Monitoring Campaigns
Report No 3

Final Version of 26/April/2022

Deliverable Number D.3.3.1.

Project Acronym	SASPAS
Project ID Number	10048261
Project Title	SAFE ANCHORING AND SEAGRASS PROTECTION IN THE ADRIATIC AREA
Priority Axis	3 - Major change Environment and cultural heritage
Specific objective	3.2 - Contribute to protect and restore biodiversity
Work Package Number	3
Work Package Title	Integrate real-time monitoring system of marine seagrasses (Phanerogamae) in the involved N2K sites
Activity Number	3.3
Activity Title	Monitoring campaigns
Partner in Charge	PP1 - SELC Soc. Coop.
Partners involved	PP1 - SELC Soc. Coop. LP - Municipality of Monfalcone PP3 - Regional Natural Park "Coastal Dunes from Torre Canne to Torre San Leonardo" PP4 – SUNCE PP5 - Kornati National Park Public Institution PP7 - CORILA (All PPs contributed to the revision of the report)
Status	Final
Distribution	Public

Summary

Abstract

This document describes the results of the activities planned in WP 3.3 (Monitoring Campaigns) regarding the additional monitoring campaigns carried out between September 2021 and February 2022 at the three project sites and includes baseline survey methodologies and all data collected, a comparison with preliminary survey data (WP 3.1) and an update on seagrass transplantations status and progress (WP 4.2).

The analysis of the data collected during the monitoring campaigns showed, at the Panzano Bay, some differences between the parameter values, probably due to different sampling periods, phenological cycles of the seagrass species and water depths. At the Kornati NP and RNP Coastal Dunes sites, changes in the mean values of the main parameters were found.

Regarding the update on the status and progress of the seagrass transplantations (planned in WP 4 activity 2), monitoring highlighted that, at the Panzano Bay, approximatively 50% of the plugs transplanted in September 2020 and almost all the plugs transplanted in April 2021 were still in place. At the Kornati NP site, the total number of shoots and the leaf length showed a slight decrease (partly due to the high sedimentation trend). At the RNP Coastal Dunes site, shoot density and height of the longest leaf, showed good leaf conditions, but physical loss of shoots was due to multiple causes, that cannot be identified with certainty (i.e., fishing, anchoring, wave erosion).

1. Introduction

1.1. Aim and objectives

SASPAS (Safe Anchoring and Seagrass Protection in the Adriatic Sea) is an INTERREG project that aims to provide a proposal to develop and share actions and advanced policies for the conservation and sustainable use of the territory.

The common challenge of Project SASPAS is to preserve and get a better status of conservation of biodiversity of the Adriatic Sea ecosystem in order to decrease its vulnerability.

The overall objective is to improve the conservation and restoration of seagrasses by installing safe anchoring systems, performing pilot transplants, carrying out monitoring activities and establishing an integrated management system for seagrasses in the Adriatic area. The change will result in an increase in the level of conservation of habitat types and species in the Natura 2000 sites involved in the Project areas. To achieve the envisaged change the project will adopt a scientific-applicative approach, following the DPSIR (Driving force – Pressure – State – Impact - Response) causal framework, analyzing the interactions between society and the environment - the cause-effect relationships between interacting components of complex social, economic, and environmental systems. By doing so, it is possible to measure the effectiveness of responses put in place.

Since marine seagrasses and especially *Posidonia oceanica* beds (1120*) are widespread along the coastal areas of Interreg Programme and their conservation status is similar in the two Member States, significant results can only be achieved by establishing a good cross-border cooperation between the Italian and Croatian key partners. The cross-border approach ensures coordinated and cooperative actions in planning and performing the protection and restoration activities, as well as in the development of the envisaged Marine Seagrass Safeguard Integrated Management Program (i.e., the proposed guidelines for the management and proper behavior in protected areas). The innovative aspect, which goes beyond the existing common practices, consists in the joint protection and restoration of biodiversity at transboundary level through the development of specifically- tailored innovative solutions, harmonized for the Adriatic area and applicable to other similar realities facing with the same biodiversity protection and restoration issues.

The project activities have been carried out within the three project study sites (Figure 1):

- Monfalcone (Bay of Panzano),
- Kornati National Park – (Nacionalni Park Kornati),
- Regional Natural Park of Coastal Dunes from Torre Canne to Torre San Leonardo.

This proposal is well suited to the Adriatic, in particular to the Apulia (Regional Natural Park of Costal Dunes from Torre Canne to Torre San Leonardo) and Kornati National Park, characterized by widespread coverage of *P. oceanica*. In both sites, in the summer, there is a significant flow of pleasure boats, and the development of the industry tourism cannot fail to reckon with the need to preserve the quality of the

territory, understood as a whole between land, coast and sea. In Monfalcone (Bay of Panzano), there is an important coverage of marine seagrasses (i.e., *Cymodocea nodosa*) too.

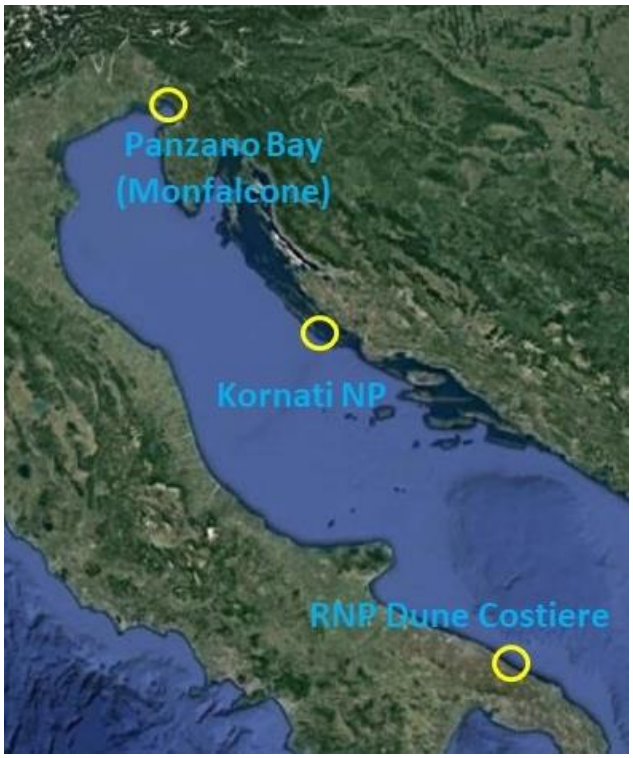

Figure 1. Location of the three project sites.

Both *P. oceanica* and *C. nodosa* play a crucial role in the consolidation of coastal sediments, slowing erosive phenomena, thanks to their rhizomial apparatus with which they anchor to the bottom; with the leaf they promote the capture of suspended sediments, helping to limit turbidity, not to mention a number of benefits for marine and lagoon organisms.

The main project outputs related to the planned activities are:

- monitoring system with 3 data collections/monitoring campaigns (1 in 2020 and 2 in 2021),
- placement of environmentally friendly anchoring systems (anchorages and simple signaling buoys),
- pilot seagrass transplants,
- Integrated Management System for seagrasses in the Adriatic area, made by a GIS Digital Information Platform (DIP) and a Marine Seagrass Safeguard Integrated Management Program (MSSIMP).

Protected areas managers, local, regional, and national public bodies, environmental associations, and NGOs, as well as the public will mainly benefit from the project activities.

1.2. Structure of Work Package 3

The objective of the Work Package 3 - *Integrate real-time monitoring system of marine seagrasses (phanerogamae) - in the involved Natura 2000 sites* – is to monitor and gather data on marine seagrasses in the three project sites, to improve the protection and to restore the biodiversity in the cross-border area.

The WP3 package consists of three activities:

- activity 3.1 - Preliminary Environmental Survey,
- activity 3.2 - Driver and Pressure Identification and Assessment,
- activity 3.3 - Monitoring campaigns.

The preliminary survey (activity 3.1) aimed to characterize the biodiversity of the project sites and gathering up-to-date information on the distribution and quality of seagrasses and their associated biota. The information collected, provided a starting point for the analysis of existing drivers and pressures, following the DPSIR (Drivers-Pressure-State-Impact-Response) procedures (activity 3.2). Monitoring campaigns were carried out to control the plants phenological life cycle and the spatial dynamics of marine seagrasses as a response to the concrete actions (activity 3.3). Moreover, they will help to identify the potential impacts that the project could have on seagrass meadows and other valuable habitats and species.

The analyses included all monitoring data, especially those concerning the retreat or surface increase dynamics that will be related to the behavior of biodiversity at eco-friendly buoys.

Thus, the goal is to characterize and quantify, in time and space, the measured impacts and assess trends in biodiversity, as far as possible over the Project time frame. The results are critical to activate or strengthen different types of protection policies, to act with additional conservation measures or to manage recreational boat areas differently.

This document describes the results of the activities planned in WP 3.3 (Monitoring Campaigns) regarding the additional monitoring campaigns carried out between September 2021 and February 2022.

All the activities were conducted adopting up-to-date safety protocols, to reduce risks during underwater operations. Expert marine and transitional water biologists, according to standard operating procedures for the macrophytobenthos, performed laboratory analyses of collected samples.

Specifically, this Monitoring Campaign Report includes baseline survey methodologies and all data collected, a comparison with preliminary survey data (WP 3.1) and a brief update on seagrass pilot transplantations status and progress (WP 4.2). A more detailed analysis of the transplantation actions results will be carried out in the final WP 3.3 and WP 4.2 reports (deliverables D.3.3.1 and D.4.2.3).

2. The three project areas and the Natura 2000 sites.

2.1. Monfalcone (Bay of Panzano)

The Bay of Panzano is a small bay of the Adriatic Sea (Friuli-Venezia Giulia), located in the northern part of the Gulf of Trieste, limited to the south-west by the Punta Sdobba, at the mouth of the Isonzo River. Inside the Panzano Bay are located two Natura 2000 sites: a Special Area of Conservation (SAC) “Cavana di Monfalcone”, a Special Area of Conservation (SAC) and a Special Protection Area (SPA) “Foce dell’Isonzo - Isola della Cona” (Mouth of the Isonzo River and Cona Island) (Figure 2).

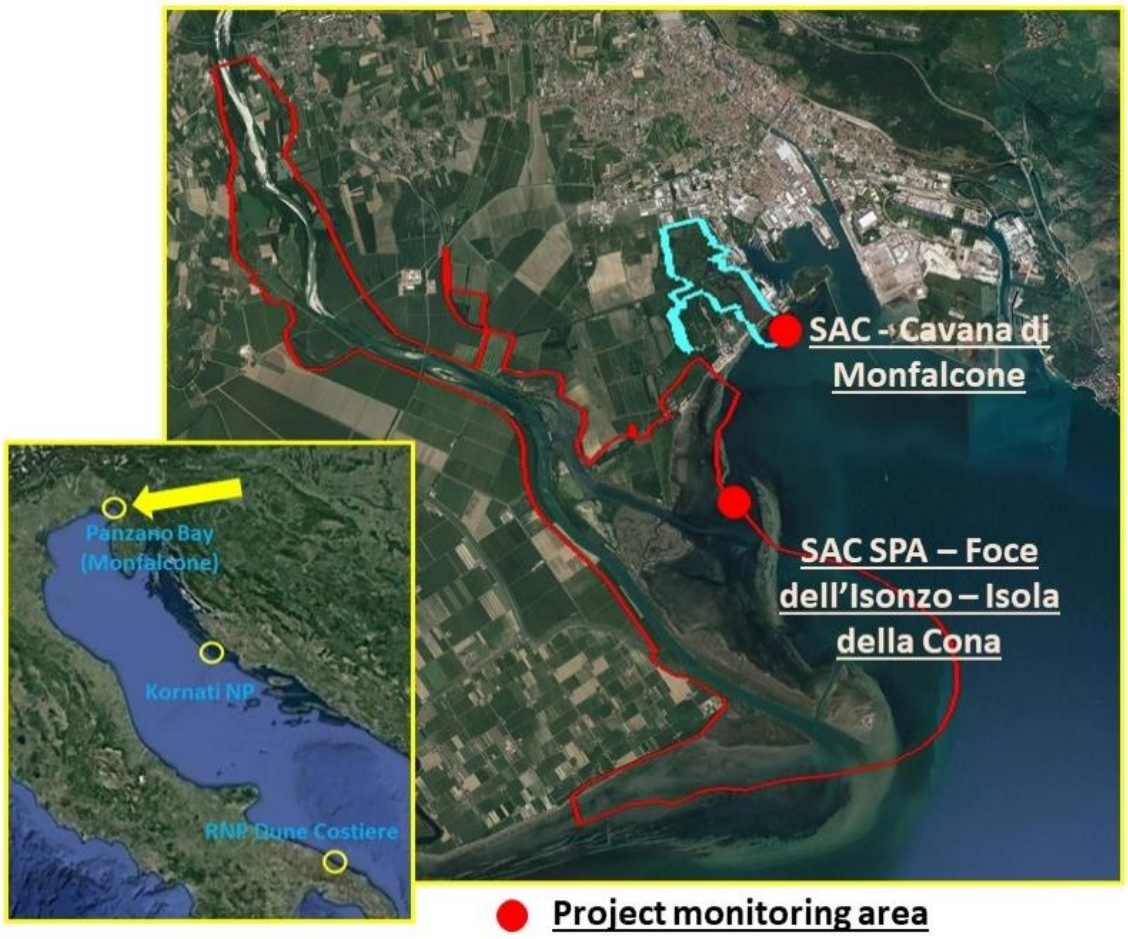

Figure 2. Location of the study areas in the Panzano Bay, positioned in two Natura 2000 sites.

Natura 2000 site: SAC IT3330007 - Cavana di Monfalcone

The "Cavana di Monfalcone" SAC extends over a surface of 133 ha, of which 12% is marine, in the transition area between the flat land and the Adriatic Sea. It is important because it includes a set of ecological systems characterized by rare habitats in a good status of conservation. A complex system of spring canals is still present, not modified by land reclamation. It is a site that includes the spring ecological system closest to the coastline and therefore in direct contact with salt and marine waters. Aquatic surfaces with different trophic status, water speed, depth and salinity preserve a rich and well-diversified aquatic vegetation.

Habitat 1110 ("*Sandbanks which are slightly covered by sea water all the time*") is present in the marine zone of the site. It consists mainly of sandy sediments (larger grain-size sediments, including boulders and cobbles, or smaller grain-size sediments including mud may also be present). These habitats are permanently submerged and predominantly surrounded by deeper water. Above the sand-bank the water depth rarely exceeds 20 m. In these sub-littoral sandbanks, seagrass meadows can be present: *Zostera marina* (in brackish-salt waters), *Cymodocea nodosa* (in salt waters) and *Zostera noltei* in shallower salty waters.

The other Habitat identified is the 1140 ("*Mudflats and sandflats not covered by sea water at low tide*") and is characterized by sands and mud emerging during the low tides, partially covered by *Zostera noltei* and partly coated by green, blue, brown macroalgae, and diatoms.

Natura 2000 site: SAC SPA IT3330005 - Foce dell'Isonzo - Isola della Cona

The "Foce dell'Isonzo – Isola della Cona" SAC SPA covers an area of 2668 ha, 40% of which is marine. It is situated in the eastern part of the Friuli Venezia Giulia region along the last stretch of the Isonzo River and coincides in large part with the "Foce dell'Isonzo Regional Nature Reserve".

The marine part of the site covers about 1.100 ha of shallow waters with relevant extensions of seagrass meadows; in the marine part of the site the Habitat 1110 ("*Sandbanks which are slightly covered by sea water all the time*") and the Habitat 1140 ("*Mudflats and sandflats not covered by sea water at low tide*") are present.

2.2. Regional Natural Park of Coastal Dunes from Torre Canne to Torre San Leonardo

The "Regional Nature Park Dune Costiere from Torre Canne to Torre San Leonado" extends for 1.100 ha, along 8 km of coastline, and includes the inland agricultural areas occupied by centuries-old olive groves and ancient "masserie" (typical Apulian farms) (Figure 3). The perimeter follows the long course of the "lame" (55 km of erosion), which characterizes the Park's territorial morphology. They are linear clefts of the land perpendicular to the coastline, with flat bottom and slightly sloping sides originated by the erosive action of surface waters.

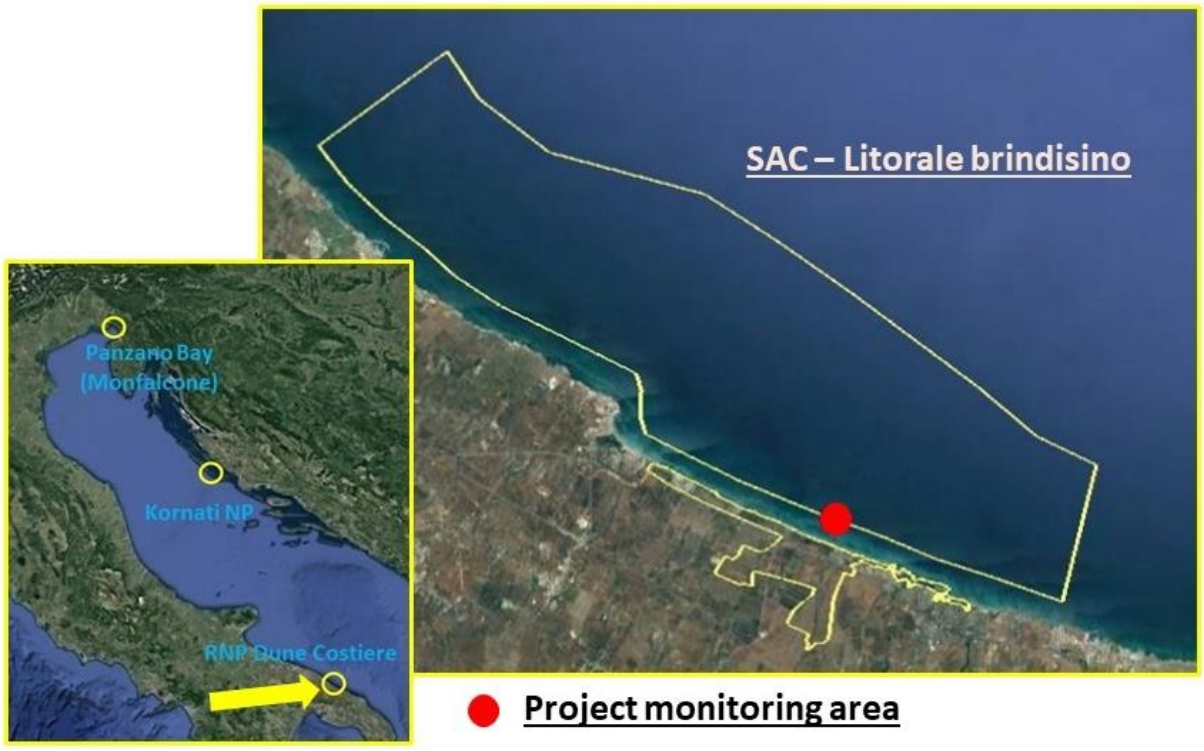

Figure 3. Location of the study area in the RNP Dune Costiere, positioned in a Natura 2000 site.

In the protected area, many habitats are present. Each habitat is a result of the geological, morphological and climatic features of the site that determines the presence of plant and animal species. Some of them are considered priority habitats, such as that colonized by *Posidonia oceanica*. Starting at a depth of 10-12 m, *P. oceanica* meadows are present on sandy bottoms.

The park includes the Special Areas of Conservation (SAC) "Litorale brindisino".

Natura 2000 site: SAC IT9140002 - Litorale brindisino

The SAC "Litorale brindisino" covers an area of 7,256 ha, 95% of which is marine. The priority habitat 1120* (*P. oceanica*) covers 50% of the total area. It is also characterized by the presence of coastal wetlands, where rare or endangered species of migratory birds stop or reproduce.

2.3. Kornati NP

Kornati National Park is designated as Site of Community Importance SCI HR4000001 - Nacionalni park Kornati (Figure 4). The park[1] was established in 1980 and its management began in 1982. It currently includes 89 islands and reefs, a total area of 217 km², of which almost 80% is marine territory (land 50 km² / sea 167 km²) and a total coastline of 238 km. Karst features dominate its geomorphology. It is estimated that at least 2,500 to 3,000 families of benthic and pelagic fauna live in the Kornati archipelago such as 353 species of macroalgae, 3 species of underwater flower plants as well as about 850 animal species – 61 species of corals, 177 species of mollusks, 127 species of polychaetes, 61 species of decapod crabs, 64 species of echinoderms and 185 species of fishes. Meadows of *P. oceanica* are also present in the park, up to a depth of 25-30 meters. The presence of alien species is included among the anthropogenic threats. *P. oceanica* is particularly threatened by some macroalgal species: *Caulerpa cylindracea*[2] (that has been observed in the last years and is spreading in the entire park) and the turf-forming red algae *Womersleyella setacea* and *Acrothamnion preissii* (two species that grow over *Posidonia* rhizomes).

Public Institution, under the competence of the Ministry of Economy and Sustainable Development, manages the Kornati National Park. The land part of the park is entirely privately owned (around 620 owners).

Four no-take zones are present where scientific research is only allowed. Sailing is allowed in the entire Kornati National Park except in the areas of strict protection. Anchoring and overnight stay are allowed only in 19 locations (bays and coves). Autonomous diving is allowed only in organized groups, with a license for autonomous diving in the Kornati NP obtained in advance.

Since 2013, traditional fishing in Kornati National Park is forbidden and only recreational fishing is allowed.

[1] The data cited in the following paragraphs are reported in the articles: Casier (2011); Mihelcic and Ramov (2018); Ivković, (2015).

[2] *Caulerpa cylindracea* Sonder [previously known as *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman *et* Boudouresque]

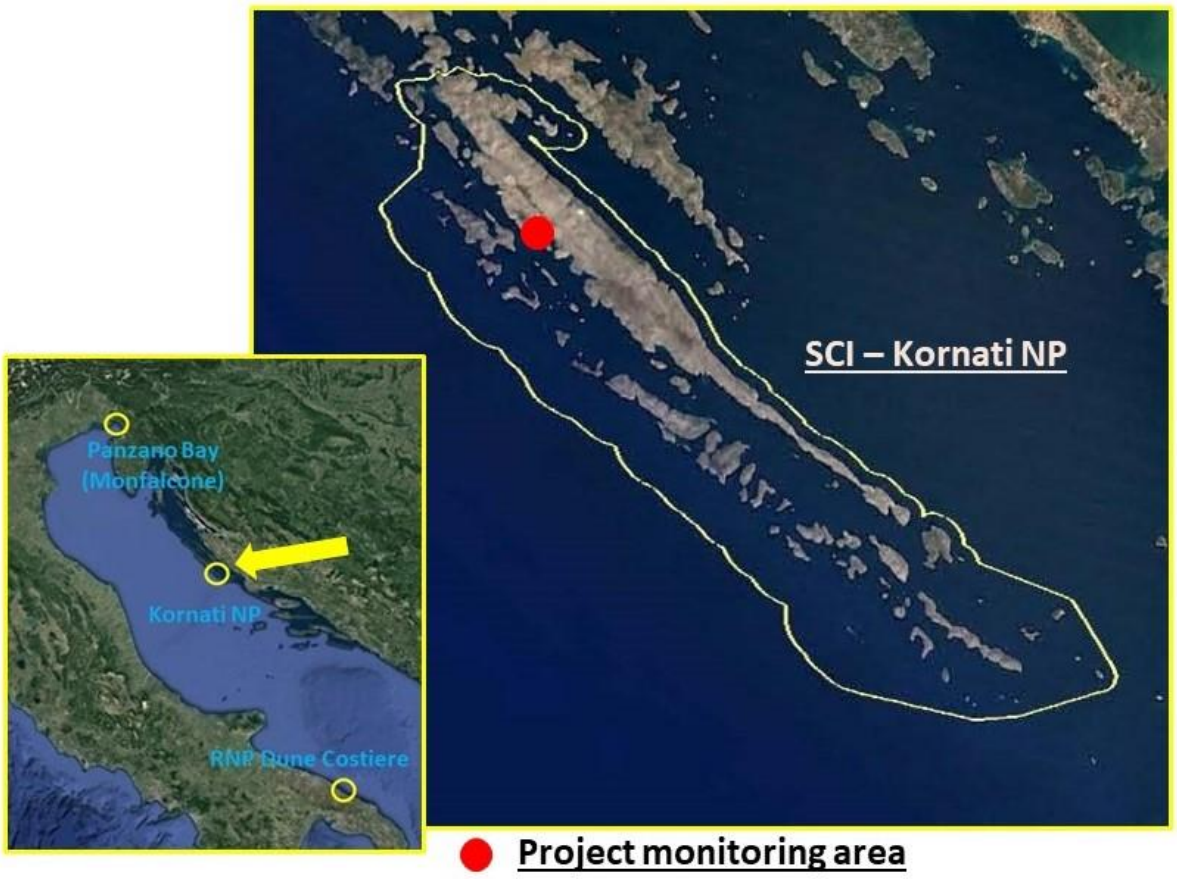

Figure 4. Location of the study area in the Natura 2000 site Kornati NP.

3. SASPAS MONITORING PROTOCOL

The SASPAS Monitoring Protocol aims to identify the best procedure to perform both field surveys and laboratory analyses in order to define a shared methodology to assess the status of seagrass meadows in Natura 2000 sites.

The protocol identifies useful indicators to monitor the status and possible changes of seagrass meadows and to assess the effects on the ecosystem of the concrete actions implemented in WP4: the pilot seagrass transplants (activity 4.2) and the placement of environmentally friendly anchoring systems (anchorages and simple signaling buoys) (activity 4.1). The monitoring protocol allows for the acquisition of necessary and univocal information related to the three project sites (Chapter 2).

The SASPAS Monitoring Protocol is a chapter in the "WP 3 Activity 1 - PRELIMINARY SURVEY REPORT" and specifies the methodologies for carrying out the activities as planned in activity 3.1 (Preliminary Environmental Survey) and activity 3.3 (Monitoring campaigns) and includes:

- a brief description of the seagrass species likely to be found at the three project sites - knowledge of these species is useful for selecting appropriate indicators because, although similar, the species have differences that may affect the applicability of the indicators;
- the best procedure to carry out field surveys and laboratory analyses;
- the description of indicators measured during the field and laboratory activities, in order to assess the status of seagrass meadows, in different stations to be appropriately placed nearby the areas where concrete actions were carried out.

In this document, the description of indicators measured during the field and laboratory activities is only reported.

3.1. Monitoring activities

The SASPAS Monitoring Protocol was applied to the field activities planned in activity 3.1 (Preliminary survey) and, more extensively, in activity 3.3 (Monitoring campaigns).

In activity 3.1, the protocol was applied to broader areas to update knowledge of the status of biodiversity at the project sites (e.g., species, bathymetry, seagrass presence/absence, meadow extension and coverage) and to identify specific areas where concrete actions were implemented (as planned in activity 4.1 and activity 4.2) to protect the habitat of *P. oceanica* and/or other marine seagrasses. Information on operational limits, general criticalities, prohibitions, local ordinances, etc. was also gathered.

The same methodologies of sampling and sample laboratory analyses, used during the preliminary survey activities (activity 3.1), were adopted during the 2020 and 2021 monitoring campaigns (activity 3.3), to check the success of the protection measure activities (activity 4.2 - pilot seagrass transplants).

In addition to the use of specific indicators, described in detail below, the monitoring protocol includes underwater photo and video surveys to document field activities.

During the boat-supported field activities, direct observations were carried out through scuba diving, video-photographic records, and seagrass sampling. All these activities were carried out by Scientific Scuba Operators, and if necessary, in the case of special operations, also considering possible requests from local Maritime Authorities.

All activities were implemented in accordance with national laws, regulations, and permissions. Diving permits to carry out the monitoring activities were obtained from the Ministry of Environmental and Nature Protection. For monitoring at sites within protected areas, permission from the management board of MPA or Park is required.

All the activities were conducted by adopting updated safety protocols, to reduce risks during diving operations. A safety plan was set up for all field activities to profile and manage surface and underwater operations according to criteria to maintain a high safety standard (such as the use of a stand-by operator, underwater communicators, floating indicators, etc.).

Because of their wide national and European distribution and similar morphological structure (leaves, roots, rhizomes), the monitoring protocols for *Zostera marina*, *Zostera noltei* and *Cymodocea nodosa* appear to be relatively similar.

Monitoring sites were examined at approximately the same time of year, each year: late spring-summer for *C. nodosa* and *Zostera* spp. and late summer-early autumn for *P. oceanica*.

Sampling planned in activity 3.3 (and in activity 3.1), according to the monitoring protocol, was performed on selected stations. In each study site, three Zones were selected where three monitoring stations were placed at different depths, for a total of nine stations (Figure 5).

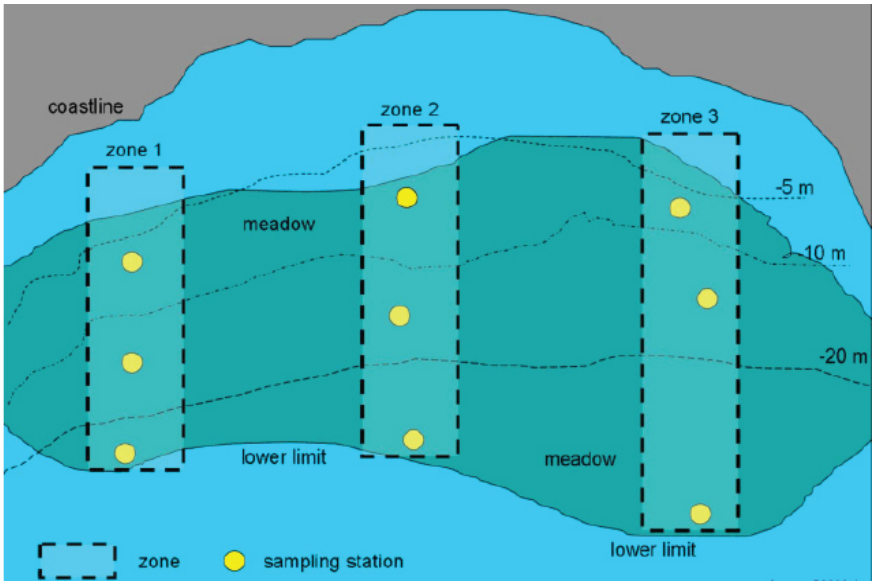

Figure 5. Example of distribution of sampling stations in the three zones and at three different bathymetric ranges (UNEP/MAP - RAC/SPA, 2014).

3.2. Sampling methodology scheme and indicators

The proposed sampling methodology and indicators are shown in Figure 6. The scheme, taken from the ISPRA monitoring protocol for *P. oceanica* (ISPRA, 2012) for the WFD monitoring, was simplified to be adapted to the objectives and timing of the SASPAS project. The indications reported in the UNEP/MAP - RAC/SPA (2014) monitoring protocol for *P. oceanica* were also considered to achieve the integration of the two protocols.

Considering that:

- the activities scheduled by the SASPAS project (39 months) allowed only two vegetative monitoring seasons,
- some status indicators have an ecological significance only if collected for several years,
- the structure and phenology of *P. oceanica*, partially differ from those of the other seagrasses,
- species require different transplanting and monitoring periods,
- seagrass meadows are characterized by great interannual variation,

only status indicators were selected for the monitoring protocol that could meaningful and useful answers over the timeframe of the project.

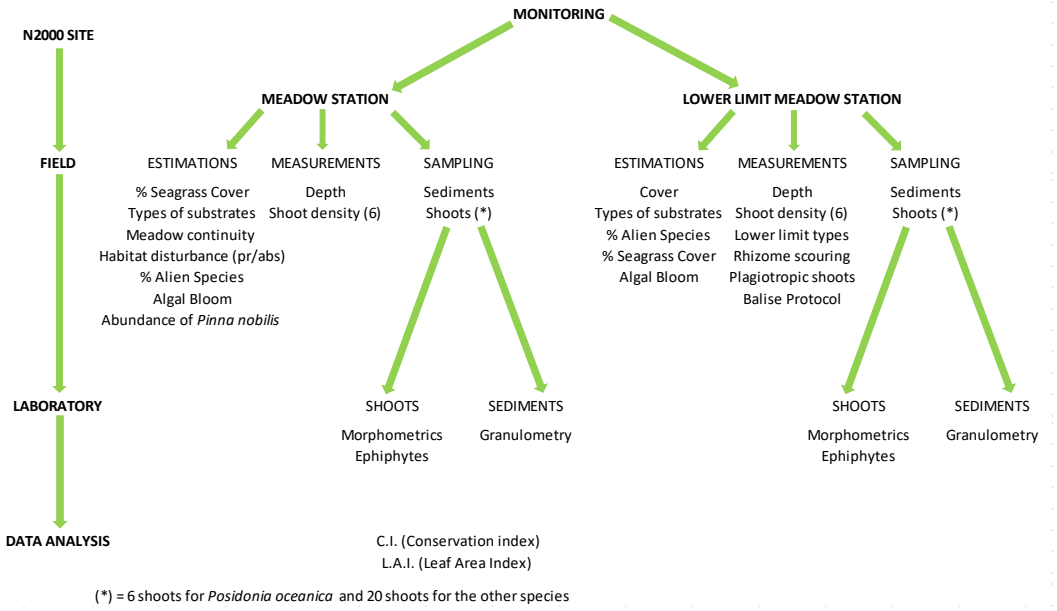

Figure 6. Sampling methodology scheme (ISPRA, 2012, modified).

The following table (Table 1) shows the indicators selected for the protocol.

Table 1. List of indicators selected for the monitoring protocol.

Indicators	Seagrass Meadows		
	Posidonia oceanica	*Zostera* spp.	*Cymodocea nodosa*
Meadow Cover (%)	x	x	x
Continuos/discontinuos meadow	x	x	x
Dead matte (%)	x		
Depth limit (m)	x		
Substrate type	x	x	x
Shoot density (shoots/m^2)	x	x	x
Shoot morphometric measurement	x	x	x
Balisage protocol	x		
Blooms and filamentous algae	x	x	x
Epiphytes (phyto-zoobenthos)	x	x	x
Pinna nobilis Abundance	x	x	x
Alien species (e.g. *Caulerpa* spp.)	x	x	x
Presence/absence of habitat disturbance	x	x	x

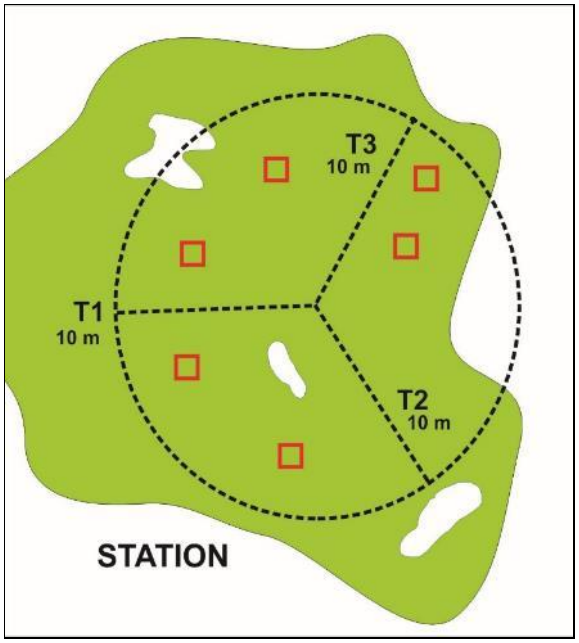

Figure 7. Sampling methodology scheme (Gerakaris et al., 2017, modified).

Figure 7 is an example of a possible sampling design to test the spatial variability within each sampling site in different circular zones (Gerakaris *et al.*, 2017, modified). At each station, shoot density was

measured in random quadrats and meadow cover was estimated along 10 m linear transects (T1, T2 and T3). The green polygon is a portion of a hypothetical meadow.

3.2.1. General data

Several types of data were collected at each station. General information was recorded at the meadow scale and the following data were recorded at each site: monitoring date; site name/code; coordinator and of the operator's name; exposure.

