BIOCENOTIC MAP

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Project Acronym	SASPAS
Project ID Number	10048261
Project Title	SAFE ANCHORING AND SEAGRASS PROTECTION IN THE ADRIATIC AREA
Priority Axis	3 - Major change Environment and cultural heritage
Specific objective	3.2 - Contribute to protect and restore biodiversity
Work Package Number	4
Work Package Title	Protecting and restoring marine seagrasses
Activity Number	4.1
Activity Title	
Partner in Charge	Regional Natural Park of Coastal Dunes from Torre Canne to Torre San Leonardo
Partners involved	Regional Natural Park of Coastal Dunes from Torre Canne to Torre San Leonardo
Status	Final
Distribution	Public

Summary

1. Introduction and objectives

This work describes the activities and results obtained from the Side Scan Sonar and Multibeam surveys carried out in May 2022 in a sea area in front of the “Coastal Dunes from Torre Canne to Torre San Leonardo” Regional Natural Park. The geoacoustic survey made it possible to draw up detailed thematic maps (biocenotic and bathymetric cartography), to be used as support tools for the management of the marine component of the “Litorale Brindisino” SAC CODE - IT9140002 and its habitats of conservation value.

2. Study area

2.1 Geographical framework

The study area is located along the Adriatic coast, between Villanova, Marina di Ostuni, and Torre Canne, Marina di Fasano, and is bounded by the following GPS points (dd pp ss) (Table 1)

UTM 33N		WGS 84	
X	Y		
708575,17	4524771,93	40° 50' 50,8764''	17° 28' 27,2279''
710625,85	4528256,71	40° 52' 41,9024''	17° 29' 58,9413''
710625,86	4528256,72	40° 52' 41,9024''	17° 29' 58,9413''
711768,33	4527472,06	40° 52' 15,4406''	17° 30' 46,7701''
713348,01	4526300,45	40° 51' 35,9937''	17° 31' 52,7586''
715940,81	4524259,72	40° 50' 27,4258''	17° 33' 40,8178''
717209,33	4523135,94	40° 49' 49,8045''	17° 34' 33,5424''
718467,41	4522490,46	40° 49' 27,7058''	17° 35' 26,3856''
717654,03	4519583,61	40° 47' 54,3032''	17° 34' 48,0609''
716173,88	4520151,86	40° 48' 14,1133''	17° 33' 45,6301''
714953,23	4520582,23	40° 48' 29,2299''	17° 32' 54,1477''

713852,26	4521084,34	40° 48' 46,5290''	17° 32' 7,8207''
712344,40	4521682,08	40° 49' 7,3129''	17° 31' 4,2473''
710788,67	4522375,47	40° 49' 31,2097''	17° 29' 58,7308''
709568,02	4523021,04	40° 49' 53,2650''	17° 29' 7,4767''
708826,05	4523427,52	40° 50' 7,1006''	17° 28' 36,3152''
708706,36	4523810,10	40° 50' 19,6198''	17° 28' 31,6580''
708754,20	4524360,08	40° 50' 37,3959''	17° 28' 34,3693''
708648,55	4524732,54	40° 50' 49,5459''	17° 28' 30,2955''
708575,17	4524771,93	40° 50' 50,8764''	17° 28' 27,2279''

The area extends parallel to the coast for about 10 km and offshore for about 5 km, from the bathymetric band of 10 meters to that of 50 meters deep, covering a total area of about 4113 hectares (Figure 1).

The study area is characterized by an environmental context of high naturalistic value, since it represents part of the “Litorale Brindisino” SAC CODE - IT9140002 (Figure 2).

