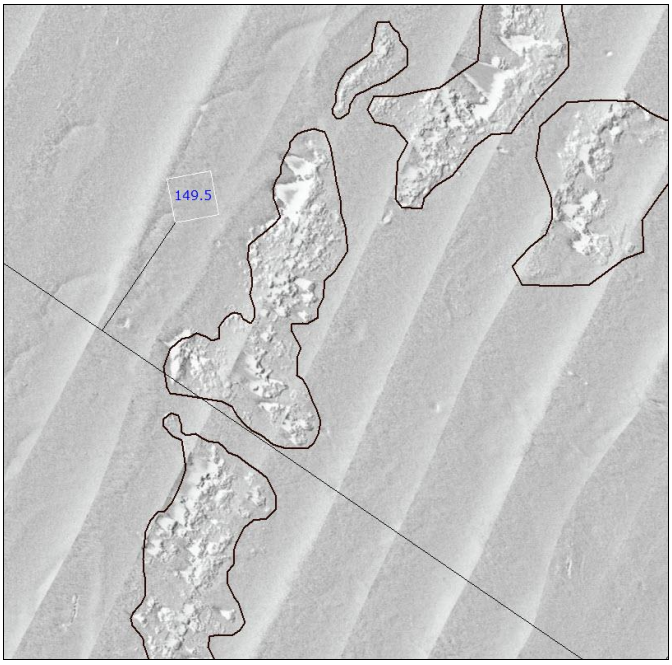
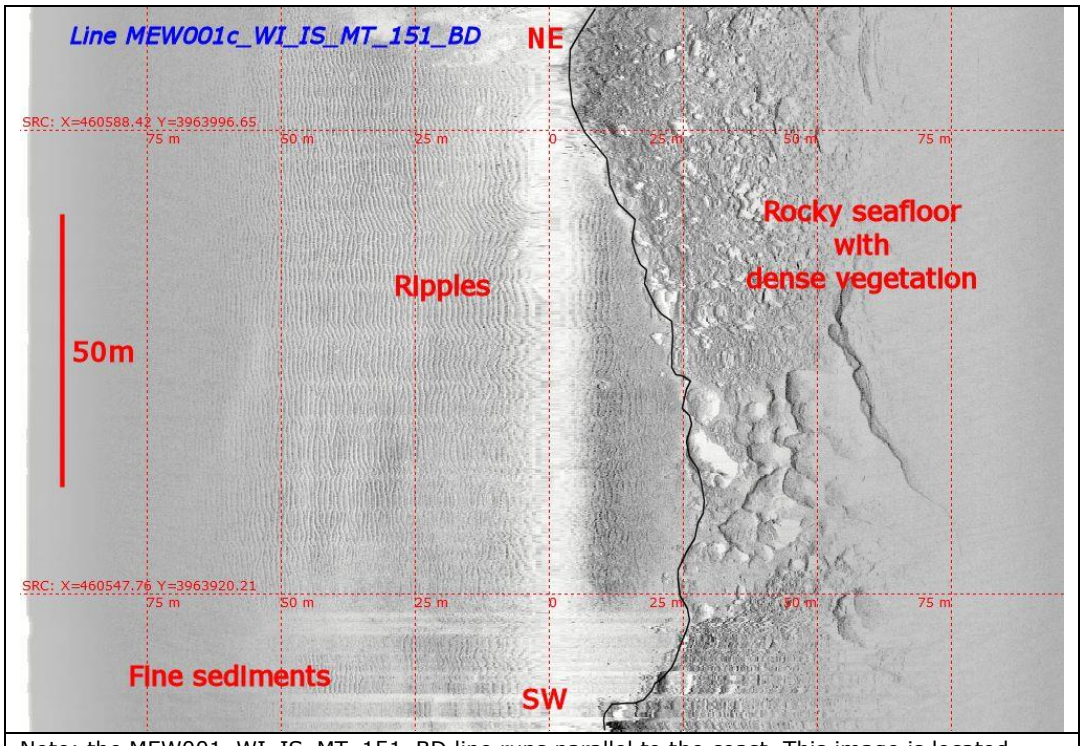


Figure 70 – SSS mosaic: details of the scattered rocky area at KP149.5



Note: the MEW001_WI_IS_MT_151_BD line runs parallel to the coast. This image is located approximately 540m S from the route at KP150.500.

Figure 71 – SSS data example: comparison between rocky and sediment covered seafloor on HF data

In the following page a sketch of the Delimara coastal area interpreted sensitive marine habitats is presented (Figure 72).