3.2.2. Percentage Cover and meadow continuity

Seagrass cover and its continuity/discontinuity describe the seafloor fraction covered by seagrasses on a 0-100% scale and provides a measure of seagrass abundance. As cover is depth-dependent, any measure of cover was related to water depth. Both density and length of shoot affect the estimation of the seagrass cover (e.g., short shoots may have the same cover as meadows of sparser but longer shoots). Seagrass cover may reflect the patchiness of seagrass stands or seagrass cover of within patches, or both.

Percent seagrass cover is usually visually estimated by a diver as the fraction of the bottom covered by seagrasses. Cover can be estimated directly as percentage or according to a cover scale. For *P. oceanica* the cover of the dead matte was also evaluated.

SASPAS protocol: all percent cover values were assessed using the Line Intercept Transect (LIT) technique (Bianchi *et al*., 2004) (Figure 8). Three transects, each of 10 m length, were monitored at each station (transects extend radially from a fixed central point). Key elements (Lx) cover measurements, along the transects (live seagrass; unvegetated muddy/sandy patches; unvegetated rocky patches; dead matte), were considered for each transect, at the nine stations.

Along the transects, all the key element changes were noted and recorded. Thus, the seagrass presence was referred as a percentage of transect length. As an approximation, this linear pattern was also reported to m^2 and averaged.

The per cent cover (R%) along a 10 m transect was calculated from the following formula:

$R\% = \sum(Lx/10*100)$

where Lx is the length of the cover, 10 is the length of the transect (Figure 9).

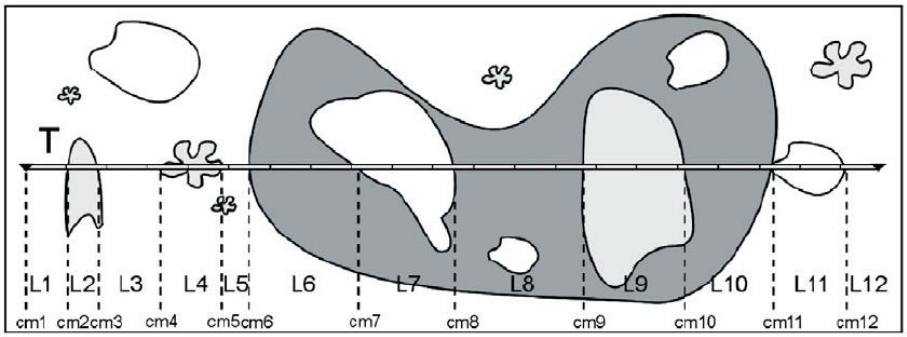

Figure 8. Line Intercept Transect (LIT) technique (Bianchi et al., 2004).

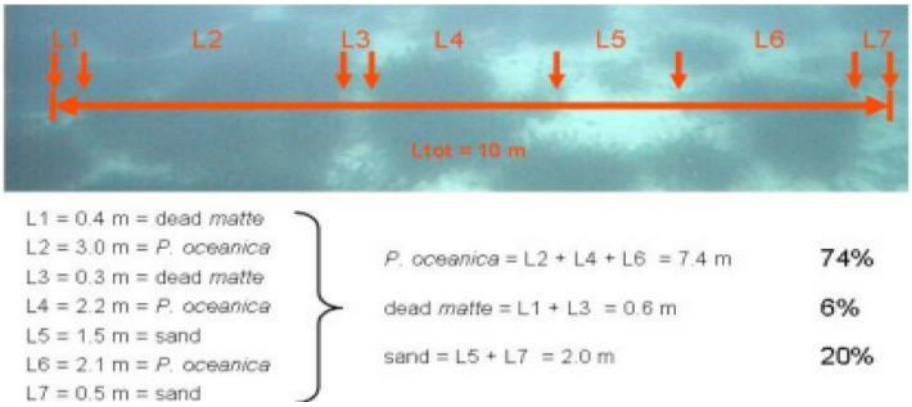

Figure 9. Example of LIT technique for the assessment of percentage cover (UNEP/MAP - RAC/SPA, 2014).

3.2.3. Shoot density

Shoot density is the number of seagrass shoots/m^2 and thus provides a measure of seagrass abundance along depth gradients. The decline in density with depth suggests that shoot density responds faster than other indicators (e.g., biomass and cover) to environmental changes and may be an early indicator of change or negative trends that are occurring in the habitat type (Borum *et al*., 2004).

SASPAS protocol: shoot density was measured non-destructively by counting the number of shoots within sampling unit (six replicated quadrats) launched randomly at least one meter apart at each sampling station. As shoot density is depth-dependent, any measure of shoot density was related to water depth.

When shoot density is high (i.e., ≥ 2500 shoots/m^2) counting of dense stands is only feasible using small sub-areas. Duarte and Kirkman (2001) suggested different frames size depending on the expected shoot density: 0.5 m x 0.5 m for less than 300 shoots/m^2, 0.25 m x 0.25 m for 300-3000 shoots/m^2 and 0.1 m x 0.1 m for more than 3000 shoots/m^2.

For *P. oceanica*, the number of shoots per m^2 is one of the most widely used descriptors to assess ecosystem health (Pergent-Martini *et al.*, 2005; UNEP/MAP-RAC/SPA, 2011) because it provides information on the viability and dynamic of meadows. This indicator also reveals changes due to human influence when measured on a multi-year time scale. Since the meadow density is strongly affected by the depth, Pergent *et al*. (1995) identified four classes, which are a function of the theoretical mean densities for each depth. They reflect the ecological conditions of the meadow (Buia *et al.*, 2004). Recently this classification was updated for the interpretation of monitoring data (UNEP/MAP-RAC/SPA, 2011) (Table 2).

Along the lower limit of *P. oceanica* meadows, rhizome scouring (laying bare of the rhizomes) and plagiotropic shoots (plagiotropic to orthotropic rhizome ratio) were also considered.

Table 2. Meaning of shoot density (shoots/m^2) for P. oceanica (UNEP/MAP-RAC/SPA, 2011 modified).

Depth (m)	High	Good			Moderate			Poor			Bad
1	> 1133	1133	to	930	930	to	727	727	to	524	< 524
2	> 1067	1067	to	863	863	to	659	659	to	456	< 456
3	> 1005	1005	to	808	808	to	612	612	to	415	< 415
4	> 947	947	to	757	757	to	567	567	to	377	< 377
5	> 892	892	to	709	709	to	526	526	to	343	< 343
6	> 841	841	to	665	665	to	489	489	to	312	< 312
7	> 792	792	to	623	623	to	454	454	to	284	< 284
8	> 746	746	to	584	584	to	421	421	to	259	< 259
9	> 703	703	to	547	547	to	391	391	to	235	< 235
10	> 662	662	to	513	513	to	364	364	to	214	< 214
11	> 624	624	to	481	481	to	338	338	to	195	< 195
12	> 588	588	to	451	451	to	314	314	to	177	< 177
13	> 554	554	to	423	423	to	292	292	to	161	< 161
14	> 522	522	to	397	397	to	272	272	to	147	< 147
15	> 492	492	to	372	372	to	253	253	to	134	< 134
16	> 463	463	to	349	349	to	236	236	to	122	< 122
17	> 436	436	to	328	328	to	219	219	to	111	< 111
18	> 411	411	to	308	308	to	204	204	to	101	< 101
19	> 387	387	to	289	289	to	190	190	to	92	< 92
20	> 365	365	to	271	271	to	177	177	to	83	< 83
21	> 344	344	to	255	255	to	165	165	to	76	< 76
22	> 324	324	to	239	239	to	154	154	to	69	< 69
23	> 305	305	to	224	224	to	144	144	to	63	< 63
24	> 288	288	to	211	211	to	134	134	to	57	< 57
25	> 271	271	to	198	198	to	125	125	to	52	< 52
26	> 255	255	to	186	186	to	117	117	to	47	< 47
27	> 240	240	to	175	175	to	109	109	to	43	< 43
28	> 227	227	to	164	164	to	102	102	to	39	< 39
29	> 213	213	to	154	154	to	95	95	to	36	< 36
30	> 201	201	to	145	145	to	89	89	to	32	< 32
31	> 189	189	to	136	136	to	83	83	to	30	< 30
32	> 179	179	to	128	128	to	77	77	to	27	< 27
33	> 168	168	to	120	120	to	72	72	to	24	< 24
34	> 158	158	to	113	113	to	68	68	to	22	< 22
35	> 149	149	to	106	106	to	63	< 63			
36	> 141	141	to	100	100	to	59	< 59			
37	> 133	133	to	94	94	to	55	< 55			
38	> 125	125	to	88	88	to	52	< 52			
39	> 118	118	to	83	83	to	48	< 48			
40	> 111	111	to	78	78	to	45	< 45			

3.2.4. Shoot morphometric measurement

The study of the phenological characteristics of marine seagrasses allows to describe the vitality of plants through the analysis of vegetation turnover and cyclic phases that characterize the species and the meadow.

SASPAS protocol - The following parameters were measured in the laboratory: shoot length (cm/shoot), shoot width (cm/shoot), average number of leaves (leaves/shoot), leaf necrosis (% leaves/shoot) of randomly collected shoots at each station (for *P. oceanica* only orthotropic shoots were sampled). At each station, 6 shoots of *P. oceanica* and 20 shoots of the other species (which were also used for epiphyte analyses) were collected.

The limited number of *P. oceanica* shoots (6) collected compared to those provided by other monitoring protocols (6-18) (ISPRA, 2012) is justified by the fact that the monitoring operations aimed to preserve the meadows as much as possible, considering how they are damaged by trawling or anchoring.

3.2.5. Leaf Area Index (LAI) and Conservation Index (CI)

To assess the conservation status of the *P. oceanica* meadows, the monitoring protocol foresees the application of two indices, the Leaf Area Index (LAI) and the Conservation Index (CI):

Leaf Area Index (LAI):

The photosynthetically active surface (m^2/m^2) was determined by multiplying the mean surface of one-shoot leaves (only one face) by meadow shoot density.

Conservation Index (CI): (only applicable to *P. oceanica*)

CI = P/(P+D)

where: P= % of alive *P. oceanica*; D= % of dead matte.

Based on the values of CI, meadows were classified according to the criterion proposed by Montefalcone (2009) following the WFD requirements:

Bad	Poor	Moderate	Good	High
CI<0.3	0.3≤CI<0.5	0.5≤CI<0.7	0.7≤CI<0.9	CI≥0.9

3.2.6. Algal blooms and filamentous algae

Macroalgal blooms can vary greatly over time both because they grow fast and because they are regulated by wind exposure and can be decimated after a storm. The presence and quantity of filamentous algae (especially the genera *Ulva* and *Cladophora*) were used as an indicator of nutrient richness in coastal waters.

SASPAS protocol: the presence/absence of macroalgal blooms was measured by visual estimations from boat using the aqua scope.

3.2.7. Abundance of epiphytes

Epiphytes (phyto- and zoo-) can be a prominent component of seagrass ecosystems when nutrient concentrations are high. Both composition and abundance are important. Samples with associated epiphytic assemblages were collected in immersion and stored frozen or in a preservation liquid until laboratory analysis.

SASPAS protocol: for each station 6 shoots of *P. oceanica* and 20 shoots of the other species (that were also used for morphometric measurements) were collected.

Each shoot collected was carefully examined under a stereomicroscope to determine the organisms present. They were classified into three morpho-functional categories: *encrusting* (encrusting or prostrate algae), *turf* (algae less than 10 mm long) and *erect* (algae greater than 10 mm) (Airoldi and Cinelli, 1997; Irving and Connell, 2002a, 2002b). Zoobenthos organisms were only reported when their presence was significant. Then, cover, i.e., the percentage of area occupied by organisms on the leaf surface, was calculated and divided among the three morpho-functional categories.

3.2.8. Associated communities

The abundance of bivalve *Pinna nobilis* (listed in the Annex IV of HD) is considered an indicator of meadow health (Borum *et al*., 2004; Díaz-Almela e Duarte, 2008). The presence of *P. nobilis* can be affected by physical impacts on the meadows (e.g., boat anchoring).

SASPAS protocol: *Pinna nobilis* density was measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long (see “Belt Transect” technique in Bianchi *et al*., 2004; Figure 10) and evaluating their status (dead or alive).

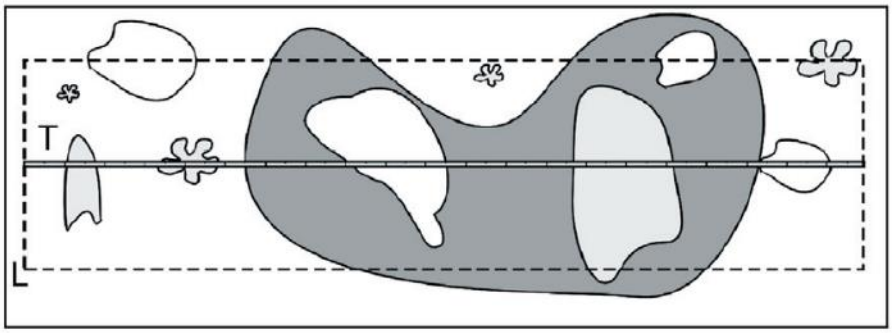

Figure 10. "Belt Transect" technique (Bianchi et al., 2004).

3.2.9. Lower limit of meadows and balise placement (only for *P. oceanica*)

The lower depth of the meadow extension is more fragile than the upper one and can be considered as an indicator of the dynamics of the entire meadows. In addition, its bathymetric identification was performed by the technique called "balisage" which allow to verify its evolution in the temporal scales envisaged by the project. It consists in the installation of marking points (balises), dead bodies were placed on the bottom at the edge of the meadow and the possible retreat or increase of the contour was monitored.

SASPAS protocol: considering the schedule of the project, the protocol adopted by the *Reseau de Surveillance Posidonies* (Charbonnel *et al.*, 2000) was applied in a simplified form with the laying of three balises and a photographic survey.

During the Preliminary Survey (WP 3.1), divers tried to find three sections of the lower limit (characterized by degraded/risk of meadows conditions) placing three balises (1 balise at each section). Only one section was identified and all three balises were placed along it. Divers took photos: no. 3 frontal pictures (central, lateral right side and lateral left side) from 0.5 m off the seafloor, using a picket installed 1.5 m from the balise, downward to the *P. oceanica* meadow.

Because of the characteristics of the two study areas (NP Kornati and Litorale Brindisino, balises were placed inside an area with discontinuous meadows, by the edge of a large patch of *Posidonia* characterized by degraded/risk conditions. The selected limit did not correspond to the actual lower limit of the meadow (as represented in the example in the Figure 11), as only possible anchor-risk contours were considered, to monitor their retreat dynamics.

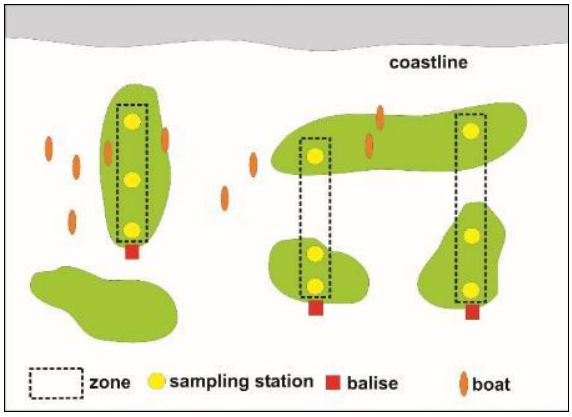

Figure 11. Example of balise placement in a discontinuous meadow.

The typology of lower limits is based on the description of Pergent *et al*. (1995) integrated by Montefalcone (2009) and UNEP/MAP-RAC/SPA (2009):

- progressive limit: with plagiotropic (horizontal) rhizomes beyond the limit oriented toward the bottom, the absence of matte, regularly decreasing cover (indicates colonization of the meadow in the depth);
- sharp limit: the meadow stops abruptly with the presence of vertical rhizomes but in the absence of matte; it is characterized by high (>25 %) or low (<25 %) cover (these limits usually indicate a state of equilibrium, but low percent cover may indicate environmental deterioration and an early imbalance);
- erosive limit: the meadow stops abruptly with the presence of a pronounced step of matte and cover > 50 %;
- sparse limit: density is less than 100 shoots per m^2 and cover less than 15 % (in general it reflects degraded conditions);
- regressive limit: the presence of dead matte beyond the limit, within the dead matte a few isolated shoots or residual patches of *P. oceanica* alive may persist, with or without step of matte, isolated or connected to the meadow (it testifies a decline of the meadow).

Recent classifications of the status of the meadow in function of lower limit depth, typology and % cover are reported in Table 3, Table 4 and Table 5 (UNEP/MAP-RAC/SPA, 2009, 2011).

Table 3. Status of the meadow in function of the lower limit depth (UNEP/MAP-RAC/SPA, 2011, modified).

	High	Good	Moderate	Poor	Bad
Depth (m)	> 34.2	34.2 to 30.4	30.4 to 26.6	26.6 to 22.8	< 22.8

Table 4. Status of the meadow in function of the lower limit tipology (UNEP/MAP-RAC/SPA, 2011, modified).

	High	Good	Moderate	Poor	Bad
Lower limit	progressive	sharp (cover > 25 %)	sharp (cover < 25 %)	sparse	regressive

Table 5. Status of the meadow in function of the lower limit cover (UNEP/MAP-RAC/SPA, 2011, modified).

	High	Good	Moderate	Poor	Bad
% cover at lower limit	> 35 %	35 % to 25 %	25 % to 15 %	15 % to 5 %	< 5 %

3.2.10. Type of substrate

The type of substrate, by means of visual observation, was also evaluated. Sediment samples were collected for laboratory grain-size and chemical analyses. For the three study sites, the results are reported in chapter 6.

3.2.11. Alien species

The presence of *alien species* is included among anthropogenic threats. *P. oceanica* is particularly threatened by some algal species: three species of the genus *Caulerpa* (*C. taxifolia*, *C. prolifera* and *C. cylindracea*) and the turf-forming red alga *Womersleyella setacea*. For this reason, their reporting and coverage estimation are required by the WFD protocols applied in the Mediterranean Sea.

SASPAS protocol: the abundance of *alien species* was evaluated as cover using the same methods described for seagrass cover (along three transects at each station).

3.2.12. Presence/absence of habitat disturbance

Evidence of mechanical pressures (e.g., mooring systems, concrete blocks, piers, chains, ropes, and trash) and signs of impacts (e.g., detached shoots, detached plates of matte, damages due to trawling or anchoring) was identified through visual observation.

4. MONITORING RESULTS

In the following paragraphs, data from the preliminary survey carried out in 2019 (WP 3.1) will be compared to the 2020 and 2021 monitoring campaigns results (WP 3.3) to control the life cycle and distributive dynamics of marine seagrasses and identify the effectiveness and potential impact of Project actions (laying of buoys and seagrass transplantation) on valuable habitats and species.

Table 6. Schedule of the preliminary survey and the monitoring campaigns in the three study sites.

	Monfalcone (Bay of Panzano)	**Kornati N.P.**	**RNP Coastal Dunes**
2019 - WP 3.1 Preliminary survey	May	June	September
2020 - WP 3.3 Monitoring campaign	September	June	October
1-2021 - WP 3.3 Monitoring campaign	April	May	February
2-2021 - WP 3.3 Monitoring campaign	September	October	February 2022 (*)

(*) The second monitoring campaign (in the RNP Coastal Dunes Park) originally scheduled for autumn 2021 was carried out in February 2022 (due to some unexpected events and adverse weather conditions).

In the project sites, at each station, general information, such as monitoring date, site name/code, coordinator and operators' names, exposure, and coordinates were recorded in the field sheets (see annexes). Also, laboratory data were reported in special sheets that are collected in the annexes.

The coordinates of the monitoring stations at the three study sites are reported in Table 7:

Table 7. Coordinates of the monitoring stations in the three study sites.

Monfalcone (Bay of Panzano)			**Kornati NP (NEW)**			**RNP Dune Costiere**		
	Latitude (N)	Longitude (E)		Latitude (N)	Longitude (E)		Latitude (N)	Longitude (E)
Z1 A	45 46' 45,81''	13 32' 12,51''	Z1 A	43 82' 46,91''	15 27' 50,53''	Z1 A	40 48' 59,81''	17 31' 25,11''
Z1 B	45 46' 45,47''	13 32' 19,19''	Z1 B	43 82' 48,69''	15 27' 53,43''	Z1 B	40 48' 59,83''	17 31' 24,42''
Z1 C	45 46' 37,97''	13 32' 27,58''	Z1 C	43 82' 52,37''	15 27' 55,52''	Z1 C	40 48' 59,81''	17 31' 23,78''
Z2 A	45 45' 34,13''	13 31' 36,79''	Z2 A	43 82' 45,74''	15 27' 53,12''	Z2 A	40 49' 00,32''	17 31' 25,01''
Z2 B	45 45' 28,69''	13 31' 54,79''	Z2 B	43 82' 48,56''	15 27' 55,03''	Z2 B	40 49' 00,39''	17 31' 24,38''
Z2 C	45 45' 23,05''	13 32' 32,63''	Z2 C	43 82' 50,92''	15 27' 58,33''	Z2 C	40 49' 00,43''	17 31' 23,51''
Z3 A	45 45' 06,27''	13 31' 54,88''	Z3 A	43 80' 90,83''	15 25' 52,50''	Z3 A	40 49' 00,91''	17 31' 24,93''
Z3 B	45 45' 09,33''	13 32' 06,01''	Z3 B	43 80' 89,44''	15 25' 50,55''	Z3 B	40 49' 00,87''	17 31' 24,10''
Z3 C	45 45' 11,00''	13 32' 35,82''	Z3 C	43 80' 88,89''	15 25' 48,61''	Z3 C	40 49' 00,92''	17 31' 23,17''
			Balise	43 49' 31,10''	15 16' 32,59''	*Balise*	40 49' 00,08''	17 31' 23,99''

4.1. Monfalcone (Bay of Panzano)

4.1.1. Monitoring area

At Monfalcone, all the monitoring campaigns took place in the two Natura 2000 sites in the Panzano Bay: SAC - *Cavana di Monfalcone* and SPA-SAC - *Foce dell'Isonzo - Isola della Cona* (Figure 14), according to the following schedule:

- Preliminary survey: May 2019,
- First monitoring campaign: September 2020,
- Second monitoring campaign: April 2021,
- Third (additional) monitoring campaign: September 2021.

In the area located in the northern part of the Panzano bay, in the site "Cavana di Monfalcone", Zone 1 (Z1) was located on a *Cymodocea nodosa* meadow, where anchoring pressures occur, due to the presence of medium-sized boats (sailboats). Within this Zone, three monitoring stations were positioned at different depths (Stations Z1-A, Z1-B and Z1-C) (Figure 12).

The Zone 2 (Z2) and Zone 3 (Z3) were placed in the "Foce dell'Isonzo – Isola della Cona". These Zones are characterized by shallow depth and are located on *Cymodocea nodosa* meadows mixed with other species (i.e., *Zostera noltei* in Z2 and *Z. marina* in Z3). In these areas anchoring pressures occur, due to the presence of small-size boats. As at Zone 1, three monitoring stations were located, within each Zone, at different depths, for a total of six stations (Z2-A, Z2-B, Z2-C, Z3-A, Z3-B and Z3-C) (Figure 12).

Figure 12. Sampling scheme applied to Zone 1 in the in the site "Cavana di Monfalcone" and to Zones 2 and 3 in the in the site "Foce dell'Isonzo, Isola della Cona".

As mentioned before, the status and possible changes of seagrass meadows were monitored to assess the effects on the ecosystem of the concrete actions implemented in WP4: two pilot seagrass transplantations carried out in 2020 and 2021 (activity 4.2) and the placement of environmentally friendly anchoring systems (anchor buoys – summer season 2021) (activity 4.1) (Figure 13).

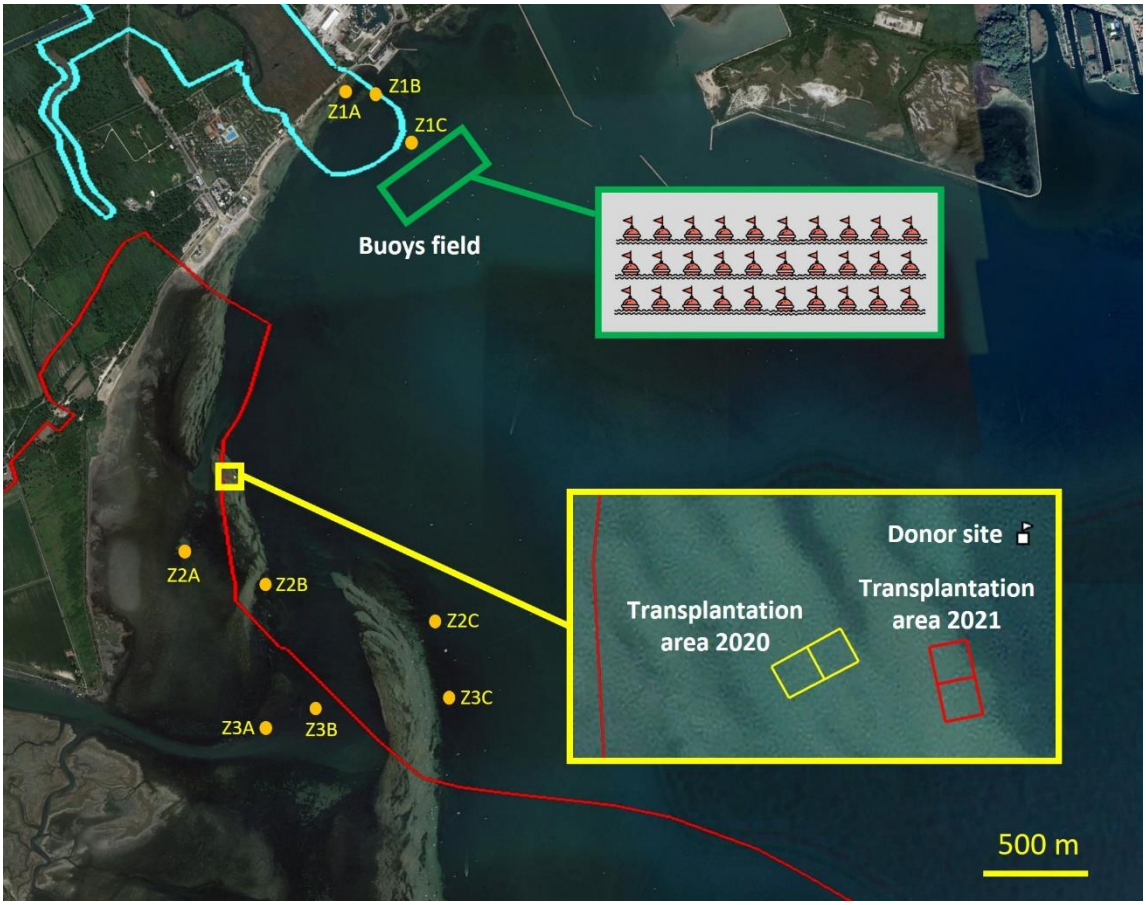

Figure 13. Bay of Panzano: location of the buoys field and of the pilot seagrass transplantation areas.

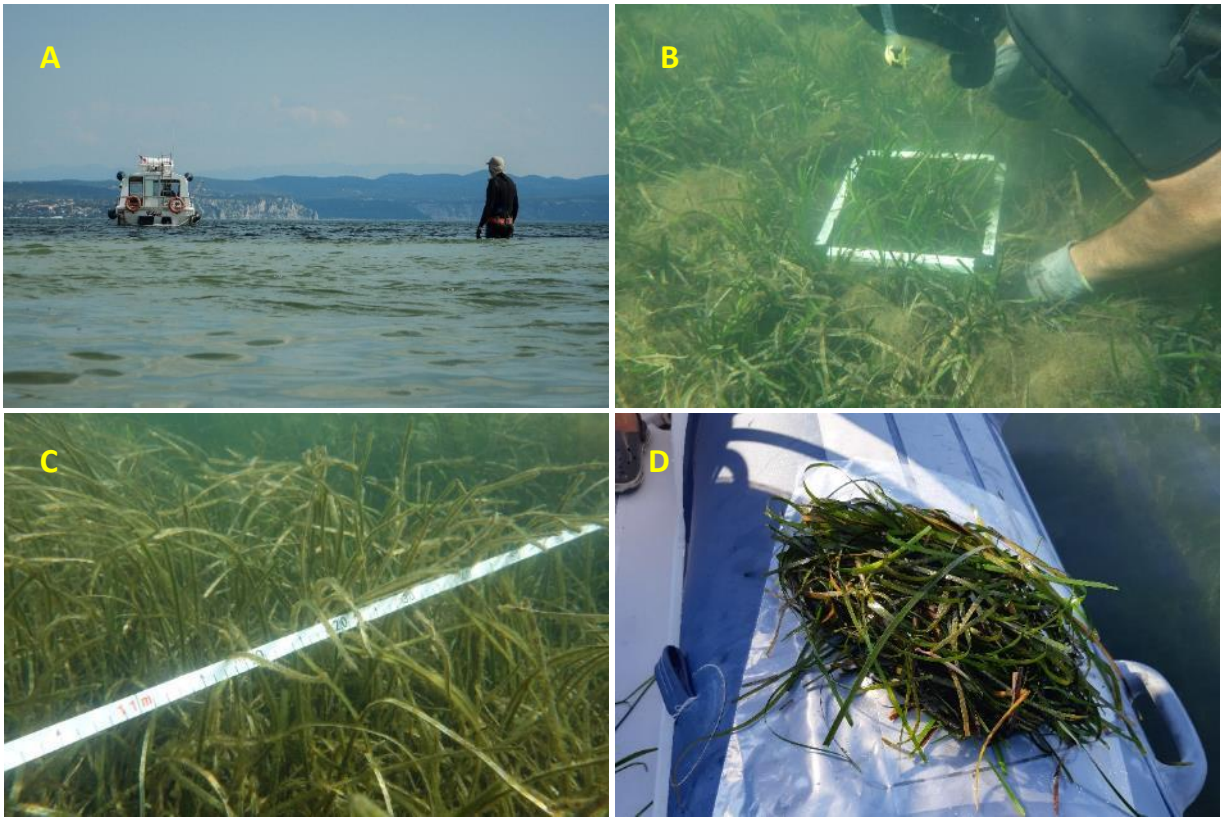

Figure 14. Monitoring campaigns: A) boat supporting monitoring activities; B) shoot density measurements; C) cover percentage and meadows continuity measurements; D) Cymodocea nodosa *shoots collected for laboratory morphometric measurements.*

4.1.2. Distribution of seagrass meadows

In the Bay of Panzano, *Cymodocea nodosa* is the most abundant seagrass species, which sometimes forms mixed meadows together with *Zostera marina* and / or *Zostera noltei*. Concerning the sampling areas, as previously mentioned, Zone 2 and Zone 3 were located on *Cymodocea nodosa* meadows, with reduced presence of other species (*Zostera noltei* in Z2 and *Zostera marina* in Z3) (Figure 15).

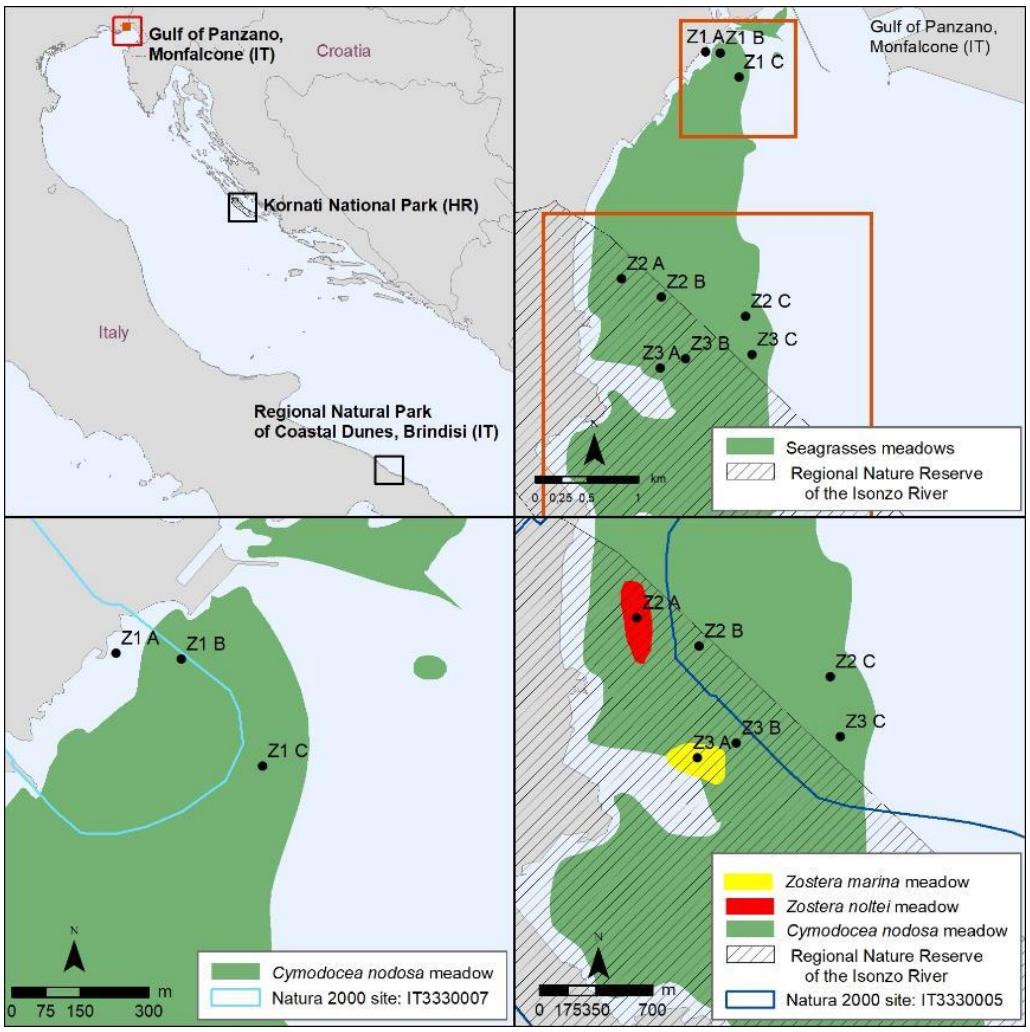

Figure 15. Seagrass distribution and monitoring stations in the Panzano Bay.

At the time of measurements, a high continuity of meadows was observed in the monitoring stations and no particular signs of disturbance were recorded. Other sites, coincident with the shallower areas were little or no colonized.

4.1.3. Percentage Cover and meadow continuity

In Zone 1 (stations Z1-A, Z1-B and Z1-C), the results of the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3) showed how the average cover of *Cymodocea nodosa* always varied between 0% and 100%. In fact, in some areas (Station Z1-C) seagrasses were absent (bare seabed). A comparison with the data from 2019 campaign (preliminary survey - WP 3 activity 1) showed a slight increase of *C. nodosa* coverage at station Z1-A. However, considering the data of spring 2019 and the ones of spring 2021, to exclude differences due to seasonal changes, no statistically significant differences ($p<0.05$) were found between the two coverage values (2019 and 2021).

In Zone 2 (stations Z2-A, Z2-B and Z2-C), as mentioned before, *Cymodocea nodosa* meadows were mixed with *Zostera noltei*. As the graphs shows, the average cover of *C. nodosa* was always close to 100% or slightly less than 100% (some discontinuity of the meadow) whereas the average cover of *Z. noltei* showed an increase between 2019 and 2021 at station Z2-A. However, no statistically significant differences ($p<0.05$) were found between the two coverage values (2019 and 2021). In Zone 3 (stations Z3-A, Z3-B and Z3-C), coverage of both species (*C. nodosa* and *Zostera marina*) was always close to 100%.

Even considering the variability due to the presence of different species characterized by different seasonal cycles, data analysis suggests the existence of limited differences of percent cover along stations and Zones. The results are summarized in Figure 16.

