Exploring the ecological importance of Erimitis marine area

Final Progress Report

iSea

Thessaloniki 2025

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this report.

Image credits

iSea & Dimitris Tosidis

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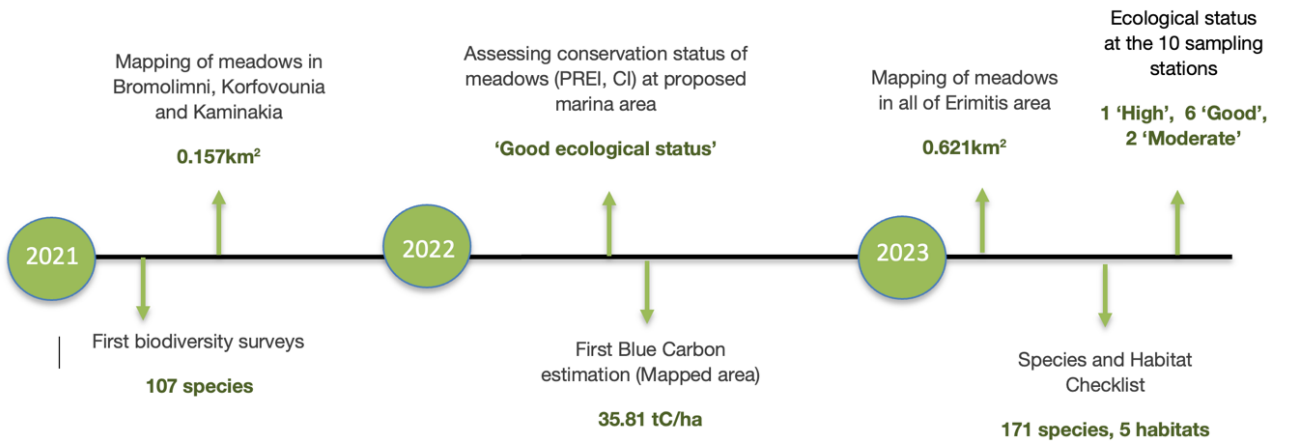
Baseline information

The endemic species *Posidonia oceanica* is an ecologically important seagrass species and one of the most **productive** marine habitats of the overfished and degraded Mediterranean basin. Posidonia meadows are also highly effective **carbon sinks** especially due to their large extent; the more extensive and healthier the seagrass meadows, the higher their potential to remove and store carbon from the atmosphere. Moreover, they help maintain clean and transparent waters. Despite the benefits and services that these ecosystems offer, they are some of the most threatened ecosystems globally.

The Eastern Ionian Sea is the area with the most extended meadows (~440 km^2) in Greece, after the South Aegean Sea[1]. However, in several areas the habitat is still poorly documented, and distribution mapping is limited even within the Natura2000 sites. At the same time, the Eastern Ionian Sea is characterized by high touristic pressure, especially from boats, being among the most popular locations in the Mediterranean for sailing. The vast number of boats has a dramatic impact on the meadows while a variety of other anthropogenic activities leave their mark on the distribution and the health of the meadows in the area, including fish farming, illegal fishing with beach seines, poor sewage treatment and mining. One of the areas that iSea has distinguished in the Eastern Ionian Sea, based on its natural characteristics, is **Erimitis**, located in the Northeast of Corfu between St. Stefanos and Kassiopi villages.

The region of Erimitis includes seven beaches that are almost intact from human disturbances as the beaches can only be approached by trails or from the sea with considerably low tourism in comparison to other places in Corfu and the Ionian. Albeit there is an undergoing development plan for the whole peninsula, which includes the construction of a marina in the bay of Vromolimni and several bungalows on the hill of Erimitis along other supporting constructions (roads, sewage treatment, water distribution, etc.), the area is still largely undisturbed and mostly enjoyed by locals and other nature lovers. A 12-year effort to preserve this natural capital is underway led by the local association of Erimitis Plous, who through the campaign of Save Erimitis and the use of legal means has been putting obstacles to the development plans. The overview actions and results undertaken by iSea over the past three years are presented in the timeline bellow [2, 3]

The activities listed in this year's project work complementary to these findings and will be used as a baseline for a proposal for the inclusion of Erimitis in the Natura2000 network, promote the science based-management of the area and inclusion of bottom-up approaches.



Actions 2024

Aim: Increase the knowledge regarding the marine habitats and species in Erimitis peninsula and collect more details on the ecosystem services of the *P. oceanica* meadows and the threats it faces in the area.

A. Monitoring biodiversity and abundance of species

A.1 Biodiversity and biomass report for fish fauna species recorded in the area using visual census.

Underwater visual census (UVC; Figure 1) is used to assess biodiversity and fish biomass in the present project. Other factors that influence the observed species composition include time of the day and depth of the survey. iSea team planned to visit the area of Erimitis in all four seasons, conducting the surveys at the same time of the day in selected isobaths (<10m, 10-20m, >20m) over Posidonia meadows (n=2), rocky reefs (n=1) and rocky/biogenic reefs (n=1) per season to allow for the standardization of results. The spring sampling was completed on the 24th and the 26th of April 2024 where in total, 4 dives were undertaken (two over Posidonia meadows and two over rocky substrate) at the locations Kapareli (39.792142N, 19.959677E), Vrachi beach (39.786218N, 19.945439E), Arias beach (39.780294N, 19.948995E) and Psilos Ena (39.770148N, 19.959756E) (Figure 2). The summer sampling took place between the 27th and the 30th of August 2024, while the autumn sampling took place between the 1st and 5th of September 2024. The locations of the dives for the summer and autumn surveys were the same as the spring sampling sites with the addition of the northern area of Kapareli and the eastern bay in Arias beach (see Figure 2). Winter surveys have been conducted the 24th and 25th of February 2025 in the areas of Kapareli and Arias beach (see Figure 2). Surveys during the fieldwork of 2021 completed in the area of the proposed marina (Vromolimni) were also included in the analysis.

Figure 1: Visual depiction of the conducted surveys using underwater visual census (UVC).

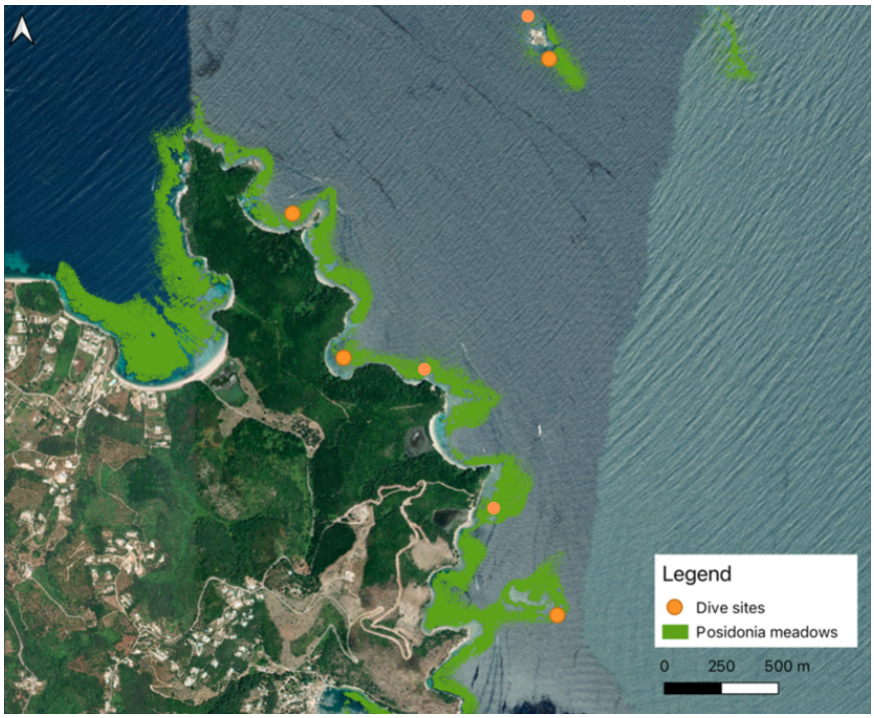


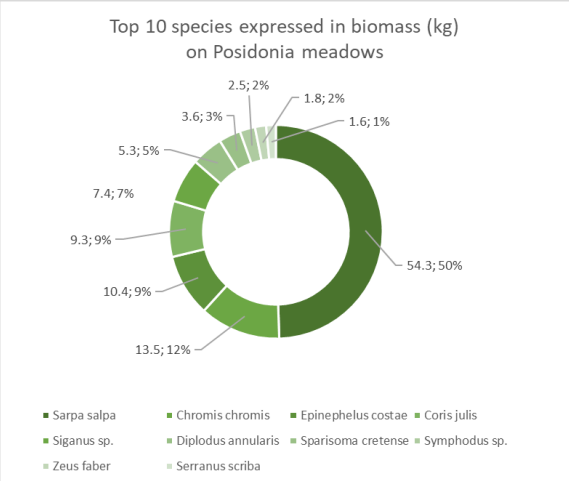
Figure 2: Dive sites for seasonal fishfauna abundance and biomass surveys.