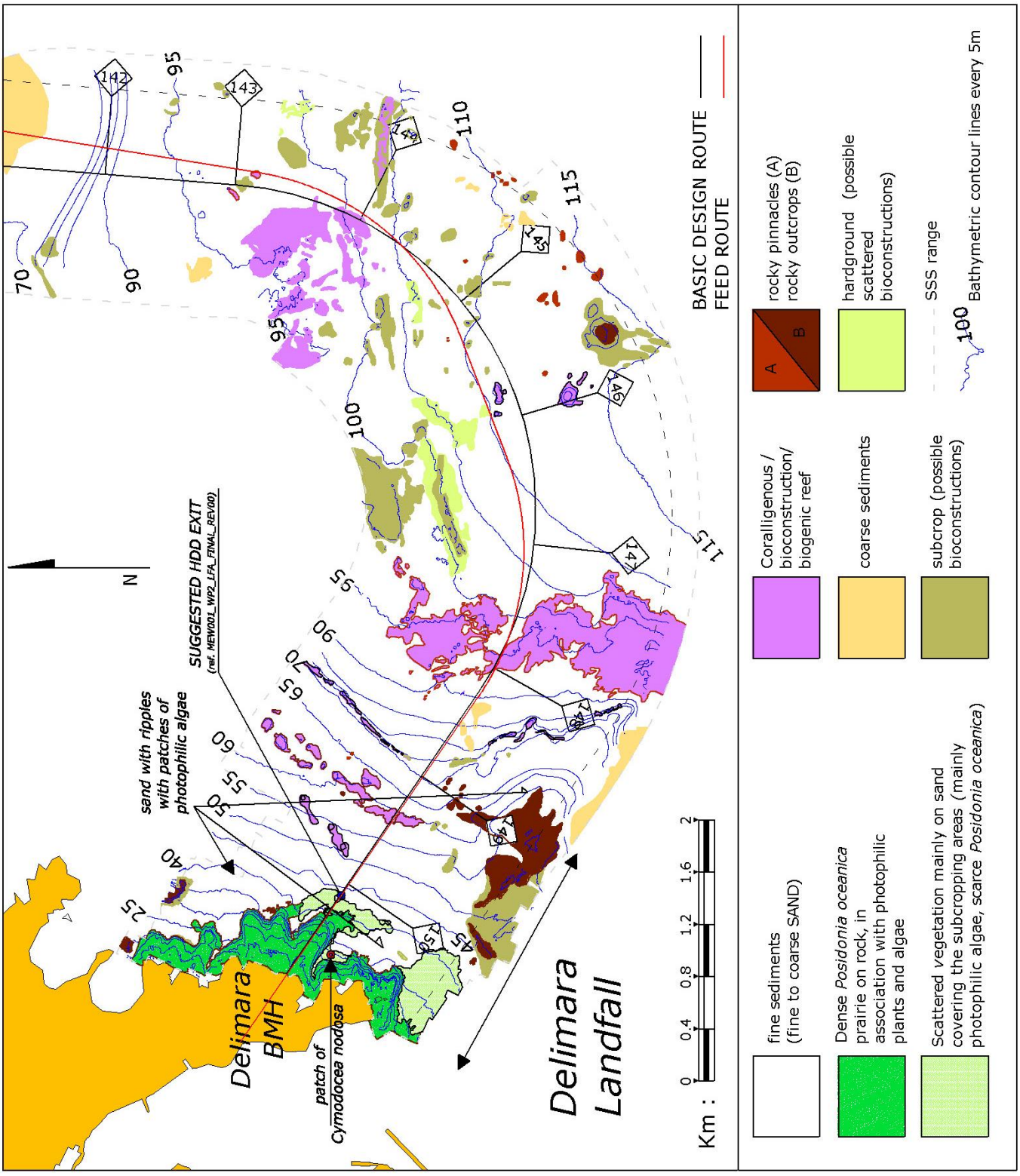


Figure 72 – Delimara survey area: sensitive marine habitats

A total of eight ROV transects parallel to the route have been acquired at Delimara landfall, starting close to the coast up to the maximum depth of approximately 85m (Figure 6). ROV analyses confirmed the geophysical interpretation and allowed defining the sensitive marine habitats definition. Four main classes have been interpreted:

- Fine to Coarse SAND (MEW001b_S20; shell fragments and corals with organic matter in a coarse SAND matrix; MEW001b_K59: very soft sand; see MEW001_GEOTECH_FINAL_REPORT_REV02 and MEW001b_FIELD_REPORT_ENV_REV00 for details) approximately from KP149 to KP149.3 and from KP149.5 to KP150.12; sand is occasionally colonised by sparse growths of photophilic algae.
- Seagrass mainly settled on bedrock (Biocoenosis of *Posidonia oceanica* meadows in association with other photophilic plants and algal species): dense meadows.
- Scattered vegetation (mainly on sand, covering subcropping rock) constituted by *Posidonia oceanica* and photophilic algae.
- Coralligenous / biogenic reef

Proceeding towards the Maltese coast the ROV inspection across the NNE-SSW aligned and scattered rocky area (roughly from KP149.408 to KP149.442) reveals a calcareous reef colonised by different species of possible Porifera and Anthozoa (Figure 73).