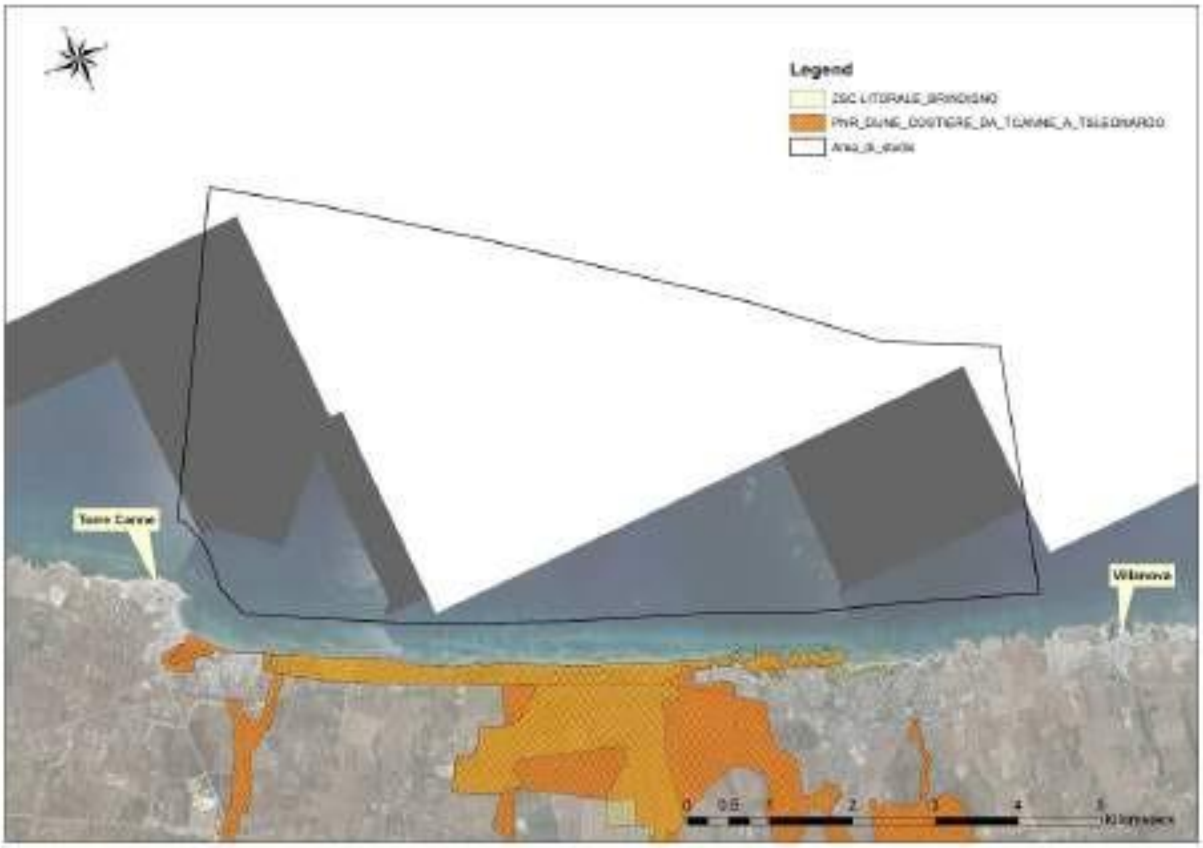

Figure 1

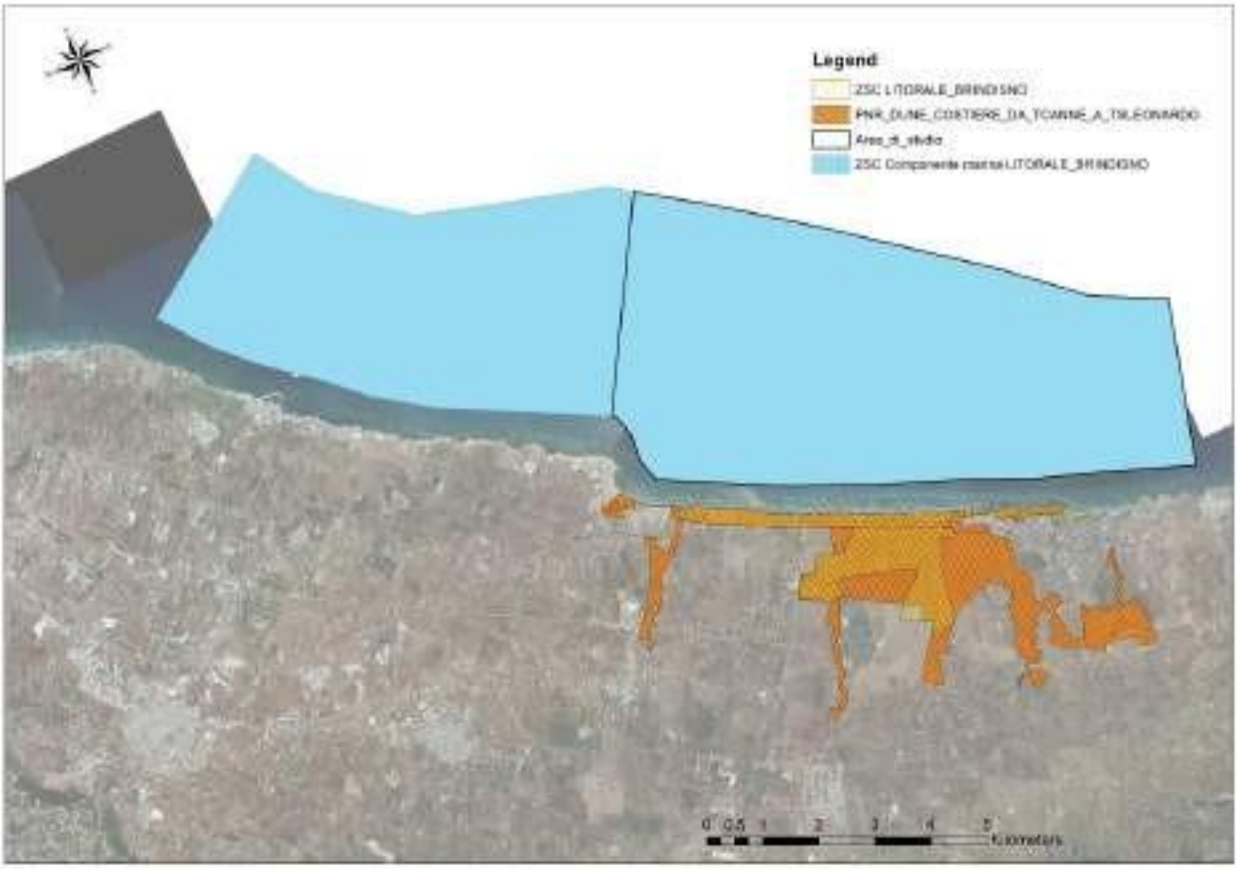

Figure 2

2.2 Previous information

The bibliographic survey carried out for the area of interest highlighted the lack of detailed marine biology and ecology studies. Most of the previous environmental data, inherent to the area of interest, come from studies conducted on a large scale, aimed at characterizing the entire regional coastal system.

The most important mapping study of the distribution of P. oceanica meadows on the seabed of the Puglia Region was conducted by CRISMA in 2005 "Inventory and Cartography of Posidonia Meadows in the Maritime Compartments of Manfredonia, Molfetta, Bari, Brindisi, Gallipoli and Taranto" . Figure 3 shows the distribution of the P. oceanica prairie in the area of Gallipoli.