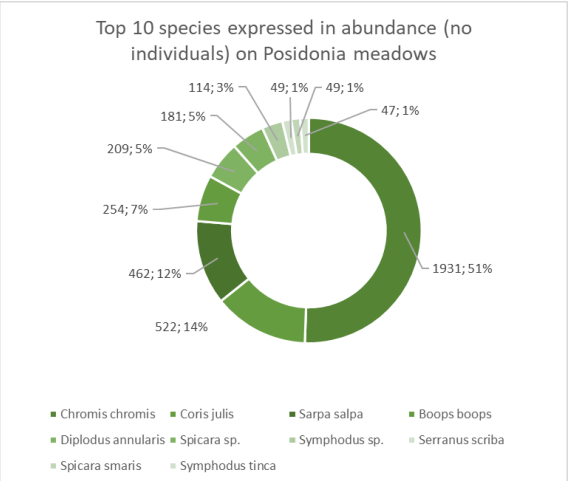
During the surveys, a 25m long (5m wide) transect was performed in different depths, ranging from five to more than 20 meters. Habitat affiliation was taken into consideration for the assessment of the ichthyofauna on Posidonia meadows and rocky reefs. This included taking notes on the length of the species observed, along with identifying the species and recording number of individuals observed. For the estimation of the biomass, the equation of length-weight ($W=aL^b$) was utilized, determining the weight of the species recorded in grams. From the above-mentioned equation, the constant parameters of "a" and "b" were derived from the online database Fishbase (version 06/2024), and from published bibliography.

The bootstrap methodology was followed, which creates a distribution of randomised series of hypothetic data based on the existing data collected in the fieldwork. The mean values were then exhibited along with the standard deviation and confidence intervals of the 97.5th and 2.5th percentile.

In total 140 transects were conducted, where 48 were performed on rocky reefs (including biogenic reefs) and 92 on Posidonia meadows, out of which, six were performed in 2021 in the proposed marina site (Vromolimni). The total species observed were 48, of which 40 species were identified on the level of the species, seven on a genus level and one on a family level. Specifically, over Posidonia, 42 species were observed (35 identified on a species level), with the most common species according to their biomass (Figure 3) being *Sarpa salpa, Chromis chromis,* and *Epinephelus costae*, while the most abundant were *Chromis chromis, Coris julis* and *Sarpa salpa*. Regarding rocky reefs, 30 species were observed (25 identified on a species level) with *Sarpa salpa, Chromis chromis* and *Diplodus sargus* exhibiting the highest biomass, whereas *Chromis chromis, Coris julis* and *Oblada melanura* were the most abundant species (Figure 3). As the surveys we conducted though all four season, the biomass, abundance and diversity (number) of species over each habitat differed. Therefore, over Posidonia the highest numbers were exhibited during autumn and the lowest during winter, while over Rocky reefs the highest was exhibited on summer and the lowest on autumn.

The bootstrap analysis showed that the mean biomass (kg/km^2) was estimated higher for rocky reefs, with **22.7 kg/1000m^2**, whereas for Posidonia it reached a value of **10.6 kg/1000m^2** (Figure 4). Furthermore, as expected, rocky reef transects exhibited a higher mean density compared to Posidonia transects.





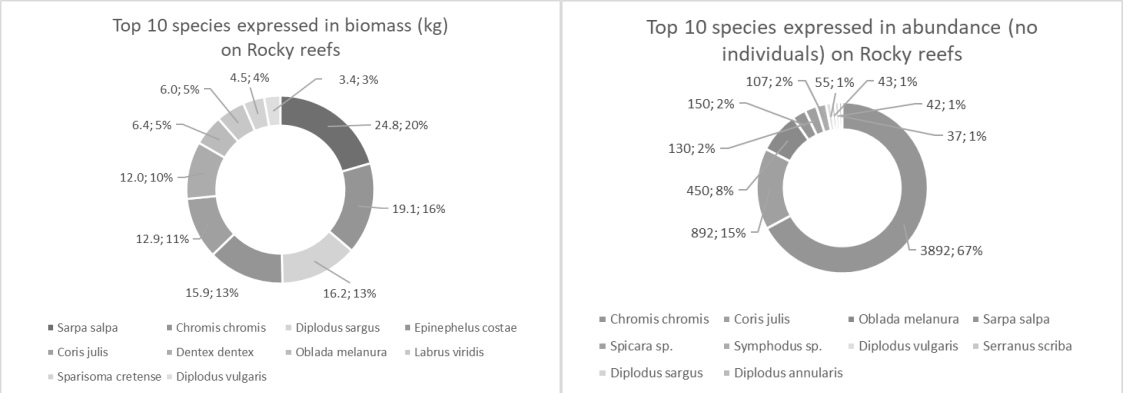


Figure 3. Top 10 species observed expressed in biomass (total biomass; exhibited percentage) and abundance (total number of individuals; exhibited percentage) on Posidonia meadows and Rocky reefs.

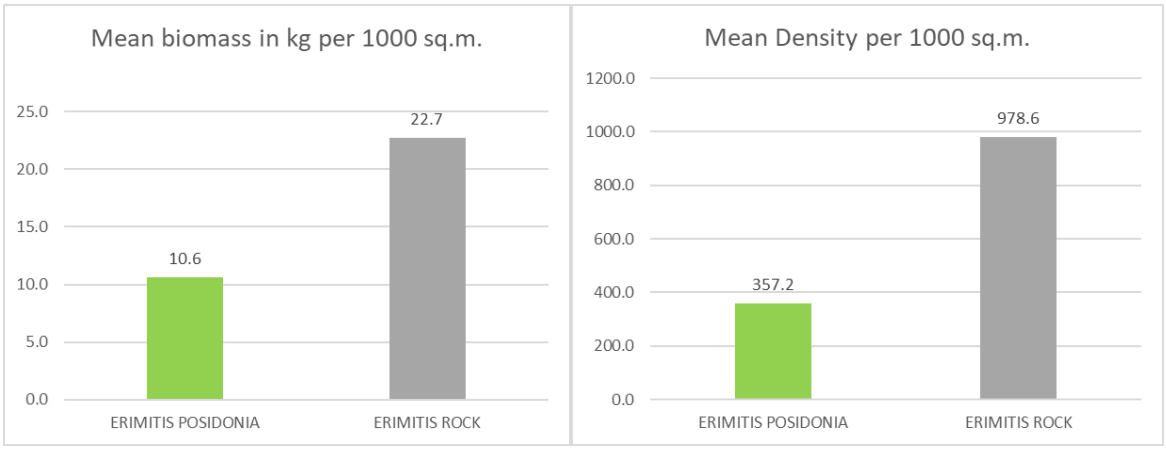


Figure 4. Mean density (abundance; number of individuals) and biomass from transects completed over the habitats of Posidonia meadows and Rocky reefs.

This could be expected as *Posidonia oceanica* acts as a nursery habitat and thus smaller individuals with smaller biomass were observed and possibly missed during the transects. Seasonality plays a significant factor on the composition of the species, as distinct species could be recorded in distinct seasons. In other studies of the Ionian [28], the exhibited mean biomass appears to be higher in the area of Erimitis in both habitats along with the mean density in the of Rocky habitats, although Posidonia meadows exhibited a lower value in the mean density. Among the seasonal analysis, the highest density was observed in autumn for Posidonia and summer for Rocky reefs which is in coordination with the report of Guidetti (2000) [26], while in the area of the Aegean some studies showed higher results in summer [27].

A.2 Further exploratory dives on the presence of priority species and habitats.

During the underwater visual census dives, the presence of other marine species that are of conservation interest and/or subject of regional and international conventions were recorded. New species that had previously not been observed in the area were added to the growing list of marine species developed in 2023 by iSea. The exploration of other key habitats (i.e., coralligenous [4], underwater caves) was completed alongside fieldwork. Specifically, two more caves were explored located around the mainland coast and in Kapareli compiling a total of 4 caves for the area. Vulnerable species (corals and sponges) were observed while one of the small caves was littered by lost fishing lines (Figure 5). A biogenic reef was recorded southeast of Serpa, bellow 20m depth, which was further explored during the ichthyofauna sampling. Pictures from this site were collected to allow for species identification. However, due to the depth, currents, and limited light availability only a small number of photographs could be utilized for identification.

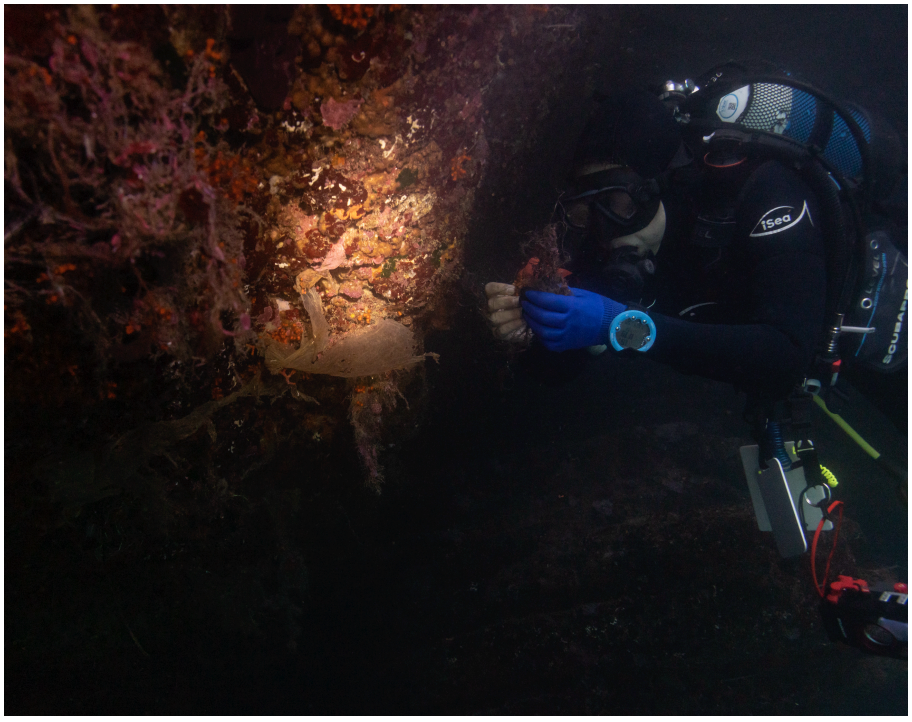


Figure 5: Diver removing lost fishing lines, entangled between corals and sponges, from an underwater cave in Kapareli.