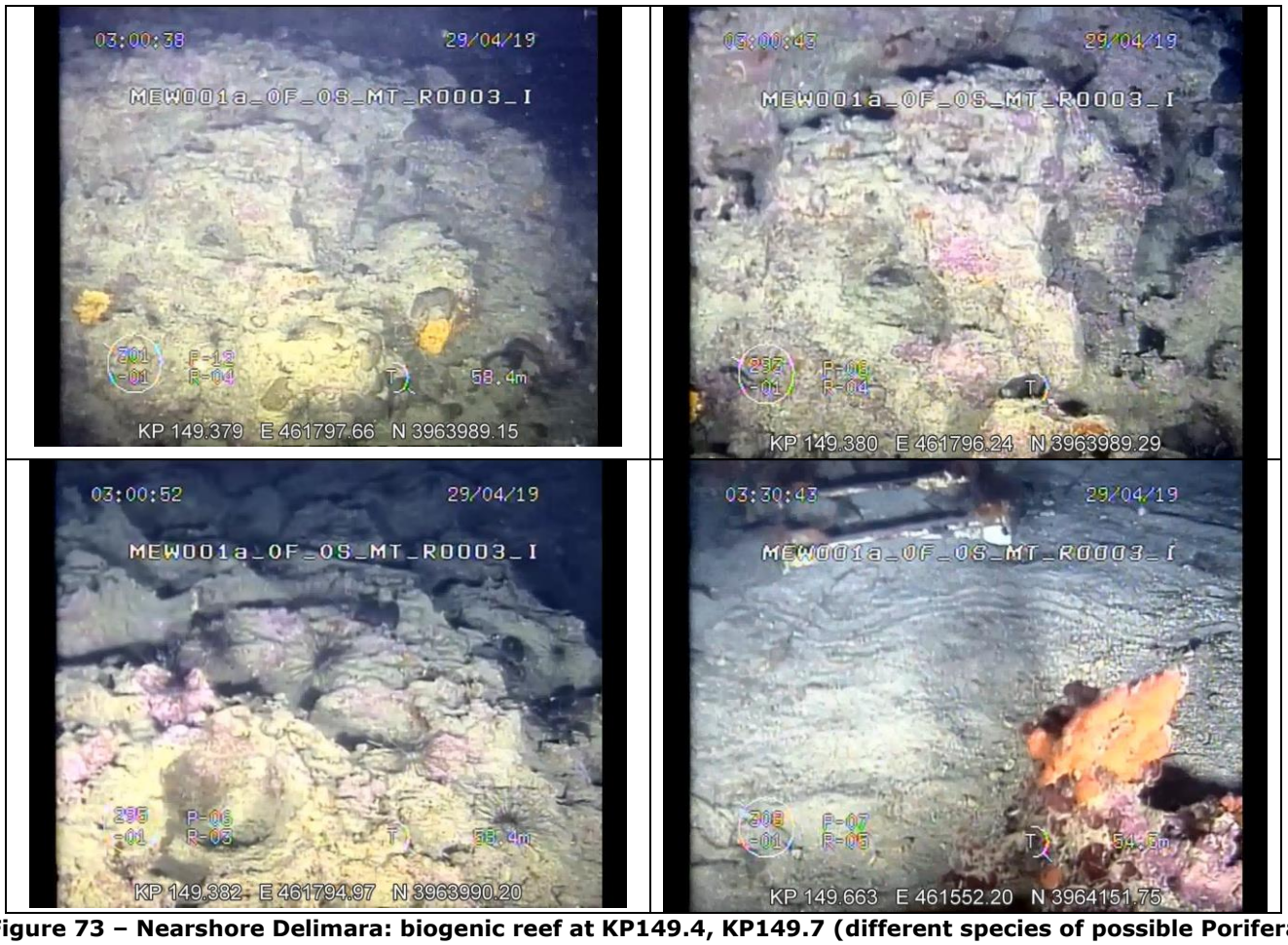
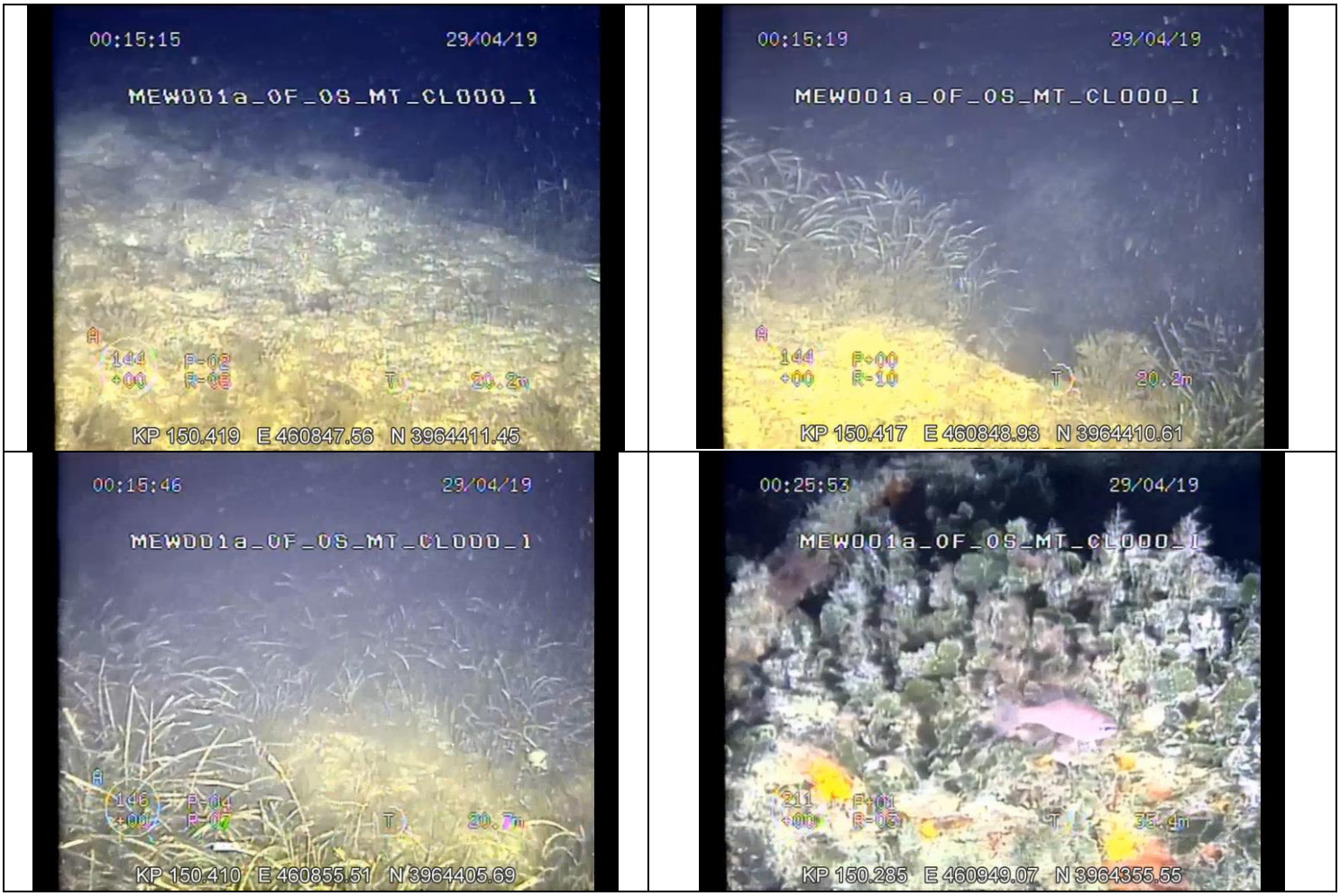


