PROJECT BEST INTERREG V-A GREECE-ITALY 2014/2020

Monitoring of Areas

University of L'Aquila – Civil, Construction-Architectural and Environmental Engineering Department (DICEAA), Environmental and Maritime Hydraulics Laboratory (LIam)

Polytechnic University of Bari – Department of Civil, Environmental, Land, Building Engineering and Chemistry (DICATECh)

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1. INTRODUCTION

This report refers to the macro-activity relating to the monitoring of areas and the design of the monitoring network, starting from the formation of a cognitive framework based on previous knowledge of environmental parameters, the definition of sampling stations, areas and detection points in depending on the characteristics of the territory, the presence of any sensitive areas (Natura 2000 sites, wetlands, protected natural areas, etc..) and in agreement with the management bodies of the protected areas affected by the activities envisaged in the plan and / or with the local authorities that are territorially competent. The ultimate goal of the implementation of the monitoring network is the preservation of biodiversity in the areas under investigation. On the other hand, the results of the analysis of the evolutive dynamics of the coasts have the objective of "informing" the monitoring of the areas by guiding the observation strategy.

The document is structured as follows:

- Chapter §2 reports the results of the preliminary recognition of existing knowledge aimed at defining the initial "zero point" reference framework, with identification and characterization of the relevant environmental factors, to be monitored.
- Chapters §3 and §4 illustrates the choice of environmental parameters to be monitored.
- Chapter §5 illustrates in detail the network, i.e. the instrumentation and the type of sensors to be used in the monitoring activity, showing the location of the monitoring stations where to perform the measurements, identified following various surveys in the areas under investigation, and for each station the planned instrumentation is shown (with the technical and functional requirements and with the cost calculation).

2. PRELIMINARY RECOGNITION OF KNOWLEDGE

The BEST project has identified a series of pilot areas for the implementation of a monitoring network aimed at the protection and conservation of biodiversity. As part of the activities related to the development of a SMART network, the preliminary recognition of existing knowledge aimed at defining the initial "zero point" reference framework plays an "information" role for the monitoring strategy.

Part of the activities concerned (i) the analysis of the biodiversity of habitats and species present in the pilot areas, concerning particularly the data available in the European network of NATURA 2000 sites; (ii) the identification of environmental factors, with particular regard to abiotic ones, to be monitored both in the terrestrial and in the aquatic environment; (iii) the definition and mapping of the areas and environments of greatest naturalistic importance in the pilot areas of the project.

The considered coastal areas fall within the territory of the municipalities of Polignano a Mare, Monopoli, Fasano and Ostuni (hereinafter referred to as Pilot Area 1.1); the territory included in the proposed perimeter for the establishment of the Mar Piccolo Regional Natural Park (hereinafter referred to as Pilot Area 1.2); the territory included in the Pilot 2 area, represented by the areas of the regional territory affected by the effects of the *Xylella fastidiosa*.

The territory of the Pilot Area 1.1 is located on the Adriatic coast of the Puglia Region and includes (i) the Regional Natural Park called "Coastal Dunes from Torre Canne to Torre S. Leonardo" (hereinafter referred to simply as "Dune Costiere") established with Regional Law (n.31 of 27 October 2006), and (ii) the Regional Natural Park called "Costa Ripagnola", located in the municipalities of Polignano a Mare and Monopoli and established by Regional Law (n. 30 of 21 September 2020) (Figure 2-1).

Pending approval of the Park Plan (and with reference to Figure 2-1), the Regional Law has indicated the division into three areas with different naturalistic, landscape and historical cultural vocation:

- **zone 1,** of significant naturalistic, landscape and historical-cultural value;
- **zone 2,** of naturalistic, landscape and historical-cultural value, characterized by the presence of inhabited and productive nuclei;
- **zona 3,** characterized by the presence of built-up centers or fractions of built-up centers.

In particular, the NATURA 2000 site - IT9140002 (geographical reference coordinates: 40,850000° N - 17,492778° E) falls within this area, which has a total area of 7,256.00 ha, of which the part located in the stretch of water in front of the coastline represents about 95% of the entire area.

Figure 2-1 : Territorial framing of Pilot Area 1.1, with particular reference to the Regional Natural Parks of "Costa Ripagnola" and "Dune Costiere".

There are numerous habitats of community and priority interest, according to NATURA 2000.

There are also numerous species of community interest and priority established on the basis of the Habitats Directive and the Birds Directive of the European Union. They are listed, coded and named in Table 2-1.

Table 2-1: Habitat of community interest and priority according to NATURA 2000 in the Pilot 1.1 area.

Group	Code	Scientific name
Birds	A293	*Acrocephalus melanopogon*
Birds	A229	*Alcedo atthis*
Birds	A054	*Anas acuta*
Birds	A056	*Anas clypeata*

Birds	A052	*Anas crecca*
Birds	A050	*Anas penelope*
Birds	A053	*Anas platyrhynchos*
Birds	A055	*Anas querquedula*
Fish	1152	*Aphanius fasciatus*
Birds	A029	*Ardea purpurea*
Birds	A024	*Ardeola ralloides*
Birds	A021	*Botaurus stellaris*
Reptiles	1224	*Caretta caretta*
Birds	A138	*Charadrius alexandrinus*
Birds	A196	*Chlidonias hybridus*
Birds	A197	*Chlidonias niger*
Birds	A081	*Circus aeruginosus*
Birds	A082	Circus cyaneus
Birds	A083	*Circus macrourus*
Birds	A084	*Circis pygargus*
Birds	A027	*Egretta alba*
Birds	A026	*Egretta garzetta*
Reptiles	1279	*Elaphe quatuorlineata*
Reptiles	1293	*Elaphe situla*
Reptiles	1220	*Emys orbicularis*
Birds	A153	*Gallinago gallinago*
Birds	A131	*Himantopus himantopus*
Birds	A022	*Ixobrychus minutus*
Birds	A023	*Nycticorax nycticorax*
Birds	A032	*Plegadis falcinellus*
Birds	A195	*Sterna albifrons*
Birds	A191	*Sterna sandvicensis*
Plant	1883	*Stipa austroitalica*

Other important flora and fauna species in the context of the area are shown in Table 2-2.

Table 2-2: Other important species of flora and fauna according to the Habitat Directive and the Birds Directive of the European Union in the Pilot 1.1 area.

Gruppo	**Codice**	**Nome Scientifico**
Plant	0	*Anacamptis piramidalis*
Birds	A050	*Anas penelope*
Birds	A053	*Anas platyrhynchos*
Birds	A055	*Anas querquedula*
Amphibians	1201	*Bufo viridis*
Reptiles	0	*Chalcides chalcides*
Reptiles	1284	*Hierophis viridiflavus*
Plant	0	*Crocus thomasii*
Reptiles	6154	*Cyrtodactylus kotschyi*

Birds	A153	*Gallinago gallinago*
Plant	0	*Helianthemum jonium*
Reptiles	0	*Lacerta bilineata*
Plant	0	*Ophrys apulica*
Plant	0	*Ophrys bertolonii*
Plant	0	*Ophrys bombyliflora*
Plant	0	*Ophrys lutea*
Plant	0	*Ophrys sphecoides*
Plant	0	*Ophrys sphecoides ssp. garganica*
Plant	0	*Ophrys tenthredinifera*
Plant	0	*Orchis collina*
Plant	0	*Orchis lactea*
Plant	0	*Orchis morio*
Plant	0	*Orchis papilionacea*
Reptiles	1250	*Podarcis sicula*
Invertebrates	0	*Scarabeus sacer*
Plant	0	*Serapias lingua*
Plant	0	*Serapias orientalis*
Plant	0	*Serapias parviflora*
Plant	0	*Serapias politisii*
Plant	0	*Serapias vomeracea*

Other features of the site concern the landscape, consisting of weak hilly undulations that degrade towards the coast, with a substratum of Cretaceous limestone. The thermo-xerophilic climate favors the presence of substeppica vegetation along the slopes. The quality and importance reside in the area of recent coastal dunes, with the presence of Mediterranean scrub vegetation. The pseudo-steppe areas are rich in orchids, including some endemic ones.
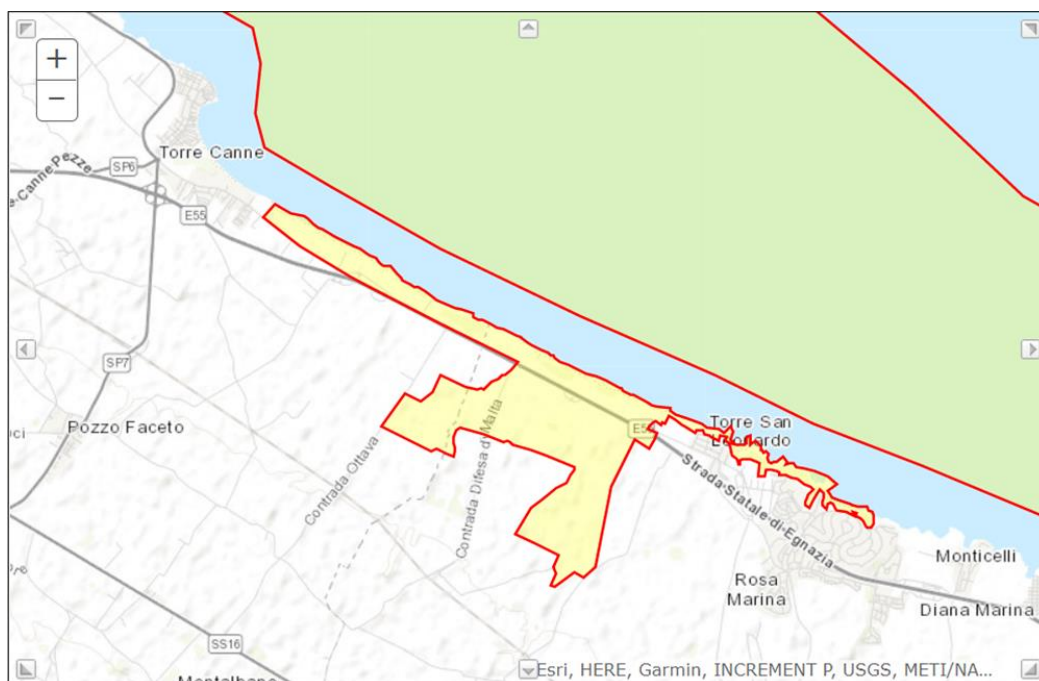
Figure 2-2: NATURA 2000 Site Map - IT9140002, focus on the land part in the Pilot 1.1 area.

The "Mar Piccolo" Regional Natural Park was established with the Regional Law (n. 30 of 21 September 2020) and includes the territories of the municipalities of Taranto, Statte, Carosino, Grottaglie, Fragagnano, Monteiasi, San Giorgio Jonico. The new park includes the areas of the "Palude La Vela" Regional Nature Reserve.

Pending approval of the Park Plan (and with reference to Figure 2-3), the Regional Law has indicated the division into three areas with different naturalistic, landscape and historical-cultural vocation:

- **zone 1,** of significant naturalistic, landscape and historical-cultural value;
- **zone 2,** of naturalistic, landscape and historical-cultural value, characterized by the presence of anthropic activities;
- **zone 3,** characterized by the presence of inhabited, military and productive nuclei.
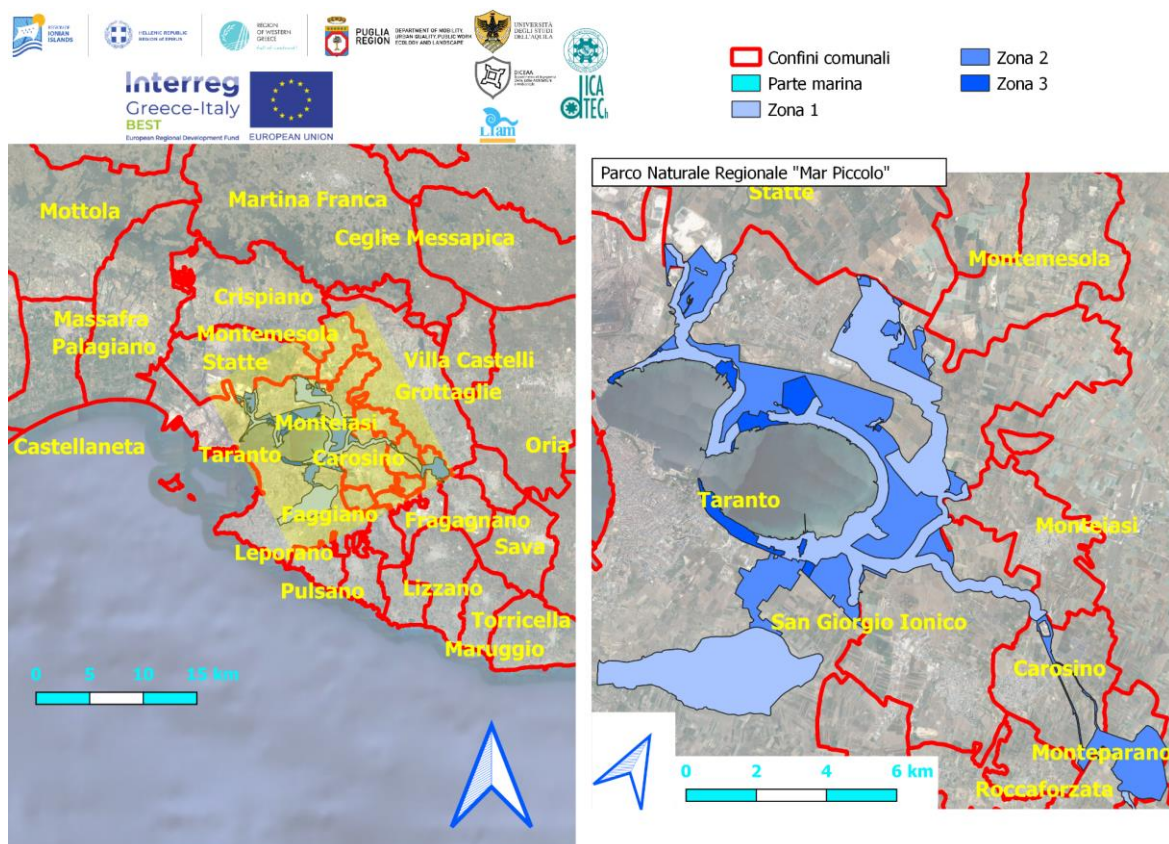
Figure 2-3: Territorial framing of Pilot Area 1.2, with particular reference to the "Mar Piccolo" Regional Natural Park.

There are numerous habitats of community interest and priority according to Natura 2000.

There are also numerous species of community interest and priority established on the basis of the Habitats Directive and the Birds Directive of the European Union (Table 2-3).

Table 2-3: Species protected by the Habitats Directive and the Birds Directive of the European Union in the pilot area 1.2.

Group	Code	Scientific Name
Birds	A055	*Anas querquedula*
Fish	1152	*Aphanius fasciatus*
Birds	A138	*Charadrius alexandrinus*
Birds	A196	*Chlidonias hybridus*
Birds	A197	*Chlidonias niger*
Birds	A081	*Circus aeruginosus*
Birds	A027	*Egretta alba*

Birds	A026	*Egretta garzetta*
Reptiles	1279	*Elaphe quatuorlineata*
Birds	A153	*Gallinago gallinago*
Birds	A123	*Gallinula chloropus*
Birds	A131	*Himantopus himantopus*
Birds	A022	*Ixobrychus minutus*
Birds	A176	*Larus melanocephalus*
Birds	A023	*Nycticorax nycticorax*
Birds	A391	*Phalacrocorax carbo sinensis*
Birds	A034	*Platalea leucorodia*
Birds	A032	*Plegadis falcinellus*
Birds	A132	*Recurvirostra avosetta*
Birds	A195	*Sterna albifrons*
Birds	A191	*Sterna sandvicensis*
Birds	A048	*Tadorna tadorna*
Birds	A162	*Tringa totanus*

Other important flora and fauna species in the context of the area are shown in Table 2-4.

Table 2-4: Other important species of flora and fauna according to the Habitat Directive and the Birds Directive of the European Union in the Pilot Area 1.2.

Group	**Code**	**Scientific Name**
Plant	0	*Bassia hirsuta*
Amphibians	1201	*Bufo viridis*
Invertebrates	0	*Cardepia hartigi*
Invertebrates	0	*Cephalota circumdata*
Invertebrates	0	*Cholevinus pallidus rufus*
Reptiles	1284	*Coluber viridiflavus*
Fish	0	*Gasterosteus aculeatus*
Plant	0	*Halopeplis amplexicaulis*
Reptiles	0	*Lacerta bilineata*
Plant	0	*Limoniastrum monopetalum*
Reptiles	1250	*Podarcis sicula*
Invertebrates	0	*Scarabaeus semipunctatus*
Invertebrates	0	*Trechus subnotatus*

The site is characterized by coastal depressions with water stagnation and high halophilia. The substrate is mainly made up of Pleistocene clays and silts. It is also characterized by the presence of coastal humid depressions with halophilous vegetation, by salt flats and by a watercourse belonging to the group of short but characteristic Ionian rivers.
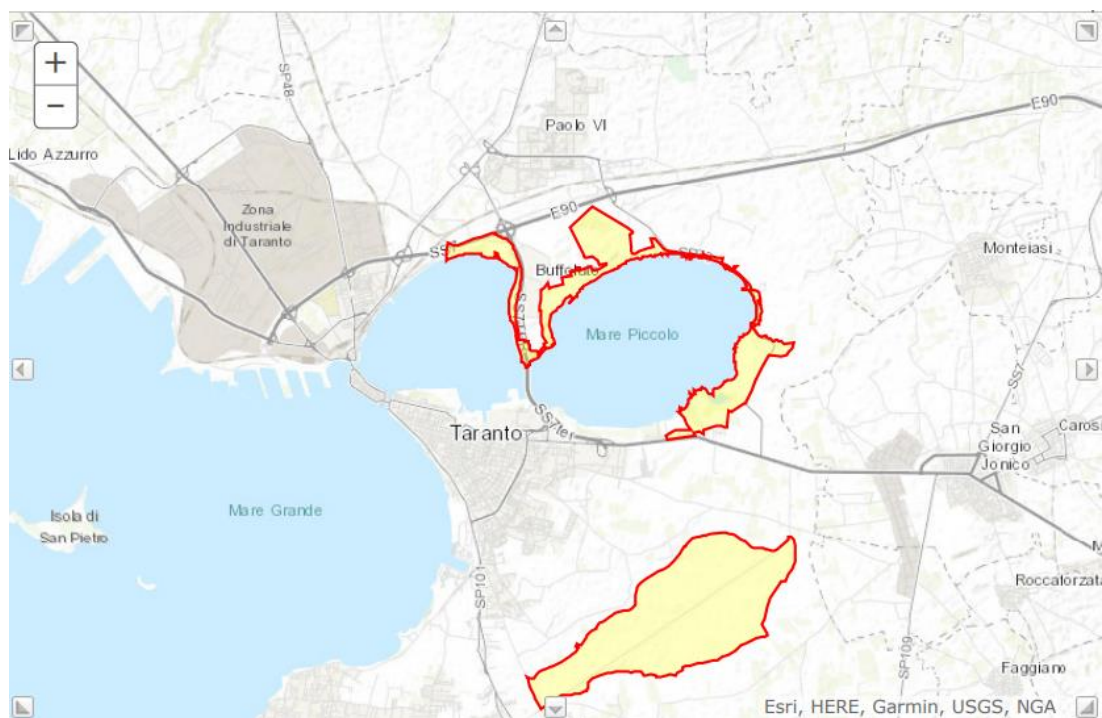
Figure 2-4: NATURA 2000 Site Map - IT9140002, focus on the terrestrial part in the Pilot 1.2 area.

3. DEFINITION OF ENVIRONMENTAL PARAMETERS

In order to control the qualitative and quantitative status of the biota environmental component / factor, as well as its evolution in space and time, knowledge of the environmental parameters in the areas under investigation is of fundamental importance. For this purpose, in some significant monitoring points, weather stations are provided for the measurement of parameters such as:

- air temperature,
- humidity of the air and soil,
- atmospheric pressure,
- wind direction and speed,
- direct irradiance
- leaf wetness
- precipitation.

In measuring stations overlooking internal water bodies, the measurement of water parameters, such as:

- pH,
- temperature,
- dissolved oxygen,
- turbidity,

will be carried out.

4. DEFINITION OF BIOLOGICAL PARAMETERS

The object of biodiversity monitoring is the biological community, represented by natural and semi-natural vegetation and by species belonging to flora and fauna (with particular regard to species and habitats included in community, national and regional legislation), the interactions carried out within the community and with the abiotic environment, as well as the related functions that take place at the ecosystem level.

Specifically, the monitoring must include the characterization of the phytocoenoses and zoocoenoses and the related floristic and faunal elements present in the areas directly affected by the project, also reporting the state of conservation. In order to define the conservation status of the ecosystems located within the boundaries of the areas of interest, it will be necessary to have knowledge of the animal and plant species that populate these areas. To this end, video cameras will be installed in some significant points for monitoring, which will continuously monitor the areas of interest in order to record the presence and passage of the species. In particular, the possibility of recording the presence of animal and vegetable species of priority interest, such as those listed above, identified in the areas of interest by the NATURA 2000 network, will be of fundamental importance.

5. MONITORING NETWORK

5.1. INSTRUMENTATION SELECTION

5.1.1. GENERAL CONSIDERATION

The creation of a biodiversity monitoring network defined as smart (which means it does not require the presence of operators in the field, it requires a remote transmission system of the acquired data, a monitoring system for the proper functioning of the stations for the definition of activities of maintenance, a security system against vandal attacks), has been, since the beginning of the activities, the driving force of the whole service entrusted to the RTI. In identifying the configuration of the measuring stations for biodiversity monitoring, an attempt was made to identify the most appropriate logical path to define quality models of the instrumentation that at the same time can comply with the requirement of being low-cost as defined by the Call .