To update the species list recorded in the area, two main sources were used, one was the records of occurrence in 2024 in Erimitis downloaded from iNaturalist (2024) [5], and the second was the species observed, recorded and photographed during the underwater visual census in 2024. All photographs were identified to the lowest taxa possible, using the book "Flora e Fauna del Mediterraneo" [6] as well as the webpage european-marine-life.org [7], and iNaturalist [5]. After the identification, a cross reference was conducted searching for the accepted scientific name, common name, and legal status, using the World Register of Marine Species (WoRMS)[8], Fish Base [9], IUCN database [10] and the European Environment Agency (EUNIS)[11].

We recorded 44 new marine species, of which 37 fauna and 7 flora were identified to species level (see Appendix 1). Regarding the IUCN status in the mediterranean, 1 species is Vulnerable, 12 'Least Concern',1 'Data Deficient' and more than 50% (23 spp.) are Not Evaluated. Of the 44 new species four are protected on a national and/or European level, and/or their exploitation is regulated (CITES). These are: Carpet coral (*Hoplangia durotrix*), Sunset cup coral (*Leptopsammia pruvoti),* Orange candlestick sponge *(Axinella cannabina)* and the common antler sponge *(Axinella polypoides)*. Four new species (*Asparagopsis taxiformis, Halophila stipulacea, Caulerpa cylindracea* and *Pterois miles)* are categorized as invasive species in the Mediterranean.

With the new species added in 2024 to the previous 2023 list in total we have identified 211 marine species (Appendix 1), across more than 120 families. Eight Invasive species and 23 protected species or under regulated exploitation. Six are in a threatened category (VU. EN. CR), one Near Threaten, 80 Least Concern, 107 Not Evaluated and eight Data Deficient. The following pictures (Figure 6) are four of the new 44 species added to the updated list.

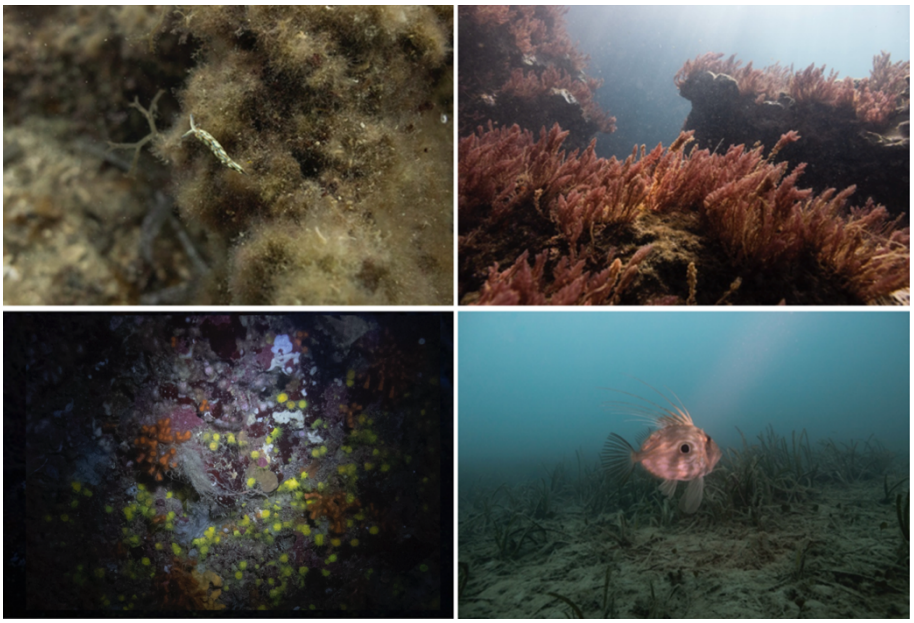


Figure 6: Pictures of new species added in the 2024 updated list. *Thuridilla hopei* (top left), *Asparagopsis taxiformis* (top right), *Leptopsammia pruvoti* (bottom left), *Zeus faber* (bottom right).

B. Posidonia meadows related research

B.1 New estimation of the total blue carbon sequestered in the meadows

In 2023 and 2024, there were four and 31 Blue Carbon samples collected respectively from Posidonia meadows (Appendix 2) considering the new distribution map of *P. oceanica* on a wide scale produced in 2023. The samplings took place in the broader area of Erimitis including Erimitis beaches and bays, as well as Serpa reef area. Emphasis was placed on the proposed marina site (Vromolimni*) in order to estimate the ecological value of the Posidonia meadow lost due to the proposed development, while sampling locations from the broader area were selected to provide a more integrated analysis and better understanding of the area's overall carbon sequestration potential.

Syki bay, located to the west of the village of Kassiopi, where aquaculture facilities are present, was also included in the samplings to assess the content of the organic carbon in the meadow under this specific human pressure and allow for a preliminary comparison. (Figure 7).

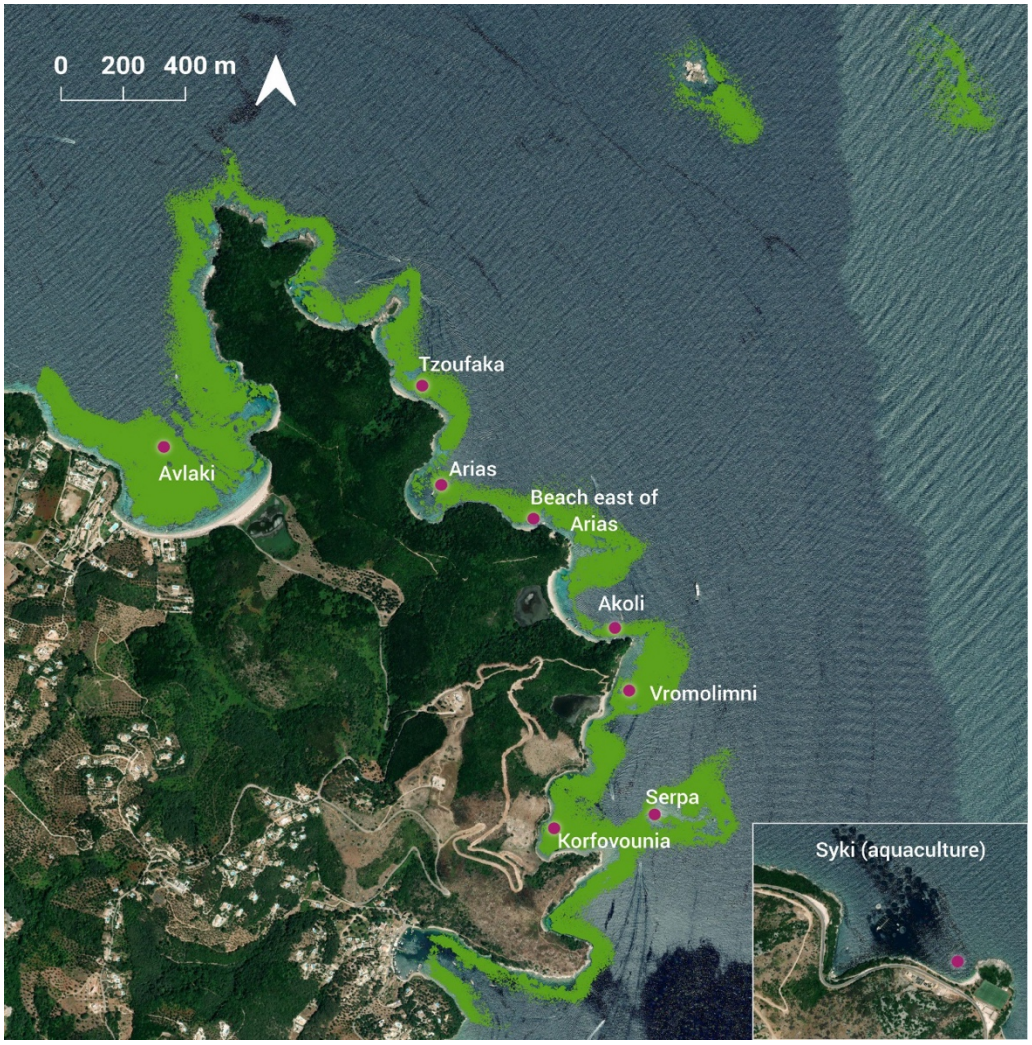


Figure 7: Blue Carbon sampling locations in Erimitis area and in Syki bay (aquaculture) west of the village of Kassiopi.