Figure 73 – Nearshore Delimara: biogenic reef at KP149.4, KP149.7 (different species of possible Porifera and Anthozoa)

Along the route (MEW001a_OF_OS_MT_CL000_I), *Posidonia oceanica* was detected down to about 40-45m w.d., mainly settled on rock but also on patches of sandy seafloor covering subcrop. The scattered vegetation areas have been detected from about 45m to 35m w.d.: here the presence of *P.oceanica* in association with other photophilic plants and algal species (es: probable *Flabellia petiolate*) settled on subcrop and sand dominate the environmental biodiversity; the sandy seafloor is featured by bedforms (ripples and megaripples) with accumulations of biogenic debris and vegetation residues.

In the following Figure 74, some ROV examples of the environment and the biodiversity along the route are reported:



:outer limit of the scattered vegetation

Figure 74 – Nearshore Delimara: *Posidonia oceanica* along the design route ROV line

All the ROV transects confirmed the maximum limit of *Posidonia oceanica* detected with Geophysical survey at about 40-45m w.d., except for MEW001a_OF_OS_MT_R0004_I, where the rocky outcrop is colonized by green algae and other sessile macro-organisms (Figure 75). MEW0y01a_OF_OS_MT_R0004_I is the seaward extension of another inshore transect (MEW001c_WI_IS_MT_006__I) where the outer *Posidonia* on rock limit has been detected at about 30m w.d.