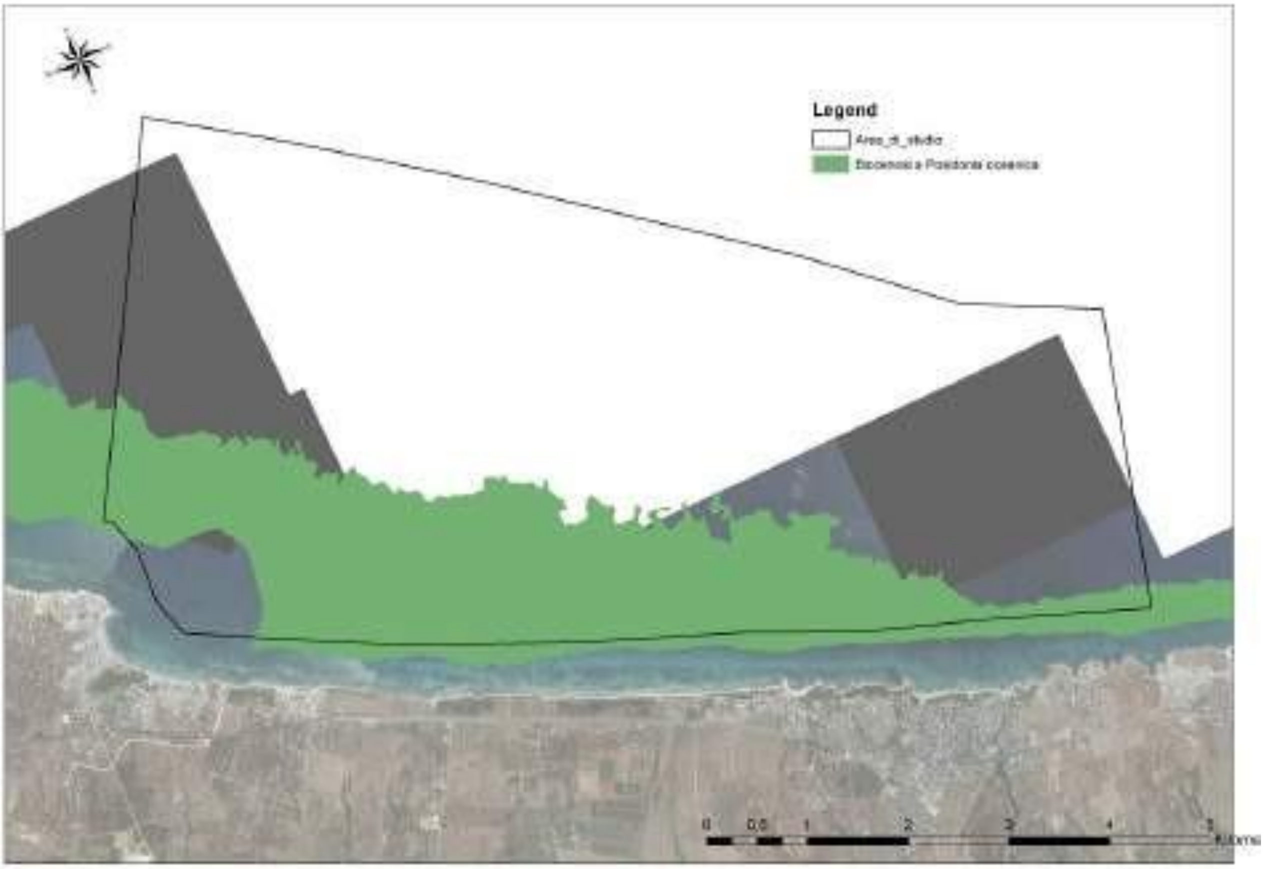

Figure 3

The BIOMAP regional project carried out by CONISMA (National Interuniversity Consortium for Marine Sciences) has helped to implement the knowledge on "1170: Reefs" habitats through the mapping of Apulian marine "bioconstructions" and the census of the biodiversity of the "cliffs" both at species level, through the production of inventories of the animal and plant component and of the community. The aforementioned study and mapping activity was completed within the 3 MPAs in Puglia and 21 SCIs, from the coastline to the 100 m bathymetric

Figure 4 shows the coralligenous biocoenoses as identified by the BIOMAP project.

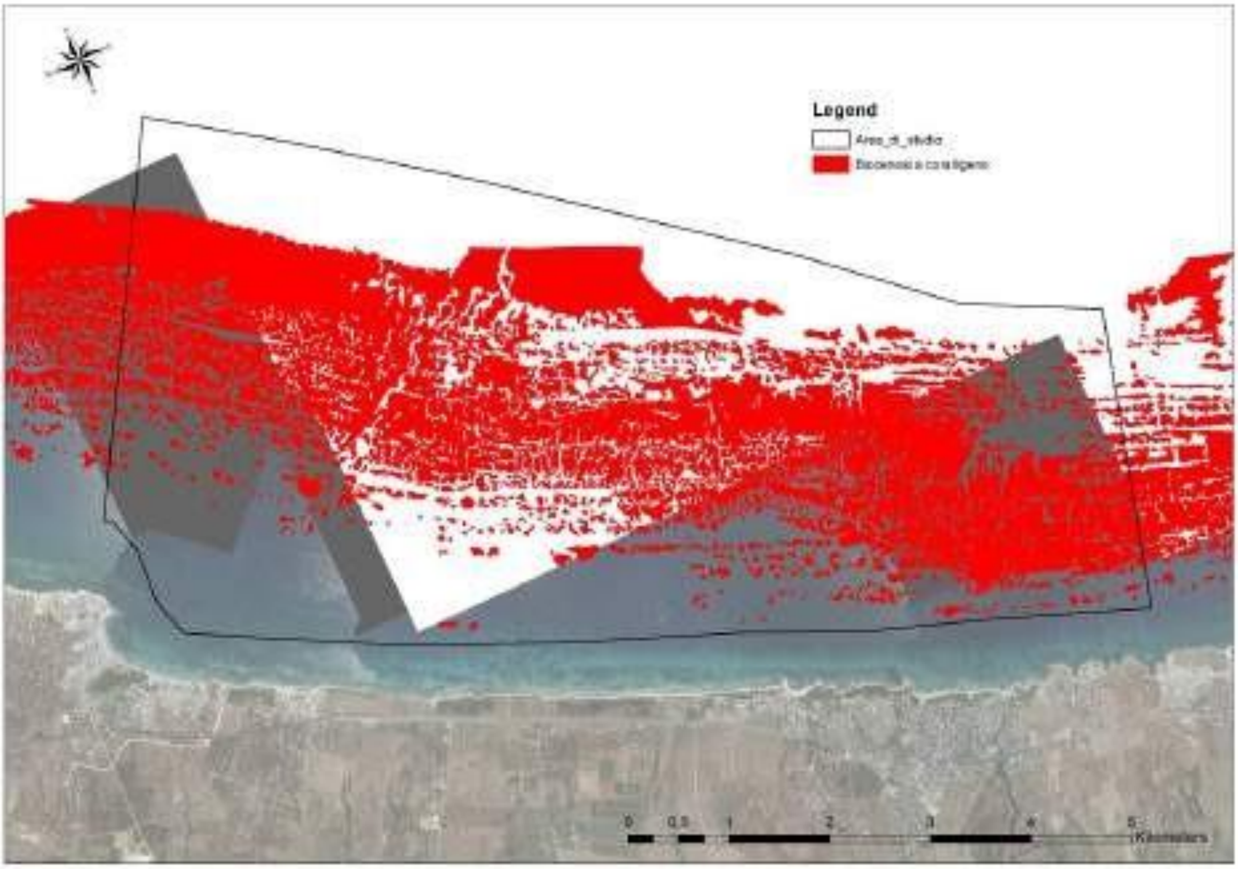

Figure 4

3. Materials and methods

3.1 Tools used

A Klein 3900 Side Scan Sonar and an R2 Sonic 2024 multi-beam echo sounder were used for the geomorphological and bathymetric study carried out in this work. The Side Scan Sonar survey produces a photogrammetry that allows to identify the different lithologies and biocoenoses that characterize the seabed investigated. The investigation with the Multibeam allows you to obtain a detailed surface area of the seabed. It is important to underline that these survey methodologies have been standardized within the Marine Strategy Framework Directive (MSFD). , which entered into force in July 2008.

The following are the technical specifications of the tools used:

- Side Scan Sonar Klein 3900 (Figure 5): The system consists of an on-board unit (TPU) for data acquisition, control and recording and an underwater vehicle called "fish" which, while being towed underwater, it emits pulses of acoustic energy at regular intervals of time. Immediately after the pulse is emitted, the systemreceives the returning echoes from the seabed and from the subsoil. The amountof reflected energy depends on the variation in acoustic impedance between the elements present in the subsoil, while the reflection time depends on the depth of the stratigraphic surface or of the object that generated the reflection. During the geomorphological survey, the TPU was connected to a DGPS (differential GPS model A100) and to a recording station using the acquisition-navigation software (SonarPro) with the ability to record geographic coordinates and sonograms.