Sediment samples were taken by manually hammering PVC corer tubes into the sediment while scuba diving, following the methodology protocol described by Howard et al. (2014). Dives were conducted across all Posidonia depth zones, covering the ranges of 5-10m, 10-20m, 20-25m. Sampling points were randomly selected during each dive to avoid spatial bias.

From a total of 35 samples, 33 were analysed, excluding samples #2 and #14 due to their small sediment quantities (less than 30gr). Additionally, one sample from Avlaki taken in 2023 was excluded from the table and analysis due to insufficient field data (location, date, depth). Therefore, no samples of Avlaki were used in the final analysis, due to sample inadequacy. To measure the carbon content of the samples, the Loss on Ignition (LOI) technique was used. LOI (%) determines the mass lost from a sample when heated to high

temperatures as components, such as organic matter are oxidized or volatilized and released as gas. In this case, the focus was specifically on the oxidation of organic carbon. However, the Loss on Ignition (LOI) value reflects the loss of all organic matter, which includes not only carbon but also hydrogen, nitrogen, oxygen, sulphur, and other elements. The estimation of organic carbon content based on LOI was calculated using the relationship Corg (%) = 0.43 * LOI (%)– 0.33, which is specific for seagrass habitats. The organic carbon stock in each sampling area was determined from the "Total Corer Carbon" expressed as Mg C/hectare (for the top 1 m of soil) [12].

The results of the analysis of the 33 samples are presented in detail in Appendix 2 while bellow they are categorised by depth zones as well as per sampled site (see Figure 8 and Figure 9). Considering the representation of the mean organic carbon per depth it appears that carbon increases with depth (Figure 8), that contradicts the studies on the relationship of depth and carbon sequestration in seagrass [13] . However, apart from depth, the authors also refer to the high variability of results related to the habitat matrix (sandy vs rocky substrate) and the depositional environment (coastal vs estuary).

Our results are likely the product of a small number of samples bellow 20m depth (n=2), as the distribution of the meadow in Erimitis is primarily in the shallower depth zone, as well as the lack of representative samples per each studied site that show different characteristics in terms of the soil and matrix environment. This can also be seen from the representation of results in Figure 8, and Table 1, where the mean organic carbon per site per depth zone shows vast differences between the sampled areas. When considering the depth zonation, the highest mean (143.10 tC/ha, n=1) was observed in Tzoufaka at depth of 10-15m, while between 15-20m the mean carbon content was estimated as 84.84 tC/ha (n=1).In Serpa, the mean value at 10-15m was 116.82 tC/ha (n=2), however no deeper samples were collected to allow for depth comparison. Arias bay showed interesting results with highest mean quantities observed in the southeast region of the bay (116.43 tC/ha) based on four samples collected bellow 15m depth. The shallow part of Arias bay resulted in a mean of 51.43 tC/ha based on four samples collected between 10-15m, while similarly, Akoli had a mean of 23.85 tC/ha, based on 1 sample at 14m. These lower values could be a result of the small number of samples for each of the sites, as well as the small sample representation bellow 15m and less than 10m but might also be the cause of the characteristics of the sediment and the increased anchoring activity in both bays during the summer months (iSea Unpublished data). Vromolimni, showed the lowest values from the whole study site, with a mean carbon of 17.39 tC/ha, and the smallest standard deviation (8.53 tC/ha) based on 11 samples (Table 1).

However, given the fact that a) the sampling was restricted to the depth range of 5.6-8.7 and had no representation bellow 10 meters, b) that the sampling was geographically restricted to the proposed marina area due to action B.2, c) the samples collected in Vromolimni had the smallest size (157gr) compared to the other sites combined (435) due to difficulties in corer extraction and d) the results of the blue carbon analysis in 2022 for the area of Vromolimni resulted in the higher mean value of 90.64 tC/ha [14] , the value is likely underestimated. When considering the results jointly with 2022 samples, the mean carbon results in 36.92 tC/ha (35.36tC/ha SD; +/- 9.13 tC/ha) based on 15 samples (depth range of 2022 samples unknown).

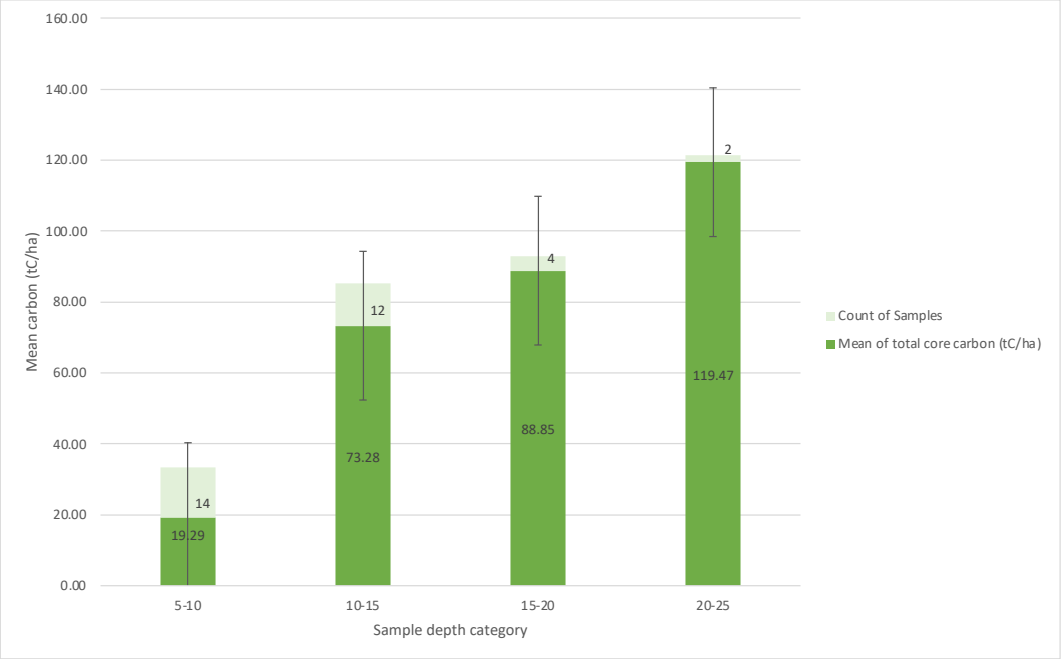


Figure 8: Graphical representation of mean corer carbon content (tC/ha) of the samples (dark green) categorized in four depth zones, with an indication of the sample size (light green).

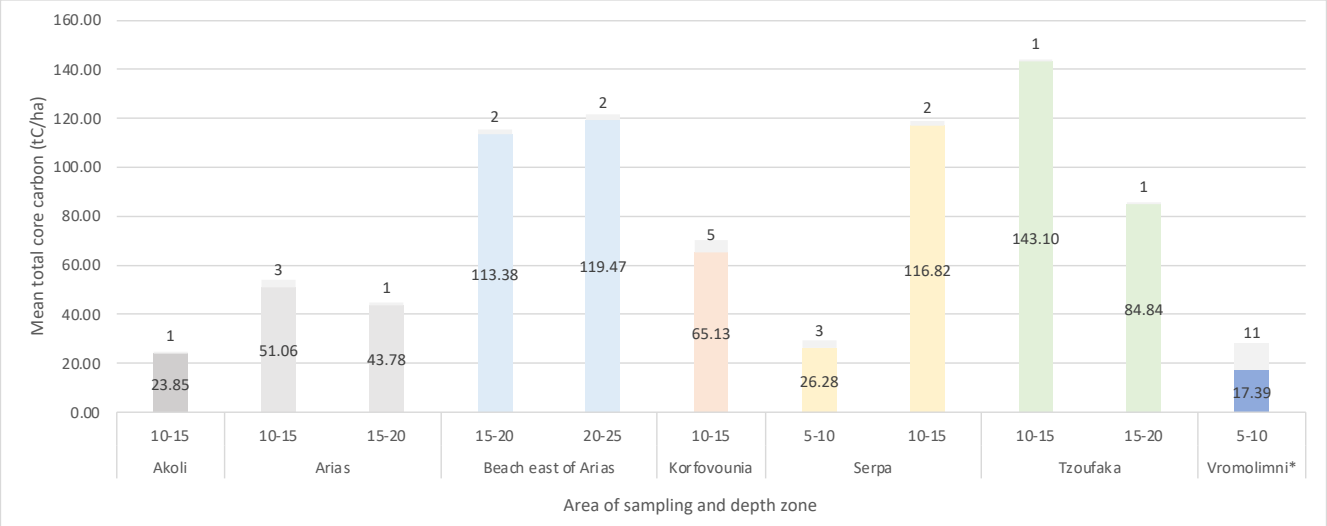


Figure 9: Mean total core carbon (tC/ha; colorful graphical area) and count of samples per depth range (5-10, 10-15, 15-20; grey graphical area) per sampled site.

Table 1: Detailed results of organic carbon content per site along with sampling considerations.