Specifically, an attempt was made to frame the problem of quality by referring to solid and established cornerstones, in the context of the experience linked to decades of industrial software development activities. The modern vision has therefore been integrated which favors the culture of service over that of the product, considered more in keeping with the objectives set. The quality characteristics taken as a reference to determine the quality profile of the entire monitoring network are:

• usability, understood as the ability of the product / service to be understood, used and appreciated (think of the quality of the data);

• functionality, understood as the product / service's ability to meet user needs;

• reliability, understood both as availability in absolute terms of the product / service, and as fault tolerance to ensure product availability, through maintenance;

• the temporal efficiency, both in terms of product / service duration, and the ability to respond promptly to requests or response time (for example, the speed of intervention of a maintenance service activated due to an error message sent by a certain acquisition system).

All this involved a careful choice of monitoring stations, considering different possibilities beyond those required by the tender (medium cost and high cost, as well as low cost), compared in particular with maintenance costs.. In fact, no matter how smart, the network needs management activities that are expressed in "monitoring the monitoring network" and with "ordinary maintenance" (with a frequency of 1-3 months depending on the growing season) and "extraordinary maintenance" (further reference should be made to the following paragraph §6.5).

The aforementioned strategy was applied at the level of the individual components, managing to define different configurations of measuring stations (e.g., low cost controller, high cost sensor, medium cost power supply). An attempt was thus made to give the entire monitoring network a "fair" cost, which

balances the choice of any higher cost components with maintenance costs, without ever interfering with the aforementioned quality parameters.

5.1.2. SYSTEM ARCHITECTURE

To describe the system architecture, the OSI (Open Systems Interconnection) model was used, for which the separation of the levels is not so clear, on the contrary the layers overlap each other to create efficient, light, capable communication protocols. to support advanced energy saving features and flexible to changes in the network itself.

A simplified scheme of the structure defined for the biodiversity monitoring network is shown in Figure 5-1. The basic components are:

1. a set of distributed sensors (stations) in some monitoring points,

2. an interconnection network (wireless, based on the use of the mobile network),

3. a data collection point,

4. a set of computational resources with medium-high performance at the point of arrival of the network data in order to manage the network and perform data-logging, data correlations, processing, status monitoring, etc.
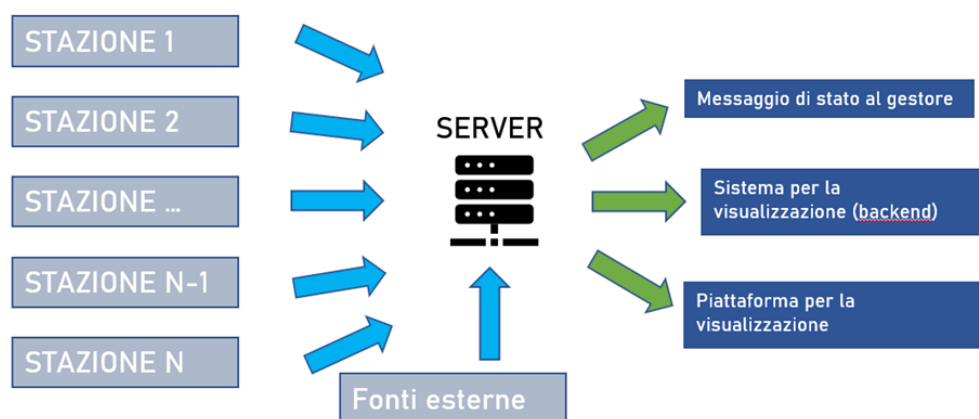
Figure 5-1: System architecture.

5.1.3. GENERAL ARCHITECTURE OF STATIONS

For each monitoring station, differentiated on the basis of the environmental and physical parameters being measured, a precise architecture has been provided, as described in the following paragraph. In general, the components of which they will be composed are:

- sensors (complete with complementary elements),
- physical support,
- power supply system (autonomous),
- data transmission system,
- system against vandalism (find me based on mobile network),
- environmental control system (waterproofing, humidity, temperature, etc).

Specifically, the choice of sensors was subsequent to the choice of parameters to be measured and of which to evaluate the space-time evolution, in this case environmental and biological parameters considered essential for the survival of the biodiversity present in the selected monitoring points. The sensor network will be completed with the implementation of automatic (also supervised) algorithms for the analysis of the measurements. The algorithms will be provided with guidelines and protocols that will allow their use even at the end of the contract.

The data transmission system must take into account the security of the transmission, i.e. it must be non-redundant, based on any public wireless networks (e.g. LoRaWan) and on a mobile network (e.g. LTE 4G), with local data storage. For the power supply system, solar panels with buffer battery will be used, adequately (pre)sized also in relation to the installed sensors, to avoid extraordinary maintenance interventions (in contrast to the "smart" goal of the network). Regarding the environmental control, IP65 enclosures will be used to protect the electronic component from atmospheric agents and passive and / or active heat sinks to maintain the temperature and humidity suitable for the electronic component.

5.1.4. MONITORING STATIONS

Part of the activities provided for the identification of the instrumentation and type of sensors to be used in the monitoring network being designed. The choice actually followed the inspections carried out in the Pilot areas, as well as the definition of the environmental and biological parameters to be monitored and found there. Performing, low/medium-cost, and energy autonomous and sustainable systems have been identified.

As described below, the network consists of a series of measurement points at which one or more monitoring stations of different types will be installed. The main characteristics of the individual stations (depending on the type) and of the measurement points are outlined below. The components

of which the monitoring stations are made are basically the following (the following paragraphs illustrate the minimum criteria for each component):

- Weather station
  - o Sensors: pluviograph (preferably tipping-bucket), air temperature and humidity sensor, direct irradiance sensor, ultrasonic anemometer, barometer, installation shed.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).
  - o Notes on operation: "continuous" operation; remote data transmission every hour.
- Flora monitoring station
  - o Sensors: leaf wetness sensor, soil moisture and temperature sensor, soil electrical conductivity sensor, infrared camera, infrared illuminator.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).
  - o Notes on operation: "continuous" operation for numerical data; acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote data transmission daily.
- Bird monitoring station
  - o Sensors: infrared camera, infrared illuminator, environmental microphone, microphone acquisition card.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).
  - o Notes on operation: "continuous" operation for numerical data; capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour.
- Station for monitoring insects, amphibians and reptiles
  - o Sensors: camera with night vision and fixed focus (focal distance equal to the distance to the ground) and motion sensor with zoom induction on the subject (specifically the animal) in motion, light plates, plate mounting bracket, soil humidity and temperature sensor.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables,

container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).

- o Notes on operation: "continuous" operation for numerical data; capturing images (snapshots) with a sampling time of 1 second.
- **Station for monitoring mammals**
  - o Sensors: infrared camera, infrared illuminator, environmental microphone, microphone acquisition card.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).
  - o Notes on operation: "continuous" operation; mammalian image acquisition (snapshots) activated by the ambient microphone; remote data transmission every hour.
- **Underwater monitoring station, type 1**
  - o Sensors: underwater video camera.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).
  - o Notes on operation: acquisition of images of fish fauna (snapshots) with sampling time equal to 1 second; remote data transmission every hour.
- **Underwater monitoring station, type 2**
  - o Sensors: underwater video camera, hydrophone.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).
  - o Notes on operation: "continuous" operation for numerical data; acquisition of images of fish fauna (snapshots) with sampling time equal to 1 second; remote data transmission every hour.
- **Underwater monitoring station, type 3**
  - o Sensors: underwater camera, pH sensor, turbidity sensor, temperature sensor, dissolved oxygen meter.
  - o Data storage: system on integrated circuit, case with heatsink, sensor acquisition module, touch screen for management, back-up power supply, 2 USB cables, cables, container (IP65), 2 cooling fans, power supply for fans, assembly (gsm-gprs module and sim subscription with flat rate, 2 years, for the station acting as an access point).

- o Notes on operation: "continuous" operation for numerical data; acquisition of images of fish fauna (snapshots) with sampling time equal to 1 second; remote data transmission every hour.

The main and common characteristics of the components of each measuring point are described in the following:

- Power supply: photovoltaic panel with buffer battery, connection cable, solar charge controller, mounting brackets, installation box, assembly.
- Data transmission: the measurement management system of one of the stations installed in the measurement point will act as an access point for all the others (installed in the same measurement point) consisting of an integrated circuit system, case with heat sink, gsm-gprs module, power supply for fans, sim subscription (flat rate, 2 years), assembly.
- Installation: labor, equipment, any support structure compatible with the environment and with the relative constraints of the installation point (the structure must ensure the installation of the instruments up to a maximum height of 7.0 m, base and thickness adequate to support all the instruments anchored to it), possible foundation construction of the support structure.

Each measuring point and each measuring station must be supplied complete with every component that ensures its operation, even if not explicitly described (eg wiring, etc ...) according to the "turnkey" formula.

5.2. MONITORING POINTS LOCATION

An accurate survey of the areas to be monitored was carried out in order to choose the points where to install the instrumentation with which to perform the measurements of the environmental and biological parameters. The result of these activities will be described below, for each of the three areas of interest. The final choice of monitoring points was made in agreement with the Client, local authorities and local management bodies (e.g. park managers, municipalities, etc.) as the main stakeholders of the project, as well as with the other partners of the project itself.

Appendix A reports the cadastral information and landscape constraints for each of the identified points.

It should be noted that the final and optimal choice of the direction to be fixed for the cameras provided in the various monitoring stations will be made during the installation and testing of the network.

5.2.1. PILOT AREA 1.1

A brief identification of the monitoring points chosen in Pilot Area 1.1 (fig. 5-2), i.e. along the coastal strip of the municipalities of Polignano a Mare, Monopoli, Fasano and Ostuni, is shown in Table 5-1. During the survey some places of particular environmental significance were identified, as they are ideal for resting and reproducing various animal species. In addition, plant species of equal environmental interest were distinguished, whose conservation is fundamental, even more so where the localized points fall within the "Dune Costiere" Park.

Figure 5-2: Location of the monitoring points provided for the Pilot Area 1.1 (Google Earth photo).

Table 5-1: Identification of monitoring points and their main characteristics within the Pilot Area 1.1.

Point	Latitude °N	Longitude °E	Location	Municipality	Sheet	Parcel	Headed
1A	40.80516	17.53903	Pilone/Rosa Marina	Ostuni	3	1	State Public Property
2A	40.810981	17.522712	Area Umida Costiera – Ostuni/ Lido Morelli	Ostuni	1	401	Ostuni Municipality

3A	40.810658	17.521701	Area Umida Costiera – Ostuni/ Lido Morelli	Ostuni	1	401	Ostuni Municipality
4A	40.810705	17.522177	Area Umida Costiera – Ostuni/ Lido Morelli	Ostuni	1	401	Ostuni Municipality
5A	40.810881	17.521956	Area Umida Costiera – Ostuni/ Lido Morelli	Ostuni	1	401	Ostuni Municipality
6A	40.812782	17.518112	Area Umida Costiera – Ostuni/ Lido Morelli	Ostuni	1	6	Ostuni Municipality
7A	40.813139	17.516730	Area Umida Costiera – Ostuni/ Lido Morelli	Ostuni	1	401	Ostuni Municipality
8A	40.806903	17.525639	Area interna – Ostuni/ Lido Morelli	Ostuni	2	24	Private property
9A	40.784470	17.552011	Montalbano - Ostuni	Ostuni	13	209	Private property
10A	40.976472	17.256103	Falesia in area costiera _Incine, Polignano a Mare	Polignano a Mare	33	303	State Public Property
11A	41.032445	17.154162	Costa Ripagnola	Polignano a Mare	1	2	State Public Property
12A	40.772035	17.657009	Torre Pozzelle	Ostuni	52	10	State Public Property
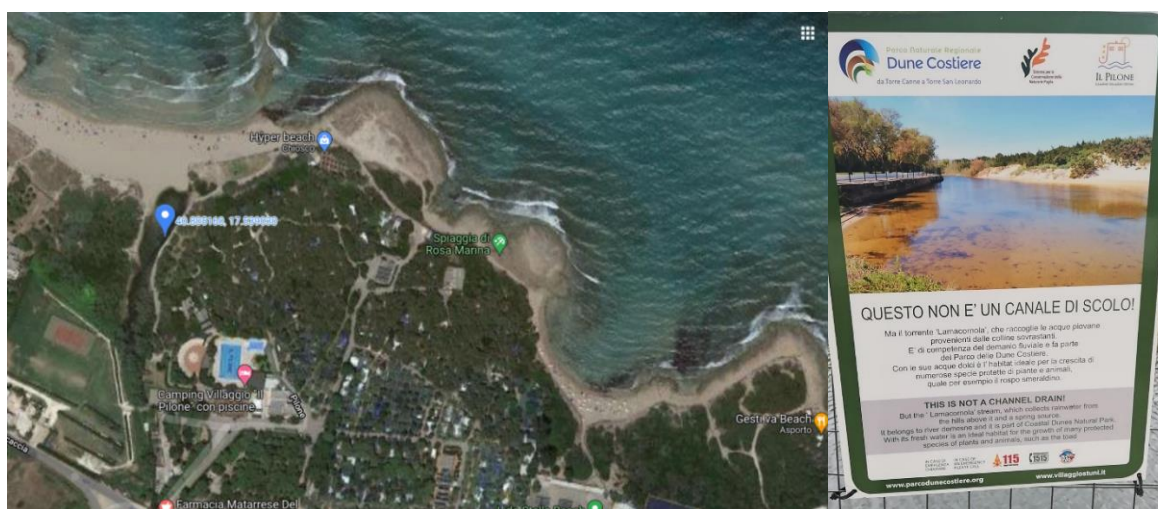
Figure 5-3: Location of monitoring point n. 1A, near Pilone/Rosa Marina (BR) (left photo from Google Maps).

Figure 5-4: View towards the land (left) and towards the sea (right) where to place the monitoring point n. 1A, near Pilone/Rosa Marina (BR).
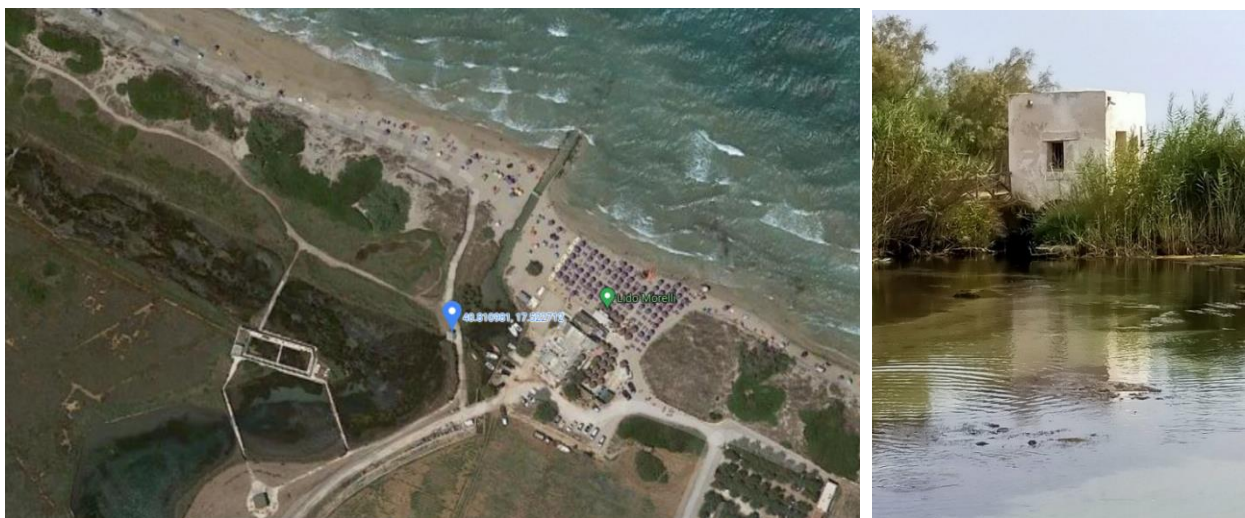
Figure 5-5: Location of monitoring point n. 2A, near the coastal wetland area of Ostuni/Lido Morelli (BR) (left photo from Google Maps).
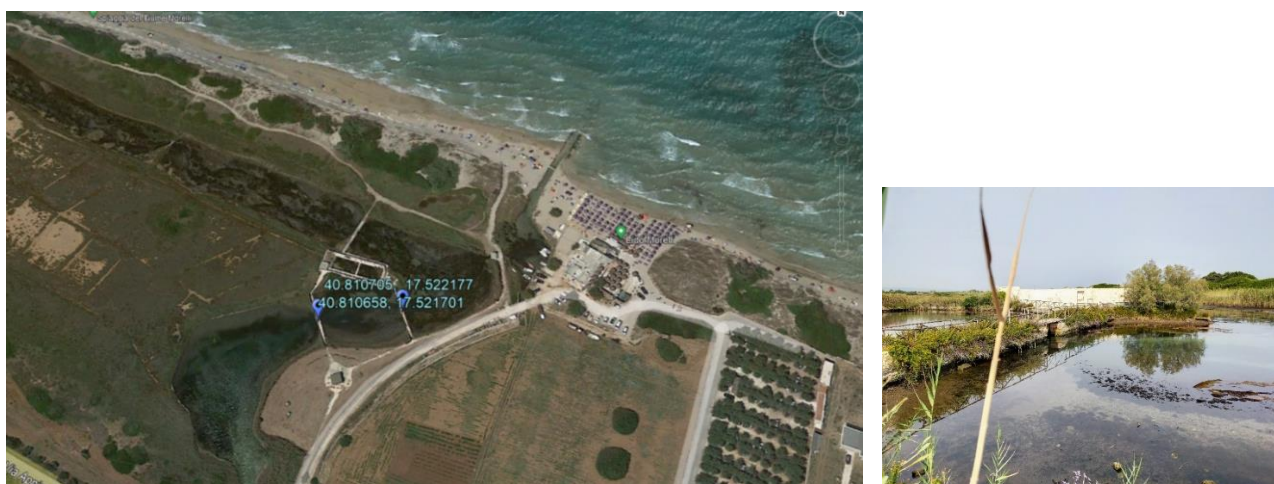
Figure 5-6: Connection with the sea of the series of internal channels near the wet coastal area of Ostuni/Lido Morelli (BR), where to place the cameras provided for monitoring points n. 3A-4A (left photo from Google Maps).
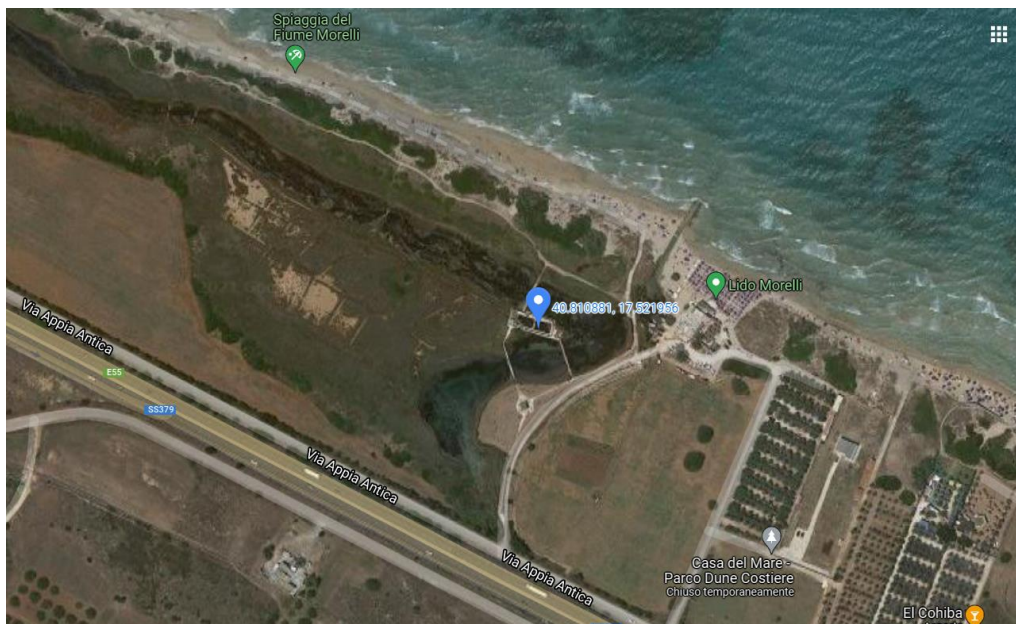
Figure 5-7: Location of monitoring point n. 5A, near the wet coastal area of Ostuni/Lido Morelli (BR) (Google Maps photo).