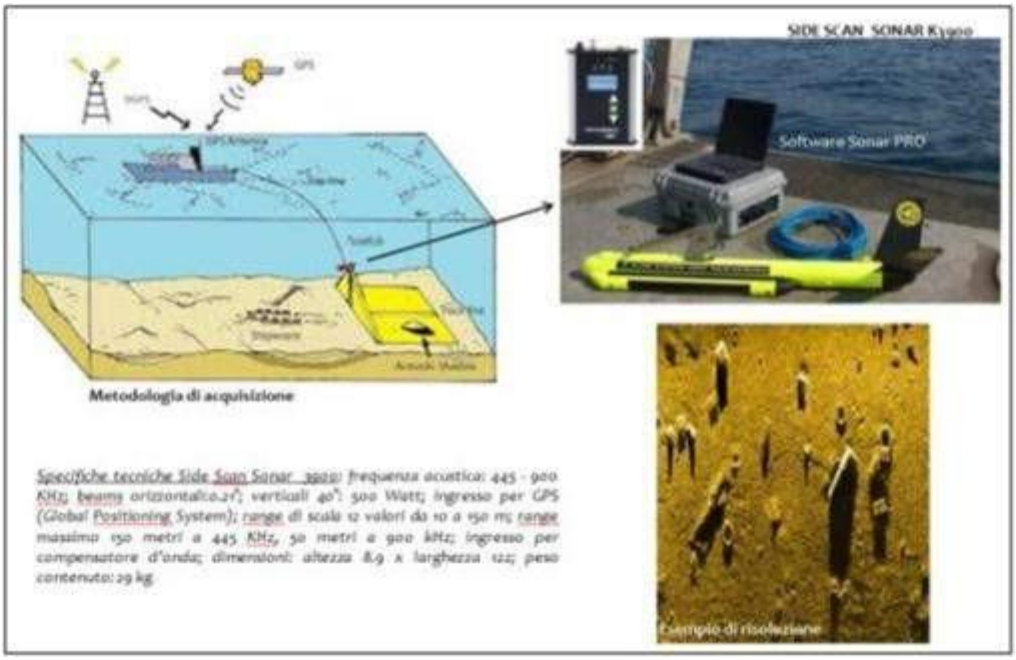

Figure 5: Side Scan Sonar 3900

The components of the Multibeam system (Figure 6) used and the related technical specifications are shown below:

- Multi-beam echo sounder (MBES - MultiBeam EchoSounder) - R2 Sonic 2022 with probe (Bottom morphology bathymetry): it is an echo sounder capable of simultaneously interpreting the return pulses on different angles rather than a single data of zenith depth, such as the normal single-beam hydrographic sonar. One of the main advantages of multibeam technology is to investigate a band of seabed that varies from 3 to 8 times the depth and therefore allow to represent the seabed by means of three-dimensional modeling. The Multibeam R2 Sonic 2022 is an instrument capable of operating with simultaneous reception of 256 beams (beams) separated by 1 ° for a total aperture (swath coverage) of 160 °, so as to detect a band of seabed equal to about 8 times the depth and thus decrease the survey times. The instrument is combined with a transducer with twenty available frequencies (200-400kHz) in 10 ° kHz steps, allowing the operator to set the system in the best possible way according to the required resolution, operating depth, characteristics of the water column and finally in terms of acoustic noise in the water column. The system also includes a compact Sonar Interface Module (SIM) processing surface unit.

- QINSy hydrographic software: it is modular, i.e. made up of a set of independent applications capable of performing all the functions required during the execution of the survey at sea (planning and design of the survey, navigation and data acquisition, filtering and processing data).
- Hemisphere V101 dual antenna GPS technology orientation sensor: it is a GPS technology compass system; the system consists of a single body that incorporates 2 antennas and GPS cards and the processing unit. The V101 is able to provide, in addition to the Heading data (heading angle), also the GPS position in differential mode (free correction where available WAAS, EGNOS), with accuracy on the position of about 60 cm. The system also supplies the PPS signal (pulse per second) which is essential for synchronizing the Multibeam data
- Motion sensor heave, pitch, roll, model TSS DMS-25: it is a sensor necessary for the determination and measurement of the angles of movement of the boat and the jolting motion of the platform (roll, pitch, wave), which combined with the sensor of heading (route) allow to orient and stabilize the single scans of the Multibeam in space.
- Self-recording profiling probe, AGEOTEC IMSVP model: the exact measurement of the depth data is a function of the return time of the sound waves emitted by the sounder transducer, whose speed is variable according to the composition, temperature, conductivity and depth of the water. The speed data on the column

under examination was detected using the AGEOTEC IMSVP probe, capable of providing the speed of sound values in water with an accuracy of ± 0.45 m / s (p = 100 bar) and resolution 0.001 m / s;