Sampling site	Mean MgC/ha	SD	Number of samples	Min. of Depth (m)	Max. of Depth (m)
Akoli	23.85	n/a	1	14	14
Arias	51.43	33.10	4	10.8	15
Beach east of Arias	116.43	34.28	4	16.2	23
Korfovounia	65.13	40.64	5	10.3	14.9
Serpa	62.50	58.66	5	3.4	14
Syki	24.78	n/a	1	10	10
Tzoufaka	113.97	41.20	2	14.8	15.6
Vromolimni*	17.39	8.53	11	5.6	8.7
Grand Total	53.86	46.74	33	3.4	23

The estimation of the total organic carbon sequestration was based on the instructions of Howard et al. (2014) , while the Syki station was excluded from this calculation as the extrapolation relates to the Posidonia meadow area of Erimitis. The extrapolated total blue carbon stock for the 62.1 ha extent of Posidonia meadows in Erimitis area [3] is approximately **3,384.16 tons of Carbon (tC)** with a standard deviation of 2,932.88 tC and a 95% confidence interval of 2,326.75 tC (lower) and 4,441.58 tC (higher). This estimate is based on an average carbon stock of 54.50 tC/ha (+/- 8.35 tC/ha; standard error of mean) with a standard deviation of 47.23 tC/ha for the top 60 cm of soil. This value is lower than the calculation of the 2022 sampling that was undertaken in the proposed marina area which resulted in a mean organic carbon content of 90.64 tC/ha for the top 60cm of soil, based on four corer samples [14]. Despite the difference in results, the 2022 estimation lies within the higher range of the 95% confidence interval of the 2024 results, while the differences could be attributed to the use of different methodology, and the increased number of sample size (four samples in 2022 versus 33 samples in 2024). When comparing to other results in the Ionian, Formicula soil organic carbon sampling has resulted in a mean of 39.88tC/ha which is lower than the estimated mean for Erimitis, however still lies withing the range of estimate when considering the confidence interval [15].

B.2 Supporting Plan Blue for the creation of a high-resolution image of the meadow in Vromolimni

This action relates to collaborating with Plan Blue to further study the Posidonia meadows in the area of Vromolimni using high- resolution hyperspectral seafloor data, by providing a boat and help during fieldwork. This was completed between the 5th and 9th of March 2024 where the team of iSea completed 4 dives (Figure 10) alongside PlanBlue and surveyed 19 quadrats within the Posidonia meadows in Vromolimni proposed marina area. The coordinates of the sampling stations can be seen in Table 2.

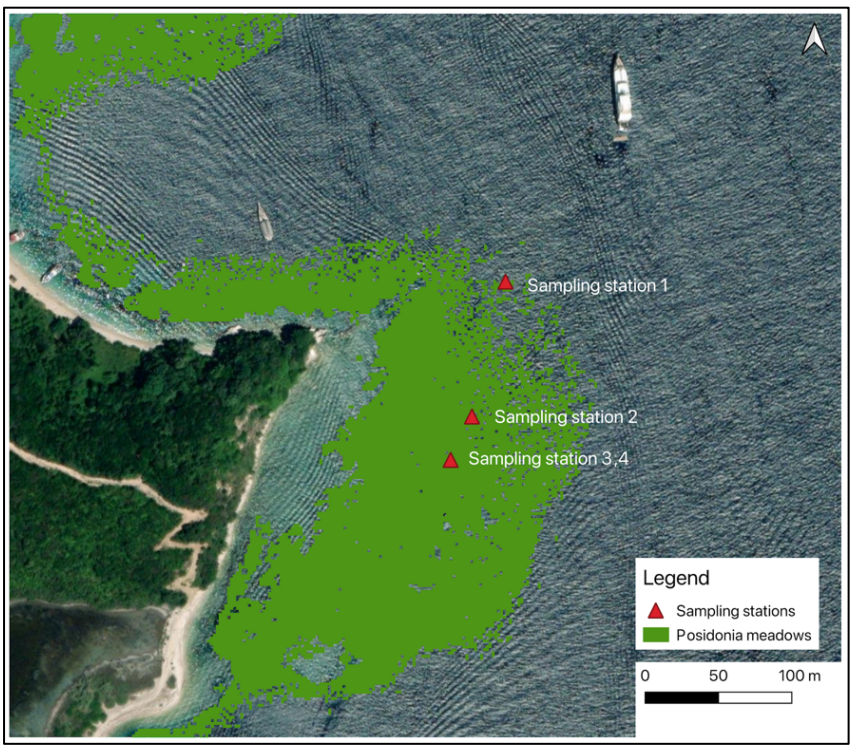


Figure 10: Map of Sampling stations surveyed during March fieldwork with PlanBlue in Vromolimni.

Table 2: Coordinates of the sampling with PlanBlue

Station	Date	Coordinates
Sampling station 1	06/05/24	39.776098961, 19.9581742007
Sampling station 2	07/05/24	39.7752730921, 19.9579065666
Sampling station 3,4	08/05/24	39.7750079725, 19.9577369168

For each quadrat, the number of orthotropic and plagiotropic shoots, depth and shoot burial was recorded, and four orthotropic shoots were collected per quadrat (if present) to be measured to calculate the BiPo index. For sampling station 1, no shoot samples were collected, however blue carbon samples and shoot density measurements were collected and therefore the BiPo index could not be estimated for this station. **Table 3** represents the results of the EQR (Ecological Quality Ratio; [16]. All sampling stations showed a Good ecological status, with the highest status observed in station 4 (EQR=0.753) and the lowest in station 2 (EQR=0.694). The EQR depth and type show the highest value of 1, representing the good characterization of the deep limit that was observed at 42 meters depth with a progressive typology (observed in 2023).

Table 3: Results of the EQR ecological status index (BiPo) at 3 sampling stations in Vromolimni.

Sampling Station	EQR'density	EQR'shoot length	EQR' Depth	EQR'type	EQR	Status
Sampling Station 2	0.504	0.274	1	1	0.694	Good ecological status
Sampling Station 3	0.63	0.313	1	1	0.736	Good ecological status
Sampling Station 4	0.62	0.391	1	1	0.753	Good ecological status

Regarding the additional parameters observed in the leaf's analyses, these included signs of herbivory, epiphytes, cut ends and brown leaf (Table 4). Herbivory was observed in only 5.8% of the analyzed leaves, with the highest percentage observed in Station 4 (10.3%). The percentage of cut leaves was 31.1%, with the highest observed in Station 3 (34%) Finally, over 90% of the leaf has had epiphyte presence, with Station 2 showing the lowest percentage (77.3%) and Station 4 the highest (95.6%). As a report on the epiphyte presence alone cannot give an indication of the physiological status of the plant in terms of pollution, further epiphyte analysis, through the utilization of the PREI index should be completed, that will assess the ratio of the biomass of the leaf compared to the biomass of the epiphyte. Although this was beyond the scope of the current action, the samples have been kept and the PREI analysis will be completed in 2025 to allow for comparison with results from the aquaculture impacted sites, where PREI index has been assessed.

Table 4: Additional parameters observed during the leaf analysis for the three sampling stations.

Parameters	Station 2		Station 3		Station 4		Grand Total	
	no.	%	no.	%	no.	%	no.	%
Epiphytes	17	77.3	90	90	65	95.6	172	90.5
Cut Ends	6	27.3	32	32	12	17.6	50	26.3
Broken Leaf	0	0.0	4	4	1	1.5	5	2.6
Brown Tissue	3	13.6	14	14	4	5.9	21	11.1
HC (Herbivory cut)	0	0	1	1	6	8.8	7	3.7
No cut leaves	16	72.7	66	66	49	72.1	131	68.9
cut leaves total	6	27.3	34	34	19	27.9	59	31.1
No grazing	21	95.5	97	97	61	89.7	179	94.2
Herbivory	1	4.5	3	3	7	10.3	11	5.8
Total leaf's	**22**	**11.6**	**100**	**52.6**	**68**	**35.8**	**190**	**100**

B.3 Report based on the findings on the meadows adjacent to the aquaculture facilities.

This action relates to estimating the impact of aquaculture facilities to adjacent meadows by collecting data related to the health of *P. oceanica* (data to estimate PREI, BiPo), at two sampling stations. The action was completed alongside the seasonal fish fauna surveys during summer and autumn while the area of interest was near the aquaculture facilities of Kassiopi, where two sampling stations were chosen at 0.8 km (SS1) and 1.04 km (SS2) from the facility, located at Syki bay and Imerolias bay accordingly (Figure 11). iSea has been working in the area since 2021 for *Posidonia oceanica,* aiming to define the health status of meadows. In 2023 the estimation of the ecological status of Posidonia was conducted by utilizing two indices, the Biotic index for *Posidonia oceanica* (BiPo; [16]) and the Conservation Index (C.I.;[17]) for 9 different sampling stations. In the current case study, one more index was utilized, namely, the *Posidonia oceanica* Rapid Easy Index (PREI; [18]).

Figure 11: Representation of sampling stations (SS1, SS2) regarding the aquaculture facility in Kassiopi.