Figure 5-8: Existing structure useful for positioning the instrumentation provided for the monitoring point n. 5A, near the wet coastal area of Ostuni/Lido Morelli (BR).
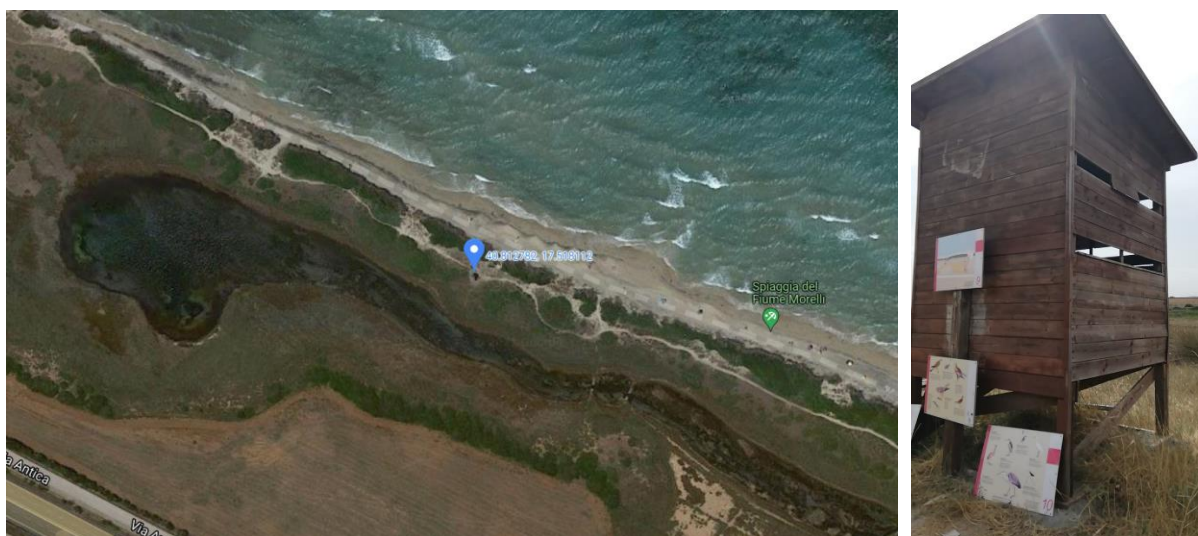
Figure 5-9: Location of monitoring point n. 6A, near the coastal wetland of Ostuni/Lido Morelli (BR) (left photo from Google Maps). The installation pole will be positioned close to the structure in the figure on the right.
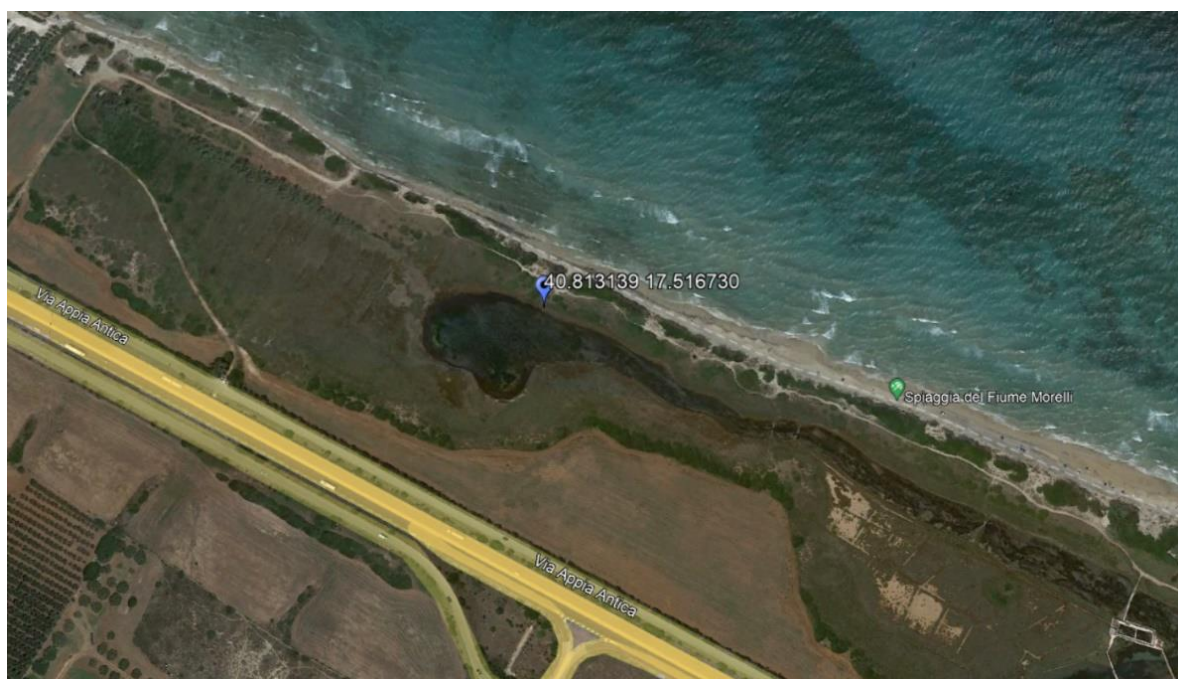
Figure 5-10: Location of monitoring point n. 7A, near the wet coastal area of Ostuni/Lido Morelli (BR) (Google Maps photo).

Figure 5-11: View of the stretch of water where to install the monitoring point n. 7A, near the wet coastal area of Ostuni/Lido Morelli (BR).
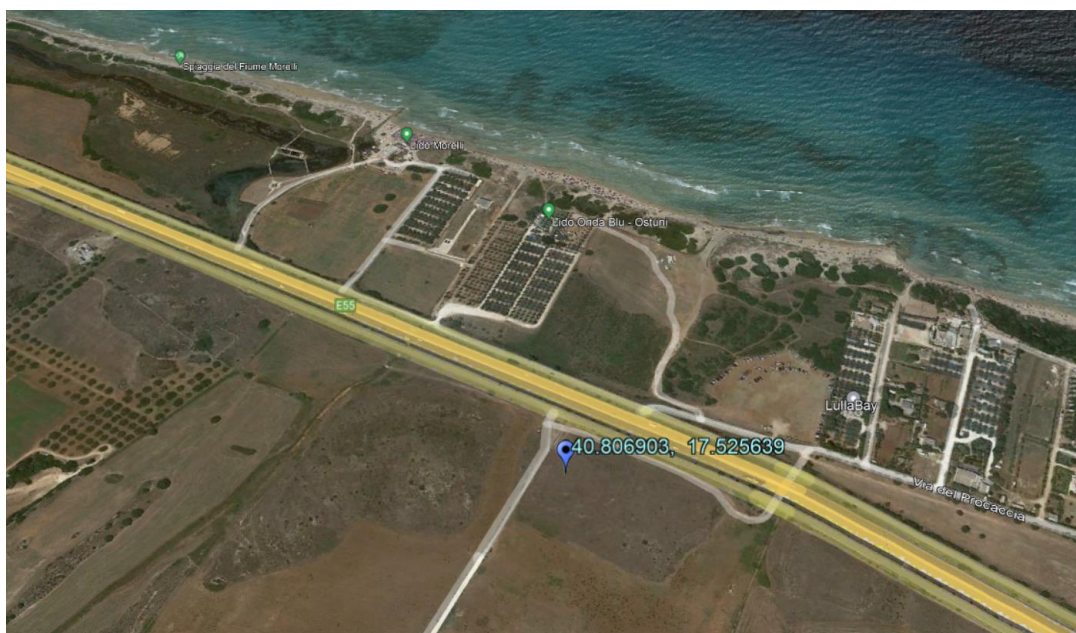
Figure 5-12: Location of monitoring point n. 8A (Google Maps photo).

Figure 5-13: Sign showing the location of the area where to place the monitoring point n. 8A.
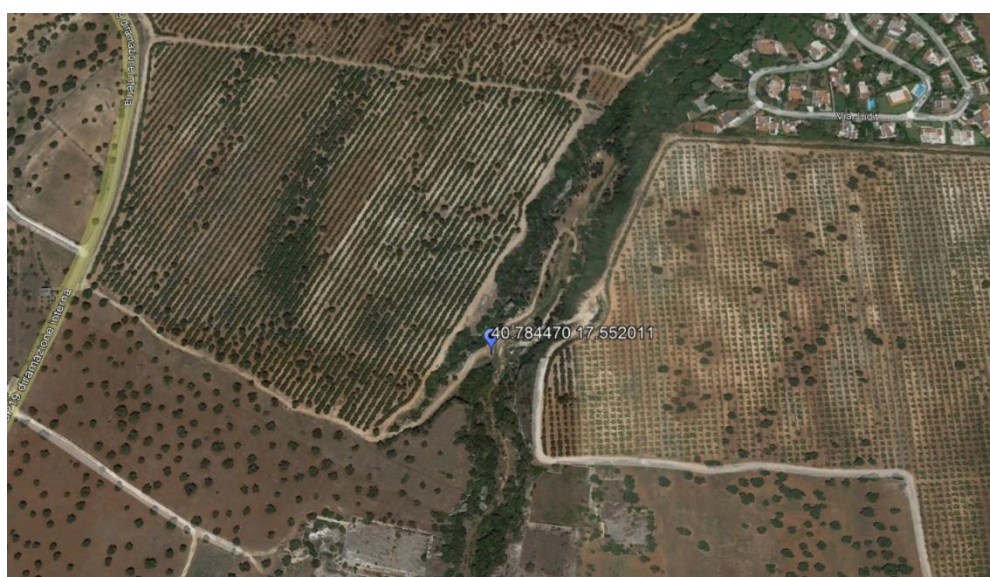
Figure 5-14: Location of monitoring point n. 9A, in the hinterland falling within the Dune Costiere, Regional Natural Park (BR) (Google Maps photo).
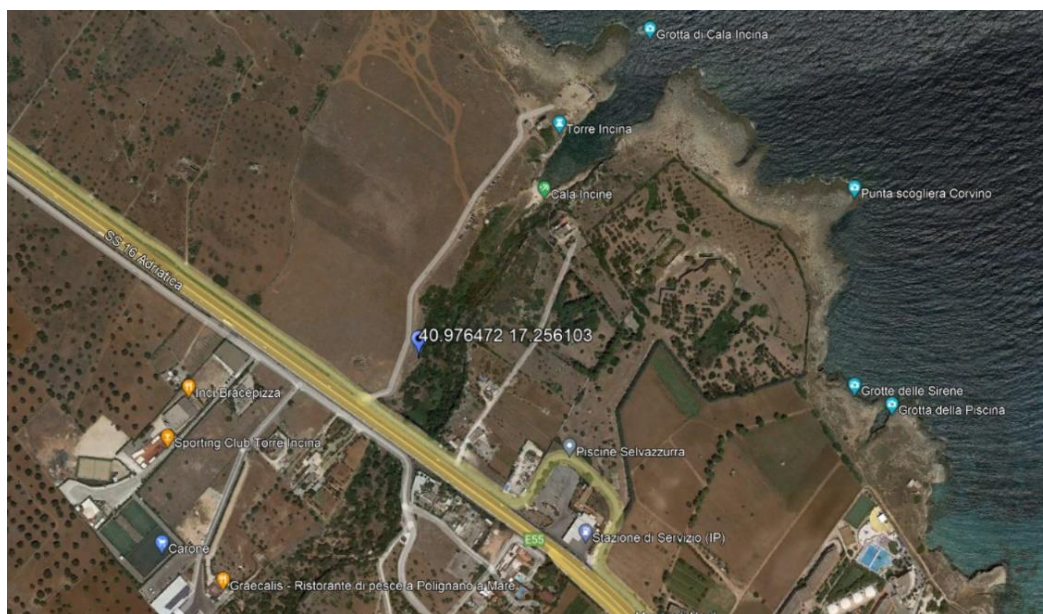
Figure 5-15: Location of monitoring point n. 10A, cliff in the coastal area named Incine, Polignano a Mare (Google Maps photo).

Figure 5-16: Support structure for the instrumentation planned at the monitoring point n. 10A, cliff in the coastal area in Incine, Polignano a Mare. In the figure on the right there is a sign showing the location of the area.
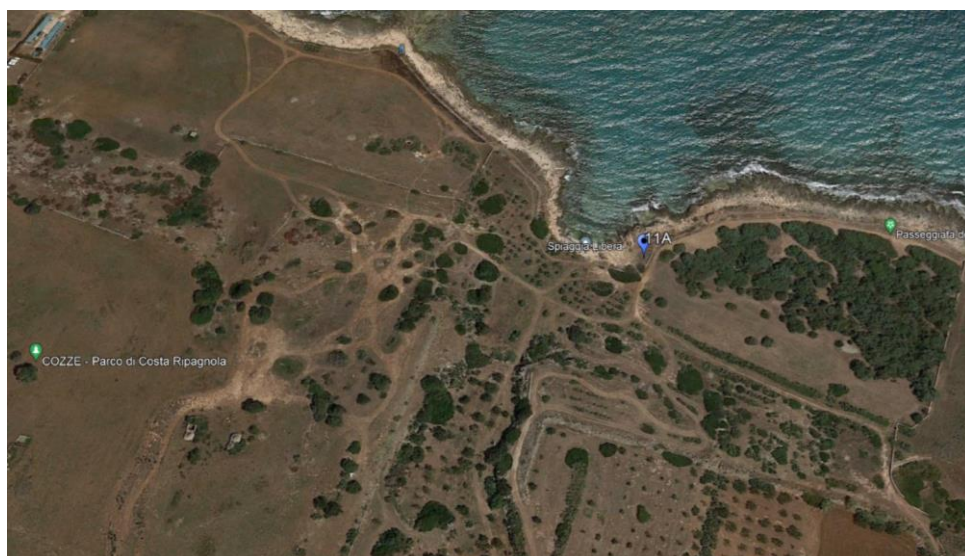
Figure 5-17: Location of monitoring point n. 11A, in Costa Ripagnola site (Google Maps photo).
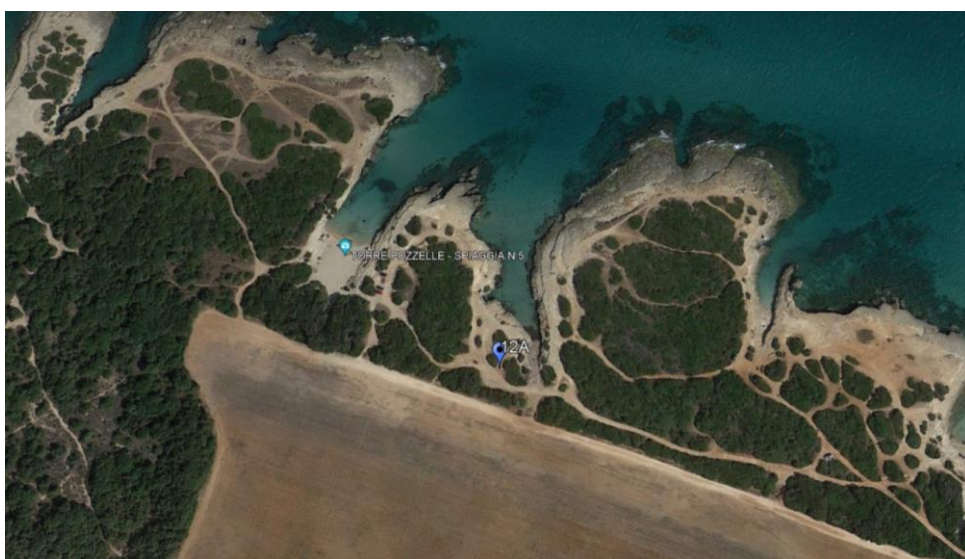
Figure 5-18: Location of monitoring point n. 12A, in Torre Pozzelle location, Ostuni (Google Maps photo).

5.2.2. PILOT AREA 1.2

The monitoring network created within the perimeter of the "Mar Piccolo" Regional Natural Park includes places of particular environmental significance, such as Lake Pappadai and Palude La Vela, rich in various animal species (see Figure 5-19 and Table 5-2).

Figure 5-19: Location of monitoring point provided for the Pilot Area 1.2 (Google Earth photo).

Table 5-2: Identification of monitoring points and their main characteristics within the Pilot Area 1.2.

Point	Latitude °N	Longitude °E	Location	Municipality	Sheet	Parcel	Headed
1B	40.467909	17.426119	Canale Marullo Cecena	Carosino (TA)	9	227	State Public Property
2B	40.459083	17.454299	Lago Pappadai	Monteparano (TA)	6	8	State property of the Puglia Region
3B	40.479625	17.344152	Canale d'Aiedda	Taranto (TA)	233	54 (near Waters)	State Public Property

4B	40.473863	17.314608	Palude La Vela	Taranto (TA)	/	/	Water – Taranto Municipality
5B	40.476760	17.319062	Palude La Vela	Taranto (TA)	/	/	Water – Taranto Municipality
6B	40.485441	17.324907	Palude La Vela	Taranto (TA)	/	/	Water – Taranto Municipality
7B	40.480906	17.268772	Mar Piccolo, seno di Ponente	Mar Piccolo (TA)	242	2 (near Waters)	Taranto Municipality
8B	40.492423	17.265648	Mar Piccolo, seno di Ponente	Mar Piccolo (TA)	242	4 (near Waters)	Taranto Municipality
9B	40.502220	17.245214	Torrente Galeso	Taranto (TA)	204	24	Province of Taranto

Figure 5-20: Location of monitoring point n. 1B, on the Marullo Cecena canal, near Lake Pappadai (TA) (Google Maps photo).

Figure 5-21: View of the two banks of the Marullo Cecena canal, near Lake Pappadai (TA), where to position the monitoring point n. 1B.
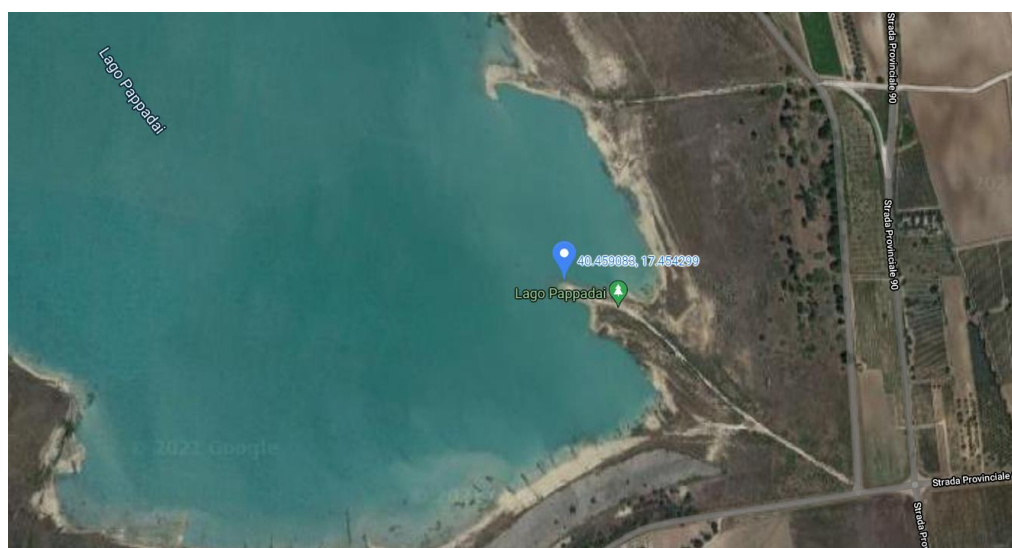
Figure 5-22: Location of monitoring point n. 2B, near Lake Pappadai (TA) (Google Maps photo).

Figure 5-23: View of the two inlets of Lake Pappadai (TA), towards which to direct the two video cameras for bird monitoring at point n. 2B.
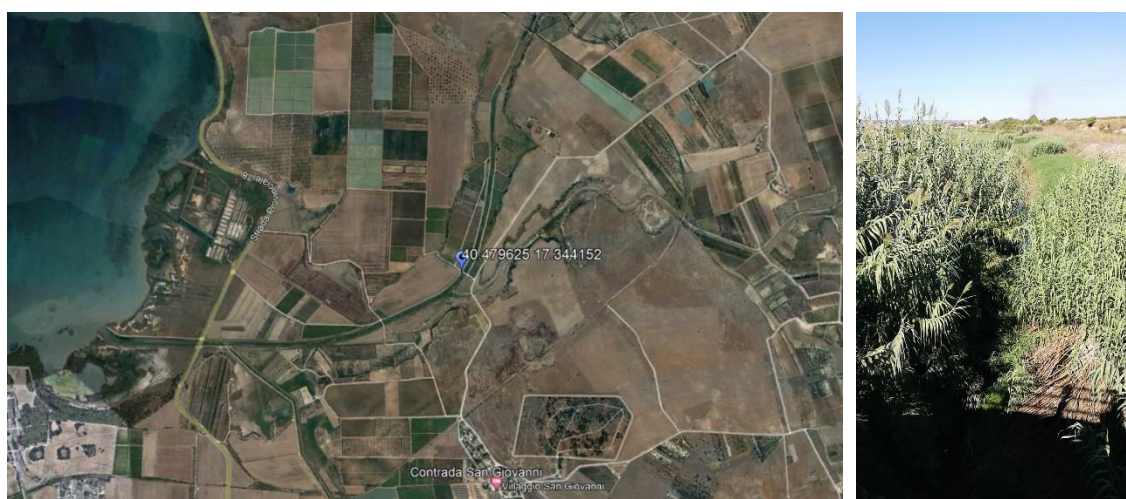
Figure 5-24: Location of monitoring point n. 3B, near the Aiedda canal (TA) (left photo from Google Maps).
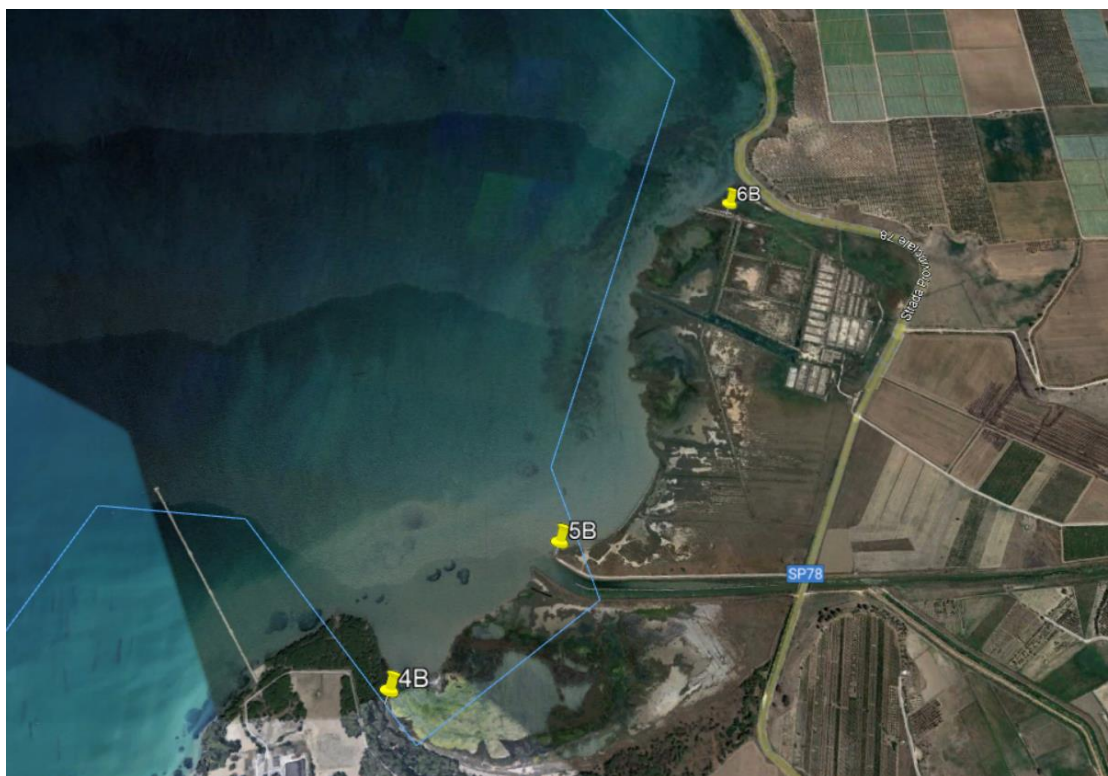
Figure 5-25: Location of monitoring points n. 4B, 5B, 6B, in the locality of Palude LA Vela (TA) (Google Maps photo).