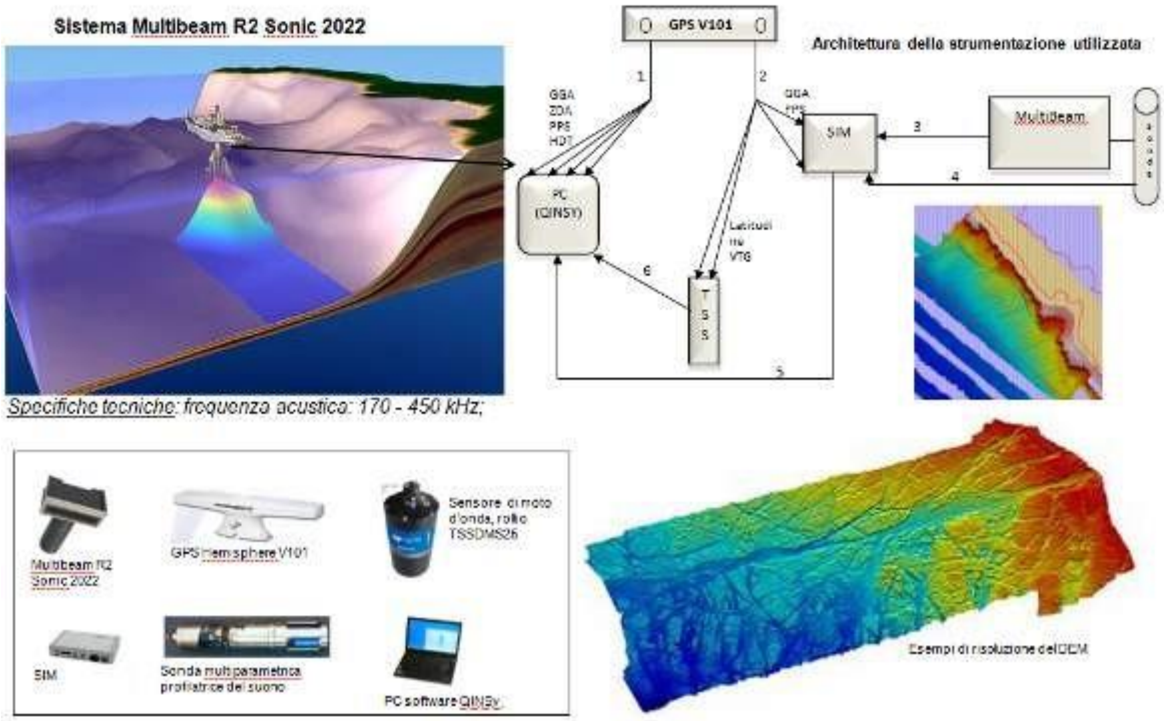

Figure 6: Multibeam R2 Sonic 2022.

3.2 Methodology

The detailed biocenotic and morpho-bathymetric characterization involved the realization of the following working phases:

1. Survey planning in a GIS environment;

2. Data acquisition activities at sea;

3. Processing and processing of the acquired data;

4. Data interpretation and validation activities;

5. Cartographic restitution.

Survey planning in GIS environment

The study area was divided into navigation routes whose distance was determined in order to ensure full coverage of the data acquired by both tools used in the survey (Figure 7).

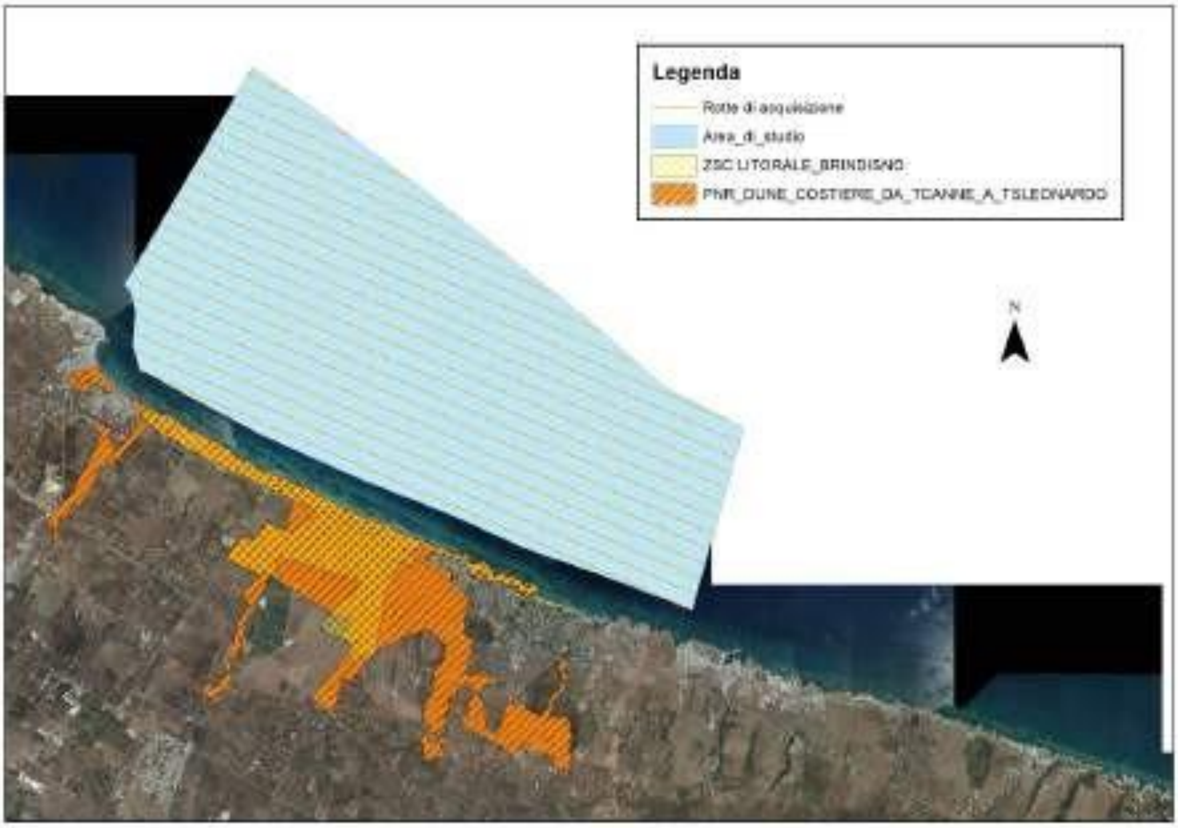

Figure 7

<u>Data acquisition activities in the sea</u>

The geoacoustic surveys were performed simultaneously in four acquisition campaigns which took place in the months of April - May 2022.

For the surveys, a boat was used with technical characteristics suitable for carrying out investigations along the coast: low draft, maneuvering, and capable of containing and transporting the necessary instrumentation for the survey. Navigation was performed along the routes planned in the planning activity.

The Side Scan Sonar was set at an acoustic frequency of 445 KHz and a lateral range of 200 meters, ensuring total coverage of the area and an over-lap of 100 meters between one sonogram and another.

The Multibeam was set at an acoustic frequency of 440 KHz and with a swath coverage angle of 120 °.

The georeferencing of the acquired data was carried out according to the following geodetic parameters:

• Datum: WGS 84

• Projection: UTM - Time Zone 33

• Central Meridian: 15 ° 00'00 "

• False East: 500,000

• Scale factor: 0.9996

<u>Processing and processing of the acquired data</u>

The sonograms obtained from the Side Scan Sonar surveys, recorded in XTF format and georeferenced in UTM-WGS 84 fused 33, were processed using SonarWiz 6 (Figure 8). The main processing steps were:

• cleaning of navigation data (in particular navigation jumps);

• application of the slant range correction (central area not covered by the lateral beams of the Side) and of the gain algorithms (necessary to optimize the display of the sonograms);

• production of the photomosaic in raster format.