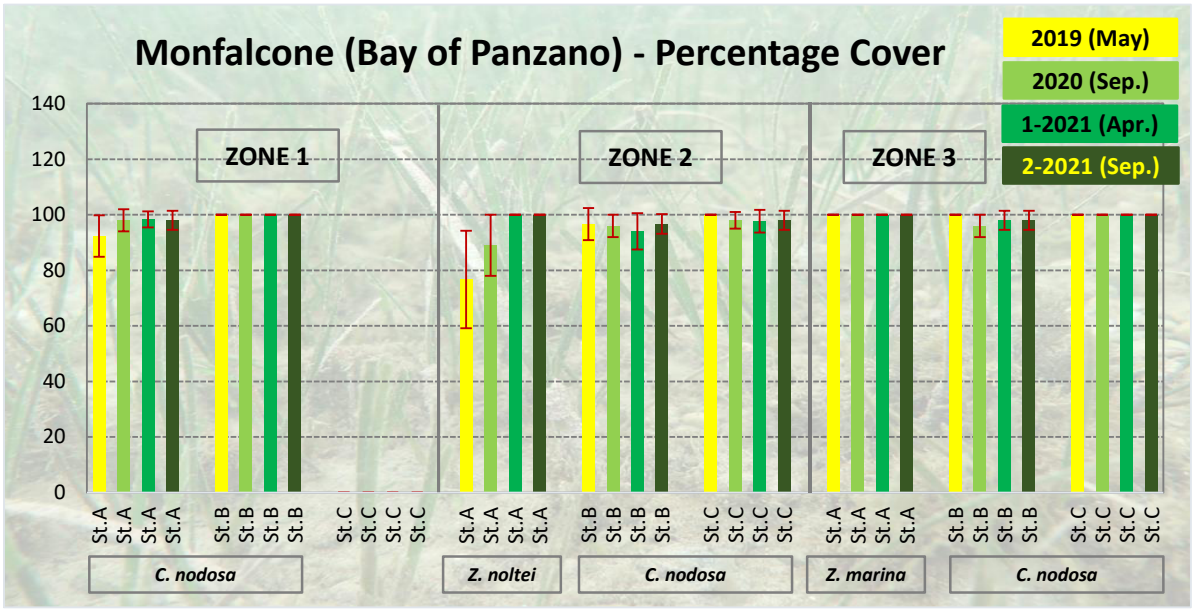

Figure 16. The average values of seagrass percentage cover as measured at the sampling stations.

4.1.4. Shoot density

In Zone 1 (stations Z1-A, Z1-B and Z1-C), considering the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3), the average shoot density of *Cymodocea nodosa* varied between 602 and 628 shoots/m^2 at station Z1-A and between 604 and 730 shoots/m^2 at station Z1-C (at Z1-C station seagrasses were absent). A comparison with data from the 2019 campaign (preliminary survey - WP 3 activity 1) highlighted an increase of *C. nodosa* shoot density in the stations Z1-A and Z1-B; however, statistically significant differences ($p<0.05$) between the shoot density values (spring 2019 and spring 2021) were only found in Z1-B.

In Zone 2 (stations Z2-A, Z2-B and Z2-C), the average value of shoot density, recorded during the three monitoring campaigns, ranged between 578 and 637 shoots/m^2 at station Z2-B and between 639 and 707 shoots/m^2 at station Z2-C for *Cymodocea nodosa*, and between 1915 and 2357 shoots/m^2 at station Z2-A for *Zostera noltei*.

A comparison with data from the 2019 campaign (preliminary survey) highlighted a general slight decrease of *C. nodosa* shoot density in the stations Z2-B and Z2-C (no statistically significant differences, $p<0.05$). For *Z. noltei*, the comparison between the spring 2019 data and the 2021 ones showed a decrease of shoot density; however, no statistically significant differences were found.

In Zone 3 (stations Z3-A, Z3-B and Z3-C), the average shoot density of *Cymodocea nodosa* ranged between 578 and 681 shoots/m^2 at station Z3-B, between 765 and 813 shoots/m^2 at station Z3-C and between 276 and 306 shoots/m^2 at station Z3-A for *Zostera marina*. Only slight variations were highlighted between the values of the preliminary survey and the monitoring campaigns' ones (no statistically significant differences, $p<0.05$).

As for the percent cover, the data analysis suggests the presence of limited differences along stations and Zones for shoot density. The differences were related to the species (*C. nodosa* e *Zostera* spp.) and characterized by different seasonal cycles (growth rate and spread, reproductive season, etc.).

The results are summarized in Figure 17.

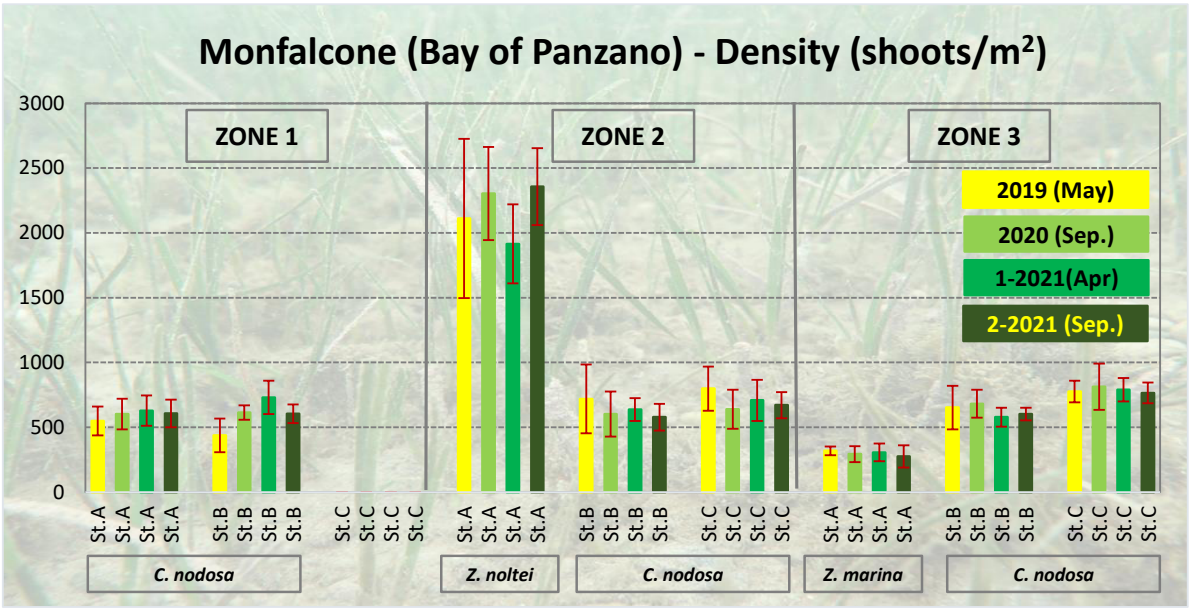

Figure 17. The average values of seagrass shoot density as measured at the sampling stations.

4.1.5. Shoot morphometric measurement

Differently from what was reported for the first two parameters considered (percentage cover and shoot density), the analysis of the data (and the graphs) suggests that the differences along stations and Zones are mainly due to: a) different seasonal sampling period (spring and autumn), b) different phenological cycles (compared to the average shoot length of *C. nodosa*, the shorter length of *Z. noltei* and the longer length of *Z. marina* are expected due to their different phenological cycles), and c) different water depths (light attenuates with increasing depth and seagrasses prolong leaves and thin shoots density to capture more light to convert into photosynthetic production).

However, a comparison between data from the 2019 spring campaign (preliminary survey - WP 3 activity 1) and the spring 2021 monitoring campaign also showed differences in the three species shoot length (decreases and/or increases). Statistically significant differences ($p<0.05$) between the two shoot length spring values (2019 and 2021) were found in all stations. The results are summarized in Figure 18.

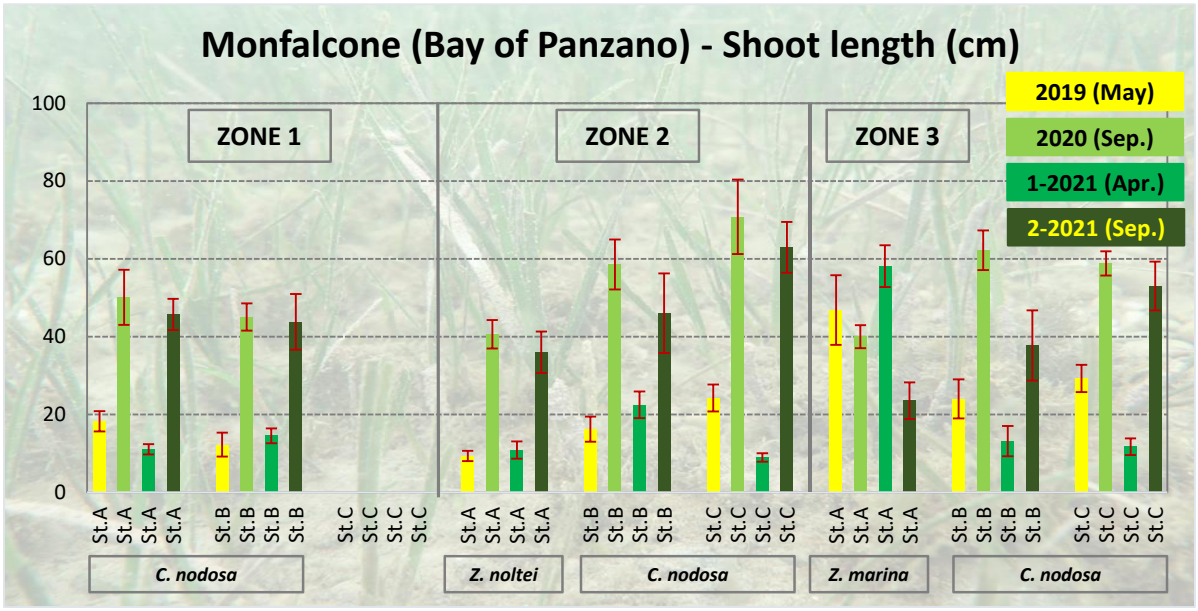

Figure 18. The average values of seagrass shoot length as measured at the sampling stations.

The other parameters are summarized in Table 8 (average values and standard deviations).

Table 8. Shoot width (cm/shoot), n. of leaves/shoot and leaf necrosis (% leaves/shoot) (average values and standard deviations).

Zone 1		Z1-A (C.n.)	Z1-B (C.n.)	Z1-C
Shoot width (cm/shoot)	**2019**	0.17±0.02	0.18±0.03	-
	2020	0.36±0.01	0.35±0.02	-
	1-2021	0.21±0.02	0.22±0.02	-
	2-2021	0.34±0.01	0.27±0.04	-
N. of leaves/shoot	**2019**	3.1±0.5	3.0±0.7	-
	2020	2.7±0.5	2.8±0.6	-
	1-2021	1.7±0.4	2.2±0.5	-
	2-2021	2.4±0.6	2.6±0.6	-
Leaf necrosis (% leaves/shoot)	**2019**	0.1±0.2	0.4±0.8	-
	2020	0.6±0.2	0.6±0.2	-
	1-2021	1.5±0.5	2.0±0.5	-
	2-2021	0.8±0.2	0.6±0.4	-

Zone 2		Z2-A (Z.n.)	Z2-B (C.n.)	Z2-C (C.n.)
Shoot width (cm/shoot)	**2019**	0.10±0,00	0.18±0.02	0.28±0.02
	2020	0.11±0.01	0.34±0.01	0.38±0.02
	1-2021	0.11±0.01	0.27±0.02	0.17±0.02
	2-2021	0.11±0.01	0.33±0.02	0.41±0.02
N. of leaves/shoot	**2019**	2.8±0.4	2.7±0.6	2.7±0.6
	2020	2.8±0.4	2.7±0.5	2.5±0.5
	1-2021	3.8±0.5	1.7±0.7	1.8±0.5
	2-2021	3.7±0.7	3.0±0.7	3.0±0.6
Leaf necrosis (% leaves/shoot)	**2019**	0.2±0.2	0.3±0.5	1.4±0.9
	2020	0.2±0.2	0.7±0.5	1.1±0.5
	1-2021	0.1±0.2	3.4±1.0	1.2±0.5
	2-2021	0.3±0.2	0.3±0.3	0.8±0.2

Zone 3		Z3-A (Z.m.)	Z3-B (C.n.)	Z3-C (C.n.)
Shoot width (cm/shoot)	**2019**	0.44±0.05	0.19±0.03	0.25±0.04
	2020	0.49±0.01	0.33±0.02	0.39±0.02
	1-2021	0.45±0.02	0.25±0.02	0.21±0.02
	2-2021	0.41±0.04	0.32±0.02	0.36±0.01
N. of leaves/shoot	**2019**	4.8±0.7	2.8±0.5	2.8±0.5
	2020	4.8±0.7	2.8±0.4	3.0±0.7
	1-2021	4.7±0.7	1.8±0.4	1.9±0.4
	2-2021	4.2±0.7	2.7±0.6	2.9±0.6
Leaf necrosis (% leaves/shoot)	**2019**	1.1±0.5	0.8±0.3	1.4±0.9
	2020	1.5±0.5	0.7±0.3	0.5±0.3
	1-2021	1.1±0.4	0.8±0.5	0.6±0.3
	2-2021	0.6±0.4	0.1±0.2	0.4±0.3

The comparison with the 2019 campaign data (preliminary survey - WP 3 activity 1) shows no particular anomalies in the three parameters' values.

4.1.6. Leaf Area Index (LAI)

The index values are reported in Table 9 (average values):

Table 9. Leaf Area Index (LAI) averages values (the values refer to 2019 Preliminary survey campaign and 2020, 1-2021, 2-2021 monitoring campaigns).

		LAI (station average value)				***LAI (Zone average value)***			
		2019	**2020**	**1-2021**	**2-2021**	**2019**	**2020**	**1-2021**	**2-2021**
Z1-A	*(C.n.)*	0.3	0.1	1.7	1.3	0.2	1.6	0.2	1.3
Z1-B	*(C.n.)*	0.1	1.6	0.2	1.2				
Z1-C	-	-	-	-	-	-	-	-	-
Z2-A	*(Z.n.)*	0.3	1.4	0.4	1.7	0.3	1.4	0.4	1.7
Z2-B	*(C.n.)*	0.2	2.1	0.3	1.5	0.5	2.3	0.2	2.3
Z2-C	*(C.n.)*	0.7	2.6	0.1	3.2				
Z3-A	*(Z.m.)*	1.8	1.4	1.9	0.6	1.8	1.4	1.9	0.6
Z3-B	*(C.n.)*	0.4	2.3	0.2	1.1	0.6	2.8	0.1	1.8
Z3-C	*(C.n.)*	0.9	3.7	0.1	2.4				

Comparison with data from the 2019 campaign (preliminary survey - WP 3 activity 1) shows decreases and increases in LAI values due to seasonal differences in density and shoot length for the three species.

4.1.7. Algal blooms and filamentous algae

During all monitoring campaigns (and the 2019 preliminary survey), a general visual assessment by boat using aqua scope in the monitoring areas showed the absence of (filamentous) macroalgal blooms.

4.1.8. Abundance of epiphytes

The average cover of the three categories was calculated (i.e., the percentage of surface area occupied by the organisms on the leaf surface) and reported in Table 10.

The data regarding the preliminary survey and all the monitoring campaigns always underlined the dominance of the *encrusting layer* (mainly represented by red calcareous algae) and this is reported in the literature as a positive condition of the quality status of seagrass meadows. In fact, in disturbed environments (e.g., in the presence of increased nutrient concentrations or water turbidity), there would be a reduction in the abundance of encrusting taxa and a simultaneous increase in the presence of filamentous algae (Ballesteros, 1987; Martínez-Crego *et al*., 2010).

Table 10. Average cover of the three categories (Encrusting layer, Erect layer and Turf layer) (the values refer to 2019 Preliminary survey campaign and 2020-2021(1)-2021(2) monitoring campaigns).

		Encrusting layer				Erect layer				Turf layer			
		2019	2020	1-2021	2-2021	2019	2020	1-2021	2-2021	2019	2020	1-2021	2-2021
Z1-A	*(C.n.)*	10%	15%	20%	20%	<5%	<5%	<5%	5%	<5%	<5%	10%	5%
Z1-B	*(C.n.)*	15%	15%	15%	20%	<5%	<5%	<5%	5%	<5%	<5%	10%	5%
Z1-C	-	-	-	-	-	-	-	-	-	-	-	-	-
Z2-A	*(Z.n.)*	10%	15%	15%	15%	<5%	<5%	<5%	5%	<5%	<5%	5%	5%
Z2-B	*(C.n.)*	15%	15%	15%	15%	<5%	<5%	<5%	<5%	<5%	<5%	10%	<5%
Z2-C	*(C.n.)*	15%	15%	15%	15%	<5%	<5%	<5%	5%	<5%	<5%	5%	<5%
Z3-A	*(Z.m.)*	15%	15%	15%	15%	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%
Z3-B	*(C.n.)*	15%	20%	20%	20%	<5%	<5%	<5%	5%	<5%	<5%	10%	<5%
Z3-C	*(C.n.)*	20%	20%	15%	20%	<5%	<5%	<5%	<5%	<5%	<5%	10%	10%

4.1.9. Associated communities

In the study area (within the corridors and in their proximity), some live and/or dead individuals of *Pinna nobilis* were found, especially during the preliminary survey in 2019 (at station Z1-B) and during the 2020 monitoring campaign (at Z2-C and Z3-C stations).

4.1.10. Alien species

No alien algal species were found in the study area during all the monitoring activities.

4.1.11. Presence/absence of habitat disturbance

Concerning human disturbance and the evidence of mechanical pressures, some fishing-nets, fixed to the sea bottom by poles, were observed near Zone 2 and Zone 3, during the preliminary survey in 2019 and the 2020 monitoring campaign.

4.1.12. Monitoring of seagrass transplantation

At Monfalcone (Figure 19), the area for pilot seagrass transplantations (planned in WP 4 activity 2) was identified in the SPA/SAC Foce dell'Isonzo – Isola della Cona (near Zone 2 and Zone 3). This area is characterized by shallow waters (about 1.2 meters above mean sea level), and by the presence of *Cymodocea nodosa* meadows, partly mixed with other species (*Zostera noltei* and *Zostera marina*). Anchoring pressures occur in this area, due to the presence of small boats. The meadows of the donor

site were selected in a nearby area (Figure 19). The donor meadow was continuous with no visible signs of disturbance.

In September 2020, *Cymodocea nodosa* shoots were transplanted using two different techniques (Figure 20). The first one, which was prevalent, involved the collection and planting of sods (vegetated units where the plant with leaves, roots and rhizomes are be taken with the native sediment surrounding it). The second one involved the collection of shoots (bare root planting units - cuttings) and subsequent replanting, using anchor staples.

In April 2021, an additional *Cymodocea nodosa* pilot transplantation was performed at Panzano Bay, in an area nearby the first transplantation by using the same two techniques. The donor site was selected in an adjacent area. Donor meadow was continuous, with no visible signs of disturbance.

Two square transplant areas (10 X 10 m) were selected, where the manual transplant of vegetated plugs and bare root planting cuttings was carried out.

The results of the monitoring campaigns carried out in September 2021 (as planned in WP 3 activity 3.3) are reported below.

First pilot transplantation (September 2020): sods showed a good development in 50% of cases, as the remaining 50% got eroded (Figure 21 and Figure 22). Regarding the other technique, only few transplanted cuttings were found. These losses showed that the cuttings technique was not the most suitable for the area (exposed to the Autumn storms, that occurred shortly after the transplant).

Additional pilot transplantation (April 2021): sods showed a rapid leaf/rhizome development and a rapid and wide colonization of the seabed (Figure 23 and Figure 24) reaching about 100% of success. Regarding the transplanted shoots, by staples, about 70% survived the transplantation and this was due to: a) the vegetative period (spring), favorable to the development of plants and b) the refinement in the transplantation technique.

A more detailed analysis of the transplantations state and progress will be carried out in the final WP 3.3 and WP 4.2 reports (deliverables D.3.3.1 and D.4.2.3).

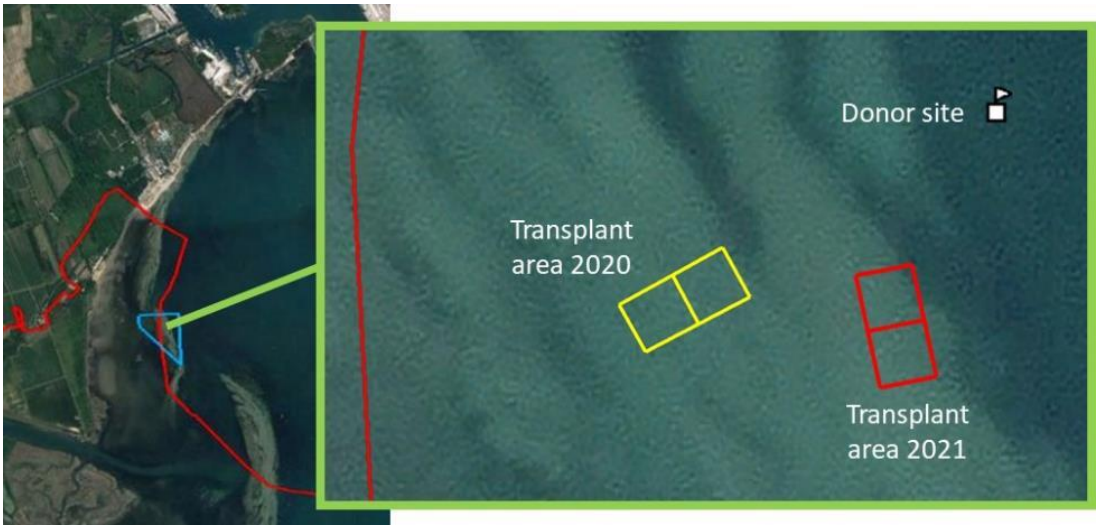

Figure 19. Seagrass transplantation: host and donor sites in Panzano Bay (Monfalcone)

Figure 20. Cymodocea nodosa *transplanting techniques: collection and planting of plugs (on the left) and collection of shoots and subsequent re-planting by staples (on the right).*

Figure 21. September 2021: sods of C. Nodosa *tranplanted in September 2020 that got eroded.*

Figure 22. September 2021: sods of C. Nodosa *tranplanted in September 2020 that showed a good development.*

Figure 23. September 2021: sods of C. Nodosa *tranplanted in April 2021 that showed a good development.*

Figure 24. September 2021: sods of C. Nodosa *tranplanted in April 2021 that showed a rapid and wide colonization of the seabed.*

4.2. KORNATI NP

4.2.1. Monitoring area

At the Kornati NP site, the monitoring campaigns took place according to the following schedule:

- Preliminary survey: June 2019,
- First monitoring campaign: June 2020,
- Second monitoring campaign: May 2021,
- Third (additional) monitoring campaign: October 2021.

In this case, two types of sites were considered, located on *P. oceanica* meadows. The first one is the "Anchoring site*"* a little bay where anchoring pressures occur and the second one is the "Diving site*",* a less confined site where diving boats anchor for authorized diving activities.

In the "Anchoring site" (in Kravljačica Bay), two Zones were selected (Zone 1 and Zone 2) on the *P. oceanica* meadows, each one hosting three monitoring stations, placed at different depths (St. A, B and C) for a total of six stations. In addition, three marking points (balises) were placed (Figure 25).

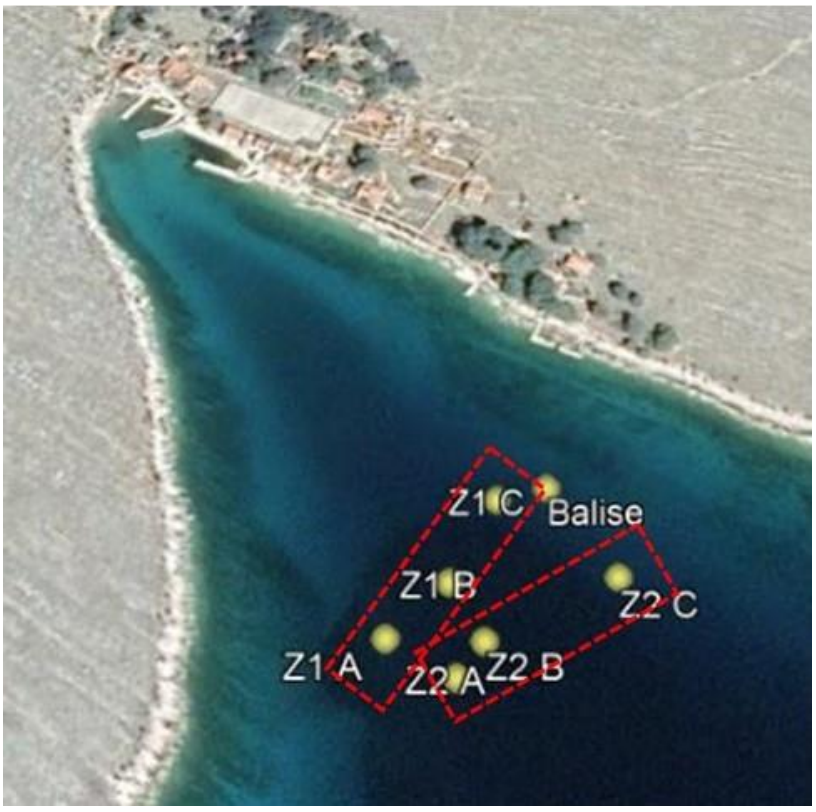

Figure 25. Sampling scheme applied to the Zone 1 and Zone 2 in the "Anchoring site "in Kravljačica Bay.

At the “Diving site”, located between the Borovnik island and Balun, dive boats anchor for authorized diving activities. Along Zone 3, three monitoring stations (St. A, B and C) were placed (Figure 26).

Figure 26. Sampling scheme applied to the Zone 3 in the “Diving site” positioned between Borovnik island and Balun Island.

As for the other sites, the status and possible changes of seagrass meadows were monitored to assess the effects on the ecosystem of the concrete actions implemented in WP4: two pilot seagrass transplantations carried out in 2019 and 2021 (activity 4.2) and the placement of environmentally friendly anchoring systems (anchor buoys – summer season 2021) (activity 4.1) (Figure 27 and Figure 28).

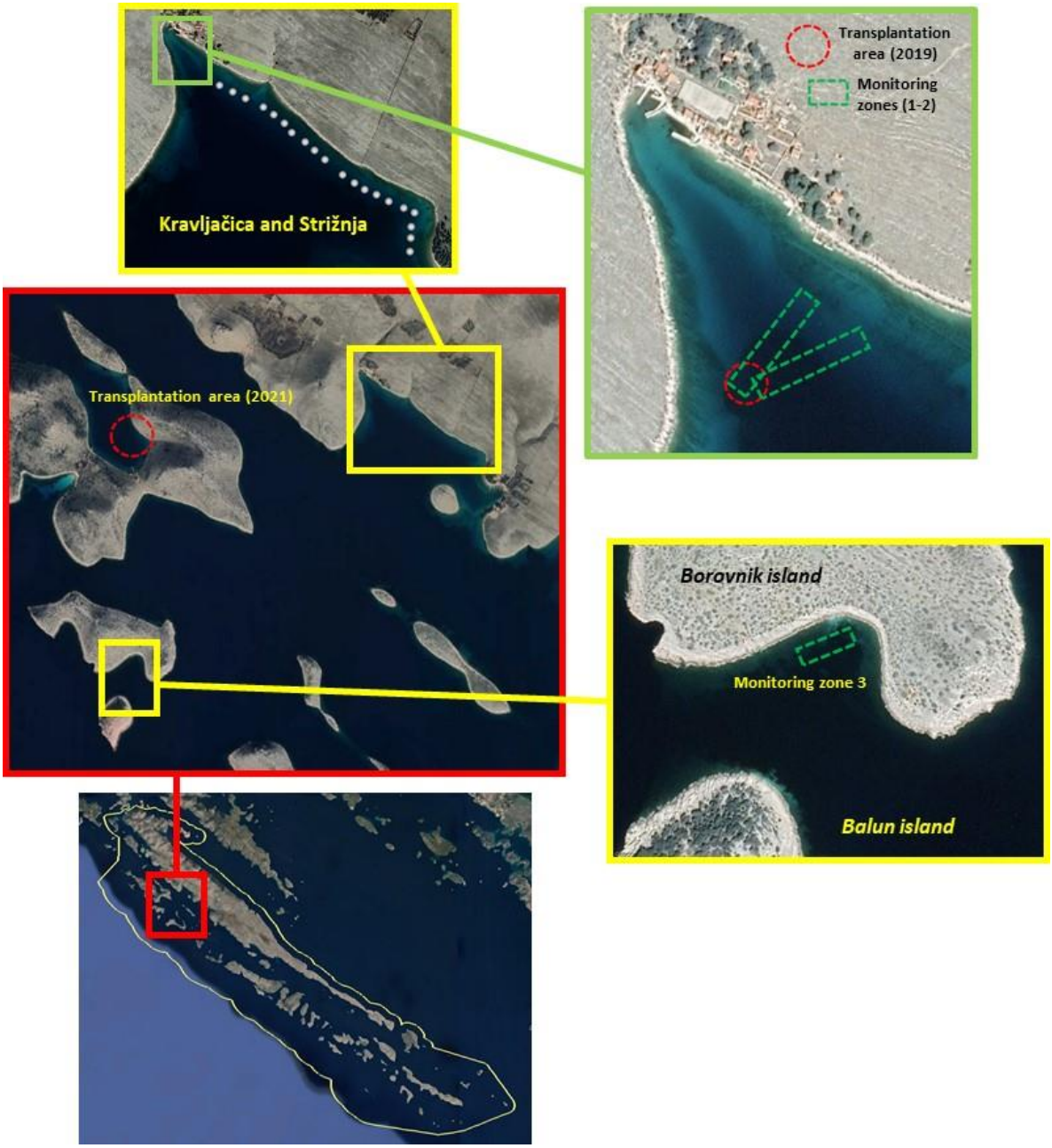

Figure 27. Kornati NP: location of the the pilot seagrass transplantation areas and of the monitoring zones.

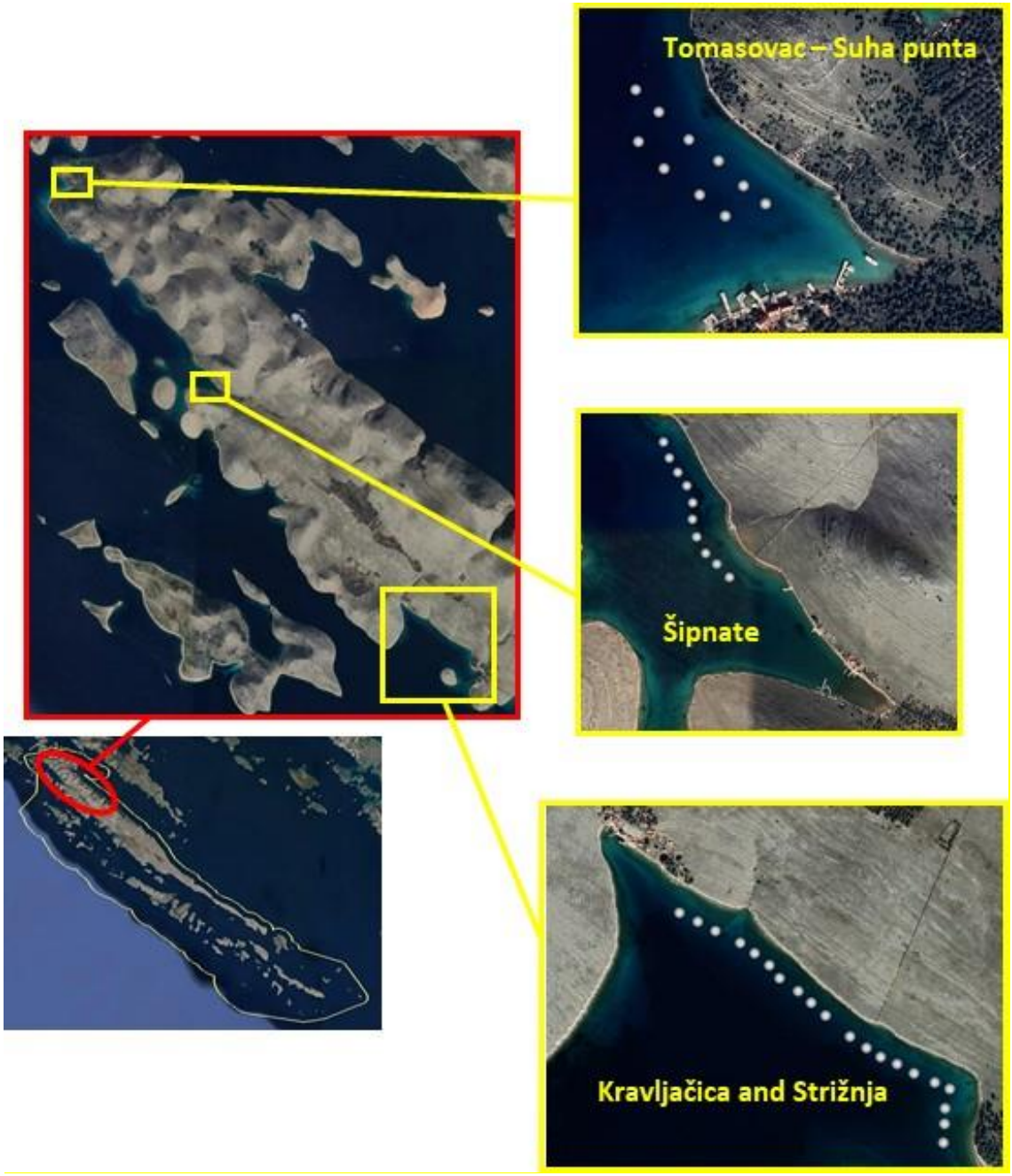

Figure 28. Kornati NP: location of the buoys fields.

Figure 29. Monitoring campaigns: A) divers taking photographs and making video in the monitoring area; B) cover percentage and meadows continuity measurements; C) Shoot density measurements; D) marking points placement (Balise) to monitor the meadow's dynamics.

4.2.2. Distribution of seagrass meadows

In an overall view, *P. oceanica* meadows are widespread in the park, down to depths of 25-30 meters and with an irregular distribution that mainly follows the bathymetric pattern of the archipelago (Figure 30).

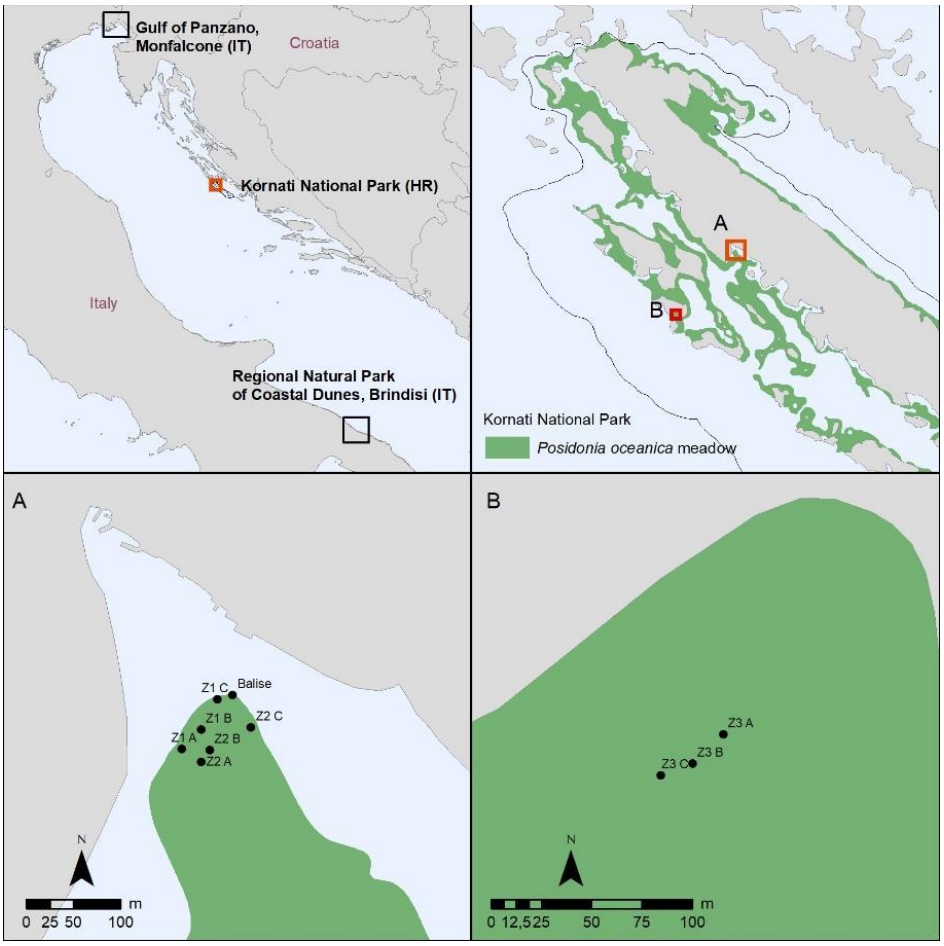

Figure 30. Seagrass distribution and monitoring stations in the Kornati NP.