The data collection was conducted in August from 30/8 to 31/8/24. Following the protocol of the sampling [19], a central point was determined as the start of the four transects of 25m, conducted in opposite direction, creating a cross-like shape. The transects were completed

using a measuring tape in order to note the coverage of the meadow and change in habitat to the nearest cm. In the surrounding area five quadrats of 40x40cm (divided in four equal sub quadrats; 20x20cm; [20]), were used to count the shoot density, percentage of plagiotropic rhizomes and from each sub-quadrat an orthotropic shoot (N=20) was collected for further phenological analysis. The deep limit of the meadow along with its typology was also recorded for the estimation of the indices. The BiPo and PREI indices are used to evaluate the meadow's ecological status in accordance with Water Framework Directive (WFD), using metrics such as shoot density, the shoot leaf surface, shoot length, the deep limit of the meadow and its typology. The PREI index also utilizes an additional descriptor, the ratio of the epiphyte biomass to the leaf biomass. The third index, CI, is an ecological index which assesses the status of the habitat considering the continuity of the meadow and the ratio between the percentage of the coverage of the live meadow against the coverage of the matte morte (dead meadow) (Table 5). Along with the indices, some additional parameters were calculated based on the phenological analysis and field observations, such as the foliar surface, photosynthetic foliar surface, and rhizome stripping (burial) length for each sampling station, accompanied by with the percentage of matte morte (dead Posidonia), grazing signs, broken leaves plagiotropic and coefficient A (cut end of the leaf) (Table 6).

Both stations according to CI have shown a high state of conservation, indicating meadows with no matte morte noted. BiPo and PREI indices indicated different results, with BiPo leading to better results, "Good" and "Moderate" ecological status for sampling station 1 and 2 accordingly. Conversely, PREI, being more susceptible to water quality, indicated a "Moderate" and "Poor" ecological status for station 2 (Table 5). Sampling station 1 exhibited better status with the mean leaf surface and the 2. A lot of plagiotropic rhizomes were observed in station 1 reaching up to almost 71%, whereas in station 2 only 16%. Both stations exhibited similar burial conditions. The ratio between the biomass of epiphytes growing on leaves and the biomass of leaves has been calculated for both adults and intermediate leaves where epiphytes were observed. The mean biomass ratio for station 1 (N=75 leaves) was lower than station 2 (N=44 leaves), even though on station 1 more leaves were colonized by epiphytes.

Another key factor for the Posidonia is how dense a meadow is. The density of a meadow and its bathymetry are negatively correlated, as the density of the meadow decreases as depth increases. According to Pergent-Martini et al. (2005), all the density values recorded at the two sampling stations ranged from bad to moderate status for the corresponding depth. In Erimitis, the Posidonia meadows identified according to the BiPo index, have displayed a EQR status of "Good Ecological Status" primarily, and a "Moderate" for areas where human related impacts have been observed such as pollution, degradation due to port facilities, and other such impacts [3] . In the current study, a "Moderate Ecological Status" was the outcome for station 2 where the *Posidonia oceanica* meadows were more affected, something that could be related to the currents that seem to lead the effluents of the facility into the bay (LEK- Local Ecological Knowledge source, 2024). The PREI index resulted in the lowest EQR status for both stations, with station 2 exhibiting the lowest value, a "Poor" ecological status. This index utilizes epiphytic growth as a sign of poor water quality. In

conditions where nutrient enrichment is observed, the load of epiphytes increases [15,16,17], especially near fish farm [24]. Fish farms can have a wide range of impact on Posidonia meadows, while studies show that effects can be seen as far as 3 km away from the aquaculture facilities [25].

Table 5: Status of each sampling station according to the three indices used.

Sampling stations	EQR value	BiPo Status	EQR value	PREI	CI value	CI Status
SS1	0.557	Good Ecological Status	0.437	Moderate Ecological Status	1	High State of Conservation
SS2	0.411	Moderate Ecological Status	0.322	Poor Ecological Status	1	High State of Conservation

Table 6: Mean values for phenological parameters calculated for each sampling station.

Sampling station	Mean Foliar surface (cm^2)	SD of Mean Foliar surface (cm^2)	Mean Photosynthetic leaf surface (cm^2)	SD of Mean Photosynthetic leaf surface (cm^2)	Grazing signs (%)	Mean Broken Leaves (%)	Mean Coefficient A (%)	Plagiotropic (%)	Matte morte (%)	Mean Rhizome Stripping/ Burial (cm)	Mean Epiphytes Biomass/Leaves Biomass
SS 1	245.9	107.	197.7	88.9	1.5	27.13	3.9	70.9	0	4.4	0.3
SS 2	147.1	102.6	108.5	83.3	2.9	37.67	7.0	16.0	0	3.5	0.6

As an additional action, the findings of this action will be communicated and shared through the creation of a layman's report (in Greek and English). The report was shared in the first months of 2025 to local stakeholders and project partners, to join the growing collection of Layman's reports regarding the impacts of aquaculture on Posidonia meadows in the areas of iSea's work.

C. Updating the inventory of the knowledge

C.1 Update the layman's report on our knowledge so far for the marine environment of Erimitis; it's ecological value and the threats it faces with the results from 2024.

The Laymans report "Inventory of Knowledge, Volume II" represents an update of the "Marine Biodiversity of Erimitis: An Inventory of Knowledge" produced by iSea in 2023 and distributed to local stakeholders. This year's version includes a) *Posidonia oceanica* related research collected in 2024, b) the existence of other habitats and the presence of other marine species with their conservation and legal status (updated from 2023) as well as c) the updated carbon estimation and d) the ichthyofauna results of this report. The final version have been published on the organisations website (in Greek and English) and shared with local stakeholders and partners.

D. Communication

D.1 Communication of the project in Social Media, iSea's website, etc

The deliverables related to this action include the production of one press release for updated Inventory of Knowledge that will be shared with local media, and a communication campaign that includes 10 social media posts about the area's species, importance and threats on SoMe platforms.

For this action, a communication strategy was developed that outlined the goals and approaches used for communication with different target groups of the project. Until now, 8 posts have been created in the context of this project. While 3 additional posts remain and are scheduled for the first months of 2025 with the topics a) Blue carbon estimation and b) the Updated Inventory of Knowledge. Completed post are as follows:

1) 12/03/24 - Results: the production of the 2023 Inventory of Knowledge, presenting the results of the work in 2023 and highlighting the importance of the area.
2) 10/05/24 - Fieldwork: activities and findings of the first fish fauna biodiversity and abundance survey.
3) 20/06/24 - Discussing threats: presenting the invasive flora identified during the fieldwork
4) 22/07/24 - Showcasing biodiversity of the area: presenting the new species of corals and sponges identified during fieldwork.
5) 17/09/24 - Fieldwork: activities completed during September
6) 27/09/24 - Discussing threats: impacts of the aquaculture in the area of Syki and the activities undertaken relevant to assessing this threat
7) 06/11/24 - Showcasing biodiversity of the area: in regard to top predator species
8) 13/11/24 - Discussing threats: presenting more invasive species of the area identified during fieldwork
9) Pending for 2025 - Showcasing the biodiversity of the area: presenting additional species identified.
10) Pending for 2025 - Results: Blue carbon estimation
11) Pending for 2025 - Results: The updated Inventory of Knowledge for Erimitis

The total reach of these posts was estimated as more than 105,000 views through the social media platforms (Facebook, Instagram, LinkedIn, Twitter/X), while the iSea's website total reach was 294,500 with 133 reach for Erimitis page specifically. A detailed communication insights report for the completed posts has been sent along with the present report.

Furthermore, two posters with the results of last year's research in Erimitis were presented at the 5th International Congress on Applied Ichthyology, Oceanography & Aquatic Environment- HydroMediT in Mytilene between the 20th of May and 2nd of June. The posters will be uploaded on Research Gate.

Regarding stakeholder communication, the team met-up with the president of the association Erimitis Plous on a number of occasions during the planned fieldwork visits. In total three in person meetings occurred in Kassiopi, multiple telephone calls and one meeting for the presentation of the project results to representatives of Erimitis Plous.

E. Project Management

E.1 Monitoring the project actions, ensuring high-quality deliverables, and reporting.

A project manager has been assigned to the project who is closely monitoring the projects actions and ensures the timeline, and the actions of the project are being met. While a broader team is involved in the implementation of various actions of the project. The project manager works with the team and coordinates the implementation of the project. It is important to mention that there have been some delays during the implementation of this project specifically these occurred in March when the seasonal fish fauna surveys were postponed to April given the bad weather conditions. Furthermore, for the same reason the dives near the aquaculture facilities were postponed for summer. Finally, the remaining winter ichthyofauna surveys will take place in the first months of 2025.

E.2 Financial monitoring

The project manager, the director and the accountant are following the finances of the project ensuring that the expenses follow the budget. The fieldwork in April was completed with the use of a rental free-of-charge boat that was kindly lent to the team by Filippos Boats company in Kasiopi. All original receipts are kept in iSea's headquarters and copies can be given to the funder upon request.

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Appendices

Appendix 1: Updated marine species list for Erimitis area.