Figure 5-26: View towards the East (photo on the left) and towards the North-West (photo on the right) with respect to monitoring point 5B, in the locality of Palude La Vela (TA).
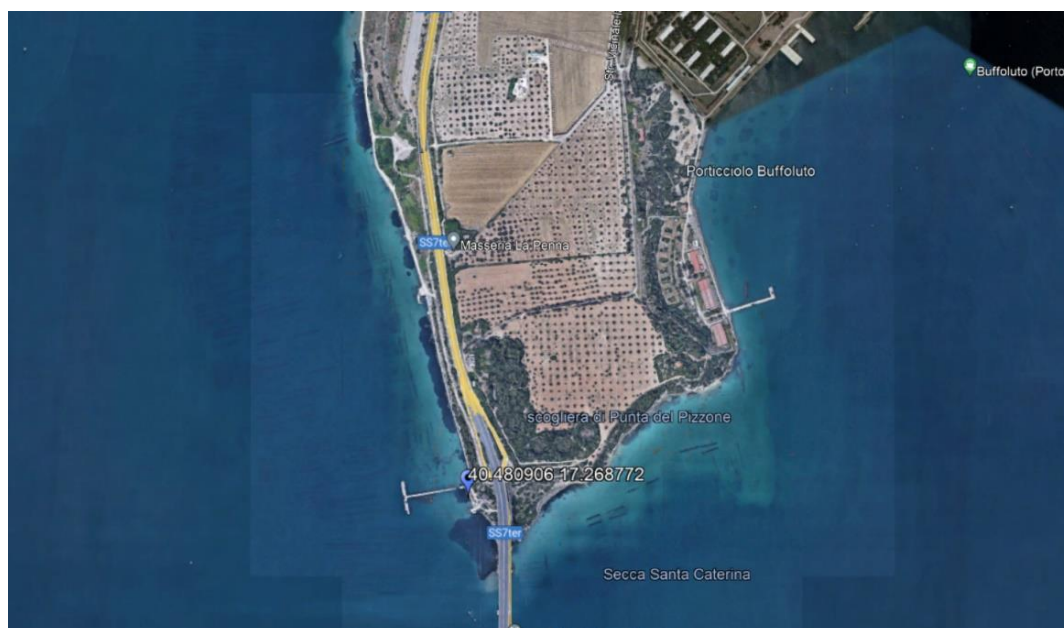
Figure 5-27: Location of monitoring point n. 7B, in the western basin of the Mar Piccolo (TA) (Google Maps photo).
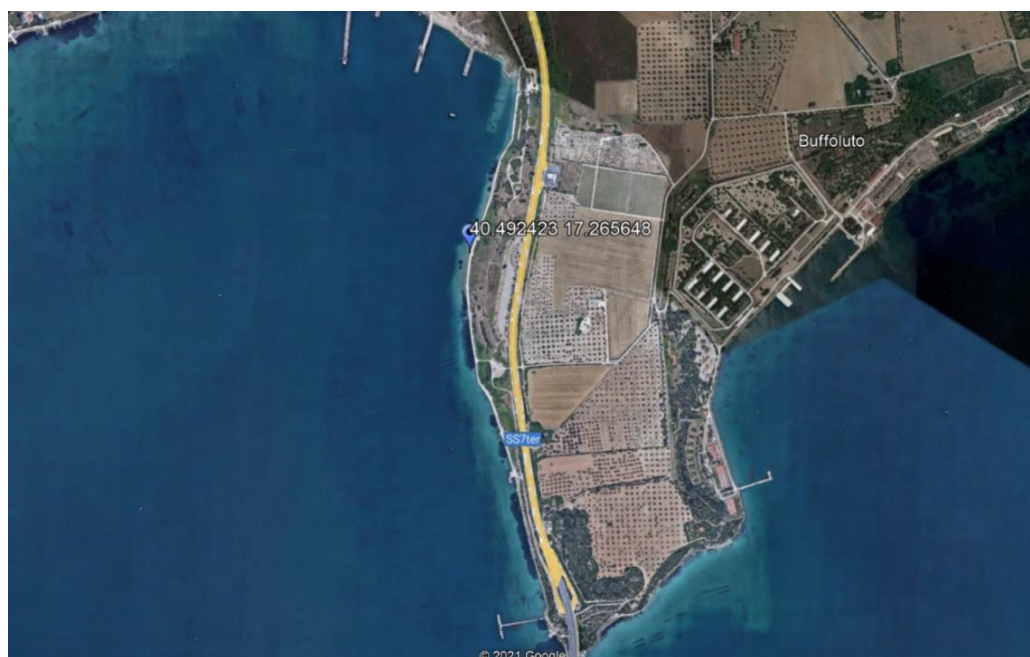
Figure 5-28: Location of monitoring point n. 8B, in the western basin of the Mar Piccolo (TA) (Google Maps photo).

Figure 5-29: Location of monitoring point n. 9B, near the stream Galeso (TA) (Google Earth photo).

5.2.3. PILOT AREA 2

To complete the monitoring network covered by this Project, additional stations have been identified in two natural parks in the territory included in the Pilot Area n. 2, represented by the areas of the regional territory affected by the *Xylella fastidiosa*.

The first two monitoring points (points 1C-2C) were chosen within the "Bosco delle Pianelle" Regional Nature Reserve, a protected natural area located in the municipality of Martina Franca (TA), as well as in the wider SIC, IT130005 "Murgia di Sud-Est", established by the Region Puglia with law of 23/12/2002, n. 27, pursuant to L.R. 19/1997 "Rules for the establishment and management of protected natural areas in the Puglia Region" and Law n. 394/1991 "Framework law on protected areas". The Reserve occupies 590 ha and was created with the aim of conserving natural biodiversity and promoting sustainable economic and fruition activities from an environmental point of view.

The third (point 3C) and fourth (point 4C)monitoring points fall within the Le Cesine Nature Reserve (LE), which, thanks to studies and research carried out or promoted over the years by the WWF, has been recognized as a SPA (Special Protection Area) due to the nesting of various animal species, and SIC (Site of Community Interest) thanks to the presence in the area of habitats and animal and plant species listed in the various annexes to the Habitat Directive and the Birds Directive. The area also represents an extraordinary training ground for knowledge and respect for nature.

The last two points (points 4C-5C) fall within the Acquatina Coastal Basin Naturalistic Oasis, a humid coastal area with an area of 100 hectares, located in the municipality of Lecce. The basin of brackish water covers an area of 45 hectares and extends for 2 km in a rear dune position. Among the plant species, there are shrubs of the Mediterranean scrub, the salt steppe and various species of spontaneous orchids. Among the animal species, there is an abundant and valuable ichthyofauna.

Table 5-3: Identification of monitoring points and their main characteristics within the Pilot Area 2.

Point	Latitude °N	Longitude °E	Location	Municipality	Sheet	Parcel	Headed
1C	40.648386	17.225220	Riserva Bosco delle Pianelle	Martina Franca (TA)	182	2	Martina Franca Municipality
2C	40.639836	17.218504	Riserva Bosco delle Pianelle	Martina Franca (TA)	182	2	Martina Franca Municipality
3C	40.354257	18.340632	Riserva Le Cesine	Vernole (LE)	17	34	Puglia Region

4C	40.351035	18.343570	Riserva Le Cesine	Vernole (LE)	17	36	Puglia Region
5C	40.437782	18.245121	Acquatina di Frigole	Lecce	83	5	University of Salento
6C	40.439436	18.240977	Acquatina di Frigole	Lecce	83	2	University of Salento
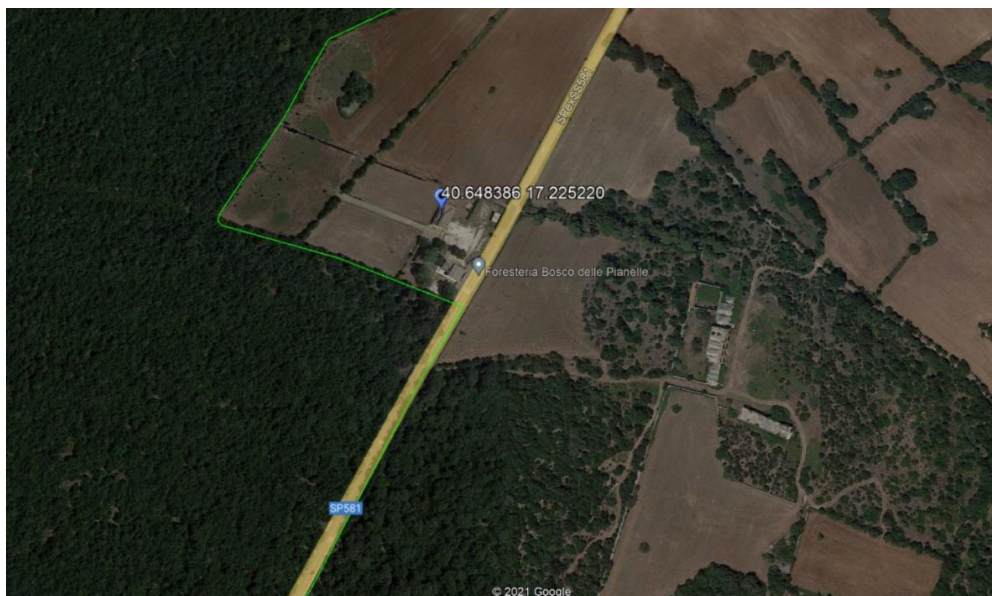
Figure 5-30: Location of monitoring point n. 1C, within the Bosco delle Pianelle Regional Nature Reserve, Martina Franca (TA), at the Guest House (Google Maps photo).

Figure 5-31: Photo of the Guest House of the Bosco delle Pianelle Regional Nature Reserve, Martina Franca (TA), where to position the monitoring point n. 1C.
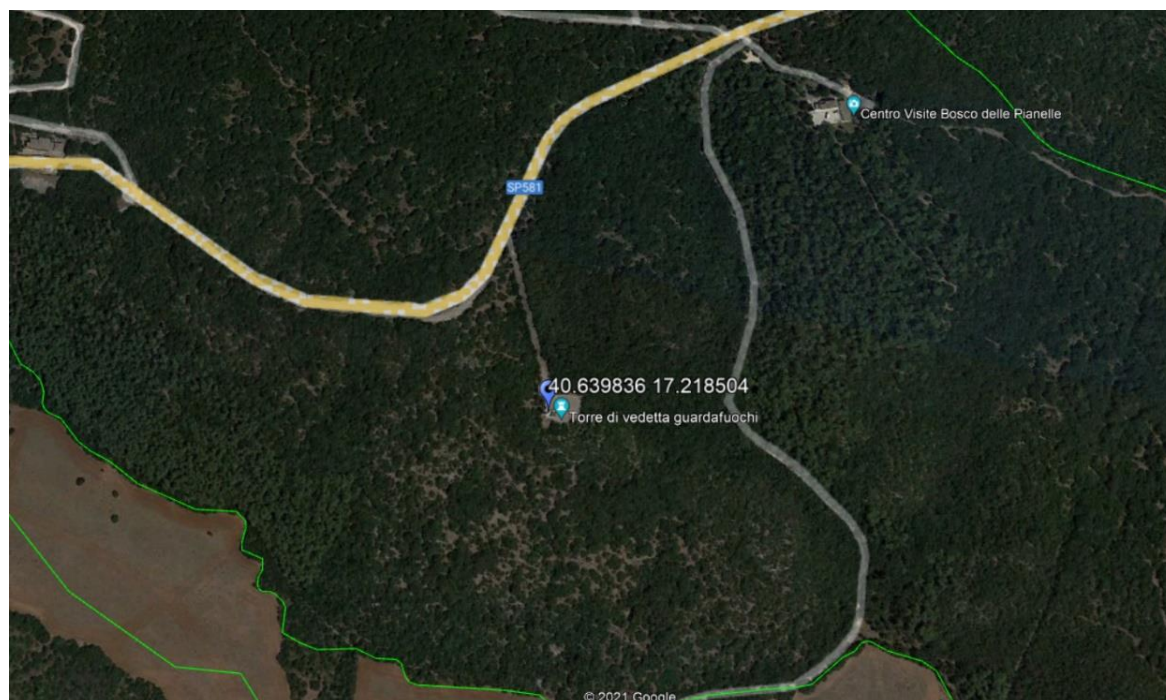
Figure 5-32: Location of monitoring point n. 2C, within the Bosco delle Pianelle Regional Nature Reserve, Martina Franca (TA), where the firefighter lookout tower is located (Google Maps photo).

Figure 5-33: View of the area at monitoring point n. 2C, within the Bosco delle Pianelle Regional Nature Reserve, Martina Franca (TA), near the firefighter lookout tower (photo on the right).
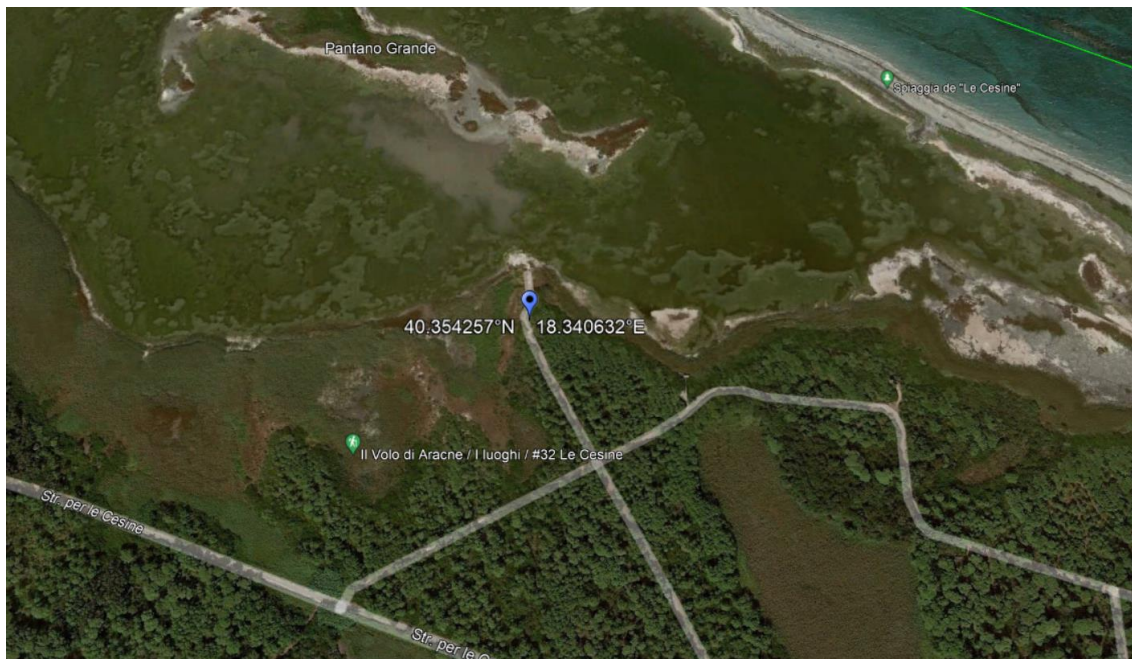
Figure 5-34: Location of monitoring point n. 3C, within Le Cesine Nature Reserve, Vernole (LE) (Google Maps photo).

Figura 5-35: Location of monitoring point n. 4C, within Le Cesine Nature Reserve, Vernole (LE) (Google Maps photo).
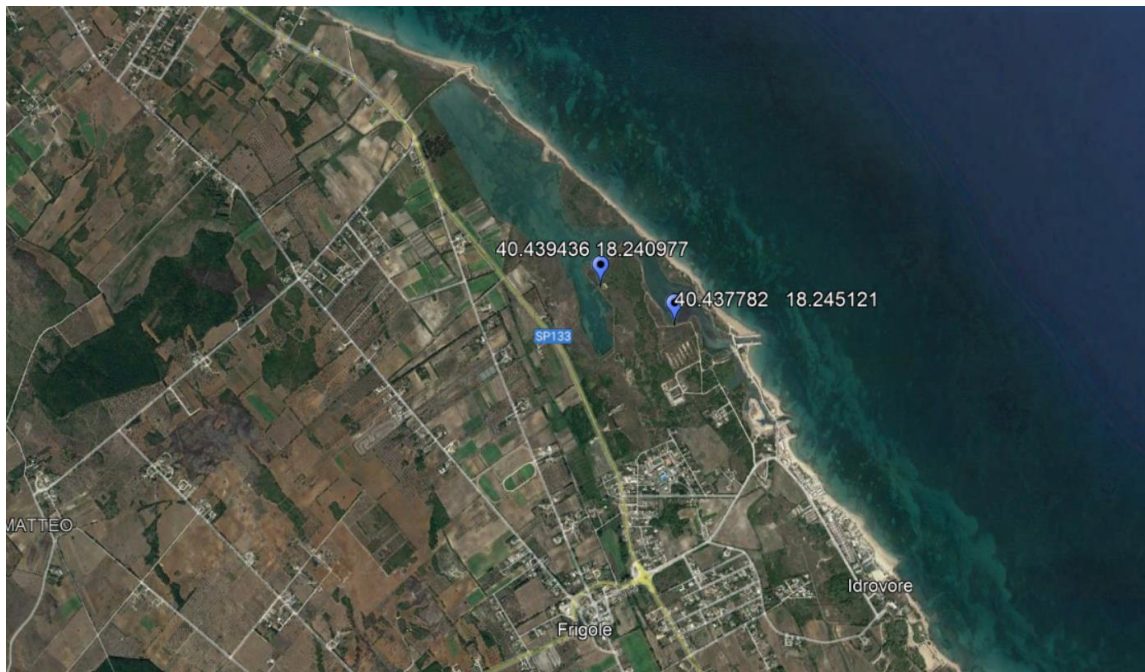
Figure 5-36: Location of monitoring points n. 4C-5C, within the Acquatina Coastal Basin naturalistic oasis, Frigole (LE) (Google Earth photo).

Figure5-37: Zoom of the monitored areas where there are points n. 4C (on the left) and 5C (on the right), within the Acquatina Coastal Basin naturalistic oasis, Frigole (LE) (Google Earth photo).

5.3. TECHNOLOGICAL AND FUNCTIONAL REQUIREMENTS

On the basis of the description illustrated in the previous paragraphs, and on the basis of the information given in the appendices, the monographic data sheets of each monitoring point (in total number of 27) and the data sheets of the components of the relative monitoring stations (in number total of 75) are shown in the following.

Each monographic data sheet of the monitoring points contains the information as follows:

- *Name of the monitoring point*
  Identification abbreviation of the monitoring point

- *Pilot* area
  Identification code of the pilot area in which the monitoring point is located

- *Coordinates of the monitoring point*
  Geographic coordinates of the monitoring point

- *Type of stations foreseen in the monitoring point and relative identification code*
  Stations planned at the monitoring point

- *Type of installation*
  Notes on the installation of stations at the point, depending on the conditions of the area

- *Image of the installation area*
  Detail of the installation area as taken from the images of the Google Earth database

- *Functional requirements of each station foreseen in the monitoring point*
  Requirements for the acquisition of each station installed at the monitoring point

For each station type (meteorological monitoring, bird monitoring, flora monitoring, mammal monitoring, insect monitoring), the minimum technical requirements of each component are reported. Furthermore, the minimum technical requirements of the server are reported.

5.4. EXECUTIVE DESIGN ACTIVITIES

Each measurement point and each measurement station will require the preparation of an executive project that describes and defines the technological and technical details for the correct functioning of the stations and for the correct installation of the instrumentation at each measurement point.

Specifically, the executive design must concern both the individual measurement stations (depending on the type) and the various measurement points. As for the measurement stations, it will be necessary to uniquely define the technological characteristics and the assembly method of the entire system. As regards the measurement points, it will be necessary to uniquely define the characteristics of the installation both from a physical point of view (e.g. need for a support

structure) and from a technological point of view (e.g. sizing of the power supply system). Each station and each measuring point, as already mentioned, must be complete with all parts (both hardware and software) necessary for its "turnkey" operation, even if not expressly described in this document.