The existing distribution map was produced on the basis of the first available information and through orthophoto observations and bathymetric maps. This map represents a potential distribution range, as there is a need for more detailed seagrass distribution maps based on actual data collected in the field. At the "Anchoring site" (Zone 1 and Zone 2) signs of disturbance on the meadows were reported and, in some areas, the cover was fragmented and patchy and damage to seagrasses appeared to be caused by anchor dragging and scraping of anchor chains along the seabed. The "Anchoring site", due to its morphology, bathymetric trend, and wind exposure, behaves as a sedimentation basin. At present, it is reasonable to assume that the numerous anchorages of pleasure boats in the summer period were also responsible for sediment re-suspension.

In the "Diving site" (Zone 3) the meadow was continuous, with no visible signs of disturbance and low sedimentation; only a few points were devoid of meadows, but this is believed to be due to natural distribution dynamics and not to the impact of human activities.

4.2.3. Percentage Cover and meadow continuity

In the "Anchoring site", considering the results of the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3), the mean *P. oceanica* coverage ranged between 31% and 60% in Zone 1 (with stations Z1-A, Z1-B, Z1-C) and between 22% and 49% in Zone 2 (with stations Z2-A, Z2-B and Z2-C), showing strong discontinuity of the meadow, with a very patchy distribution, attributable to different pressures, as below suggested. A comparison with the results of June 2019 (preliminary survey - WP 3 activity 1) highlighted a general increase in the "Anchoring site" (with the only exception of station Z2-B). However, statistically significant differences ($p<0.05$) between the two coverage values of 2019 and 2020 were recorded in three out of the six stations (Z2-B, Z3-A and Z3-C stations) and between the two coverage values of 2019 and 2021[3] only in one out of the six stations (Z1-B station).

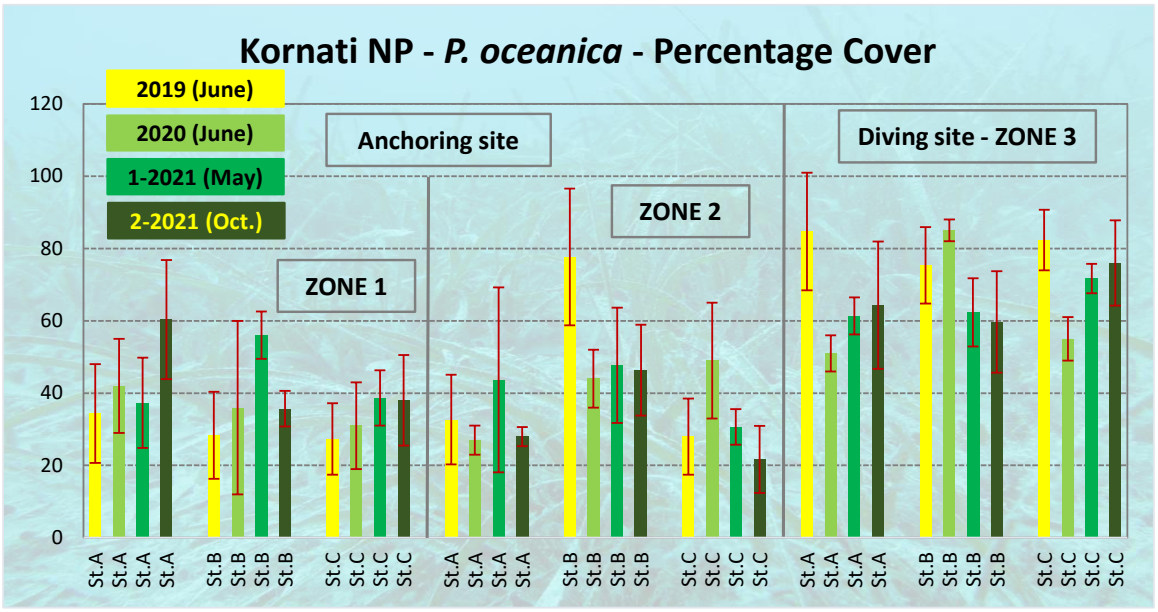

Figure 31. The average values of P. oceanica *per cent cover as measured at the sampling stations.*

In the "Diving site" (where Zone 3, with stations Z3-A, Z3-B and Z3-C was located), considering the results of the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3), the mean coverage of *P. oceanica* ranged between 51% and 85%. The distribution resulted homogeneous, with sandy lenses to interrupt meadows and a few signs interpreted as anchorage disturbances. A comparison with the results of June 2019 (preliminary survey - WP 3 activity 1) showed a general coverage decrease in the three

[3] Only the 2021 spring campaign was considered to exclude the natural variability related to different monitoring seasons.

stations. The presence of sandy lenses that cause variations in the overall values of coverage in this site was probably responsible for these differences. However, these differences were not statistically significant ($p<0.05$).

The data analysis suggests the existence of differences in the cover percentage of *P. oceanica* along stations in the "Anchoring site" and in the "Diving site". In particular, the stations placed in the "Diving site" were characterized by coverage values higher than the ones in the "Anchoring site". This is an expected result because, as mentioned before, in the "Anchoring site" *P. oceanica* meadows suffered from mechanical damage caused by boat anchoring and correlated disturbances (physical impacts, sediment burial, over-sedimentation on the canopy, light attenuation…) resulting in a very irregular residual distribution. The results are summarized in Figure 31.

4.2.4. Shoot density

At the "Anchoring site" (Zone 1 and Zone 2), considering the results of the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3), the mean density of *P.oceanica* shoots ranged between 264 and 322 shoots/m^2 in Zone 1 and between 246 and 302 shoots/m^2 in Zone 2. A comparison with the results of June 2019 (preliminary survey - WP 3 activity 1) showed, as for the percentage cover, contradictory signs of decrease and increase of density for the different stations of the anchoring site, which correspond to such an irregular disturbance to the meadow. However, statistically significant differences ($p<0.05$) were found between the two density values of 2019 and 2020 only in three out of the six stations (Z1-A, Z3-A and Z3-C stations) and between the two density values of 2019 and 2021 only in two out of the six stations (Z1-C and Z2-A stations).

As for the percentage cover, the existence of marked differences along stations at the "Anchoring site" for shoot density of *P. oceanica* were mainly related to the presence of anchoring pressure. This impact was not the result of an instantaneous disturbance, but a signal of suffocation and degradation of the leaf canopy caused by continuous mooring at anchor in the bays and by the presence of numerous pleasure boats throughout the long summer season (arrival and departure, sewage discharge, bathing activities, restaurants on the shore, etc.). In particular, physical damage to seagrasses seems caused by dragging anchors and scraping anchor chains along the seabed.

In the "Diving site" (Zone 3), considering the results of the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3), the average shoot density of *P. oceanica* ranged between 209 and 342 shoots/m^2. A comparison with the results of June 2019 (preliminary survey) highlights an increase of shoot density in stations Z3-A and Z3-C. However, statistically significant differences ($p<0.05$) were found only between the two density values of 2019 and 2020 in two out of the six stations (Z3-A and Z3-C). The results are summarized in Figure 32.

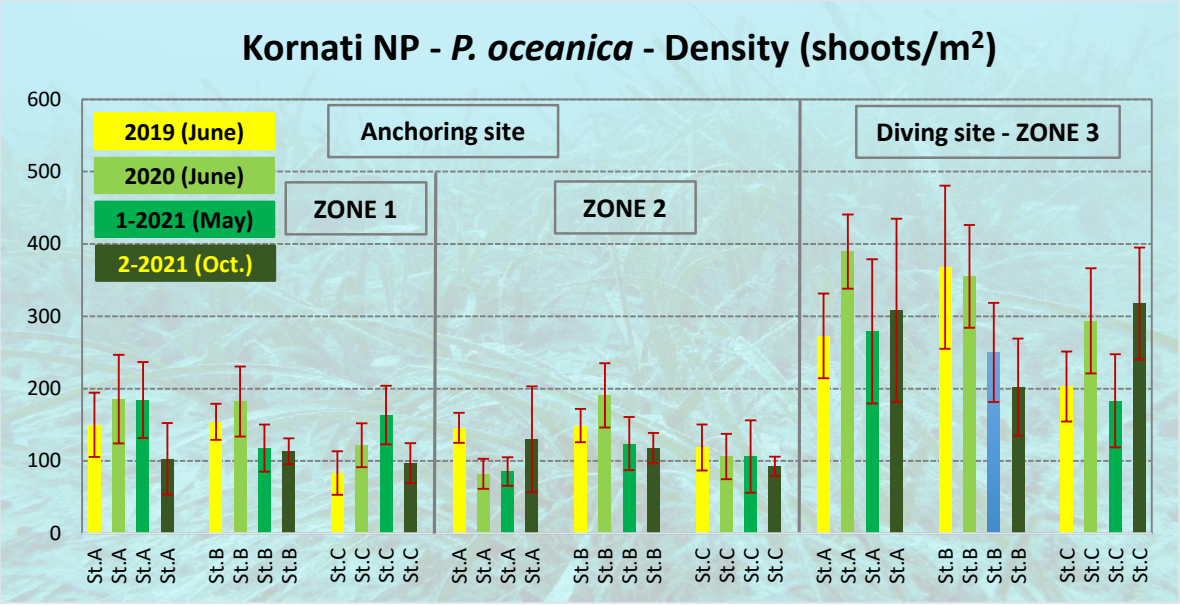

Figure 32. The average values of P. oceanica *shoot density as measured at the sampling stations.*

In Table 11, the values of shoot density and depth are related to the five classes for the final ecological classification (*sensu* WFD) (UNEP/MAP-RAC/SPA, 2011) (see par. 3.2.3).

Table 11. Shoot density and depth values in relation to the five classes for the final ecological classification (sensu WFD) (UNEP/MAP-RAC/SPA, 2011).

		Density (shoots/m2)	Depth (m)	Ecological classification (sensu WFD)
Z1	**2019**	129	12	BAD
	2020	163	13	POOR
	1-2021	155	13	BAD
	2-2022	105	14	BAD
Z2	**2019**	138	14	BAD
	2020	126	14	BAD
	1-2021	105	15	BAD
	2-2022	114	13	BAD
Z3	**2019**	281	10	POOR
	2020	346	10	POOR
	1-2021	238	9	POOR
	2-2022	276	10	POOR

Comparison with data from the 2019 monitoring campaign (preliminary survey - WP 3 activity 1) showed no changes in the ecological conditions of the meadow (still BAD in the “Anchoring site” and POOR in the “Diving site”).

4.2.5. Shoot morphometric measurement

Unlike the previous parameters, as far as shoot length is concerned, the existence of differences along the stations in the “Anchoring site” and in the “Diving site” was less evident. However, even in this case, they seemed to be related, at least in part, to the presence or reduced presence of anchoring pressure.

Considering the results of the monitoring campaigns (2020, 1-2021 and 2-2021 - WP 3 activity 3), at the “Anchoring site”, in Zone 1 (stations Z1-A, Z1-B and Z1-C), the average length of *P. oceanica* shoots ranged between 29.1 to 56.5 cm; in Zone 2 (stations Z2-A, Z2-B and Z2-C) between 31.9 and 59.8 cm. In the “Diving site”, in Zone 3 (stations Z3-A, Z3-B and Z3-C), the average length of *P. oceanica* shoots ranged between 24.2 and 74.3 cm.

A comparison between data from the June 2019 monitoring campaign (preliminary survey - WP 3 activity 1) and the spring monitoring campaigns (June 2020 and May 2021) showed, in the “Anchoring site, a general reduction in the length of the shoots and only a slight increase at the station Z1-C (statistically significant differences ($p<0,05$) in Z1-A, Z1-B and Z2-A stations). On the contrary, considering the data of October 2021, a general increase of shoot length is highlighted between 2019 and 2021 (with the exception of station Z1-A). At the “Diving site”, a general decrease in the shoot length was recorded at the three stations. However, statistically significant differences ($p<0.05$) were only found between the two density values of June 2019 and May 2021 in one out of three stations (Z3-A). The results are summarized in Figure 33.

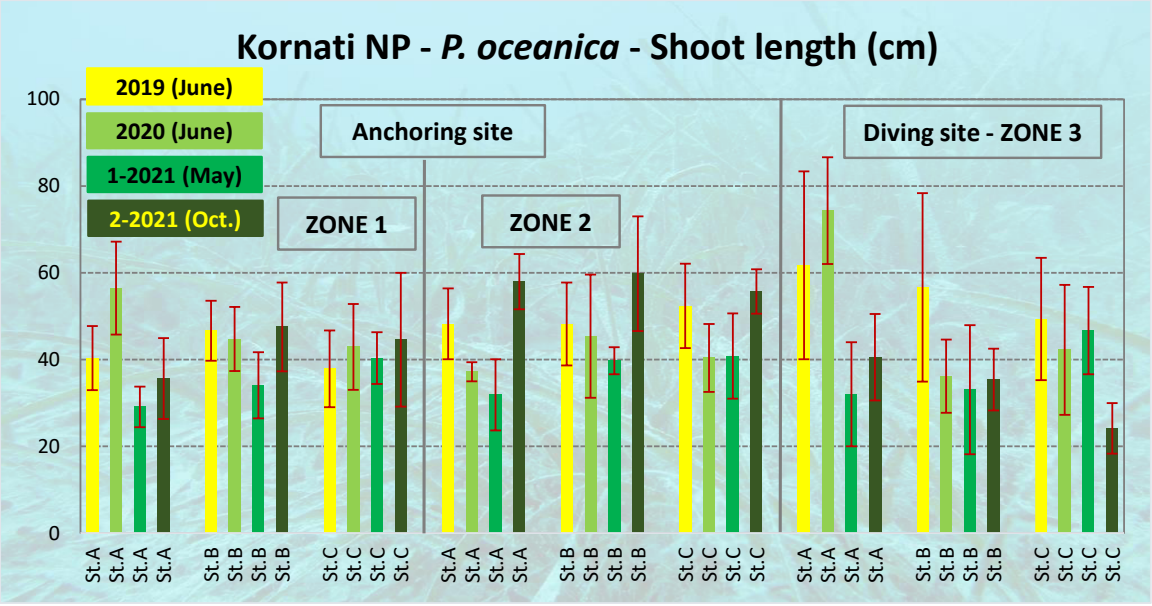

Figure 33. The average values of P. oceanica shoot length as measured at the sampling stations.

The other parameters are summarized in Table 12 (average values and standard deviations).

Table 12. Shoot width (cm/shoot), n. of leaves/shoot and leaf necrosis (% leaves/shoot) (verage values and standard deviations).

Zone 1		Z1-A	Z1-B	Z1-C
Shoot width (cm/shoot)	**2019**	1.06±0.51	0.84±0.03	0.79±0.01
	2020	0.93±0.04	0.91±0.06	0.93±0.08
	1-2021	0.79±0.03	0.83±0.06	0.96±0.01
	1-2022	0.89±0.01	0.89±0.01	0.90±0.00
N. of leaves/shoot	**2019**	6.2±2.4	6.2±1.6	5.8±0.8
	2020	4.5±0.5	6.0±2.4	5.0±1.4
	1-2021	5.3±1.0	6.2±2.3	7.0±1.9
	1-2022	6.3±0.8	6.5±1.5	5.7±0.5
Leaf necrosis (% leaves/shoot)	**2019**	15.9±7.7	12.4±6.6	3.2±2.6
	2020	1.4±0.6	1.2±0.8	0.2±0.4
	1-2021	0.3±0.4	0	1.7±4.1
	1-2022	5.0±3.5	4.0±3.9	4.1±3.2

Zone 2		Z2-A	Z2-B	Z2-C
Shoot width (cm/shoot)	**2019**	0.79±0.05	0.81±0.03	0.89±0.01
	2020	0.82±0.02	0.92±0.09	0.91±0.05
	1-2021	0.82±0.05	0.86±0.03	0.96±0.03
	1-2022	0.90±0.02	0.89±0.02	0.90±0.01
N. of leaves/shoot	**2019**	6.8±1.8	6.7±1.2	6.7±3.7
	2020	5.2±0.8	5.7±1.0	5.7±2.2
	1-2021	4.5±0.5	5.8±1.7	6.5±2.1
	1-2022	5.2±1.2	5.2±1.0	5.5±0.5
Leaf necrosis (% leaves/shoot)	**2019**	17.7±9.9	9.1±5.4	9.3±3.7
	2020	5.8±6.0	1.9±1.9	10.1±10.9
	1-2021	0.9±0.6	1.3±1.0	0.2±0.6
	1-2022	2.3±2.6	2.3±2.6	3.7±3.0

Zone 3		Z3-A	Z3-B	Z3-C
Shoot width (cm/shoot)	**2019**	0.69±0.03	0.70±0.03	0.70±0.03
	2020	0.81±0.04	0.76±0.04	0.71±0.02
	1-2021	0.74±0.05	0.73±0.05	0.95±0.01
	1-2022	0.81±0.06	0.81±0.04	0.77±0.05
N. of leaves/shoot	**2019**	6.8±2.0	5.3±0.5	6.0±1.3
	2020	5.7±1.0	4.8±0.8	6.0±0
	1-2021	5.3±0.8	8.0±4.0	7.0±2.4
	1-2022	6.0±1.8	6.8±2.1	5.3±1.0
Leaf necrosis (% leaves/shoot	**2019**	22.2±10.0	30.7±6.4	36.3±10.6
	2020	8.5±8.5	5.5±5.1	3.9±2.1
	1-2021	1.5±1.5	0.6±0.9	17.9±7
	1-2022	3.5±2.4	3.5±1.8	0.8±0.6

Comparison with data from the 2019 monitoring campaign (preliminary survey - WP 3 activity 1) showed a general decrease in leaf necrosis of *Posidonia* leaves at both the Anchoring site (Zone 1 and 2) and the Diving site (Zone 3).

4.2.6. Leaf Area Index (LAI) and Conservation Index (CI)

To assess the conservation status of *P. oceanica* meadows, two indices were applied: the Leaf Area Index (LAI) and the Conservation Index (CI).

Leaf Area Index (LAI)

The values of the indices are shown in Table 13 (average values):

Table 13. Average Leaf Area Index (LAI) (the values refer to 2019 Preliminary survey campaign and 2020, 1-2021, 2-2021 monitoring campaigns).

	LAI (station average value)				*LAI (Zone average value)*			
	2019	**2020**	**1-2021**	**2-2021**	**2019**	**2020**	**1-2021**	**2-2021**
Z1-A	2.3	3.1	1.4	1.0	1.8	2.4	1.7	1.1
Z1-B	2.1	2.6	1.3	1.3				
Z1-C	0.9	1.7	2.4	1.0				
Z2-A	1.9	0.8	0.7	1.6	2.1	1.7	1.3	1.3
Z2-B	2.1	2.9	1.5	1.2				
Z2-C	2.2	1.3	1.7	1.0				
Z3-A	4.8	6.3	2.4	2.0	3.9	4.0	2.9	1.8
Z3-B	4.1	3.0	2.8	1.8				
Z3-C	2.7	2.7	3.5	1.5				

Comparison with data from the 2019 campaign (preliminary survey - WP 3 activity 1) showed a general decrease in LAI values mainly due to seasonal differences in density and shoot length.

Conservation Index (CI)

The CI values ranged from 0 (maximum alteration or minimum conservation status, only presence of dead matte) to 1 (high conservation status) (Table 14).

Table 14. Conservation Index (CI) average values (the values refer to 2019 Preliminary survey campaign and 2020, 1-2021, 2-2021 monitoring campaigns).

Bad	Poor	Moderate	Good	High
CI<0.3	0.3≤CI<0.5	0.5≤CI<0.7	0.7≤CI<0.9	CI≥0.9

	CI (station average value)				*CI (Zone average value)*			
	2019	**2020**	**1-2021**	**2-2021**	**2019**	**2020**	**1-2021**	**2-2021**
Z1-A	0.34	0.42	0.37	0.60	0.30	0.37	0.44	0.45
Z1-B	0.28	0.36	0.56	0.36				
Z1-C	0.27	0.31	0.39	0.38				
Z2-A	0.33	0.27	0.44	0.28	0.46	0.40	0.41	0.32
Z2-B	0.78	0.44	0.48	0.46				
Z2-C	0.28	0.49	0.31	0.22				
Z3-A	0.95	0.51	0.61	0.64	0.84	0.64	0.65	0.67
Z3-B	0.75	0.85	0.60	0.60				
Z3-C	0.82	0.55	0.72	0.76				

The decrease recorded (compared to 2019) in the percentage of cover in Zone 2 and Zone 3 caused the meadow conservation status to change from MODERATE to POOR in the Zone 2 of “Anchoring site”, and from GOOD to MODERATE in the “Diving site” (Zone 3).

4.2.7. Algal blooms and filamentous algae

During all the monitoring campaigns (as during the 2019 preliminary survey), a general visual assessment by boat using aqua scope in the monitoring areas showed the absence of (filamentous) macroalgal blooms.

4.2.8. Abundance of epiphytes

The average cover of the three categories was calculated and reported in Table 15.

Table 15. Average cover of the three categories (Encrusting layer, Erect layer and Turf layer) (the values refer to 2019 Preliminary survey campaign and 2020-2021(1)-2021(2) monitoring campaigns).

	Encrusting layer				Erect layer				Turf layer			
	2019	2020	1-2021	2-2021	2019	2020	1-2021	2-2021	2019	2020	1-2021	2-2021
Z1-A	30%	30%	35%	30%	5%	5%	5%	5%	10%	10%	10%	10%
Z1-B	35%	35%	30%	30%	5%	5%	5%	5%	5%	10%	10%	10%
Z1-C	25%	30%	35%	30%	5%	5%	5%	5%	10%	10%	10%	10%
Z2-A	30%	30%	25%	30%	5%	5%	5%	5%	10%	10%	15%	10%
Z2-B	25%	30%	30%	25%	5%	5%	5%	5%	<5%	10%	10%	10%
Z2-C	35%	35%	35%	30%	5%	5%	5%	5%	15%	15%	10%	10%
Z3-A	35%	35%	35%	30%	5%	10%	10%	5%	10%	15%	15%	15%
Z3-B	35%	30%	30%	30%	10%	10%	10%	10%	15%	15%	15%	15%
Z3-C	40%	35%	35%	30%	5%	5%	10%	10%	10%	10%	15%	10%

As for the other study sites, the data regarding the preliminary survey and all the monitoring campaigns showed the dominance of the encrusting layer (mainly represented by red calcareous algae) and this can be considered a positive condition of the quality status of seagrass meadows.

4.2.9. Associated communities

In the study area (within the corridors and in their proximity), some live and/or dead individuals of *Pinna nobilis* were found, especially during the preliminary survey in 2019 (at station Z2-B, one dead individual and at station Z3 – live individuals outside the transect line) and during the October 2021 campaign (at Z3-B - one dead individual).

4.2.10. Lower limit of meadows and balise placement

In June 2019, as planned by the WP 3.1 activities, three marking points (balises - dead bodies) were placed in the "Anchor site" on the seabed at the meadow edge of the station (at 14 meters depth), along stretches of the lower limit characterized by degraded/risk conditions. In this case, only one section of the limit was selected, and divers took photographs (central and lateral) of the area where the balises were placed for future comparison, to highlight possible retreat or increase in the limit of the meadows.

The selected limit did not correspond to the actual lower limit of the meadow as only the potential contours endangered by anchoring were considered. The depth of the upper limit (13.2 m) was measured at station Z1-C.

During the preliminary survey and the following monitoring campaigns, some photos of the balises were taken (Figure 34, Figure 35 and Figure 36). The analysis of these photos always showed a stable condition of the meadows, as no signs of retreat of *Posidonia* were visible.

Figure 34. Photos taken during different monitoring campaigns: balise (n. 2) placed by the edge of the meadow on the left of the central one.

Figure 35. Photos taken during different monitoring campaigns: balise (n. 1) placed by the edge of the meadow between the other two balises.

Figure 36. Photos taken during different monitoring campaigns: balise (n. 3) placed by the edge of the meadow on the right of the central one.

4.2.11. Alien species

Although the invasive marine alga *Caulerpa cylindracea* was observed in the last years, spreading throughout the Park, no alien algae were detected during the monitoring activities at the "Anchoring site" and at the "Diving site".

4.2.12. Presence/absence of habitat disturbance

At the "Anchoring site" (Zone 1 and Zone 2) signs of disturbance and some litter on the seabed were always reported (bottles and cans plastic containers). At the "Diving site" (Zone 3) the meadow was continuous with low sedimentation and no visible signs of disturbance; only a few points were devoid of meadow, possibly due to anchoring (anchor and chains).

4.2.13. Monitoring of seagrass transplantation

In NP Kornati, two pilot transplantation campaigns were carried out: the first in October 2019 and the second in October 2021. *P. oceanica* transplantation were carried out using two different manual techniques.

In October 2019, at the Kornati NP site, two closed pilot seagrass transplantation plots were realized at Kravljačica bay, so called the "Anchoring site" (near Zone 1 and Zone 2), as planned in WP 4 activity 2 (Figure 37), following the method of Scannavino *et al*. (2014). These plots were characterized by the absence of seagrasses or by very spotty covers and by the evidence of frequent presence of anchored boats. The meadow of the donor site was selected in the "Diving site".

Figure 37. Seagrass transplantation: transplant site in "Anchoring site" and photo-mosaic of the transplanting areas.

The cuttings collected in the donor meadow were fixed to the arms of a biodegradable support and 12 patches composed each of 6 supports were placed in the area to be reforested (Figure 38).

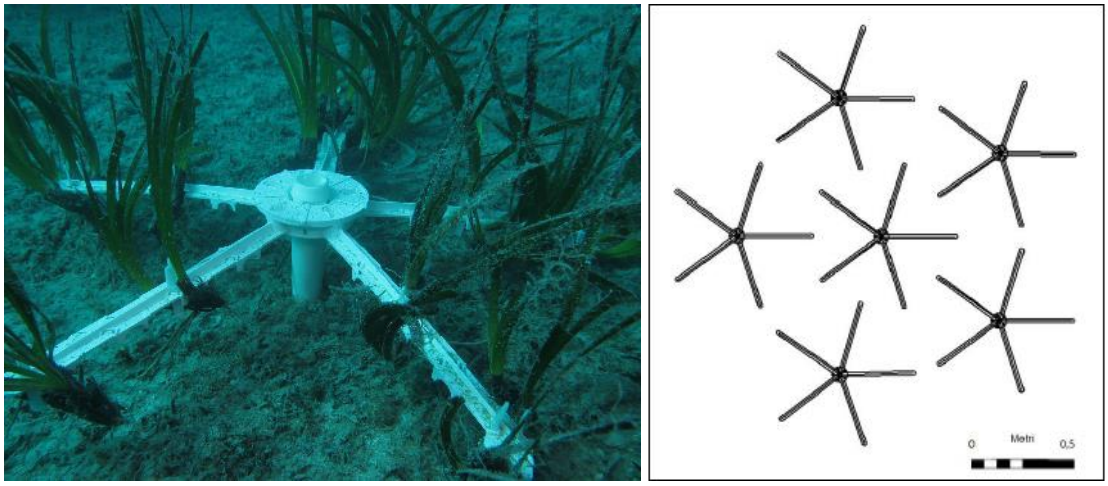

Figure 38. Examples of support with cuttings and of a "transplant patch".

Monitoring was carried out in October 2019, identifying, and labelling a total of 6 supports randomly distributed along the transplant patches. Shoot density, height of the longest leaf and increase length of the rhizome were measured. Since October 2019, the transplanted area in Kravljačica Bay was frequently monitored and all transplants were in good conditions even if high sedimentation trend was still going on,

together with the growth of roots but a general slow decrease of shoots number and leaf length. In May 2021 and October 2021, *Caulerpa cylindracea* was observed in the transplantation area.

Figure 39. October 2021: seagrass transplantation monitoring activities in the Anchoring site.

The second (additional) pilot transplantation of *P. oceanica* area was carried out in October 2021 and the area chosen for this activity was located at the Anica Bay, on the island of Levrnaka, two miles from Kravljačica. Although this site reflects a lower biological confinement, due to many years of uncontrolled anchoring, meadows of the *P. oceanica* at the Anica Bay are partially destroyed, settled on dead matte with discontinuity and low density.

Figure 40. October 2021: Transplantation area in Levrnaka Bay and donor sites.

The rhizome transplantation method was carried out using an alternative method to the technique used for the first transplantation. Shoots were mounted on exotic wood supports, heavy enough and of low degradability to resist on the sea floor at least for a couple of years. The cuttings, each formed of at least three shoots of leaves, were attached with biodegradable plastic ties to the wooden supports, and the wooden base was fixed on matte with iron pin (Figure 41).

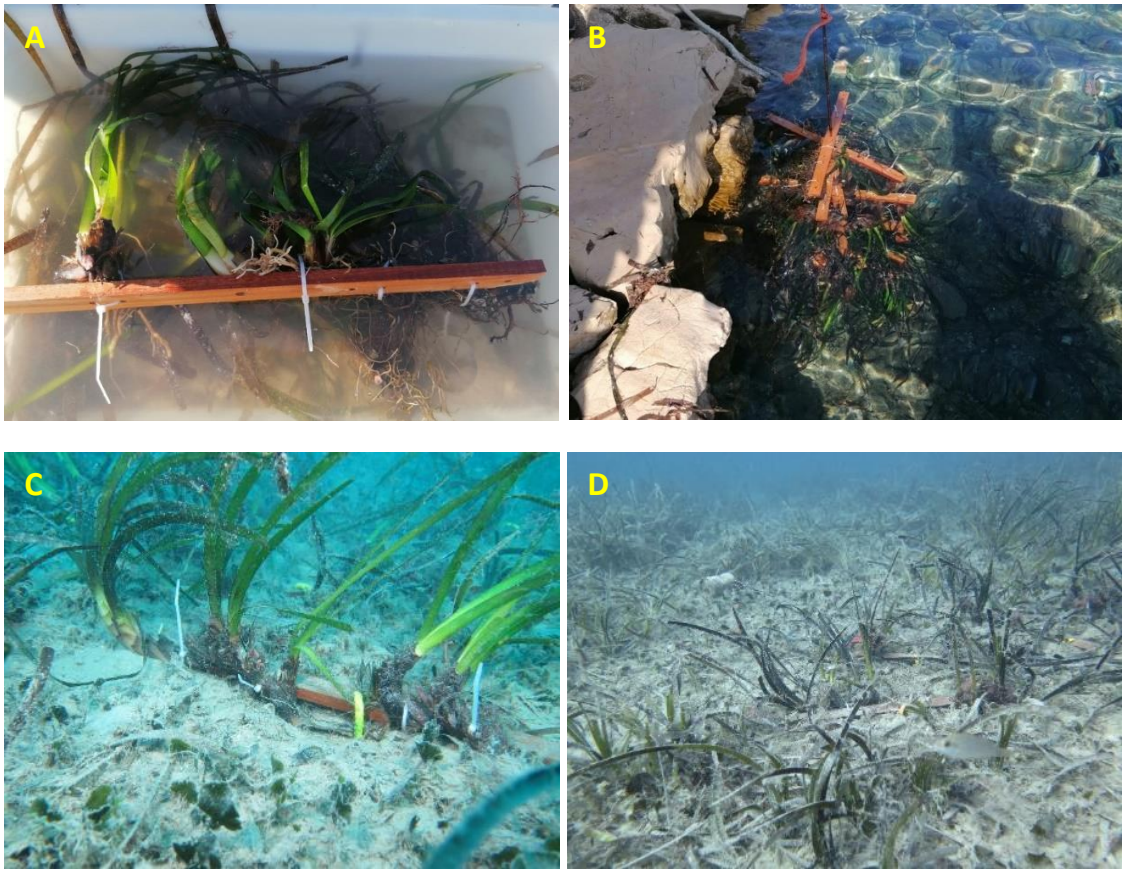

Figure 41. October 2021. Seagrass transplantation: A) preparation of the transplanted cuttings and their supports; B) cuttings fixed and ready for transport to the host area; C) and D) transplanted cuttings and supports on the seabed.

The plant scheme inside the transplant area provided the positioning of 25 nuclei, each formed by 8 wooden bases (Figure 42). It allowed to obtain a nucleus with sufficient density to allow an initial centrifugal colonization thrust and thus to have a meadow effect, which increases as the various nuclei come into contact each other. A total of 200 wooden basis were placed, on which approximately 800-900 cuttings were mounted. The 25 nuclei were placed to cover a surface of about 200 m².

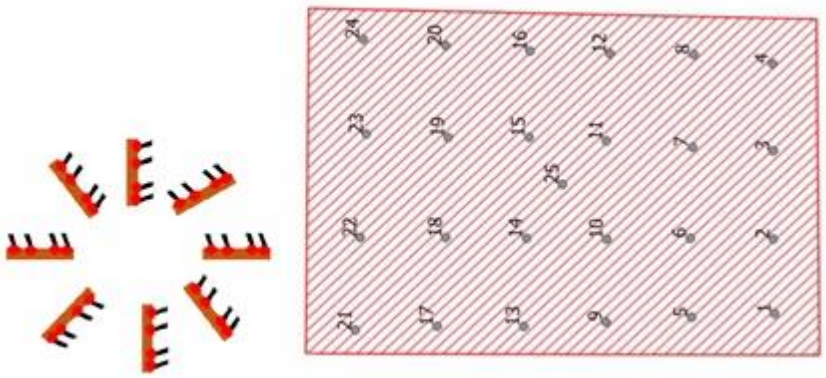

Figure 42. Example of nucleus of wooden bases and arrangement of the nuclei inside the transplanting area.

A more detailed analysis of the transplantations state and progress will be carried out in the final WP 3.3 and WP 4.2 reports (deliverables D.3.3.1 and D.4.2.3).

4.3. Regional Natural Park of Coastal Dunes from Torre Canne to Torre San Leonardo

4.3.1. Monitoring area

In the Regional Natural Park of Coastal Dunes site, the monitoring campaigns took place according to the following schedule:

- Preliminary survey: September 2019,
- First monitoring campaign: October2020,
- Second monitoring campaign: February 2021,
- Third (additional) monitoring campaign: February 2022[4]

The study area is located at about 500 meters from the coast and the zones are arranged almost parallel to the coastline. Location Z1 is the closest Zone, while Z3 is the most distant (Figure 43).

The three Zones were located in *P. oceanica* meadow, where anchoring pressures occur due to the presence of medium-sized boats. Within each Zone, three monitoring stations were placed at different depths (Stations Z1-A, Z1-B and Z2-C; Z2-A, Z2-B and Z3-C; Z3-A, Z3-B and Z1-C).

As for the other sites, the status and possible changes of seagrass meadows were monitored to assess the effects on the ecosystem of the concrete actions implemented in WP4: one pilot seagrass transplantation carried out in February 2021 (activity 4.2) (Figure 43). Differently from the other sites, the placement of environmentally friendly anchoring systems (planned in activity 4.1) was not carried out. In fact, the monitoring field data (Preliminary survey – WP 3.1) and the information acquired (DPSIR analysis – WP 3.2) suggested that marine seagrass rarefaction due to summer anchoring boats on the meadows was a negligible impact on this area.

It was proposed to conduct a survey of the *Posidonia oceanica* meadows, including the entire front of the RNP Coastal Dunes and focusing essentially on their upper limit, more subject to erosion and retreat and including a final evaluation of the areas mainly impacted by the anchorage of leisure boats and their overlap with the meadows. These areas could be considered in the future as possible buoys fields locations.