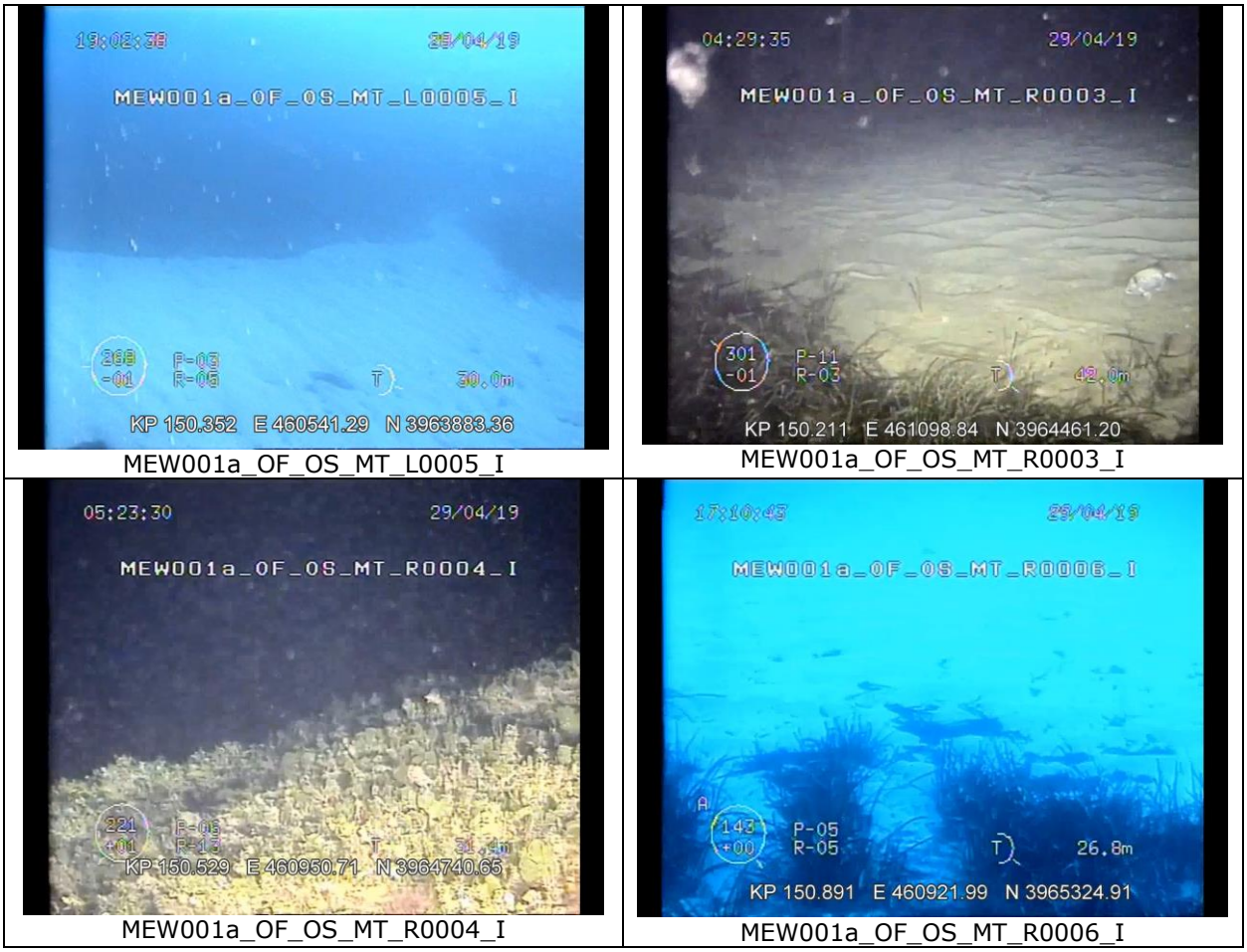


Figure 75 – Nearshore Delimara: outer limit of the vegetation on the ROV lines lateral to the route

The dense vegetation class is featured by *Posidonia oceanica* meadows settled mainly on rock associated with different species of green and brown algae such as a possible *Dictyopteris polypodioides and Cystoseira sp.* (Figure 76, Figure 77). Only at the start of the ROV line MEW001c_WI_IS_MT_003__I (see Figure 6 for location) the scattered vegetation domain is featured by scattered *Cymodocea nodosa* on sand (draping subcropping rock, as per geophysical interpretation; see Figure 78) at water depths of about 28-30m.