The bathymetric data acquired and suitably georeferenced were processed using dedicated software. The main processing steps are:

• quality control using a QINSy acquisition-navigation software module, in order to eliminate anomalous points (spikes) with respect to the continuity of the survey;

• data correction with the tide value;

• elaboration of the Digital Elevation Model

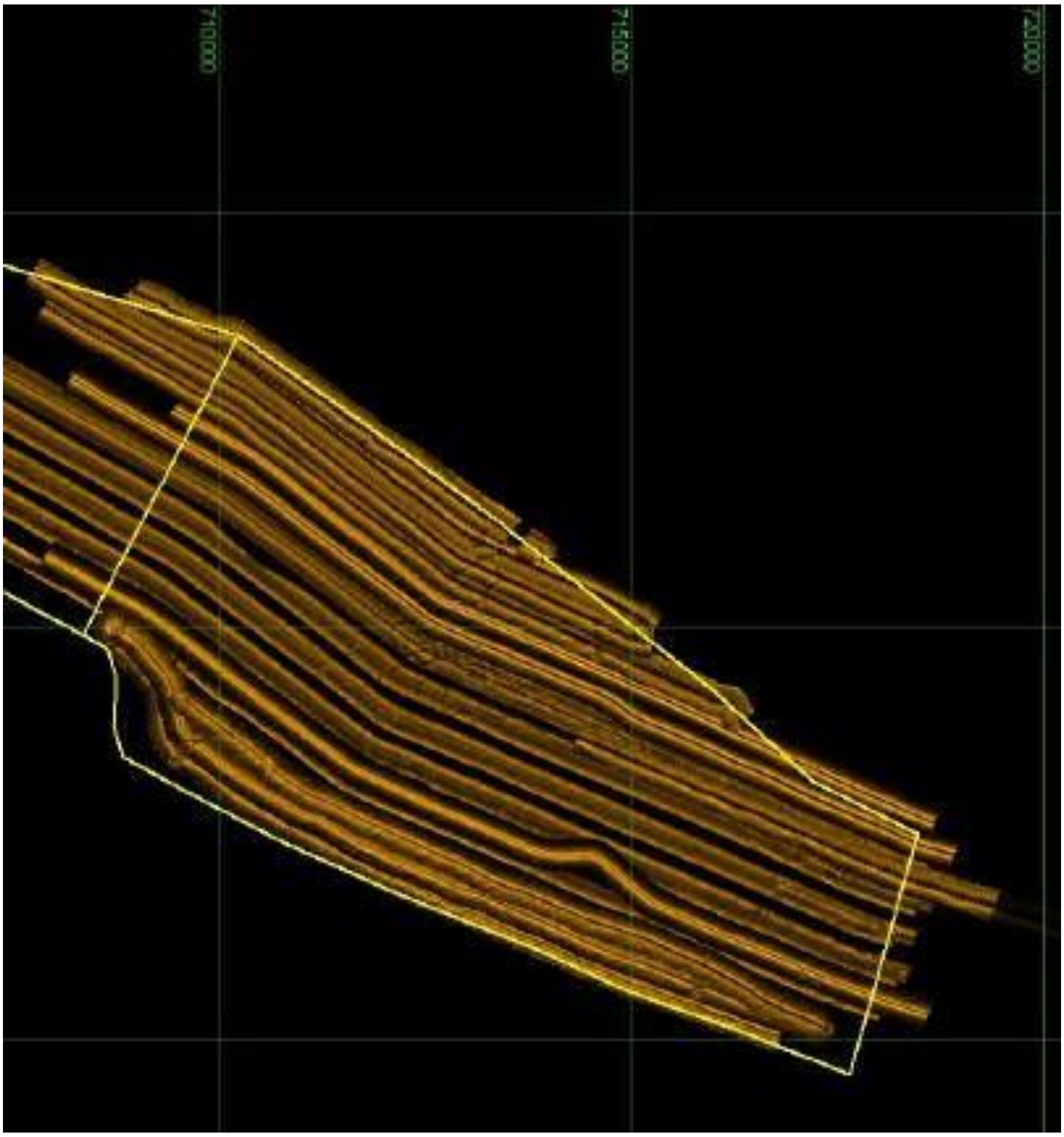

Figure 8

Data interpretation and validation activities

The photomosaic was interpreted with dedicated software. In this phase, in particular, the distribution patterns of the different habitats and substrates found were defined. The categories of habitats found were defined according to the nomenclature and classification scheme established by the RAC-SPA (Regional Activity Center for Specially Protected Areas of the Mediterranean Action Plan (MAP) of the United Nations Environment Program (UNEP), also adopted by the MATT Nature Conservation Service (SCN Decree 9038 of 11 June 1998) .The results obtained were validated by means of visual census in underwater diving.

Cartographic restitution.

All the data acquired and processed in this work have been entered in a geodatabase set up in a GIS environment. This procedure made it possible to draw up detailed thematic maps for a spatially explicit visualization of the results obtained.

4. Investigation through the truth at sea

In order to validate the spatially explicit data obtained from the interpretation of the mosaic of the SIDE SCAN SONAR sonograms, n. 28 prospecting points (truth at sea) along 7 transepts. The validation points were located between 10 and 20 meters deep, in order to characterize and define, more precisely, the Posidonia oceanica habitats (Figure 9).

Below is the list of the prospecting points identified with their planimetric coordinates:

	Y	X
1	4524139	708615,5
2	4524539	708834,3
3	4524946	709067
4	4525302	709252,6
5	4525494	709357,6
6	4523698	709667
7	4524250	709969,6

8	4524903	710327
9	4524614	710168,9
10	4522577	710525,8
11	4523114	710819,8
12	4523481	711020,5
13	4523702	711135,4
14	4523980	711294,4
15	4521925	712046,6
16	4522357	712283,1
17	4522924	712594,8
18	4523177	712755
19	4521292	713733,2
20	4521593	713897,7
21	4521944	714089,9
22	4522211	714238,6
23	4520453	715531,6
24	4520665	715647,5
25	4520899	715775,7
26	4519796	717301,5
27	4519939	717379,7
28	4520081	717457,7