[4] The third monitoring campaign (WP 3.3) in the RNP Coastal Dunes site (originally planned in October/November 2021) was postponed in February 2022 due to weather-related delays and organizational problems.

Figure 43. Sampling scheme applied to the monitoring Zones (1-2-3) in the Regional Natural Park of Coastal Dunes and Posidonia oceanica *pilot transplantation area.*

Figure 44. Monitoring campaigns: A) Posidonia oceanica *morphometric measurements; B) divers taking photographs and making video in the monitoring area; C) cover percentage and meadows continuity measurements; D) marking points placement (Balise) to monitor the meadow's dynamics.*

4.3.2. Distribution of seagrass meadows

The presence of *P. oceanica*, along the coast of the park, was detected a few hundred meters offshore, at a depth of about 7 meters, where the upper limit showed an irregular pattern (Figure 45).

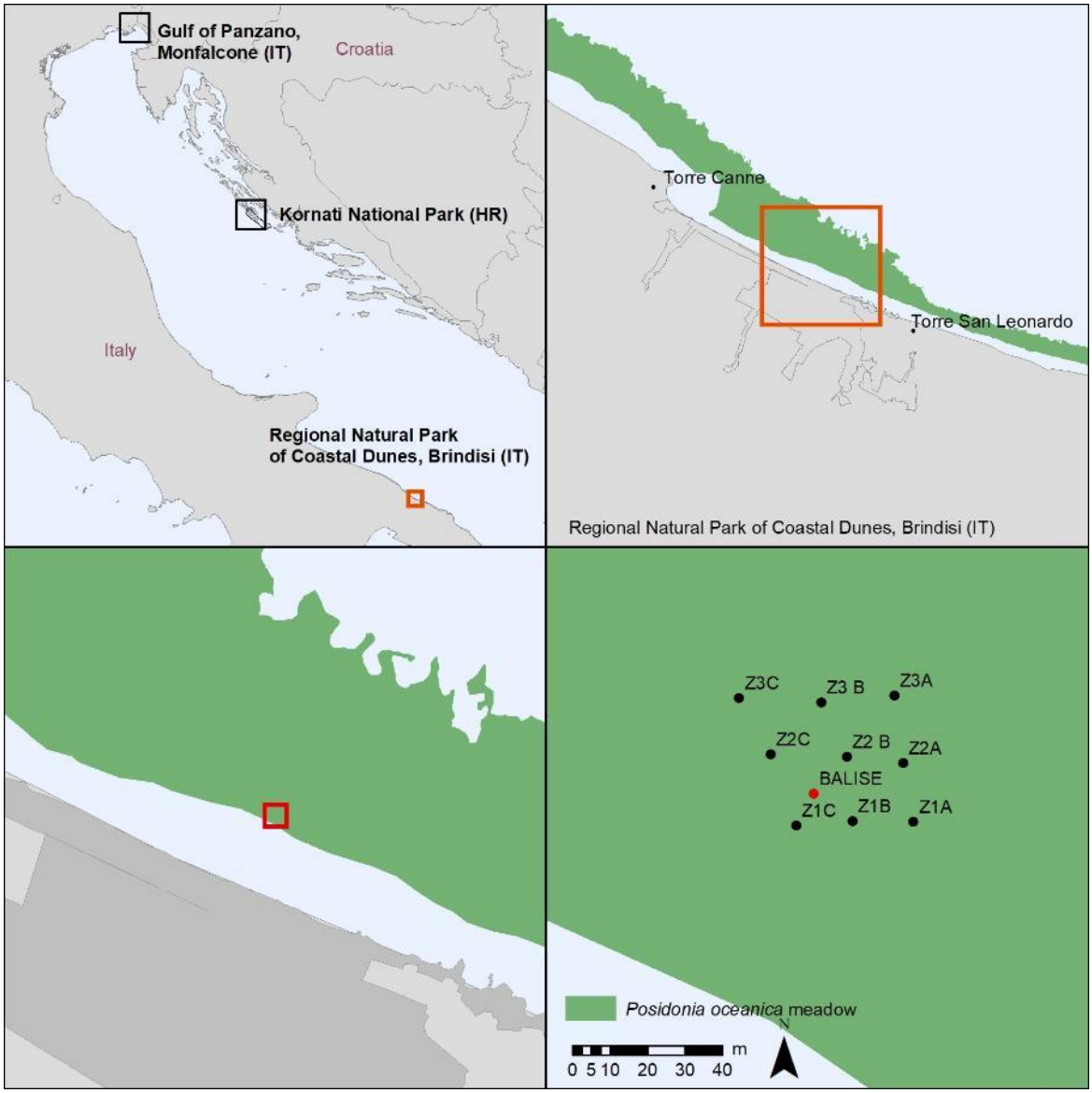

Figure 45. Seagrass distribution and monitoring stations in the Regional Natural Park of Coastal Dunes.

The lower limit is much further offshore, at a depth that has not been investigated. The site identified for the measurements and to carry out the pilot transplantations is approximately opposite to Rosa Marina.

The meadow coverage was approximately 70-75%, on matte, with the presence of numerous areas of inter-matte sandy deposits.

Several areas of matte were observed where seagrass was certainly retreated, for reasons not directly related to anthropogenic pressures.

4.3.3. Percentage Cover and meadow continuity

Considering the data of the monitoring campaigns (2020, 2021 and 2022 - WP 3 activity 3), the average coverage of *P. oceanica* ranged between 64% and 93% in Zone 1 (stations Z1-A, Z1-B and Z1-C), and between 20% and 85% in Zone 2 (stations Z2-A, Z2-B and Z2-C). In these Zones, the meadows were continuous. On the contrary, in Zone 3, with the exception of station Z3-A, the average coverage of *P. oceanica* was lower than in Zone 1 and 2 (14-22% - in stations Z3-B and 7-20% in Z3-C and 36-82% in Z3-A), highlighting a discontinuity of the meadow.

The data analysis suggests the existence of differences along the stations between Zones 1 and 2 and Zone 3. In particular, the stations placed in Zone 1 and Zone 2 are characterized by a higher cover percentage than those in Zone 3, with the exception of station Z3-A.

The comparison with data from the 2019 campaign (preliminary survey - WP 3 activity 1) also showed a decrease in the average coverage at the monitoring stations in Zone 2 and Zone 3 an increase in Zone 1. However, these differences were partly due to the different sampling seasons (September in 2019, February in 2021 and February 2022). The comparison between data of autumn 2019 campaign and autumn 2020 one showed a slight decrease in the coverage at the monitoring stations with the exception of Z1-C, Z2-C and Z3-A (and the difference between 2019 and 2020 values was statistically significant, $p<0,05$).

The results are summarized in Figure 46 and confirm an irregular coverage pattern (in time and space) that was observed during the diving campaigns, highlighting erosion dynamics that did not respond to a determined trend.

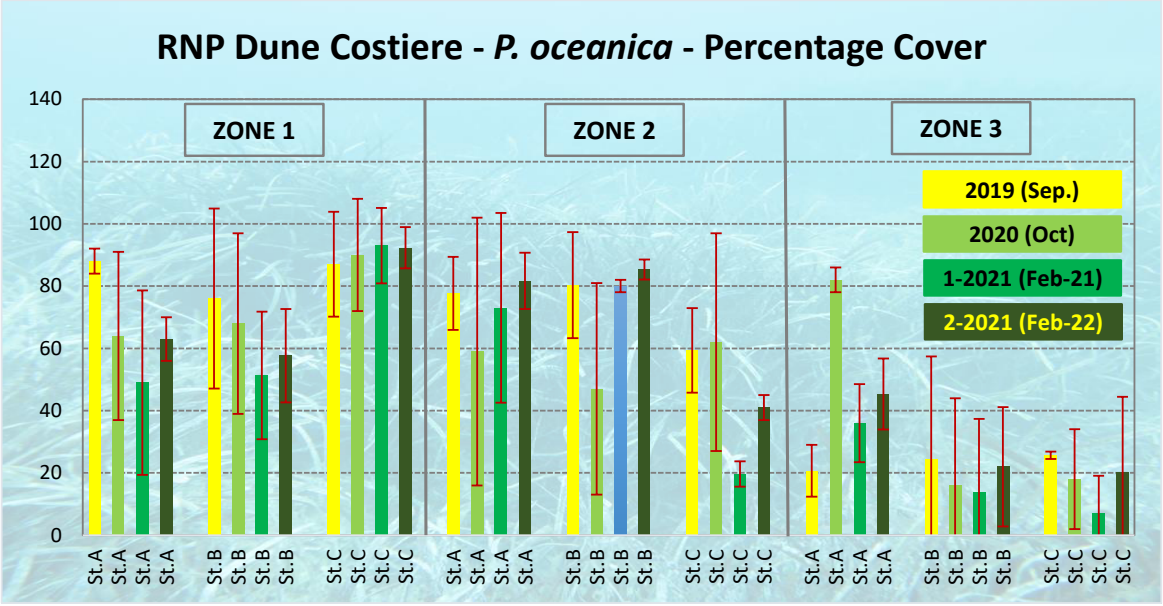

Figure 46. The average values of P. oceanica *percent cover as measured at the sampling stations.*

4.3.4. Shoot density

Considering the data of the monitoring campaigns (2020, 2021 and 2022 - WP 3 activity 3), in Zone 1 (stations Z1-A, Z1-B and Z1-C), the average density of *P. oceanica* shoots ranged between 264 and 322 shoots/m^2, in Zone 2 (stations Z2-A, Z2-B and Z2-C) the range was 246-302 shoots/m^2 and in Zone 3 209-342 shoots/m^2. As already recorded in 2019, data analysis suggested the existence of limited differences along stations and Zones for shoot density. Comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) also showed an overall decrease in the mean shoot density at the monitoring stations with the exception of Z1-B, where very slight increases were recorded.

As for the per cent cover, these decreases were largely due to the different sampling seasons (September in 2019 and February in 2021 and 2022). Considering only the data of the 2019 and 2020 autumn campaigns, statistically significant differences ($p<0,05$) between the two density values (2019 and 2020) have been found only in two out of nine stations (Z2-A and Z3-B stations). The results are summarized in Figure 47.

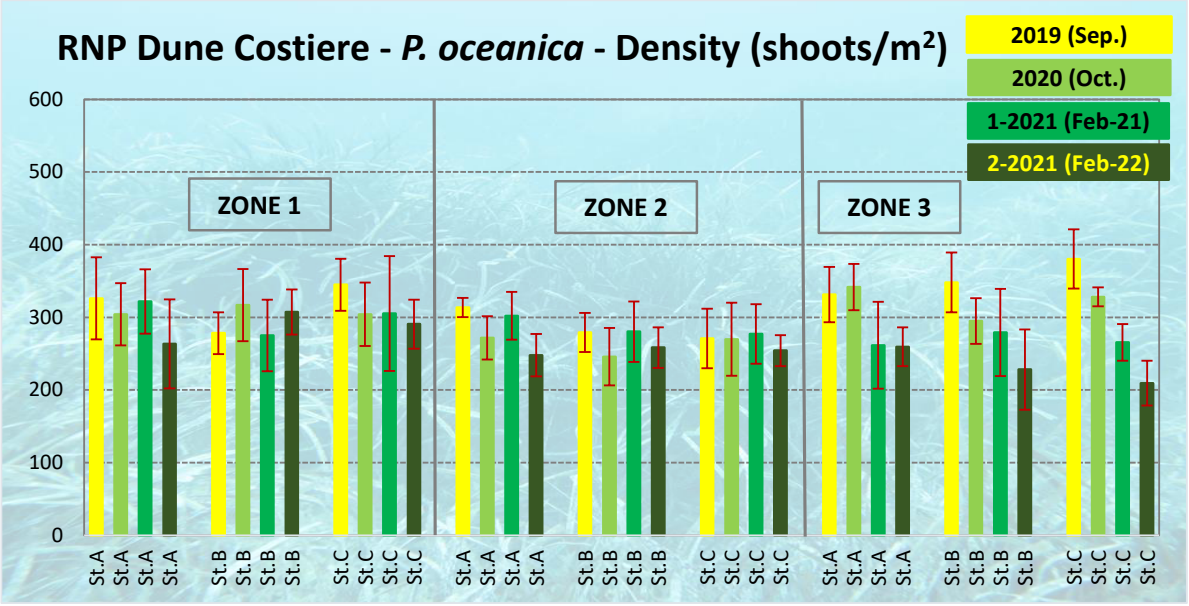

Figure 47. The average values of P. oceanica *shoot density as measured at the sampling stations.*

In Table 16, shoot density and depth values are related to the five classes of ecological status (*sensu* WFD) (UNEP/MAP-RAC/SPA, 2011) (see par. 3.6.3 and par. 4.2.4).

Table 16. Shoot density and depth values in relation to the five classes for the final ecological classification (sensu WFD) (UNEP/MAP-RAC/SPA, 2011).

		Density (shoots/m2)	Depth (m)	Ecological classification (sensu WFD)
Z1	**2019**	316	7	POOR
	2020	308	7	POOR
	1-2021	301	7	POOR
	2-2022	287	7	POOR
Z2	**2019**	288	7	POOR
	2020	263	7	POOR
	1-2021	286	7	POOR
	2-2022	253	7	BAD
Z3	**2019**	353	8	POOR
	2020	322	8	POOR
	1-2021	269	8	POOR
	2-2022	232	8	BAD

Comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) showed no changes in the ecological conditions of the meadow in Zone 1 (still POOR); in the Zone 2 and Zone 3, the decrease recorded (compared to 2019) in shoot density caused the decrease of the index value (from POOR to BAD).

4.3.5. Shoot morphometric measurement

Considering the data of the monitoring campaigns (2020, 2021 and 2022 - WP 3 activity 3), the mean shoot length of *P. oceanica* ranged between 34.4 and 43.6 cm in Zone 1 (stations Z1-A, Z1-B and Z1-C); 21.8 and 40.2 cm in Zone 2 (stations Z2-A, Z2-B and Z2-C) and 22.1 and 55.7 cm in Zone 3 (stations Z3-A, Z3-B and Z3-C). Comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) showed an overall decrease in the average shoot length at the monitoring stations, with the only exception of station Z1-C (where a slight increase was recorded) and station Z2-B (similar values in all the campaigns).

Considering only the data of the 2019 and 2020 autumn campaigns (to exclude differences due to the different sampling seasons), statistically significant differences ($p<0,05$) between the two density values (2019 and 2020) have been found only in two out of nine stations (Z2-A and Z3-B stations). The results are summarized in Figure 48.

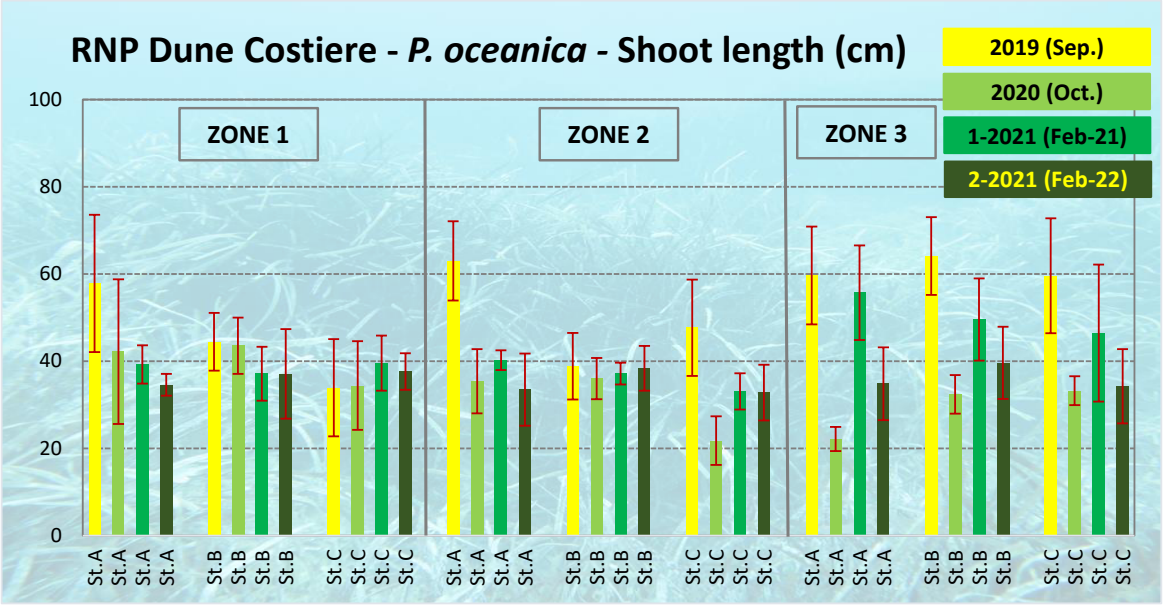

Figure 48. The average values of P. oceanica *shoot length as measured at the sampling stations.*

Other derivate parameters are summarized in Table 17 (average values and standard deviations). Comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) showed an overall general decrease of leaf necrosis in *Posidonia*.

Table 17. Shoot width (cm/shoot), n. of leaves/shoot and leaf necrosis (% leaves/shoot) (verage values and standard deviations).

Zone 1		Z1-A	Z1-B	Z1-C
Shoot width (cm/shoot)	**2019**	0.81±0.03	0.84±0.02	0.81±0.03
	2020	0.81±0.06	0.83±0.05	0.76±0.03
	1-2021	0.82±0.04	0.85±0.05	0.83±0.02
	2-2021	0,81±0,04	0,79±0,04	0,84±0,05
N. of leaves/shoot	**2019**	6.0±1.7	5.5±1.0	5.7±1.4
	2020	5.5±1.0	6.7±0.8	5.8±0.8
	1-2021	6.0±0.6	4.2±0.8	4.8±0.8
	2-2021	4,8±0,8	5,2±0,4	5,2±0,4
Leaf necrosis (% leaves/shoot)	**2019**	4.1±3.9	9.8±4.9	8.5±4.0
	2020	1.8±1.3	1.9±0.8	0.6±1.4
	1-2021	0.4±0.8	0	0.1±0.1
	2-2021	0,6±0,1	0,6±0,5	1,2±0,7

Zone 2		Z2-A	Z2-B	Z2-C
Shoot width (cm/shoot)	**2019**	0.80±0.03	0.83±0.04	0.84±0.04
	2020	0.87±0.04	0.82±0.03	0.79±0.02
	1-2021	0.85±0.04	0.81±0.04	0.80±0.10
	2-2021	0,80±0,05	0,82±0,03	0,79±0,02
N. of leaves/shoot	**2019**	5.5±1.2	5.3±0.5	5.2±1.3
	2020	6.0±0.6	6.0±0	4.8±0.8
	1-2021	5.0±0.6	4.5±0.5	5.0±0.9
	2-2021	5,0±0,6	4,5±0,8	4,8±0,8
Leaf necrosis (% leaves/shoot)	**2019**	5.9±5.1	7.7±4.3	11.2±6.6
	2020	0.8±0.8	1.0±0.8	0.6±0.7
	1-2021	0.5±0.7	0.1±0.2	1.7±2.0
	2-2021	1,4±09	1,0±0,5	1,3±0,7

Zone 3		Z3-A	Z3-B	Z3-C
Shoot width (cm/shoot)	**2019**	0.81±0.03	0.84±0.02	0.85±0.01
	2020	0.74±0.01	0.73±0.02	0.69±0.03
	1-2021	0.86±0.03	0.90±0	0.89±0.02
	2-2021	0,80±0,03	0,82±00,8	0,80±0,03
N. of leaves/shoot	**2019**	5.8±1.2	4.8±0.4	5.5±1.8
	2020	7.0±0.9	5.2±0.8	7.5±1.6
	1-2021	5.0±0.6	4.8±1.5	4.3±0.5
	2-2021	5,0±0,6	5,0±0,6	4,8±0,8
Leaf necrosis (% leaves/shoot)	**2019**	7.8±7.2	7.1±4.9	18.4±6.9
	2020	0.6±0.5	0	0.1±0.3
	1-2021	0.3±0.8	0	0
	2-2021	1,2±0,7	1,6±0,8	1,4±0,8

4.3.6. Leaf Area Index (LAI) and Conservation Index (CI)

To assess the conservation status of Posidonia meadows, two indices were applied: the Leaf Area Index (LAI) and the Conservation Index (CI).

Leaf Area Index (LAI)

LAI values are reported in Table 18 (average values and standard deviations):

Table 18. Average Leaf Area Index (LAI) (the values refer to 2019 Preliminary survey campaign and 2020, 1-2021, 2-2021 monitoring campaigns).

	LAI (station average value)				***LAI (Zone average value)***			
	2019	**2020**	**1-2021**	**2-2021**	**2019**	**2020**	**1-2021**	**2-2021**
Z1-A	4.1	2.9	3.8	2.1	3.2	3.0	3.1	2.5
Z1-B	3.0	3.6	2.4	2.4				
Z1-C	2.7	2.3	3.1	2.8				
Z2-A	3.8	2.0	3.3	2.0	3.2	1.6	2.8	2.1
Z2-B	2.7	1.8	2.6	2.3				
Z2-C	3.2	1.1	2.5	2.0				
Z3-A	4.9	2.0	3.8	2.2	5.0	2.1	3.6	2.0
Z3-B	4.4	1.6	4.1	2.3				
Z3-C	5.6	2.6	3.0	1.7				

Comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) showed an overall stability of the LAI mean values in the three Zones and differences are mainly due to different sampling seasons.

Conservation Index (CI)

The CI values are reported in Table 19 (average values and standard deviations):

Table 19. Conservation Index (CI) average values (the values refer to 2019 Preliminary survey campaign and 2020, 1-2021, 2-2021 monitoring campaigns).

Bad	Poor	Moderate	Good	High
CI<0.3	0.3≤CI<0.5	0.5≤CI<0.7	0.7≤CI<0.9	CI≥0.9

	CI (station average value)				*CI (Zone average value)*			
	2019	**2020**	**1-2021**	**2-2021**	**2019**	**2020**	**1-2021**	**2-2021**
Z1-A	1.00	0.72	0.49	0.63	0.95	0.78	0.65	0.71
Z1-B	0.92	0.73	0.54	0.58				
Z1-C	0.92	0.90	0.93	0.92				
Z2-A	0.80	0.65	0.73	0.82	0.80	0.60	0.74	0.77
Z2-B	0.89	0.53	0.92	0.94				
Z2-C	0.71	0.62	0.57	0.56				
Z3-A	1.00	0.86	0.43	0.53	1.00	0.95	0.51	0.33
Z3-B	1.00	1.00	0.62	0.22				
Z3-C	1.00	1.00	0.48	0.24				

Comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) showed:

- no change in the conservation status of the meadow in Zone 2 (still GOOD);
- a slight decrease in the index value in Zone 1 (conservation status of th meadow from HIGH to GOOD);
- a decrease of the index value in Zone 3 (conservation status of the meadow from HIGH to POOR), mainly due to the reduction in the average coverage at the monitoring stations.

4.3.7. Algal blooms and filamentous algae

The visual assessment by boat using an aqua scope in the monitoring areas showed the absence of (filamentous) macroalgal blooms.

4.3.8. Abundance of epiphytes

The average coverage of the three categories was calculated and reported in in Table 20:

Table 20. Average cover of the three categories (Encrusting layer, Erect layer and Turf layer) (the values refer to 2019 Preliminary survey campaign and 2020-2021(1)-2021(2) monitoring campaigns).

	Encrusting layer				Erect layer				Turf layer			
	2019	2020	1-2021	2-2021	2019	2020	1-2021	2-2021	2019	2020	1-2021	2-2021
Z1-A	35%	30%	35%	30%	5%	5%	5%	<5%	5%	5%	10%	10%
Z1-B	40%	35%	30%	30%	<5%	5%	5%	5%	5%	10%	10%	5%
Z1-C	30%	35%	30%	25%	5%	5%	10%	5%	10%	10%	5%	10%
Z2-A	35%	40%	30%	30%	<5%	5%	5%	<5%	10%	10%	5%	5%
Z2-B	35%	35%	30%	30%	5%	5%	5%	5%	5%	5%	5%	5%
Z2-C	30%	30%	25%	25%	<5%	5%	5%	5%	5%	5%	5%	5%
Z3-A	40%	40%	25%	30%	5%	10%	10%	5%	10%	10%	5%	10%
Z3-B	35%	30%	30%	30%	<5%	5%	10%	5%	10%	5%	5%	5%
Z3-C	30%	30%	30%	30%	5%	5%	5%	5%	5%	5%	10%	5%

As for the other study sites, the data regarding the preliminary survey and all the monitoring campaigns showed the dominance of the encrusting layer (mainly represented by red calcareous algae) and this is related to a positive condition of the quality status of seagrass meadows.

4.3.9. Associated communities

During all the monitoring campaigns (2019, 2020, 2021 and 2022) no live or dead individuals of *Pinna nobilis* were found in the study area (within the corridors and in their proximity).

4.3.10. Lower limit of meadows and balise placement

In September 2019, three marking points (balises - dead bodies) were placed between Zone 1 and Zone 2 on the seabed by the edge of the meadow (positioned at a depth of 7,5 meters), along sections of the lower meadow limit characterized by degraded/risk conditions (erosion and retreat of the meadow).

As in the Kornati NP site, only one section of the limit was selected where the balises were placed for future comparison to highlight possible retreat or increase of the meadow limit that was characterized by erosion and retreat. It did not correspond to the proper lower limit of the meadow (as only possible endangered contours were considered).

In October 2020, the balise located at the edge of the meadow to the left of the central balise was not found during the monitoring activities. During the second monitoring campaign, carried out in February 2021, the “missing” balise was found some meters away from its original position completely covered by

sand and repositioned. The displacement of the balise and the traces of mobility of the sandy lenses suggest a certain energy at the sea-bottom during weather events of considerable magnitude.

During the preliminary survey and the following monitoring campaigns, some photos of the balises were taken (Figure 49, Figure 50 and Figure 51). The analysis of these photos shows a stable condition, as no significant clues of retreat where observed.

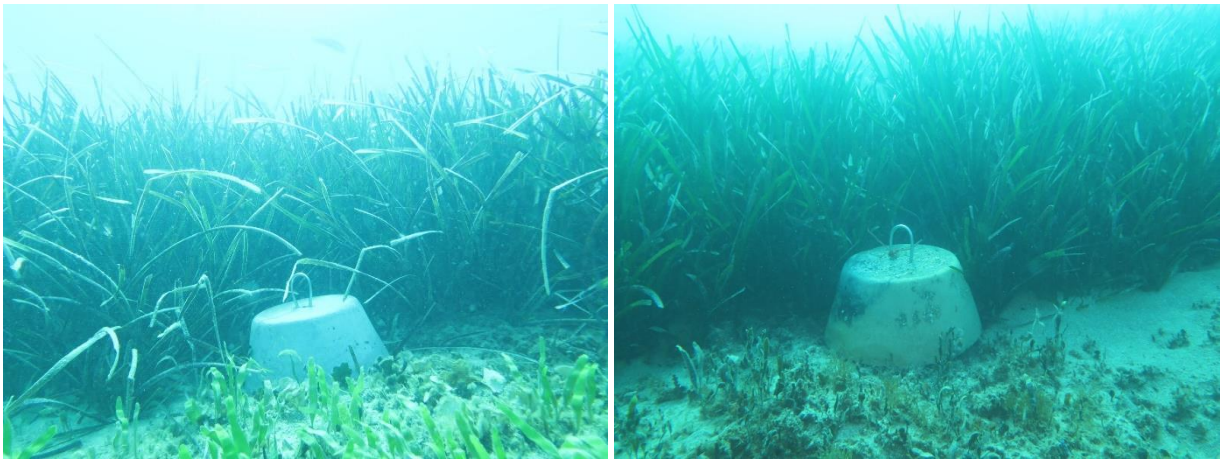

Figure 49. Photos taken during different monitoring campaigns: balise (n. 2) placed by the edge of the meadow on the left of the central one.

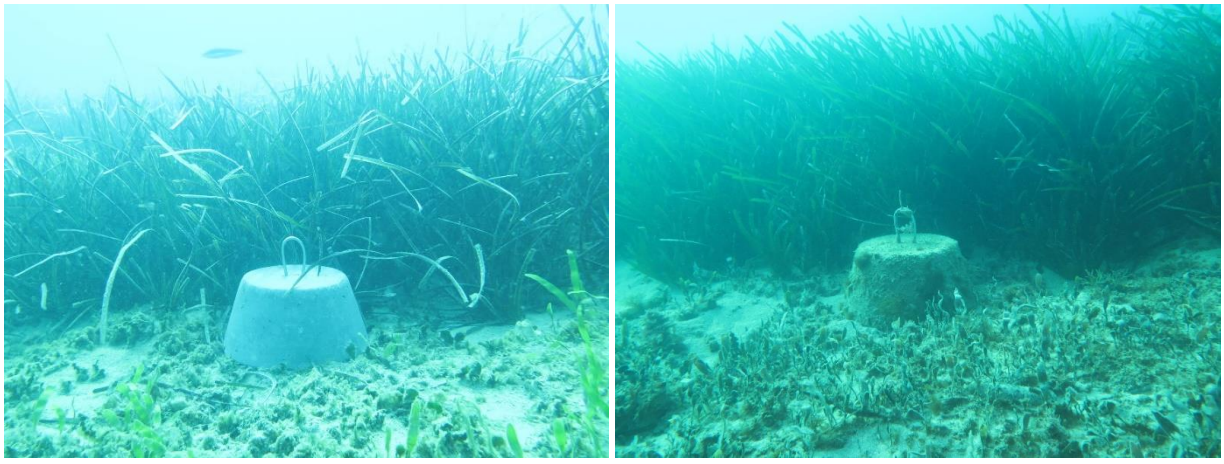

Figure 50. Photos taken during different monitoring campaigns: balise (n. 1) placed by the edge of the meadow between the other two balises.

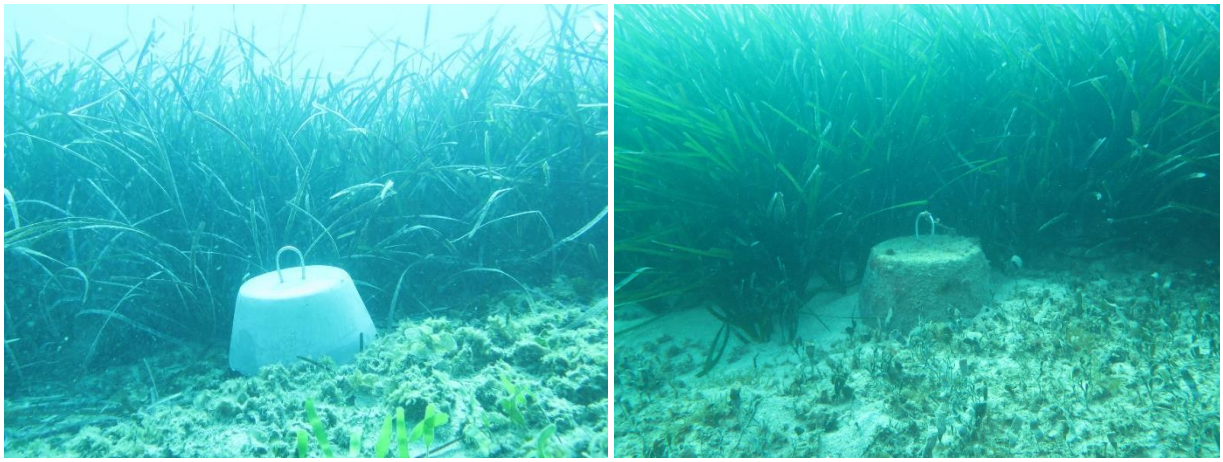

Figure 51. Photos taken during different monitoring campaigns: balise (n. 3) placed by the edge of the meadow on the right of the central one.

4.3.11. Alien species

No alien species were found in the study area during all the monitoring activities. However, it was always emphasized the abundant presence of *Caulerpa prolifera* (Figure 52), an indigenous green alga, congeneric with the alien *Caulerpa taxifolia* and *Caulerpa racemosa* which are invading some areas of the Mediterranean Sea. In fact, regressed meadows are prone to invasion by one or more of the potential substitutes of *P. oceanica* such as *C. racemosa*, or other common Mediterranean seagrasses such as *Cymodocea nodosa*.

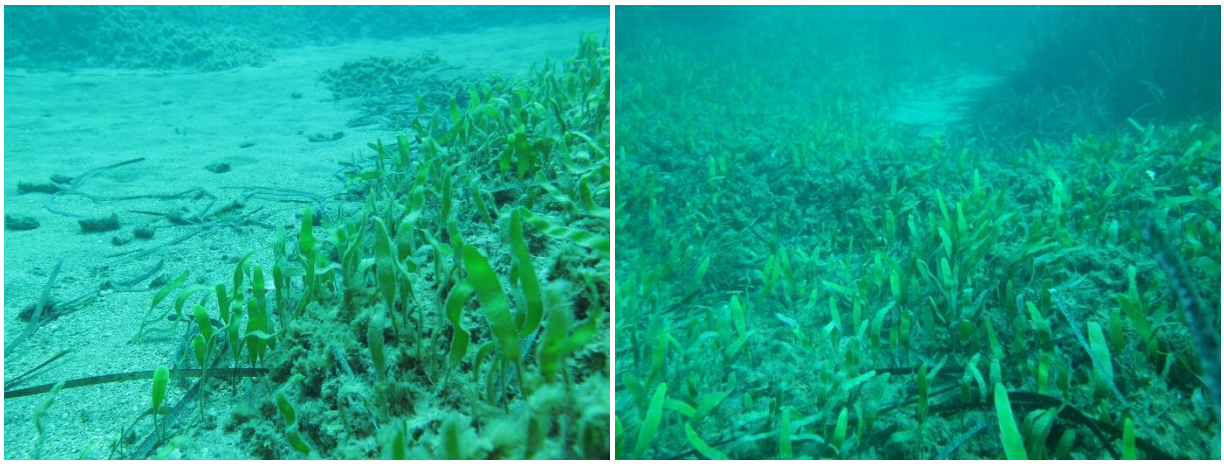

Figure 52. Photos taken during different monitoring campaigns: abundant presence of Caulerpa prolifera.

4.3.12. Presence/absence of habitat disturbance

Concerning human disturbance and evidence of mechanical pressures, none were observed in or near the monitoring Zones during all the monitoring campaigns.

4.3.13. Seagrass transplantation

In the RNP Coastal Dunes site, the area to perform the pilot seagrass transplantation (planned in WP 4 activity 2) was identified near Zone 1. This area is characterized by the absence of seagrasses (bare seabed) or low meadows coverage values and the frequent presence of anchored boats (Figure 53).

The transplantation, originally planned in October 2020, was postponed (due to difficulties in obtaining permits from the competent authorities to RNP administrative constraints, and to the COVID-19 emergency) and carried out at the end of February 2021.

The transplantation area was located near to the SIC Area "Litorale Brindisino", in a discontinuous meadow with the upper limit at a depth of 8 m, characterized by the presence of patches of *Posidonia oceanica*, dead matte and sandy sediments (Figure 53). The distribution of the dead matte is fragmented and is partially localized on sub-superficial rocky states.

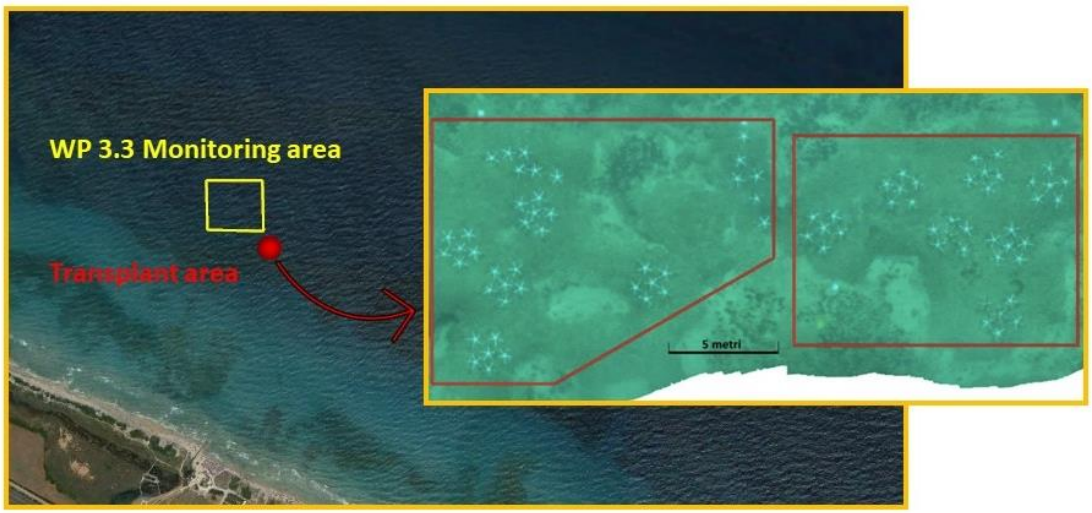

Figure 53. Seagrass transplantation: transplant site and photo-mosaic of the transplanting areas.