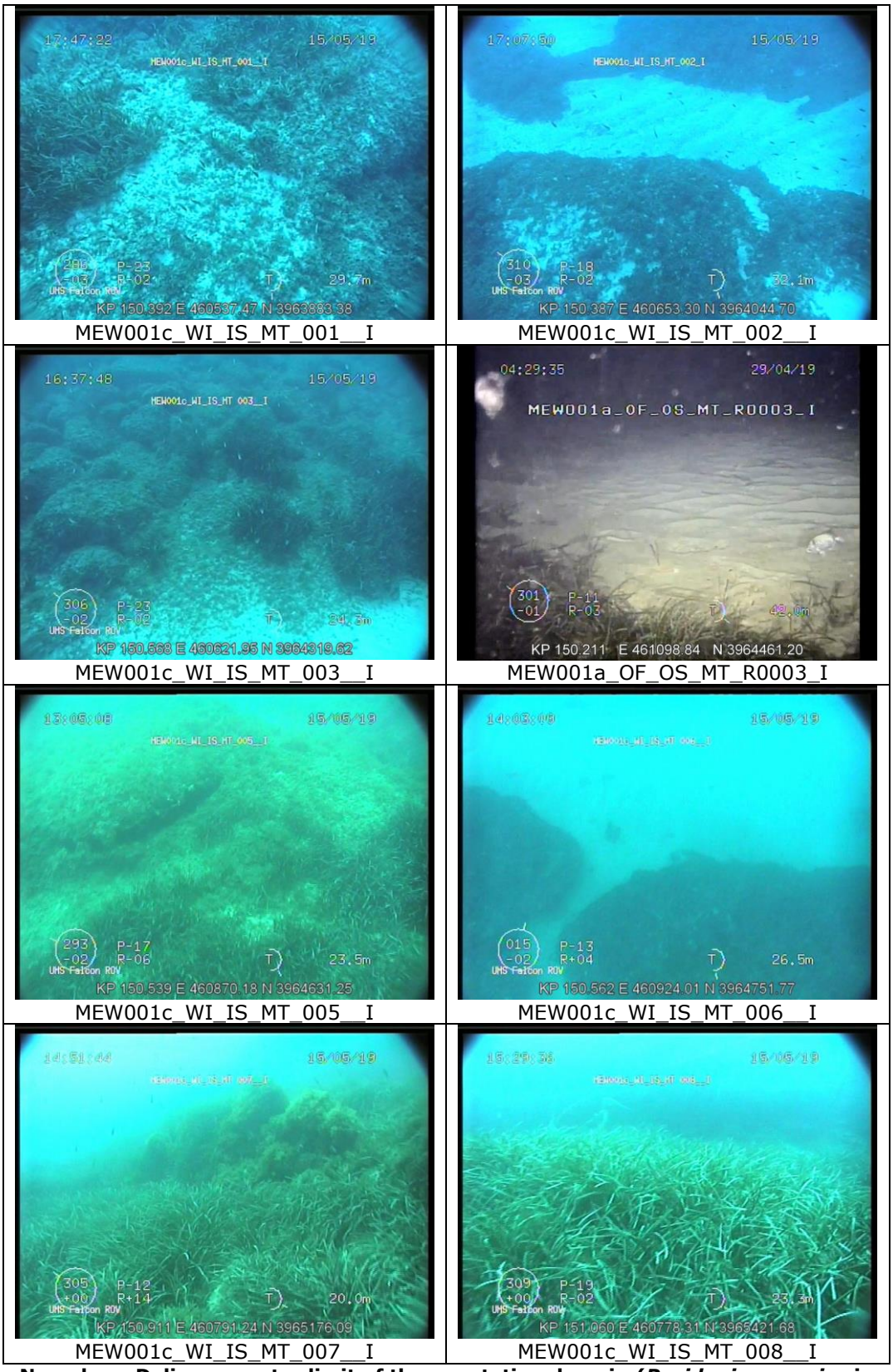


Figure 76 – Nearshore Delimara: outer limit of the vegetation domain (*Posidonia oceanica* in association with *Cystoseira sp)*

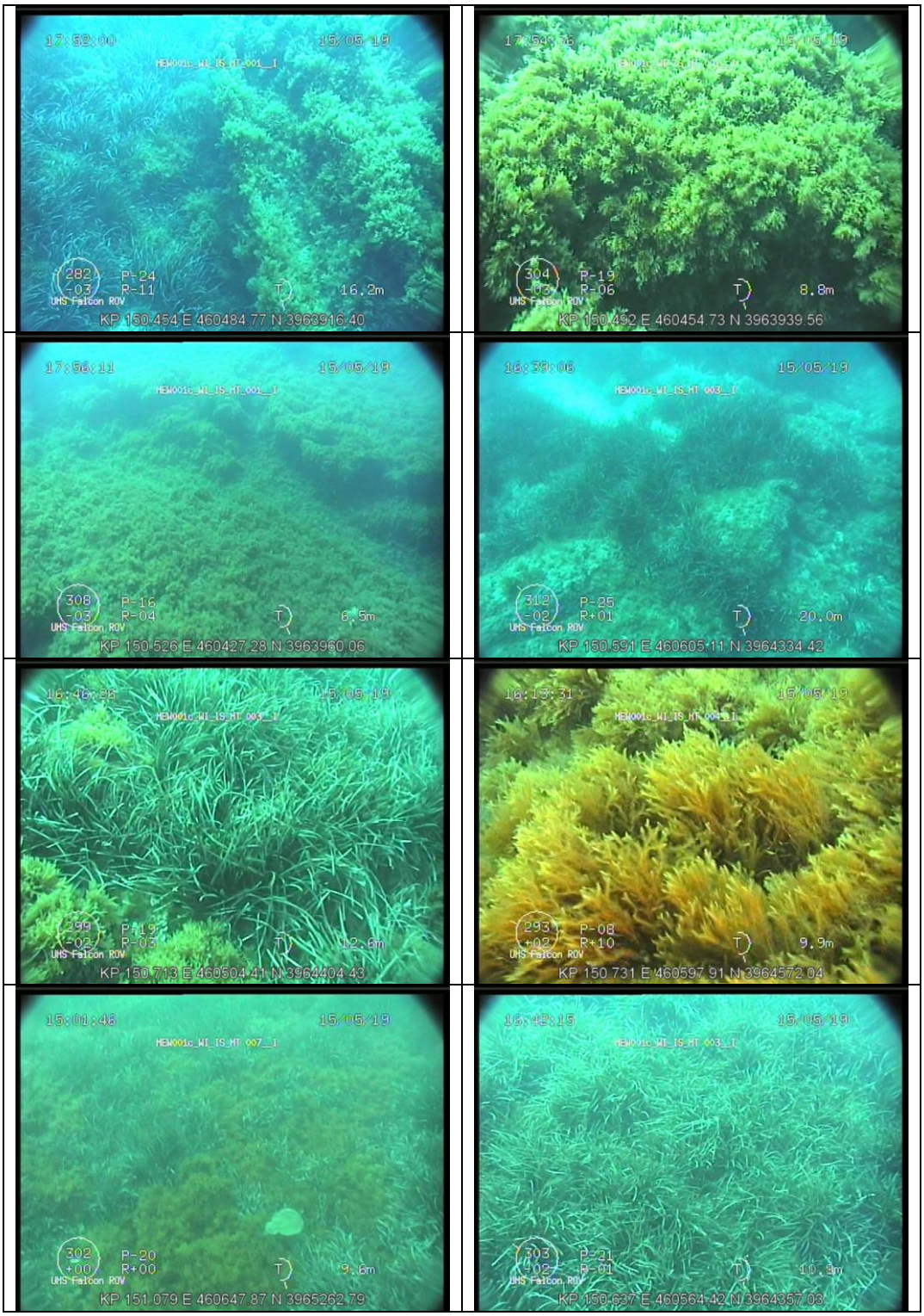


Figure 77 – Nearshore Delimara: outer limit of the vegetation on the ROV lines lateral to the route (*Posidonia oceanica* in association with *Cystoseira sp)*