Scientific Name	Common name	IUCN Status	Legal Status	
Animalia				
Mamalia				
Delphinus delphis	Common Dolphin	DD	Directive 92/43/EEC Annex IV, Bern Convention Annex II, Bonn Convention Annex I & II, ACCOBAMS, ASCOBANS, CITES Annex II, Regulation No 1320/2014 Annex A, Barcelona Convention (SPA/BD Protocol) Annex II, Greek Presidential Degree 67/81	10
Monachus monachus	Mediterranean Monk Seal	VU	Directive 92/43/EEC Annex II & IV, Bern Convention Annex II, Bonn Convention (CMS) Annex I & II, MSeal, CITES Annex I, EU No 1320/2014 amending EC No 338/97 Annex A, SPA/BD Protocol Annex II, Greek Presidential Degree 67/81.	9
Tursiops truncatus	Bottlenose dolphin	DD	Directive 92/43/EEC Annex IV, Bern Convention Annex I (Resolution 6) & II, Bonn Convention Annex I & II, ACCOBAMS, ASCOBANS, CITES Annex II, Regulation No 1320/2014 Annex A, Barcelona Convention (SPA/BD Protocol) Annex II, Greek Presidential Degree 67/81	3
Reptilia				
Caretta caretta	Loggerhead Turtle	NE	CITES Annex I, Directive 92/43/EEC Annex II & IV, Bern Convention Annex I (Resolution 6) &II, Bonn Convention Annex I & II, EU Regulation No 1320/2014 Annex A, Barcelona Convention (SPA/BD Protocol) Annex II, OSPAR Convention, Greek Presidential Degree 67/81	4
Chelonia mydas	Green Turtle	NE	CITES Annex I, Directive 92/43/EEC Annex II & IV, Bern Convention Annex I (Resolution 6) &II, Bonn Convention Annex I & II, EU Regulation No 1320/2014 Annex A, Barcelona Convention (SPA/BD Protocol) Annex II, Greek Presidential Degree 67/81	7, 8
Actinopterygii				
Aidablennius sphynx	Blenny Sphinx	LC		2
Anthias anthias	Sea perch	LC		1
Apogon imberbis	Cardinal Fish	LC		2
Argyrosomus regius	Meagre	LC		2
Atherina boyeri	Big-scale Sand Smelt	LC		2
Balistes capriscus	Grey Triggerfish	DD		2
Belone belone	Garpike	LC		2
Boops boops	Bogue	LC		2
Bothus podas	Wide-eyed Flounder	LC		2
Centrolabrus melanocercus	Black-tailed wrasse	LC		11
Chelon labrosus	Thicklip Grey Mullet	LC		2
Chromis chromis	Damselfish	LC		2
Conger conger	Conger	LC		1
Coris julis	Mediterranean Rainbow Wrasse	LC		2
Coryphaena hippurus	Common Dolphinfish	LC		2
Coryphoblennius galerita	Montagu's Blenny	LC		2
Dactylopterus volitans	Flying Gurnard	LC		2
Dentex dentex	Common dentex	VU		11
Dicentrarchus labrax	Capemouth	LC		1
Diplodus annularis	Annular bream	LC		2
Diplodus puntazzo	Sharpsnout Seabream	LC		2
Diplodus sargus	White seabream	NE		2
Diplodus vulgaris	Common Two-banded Seabream	LC		2
Epinephelus costae	Goldblotch grouper	DD		1
Epinephelus marginatus	Dusky Grouper	EN	Bern Convention Annex III, Barcelona Convention (SPA/BD Protocol) Annex I	2

Gobius cobitis	Giant Goby	LC		2
Gobius geniporus	Slender Goby	LC		2
Gobius incognitus	Incognito Goby	NE		2
Gobius luteus	Golden goby	LC		1
Labrus merula	Brown wrasse	LC		1
Labrus mixtus	Cuckoo wrasse	LC		1
Labrus viridis	Green wrasse	VU		1
Lagocephalus sceleratus	Silver Puffer	NE		2
Lepadogaster purpurea	Shore Clingfish	LC		2
Lithognathus mormyrus	Striped Seabream	LC		6
Mugil cephalus	Black true mullet	LC		1
Mullus barbatus barbatus	Red Mullet	LC		2
Mullus surmuletus	Striped Red Mullet	LC		2
Muraena helena	Black Moray	LC		2
Mycteroperca rubra	Mottled Grouper	LC		5
Oblada melanurus	Saddled Seabream	LC		2
Oedalechilus labeo	Boxlip Mullet	LC		2
Pagellus acarne	Axillary Seabream	LC		2
Pagellus erythrinus	Becker	LC		2
Parablennius gattorugine	Tompot Blenny	LC		2
Parablennius sanguinolentus	Rusty Blenny	LC		2
Parablennius zvonimiri	Zvonimir's blenny	NE		2
Pomatomus saltatrix	Bluefish	LC		2
Pseudocaranx dentex	White Trevally	DD		2
Pterois miles	Devil firefish/Lionfish	LC		11
Salaria pavo	Peacock Blenny	LC		2
Sarda sarda	Atlantic bonito	LC		11
Sarpa salpa	Karanteen	LC		2
Sciaena umbra	Brown meagre	NT		6
Scorpaena maderensis	Madeira Rockfish	LC		5
Scorpaena notata	Small red scorpionfish	LC		6
Scorpaena scrofa	Large-scaled scorpion fish	LC		1
Seriola dumerili	Greater amberjack	LC		1
Serranus cabrilla	Comber	LC		1
Serranus scriba	Painted Comber	LC		5
Siganus luridus	Dusky Spinefoot	LC		2
Siganus rivulatus	Marbled spinefoot	LC		11
Siganus sp.				11
Sparideae sp.				11
Sparisoma cretense	Parrotfish	NE	Greek Presidential Degree 67/81	5
Sparus aurata	Gilt-head Seabream	LC		2
Sphyraena viridensis	Yellowmouth Barracuda	LC		2
Spicara maena	Blotched Picarel	LC		11
Spicara Maena	Blotched Picarel	LC		11
Spicara smaris	Picarel	LC		11
Spicara sp.				11
Symphodus mediterraneus	Axillary Wrasse	LC		2
Symphodus melanocercus	Blacktailed Wrasse	LC		6
Symphodus ocellatus	Ocellated Wrasse	LC		2

Symphodus roissali	Five-spotted Wrasse	LC		2
Symphodus rostratus	Pointed-snout Wrasse	LC		2
Symphodus sp.				11
Symphodus tinca	East Atlantic Peacock Wrasse	LC		2
Synodus saurus	Atlantic lizardfish	LC		1
Thalassoma pavo	Ornate Wrasse	LC		2
Trachinotus ovatus	Pompano	LC		2
Trachinus araneus	Spotted Weever	LC		2
Trachinus draco	Greater weever	LC		11
Trachinus sp.				11
Trachipterus trachypterus	Mediterranean Dealfish	DD		2
Trachurus trachurus	Atlantic Horse Mackerel	LC		2
Tripterygion melanurus	Small Triplefin Blenny	LC		6
Tripterygion tripteronotum	Peperoncino	LC		1
Uranoscopus scaber	Atlantic stargazer	LC		1
Xyrichtys novacula	Cleaver wrasse	LC	Greek Presidential Degree 67/81	2
Zeus faber	John Dory	LC		11
Annelida				
Eupolymnia sp.				11
Hermodice carunculata	Bearded Fireworm	NE		1
Protula intestinum	Blood Red Tubeworm	NE		1
Protula tubularia	Smooth Tubeworm	NE		6
Sabella spallanzanii	Mediterranean Fanworm	NE		6
Serpula vermicularis	Serpulid Worm	NE		6
Spirorbis (Spirorbis) spirorbis	Sinistral Spiral Tubeworm	NE		1
Arthropoda				
Maja crispata	Lesser Spider Crab	NE		6
Pachygrapsus marmoratus	Marbled Crab	NE		6
Perforatus perforatus	Barnacle	NE		6
Scyllarides latus	Mediterranean slipper lobster	DD	Directive 92/43/EEC (EU Habitats Directive) Annex V, Bern Convention Annex III	5
Bryozoa				
Electra posidoniae	Neptune Grass Sea Mat	NE		6
Myriapora truncata	False coral	NE		11
Reptadeonella violacea		NE		6
Cnidaria				
Actinia equina	Beadlet anemone	NE		1
Anemonia viridis	Snakelocks anemone	NE		1
Balanophyllia (Balanophyllia) europaea	Tooth coral	LC	CITES Annex II	6
Clavularia crassa		LC		
Condylactis aurantiaca	Golden anemone	LC		11
Hoplangia durotrix	Carpet coral	DD	CITES Appendix II: International trade monitored	11
Leptopsammia pruvoti	Sunset cup coral	NE	CITES Appendix II: International trade monitored	11
Parazoanthus axinellae	Yellow cluster anemone	NE		11
Pennaria disticha	Feather hydroid, christmas tree	NE		11