5.5. MAINTENANCE ACTIVITIES

To complete the planning activities of the monitoring network and to guarantee its correct functioning over time, ordinary and extraordinary maintenance must be carried out, as follows:

- ✓ **Ordinary maintenance**: is aimed at maintaining the efficiency of the monitoring network as a whole and over time. As regards the monitoring stations and the control of their correct functioning and state of the places, four annual *in situ* visits must be planned, specifically in the months of January, March, June, September, after which an inspection report with photographic attachments must be drawn up.
- ✓ **Extraordinary maintenance**: it concerns the rectification or replacement of parts of the instrumental components of the monitoring network that show malfunctions; the extraordinary maintenance activity will be managed by the centralized data collection system which, among other things (refer to paragraph §5.5.3) will be able to highlight any malfunctions of the stations.

In addition to the aforementioned physical maintenance interventions of the monitoring stations, the maintenance services of application software must be added, which must include (refer to paragraph §5.5.3) diagnosis and removal of the causes and effects of any malfunctions of the applications and running programs. This activity should preferably be carried out remotely, but may sometimes require an *in situ* visit if accompanied by malfunctions of the hardware component.

The activities of taking charge of the products developed and to be released in operation, in order to acquire the know-how necessary for the correct performance of the service, are to be considered an integral part of the maintenance of the software component.

5.5.1. MONOGRAPHIC SHEETS OF THE MONITORING POINTS

Monitoring point	1A
Pilot area	1.1
Coordinates of the monitoring point	40.80516N, 17.53903E (WGS84)
Monitoring stations	• Bird monitoring • Mammal monitoring • Flora monitoring
Installation	• Installation on a single color pole with low landscape impact; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) • Bird monitoring in North direction • Mammal monitoring in North-East direction • Flora monitoring in West direction • The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge •
Installation area	

Functional requirements	• Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.
	• Flora monitoring: "continuous" operation for numerical data; acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote transmission of data once a day, with deletion of data locally after verification of correct transmission.

Monitoring point	2A
Pilot area	1.1
Coordinates of the monitoring point	40.810981N, 17.522712E (WGS84)
Monitoring stations	• Fish monitoring with water parameters measurement
Installation	• Installation of two video cameras (with framing along the axis of the canal, with opposite view) on submerged poles located just upstream of the section narrowing. The electronic components can be installed on the nearby structure (in direct correspondence with the narrowing), suitably connected to the sensors. • Installation of sensors for the measurement of water parameters on immersed posts, with low impact on the landscape. • The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	• Fish monitoring: capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. • Water parameters monitoring: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	3A
Pilot area	1.1
Coordinates of the monitoring point	40.810658N, 17.521701E (WGS84)
Monitoring stations	Fish monitoring
Installation	- Installation of two video cameras (with framing along the axis of the channel, with opposite view) on submerged poles. The electronic components can be installed on the nearby structure, suitably connected to the sensors. - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	Fish monitoring: capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	4A
Pilot area	1.1
Coordinates of the monitoring point	40.810705N, 17.522177E (WGS84)
Monitoring stations	Fish monitoring
Installation	- Installation of two video cameras (with framing along the axis of the channel, with opposite view) on submerged poles. The electronic components can be installed on the nearby structure, suitably connected to the sensors. - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Fish monitoring: capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	5A
Pilot area	1.1
Coordinates of the monitoring point	40.810881N, 17.521956E (WGS84)
Monitoring stations	Weather station
Installation	- Installation of the station on an existing structure with the use of a meteorological shed. - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	Monitoring of physical parameters: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	6A
Pilot area	1.1
Coordinates of the monitoring point	40.812782N, 17.518112E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Flora monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single color pole with low landscape impact placed at the existing structure; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South-West and South-East direction - Mammal monitoring in West direction - Flora monitoring in South direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a

	sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.
	• Flora monitoring: "continuous" operation for numerical data (leaf wetness, soil sensor); acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote transmission of data once a day, with deletion of data locally after verification of correct transmission.
	• Reptile monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	7A
Pilot area	1.1
Coordinates of the monitoring point	40.813139N, 17.516730E (WGS84)
Monitoring stations	- Bird monitoring - Underwater parameter monitoring
Installation	- Installation of the bird monitoring station on a low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South-West direction - Installation of sensors for the measurement of water parameters on immersed posts, with low impact on the landscape - The electronic components are provided on the single existing pole - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Water parameters monitoring: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	8A
Pilot area	1.1
Coordinates of the monitoring point	40.806903N, 17.525639E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South direction - Mammal monitoring in East direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.

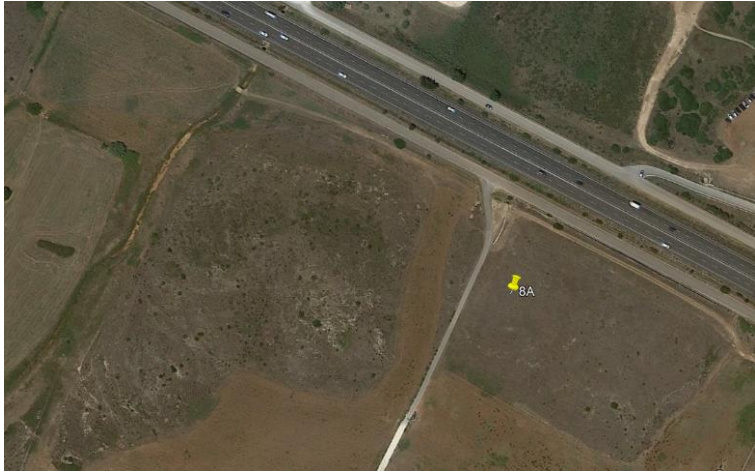|	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. • Reptile monitoring: "continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. • Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	9A
Pilot area	1.1
Coordinates of the monitoring point	40.784470N, 17.552011E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in North direction - Mammal monitoring in East direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour

	with deletion of data locally after verification of correct transmission. • Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. • Reptile monitoring: "continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. • Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	10A
Pilot area	1.1
Coordinates of the monitoring point	40.976472N, 17.256103E (WGS84)
Monitoring stations	Bird monitoring
Installation	- Installation of the bird station on a color pole with low landscape impact; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in North-East direction. - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge.
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission..

Monitoring point	11A
Pilot area	1.1
Coordinates of the monitoring point	41.032445N, 17.154162E (WGS84)
Monitoring stations	• Weather station • Bird monitoring • Mammal monitoring • Flora monitoring • Reptile monitoring • Insect monitoring
Installation	• Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) • The meteorological station must be equipped with a meteorological shed, with low landscape impact • Bird monitoring in North direction • Mammal monitoring in East direction • Flora monitoring in West direction • Reptile monitoring towards the ground • Insect monitoring on an illuminated plate The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	

Functional requirements	- Monitoring of physical parameters: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Flora monitoring: "continuous" operation for numerical data (leaf wetness, soil sensor); acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote transmission of data once a day, with deletion of data locally after verification of correct transmission. - Reptile monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	12A
Pilot area	1.1
Coordinates of the monitoring point	40.772035N, 17.657009E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Flora monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South-East direction - Mammal monitoring in East direction - Flora monitoring in South direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds;

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remote data transmission every hour with deletion of data locally after verification of correct transmission.

- Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

- Flora monitoring: "continuous" operation for numerical data (leaf wetness, soil sensor); acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote transmission of data once a day, with deletion of data locally after verification of correct transmission.

- Reptile monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.

- Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

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Monitoring point	1B
Pilot area	1.2
Coordinates of the monitoring point	40.467909N, 17.426119E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in North-West direction - Mammal monitoring in South-East direction - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	2B
Pilot area	1.2
Coordinates of the monitoring point	40.459083N, 17.454299E (WGS84)
Monitoring stations	- Weather station - Bird monitoring - Mammal monitoring - Fish monitoring with water parameters measurement
Installation	- Installation on a single color pole with low landscape impact; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - The meteorological station must be equipped with a meteorological shed - Bird monitoring towards the two diametrically opposite inlets - Mammal monitoring in the opposite direction to Lake Pappadai (towards land) - Installation of video camera and water parameter measurement sensors on immersed poles, with power supply on the installation pole of the other stations - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Monitoring of physical parameters: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission

	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Fish monitoring: capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Water parameters monitoring: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	3B
Pilot area	1.2
Coordinates of the monitoring point	40.479625N, 17.344152E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring downstream of the canal - Monitoring of mammals downstream of the canal - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	4B
Pilot area	1.2
Coordinates of the monitoring point	40.473863N, 17.314608E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South-East and North-East - Mammal monitoring in South direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.

	- Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Reptile monitoring: "continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	5B
Pilot area	1.2
Coordinates of the monitoring point	40.476760N, 17.319062E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South and North-West direction - Mammal monitoring in East direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.

	- Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Reptile monitoring: "continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	6B
Pilot area	1.2
Coordinates of the monitoring point	40.485441N, 17.324907E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South and North direction - Mammal monitoring in South direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.

	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. • Reptile monitoring: "continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. • Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	7B
Pilot area	1.2
Coordinates of the monitoring point	40.480906N, 17.268772E (WGS84)
Monitoring stations	Underwater monitoring with hydrophone
Installation	• Installation to be verified *in situ*, probably by means of a support anchored to the bank where to place the submerged sensors, with a low landscape impact color • The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Underwater monitoring: "continuous" operation for numerical data (hydrophone); capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.

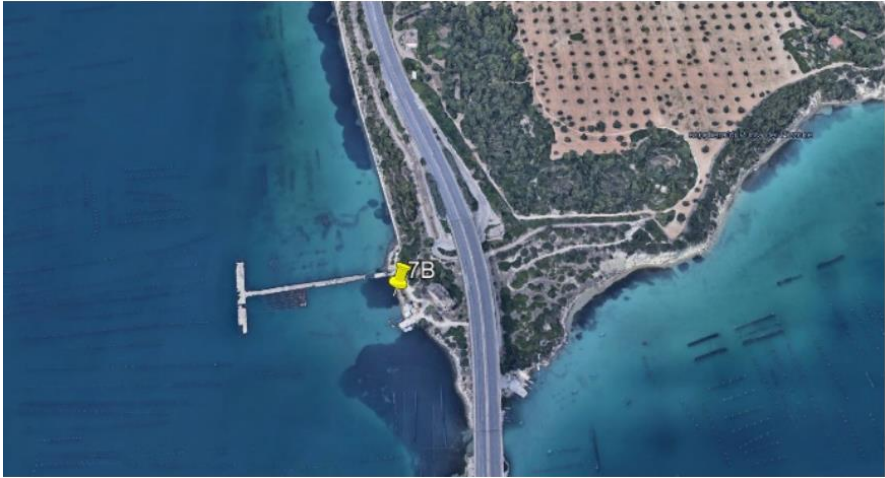| Monitoring point	8B
Pilot area	1.2
Coordinates of the monitoring point	40.492423N, 17.265648E (WGS84)
Monitoring stations	Underwater monitoring with hydrophone
Installation	- Installation to be verified *in situ*, probably by means of a support anchored to the bank where to place the submerged sensors, with a low landscape impact color - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Underwater monitoring: "continuous" operation for numerical data (hydrophone); capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.

Monitoring point	9B
Pilot area	1.2
Coordinates of the monitoring point	40.502220N, 17.245214E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Flora monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in South direction - Mammal monitoring in West direction - Flora monitoring in West direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling

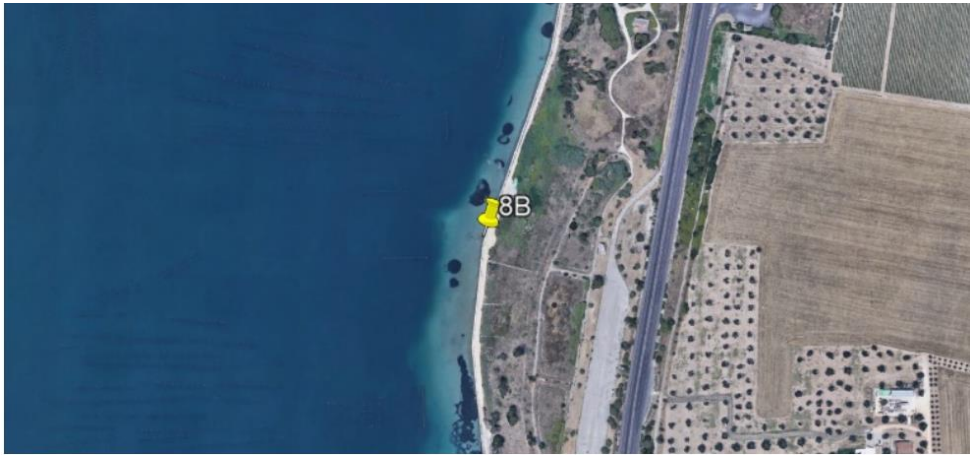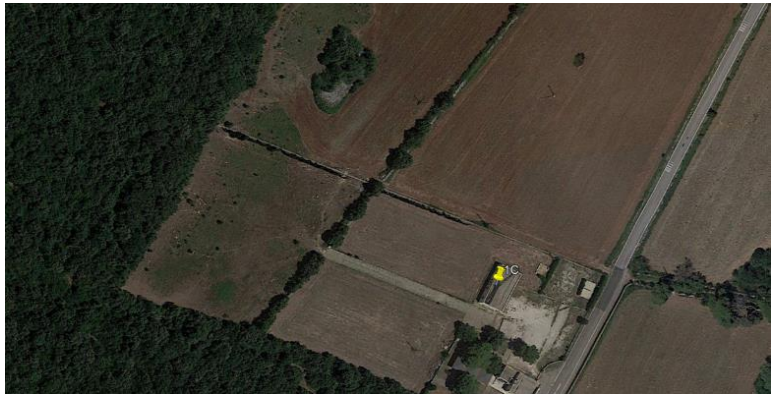|	time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.
	• Flora monitoring: "continuous" operation for numerical data (leaf wetness, soil sensor); acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote transmission of data once a day, with deletion of data locally after verification of correct transmission.
	• Reptile monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	1C
Pilot area	2
Coordinates of the monitoring point	40.648386N, 17.225220E (WGS84)
Monitoring stations	- Weather station - Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - The meteorological station must be equipped with a meteorological shed, with low environmental impact - Bird monitoring in North direction - Mammal monitoring in East - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Monitoring of physical parameters: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Reptile monitoring: continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	2C
Pilot area	2
Coordinates of the monitoring point	40.639836N, 17.218504E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in North direction - Mammal monitoring in East - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.

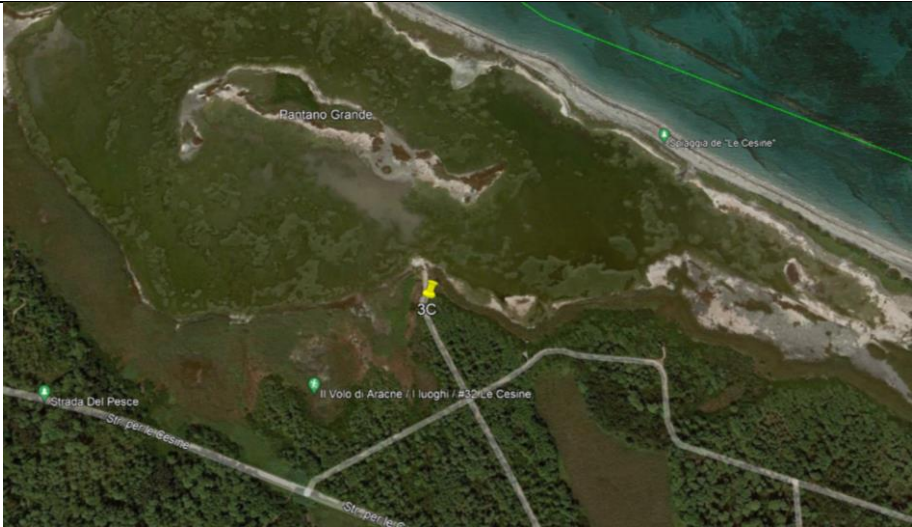|	
	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. • Reptile monitoring: continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. • Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	3C
Pilot area	2
Coordinates of the monitoring point	40.354257N, 18.340632E (WGS84)
Monitoring stations	- Weather station - Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - The meteorological station must be equipped with a meteorological shed, with low landscape impact - Bird monitoring in North direction - Mammal monitoring in North direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Monitoring of physical parameters: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Reptile monitoring: continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	4C
Pilot area	2
Coordinates of the monitoring point	40.351035N, 18.343570E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single low landscape impact coloring pole; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in North direction - Mammal monitoring in North direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	- Monitoring of physical parameters: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling

	time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.
	• Reptile monitoring: continuous" operation for numerical data (soil sensor); acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission.
	• Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	5C
Pilot area	2
Coordinates of the monitoring point	40.437782N, 18.245121E (WGS84)
Monitoring stations	- Bird monitoring - Mammal monitoring - Reptile monitoring - Insect monitoring
Installation	- Installation on a single color pole with low landscape impact placed at the existing structure; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) - Bird monitoring in North direction - Mammal monitoring in South direction - Reptile monitoring towards the ground - Insect monitoring on an illuminated plate - The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	
Functional requirements	Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission.

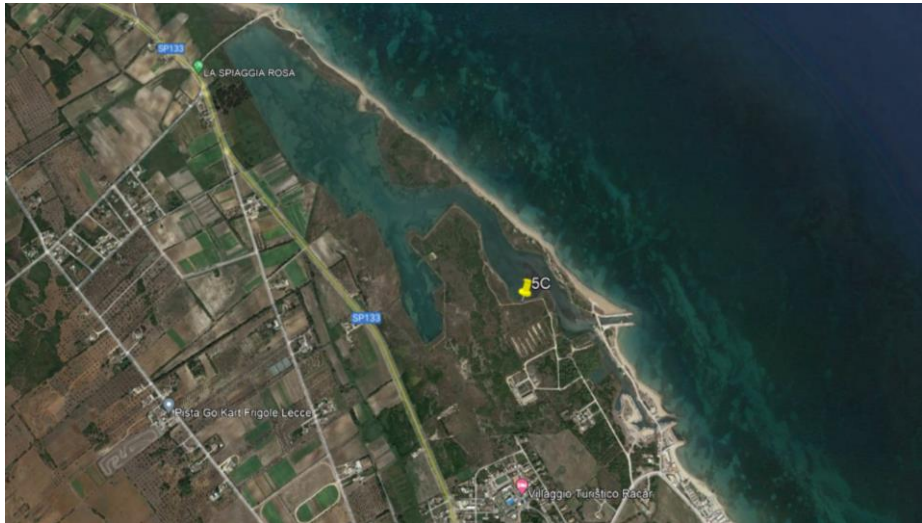|	
	• Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. • Reptile monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. • Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission.

Monitoring point	6C
Pilot area	2
Coordinates of the monitoring point	40.439436N, 18.240977E (WGS84)
Monitoring stations	• Bird monitoring • Mammal monitoring • Flora monitoring • Reptile monitoring • Insect monitoring • Fish monitoring with water parameter measurement
Installation	• Installation on a single color pole with low landscape impact placed at the existing structure; instrumentation coated with low landscape impact colors, like any other component of the system (mimetic cloth tape, green or mimetic silicone sheaths, etc.) • Bird monitoring in West direction • Mammal monitoring in East monitoring • Flora monitoring in South direction • Reptile monitoring towards the ground • Insect monitoring on an illuminated plate • Installation of video camera and water parameter measurement sensors on immersed poles, with power supply on the installation pole of the other stations • The installed stations will be powered by a single photovoltaic panel, suitably sized in order to ensure the autonomous operation of the measuring point for at least 5 days even in the event of a non-optimal recharge
Installation area	

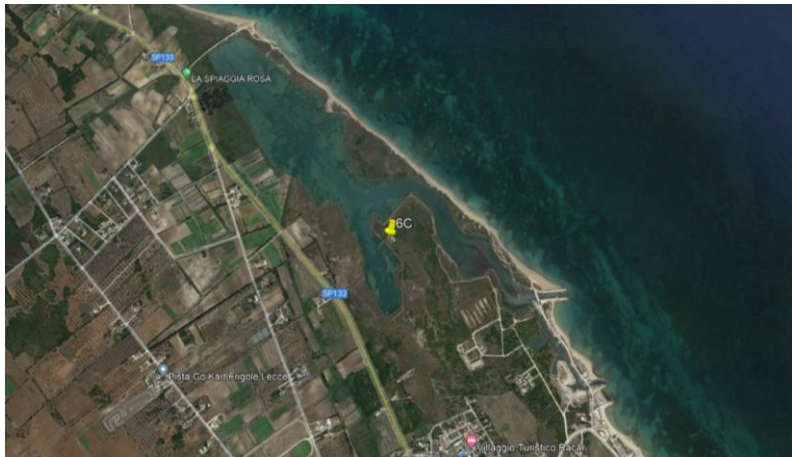| Functional requirements	- Bird monitoring: "continuous" operation for numerical data (microphone); capturing images of birds (snapshots) with a sampling time of 5 seconds; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Mammal monitoring: "continuous" operation (microphone); acquisition of images of mammals (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Flora monitoring: "continuous" operation for numerical data (leaf wetness, soil sensor); acquisition of vegetation images (averages and snapshots) with a sampling time of 6 hours; remote transmission of data once a day, with deletion of data locally after verification of correct transmission. - Reptile monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Insect monitoring: acquisition of images (snapshots) with a sampling time of 1 second; remote transmission of data every hour with deletion of data locally after verification of correct transmission. - Fish monitoring: capturing images of fish fauna (snapshots) with a sampling time of 1 second; remote data transmission every hour with deletion of data locally after verification of correct transmission. - Water parameters monitoring: "continuous" operation; remote data transmission every hour with deletion of data locally after verification of correct transmission.