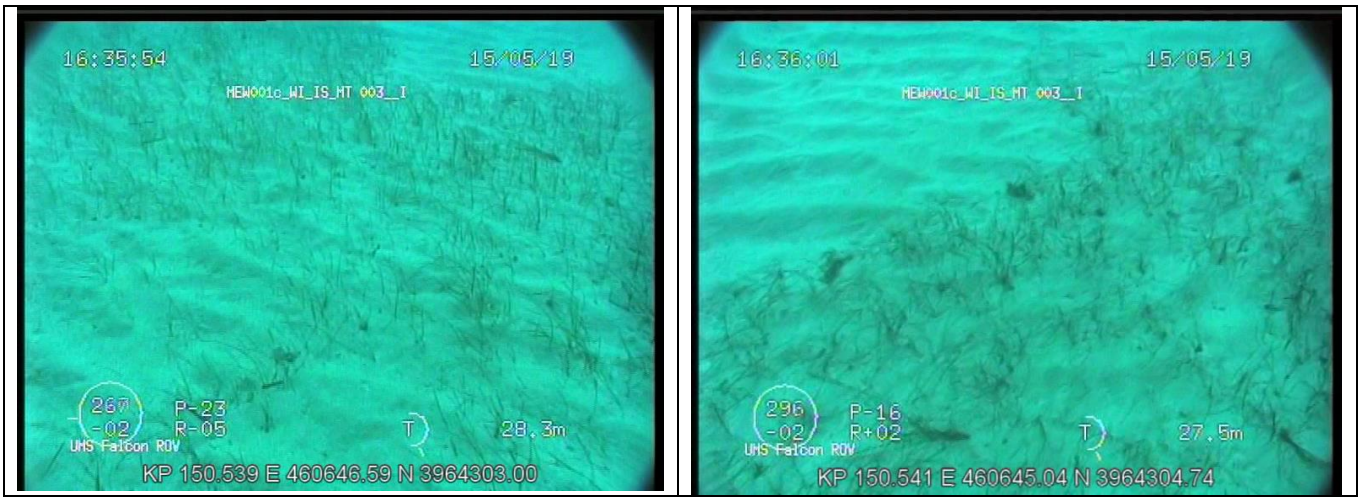


Figure 78 – Nearshore Delimara: scattered vegetation domain with *Cymodocea nodosa*

5.0.0 CONCLUSIONS

The combined interpretation of geophysical data (SSS, SBP and MBES), seabed samplings and ROV visual inspection analyses allowed the definition of the following main sensitive marine habitats:

- *Cymodocea nodosa* prairies with presence of individuals of the green alga *Caulerpa* at Gela coastal area;
- biogenic constructions at spotted areas along the design pipeline offshore section;
- biogenic constructions at Malta shallow water and Delimara coastal area;
- *Posidonia oceanica* prairies in association with green and brown algae and biogenic reef at Delimara coastal area.

ROV inspections do not highlight the presence of *Sabellaria alveolata* reefs.

The sensitive marine habitats mapping from the PMRS results are summarized in the following Table 2.

Table 2 – Summary of the results

ID#	FROM KP – TO KP along the basic design pipeline route CHART REFERENCE	WATER DEPTH RANGE	DESCRIPTION
1	KP0.643 – KP7.273 MEW001_NU_POSMH_5K_FINAL_00-1 MEW001_NU_POSMH_5K_FINAL_00-2 MEW001_NU_POSMH_5K_FINAL_00-3	5m – 19.4m	Alternation of dense and scattered *Cymodocea nodosa* prairies with presence of individuals of the green alga *Caulerpa* at Gela coastal area
2	KP40.5 - KP41.6 MEW001_NU_POSMH_5K_FINAL_00-4	105m – 120m	Biogenic concretions/Bioconstructions (coralligenous: probable *Scleractinia*
3	KP55.6 – KP61.5 MEW001_NU_POSMH_5K_FINAL_00-5 MEW001_NU_POSMH_5K_FINAL_00-6	140m – 155m	Biogenic concretions/Bioconstructions (coralligenous: *Callogorgia verticillata*) both at two wide tabular NW-SE elongated flat-top ridges and at scattered small sub-conical, dome-like features
4	KP129.5 - KP134.0 MEW001_NU_POSMH_5K_FINAL_00-7 MEW001_NU_POSMH_5K_FINAL_00-8	126m - 112m	Biogenic concretions/Bioconstructions (coralligenous: possible Polychaeta, Porifera (probable *Axinellae sp*); *Pennatuacea sp.; Bonellia viridis*)
5	KP137.8 - KP138.7 MEW001_NU_POSMH_5K_FINAL_00-9	75m - 83m	Maërl beds (possible Lithothamnion corallioides and Phymatolithon calcareum) and coralligenous biocoenosis (Echinoidea (probable Cidaris cidaris), Asteroidea) at the moderate to steep flanks of the northern subcropping area
6	KP139 – KP149.8 MEW001_NU_POSMH_5K_FINAL_00-9 MEW001_NU_POSMH_5K_FINAL_00-10 MEW001_NU_POSMH_5K_FINAL_00-11	96m – 50m	Biogenic concretions/Bioconstructions (coralligenous: possible *Antipathella subpinnata, Bonellia viridis,* Echinoidea taxum, probable *Palinurus elephas,* probable Anthozoa taxa; possible arborescent colony of *Antipathes dichotoma;* probable *Ophidiaster ophidianus and Cidaris cidaris* organisms) at the pinnacles outcrops; possible same