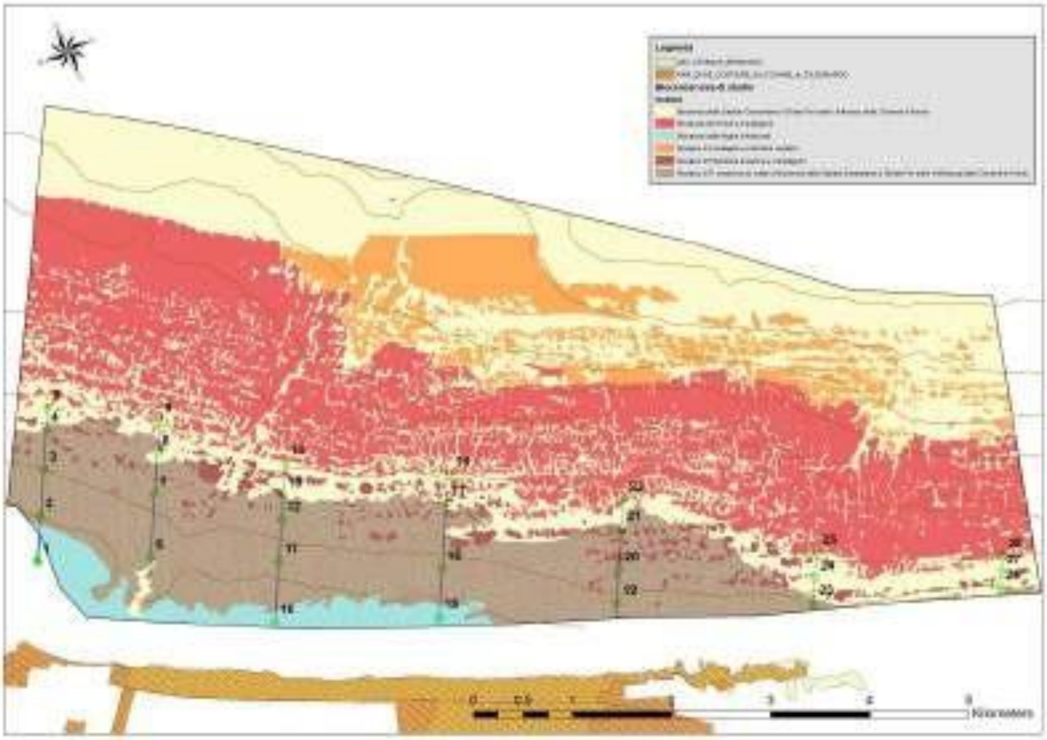

Figure 9: Localizzazione su planimetria dei punti di verità a mare lungo i n.7 transetti

The "Verità a mare" activities were carried out in May 2022 using a boat equipped with an echo sounder and a cartographic GPS (Global Position System) (Figure 10).

Figure 10

The data relating to the type of population and substrate are acquired by direct detection in underwater diving. Having identified the correct sampling site with the aid of GPS, the biologist diver performs a series of apnea dives (Figure 11, Figure 12) communicating the alternation of the populations and substrates found to an experienced operator on board. In order to improve the environmental investigation and acquisition phase, the operator made numerous shots with the aid of an underwater camera model Apeman Trawo a100 Action cam model (Figure 13). The multimedia material collected has the function of improving the knowledge of the environmental components under investigation.

Figure 11

Figure 12:

Figure 13

In order to implement the number of information to be acquired in the "Truth at sea" phase, the direct detection of the deeper sites was carried out through the use of a biologist diver equipped with scuba equipment. Specifically, the biologist performed n. 7 videos that show the path taken by the operator himself between the last two points of each transept (Figure 14, Figure 15).

Figure 14

Figure 15

The equipment used by the expert operator for making videos along the transepts is as follows:

• Suex JS model underwater scooter on which a GoPro Hero 10 action camera and two Archon Dm60 / Wm66 underwater lights were mounted (Figure 16, Figure 17);

• Canon 5D Mark III digital camera with Tokina 10/17 mm fisheye lens all in Nauticam 5DIII underwater housing with No. 2 Inon Z330 model flashes (Figure 18);

• Scubapro digital depth gauge;

• Scubapro underwater analog compass.

Figure 16

Figure 17

Figure 18

5. Verification and validation of the "Verita' a mare" activities

Below are the images acquired and the biocenoses identified

ID	PHOTOS AND VIDEOS ACQUIRED IN SAMPLING	biocenosis detected
1		biocenosis of infralittoral algae

1		biocenosis of infralittoral algae
2		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

2		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
3		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

3		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
4-5		VIDEO

6		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
6		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

7		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
7		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

8-9		VIDEO
10		biocenosis of infralittoral algae

10		biocenosis of infralittoral algae
11		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

11		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
12		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

12		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
13-14		VIDEO

15		biocenosis of infralittoral algae
15		biocenosis of infralittoral algae

16		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
16		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

17-18		VIDEO
19		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

19		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
20		Coralligenous biocenosis

20		Coralligenous biocenosis
21-22		VIDEO

23		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
23		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

24-25		VIDEO
26		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents

26		Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and fine gravels under the influence of buttom currents
27-28		VIDEO

6. Results

The surveys carried out through multibeam allowed to elaborate, in a GIS environment, the map of the bathymetry of the study area. The spatial elaboration of this theme has allowed the production of isobaths every meter of depth (Figure 19).