The transplantation was carried out in two contiguous quadrats, in relation to the area's bathymetry, each of which represented approximately an area of about 100 m^2, for a total transplant area of about 200 m^2.

The cuttings collected in the donor meadow were fixed to the arms of a biodegradable support and 14 patches were arranged in the area. On the whole a total of 84 anchoring modules and about 2,500 rhizome patches composed each of 6 supports were placed in the area to be reforested. The used technique was

that reported by Scannavino *et al*. (2014). During the first monitoring campaign (May 2021), a total of 6 supports randomly distributed along the transplant patches was identified and labelled.

In general, shoot density and length showed good leaf conditions; however physical loss of shoots was found due to multiple causes that cannot be identified with certainty (i.e., fishing, anchoring, wave erosion) (Figure 54).

A more detailed analysis of the transplantations state and progress will be carried out in the final WP 3.3 and WP 4.2 reports (deliverables D.3.3.1 and D.4.2.3).

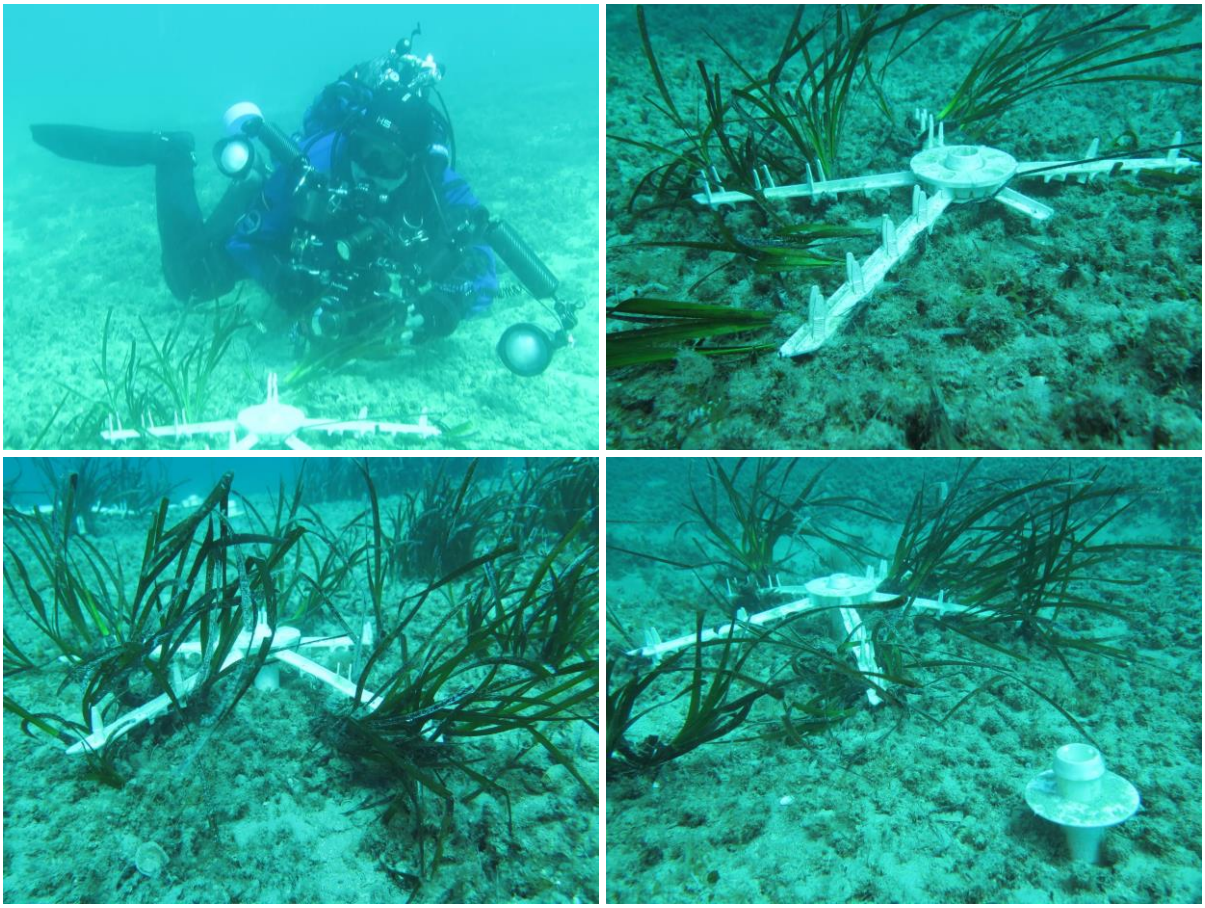

Figure 54. Seagrass transplantation monitoring activities in the RNP Coastal Dunes site.

5. ANALYSES OF THE SURFACE SEDIMENTS DATA AND SEAGRASS GENETIC STUDY[5]

5.1. Monitoring of Surface sediments

Grain size of surface sediment

For all the study areas, the analyses of the surface sediment grain size showed a percentage of sand (0,063mm<ϕ<2 mm) higher than the one of silt (0,0039 mm<ϕ< 0,063mm) (Figure 55). In fact, a percentage of sandy sediment over 70% was calculated. In detail, the average values of the sampling zones were 92.7% in the RNP Coastal Dunes site, 70.7% in the Kornati NP site and 73.2% in the Monfalcone (Bay of Panzano) site. In the monitoring Zone 1 of the RNP Coastal Dunes site, the higher percentage of sand was found (about 96.7%); the lower values were recorded in the Zone 3 of Monfalcone (Bay of Panzano) site (67.5%) and in Zone 2 of the Kornati NP site (67.6%).

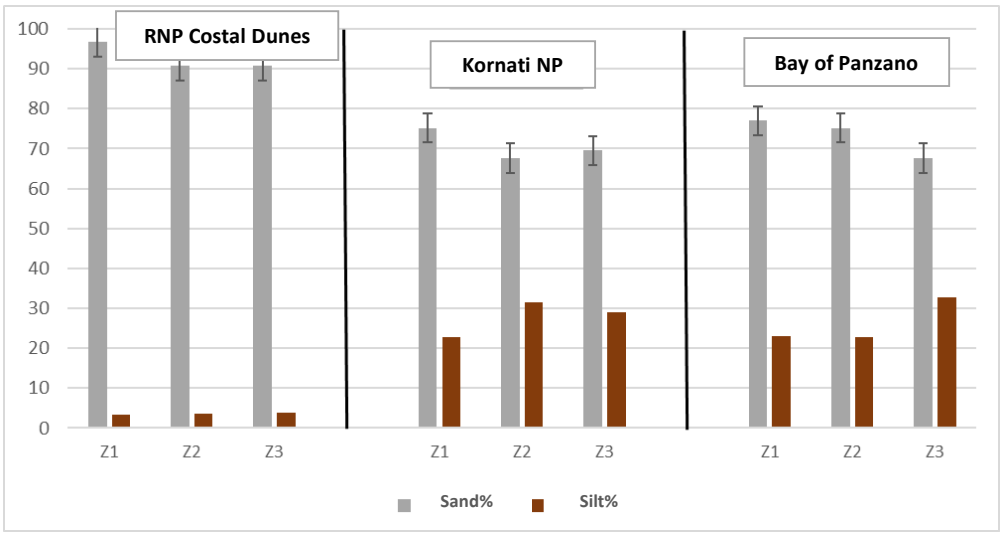

Figure 55. Grain size of surface sediment.

Considering the silt sediment component, its percentage was about 3.53% in the RNP Coastal Dunes site, 27.1% in the Kornati NP site and 26.17% in the Monfalcone (Bay of Panzano) site. The variability among the Zones' data was very low; however, in the three stations of Zone 3 of the Monfalcone (Bay of Panzano) site, the percentage of silt was higher (32.6%). In fact, these stations are located near the mouth of the Stella River and are probably characterized by a greater amount of suspended particulate matter deposition on the seabed.

5 (Sediment analyses and genetic study carried out by DAIS-UNIVE (PP7 CORILA): Professor A. Sfriso, A. Buosi, K. Sciuto)

Total and Organic Phosphorus

Considering all the monitoring campaigns, the means values of Total Phosphorus in the surface sediment in the three study areas were 214.5± 63.1 µg g^{-1} in the RNP Coastal Dunes site, 295.5±16.7 µg g^{-1} in the Kornati NP site and 268.7±55.5 µg g^{-1} in the Monfalcone (Bay of Panzano) site (Figure 56).

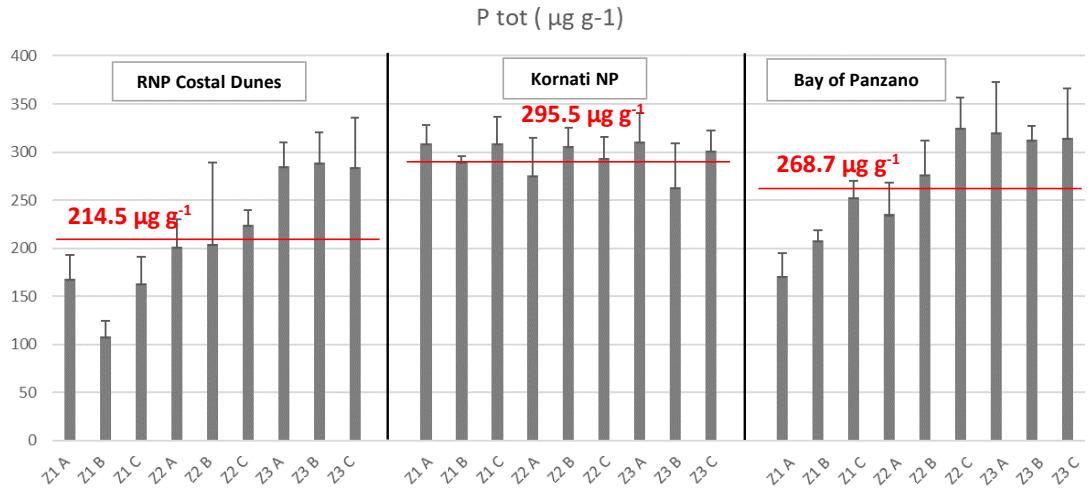

Figure 56. Total Phosphorus in all stations of RNP Coastal Dunes site, Kornati NP site and Monfalcone (Bay of Panzano) site, the red lines indicate the mean values.

In the RNP Coastal Dunes and Monfalcone (Bay of Panzano) sites, the higher variability among the three monitoring zones (Z1, Z2 and Z3) was present. In particular, the stations of Zone 1 of the RNP Coastal Dunes site were characterized by a lower mean value and the minimum concentration (means value of 108.6 µg g^{-1}) was found in the stations Z1-B. For the other two Zones (2 and 3) in the RNP Coastal Dunes site, the data showed higher values, and the maximum concentration in the stations of Zone 3 (mean value 286.4 µg g^{-1}). In the Panzano Bay site, the lower average concentration was observed in the Zone 1 (210.7 µg g^{-1}); in the Z2 and Z3 zones means values were higher, respectively 279.2 and 316.1 µg g^{-1}. However, it should be emphasized that Zone 1 is far from the other two. In the station Z2-C, the higher concentration of 320.3 1 µg g^{-1} was found.

In the sediment of the Kornati NP site, the higher concentration value was recorded and the variability between the monitoring stations was very low (±16.7). In fact, the means among the Zones were very similar (Z1 stations showed the higher average values).

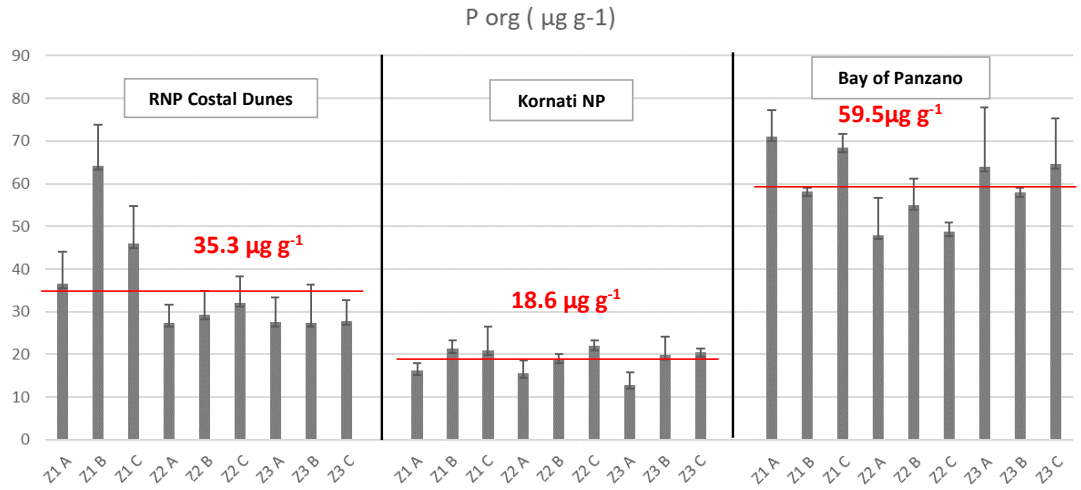

Figure 57. Organic Phosphorus in all stations of RNP Coastal Dunes site, Kornati NP site and Monfalcone (Bay of Panzano) site, the red lines indicate the mean values.

Regarding the Organic Phosphorus, the percentage was 16.4% in the RNP Coastal Dunes site, 6.3% in Kornati NP site and 22.2% in the Monfalcone (Bay of Panzano) site (Figure 57). In the three study areas, the means concentrations were 35.3±12.5 µg g^{-1} in the RNP Coastal Dunes site, 18,6±3.09 µg g^{-1} in the Kornati NP site and 59,5±8.15 µg g^{-1} in the Monfalcone (Bay of Panzano) site. In this area, the higher concentrations were found in the Zone 1 stations, with a mean value about 71.0 µg g^{-1} in Z1-A station.

The higher standard deviation among the stations were recorded in the RNP Coastal Dunes site, with the higher value in the Z1-B station (64.2 µg g^{-1}) located in Zone 1; in Zone 2 and Zone 3, the concentrations were lower. The stations located in the Kornati NP site showed lower concentration and variability, with a maximum in Z2-C station (21.9 µg g^{-1}) and a minimum in Z3-A station (12.8 µg g^{-1}).

Total and Organic Carbon

The sediment Total Carbon showed the higher mean concentration in the Kornati NP site (101±6.6 mg/g) and lower values in the Monfalcone (Bay of Panzano) site (73.0±11.6 mg/g) and in the RNP Coastal Dunes site (85.6±6.9 mg/g) (Figure 58). In the Monfalcone (Bay of Panzano) site, the higher variability among the stations were found (mean values of 82.5 mg/g in Zone 3, 78.2 mg/g in Zone 1 and 58.4 mg/g in Zone 2).

In the Kornati NP site, the higher concentration of Total Carbon was recorded (higher mean value in Zone 2 due to an average value of 104.7 mg/g in Z2-C) and, in the RNP Coastal Dunes site, only in Zone 3 stations a high mean value was recorded.

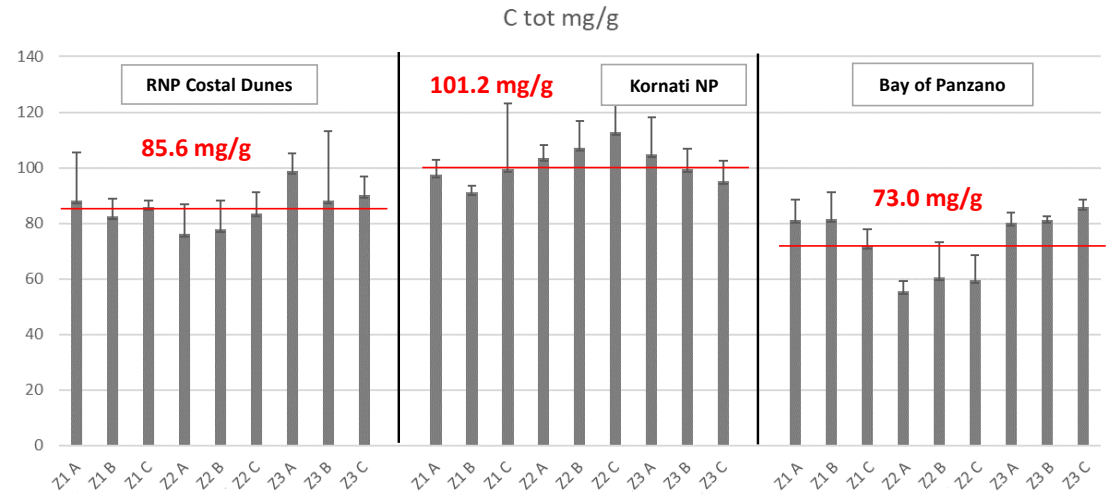

Figure 58. Total carbon in all stations of RNP Coastal Dunes site, Kornati NP site and Monfalcone (Bay of Panzano) site, the red lines indicate the mean values.

The percentage of sediment Organic Carbon ranged from 3.12% (in the Kornati NP site) to 10.4% (in the Monfalcone - Bay of Panzano - site) (Figure 59). The average values were 5.59±0.6 mg/g in the RNP Coastal Dunes site, 3.17±0.5 mg/g in the Kornati NP site and 7.65±1.2 mg/g in the Monfalcone (Bay of Panzano) site. The higher value in the Monfalcone (Bay of Panzano) site can be due to the transport of organic matter from the Stella River to the Zone 3 monitoring stations (where the higher means concentration was recorded).

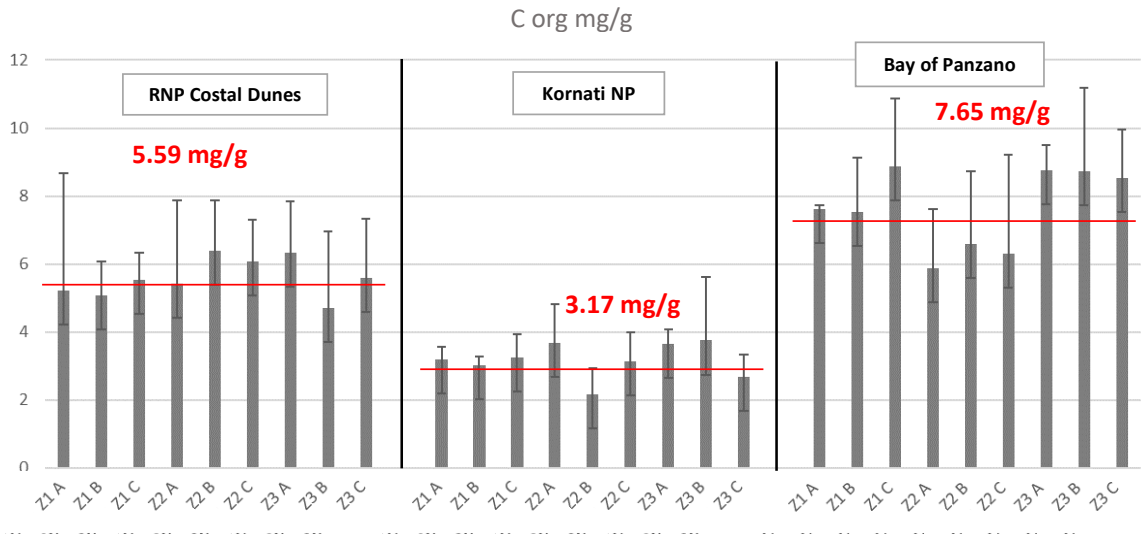

Figure 59. Organic carbon in all stations of RNP Coastal Dunes site, Kornati NP site and Monfalcone (Bay of Panzano) site, the red lines indicate the values means

Total Nitrogen

The Total Nitrogen average concentration in the sediment highlighted a very marked variability between stations and study areas (Figure 60). The mean value recorded in the RNP Coastal Dunes site was about 169±0.48 mg/g; lower concentrations were found in the Kornati NP site (1.34±0.41 mg/g) and in the Monfalcone (Bay of Panzano) site (1.08±0.21 mg/g).

The higher concentration mean values were found in the stations Z1-C (2.11mg/g), Z2-A (2.14 mg/g) and Z3-B (2.10 mg/g), in the RNP Coastal Dunes site. On the contrary, the lowest concentration was recorded in the Monfalcone (Bay of Panzano) site, in the station Z1-C (0.62 mg/g) where the seagrass meadows were not present.

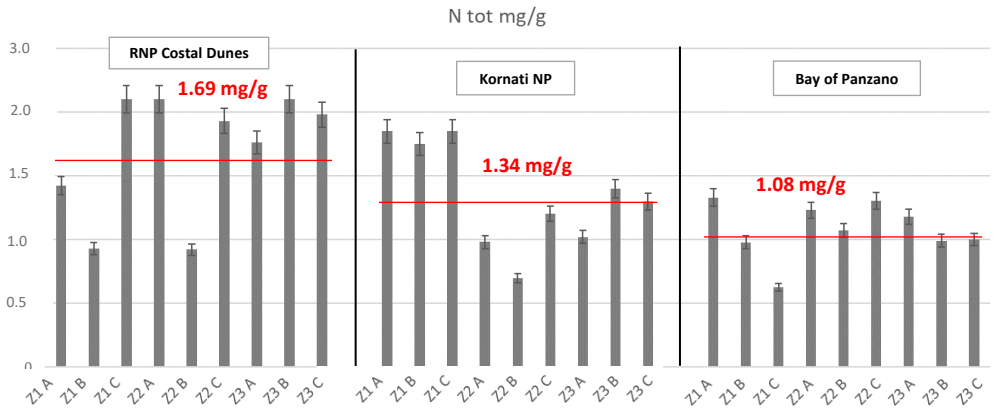

Figure 60. Total nitrogen in all stations of RNP Coastal Dunes site, Kornati NP site and Monfalcone (Bay of Panzano) site, the red lines indicate the mean values.

5.2. Seagrass genetic study

The genetic analysis on the seagrass in the stations of the SASPAS project were carried out with the main purpose of evaluating their genetic variability and possibly correlating it with the quality of the meadows. The seagrass samples analysed were collected in the Bay of Panzano (Monfalcone) site (*Cymodocea nodosa*), in the Kornati National Park site (*Posidonia oceanica*) and in the RNP Coastal Dunes site (*Posidonia oceanica*)

Multiple samples were collected and at least 3 leaf samples were analysed for each station (Z1A, Z1B, Z1C, Z2A, Z2B, Z2C, Z3A, Z3B, Z3C) of each study site, for a total of 81 samples (3 leaves x 9 stations x 3 sites).

Genetic analyses involved several different steps:

- DNA extraction, paying attention to remove epiphytic organisms from the leaves (otherwise they could have interfered with the subsequent phases);

- the extracted DNAs were used for PCR amplification of molecular markers. The molecular markers were the matK plastid gene, the intergenic plastid spacer trnH-psbA and the 18S-28S rRNA ITS (ITS) nuclear intergenic spacer. The last two molecular markers, as intergenic spacers, are generally more variable and therefore usually also used to evaluate the differences between subspecies or populations within a species. The primers and PCR protocols for the amplification of the markers from the collected seagrasses were taken from the literature (Bruni *et al*. 2012 for the matK and for the trnH-psbA; Fuentes-Bazan *et al*. 2012 for the ITS);
- DNA purification;
- DNA sequencing;
- bioinformatics analysis.

The results showed that for each of the markers considered, the sequences in the 3 replicates of samples within each Zone were 100% identical. This data confirms that the organisms within each Zone were clones of the same mother plant. Therefore, using the DNA barcoding method, the results of this marker could only confirm the belonging of the sampled organisms to the species identified at the morphological level.

Regarding the trnH-psbA marker, differences were not found between the *C. nodosa* samples, collected in the different Zones of the Panzano Bay (Monfalcone) site. This indicated a lack of genetic variability for the area. The sequences obtained were also compared with those present in the public databases of the INSDC (International Nucleotide Sequence Database Collaboration) using the BLAST tool; it confirmed an identity of 95.82% with the only available sequence of the genus *Cymodocea*, however obtained from a different species of this genus sampled in India (*C. serrulata*).

Regarding the *P. oceanica* samples, the trnH-psbA marker led to more complex results. In particular, the sequences of the samples collected in the different Zones in the RNP Coastal Dunes site were all identical to each other. The samples collected in the Kornati National Park site, in Zones 1 and 2 presented trnH-psbA sequences identical to each other and slightly different from those of the samples collected in Zone 3.

Furthermore, comparing the sequences obtained from all the *P. oceanica* samples collected with those present in the public databases of the INSDC (using the BLAST tool), it was found that the sequences of the samples of Zone 3 of the Kornati National Park site, the ones of the three Zones of the RNP Coastal Dunes site and a sample of *P. oceanica* collected in Ischia were identical to each other (these sequences were named "haplotype[6] 1"). Therefore, the sequences of Zones 1 and 2 of the Kornati National Park site were named "haplotype 2". The "haplotypes 1 and 2" of the trnH-psbA marker of *P. oceanica* differ in an indel (insertion or deletion mutation) of 10 nucleotides, present in "haplotype 1" and absent in "haplotype 2".

It is interesting to highlight that in the Kornati National Park site, the two haplotypes were found in two different areas characterized by different environmental conditions, pressures, and general

6 Haplotypes: group of alleles in an organism that are inherited together from a single parent.

characteristics of the seagrass meadows. In particular, haplotype 1 was found in Zone 3, near the island of Borovnik (in the “Diving site”, see par. 4.2.1), while “haplotype 2” was found in Zones 1 and 2, in the bay of Kravljačica (in the “Anchoring site”, see par. 4.2.1).

Therefore, it is possible that the differences observed between the meadows are not only due to the pressures related to anthropogenic activities, but also to the genetic differences between the *P. oceanica* populations.

However, the analyses carried out with the ITS marker did not show any differences in the sequences of the analyzed samples, both considering the different Zones within each of the Natura 2000 Areas and between the RNP Coastal Dunes and the Kornati National Park sites.

This data confirms what was previously reported in the literature for *P. oceanica*, whose populations do not present in general genetic diversity for the ITS marker (e.g., Aires et al. 2011).

6. CONCLUSIONS

The comparison of the data collected during the monitoring campaigns carried out in 2020, 2021 and 2022 with those collected during the preliminary survey (preliminary survey - WP 3 activity 1 - 2019) shows that:

- at the Panzano Bay, some differences were present between the parameter values, probably due to different sampling periods, phenological cycles of the seagrass species (*Cymodocea nodosa*, *Zostera noltei* and *Z. marina*), and water depths. However, **no anomalies were found**;
- at the Kornati NP, changes in the mean values of the main parameters were found. In particular, the meadow **conservation status** changed from MODERATE to POOR in the Zone 2 of "Anchoring site", and from GOOD to MODERATE in the "Diving site" (Zone 3) due to the decrease recorded (compared to 2019) in the percentage of cover in Zone 2 and Zone 3. However, data analysis showed no changes in the **ecological conditions** of the meadow (BAD in the "Anchoring site" and POOR in the "Diving site") and the analysis of balises highlighted stable meadows condition, as signs of retreat were not recorded and some denser patches of *Posidonia* were observed;
- at the RNP Coastal Dunes, changes in the mean values of the main parameters were found. In fact, a comparison with data of the 2019 campaign (preliminary survey - WP 3 activity 1) showed decrease of the index value related to the **ecological conditions** of the meadow in the Zone 2 and Zone 3 (from POOR to BAD) (due to the decrease recorded in shoot density) and no changes in the ecological conditions of the meadow in Zone 1 (still POOR). Considering the **conservation status** of the meadow, no change or a slight decrease in the index value was found in Zone 2 (still GOOD) and in Zone 1 (from HIGH to GOOD); whereas the reduction in the average coverage at the Zone 3 stations resulted in a decrease of the index value (from HIGH to POOR). However, as for the Kornati NP site, the analysis of balises showed a stable meadow condition, as there were no signs of retreat.

Regarding the update on the status and progress of the seagrass transplantations (planned in WP 4 activity 2), it is important to underline that:

- at the Panzano Bay in April 2021, a monitoring of the restored sites was carried out highlighting that approximatively 50% of the plugs transplanted in September 2020 and almost all the plugs transplanted in April 2021 were still in place suggesting the effectiveness of the spring season thrust in driving a rapid growth;
- at the Kornati NP site, the total number of shoots and the leaf length showed a slight decrease, and it was partly due to the high sedimentation trend still going, which results as a contour condition;
- at the RNP Coastal Dunes site, the transplant, originally planned in October 2020, was postponed, and carried out in February 2021. Shoot density and height of the longest leaf, showed good leaf conditions, but physical loss of shoots was due to multiple causes, that cannot be identified with certainty (i.e., fishing, anchoring, wave erosion).

7. AKNOWLEDGEMENTS

In the Monfalcone site, the monitoring campaign was carried thanks to the concrete support, in time, by the Civil Protection Service and the Hannibal Marina of Monfalcone. Coordination of activities was also carried out by LP.

In the Regional Natural Park Coastal Dunes, the monitoring campaign was carried out with the collaboration of the Ostuni delegation of Italian “Lega Navale”. Coordination of activities was carried out by the RNP partner.

Help and cooperation was received from the competent Offices of the Maritime Authority (“Capitaneria di Porto” of Monfalcone and “Delegazione di Spiaggia” of Ostuni).

In the Kornati NP, the survey was carried out by the competent partners (PP1 SELC, PP4 SUNCE, PP5 Park Kornati), with the expert support of the Najada Diving of Murter and the Park Kornati pilots and maritime personnel.

In addition to the partners directly involved in the field activities, a special thanks go to the professors A. Falace and A. Sfriso, respectively of UNI-TS (PP2 CONISMA) and DAIS-UNI-VE (PP7 CORILA) partners, for the comments and suggestions necessary for the completion of the document.

8. REFERENCES

Aires T., Marba N., Cunha R., Kendrick G., Walker D., Serrao E., Duarte C., Arnaud-Haond S. 2011. Evolutionary history of the seagrass genus *Posidonia*. Marine Ecology-Progress Series. 421. 117-130. 10.3354/Meps08879.

Airoldi L., Cinelli F., 1997. Effects of sedimentation on subtidal macroalgal assemblages: an experimental study from a Mediterranean rocky shore. *J. Exp. Mar. Biol. Ecol.*, 215: 269-288.

Ballesteros E., 1987. Structure and dynamics of the leaf phytoepiphytes of *Posidonia oceanica* (L.) Delile in Tossa de Mar (Catalonia, Western Mediterranean). *Butlletí dela Institució Catalana d'Història Natural*, 54: 13-30.

Bianchi C.N., Pronzato R., Cattaneo-Vietti R., Benedetti Cecchi L., Morri C., Pansini M., Chemello R., Milazzo M., Fraschetti S., Terlizzi A., Peirano A., Salvati E., Benzoni F., Calcinai B., Cerrano C., Bavestrello G., 2004. Hard bottoms. *Biol. Mar. Medit.*, 11(suppl. 1), 185-215.

Borum J., Duarte C.M., Krause-Jensen D., Greve T.M., 2004. European Seagrasses: An Introduction to Monitoring and Management (The M&MS Project, Copenhagen). Pp.95.

Bruni I., De Mattia F., Martellos S., Galimberti A., Savadori P., et al. 2012. DNA Barcoding as an Effective Tool in Improving a Digital Plant IdentificationSystem: A Case Study for the Area of Mt. Valerio, Trieste (NE Italy). PLoS ONE 7(9): e43256. doi:10.1371/journal.pone.0043256

Buia M.C., Gambi M.C., Dappiano M., 2004. Seagrass systems. *Biol. Mar. Medit.*, 11 (Suppl. 1): 133-183.

Casier R., 2011. Marine Protected Areas in the Mediterranean Sea. Alfred Toepfer Natural Heritage Scholarschip 2011. Awarded on the EUROPARC Conference 2011 in Bad Urach, made possible by the Alfred Toepfer Stiftung F.V.S.

Charbonnel E., Boudouresque C.F., Meinesz A., Bernard G., Bonhomme P., Patrone J., Kruczek R., Cottalorda J.M., Bertrandy M.C., Foret P., Ragazzi M.., Le Direac'h L., 2000. Le Réseau de Surveillance Posidonies de la Région Provence-Alpes-Côte d'Azur. Première partie: présentation et guide méthodologique. Année 2000. Région PACA, Agence de l'Eau RMC, GIS Posidonie, CQEL 13, CQEL 83, Conseil Général 06, GIS Posidonie publ.: 1-76.

Díaz-Almela E., Duarte C.M., 2008. Management of Natura 2000 habitats. 1120 **Posidonia* beds (*Posidonion oceanicae*). European Commission.

Duarte C.M., Kirkman H., 2001. Methods for the measurement of seagrass abundance and depth distribution, in: Short, F.T. et al. (Ed.) Global seagrass research methods. pp. 141-153 In: Short, F.T.; Coles, R.G.; Short, C.A. (Ed.) (2001). Global seagrass research methods. Elsevier Science: Amsterdam. ISBN 0-444-50891-0. VII, 473 pp.

Fuentes-Bazan S., Uotila P., Borsch T. 2012. A novel phylogeny-based generic classification for Chenopodium sensu lato, and a tribal rearrangement of Chenopodioideae (Chenopodiaceae). Willdenowia 42(1): 5-24. [available online at: http://www.ingentaconnect.com/content/bgbm/will/

2012/00000042/00000001/art00001]

Gerakaris V., Panayotidis P., Vizzini S., Nicolaidou A., Economou-Amilli A. 2017. Effectiveness of *Posidonia oceanica* biotic indices for assessing the ecological status of coastal waters in Saronikos Gulf (Aegean Sea, Eastern Mediterranean). *Mediterranean Marine Science*, 18, 161-178.

Irving A.D., Connell S.D., 2002a. Interactive effects of sedimentation and microtopography on the abundance of subtidal turf-forming algae. *Phycologia*, 41: 517-522.

Irving A.D., Connell S.D., 2002b. Sedimentation and light penetration interact to maintain heterogeneity of subtidal habitat: algal versus invertebrate dominated assemblages. *Mar. Ecol. Prog. Ser.*, 245: 83-91.

ISPRA, 2012. Elemento di Qualità Biologica Angiosperme Scheda metodologica ISPRA per il calcolo dello stato ecologico secondo la metodologia PREI. Procedure di campionamento per la raccolta dati. http://www.isprambiente.gov.it/files/icram/scheda-metodologia-posidonia-new.pdf/view

Ivković N., 2015. Invasive tropical algae of genus *Caulerpa* in the Adriatic Sea. Thesis performed at Subdepartment of Water Ecology. Pp. 22.

Martínez-Crego B., Prado P., Alcoverro T., Romero J., 2010. Composition of epiphytic leaf community of *Posidonia oceanica* as a tool for environmental biomonitoring. *Estuarine, Coastal and Shelf Science*, 88: 199-208.

Mihelcic V., Ramov M., 2018. Specific fishing regulations in Croatia: the case of Kornati National Park and Telašćica Nature Park. Presentation (MedPAN Workshop 2018).

Montefalcone M., 2009. Ecosystem health assessment using the Mediterranean seagrass *Posidonia oceanica*: A review. *Ecological Indicators*, vol. 9 (4): 595-604.

Pergent G., Pergent-Martini C., Boudouresque C.F., 1995. Utilisation de l'herbier à *Posidonia oceanica* comme indicateur biologique de la qualité du milieu littoral en Mediterranée: état de conneissances. Mésogée, 54: 3-29.