ID#	FROM KP – TO KP along the basic design pipeline route CHART REFERENCE	WATER DEPTH RANGE	DESCRIPTION
			interpretation of the subcropping and hardground areas in deeper w.d. not covered by ROV
7	KP149 – KP149.3 MEW001_NU_POSMH_5K_FINAL_00-11	70m – 60m	Fine to Coarse SAND occasionally colonised by sparse growths of photophilic algae (es: probable *Flabellia petiolate*)
8	KP149.5 - KP150.12 MEW001_NU_POSMH_5K_FINAL_00-11	57m – 42m	Fine to Coarse SAND occasionally colonised by sparse growths of photophilic algae (es: probable *Flabellia petiolate*)
9	KP150.156 - KP150.24 MEW001_NU_POSMH_5K_FINAL_00-11	46m – 40m	Scattered vegetation (mainly on sand, covering subcropping rock) constituted by *Posidonia oceanica* associated with different species of green and brown algae such as a possible *Dictyopteris polypodioides and Cystoseira sp*
10	KP150.50 – KP 150.54 MEW001_NU_POSMH_5K_FINAL_00-11	28-30m roughly 190m SW of the route	Scattered *Cymodocea nodosa* on sand (N.B.: isolated patch, detected only on one ROV line)
11	KP150.24 – KP150.60 MEW001_NU_POSMH_5K_FINAL_00-11	40m – 7m	Dense Posidonia oceanica meadows mainly settled on rock, in association with brown and green algae such as a possible *Dictyopteris polypodioides and Cystoseira sp*

Details on the biodiversity and protected species can be found in MEW001_WP2_EBB, latest revision.

Details on the restricted areas, marine protected areas and sensitive areas can be found in MEW001_WP2_SOGECORA, latest revision. A synthesis of the restricted areas and marine protected areas is given below in Table 3.

Table 3 – Restricted areas and MPA

ID#	FROM KP	TO KP	DESCRIPTION	CLASSIFICATION
1	0.000	3.374	SIN area (Contaminated Sites of National Interest)	RESTRICTED AREA
3	0.000	1.228	Restricted area	RESTRICTED AREA
4	0.342	1.024	Restricted area	RESTRICTED AREA
5	1.076	2.306	Natura2000 site "Torre Manfria, Biviere e Piana di Gela" (ITA020012)	MARINE PROTECTED AREA
6	108.396	126.200	Natura 2000 site "Żona fil-Baħar tal-Grigal" (MT0000107)	MARINE PROTECTED AREA
7	130.643	148.947	Natura 2000 site "Żona fil-Baħar fil-Lvant" (MT0000108)	MARINE PROTECTED AREA
8	148.944	149.573	Natura 2000 site "Żona fil-Baħar fil-Lbiċ" (MT0000111)	MARINE PROTECTED AREA

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7.0.0 ENCLOSURES

A total of 11 North-Up charts dedicated to the Sensitive Marine Habitats are enclosed to this report.

The enclosures file name is defined as follows:

IDP_NU_Information_Scale_Emission_Revision-Relative progressive number

where:

- IDP (LGH code): MEW001
- NU: North-Up charts
- Information: POSMH (Posidonia oceanica / Sensitive Marine Habitats charts)
- Scale: 5K (1:5000)
- Emission: FINAL
- Revision: 00
- Relative Progressive Number: progressive number of the chart (1 to 12)

The list of the charts enclosed is reported in Table 4.

Table 4 – Enclosures list

Enclosure #	From KP to KP	Name	Scale	File Name
01	0.000-3.464	Sensitive Marine Habitats Chart 1 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-1
02	3.293-7.857	Sensitive Marine Habitats Chart 2 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-2
03	7.693-11.811	Sensitive Marine Habitats Chart 3 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-3
04	38.453-42.608	Sensitive Marine Habitats Chart 4 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-4
05	55.062-59.674	Sensitive Marine Habitats Chart 5 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-5
06	59.501-64.113	Sensitive Marine Habitats Chart 6 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-6
07	127.320-131.326	Sensitive Marine Habitats Chart 7 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-7
08	131.176-135.187	Sensitive Marine Habitats Chart 8 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-8
09	135.036-139.050	Sensitive Marine Habitats Chart 9 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-9
10	142.762-148.324	Sensitive Marine Habitats Chart 10 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-10
11	146.286-150.836	Sensitive Marine Habitats Chart 11 of 11	1:5000	MEW001_NU_POSMH_5K_FINAL_00-11