5.5.2. COMPONENTS OF THE MONITORING STATIONS

As previously mentioned, for each of the types of stations (meteorological monitoring, bird monitoring, flora monitoring, mammal monitoring, insect and reptile monitoring, underwater monitoring), the minimum technical requirements of each component are reported. In addition, the minimum technical requirements of the server are reported (to be installed at the regional office) on which all the data of the entire monitoring network will converge.

Table 5-4: Identification of the minimum requirements of the components of the monitoring stations.

Description	Minimum requirements
Power supply	
Photovoltaic panel	Polycrystalline with sufficient power for the operation of the single measuring point
Connecting cable	Compatible with photovoltaic panel
Solar Charge Controller	Nominal charging current, charging voltage and protective devices suitable for the operation of the measuring stations. Operating temperature: -20 ÷ +60 ℃
Battery	Normal voltage and capacity compatible with the measuring stations and adequate to ensure the autonomous operation of the specific measuring point for at least 5 days, even in the case of non-optimal recharging.
Mounting brackets	Material: weatherproof steel for professional installation
Installation box	ABS material, compatible with measuring point constraints, resistant to UV rays, IK 10 impact resistance, UL 94 HB FLAMMABILITY; TEMPERATURE RANGE from -40 ° C to + 80 ° C; minimum size adequate to house all the electronic component; with adequate ventilation (in the lower part); with adequate devices to eliminate the possibility of damage to the electronic components installed inside it; with suitable devices for installing sensors.

Measure management	
Integrated circuit management system	Microcontroller, ARM Processor; 4 GB RAM memory; Wireless connection card; Bluetooth 5.0; USB 3.0 and 2.0 ports in an adequate number to connect the sensors and devices installed; GPIO ports in number and type suitable for the connection of the sensors installed; video, audio and composite porte in number and typology suitable for the connection of sensor installations; complete di operative system and software sviluppato ad hoc. Operating temperature: 0 – 50 °C
Case with heatsink	Material: ABS and Aluminum; with active and passive heatsink
Module gsm-gprs-gps	LTE Cat-4: LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28/B66; LTE-TDD: B34/B38/B39/B40/B41; 3G: UMTS/HSDPA/HSPA +: B1/B2/B4/B5/B6/B8/B19; 2G: GSM/GPRS/EDGE: 850/900/1800/1900 MHz; Satellite systems: GPS/Beidou/GLONASS; Receiver type: 16 canals - Code C/A; Sensitivity: -159 dBm (GPS)/-158 dBm (GLONASS)/TBD (BeiDou)
Sensor acquisition module	Microcontroller ATmega2560; Operating Voltage 5V; Input Voltage (recommended) 7-12V; Input Voltage (limits) 6-20V; Digital I/O Pins 54 (of which 14 provide PWM output); Analog Input Pins 16; DC Current per I/O Pin 40 mA; DC Current for 3.3V Pin 50 mA; Flash Memory 256 KB of which 8 KB used by bootloader; SRAM 8 KB; EEPROM 4 KB; Clock Speed 16 MHz
Touch screen for management	5-inch screen; cable from USB to Micro USB 30 cm; cable from HDMI to Micro HDMI 30 cm
Buffer power supply	lithium polymer; sufficient capacity to power the individual stations for at least 2 days in the absence of other energy sources
Cables USB	As standard
Cable	As standard

Installation box	ABS material, compatible with the constraints of the measuring point, resistant to UV rays, IK 10 impact resistance, UL 94 HB FLAMMABILITY; TEMPERATURE RANGE from -40 ° C to + 80 ° C; minimum size adequate to house all the electronic component; with adequate ventilation (in the lower part); with adequate devices to eliminate the possibility of damage to the electronic components installed inside it; with suitable devices for installing sensors.
2 cooling fans	USB power supply, speed suitable for keeping the temperature inside the container below that compatible with the station instrumentation
Power supply for fans	lithium polymer; sufficient capacity to power the individual stations for at least 2 days in the absence of other energy sources
Sim subscription	Flat rate, 2 years
Installation	
Pole	Appropriately sized to support all components installed at the measuring point up to a maximum height of 7 m.
Instrumentation - Weather station	
Pluviograph	Built and installed according to the dictates of the World Meteorological Association (WMO)
Barometer	Operating range: 600…1100 hPa [mbar] -40 … +60°C; Piezoresistive pressure measuring cell; Resolution 0,05 hPa; Accuracy ±0,5 hPa at 25°C; Current consumption <1mA at 12V
Humidity and Temperature	Measuring range 0 … 100%RH (humidity) -40 … +60°C (temperature); Accuracy ±1,8%RH (0 … 90%RH), ±3,0%RH (>90%RH); ±0,3°C (0 … 60°C), ±0,5°C (for the remaining range values); Resolution 0,01%RH 0,01°C; Working temperature -40 …. +60°C; Ingress Protection electronics – IP 66, sensing element – IP 40
Direct irradiance sensor	

	Working temperature -40 …. +65°C; Radiation intensity range 0 … 1500 W/m2; Sensitivity range 300 – 1000 nm; Accuracy +/- 5%; Sensitivity 2mV per W/m2;
Anemometer	Ultrasonic sensor, Working temperature -35 ...+70°C; Wind direction resolution 1°; Wind direction range 0° - 359°; Wind direction accuracy ±2° (at 12 m/s); Wind speed resolution 0,01 m/s; Wind speed range 0 – 60 m/s; Wind speed accuracy ±2° (at 12 m/s)
Shed	Double high impact thermoplastic lamellas; white outer layer, with UV stabilizer for long-term weather resistance; extra black inner layer; aluminum frame with durable white powder coating; A4 (316) grade stainless steel bolts; High impact UV stable covers; Padlockable doors on the front and back
Instrumentation - Insect / reptile monitoring station	
Video camera	4K video capture resolution; USB connectivity technology; Image acquisition speed 30 fps; Manual focus; Image resolution 3840x2160 pixel; IR filter 650 +/- 10nm
2 light plates	LED plate, 100 W, minimum plate size 34 x 26 cm; two colours (3000k e 6000k); with automatic lighting module with twilight sensor
Soil sensor	Measuring range 0 ... 60% VWC (volumetric water content) -40 ... + 60 ° C (temperature); Resolution 0.1% (volumetric water content) 0.1 ° C (temperature); Operating temperature -40... + 60 ° C; Degree of protection IP67
Instrumentation - Flora Monitoring Station	
Video camera	Integrated IR-CUT camera (day and night vision), 4K video capture resolution; USB connectivity technology; Image acquisition speed 30 fps; Manual focus; Image resolution 3840x2160 pixel
Infrared Illuminator	IR headlight Infrared LED (compatible with selected camera), IP 66 protection class, depth 130 m

Leaf wetness	Operating range: - 30 + 60 °C; Accuracy: +/- 5 %; Degree of protection: IP67
Soil sensor	Measuring range 0 ... 60% VWC (volumetric water content) -40 ... + 60 ° C (temperature); Resolution 0.1% (volumetric water content) 0.1 ° C (temperature); Operating temperature -40... + 60 ° C; Degree of protection IP67
Instrumentation - Bird Monitoring Station	
Video camera	Integrated IR-CUT camera (day and night vision), 4K video capture resolution; USB connectivity technology; Image acquisition speed 30 fps; Manual focus; Image resolution 3840x2160 pixel
Infrared Illuminator	IR headlight Infrared LED (compatible with selected camera), IP 66 protection class, depth 130 m
Microphone	Frequency response 20Hz - 20 KHz; variable gain
Microphone acquisition	MICROCONTROLLER nRF52840; ANALOG INPUT PINS 8 (ADC 12 bit 200 k samples)
Instrumentation – Mammal Monitoring Station	
Video camera	Integrated IR-CUT camera (day and night vision), 4K video capture resolution; USB connectivity technology; Image acquisition speed 30 fps; Manual focus; Image resolution 3840x2160 pixel
Infrared Illuminator	IR headlight Infrared LED (compatible with selected camera), IP 66 protection class, depth 130 m
Microphone	Frequency response 20Hz - 20 KHz; variable gain
Microphone acquisition	MICROCONTROLLER nRF52840; ANALOG INPUT PINS 8 (ADC 12 bit 200 k samples)

Instrumentation - Underwater Monitoring Station with hydrophone	
Underwater Video Camera	Integrated IR-CUT camera (day and night vision); underwater, equipped with infrared lamp, infrared lamp irradiation distance: 1-3 meters; Backlight Compensation: LED; Definition: 650TVL; TV system: PAL; Viewing angle: 92 °; Length of the connection cable 50m; Working temperature: -20 ~ + 75
Hydrophone	Sensitivity: -180dB re: 1V/microPa (+/- 4dB 20Hz-4KHz); Polar Response: Omnidirectional
Instrumentation - Underwater Monitoring Station with water parameters sensors	
Underwater Video Camera	Integrated IR-CUT camera (day and night vision); underwater, equipped with infrared lamp, infrared lamp irradiation distance: 1-3 meters; Backlight Compensation: LED; Definition: 650TVL; TV system: PAL; Viewing angle: 92 °; Length of the connection cable 50m; Working temperature: -20 ~ + 75
pH sensor	Range PH: 0-14 PH; Temperature range: 0-80 ℃
Turbidity sensor	Measurement range TDS: 0 ~ 1000 ppm; Accuracy of measurement TDS: ± 10% F.S.
Temperature sensor	Precision +/-0,5°
Dissolved oxygen meter	Resolution 0,01 mg/ l; Precision ± 0,4 mg / l
Instrumentation - Water parameters sensors	
pH sensor	Range PH: 0-14 PH; Temperature range: 0-80 ℃
Turbidity sensor	

	Measurement range TDS: 0 ~ 1000 ppm; Accuracy of measurement TDS: ± 10% F.S.
Temperature sensor	Precision +/-0,5°
Dissolved oxygen meter	Resolution 0,01 mg/ l; Precision ± 0,4 mg / l

All components must be available on the market in order to allow any future replacements to be made as part of extraordinary maintenance. Each station must be complete with every component (if not described in the previous table) necessary to make the system work "turnkey".

5.5.3. OPERATION OF THE MONITORING NETWORK

Following the description of the monitoring network, its operation is illustrated below. The information acquired by the stations that make up the network consist of:

• images,
• numerical values,
• audio tracks.

The type of data depends on the type of station. Table 6-5 summarizes the type of data associated with each type of station.

Tabella 5-5: Tipologia di dato associata alla tipologia di stazione.

Type of station	Type of data
Bird monitoring	Images Audio tracks
Mammal monitoring	Images Audio tracks
Flora monitoring	Images Audio tracks Numerical values
Underwater monitoring	Images
Underwater monitoring with water parameter measurements	Images Numerical values
Underwater monitoring with water parameter measurements and hydrophone	Images Audio tracks Numerical values
Weather monitoring	Numerical values
Insect or reptile monitoring	Images

Numerical values

As already mentioned, the installation of multiple types of stations is envisaged at each measurement point. In general, the information acquired at each measurement point by each station must be sent to the remote data storage server (managed by an independent integrated circuit management system, which ensures the necessary redundancy). With the aim of limiting the costs related to utilities for the transfer via the mobile network, one station (for each measurement point) will act as an access point to the transmission network for all the other stations installed in the same measurement point. Figure 6-40 schematizes the transmission system between the stations installed at the same measurement point and between the measurement point and the storage server. It can be seen that the transmission between the measuring point and the server is bidirectional. In fact, the measurement stations must be able to query the storage server for network management purposes, as detailed below.
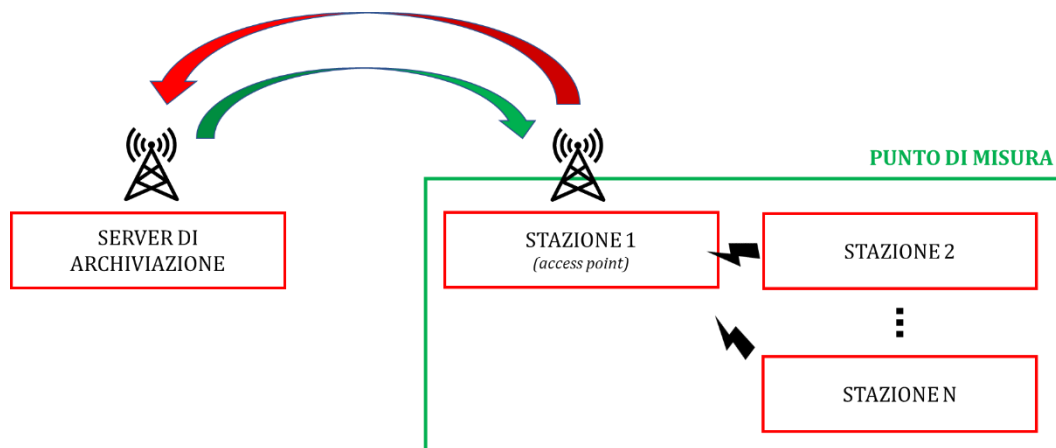
Figure 5-38: Conceptual scheme of the bidirectional transmission system between measurement point and storage server.

Indeed, each station will be equipped with a management system on an integrated circuit (e.g. Raspberry Pi type) on which the necessary software will be installed (i) to acquire the information from the sensors, (ii) to transmit the information to the acquisition server, and (iii) to monitor the correct functioning of the station. It is emphasized, as already stated, that the software will be developed as part of the supply of the network. In particular, the software must allow extreme flexibility as regards the characteristics of the acquisition (e.g. sampling frequency), the parameters of the transmission to the acquisition server (e.g. transmission interval, server address, archive folder) and the quantities relating to system diagnostics (e.g. battery charge, operation of the cooling fans, solar irradiation of photovoltaic panels). The flexibility of the software to be developed, therefore, can be exploited to change the parameters of the station operation by querying the storage server. In practice, at regular intervals (e.g. daily) each station will create a local copy of the software present in the storage server which, at any time, can be modified by the physical network manager. This requires the use of an application that manages the remote server query and software update procedure installed in the station.

Figure 6-41 shows the high-level flow diagram of the software operation, intended as the set of procedures (in the form of a script) aimed, in modular form, at the acquisition of measurements, transmission and management of the network.
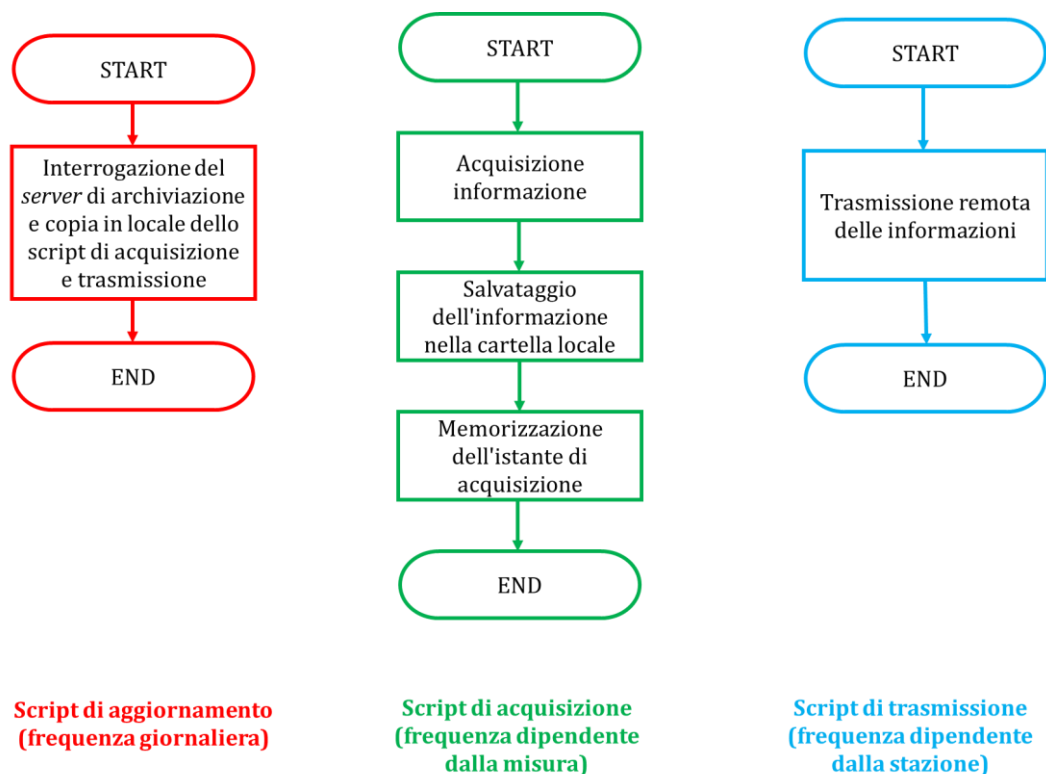
Figure 5-39: High-level flowcharts of the upgrade script, the capture script, and the broadcast script

The execution of the "update script" is scheduled on a daily basis, at night. Before running the update script, each station must be reinitialized to avoid problems related to the possible saturation of the volatile memory of each system on the integrated circuit.

The execution of the "acquisition script" is scheduled with different frequency depending on the type of station and the type of sensor. In fact, it is highlighted that more than one "acquisition script" can be installed in each station.

The execution of the "transmission script" is scheduled with different frequency depending on the type of station. It is emphasized that the transmission of the stations installed in the same measurement point must not be simultaneous to avoid overloading the mobile transmission network.

The values of the execution frequencies, foreseen in the initial phase of the experimentation of the network, are summarized in Table 5-6 according to the type of station. In this regard, it is emphasized that the network will be used in an experimental configuration for a period of not less than six months from the date of installation. This phase will allow to verify/modify the acquisition parameters in view of its operational functioning in the following period.

Any non-transmission of information will be managed on the server side and resolved by updating the transmission scripts.

All scripts must be implemented with open source tools, preferring the interpreted language known as Python and must be supplied complete with a technical guide describing the applications and use.

Table 5-6: Experimental values of the frequency of execution of management, acquisition and transmission scripts

Station type	Update script	Acquisition script	Transmission script
Bird monitoring		- Continuous for numerical data - Continuous for images with a sampling time of 5 seconds	Hourly
Mammal monitoring		- Continuous for numerical data - Continuous for images with a sampling time of 1 second	Hourly
Flora monitoring	Once a day	- Continuous for numerical data - Continuous for images with a sampling time of 6 hours	Once a day
Underwater monitoring		- Continuous with a sampling time of 1 seconds	Hourly
Water parameter monitoring		- Continuous for numerical data	Hourly
Weather monitoring		- Continuous	Hourly
Insect or reptile monitoring		- Continuous for numerical data - Continuous for images with a sampling time of 1 second	Hourly

5.6. ESTIMATE OF THE MONITORING NETWORK COSTS

Based on the definition of the consistency of the network, on the identification of its components and its architecture, it is possible to make a reliable forecast of costs, considering a first hypothesis of sizing the monitoring system.

In detail, the costs refer to:

- executive design of the measurement stations;

- executive design of the installations of each measurement point;

- implementation of the software to be installed in the individual stations for the acquisition of measurements and for transmission to the storage and analysis server;

- implementation of the software to be installed on the measurement acquisition server;

- signing of a mobile telephone contract (lasting 24 months) for the data transmission;

- provision of measurement stations;

- installation of measurement stations;

- maintenance of measuring stations (for 24 months);

- provision of the measurement acquisition server;

- installation of the measurement acquisition server;

- everything needed to make the monitoring network operational according to the "turnkey" formula.

Based on the market analysis, it was possible to associate the relative cost to each type of station. In detail, the cost of each station was obtained also taking into account the cost of the executive design of the individual stations (in an amount equal to 10% of the components), the maintenance cost (in an amount equal to 30% of the components) and the management cost relating to the subscription to the mobile network for data transmission.

It follows that the total cost is equal to:

- € 82'414.25 (excluding VAT) for monitoring stations to be installed in the Pilot Area 1.1 (€100'545.38 including VAT);

- € 56'931.26 (excluding VAT) for monitoring stations to be installed in the Pilot Area 1.2 (€69'456.14 including VAT);

- € 54'748.15 (excluding VAT) for monitoring stations to be installed in Pilot Area 2 (€ 66'792.74 including VAT);

- € 15,000 (excluding VAT) for the development, implementation and installation of the software necessary for the acquisition and archiving of the measurements (€ 18,300 including VAT).

The total cost of the entire monitoring network, all included to make it operational and active for a duration of 24 months, reaches **€ 209'094** (excluding VAT), equal to **€ 255'094 including VAT.**

APPENDIX A

For the individual stations in the project, the cadastral frameworks and the constraint analysis for verifying the feasibility of the works and permits / authorizations / clearances, the latter according to the indications of the Regional Landscape and Territorial Plan (PPTR), are shown in the following.

In the same context of the constraint analysis, it was verified whether the selected monitoring points fall within areas defined by current legislation Natura 2000 Sites, Sites of Community Importance (SCI), Special Conservation Areas (ZSC), or delimited by the Hydrogeological Plan (PAI).

Tables B-1, B-2, B-3 and Figures B-1 ÷ B-24 show the result of this analysis. Mappings of the points that do not fall within any area defined by the aforementioned regulations in force have been omitted.

Table B-1: Constraint analysis for the monitoring points within the Pilot Area 1.1.