Pergent-Martini et al., 2005. Descriptors of *Posidonia oceanica* meadows: Use and application. *Ecological Indicators*, 5: 213-230.

Scannavino A., Pirrotta M., Tomasello A., Di Maida G., Luzzu F., Bellavia C., Bellissimo G., Costantini C., Orestano C., Sclafani G., Calvo S. 2014. Biodegradable anchor modular system for transplanting Posidonia oceanica cuttings. Conference Paper. 5th Mediterranean Symposium on Marine Vegetation (Portorož, Slovenia).

UNEP/MAP - RAC/SPA, 2009. Rapport sur le projet MedPosidonia. Rais C., Pergent G., Dupuy de la Grandrive R., Djellouli A. eds. Document d'information pour la neuvième réunion des points focaux nationaux pour les ASP, Floriana – Malte, 3 – 6 juin 2009, CAR/ASP Publ., UNEP(DEPI)/MED WG.331/Inf. 11: 1-107 + annex.

UNEP/MAP - RAC/SPA, 2011. Draft Guidelines for the Standardization of Mapping and Monitoring Methods of Marine Magnoliophyta in the Mediterranean. Tenth Meeting of Focal Points for SPAs Marseilles, France, 17-20 May 2011, RAC/SPA Publ., UNEP(DEPI)/MED WG 359/9. 1-63.zx

UNEP/MAP - RAC/SPA, 2014. Monitoring protocol for *Posidonia oceanica* beds. By Guala I., Nikolic V., Ivesa L., Di Carlo G., Rajkovic Z., Rodic P., Jelic K., Ed. RAC/SPA - MedMPAnet Project, Tunis. 37 pages + annexes.

WATER FRAMEWORK DIRECTIVE 2000/60/EC. Council Directive of the European Parliament of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Union, 22/12/2000, L 327.

9. ANNEXES

- Field Sheets.
- Laboratory Data Sheets.

Field Data Sheets

Bay of Panzano (Monfalcone)

European Regional Development Fund

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** **Z1-A (Panzano Bay)**

Depth: 1,9 m

Coordinates: 45°46'45,81" 13°32'12,51"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Cymodocea nodosa* meadow

Seagrass: Cymodocea nodosa

Other Seagrasses: /

Meadow continuity: yes ☒ no

Type of substrate: Sandy

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no ☒

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	44	1,9	
2	57	1,9	
3	53	1,9	
4	72	1,8	
5	49	1,9	
6	52	1,9	

Collection of shoots for laboratory analyses: yes / no ☒

Collection of sediment for laboratory analyses: yes / no ☒

Zone and sampling station: Z1-A **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Cn	1000		Cn	1000		Cn	390	
						Sa	410	
						Cn	960	
						Sa	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** Z1-B (Panzano Bay)

Depth: 2,1 m

Coordinates: 45°46'45,47" 13°32'19,19"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Cymodocea nodosa* meadow

Seagrass: Cymodocea nodosa

Other Seagrasses: /

Meadow continuity: yes X no

Type of substrate: Sandy

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no X

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	59	2,1	
2	50	2,1	
3	55	2,0	
4	64	2,0	
5	52	2,1	
6	46	2,1	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z1-B **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Cn	1000		Cn	1000		Cn	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes: _____

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** Z1-C (Panzano Bay)

Depth: 4,1 m

Coordinates: 45°46'37,97" 13°32'27,58"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): /

Seagrass: /

Other Seagrasses: /

Meadow continuity: yes / no

Type of substrate: Sandy-silt

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: **yes / no** X

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	0	4,0	
2	0	4,1	
3	0	4,1	
4	0	4,1	
5	0	4,0	
6	0	4,0	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z1-C

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Sa	1000		Sa	1000		Sa	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** **Z2-A (Panzano Bay)**

Depth: 0,9 m

Coordinates: 45°45'34,13" 13°31'36,79"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Zostera noltei* meadow

Seagrass: Zostera noltei

Other Seagrasses: /

Meadow continuity: yes X no

Type of substrate: Sandy-silt

For *Posidonia oceanica* : **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis* : **yes / no X**

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	202	0,9	
2	210	0,9	
3	186	0,9	
4	188	1,0	
5	233	0,9	
6	254	0,9	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z2-A

% Coverage

Size of sampling units: transect 10 m

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Zn	1000		Zn	1000		Zn	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** **Z2-B (Panzano Bay)**

Depth: 1,2 m

Coordinates: 45°45'28,69" 13°31'54,79"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Cymodocea nodosa* meadow

Seagrass: *Cymodocea nodosa*

Other Seagrasses: /

Meadow continuity: yes X no

Type of substrate: Sandy-silt

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no X

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	40	1,1	
2	45	1,2	
3	61	1,2	
4	53	1,1	
5	49	1,2	
6	64	1,2	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z2-B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Cn	880		Cn	120		Cn	1000	
Sa	910		Sa	140				
Cn	1000		Cn	660				
			Sa	710				
			Cn	1000				

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** Z2-C (Panzano Bay)

Depth: 2,4 m

Coordinates: 45°45'23,05" 13°31'32,63"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Cymodocea nodosa* meadow

Seagrass: *Cymodocea nodosa*

Other Seagrasses: /

Meadow continuity: yes X no

Type of substrate: Sandy

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no X

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	72	2,4	
2	55	2,3	
3	66	2,3	
4	59	2,4	
5	46	2,4	
6	64	2,4	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z2-C

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Cn	1000	Cn	Cn	1000		Cn	780	
						Sa	840	
						Cn	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes: _____

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** **Z3-A (Panzano Bay)**

Depth: 2,0 m

Coordinates: 45°45'06,27" 13°31'54,88"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Zostera marina* meadow

Seagrass: *Zostera marina*

Other Seagrasses: /

Meadow continuity: yes / no

Type of substrate: Sandy-silt

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	25	2,1	
2	33	2,0	
3	12	2,0	
4	20	2,1	
5	29	1,9	
6	30	2,1	

Collection of shoots for laboratory analyses: yes / no

Collection of sediment for laboratory analyses: yes / no

Zone and sampling station: Z3-A

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Zm	1000		Zm	1000		Zm	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** **Z3-B (Panzano Bay)**

Depth: 1,7 m

Coordinates: 45°45'09,33" 13°32'06,01"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Cymodocea nodosa* meadow

Seagrass: *Cymodocea nodosa*

Other Seagrasses: /

Meadow continuity: yes X no

Type of substrate: Sandy-silt

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no X

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	55	1,7	
2	49	1,7	
3	60	1,8	
4	53	1,7	
5	58	1,9	
6	50	1,7	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z3-B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Cn	1000		Cn	660		Cn	1000	
			Sa	690				
			Cn	880				
			Sa	900				
			Cn	990				
			Sa	1000				

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 13/09/2021 **Zone and sampling station:** Z3-C (Panzano Bay)

Depth: 2,9 m

Coordinates: 45°45'11,00" 13°32'35,82"

Coordinator: A. Rismondo

Operators: A. Rismondo - D. Curiel

Habitat characterization and disturbance (potential pressures in the area and signs of impact): *Cymodocea nodosa* meadow

Seagrass: *Cymodocea nodosa*

Other Seagrasses: /

Meadow continuity: yes X no

Type of substrate: Sandy

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: /

Algal blooms and filamentous algae: /

Presence of *Pinna nobilis*: yes / no X

Shoot density

Size of sampling units: 30 x 30 cm

Replicate	No of shoots	Depth (m)	Notes
1	65	2,8	
2	75	2,9	
3	64	2,9	
4	77	2,8	
5	73	2,8	
6	59	2,9	

Collection of shoots for laboratory analyses: yes / no X

Collection of sediment for laboratory analyses: yes / no X

Zone and sampling station: Z3-C **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
Cn	1000		Cn	1000		Cn	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes: _____

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	/	/
2	/	/
3	/	/

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

Field Data Sheets

Kornati NP

WP 3.3 - Monitoring Campaigns

Date: 18.10.2021. **Zone and sampling station:** **Kravljačica bay, Z1A**

Depth: 14,4

Coordinates: **43,8246910(15,27505300**

Coordinator: Fedra Dokoza

Operators: Anamarija Paradinović, Ante Gugić, Samanta Šećer

Habitat characterization and disturbance (potential pressures in the area and signs of impact): A lot of mud and dead matte. Bad visibility.
A lot of bottles, cans plastic containers.
Posidonia meadow is not compact and doesn't have continuity

Seagrass: Yes

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sand, mud, meadow

For *Posidonia oceanica*: **Upper limit depth …?… / Lower limit depth: …..?…..**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: yes / no No

Shoot density

Size of sampling units: …… x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	26	14,7	
2	11	14,9	
3	8	14,4	
4	11	14,6	
5	26	14,8	
6	17	14,3	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Kravljačica bay, Z1A **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	170		P	70		P	80	
D	220		D	100		D	100	
P	280		P	220		P	140	
D	400		D	300		D	320	
P	420		P	370		P	390	
D	500		D	390		D	430	
P	520		P	660		P	450	
D	600		D	730		D	520	
P	660		P	800		P	530	
D	680		D	810		D	590	
P	1000		P	860		P	680	
			D	910		D	780	
			P	1000		P	810	
						D	850	
						P	910	
						D	920	
						P	930	
						D	960	
						P	970	
						D	1000	

C = categories **O = other species** **i = intercept (cm)**

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes: _____

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.10.2021. **Zone and sampling station:** Kravljačica bay, Z1B

Depth: **14,1**

Coordinates: **43,82486900** **15,27534300**

Coordinator: Fedra Dokoza

Operators: Agata Kovačev, Andrea Markov Bosna

Habitat characterization and disturbance (potential pressures in the area and signs of impact): A lot of mud and dead matte. Bad visibility.
A lot of bottles, cans plastic containers.
Posidonia meadow is not compact and doesn't have continuity

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: mud, sand, meadow

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: **yes / no** No

Shoot density

Size of sampling ur 40x40

Replicate	No of shoots	Depth (m)	Notes
1	19	14,7	
2	20	14,2	
3	17	14,4	
4	21	14,7	
5	13	14,8	
6	19	15	

Collection of shoots for laboratory analyses: yes / no Yes

Collection of sediment for laboratory analyses: yes / no Yes

Zone and sampling station: Kravljačica Bay, Z1B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	270		D	130		D	140	
P	320		P	160		P	170	
D	350		D	270		D	210	
P	380		P	310		P	220	
D	400		D	360		D	240	
P	420		P	370		P	260	
D	660		D	510		D	310	
P	710		P	580		P	360	
D	780		D	640		D	370	
P	810		P	660		P	410	
D	830		D	740		D	440	
P	850		P	760		P	470	
D	900		D	780		D	700	
P	930		P	830		P	720	
D	940		D	860		D	760	
P	980		P	920		P	800	
D	1000		D	970		D	820	
			P	1000		P	900	
						D	920	
						P	940	
						D	1000	

C = categories **O = other species** **i = intercept (cm)**

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.10.2021. **Zone and sampling station:** Kravljačica bay, Z1C

Depth: **15,8 m**

Coordinates: **43,82523700** **15,27555200**

Coordinator: Fedra Dokoza

Operators: Matea Martinović, Katarina Bilušić

Habitat characterization and disturbance (potential pressures in the area and signs of impact): A lot of mud and dead matte. Bad visibility.
A lot of bottles, cans plastic containers.
Posidonia meadow is not compact and doesn't have continuity

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sand, mud, meadow

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	8	13,8	
2	15	13,9	
3	21	14,0	
4	17	14,0	
5	14	13,4	
6	18	14,5	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Kravljačica bay, Z1C **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	140		P	90		D	270	
P	180		D	150		P	280	
D	210		P	160		D	310	
P	220		D	190		P	330	
D	260		P	290		D	380	
P	270		D	410		P	390	
D	380		P	440		D	470	
P	430		D	770		P	490	
D	440		P	780		D	700	
P	500		D	830		P	710	
D	510		P	840		D	770	
P	550		D	870		P	790	
D	590		P	880		D	830	
P	710		D	910		P	910	
D	720		P	920		D	980	
P	780		D	950		P	1000	
D	800		P	980				
P	830		D	1000				
D	940							
P	990							
D	1000							

C = categories **O = other species** **i = intercept (cm)**

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes:
Marine litter

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.10.2021. **Zone and sampling station:** Kravljačica bay, Z2A

Depth: 9,4

Coordinates: **43,82457400 15,27531200**

Coordinator: Fedra Dokoza

Operators: Anamarija Paradinović, Ante Gugić, Samanta Šećer

Habitat characterization and disturbance (potential pressures in the area and signs of impact): A lot of mud and dead matte. Bad visibility.
A lot of bottles, cans plastic containers.
Posidonia meadow is not compact and doesn't have continuity

Seagrass: Yes

Other Seagrasses: No

Meadow continuity: yes / no No

Type of substrate: Sand, mud, meadow

For *Posidonia oceanica*: **Upper limit depth ...?... / Lower limit depth: .....?.....**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	11	9	
2	21	9,4	
3	14	9,1	
4	27	9	
5	41	8,5	
6	11	10,4	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Kravljačica bay, Z2A **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	130		P	130		P	110	
D	230		D	150		D	170	
P	240		P	220		P	200	
D	330		D	230		D	290	
P	340		P	250		P	310	
D	370		D	310		D	400	
P	380		P	330		P	410	
D	480		D	360		D	470	
P	510		P	370		P	490	
D	540		D	400		D	580	
P	550		P	410		P	590	
D	630		D	520		D	660	
P	670		P	540		P	670	
D	750		D	580		D	670	
P	770		P	610		P	700	
D	810		D	1000		D	710	
P	820					P	730	
D	1000					D	1000	

C = categories **O = other species** **i = intercept (cm)**

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes: _____

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.10.2021. **Zone and sampling station:** Kravljačica bay, Z2B

Depth: 14,7 m

Coordinates: 43,82485600 15,27550300

Coordinator: Fedra Dokoza

Operators: Agata Kovačev, Andrea Markov Bosna

Habitat characterization and disturbance (potential pressures in the area and signs of impact): A lot of mud and dead matte. Bad visibility.
A lot of bottles, cans plastic containers.
Posidonia meadow is not compact and doesn't have continuity

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: mud, sand, meadow

For *Posidonia oceanica* : **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no Yes

Shoot density

Size of sampling ur 40x40

Replicate	No of shoots	Depth (m)	Notes
1	17	14,4	
2	16	14,7	
3	18	14,7	
4	22	14,1	
5	24	15,2	
6	16	14,8	

Collection of shoots for laboratory analyses: yes / no Yes

Collection of sediment for laboratory analyses: yes / no Yes

Zone and sampling station: Kravljačica bay, Z2B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	130		D	60		P	30	
P	150		P	90		D	110	
D	190		D	110		P	120	
P	200		P	140		D	150	
D	280		D	250		P	170	
P	310		P	260		D	180	
D	370		D	300		P	200	
P	400		P	350		D	210	
D	480		D	380		P	230	
P	490		P	420		D	260	
D	500		D	450		P	330	
P	520		P	530		D	380	
D	540		D	550		P	400	
P	550		P	620		D	430	
D	660		D	710		P	470	
P	730		P	800		D	490	
D	740		D	920		P	510	
P	800		P	1000		D	520	
D	910					P	630	
P	980					D	640	
D	1000					P	650	
						D	700	
						P	780	
						D	800	
						P	820	
						D	840	
						P	910	
						D	930	
						P	970	
						D	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.10.2021. **Zone and sampling station:** Kravljačica bay, Z2C

Depth: **14 m**

Coordinates: **43,8250920(15,27583300**

Coordinator: Fedra Dokoza

Operators: Matea Martinović, Katarina Bilušić

Habitat characterization and disturbance (potential pressures in the area and signs of impact): A lot of mud and dead matte. Bad visibility.
A lot of bottles, cans plastic containers.
Posidonia meadow is not compact and doesn't have continuity

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sand, mud, meadow

For *Posidonia oceanica* : **Upper limit depth ……. / Lower limit depth: …….**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: …… x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	16	16,2	
2	13	16,4	
3	18	15,6	
4	15	15,8	
5	12	16,2	
6	15	16,3	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Kravljačica bay, Z2C

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	50		P	60		D	60	
P	60		D	140		P	70	
D	120		P	150		D	260	
P	130		D	550		P	270	
D	170		P	560		D	310	
P	180		D	690		P	330	
D	210		P	710		D	470	
P	230		D	960		P	500	
D	260		P	970		D	580	
P	270		D	1000		P	590	
D	360					D	680	
P	390					P	690	
D	490					D	790	
P	500					P	810	
D	530					D	850	
P	550					P	880	
D	630					D	900	
P	670					P	1000	
D	740							
P	760							
D	800							
P	820							
D	890							
P	900							
D	950							
P	1000							

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 19.10.2021. **Zone and sampling station:** Island Balun, Z3A

Depth: 9,2 m

Coordinates: **43,80908300 15,25525000**

Coordinator: Fedra Dokoza

Operators: Anamarija Paradinović, Ante Gugić, Samanta Šećer

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Good visibility.
Posidonia meadow is compact and has continuity

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sand, mud, meadow

For *Posidonia oceanica*: **Upper limit depth …?… / Lower limit depth: …..?…..**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: yes / no No

Shoot density

Size of sampling units: …… x …. 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	47	9,5	
2	76	9,7	
3	31	10	
4	36	9,6	
5	33	9,3	
6	73	9,4	

Collection of shoots for laboratory analyses: yes / no Yes

Collection of sediment for laboratory analyses: yes / no Yes

Zone and sampling station: Island Balun, Z3A **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	60		P	10		D	100	
P	140		D	50		P	400	
D	350		P	130		D	470	
P	450		D	200		P	860	
D	560		P	240		D	900	
P	620		S	270		P	910	
D	760		P	670		D	930	
P	860		D	750		P	950	
D	900		P	970		D	980	
P	1000		D	1000		P	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes: _____

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 9.10.2021 **Zone and sampling station:** Z3B

Depth: 9,8

Coordinates: 43,80894400, 15,25505500

Coordinator: Fedra Dokoza

Operators: Matea Martinović, Katarina Bilušić

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Good visibility.
Posidonia meadow is compact and has continuity

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: mud, sand, meadow

For *Posidonia oceanica*: **Upper limit depth ..... / Lower limit depth: .....**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: yes / no Yes

Shoot density

Size of sampling 40x40

Replicate	No of shoots	Depth (m)	Notes
1	21	9,9	
2	28	9,4	
3	26	9,3	
4	33	10,4	
5	34	10,2	
6	52	9,7	

Collection of shoots for laboratory analyses: yes / no Yes

Collection of sediment for laboratory analyses: yes / no Yes

Zone and sampling station: Z3B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	40		P	30		P	130	
D	120		D	90		D	150	
P	240		P	230		P	190	
D	550		D	260		D	260	
P	740		P	360		P	400	
D	890		D	420		D	460	
P	1000		P	530		P	570	
			D	580		D	650	
			P	690		P	680	
			D	730		D	800	
			P	770		P	940	
			D	790		D	1000	
			P	1000				

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei
D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	One dead individual
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 19.10.2021. **Zone and sampling station:** Z3C

Depth: **10,3 m**

Coordinates: **43,80888900 15,25486100**

Coordinator: Fedra Dokoza

Operators: Agata Kovačev, Andrea Markov Bosna

Habitat characterization and disturbance (potential pressures in the area and signs of impact):

Seagrass: *Posidonia oceanica*

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sand, mud, meadow

For *Posidonia oceanica*: **Upper limit depth ……. / Lower limit depth: …….**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: **yes / no** No

Shoot density

Size of sampling units: …… x ….. 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	47	9,7	
2	31	9,9	
3	45	9,4	
4	64	10,3	
5	56	10,2	
6	62	10	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z3C **Page: 2/2**

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	160		P	140		P	260	
D	230		D	240		D	330	
P	390		P	360		P	450	
D	420		D	390		D	520	
P	610		P	480		P	630	
D	650		D	640		D	670	
P	1000		P	820		P	890	
			D	900		D	920	
			P	1000		P	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes: _____

Presence and density of *Pinna nobilis* *

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

Field Data Sheets

RNP Dune Costiere

European Regional Development Fund

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z1-A (RNP Coastal Dunes)**

Depth: 7,1

Coordinates: **40°48'59,81** **17°31'25,11**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica*: **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis*: yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	50	6,8	
2	48	6,9	
3	27	7,0	
4	45	6,9	
5	33	6,8	
6	50	7,0	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z1A

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	650		P	150		P	180	
D	950		D	520		D	340	
P	1000		P	1000		P	400	
						D	680	
						P	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z1-B (RNP Coastal Dunes)**

Depth: 7,1

Coordinates: **40°48'59,83** **17°31'24,42**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	54	6,9	
2	51	7,0	
3	42	7,1	
4	44	7,1	
5	53	7,0	
6	51	6,9	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z1B

% Coverage

Size of sampling units: transect 10 m

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	300		D	480		D	150	
P	1000		P	890		P	600	
			M	1000		D	830	
						P	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z1-C (RNP Coastal Dunes)**

Depth: 6,9

Coordinates: **40°48'59,81** **17°31'23,78**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	54	6,8	
2	40	6,8	
3	43	6,7	
4	45	6,9	
5	45	6,8	
6	52	6,8	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z1C

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	1000		P	860		P	430	
			D	970		D	550	
	100		P	1000		P	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species

i = intercept (cm)

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z2-A (RNP Coastal Dunes)**

Depth: 6,9

Coordinates: **40°49'00,32** **17°31'25,01**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	33	7,0	
2	43	7,0	
3	44	6,9	
4	38	6,8	
5	36	7,0	
6	44	6,8	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z2A

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	910		P	480		P	670	
D	1000		D	560		D	860	
			P	650		P	1000	
			D	840				
			P	1000				

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z2-B (RNP Coastal Dunes)**

Depth: 7,7

Coordinates: **40°49'00,39** **17°31'24,38**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	40	8,1	
2	48	7,9	
3	35	7,8	
4	44	8,1	
5	39	8,0	
6	42	8,0	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z2B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
P	890		P	550		P	150	
Sa	1000		D	710		Sa	280	
			P	1000		P	680	
	890					Sa	720	
						P	1000	

C = categories

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

O = other species **i = intercept (cm)**

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z2-C (RNP Coastal Dunes)**

Depth: 7,3

Coordinates: **40°49'00,43** **17°31'25,51**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	35	7,2	
2	44	7,2	
3	43	7,0	
4	40	7,3	
5	43	7,2	
6	39	7,1	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z2C

% Coverage

Size of sampling units: transect 10 m

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	280		P	390		P	240	
P	650		D	690		Sa	830	
D	1000		Sa	940		P	1000	
			P	1000				

C = categories

O = other species

i = intercept (cm)

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z3-A (RNP Coastal Dunes)**

Depth: 8,1

Coordinates: **40°49'00,91** **17°31'24,93**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	36	8,2	
2	48	8,2	
3	41	8,2	
4	38	8,3	
5	44	8,4	
6	42	8,3	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z3A

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	440		P	290		D	390	
P	620		D	410		P	670	
D	700		P	520		D	850	
P	890		Sa	610		Sa	920	
Sa	950		P	790		P	1000	
P	1000		D	1000				

C = categories **O = other species** **i = intercept (cm)**

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z3-B (RNP Coastal Dunes)**

Depth: 8,3

Coordinates: **40°49'00,87** **17°31'24,10**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	50	8,3	
2	31	8,2	
3	29	8,5	
4	34	8,4	
5	45	8,3	
6	30	8,4	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z3B

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	330		D	1000		D	210	
P	640					P	350	
D	1000					Sa	410	
						P	620	
						D	1000	

C = categories

O = other species

i = intercept (cm)

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

WP 3.3 - Monitoring Campaigns

Date: 18.02.2022 **Zone and sampling station:** **Z3-C (RNP Coastal Dunes)**

Depth: 8,2

Coordinates: **40°49'00,92** **17°31'23,17**

Coordinator: Luciana Muscogiuri

Operators: Luciana Muscogiuri, Cataldo Licchelli

Habitat characterization and disturbance (potential pressures in the area and signs of impact): Posidonetum

Seagrass: Posidonia oceanica

Other Seagrasses: No

Meadow continuity: yes / no Yes

Type of substrate: Sandy

For *Posidonia oceanica* : **Upper limit depth ... / Lower limit depth: ...**

Presence of alien species: No

Algal blooms and filamentous algae: No

Presence of *Pinna nobilis* : yes / no No

Shoot density

Size of sampling units: ..... x 40x40 cm

Replicate	No of shoots	Depth (m)	Notes
1	35	8,3	
2	40	8,2	
3	28	8,2	
4	29	8,1	
5	31	8,2	
6	38	8,1	

Collection of shoots for laboratory analyses: yes / no yes

Collection of sediment for laboratory analyses: yes / no yes

Zone and sampling station: Z3C

% Coverage **Size of sampling units: transect 10 m**

Replicate 1			Replicate 2			Replicate 3		
C	i	O	C	i	O	C	i	O
D	150		D	740		Sa	230	
P	330		Sa	810		D	1000	
D	380		P	950				
Sa	450		Sa	1000				
P	740							
D	1000							

C = categories **O = other species** **i = intercept (cm)**

P = P. oceanica
Cn = C. nodosa
Zm = Z. marina
Zn = Z. noltei

D = Dead *matte*
M = Mud
Sa = Sand
St = Stones/Pebbles
R = Rock

Notes:

Presence and density of Pinna nobilis*

Replicate	No of alive individuals	No of dead individuals
1	No alive individuals	No dead individuals
2		
3		

* density is measured counting all individuals encountered within a 1 m corridor for both sides of each of three transects 10 m long and evaluating their status (dead or alive)

Interreg
Italy - Croatia
SASPAS

EUROPEAN UNION

Laboratory Data Sheets

Bay of Panzano (Monfalcone)

Zone and sampling station: Monfalcone - Z1A

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	8,1	36,6	0,30	1
1	8,1	9,9	0,30	0
2	7,9	31,3	0,35	1
2	7,9	22,8	0,30	1
3	8,9	41,2	0,35	1
3	8,9	30,7	0,35	1
4	7,4	37,6	0,35	1
4	7,4	22,6	0,35	1
4	8,3	11,1	0,30	0
5	6,9	38,2	0,35	1
5	6,9	18,9	0,35	1
6	8,1	39,6	0,35	1
6	8,1	19,4	0,35	1
6	8,1	7,5	0,30	0
7	7,5	31,3	0,35	1
7	7,5	15,7	0,35	1
7	7,5	8,2	0,30	0
8	7,3	35,5	0,35	1
8	7,3	22,2	0,35	1
8	7,3	10,8	0,30	0
9	6,8	31,1	0,35	1
9	6,8	12,7	0,30	1
10	8,8	39,9	0,35	1
10	8,8	26,3	0,35	1
11	8,7	38,7	0,35	1

Zone and sampling station: Monfalcone - Z1A

Seagrass: *Cymodocea nodosa* **Page: 2/2**

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
11	8,7	25,4	0,35	1
12	7,7	36,4	0,35	1
12	7,7	19,8	0,35	1
13	8,1	38,7	0,35	1
14	9,2	41,1	0,35	1
14	9,2	28,9	0,35	1
14	9,2	7,8	0,30	0
15	8,3	34,8	0,35	1
15	8,3	21,5	0,35	1
15	8,3	11,1	0,30	0
16	7,5	36,9	0,35	1
16	7,5	19,7	0,35	1
16	7,5	10,7	0,30	0
17	8	39,9	0,35	1
17	8	9,8	0,30	0
18	6,4	42,1	0,35	1
18	6,4	31,8	0,35	1
18	6,4	12,8	0,30	0
19	8,9	43,8	0,35	1
19	8,9	29,7	0,35	1
20	8,6	40,3	0,35	1
20	8,6	28,9	0,35	1
20	8,6	17,2	0,30	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z1B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	6,9	46,5	0,35	1
1	6,9	35,6	0,35	0
1	6,9	6,4	0,35	0
2	8,0	38,5	0,30	0
2	8,0	33,9	0,30	0
2	8,0	3,1	0,30	0
3	4,9	33,4	0,20	1
3	4,9	20,4	0,20	0
4	8,5	51,2	0,35	1
4	8,5	36,9	0,35	1
5	5,6	37,8	0,25	1
5	5,6	6,2	0,20	0
6	6,1	27,7	0,30	1,5
6	6,1	25,6	0,30	1
7	5,2	37,6	0,25	2
7	5,2	37,0	0,25	2
7	5,2	23,0	0,25	0
8	9,1	47,9	0,30	1,5
8	9,1	43,0	0,30	1
8	9,1	32,9	0,25	0
8	9,1	13,2	0,20	0
9	7,1	39,9	0,30	0
9	7,1	39,0	0,30	0
9	7,1	17,0	0,20	0

Zone and sampling station: Monfalcone - Z1B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
10	8,1	41,0	0,35	2
10	8,1	39,8	0,30	1
11	7,4	31,8	0,35	1
11	7,4	27,2	0,30	0
11	7,4	11,3	0,25	0
12	8,2	41,2	0,35	1
12	8,2	30,7	0,30	1
13	6,9	36,7	0,30	1
13	6,9	29,5	0,30	1
13	6,9	10,5	0,25	0
14	5,8	29,4	0,25	1
14	5,8	12,7	0,20	0
15	7,1	33,2	0,30	1
15	7,1	17,9	0,25	0
16	8,6	35,7	0,30	1
16	8,6	22,5	0,25	0
16	8,6	10,9	0,20	0
17	7,7	29,5	0,30	0
17	7,7	21,5	0,25	0
17	7,7	9,1	0,20	0
18	6,7	30,8	0,25	1
18	6,7	12,3	0,20	0
19	7,5	28,8	0,25	0
19	7,5	17,9	0,25	0

Zone and sampling station: Monfalcone - Z1B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
20	8,4	33,8	0,30	1
20	8,4	22,6	0,25	0
20	8,4	15,4	0,20	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z1C

Seagrass: *no seagrasses*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)

Note: _____

_____

Zone and sampling station: Monfalcone - Z2A

Seagrass: *Zostera noltei*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	7,8	22,7	0,15	1
1	7,8	19,3	0,10	0
1	7,8	8,4	0,10	0
1	7,8	0,9	0,10	0
2	6,9	20,8	0,15	1
2	6,9	11,9	0,10	0
2	6,9	7,5	0,10	0
2	6,9	1,1	0,10	0
3	7,9	23,1	0,15	1
3	7,9	15,7	0,10	0
3	7,9	9,6	0,10	0
3	7,9	3,3	0,10	0
3	7,9	0,8	0,10	0
4	6,6	19,9	0,15	1
4	6,6	11,5	0,10	0
4	6,6	7,6	0,10	0
4	6,6	2,1	0,10	0
5	9,7	29,8	0,15	1
5	9,7	20,1	0,15	1
5	9,7	12,7	0,10	0
5	9,7	3,5	0,10	0
6	10,5	33,2	0,15	1
6	10,5	22,8	0,15	1
6	10,5	15,1	0,10	0

Zone and sampling station: Monfalcone - Z2A

Seagrass: *Zostera noltei*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
6	10,5	7,5	0,10	0
7	8,9	31,1	0,15	1
7	8,9	21,5	0,15	1
7	8,9	12,7	0,10	0
7	8,9	5,3	0,10	0
8	6,9	27,8	0,15	1
8	6,9	19,4	0,10	0
8	6,9	7,5	0,10	0
9	8,7	33,2	0,15	1
9	8,7	25,5	0,15	1
9	8,7	15,4	0,10	0
9	8,7	7,1	0,10	0
9	8,7	0,9	0,10	0
10	7,2	29,3	0,15	1
10	7,2	21,1	0,15	1
10	7,2	15,2	0,10	0
10	7,2	8,1	0,10	0
11	8,8	33,7	0,15	1
11	8,8	20,2	0,10	0
11	8,8	12,1	0,10	0
11	8,8	1,9	0,10	0
12	8,1	27,5	0,10	1
12	8,1	18,2	0,10	0
12	8,1	8,2	0,10	0

Zone and sampling station: Monfalcone - Z2A

Seagrass: *Zostera noltei*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
13	7	24,8	0,10	1
13	7	15,8	0,10	0
13	7	7,7	0,10	0
14	8,4	31,2	0,15	1
14	8,4	19,5	0,10	0
14	8,4	10,4	0,10	0
15	6,9	22,4	0,10	0
15	6,9	12,7	0,10	0
15	6,9	5,1	0,10	0
16	10,1	33,5	0,15	1
16	10,1	20,7	0,10	0
16	10,1	12,3	0,10	0
16	10,1	3,1	0,10	0
17	9,1	30,2	0,15	1
17	9,1	20,5	0,10	0
17	9,1	11,7	0,10	0
17	9,1	2,3	0,10	0
18	7,3	25,5	0,10	0
18	7,3	17,2	0,10	0
18	7,3	7,7	0,10	0
19	7,7	28,1	0,15	0
19	7,7	17,3	0,10	0
19	7,7	8,8	0,10	0
20	7,9	29,3	0,15	1

Zone and sampling station: Monfalcone - Z2A

Seagrass: *Zostera noltei* **Page: 4/4**

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
20	7,9	19,9	0,10	0
20	7,9	8,2	0,10	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z2B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	13,5	41	0,35	1
1	13,5	33,5	0,35	1
1	13,5	14,5	0,35	0
1	13,5	2	0,30	0
2	6	42	0,35	1
2	6	29,7	0,35	0
2	6	5,8	0,30	0
3	6,2	28,9	0,30	0
3	6,2	17,4	0,30	0
3	6,2	4,9	0,30	0
4	4,8	20,6	0,30	0
4	4,8	13,3	0,25	0
4	4,8	7	0,25	0
5	5	35,5	0,35	1
5	5	19,5	0,35	0
5	5	9,7	0,30	0
6	8,1	30,8	0,35	1
6	8,1	26,7	0,35	0
7	7	30,9	0,35	1
7	7	25,2	0,35	0
7	7	10,7	0,30	0
8	15	42,3	0,40	2
8	15	41,5	0,40	1
8	15	1,9	0,30	0

Zone and sampling station: Monfalcone - Z2B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
9	11,4	44,4	0,35	0
9	11,4	32,5	0,35	0
9	11,4	26,7	0,30	0
10	9	59,7	0,40	1
10	9	30,2	0,35	0
10	9	28,9	0,35	0
11	6,9	33,2	0,35	1
11	6,9	19,9	0,35	0
11	6,9	2,2	0,30	0
12	7,4	41,2	0,40	1
12	7,4	31,1	0,35	0
12	7,4	5,5	0,30	0
13	8,4	39,9	0,35	1
13	8,4	28,9	0,35	0
13	8,4	7,5	0,30	0
14	10,1	40,2	0,40	1
14	10,1	29,8	0,35	0
14	10,1	7,6	0,30	0
15	5,9	38,7	0,35	1
15	5,9	17,9	0,35	0
15	5,9	6,7	0,30	0
16	12,7	49,7	0,40	1
16	12,7	38,8	0,40	1
16	12,7	22,1	0,35	0

Zone and sampling station: Monfalcone - Z2B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
16	12,7	12,1	0,30	0
17	6,5	32,3	0,35	1
17	6,5	19,9	0,30	0
17	6,5	5,1	0,30	0
18	7,4	29,1	0,30	0
18	7,4	20,3	0,30	0
19	8,8	37,5	0,35	1
19	8,8	23,9	0,30	0
19	8,8	9,9	0,30	0
20	7,2	35,3	0,35	1
20	7,2	19,9	0,30	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z2C

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	10,1	49,5	0,40	2
1	10,1	32,6	0,40	1
1	10,1	13,2	0,35	0
2	9,9	43,1	0,40	1
2	9,9	30,1	0,40	1
2	9,9	18,8	0,35	0
3	11,2	49,8	0,45	2
3	11,2	37,5	0,40	1
3	11,2	21,1	0,35	0
4	10,5	44,1	0,45	1
4	10,5	30,1	0,40	1
4	10,5	10,8	0,35	0
5	11,1	45,5	0,45	1
5	11,1	31,2	0,40	1
6	12	53,2	0,45	2
6	12	40,3	0,45	1
6	12	22,8	0,40	0
7	10,9	55,5	0,45	2
7	10,9	42,8	0,45	1
7	10,9	31,1	0,40	0
7	10	18,3	0,35	0
8	10,9	45,8	0,45	1
8	10,9	33,6	0,40	1
8	10,9	13,2	0,35	0