Thecocaulus sp.		NE		1
Echinodermata				
Antedon mediterranea	Mediterranean feather star	NE		5
Arbacia lixula	Black sea urchin	NE		6
Coscinasterias tenuispina	White sea star	NE		1
Echinaster (Echinaster) sepositus	Red starfish	NE		1
Holothuria forskali	Sea Cucumber	LC		1
Ophidiaster ophidianus	Purple seastar	NE	Bern Convention Annex II, Barcelona Convention (SPA/BD Protocol) Annex II	1
Ophioderma guineense	Brittle Star	NE		1
Paracentrotus lividus	Purple sea urchin	NE	Bern Convention Annex III, Barcelona Convention (SPA/BD Protocol) Annex III	1
Sphaerechinus granularis	Violet sea urchin	NE		1
Mollusca				
Arca noae	Noah's Ark shell	NE		2
Bolinus brandaris	Purple dye murex	NE		11
Callochiton spp.		NE		1
Cerithium nodulosum	Giant knobbed cerith	NE		2
Cerithium vulgatum	Horn Shell	NE		2
Chama gryphoides	Jewel boxes	NE		2
Columbella rustica	Rustic Dove-shell	NE		2
Conus ventricosus	Mediterranean Cone Snail	NE		2
Cratena peregrina	Tricolor nudibranch	NE		11
Diadora spp.				1
Donacilla cornea	Corneous wedge clam	NE		2
Episcomitra cornicula	Little trumpet mitre	NE		2
Felimare picta	Regal Sea Goddess	NE		2
Flabellina affinis	Mediterranean flabellina	NE		11
Glycymeris glycymeris	European Bittersweet Clam	NE		2
Haliotis tuberculata	Greeen Ormer	VU		2
Hexaplex trunculus	Banded murex	NE		6
Lepidochitona cinerea		NE		1
Lithophaga lithophaga	Date Shell	NE	CITES Appendix II: International trade monitored	2
Luria lurida	Cowry	NE		11
Muricidae spp.	Murex Snails			2
Octopus vulgaris	Common Octopus	LC		6
Osilinus turbinatus		NE		1
Ostrea stentina	True Oysters	NE		2
Patella caerulea	Rayed mediterranean limpet	NE		2
Patella caerulea	Mediterranean Limpet	NE		2
Patella rustica	Rustic Limpet	NE		2
Patella vulgata	Common limpet	NE		1
Phorcus spp.				2
Phorcus turbinatus	Turbinate Monodont	NE		2
Pinna nobilis	Fan Mussel	CR	Directive 92/43/EEC (EU Habitats Directive) Annex IV, Barcelona Convention (SPA/BD Protocol) Annex II, Greek Presidential Degree 67/81	2
Pinna rudis	Spiny Fan Mussel	NE	Bern Convention Annex II, Barcelona Convention (SPA/BD Protocol) Annex II	2

Semicassis undulata	Mediterranean bonnet snail	NE		2
Sepia officinalis	European Common Cuttlefish	LC		2
Spondylus gaederopus	European Thorny Oyster	NE		6
Steromphala spp.				2
Thuridilla hopei	Sapsucking slug	NE		11
Tonna galea	Giant Tun Snail	NE	Bern Convention Annex II, Barcelona Convention (SPA/BD Protocol) Annex II	2
Umbraculum umbraculum	Umbrella snail	NE		11
Porifera				
Agelas oroides	Orange elephant ear sponge	NE		11
Aplysina Aerophoba		NE	Barcelona Convention (SPA/BD Protocol) Annex II	1
Axinella cannabina	Orange Candlestick Sponge	NE	Barcelona Convention (SPA/BD Protocol) Annex II	11
Axinella polypoides	Common antler sponge	NE	Bern Convention Annex II, Barcelona Convention (SPA/BD Protocol) Annex II	11
Axinella verrucosa	Finger sponge	NE		11
Chondrilla nucula	Potato sponge	NE		6
Chondrosia reniformis		NE		1
Clathrina clathrus	Yellow lattice sponge	NE		11
Cliona celata	Boring sponge	NE		6
Cliona schmidti	Sponge	NE		6
Cliona viridis	Sponge	NE		6
Crambe crambe	Orange-red encrusting sponge	NE		1
Hemimycale columella	Crater sponge	NE		1
Ircinia spp.		NE		1
Ircinia variabilis	Sponge	NE		6
Oscarella lobularis	Bubble oscar sponge	NE		1
Petrosia (Petrosia) ficiformis		NE		1
Sarcotragus spinosulus	Black Leather Sponge	NE		6
Scalarispongia scalaris	Leather sponge	NE		11
Spirastrella cunctatrix		NE		6
Spongia (Spongia) officinalis	Greek bathing sponge	NE		11
Tunicata				
Aplidium tabarquensis		NE		11
Halocynthia papillosa	Tunicates	NE		1
Plantae				
Chlorophyta				
Acetabularia acetabulum	Mermaid's wine glass	NE		2
Caulerpa cylindracea		NE		11
Codium bursa	Basquet beret	NE		1
Codium fragile	Dead Man's Fingers	NE		1
Flabellia petiolata	Fan weed	NE		11
Hydrocharitaceae				
Halophila stipulacea	Broadleaf seagrass	LC		11

Rhodophyta				
Asparagopsis taxiformis	Red Sea Plume	NE		11
Corallina officinalis	Common Coral Weed	NE		2
Dasya corymbifera		NE		1
Florideophyceae spp.	Florideophycean Algae			2
Galaxaura rugosa		NE		2
Jania rubens	Fine coral moss	NE		1
Liagora ceranoides		NE		2
Liagora viscida		NE		2
Lithophyllum incrustans		NE		1
Lithophyllum sp.				11
Peyssonnelia spp.				2
Peyssonnelia squamaria		NE		11
Tricleocarpa fragilis		NE		2
Tracheophyta				
Cymodocea nodosa	Little Neptune Grass	NE	Bern Convention Annex I, Barcelona Convention (SPA/BD Protocol) Annex II, EU Regulation (1967/2006/EC)	1
Posidonia oceanica	Neptune Grass	LC	Directive 92/43/EEC (EU Habitats Directive) Annex I, Bern Convention Annex I, Barcelona Convention (SPA/BD Protocol) Annex II, EU Regulation (1967/2006/EC)	5
Chromista				
Ochrophyta				
Colpomenia sinuosa	Oyster thief	NE		1
Cystoceira spp.		NE		1
Dictyota dichotoma	Brown fan weed	NE		11
Padina pavonica	Peacock's tail	NE		2

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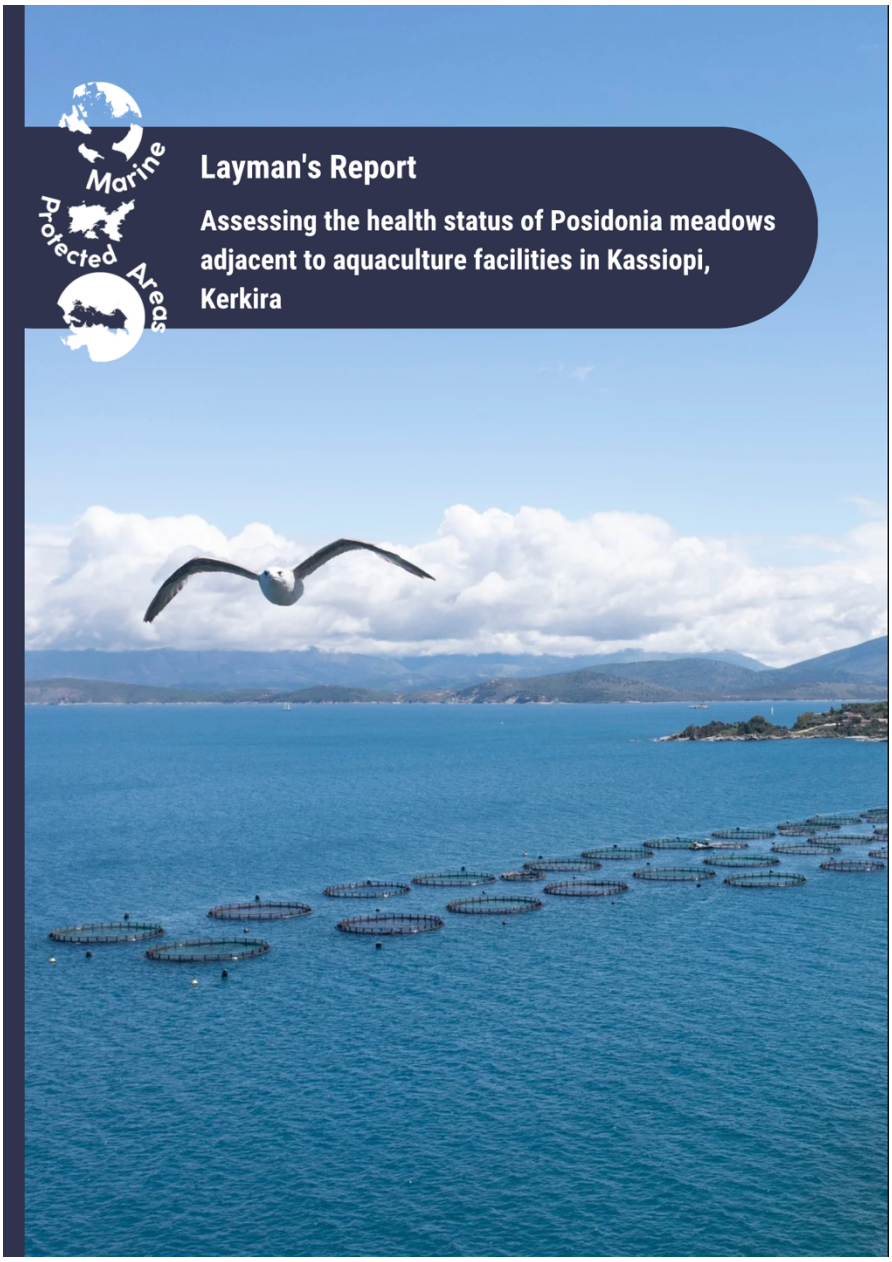
Appendix 4: Preview of first page of Laymans report on the impact of aquaculture on Posidonia meadows in Kassiope, to be finalised and disseminated during 2025.



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