Point	NAT2000	SIC Area	ZSC Area	PAI Area	Constraints – Components PPTR	
1A	Yes	No	Yes	Flood Hazard - BP (Low Hazard)	Geomorphological	Erosive furrows and canyons
					Hydrological	Coastal territories, Connection hydrographic network
					Botanical-vegetational	Wet areas
					Protected areas	Parks and reserves, Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	Visual cones
2A	Yes	No	Yes	Flood Hazard - MP (Medium Hazard)	Geomorphological	/
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods, Wet areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes, Areas of respect of the

						components, Historical and cultural sites
					Perceptual values	Visual cones
3A	Yes	No	Yes	Flood Hazard - AP (High Hazard)	**Geomorphological**	/
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods, Wet areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes, Areas of respect of the components, Historical and cultural sites
					Perceptual values	Visual cones
4A	Yes	No	Yes	Flood Hazard - AP (High Hazard)	**Geomorphological**	/
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods, Wet areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes, Areas of respect of the components, Historical and cultural sites
					Perceptual values	Visual cones
5A	Yes	No	Yes	Flood Hazard - AP (High Hazard)	**Geomorphological**	/
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods, Wet areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes, Areas of

						respect of the components, Historical and cultural sites
					Perceptual values	Visual cones
6A	Yes	No	Yes	No	**Geomorphological**	/
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods, Wet areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	Visual cones
7A	Yes	No	Yes	Flood Hazard - AP (High Hazard)	**Geomorphological**	/
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods, Wet areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	Visual cones
8A	Yes	No	Yes	No	**Geomorphological**	/
					Hydrological	/
					Botanical-vegetational	Natural meadows and pastures
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	Visual cones
9A	Yes	No	No	No	**Geomorphological**	Erosive furrows and canyons, Slopes

					Hydrological	Rivers and streams, Public waters
					Botanical-vegetational	Woods
					Protected areas	Parks and reserves
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	Visual cones
10A	No	No	No	No	**Geomorphological**	Erosive furrows and Canyons, Caves
					Hydrological	Coastal territories, Rivers and streams, Public waters, Hydrographic connectivity network
					Botanical-vegetational	Woods
					Protected areas	Parks and reserves
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	/
11A	No	No	No	No	**Geomorphological**	Dunes
					Hydrological	Rivers and streams, Public waters, Coastal territories
					Botanical-vegetational	Areas of respect for the woods
					Protected areas	/
					Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
					Perceptual values	/
12A	No	No	No	No	**Geomorphological**	Dunes
					Hydrological	Coastal territories
					Botanical-vegetational	Areas of respect for the woods

						Protected areas	/
						Cultural and settlement	Buildings and areas of considerable interest, Rural landscapes
						Perceptual values	/

Figure B-1: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring point n. 1A.
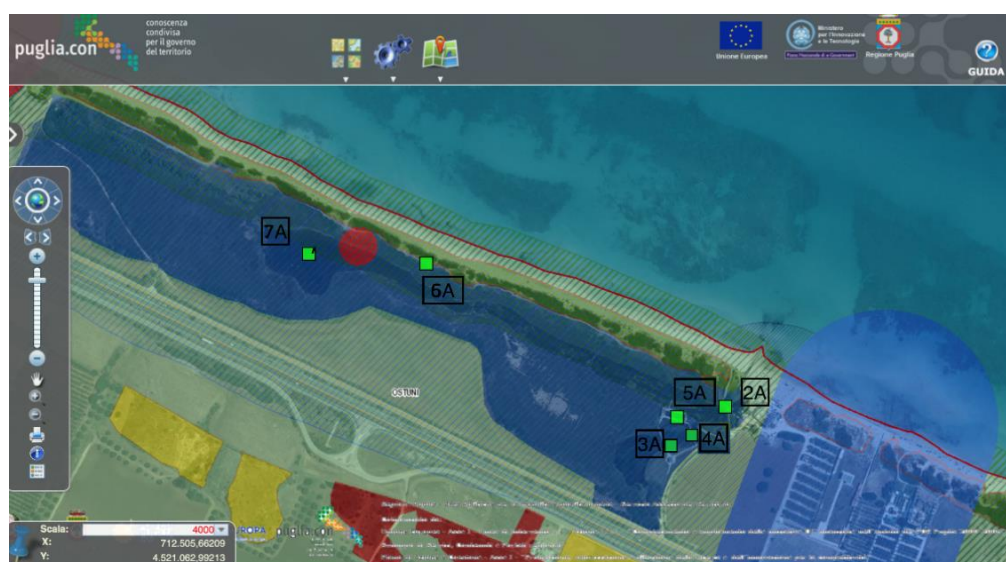

Figure B-2: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring points n. 2A, 3A, 4A, 5A, 6A, 7A.

Figure B-3: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring point n. 8A.

Figure B-4: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring point n. 9A.

Figure B-5: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring point n. 10A.

Figure B-6: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring point n.11A.
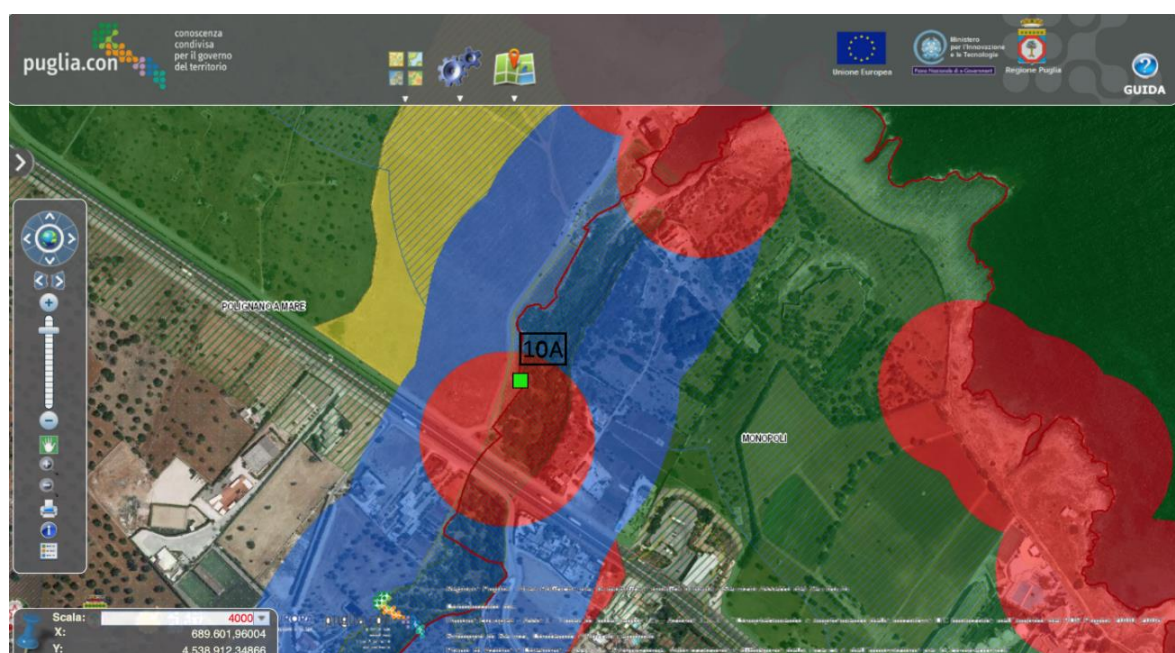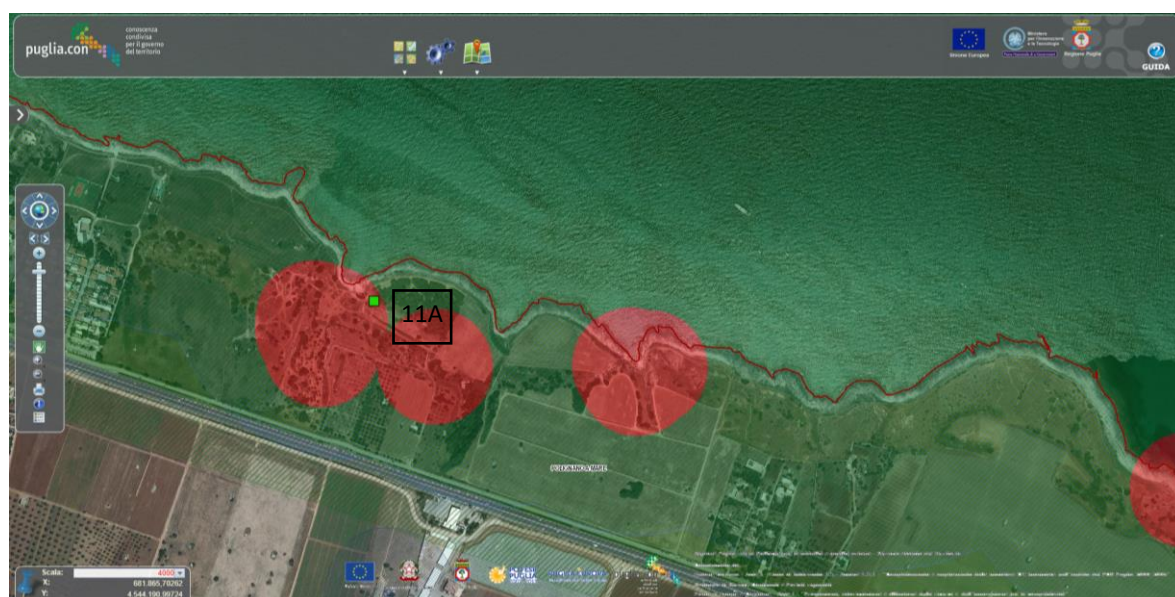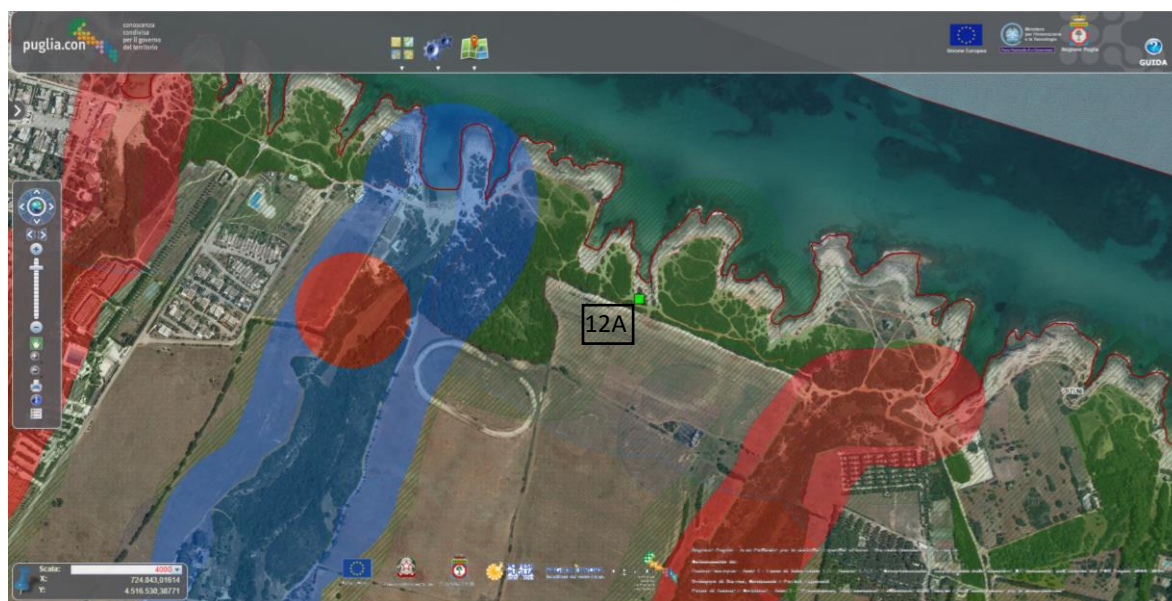
Figure B-7: Constraint components in the Pilot Area 1.1 according to the PPTR, monitoring point n. 12A.
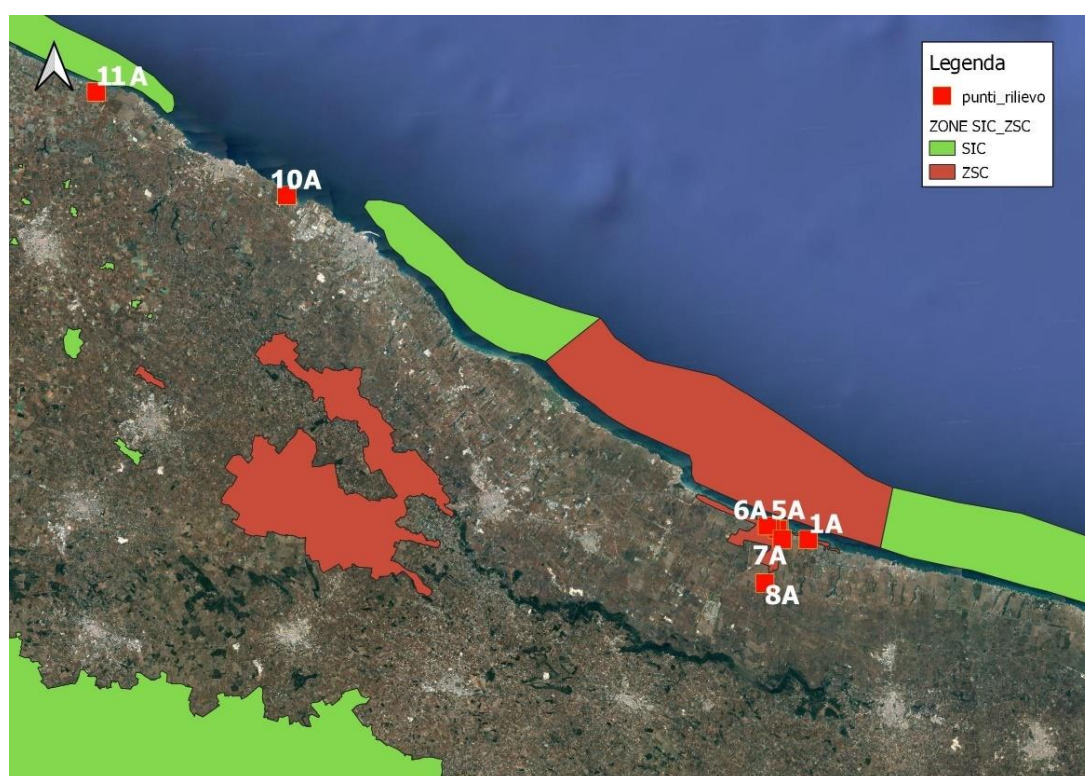

Figure B-8: Constraint components in the Pilot Area 1.1 according to Rete Natura 2000.
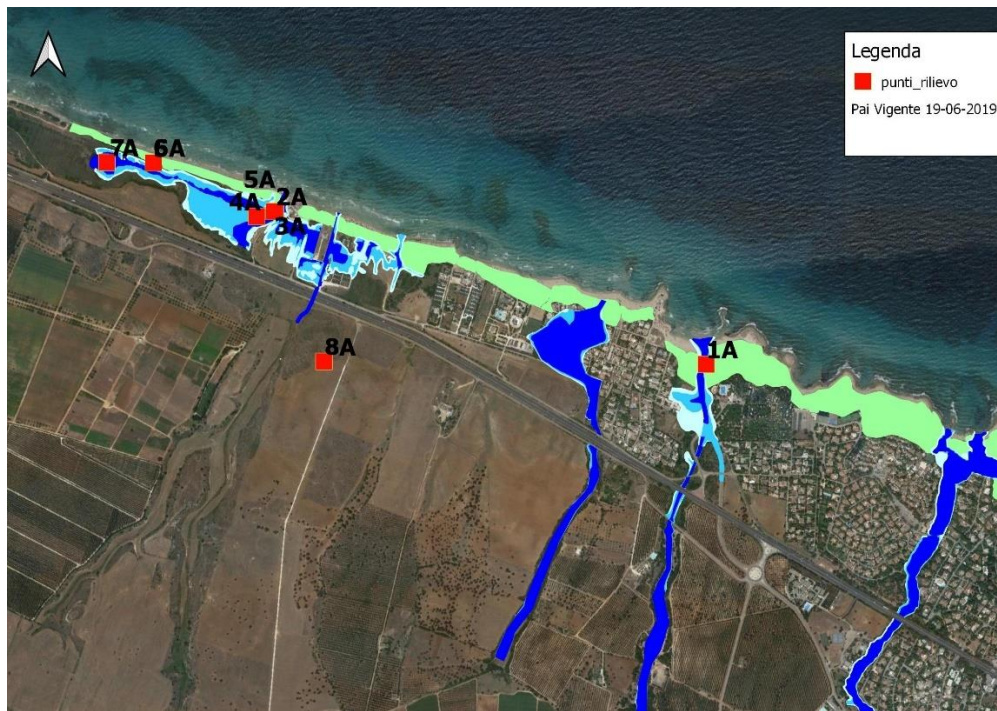
Figura B-9: Constraint components in the Pilot Area 1.1 according to PAI.

Table B-2: Constraint analysis for the monitoring points within the Pilot Area 1.2.

Point	NAT2000	SIC Area	ZSC Area	PAI Area	Constraints – Components PPTR	
1B	No	No	Yes	Flood Hazard - AP (High Hazard)	**Geomorphological**	/
					Hydrological	Connection hydrographic network
					Botanical-vegetational	/
					Protected areas	Parks and reserves, Respect areas of parks and reserves
					Cultural and settlement	/
					Perceptual values	/
2B	No	No	No	No	**Geomorphological**	/
					Hydrological	/
					Botanical-vegetational	/
					Protected areas	Parks and reserves
					Cultural and settlement	/

					Perceptual values	/
3B	No	No	No	No	**Geomorphological**	/
					Hydrological	Rivers and streams, Public waters, Hydrogeological constraint (at the limit)
					Botanical-vegetational	/
					Protected areas	Parks and reserves
					Cultural and settlement	Buildings and areas of considerable interest
					Perceptual values	/
4B	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	Coastal territories, Hydrogeological constraint
					Botanical-vegetational	Areas of respect for the woods, wetlands, parks and reserves, sites of naturalistic importance
					Protected areas	Parks and reserves, sites of naturalistic importance
					Cultural and settlement	Landscape Assets, Buildings and areas of considerable interest
					Perceptual values	/
5B	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	Rivers and streams, Public waters, Coastal territories, Hydrogeological constraint
					Botanical-vegetational	Wetlands, parks and reserves, sites of naturalistic importance
					Protected areas	Parks and reserves, sites of naturalistic importance

					Cultural and settlement	Landscape Assets, Buildings and areas of considerable interest
					Perceptual values	/
6B	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	Coastal territories, Hydrogeological constraint
					Botanical-vegetational	Wetlands, parks and reserves, sites of naturalistic importance
					Protected areas	Parks and reserves
					Cultural and settlement	Landscape Assets, Buildings and areas of considerable interest
					Perceptual values	/
7B	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	/
					Botanical-vegetational	/
					Protected areas	Parks and reserves
					Cultural and settlement	/
					Perceptual values	/
8B	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	/
					Botanical-vegetational	/
					Protected areas	Parks and reserves
					Cultural and settlement	/
					Perceptual values	/
9B	No	No	No	No	**Geomorphological**	Erosive furrows and Canyons
					Hydrological	Rivers and streams, Public waters
					Botanical-vegetational	Areas of respect of the Woods

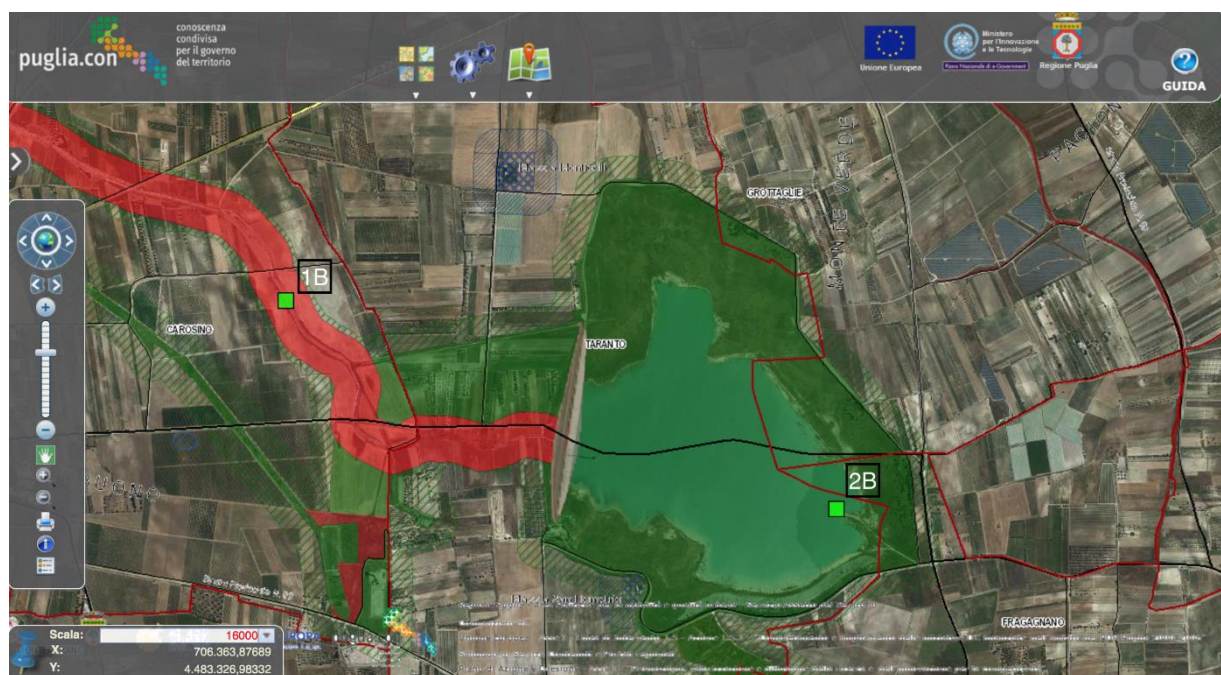|					**Protected areas**	Parks and Reserves
					Cultural and settlement	Buildings and areas of considerable interest
					Perceptual values	/

Figure B-10: Constraint components in the Pilot Area 1.2 according to the PPTR, monitoring point n. 1B, 2B.