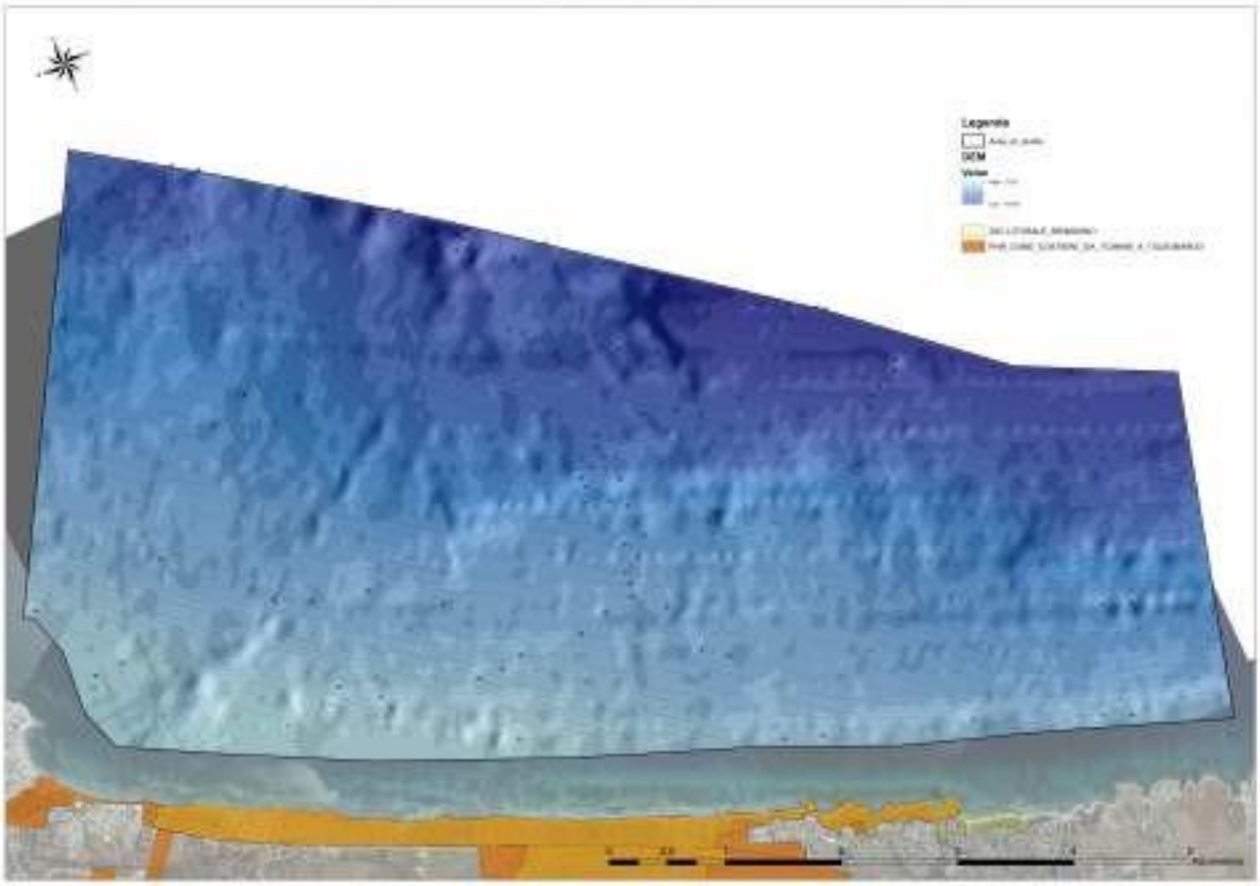

Figure 19

The surveys carried out through the use of the Side Scan Sonar validated in the "truth at sea" phase made it possible to develop, in the GIS environment, the map of the biocoenoses of the study area (Figure 20).

The types of habitats identified are listed below:

Tabella 1

Habitat	Area_ha	Percentuale
Biocenosis of coarse sands and line gravels under the influence of bottom currents	1529,62	37,19%
Coralligenous biocenosis	1253,90	30,48%
Biocenosis of infralittoral algae	117,40	2,85%
Mosaic of coralligenous and Biocenosis of the coastal detritic bottom	351,73	8,55%
Mosaic of Posidonia oceanica meadows and coralligenous biocenosis	90,78	2,21%
Mosaic of Posidonia oceanica meadows and Biocenosis of coarse sands and line gravels under the influence of bottom currents	769,99	18,72%
TOTALE	**4113,42**	**100,0 %**

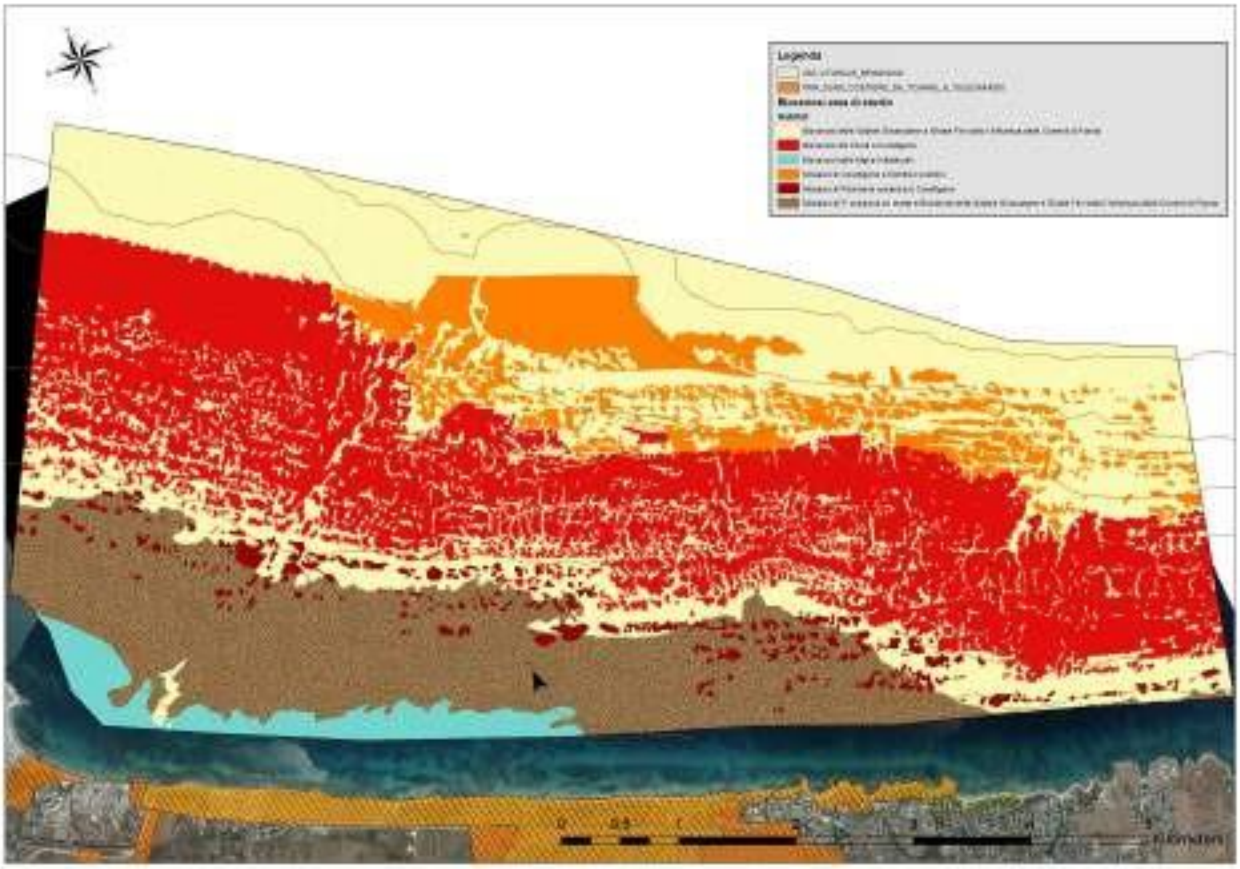

Figure 20

The biocenosis of infralittoral algae (Figure 21) is a typical population that colonizes the well-lit rocky infralittoral. The biocoenosis of infralittoral algae, in the survey area, colonizes the rocky substrate identified in the bathymetric belt between 0 and -10 meters deep and is mainly located in the northernmost stretch of sea.

Figure 21

In the range between -10 and -20 meters deep, the prevailing biocenoses show a mosaic of P. oceanica on matte and Biocenosis of the Coarse Sands and Fine Gravels under the influence of the background currents (Figure 22).

Figure 22

The depth of the study area, with a depth of -20 m, is characterized by the constant presence of the Coralligenous Biocoenosis. The term coralligenous indicates a biogenic substrate, that is, "built" by living organisms and in particular by the set of calcareous concretions mainly formed by red algae with calcareous thallus, serpulids and bryozoans (Figure 23).

The habitat called "Biocenosis of the Coarse Sands and Fine Gravels under the Influence of the Bottom Currents", which colonizes most of the investigated area, is characterized by typical soft bottom species, mainly molluscs and polychaetes.

Figure 23