Zone and sampling station: Monfalcone - Z2C

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
9	9,8	48,9	0,45	1
9	9,8	38,7	0,40	1
9	9,8	20,1	0,35	0
10	10,7	50,2	0,45	1
10	10,7	40,3	0,40	1
10	10,7	19,5	0,35	0
11	10,5	51,1	0,45	1
11	10,5	33,9	0,40	1
12	11,8	59,8	0,45	2
12	11,8	46,2	0,45	1
12	11,8	29,3	0,35	0
12	11,8	11,8	0,35	0
13	10,4	49	0,45	1
13	10,4	33,3	0,40	0
14	10,8	53,4	0,45	1
14	10,8	39,5	0,45	1
14	10,8	20,5	0,40	0
15	9,7	60,2	0,45	2
15	9,7	49,5	0,45	1
15	9,7	30,7	0,40	0
16	11,8	63,8	0,45	1
16	11,8	44,7	0,45	1
16	11,8	34	0,40	1
17	12,2	60,8	0,45	2

Zone and sampling station: Monfalcone - Z2C

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
17	12,2	47,4	0,45	1
17	12,2	29,3	0,40	0
18	12	60,4	0,45	2
18	12	51,1	0,45	1
18	12	39,4	0,40	1
18	12	17,5	0,35	0
19	11,4	48,7	0,45	1
19	11,4	31,1	0,40	1
20	9,4	49,5	0,45	1
20	9,4	30,7	0,45	0
20	9,4	17,6	0,40	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z3A

Seagrass: *Zostera marina*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	5,4	17,6	0,50	3
1	5,4	13,9	0,50	2
1	5,4	11,9	0,50	0
1	5,4	10,2	0,45	0
2	5,9	23,5	0,50	2
2	5,9	18,5	0,50	1
2	5,9	16	0,50	0
2	5,9	12,5	0,45	0
3	3,8	11,2	0,40	1
3	3,8	11	0,40	1
3	3,8	10,7	0,40	0
3	3,8	2,3	0,35	0
4	5,2	16	0,50	4
4	5,2	14,8	0,45	2
4	5,2	12,8	0,40	1
4	5,2	10,3	0,40	0
4	5,2	5,5	0,35	0
5	4,3	13	0,50	1
5	4,3	12,4	0,45	0
5	4,3	6,8	0,40	0
6	3,6	13,9	0,35	2
6	3,6	12	0,30	0
6	3,6	10,5	0,30	0
6	3,6	6	0,30	0

Zone and sampling station: Monfalcone - Z3A

Seagrass: *Zostera marina*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
7	6,5	15,6	0,45	2
7	6,5	14,7	0,45	1
7	6,5	12,2	0,40	0
7	6,5	8,1	0,35	0
7	6,5	6,1	0,35	0
8	7,4	18,3	0,45	3
8	7,4	12,3	0,40	1
8	7,4	10,8	0,40	0
8	7,4	10,5	0,40	0
8	7,4	1,8	0,35	0
9	5,4	14	0,40	2
9	5,4	9,7	0,35	0
9	5,4	9,3	0,35	0
9	5,4	5,3	0,35	0
10	4,2	18,3	0,40	4
10	4,2	11,4	0,35	0
10	4,2	10,6	0,35	0
10	4,2	10,3	0,35	0
11	5,7	19,7	0,45	2
11	5,7	15,4	0,40	1
11	5,7	14,9	0,40	0
11	5,7	11,2	0,35	0
11	5,7	2,2	0,35	0
12	6,1	20,7	0,45	1

Zone and sampling station: Monfalcone - Z3A

Seagrass: *Zostera marina*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
12	6,1	15,2	0,40	0
12	6,1	10,8	0,35	0
12	6,1	5,5	0,35	0
13	5,9	22,1	0,45	2
13	5,9	18,8	0,40	1
13	5,9	11,6	0,40	0
13	5,9	10,5	0,35	0
13	5,9	2,1	0,35	0
14	4,9	19,9	0,45	1
14	4,9	16,7	0,40	0
14	4,9	11,3	0,40	0
14	4,9	8,8	0,35	0
15	6,6	28,9	0,50	2
15	6,6	21,2	0,45	1
15	6,6	18,3	0,40	0
15	6,6	11,7	0,40	0
15	6,6	1,2	0,35	0
16	5,1	19,9	0,45	1
16	5,1	17,5	0,40	0
16	5,1	10,5	0,40	0
16	5,1	6,3	0,35	0
17	4,3	16,1	0,45	1
17	4,3	10,2	0,40	0
17	4,3	9,8	0,40	0

Zone and sampling station: Monfalcone - Z3A

Seagrass: *Zostera marina*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
18	4,1	17,6	0,45	1
18	4,1	14,3	0,40	0
18	4,1	11,2	0,40	0
18	4,1	5,2	0,40	0
19	4,4	18,9	0,45	1
19	4,4	15,9	0,40	0
19	4,4	10,5	0,40	0
19	4,4	7,7	0,40	0
20	5,5	21,1	0,50	3
20	5,5	18,7	0,45	2
20	5,5	16,3	0,40	1
20	5,5	10,1	0,40	0
20	5,5	4,1	0,40	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z3B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	5,1	44,5	0,30	1
1	5,1	19,6	0,30	0
2	4,1	15,2	0,30	0
2	4,1	14,3	0,30	0
2	4,1	5,6	0,30	0
3	12	47	0,35	0
3	12	39,2	0,35	0
4	6,1	28,9	0,35	0
4	6,1	19,6	0,30	0
4	6,1	15,7	0,30	0
5	5,5	31,1	0,35	0
5	5,5	19,9	0,30	0
5	5,5	2,2	0,25	0
6	6,6	33,4	0,35	0
6	6,6	20,1	0,35	0
6	6,6	11,1	0,30	0
7	5,8	29,1	0,35	1
7	5,8	21,1	0,30	0
7	5,8	14,1	0,30	0
8	5,1	19,9	0,30	0
8	5,1	11,2	0,30	0
8	5,1	5,2	0,30	0
9	10,1	22,2	0,35	0
9	10,1	14,8	0,30	0

Zone and sampling station: Monfalcone - Z3B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
10	9,8	25,5	0,35	0
10	9,8	15,5	0,30	0
10	9,8	8,8	0,30	0
11	4,8	27,2	0,35	0
11	4,8	18,1	0,30	0
12	7,4	26,3	0,35	0
12	7,4	14,2	0,30	0
13	8,1	31,2	0,35	1
13	8,1	20,4	0,30	0
13	8,1	14,1	0,30	0
14	8,7	38,8	0,35	1
14	8,7	25,1	0,35	0
14	8,7	12,9	0,30	0
15	8,5	39,4	0,35	1
15	8,5	29,2	0,35	0
15	8,5	17,5	0,30	0
15	8,5	2,9	0,30	0
16	5,9	31,1	0,35	0
16	5,9	19,4	0,30	0
17	4,9	24,4	0,35	0
17	4,9	17,1	0,30	0
17	4,9	10,5	0,30	0
18	6,3	29,4	0,35	0
18	6,3	18,8	0,30	0

Zone and sampling station: Monfalcone - Z3B

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
18	6,3	9,9	0,30	0
19	5,8	33,3	0,30	0
19	5,8	20,1	0,30	0
19	5,8	12,4	0,30	0
20	6,1	40,1	0,35	1
20	6,1	29,8	0,35	0

Note: _____

_____

Zone and sampling station: Monfalcone - Z3C

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
1	9,4	40,1	0,40	1
1	9,4	29,9	0,35	0
1	9,4	12,3	0,30	0
2	9,9	45,2	0,40	1
2	9,9	30,8	0,35	0
2	9,9	13,5	0,30	0
3	8,9	39,5	0,35	1
3	8,9	27,5	0,35	0
3	8,9	18,8	0,35	0
4	10,1	41,1	0,40	1
4	10,1	30,7	0,35	1
5	8,8	31,5	0,35	0
5	8,8	19,9	0,35	0
6	11,1	44,1	0,40	1
6	11,1	30,7	0,35	0
6	11,1	19,7	0,35	0
7	10,8	39,9	0,40	1
7	10,8	30,3	0,40	1
7	10,8	19,4	0,35	0
8	9,4	43,8	0,40	1
8	9,4	34,2	0,40	0
8	9,4	25,8	0,35	0
8	9,4	12,7	0,35	0
9	8,4	49,2	0,40	1

Zone and sampling station: Monfalcone - Z3C

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
9	8,4	33,2	0,35	0
9	8,4	19,9	0,35	0
10	7,9	45,6	0,40	1
10	7,9	30,9	0,35	0
10	7,9	15,8	0,35	0
11	11,3	51,1	0,40	1
11	11,3	38,8	0,40	1
11	11,3	20,7	0,35	0
12	10,8	38,9	0,40	1
12	10,8	28,7	0,35	0
12	10,8	11,7	0,35	0
12	10,8	2,3	0,30	0
13	9,3	37,5	0,35	0
13	9,3	22,3	0,35	0
13	9,3	9,3	0,35	0
14	7,4	41,7	0,40	1
14	7,4	29,9	0,35	0
15	6,9	37,4	0,35	0
15	6,9	27,5	0,35	0
16	8,5	44,7	0,40	1
16	8,5	31,2	0,35	0
16	8,5	18,6	0,35	0
17	10,7	48,8	0,40	1
17	10,7	35,5	0,35	0

Zone and sampling station: Monfalcone - Z3C

Seagrass: *Cymodocea nodosa*

	Leaves			
Shoot n.	Leaf sheath (cm)	Length (cm)	Width (cm)	Necrosis (%)
17	10,7	19,7	0,35	0
18	11,5	42,2	0,35	1
18	11,5	32,1	0,35	0
18	11,5	8,9	0,35	0
19	11,8	55,3	0,40	1
19	11,8	41,1	0,40	1
20	9,6	50,3	0,40	1
20	9,6	39,7	0,35	0
20	9,6	18,4	0,35	0

Note: _____

_____

Laboratory Data Sheets

Kornati NP

European Regional Development Fund

Zone and sampling station: Kornati NP - Z1A **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	7,5	0,8	2,5	0					+
1	10,9	0,9	2,5	0					+
1	16,8	0,9	2,5	0					+
1	5,2	0,8	3	0					+
1					3,1	41,8	0,9	0	+
1					3,1	22,5	0,9	0	+
1					3,1	43,9	0,9	10	-
2	5,8	0,9	2,6	0					+
2	8,6	0,9	2,6	0					+
2	26,7	0,9	2,6	0					+
2	18,6	0,9	3,1	0					+
2					2,8	20,4	0,9	20	-
2					2,8	34,9	0,9	30	-
3	4,2	0,9	4,2	0					+
3	7,6	0,9	4	0					+
3	11,7	0,9	3,5	0					+
3					3,1	12,8	0,9	0	+
3					3,1	15,7	0,9	0	+
3					3,1	13,8	0,9	0	+
3					3,1	14,8	0,9	0	+
4	1,5	0,8	1,5	0					+
4	9,5	0,9	2,8	0					+
4	4,5	0,9	4	0					+
4	13,9	0,9	2,5	0					+

Zone and sampling station: Kornati NP - Z1A **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
4					3,1	32,8	0,9	10	+
4					3,1	28,9	0,9	20	+
5	4,2	0,8	4,2	0					+
5	8,2	0,9	3,8	0					+
5	16,9	0,9	3,5	0					+
5					3,2	23,8	0,9	0	+
5					3,2	31,7	0,9	10	+
5					2,9	20,4	0,9	30	-
5					2,9	19,8	0,9	10	+
6	5,5	0,9	3,8	0					+
6	2,4	0,9	2,4	0					+
6	12,8	0,9	3	0					+
6					2,8	36,8	0,9	10	-
6					2,8	29,8	0,9	30	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z1B **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	1,2	0,8	1,2	0					+
1	7,9	0,9	2,4	0					+
1	14,6	0,9	2,4	0					+
1	18,9	0,9	2	0					+
1					2,8	18,9	0,9		+
1					2,8	25,7	0,9	20	-
1					2,8	10,9	0,9	5	+
2	5,2	0,9	2,6	0					+
2	9,8	0,9	2,6	0					+
2	16,8	0,9	2,6	0					+
2					3,2	17,8	0,9	0	+
2					3,2	27,1	0,9	0	+
2					3,4	40,2	0,9	20	-
3	4	0,9	2,2	0					+
3	9,8	0,9	2,9	0					+
3	14,8	0,9	2,2	0					+
3					2,6	51,8	0,9	0	-
3					2,8	43,9	0,9	0	-
4	1,9	0,8	1,9	0					+
4	6,4	0,9	2,8	0					+
4	15,7	0,9	2,8	0					+
4					3,2	47	0,9	0	-
4					3,2	29,5	0,9	0	+
5	3,8	0,9	3	0					

Zone and sampling station: Kornati NP - Z1B **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5	4,1	0,9	3	0					
5	16,8	0,9	2,8	0					
5	7,2	0,9	2,8	0					
5					3,2	18	0,9	20	-
5					3,2	45,2	0,9	0	+
5					3,2	52	0,9	50	-
6	1,8	0,8	1,8	0					+
6	2,9	0,9	2	0					+
6	6,1	0,9	2,7	0					+
6	21,8	0,9	2,8	0					+
6	14,9	0,9	2,8	0					+
6	26,1	0,9	3	0					+
6					3,4	29,5	0,9	0	+
6					3,4	49,8	0,9	10	-
6					3	21,4	0,9	50	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z1C

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	4,2	0,9	2,2	0					
1	9,2	0,9	2,2	0					
1	19,4	0,9	2,2	0					
1					2,1	11,9	0,9	0	+
1					2,5	22,8	0,9	5	-
2	3,2	0,9	3	0					+
2	6,5	0,9	3	0					+
2	13,8	0,9	3	0					+
2					2,5	13,8	0,9	0	+
2					2,5	26,9	0,9	10	-
2					2,5	29,8	0,9	30	-
3	4,5	0,9	1,5	0					+
3	6,8	0,9	1,5	0					+
3	14,9	0,9	1,5	0					+
3					2,4	28,4	0,9	0	+
3					2,4	45,9	0,9	20	-
3					2,4	51,2	0,9	10	+
4	2,5	0,9	2,2	0					+
4	9,8	0,9	2,2	0					+
4	15,8	0,9	2,2	0					+
4					2,9	29,8	0,9	0	+
4					2,9	25,6	0,9	0	-
4					2,9	63,7	0,9	50	+
5	3,5	0,9	3,1	0					+

Zone and sampling station: Kornati NP - Z1C **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5	6,5	0,9	3,1	0					+
5	18,3	0,9	3,1	0					+
5					3,2	16,8	0,9	0	+
5					3,2	23,5	0,9	0	+
5					3,2	48,6	0,9	20	-
6	4,5	0,9	2,9	0					+
6	5,2	0,9	3	0					+
6	16,5	0,9	3	0					+
6					2,8	25,8	0,9	0	+
6					2,8	34,9	0,9	0	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note:

Zone and sampling station: Kornati NP - Z2A **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	2,3	0,8	2,3	0					+
1	7,2	0,8	3,1	0					+
1	15,3	0,9	3	0					+
1					3,2	31,4	0,9	0	+
1					3,2	45,4	0,9	0	+
2	1,8	0,8	1,8	0					+
2	5,5	0,9	2	0					+
2	13,4	0,9	2	0					+
2	22,8	0,9	2	0					+
2					3,8	27,4	0,9	0	+
2					3,8	49,3	0,9	0	+
3					4	52,4	0,9	10	-
3	14	0,8	1,4	0					+
3	8,7	0,9	2	0					+
3					3,1	22,3	0,9	0	+
3					3,2	41,2	0,9	20	-
3					4	61,7	1	10	+
4	2,1	0,9	2,1	0					+
4					4,1	54,8	0,9	0	+
4					4,1	60,3	0,9	0	+
4					4	24,1	1	20	-
5	2,7	0,9	2,7	0					+
5	10,1	0,9	3	0					+
5					3,2	37,4	0,9	0	+

Zone and sampling station: Kornati NP - Z2A **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5					3,2	51,4	0,9	0	+
6	2,9	0,9	2,1						+
6	19,7	0,9	2,5						+
6	22,1	0,9	2,5						+
6				0	2,9	22,8	0,9	0	+
6				0	2,9	36,7	0,9	10	-
6				0	3	55	0,9	0	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z2B **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	1	0,9	1	0					+
1	5,1	0,9	1,5	0					+
1	9,4	0,9	2	0					+
1					4,1	23,1	0,9	0	+
1					4,1	52,4	0,9	0	+
1					4	21,4	0,9	0	+
2	1,4	0,9	1,4	0					+
2	2,2	0,9	2	0					+
2					3,8	18,3	0,9	0	+
2					3,8	10,4	0,9	0	+
2					4	38	0,9	20	-
2					4	53,1	0,9	10	+
3	1,3	0,8	1,3						+
3	2,2	0,8	1,3						+
3	18,7	0,9	1,3						+
3				0	3,2	33	0,9	10	-
4	1,2	0,8	1,2	0					+
4	5,4	0,9	2	0					+
4	18,3	0,9	2	0					+
4	22,1	0,9	2	0					+
4					4,1	52,7	0,9	0	+
4					4,1	66	0,9	0	+
5	2,2	0,8	2,2	0					+
5	5,1	0,9	2	0					+

Zone and sampling station: Kornati NP - Z2B **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5					3,2	65	0,9	0	+
5					3,4	17,8	0,9	20	-
5					3,5	48,1	0,9	0	+
6	1,7	0,9	1,8	0					+
6	3,8	0,9	2	0					+
6					4,1	24,3	0,9	0	+
6					4	66,7	0,9	0	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z2C **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	1,8	0,9	1,8	0					+
1	7,2	0,9	4,1	0					+
1	22,1	0,9	4	0					+
1					2,1	44	0,9	30	-
1					2,2	18,7	0,9	10	-
2	1	0,9	1	0					+
2	5,2	0,9	1,4	0					+
2	1,4	0,9	2,5	0					+
2					3,2	22	0,9	0	+
2					3,2	29	0,9	10	-
2					3,2	57	0,9	10	-
3	7,2	0,9	2,5	0					+
3	16,2	0,9	3	0					+
3	24	0,9	3	0					+
3					3,4	55,1	0,9	10	-
3					3,4	40,9	0,9	10	-
4	1,5	0,8	1,5	0					+
4	6,5	0,9	2,5	0					+
4	13,8	0,9	2,5	0					+
4					2,5	17,8	0,9	0	+
4					2,8	42,9	0,9	5	-
4					2,4	56,4	0,9	0	+
5	3,5	0,9	2,5	0					+
5	7	0,9	2	0					+

Zone and sampling station: Kornati NP - Z2C **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5	13,4	0,9	2	0					+
5					3	43,7	0,9	0	+
5					3	52,8	0,9	0	+
6	3,1	0,9	3,1	0					+
6	8,8	0,9	3	0					+
6	10,2	0,9	3	0					+
6					2,8	37,2	0,9	+	+
6					2,8	22,1	0,9	10	+
6					2,8	51,9	0,9	20	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z3A

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	14,7	0,9	3,5	4					+
1	9,2	0,9	3,5	5					+
1	2,4	0,9	4	1					+
1	3,9	0,9	2,8	0					+
1					2,5	30,3	0,9	20	-
1					3	19,9	0,9	10	+
1					3	28,7	0,9	3	+
2	8,7	0,8	3,5	0					+
2	3,6	0,8	3,5	0					+
2					3	42,4	0,8	10	-
2					3	17,9	0,8	2	+
3	4,8	0,8	3,5	0					+
3	1,5	0,8	3,5	0					+
3					3	47,3	0,8	20	+
3					3	9,4	0,8	0	-
3					3	18,7	0,8	0	+
4	3,4	0,8	3,5	0					+
4	8,6	0,8	3,5	0					+
4	0	0,8	3,5	0					+
4					3,2	47,9	0,8	20	-
4					2,7	17,9	0,8	10	+
5	8,9	0,7	3,5	0					+
5	6,6	0,7	3,5	0					+
5	1,8	0,7	3,5	0					+

Zone and sampling station: Kornati NP - Z3A **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5	0	0,7	2,2	0					+
5					3,2	33,9	0,7	10	-
5					3	24,7	0,7	2	+
6	6,4	0,8	3,5	0					+
6	3,6	0,8	3,5	0					+
6	4,5	0,8	3,5	0					-
6	0,2	0,8	3	0					+
6	0,3	0,8	3	0					+
6	2,3	0,8	3,5	0					+
6					3	12,4	0,9	0	+
6					2,8	23,8	0,9	0	+
6					2,8	16,1	0,9	0	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z3B **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	9,6	0,8	3,5	0					+
1	0,9	0,8	3,5	0					+
1	4	0,8	3,5	0					+
1					2,5	28,7	0,8	10	-
1					2,7	30,7	0,8	10	-
1					2,5	16,9	0,8	0	+
2	12,7	0,8	3,5	0					+
2	6,5	0,8	3,5	0					+
2	1,4	0,8	3,5	0					+
2					3,3	28,7	0,8	2	-
2					3,4	32,9	0,9	10	+
2					3	22,3	0,9	0	+
3	10,7	0,8	3,5	0					+
3	4,5	0,8	3,5	0					+
3	0,5	0,8	3,5	0					+
3					2,5	36,5	0,8	25	+
3					2,5	25,7	0,8	15	-
3					2,5	17,4	0,8	2	+
4	8,8	0,8	3	0					+
4	4,1	0,7	3	0					+
4	0,4	0,7	3	0					+
4					2,2	13,5	0,8	4	-
4					2,1	20,3	0,8	10	-
5	17,5	0,8	4	0					+

Zone and sampling station: Kornati NP - Z3B **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5	8,9	0,8	4	0					+
5	3,3	0,8	4	0					+
5	0	0,8	3,6	0					+
5					3,3	35,1	0,8	10	-
5					3,2	30,2	0,8	10	-
5					3	29,9	0,8	5	+
6	22,6	0,9	4	0					+
6	12,8	0,9	4	0					+
6	0,9	0,9	4	0					+
6	6,1	0,9	4	0					+
6	12,5	0,9	4	0					+
6	1,2	0,9	4	0					+
6	5,9	0,9	4	0					+
6					3,5	39,5	0,9	10	-
6					3,8	26,6	0,8	10	-
6					3,2	16,3	0,8	0	+
6					3,5	28,6	0,9	4	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: Kornati NP - Z3C **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
1	8,1	0,8	3,5	0					+
1	3,4	0,8	3,5	0					+
1	0,3	0,8	2,8	0					+
1					2,4	13,3	0,8	0	+
1					2	13,5	0,8	0	+
1					2,2	13,9	0,8	0	+
2	12,6	0,8	3,5	4					+
2	5,4	0,8	3,5	0					+
2	0,9	0,8	3,5	0					+
2					2,3	18,2	0,8	2	+
2					2,3	17,3	0,8	1	+
2					2,3	17,2	0,8	2	+
3	17,1	0,7	3,5	2					+
3	6,4	0,7	3,5	0					+
3	0,9	0,7	3,5	0					+
3					2,4	29,9	0,7	3	-
4	7	0,7	3,5	0					+
4	9,1	0,7	3,5	0					+
4	1,1	0,7	3,5	0					+
4					2,2	19,4	0,7	1	-
5	9,9	0,8	3,5	0					+
5	4,3	0,8	3,5	1					+
5	1,6	0,8	3,5	0					+
5	0	0,8	3,5	0					+

Zone and sampling station: Kornati NP - Z3C **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Grazing
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	si - / no +
5					2,3	25,2	0,8	4	-
5					2,1	21,2	0,8	2	+
6	8,6	0,8	3,5	0					+
6	4,1	0,8	3,5	0					+
6	0,5	0,8	3,5	0					+
6					2,3	21,2	0,8	1	-
6					2,3	24,7	0,8	1	-
6					2,3	16,2	0,8	0	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Interreg Italy - Croatia SASPAS

EUROPEAN UNION

Laboratory Data Sheets

RNP Dune Costiere

European Regional Development Fund

Zone and sampling station: RNP Dune Costiere - Z1A **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	12	0,8	4	0					
1	20,5	0,8	4,5	0					
1					4,5	31,1	0,8	1	+
1					4,5	34,5	0,8	1	+
2	8	0,8	3,5	0					
2					4,2	25,5	0,8	1	+
2					4,2	29,4	0,8	1	+
2					4,2	30,2	0,8	1	-
3	9	0,8	3	0					
3	11,3	0,9	3,5	0					
3					3,5	26,6	0,9	1	+
3					3,8	28	0,9	1	-
3					3,8	31,2	0,9	1	+
4	8	0,8	3,5	0					
4	9	0,8	3,5	0					
4					4	26,5	0,8	0	+
4					4	29,8	0,8	1	+
4					4	30	0,8	1	+
5	6	0,8	3,5	0					
5	9	0,8	3,5	0					
5					3,8	12,5	0,8	1	+
5					3,8	22,3	0,8	1	-
5					3,8	25	0,8	0	+
5					4	29,7	0,8	2	-

Zone and sampling station: RNP Dune Costiere - Z1A **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
6	6,5	0,7	3	0					
6					3,5	17,8	0,8	1	+
6					3,5	20	0,8	0	+
6					4	22,3	0,8	1	+
6					4	27,4	0,8	1	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z1B **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	7,5	0,7	2,8	0					
1	11,2	0,7	3	0					
1					2,8	12,9	0,7	0	+
1					3	13,3	0,8	1	+
1					3	14,2	0,8	1	-
2	8	0,8	3,5	0					
2	11	0,8	3,5	0					
2					3,8	25,4	0,8	1	+
2					3,8	32,6	0,8	1	-
2					3,8	39,5	0,8	1	-
3	8	0,8	4	0					
3					4,2	29,5			
3					4,2	27,6			
3					4,5	28			
3					4,5	30,2			
4	7,5	0,7	4	0					
4	9	0,7	4	0					
4					4,3	25,9	0,8	1	+
4					4,3	33,8	0,8	1	+
4					4,3	38	0,8	1	+
5	4,5	0,8	4	0					
5	6	0,8	4	0					
5					4,4	26,5	0,9	1	+
5					4,4	31,5	0,9	1	-

Zone and sampling station: RNP Dune Costiere - Z1B **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
5					4,4	36,7	0,9	1	-
5					4,5	38	0,9	1	+
6	6	0,8	3,5	0					
6					3,5	29,9	0,8	1	+
6					3,5	32,5	0,8	5	-
6					3,8	34	0,8	1	+
6					4	38,5	0,8	1	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z1C

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	10	0,9	3,8	0					
1	14,5	0,9	4	0					
1					4	18,2	0,9	1	-
1					4	25,5	0,9	1	+
1					4	30,4	0,9	1	+
2	9,5	0,8	3,8	0					
2	11	0,8	4	0					
2					4	22,2	0,8	1	+
2					4	25,3	0,8	1	+
2					4,2	32,4	0,8	1	+
3	8	0,8	3,5	0					
3	9,5	0,8	3,5	0					
3	12	0,8	3,5	0					
3					4,2	29,6	0,8	1	+
3					4,3	35,5	0,8	1	+
3					4	41,5	0,8	1	+
4	7	0,8	3,5	0					
4	11,6	0,8	3,8	0					
4					4	31,2	0,9	5	-
4					4	33,3	0,9	1	+
4					4	34	0,9	1	-
5	12,5	0,9	4	0					
5					4,2	22,2	0,9	5	+
5					4,2	23,6	0,9	5	-

Zone and sampling station: RNP Dune Costiere - Z1C **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
5					4,3	25,9	0,9	1	-
5					4	30	0,9	1	+
6	10	0,7	3,5	0					
6	12,2	0,8	3,5	0					
6					3,8	25,6	0,8	1	+
6					4	29	0,8	5	+
6					3,8	33,4	0,8	1	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z2A **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	6,5	0,7	2,5	0					
1	12,6	0,8	3	0					
1					3	13,1	0,8	1	+
1					3	15,5	0,8	1	+
1					3,2	17,9	0,8	1	+
2	8	0,8	3,3	0					
2	11,5	0,8	3,2	0					
2					3,5	22,2	0,8	5	-
2					3,5	25,6	0,8	5	-
2					3,5	31,2	0,8	5	+
3	9,5	0,8	3,5	0					
3	12,3	0,8	4	0					
3	13	0,8	4	1					
3					4	26,6	0,8	1	+
3					4,2	32,5	0,8	1	-
3					4	39,6	0,8	1	+
4	10	0,7	3,2	0					
4					3,6	21,5	0,8	1	+
4					3,5	26,9	0,8	5	-
4					3,7	32,5	0,8	1	-
4					3,5	37,2	0,8	1	+
5	5	0,7	2,5	0					
5					2,5	19,5	0,8	1	+
5					2,5	22,2	0,8	1	+

Zone and sampling station: RNP Dune Costiere - Z2A **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
5					2,8	25	0,8	1	+
6	9,5	0,8	3	0					
6	11,2	0,8	3	1					
6					3	21,2	0,9	1	-
6					3	22,6	0,9	5	-
6					3,2	29,8	0,9	1	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z2B **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	8	0,8	4	0					
1					4	25,5	0,8	1	+
1					4	29,5	0,8	1	+
1					4,1	30,5	0,8	1	+
2	7,5	0,8	3,5	0					
2					4	29,9	0,9	1	-
2					4,2	32,5	0,9	5	+
2					4	38,4	0,9	1	+
3	4,8	0,7	3,8	0					
3	9,5	0,8	3,8	0					
3					4,2	29,9	0,8	1	+
3					4,4	30,5	0,8	1	+
3					4,3	36,9	0,8	1	+
3					4,2	40,9	0,8	1	+
4	9,5	0,8	4	0					
4					4,2	15,6	0,8	1	+
4					4,3	22,2	0,8	1	+
4					4,3	26,7	0,8	1	+
5	10	0,7	3,5	0					
5	11,5	0,8	3,5	0					
5					4,1	25,5	0,9	1	-
5					4	29,6	0,9	5	+
5					4	35,7	0,9	1	-
6	7,2	0,8	2,9	0					

Zone and sampling station: RNP Dune Costiere - Z2B **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
6					3,2	26,6	0,8	1	-
6					3,2	29,7	0,8	1	-
6					3	34,5	0,8	1	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z2C

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	11	0,8	3,2	0					
1	12,1	0,8	2,9	0					
1					3,5	13,5	0,8	1	+
1					3,5	15,1	0,8	1	+
1					3,5	17,5	0,8	1	+
2	9,8	0,7	3,5	0					
2	12,6	0,8	3,5	0					
2					3,8	22,5	0,8	1	-
2					3,8	26,8	0,8	5	+
2					3,6	29,5	0,8	5	+
2					3,9	32,5	0,8	1	-
3	8,5	0,7	3	0					
3					3,5	20,5	0,8	5	+
3					3,3	25,4	0,8	1	+
3					3,3	26,3	0,8	5	+
3					3,5	29	0,8	1	+
4	7,2	0,8	3,2	0					
4					3,2	19,9	0,8	1	-
4					3,5	23,5	0,8	1	+
4					3,5	28,4	0,8	1	+
5	8,5	0,7	2,9	0					
5	9,2	0,8	3,1	0					
5					3,5	25,5	0,8	1	-
5					3,4	30,1	0,8	5	+

Zone and sampling station: RNP Dune Costiere - Z2C **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
5					3,5	32,3	0,8	1	-
6	7,4	0,8	3	0					
6					3,3	25,6	0,8	1	-
6					3,3	28,7	0,8	1	-
6					3,4	35,9	0,9	1	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z3A

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	8	0,8	3	0					
1	10,5	0,8	3,5	0					
1					3,5	11,9	0,8	0	+
1					3,5	13,2	0,8	1	-
1					3,8	14,5	0,8	1	+
2	7,5	0,8	3,8	0					
2	9,2	0,8	4	0					
2					4,2	17,8	0,8	1	+
2					4,6	22,5	0,8	1	+
2					4,5	27,6	0,8	1	-
2					4,6	34,5	0,8	1	+
3	11,5	0,8	3,5	0					
3					3,5	20,2	0,8	1	-
3					3,8	26,6	0,8	5	-
3					3,5	27,9	0,8	1	+
3					3,5	32,6	0,8	1	+
4	5,5	0,7	3,2	0					
4					3,5	25,5	0,8	1	+
4					3,5	29,8	0,8	1	+
4					3,5	32,6	0,8	1	+
5	9,7	0,8	4,1	0					
5	12,3	0,8	4,2	0					
5					4,5	29,6	0,9	5	-
5					4,5	35,5	0,9	1	+

Zone and sampling station: RNP Dune Costiere - Z3A **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
5					4,5	36,8	0,9	1	+
6	6,3	0,7	3,5	0					
6	11,2	0,8	3,8	0					
6					3,9	22,5	0,8	5	-
6					4	29,6	0,8	5	-
6					4	34,1	0,8	1	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z3B **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	10,5	0,8	2,9	0					
1	14,6	0,8	3	0					
1					3	15	0,8	1	+
1					3,2	20,2	0,8	1	+
1					3	21,6	0,8	1	+
2	12,3	0,8	3,2	0					
2	15,6	0,8	3,4	0					
2					3,5	25,6	0,8	5	-
2					3,6	29,8	0,8	5	-
2					3,5	36,4	0,8	1	+
3	8,5	0,8	4	0					
3	12,9	0,8	4	0					
3					4	23,6	0,8	1	-
3					4,2	29,8	0,8	5	-
3					4	34,6	0,8	1	+
3					4	39,7	0,8	5	-
4	9	0,8	3,9	0					
4					4,2	26,9	0,9	5	-
4					4,3	32,3	0,9	5	-
4					4	39,5	0,9	1	-
4					4,3	42,6	0,9	1	+
5	6,5	0,7	3,8	0					
5	10,8	0,8	4	0					
5					4	26,6	0,9	5	-

Zone and sampling station: RNP Dune Costiere - Z3B **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
5					4	36,4	0,9	1	+
5					4	41,8	0,9	1	+
6	6,5	0,8	3,5	0					
6					3,5	19,5	0,8	1	+
6					3,5	26,8	0,8	1	+
6					3,5	33,3	0,8	1	+

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____

Zone and sampling station: RNP Dune Costiere - Z3C **Page: 1/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
1	8,5	0,7	3	0					
1					3,1	13	0,8	1	+
1					3	14,5	0,8	1	+
1					3,2	17	0,8	1	+
2	9,2	0,8	3,2	0					
2	11,6	0,8	3	0					
2					3,5	20,9	0,8	1	+
2					3,4	25,6	0,8	1	+
2					3,5	26,3	0,8	1	+
3	10	0,7	3,2	0					
3					3,5	15,6	0,8	1	+
3					3,4	23,3	0,8	5	-
3					3,6	25,4	0,8	1	+
3					3,5	32,6	0,8	1	-
4	9,5	0,8	3	0					
4	13,8	0,8	3	0					
4					3,4	27,6	0,9	5	-
4					3,2	31,6	0,9	5	-
5	11,6	0,8	3,8	0					
5	14,5	0,8	3,9	0					
5	16	0,8	3,9	1					
5					4,3	25,5	0,8	5	-
5					4,2	32,6	0,8	1	-
5					4,2	40,6	0,8	5	+

Zone and sampling station: RNP Dune Costiere - Z3C **Page: 2/2**

Seagrass: *Posidonia oceanica*

	Juvenile and intermediate leaves				Adult leaves				Apex
Shoot n.	Length (cm)	Width (cm)	non-ph. (cm) *	Necrosis (%)	Leaf base (cm)	Length (cm)	Width (cm)	Necrosis (%)	+ / - **
6	9,4	0,7	2,9	0					
6					3,1	19,6	0,8	1	-
6					3,1	26,6	0,8	1	-
6					3,2	35,5	0,8	1	+
6					3	36,8	0,8	1	-

(* non-photosynthetic tissue) (** + = intact apex / - = eroded apex)

Note: _____