Figure B-11: Constraint components in the Pilot Area 1.2 according to the PPTR, monitoring point n. 3B.
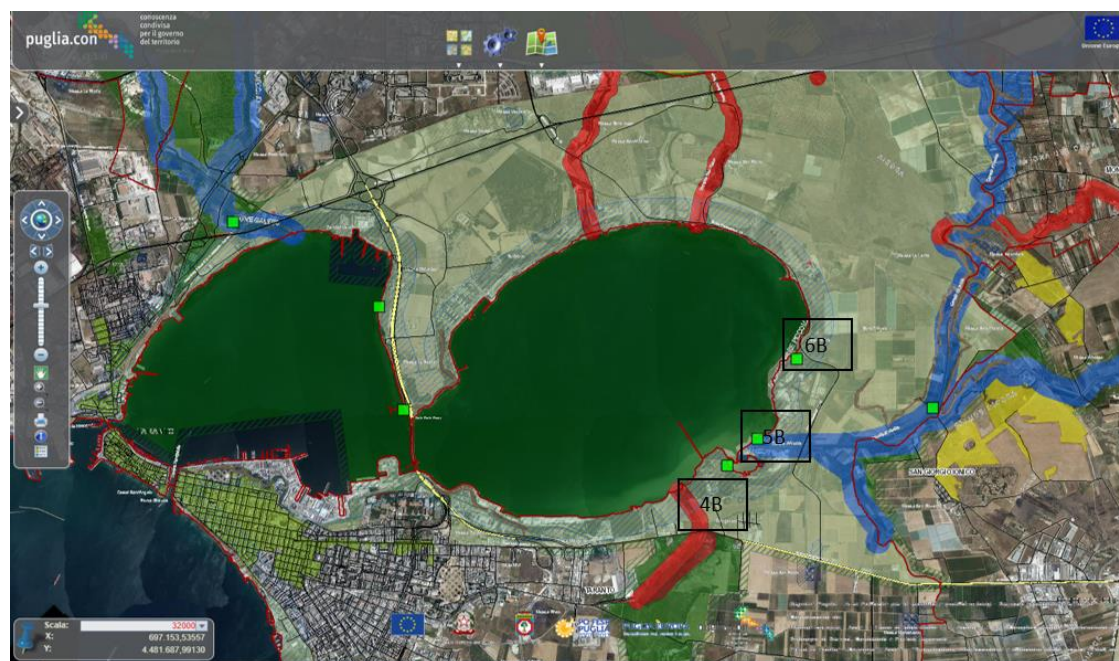

Figure B-12: Constraint components in the Pilot Area 1.2 according to the PPTR, monitoring points n. 4B, 5B, 6B.

Figure B-13: Constraint components in the Pilot Area 1.2 according to the PPTR, monitoring points n. 7B, 8B.

Figure B-14: Constraint components in the Pilot Area 1.2 according to the PPTR, monitoring point n. 9B.
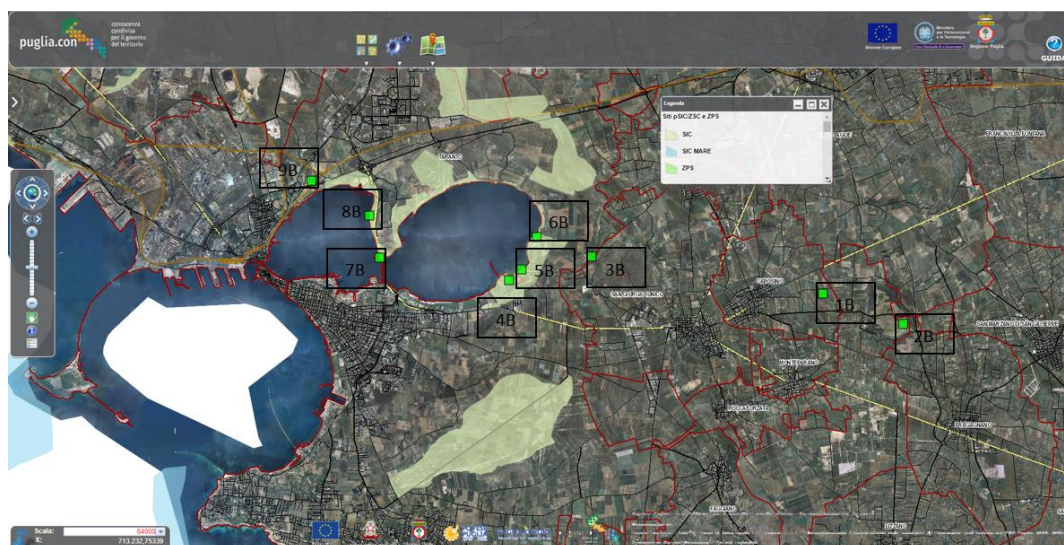
Figure B-15: Constraint components in the Pilot Area 1.2 according to Rete Natura 2000.
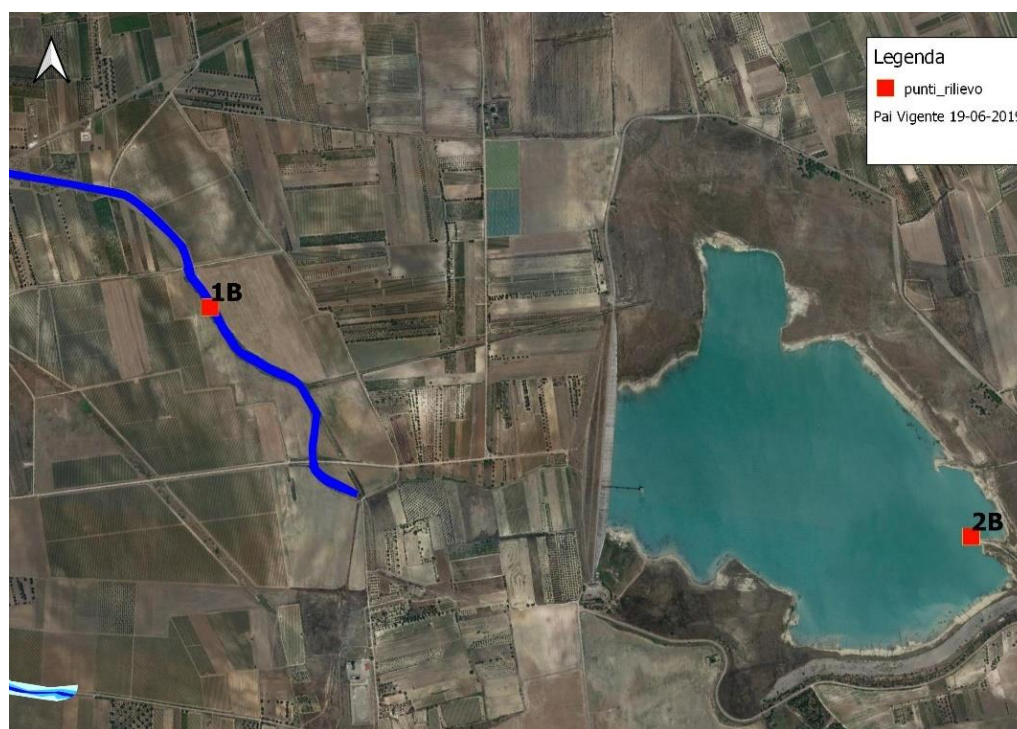

Figure B-16: Constraint components in the Pilot Area 1.2 according to PAI.

Table B-3: Constraint analysis for the monitoring points within the Pilot Area 2.

Point	NAT2000	SIC Area	ZSC Area	PAI Area	Constraints – Components PPTR	
1C	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	/
					Botanical-vegetational	Respect areas of woods
					Protected areas	Respect areas of parks and reserves, Sites of naturalistic importance
					Cultural and settlement	/
					Perceptual values	/
2C	Yes	Yes	No	No	**Geomorphological**	/
					Hydrological	Hydrogeological constraint
					Botanical-vegetational	Woods
					Protected areas	Parks and reserves
					Cultural and settlement	/
					Perceptual values	/
3C	Yes	Yes	No	No	**Geomorphological**	Dunes
					Hydrological	Areas bordering the lakes, Hydrogeological constraint
					Botanical-vegetational	Woods, Areas of respect for the woods, Ramsar wetlands
					Protected areas	Parks and reserves, Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest
					Perceptual values	/
4C	Yes	Yes	Yes	No	**Geomorphological**	/

					Hydrological	Hydrogeological constraint
					Botanical-vegetational	Wet areas, woodland areas
					Protected areas	Parks and reserves, Sites of naturalistic importance
					Cultural and settlement	Landscape Assets, Buildings and areas of considerable interest
					Perceptual values	/
5C	Yes	Yes	Yes	No	Geomorphological	/
					Hydrological	Areas bordering lakes, Hydrogeological constraint
					Botanical-vegetational	Wet areas, woodland areas
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest
					Perceptual values	/
6C	Yes	Yes	Yes	No	Geomorphological	/
					Hydrological	Areas bordering lakes, Hydrogeological constraint
					Botanical-vegetational	Woods
					Protected areas	Sites of naturalistic importance
					Cultural and settlement	Buildings and areas of considerable interest
					Perceptual values	/

Figure B-17: Constraint components in the Pilot Area 2 according to the PPTR, monitoring points n. 1C, 2C.
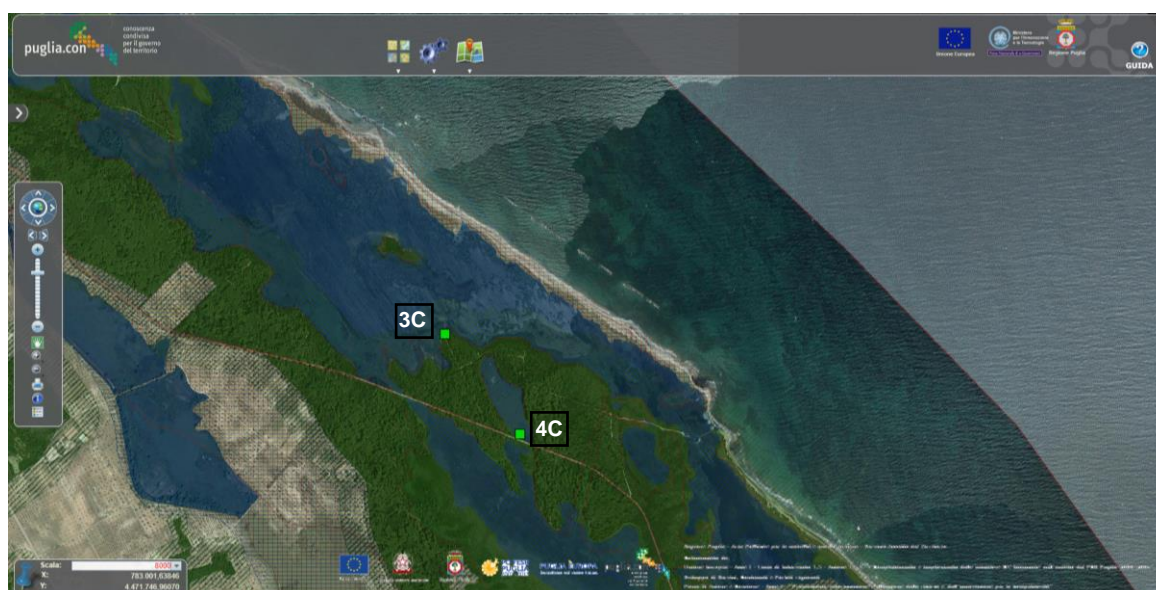

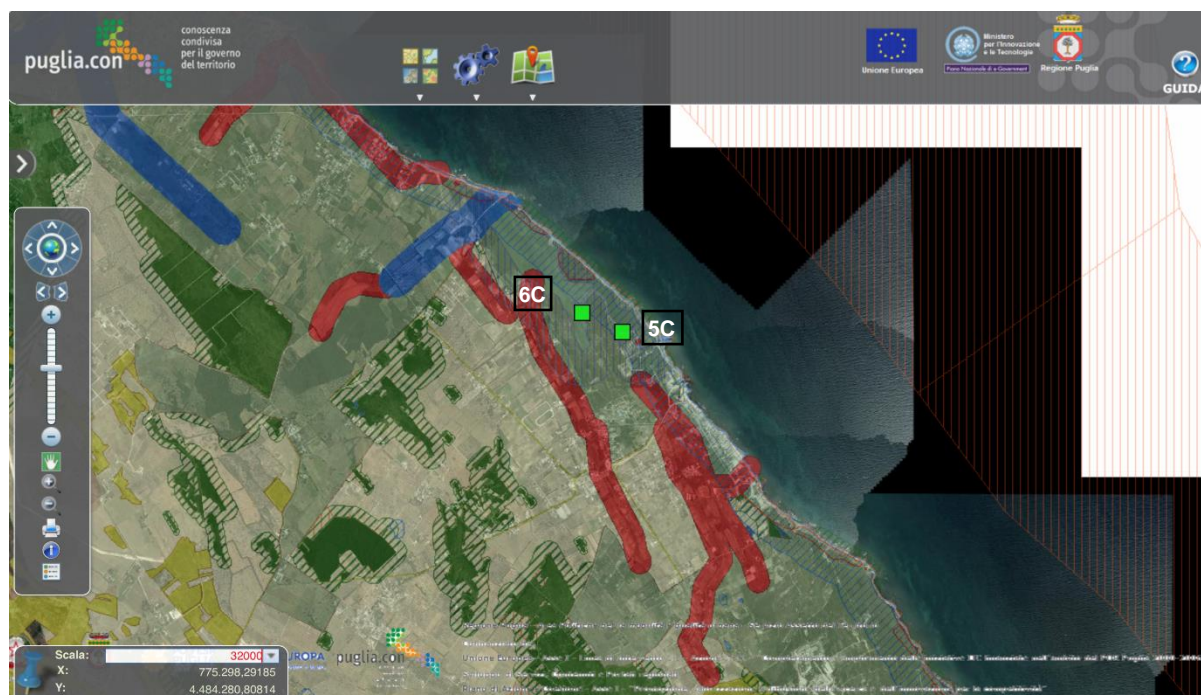*Figure B-18: Constraint components in the Pilot Area 2 according to the PPTR, monitoring points n. 3C, 4C.*

Figure B-19: Constraint components in the Pilot Area 2 according to the PPTR, monitoring points n. 5C, 6C.
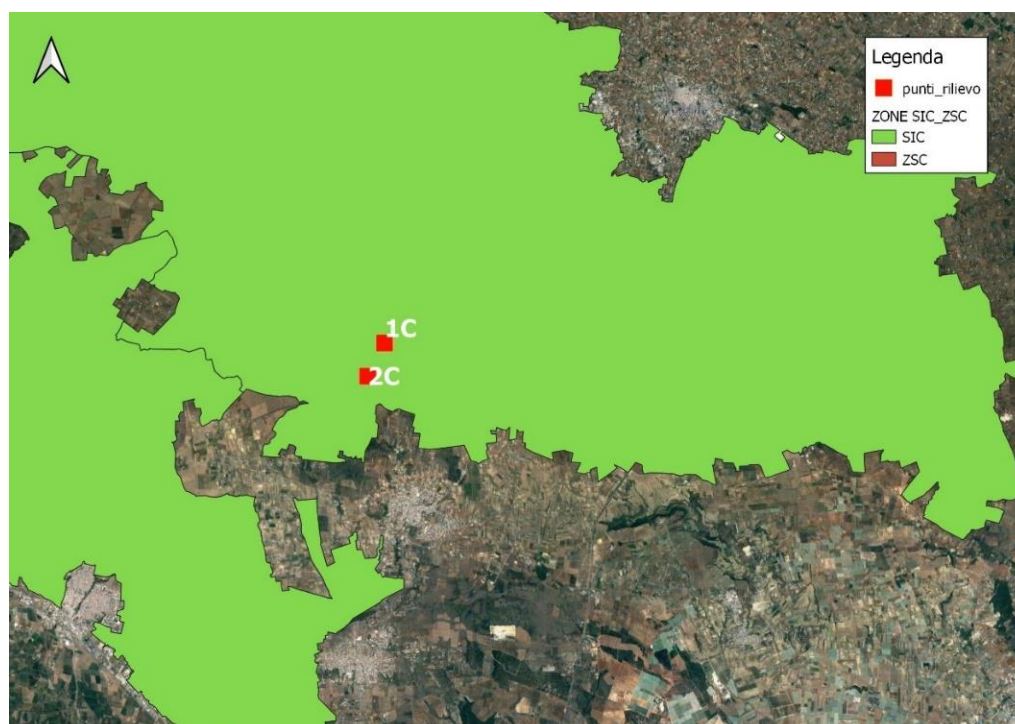

Figure B-20: Constraint components in the Pilot Area 2 according to Rete natura 2000, monitoring points n. 1C, 2C.

Figure B-21: Constraint components in the Pilot Area 2 according to Rete natura 2000, monitoring points n. 3C, 4C.

Figure B-22: Constraint components in the Pilot Area 2 according to Rete natura 2000, monitoring points n. 5C, 6C.
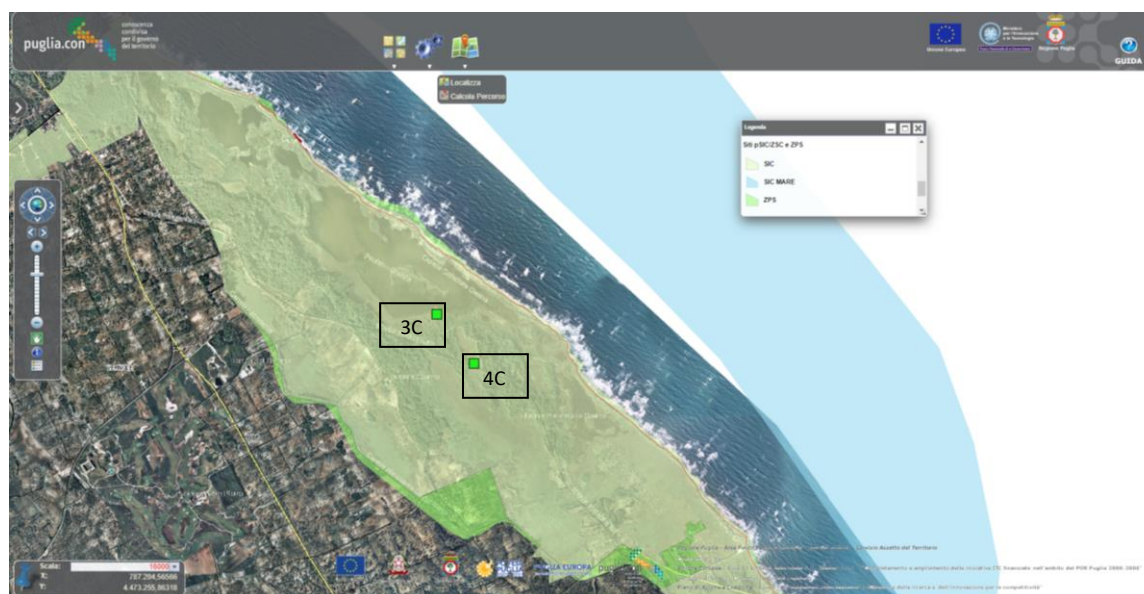
Figure B-23: Constraint components in the Pilot Area 2 according to Rete Natura 2000, monitoring points n. 3C, 4C.
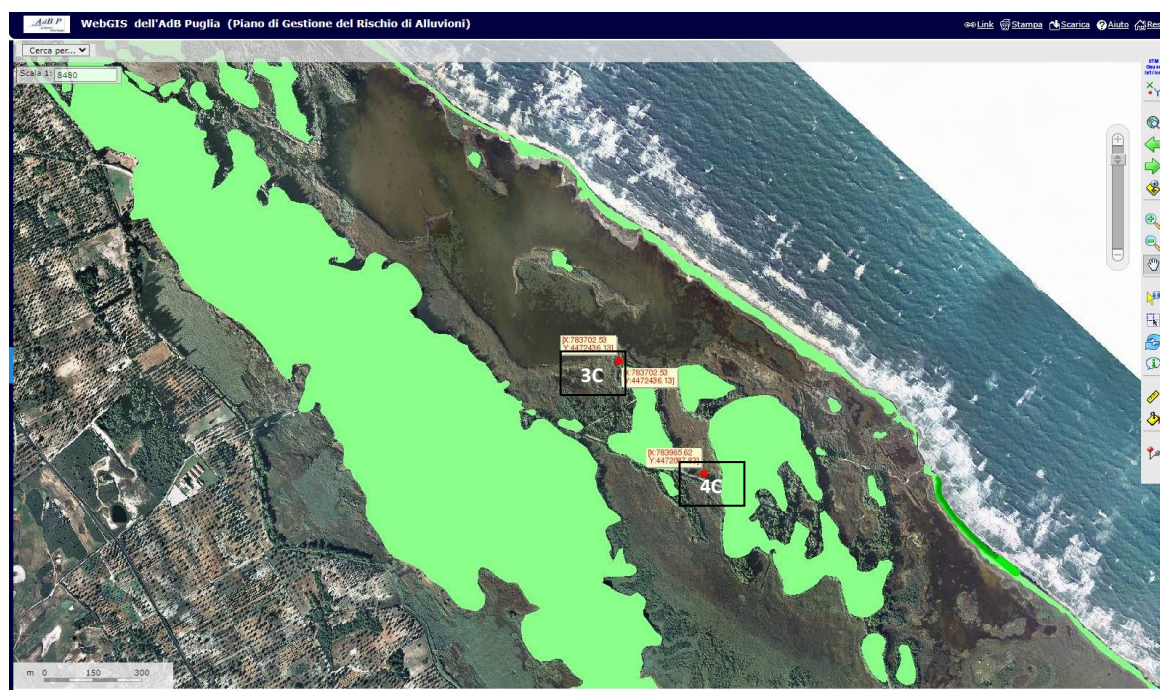

Figure B-24: Constraint components in the Pilot Area 2 according to the PAI, monitoring points n. 3C, 4C.