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# Epibenthic Communities on Artificial Reefs in Greece, Mediterranean Sea

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**Abstract:** The marine ecosystems in the Mediterranean are in alarming condition due to the complex and cumulative impacts of anthropogenic activities and natural disturbances. Management, conservation, and restoration of resources in these impacted ecosystems are among the priorities set by Mediterranean countries. Artificial reefs (ARs) are one of the countermeasures widely promoted. The present study describes the hard substrate epibenthic communities found on three ARs (Ierisssos, Kalymnos, and Preveza) located in the Aegean and Ionian Seas (Greece). Samples were collected from the ARs seasonally (four times/year), during 2013 and 2014. Overall, 117 species were identified and a multivariate analysis showed that each area holds a distinct diversity. Serpulid polychaetes dominate Ierissos and Preveza communities, while gastropods were identified as the prevailing taxa in Kalymnos. No seasonal effects were detected, suggesting "stability" and good adaptation of the communities to the local environmental conditions. Salinity was found to affect the community structure. The results of this study illustrate the need for comparative research on ecological processes under contrasting environmental abiotic and biotic local conditions affecting epibenthic communities.

**Keywords:** artificial substrate; colonization; benthic communities; Serpulidae

## 1. Introduction

Artificial reefs (ARs) have become a very popular and important tool for studying the associated ichthyofauna and sessile communities, for recreational fishing, and, more recently, as touristic attractions for divers [1,2]. The first deployments of ARs strongly aimed to increase the associated ichthyofauna for the improvement of commercial fishing [3,4]. However, during the last decade, the studies of ARs have shifted towards a more integrated ecosystem approach (e.g., [5,6]), in order to understand the communities colonizing the ARs, and how to use the gained knowledge for habitat "rehabilitation" and "restoration" [4,7–13].

Identification and quantification of the community is a fundamental step in order to identify patterns related to different environmental factors affecting the organisms' settlement, growth, and survival [14–16]. Sessile marine organisms usually display similar patterns regarding their average abundance or their spatial distribution, which is often correlated with biotic and abiotic parameters [17,18]. The structure of such communities usually depends on spatial heterogeneity, food availability, season, water physical characteristics (e.g., temperature, salinity, and water currents), and disturbance regimes that might occur either due to anthropogenic interventions or natural events such as storms [14–16,18–24]. Another important parameter affecting the community's composition is the intra- and interspecific competition including grazing, herbivory, predation, and overgrowth [16,17,21,22]. Ideally, for the understanding of benthic communities, all the aforementioned parameters should be considered in order to have a clear conclusion. However, not all the aforementioned parameters are examined in this study.

The majority of studies concerning hard bottom communities in the Mediterranean are usually focused on a single taxon or environmental parameter with some exceptions over the last decade [13,15,19,20,25]; hence, it is often difficult to generate general conclusions [15]. The present study examines a wide range of factors potentially affecting the community composition found on the ARs and hard substrata in general. It investigates the species richness and abundance on three ARs in Greece for the years 2013 and 2014, throughout the seasonal cycle and in correlation with a range of selected environmental parameters. Furthermore, as the three ARs share a common substrate (concrete) and similar three-dimensional structure (modules), the research questions were focused on (1) the effect of environmental parameters and (2) the seasonal changes of the epibenthic communities' composition and diversity.

This study aims to describe for the first time the communities present in the three artificial reefs, whilst also providing new information regarding the local fauna. It also examines the correlation of the species composition with the environmental parameters present in each area and how this information can be used for future AR deployment and management in environmentally similar areas.

## 2. Materials and Methods

### 2.1. Study Sites

The three ARs were established at the sublittoral zone in 2005 aiming to increase the local biodiversity. Several hundred concrete blocks and pyramids organized in modules are the main structural feature on the seafloor. The first AR studied herein is located at the Ierissos Gulf (hereafter Ierissos), and is deployed at 10–40 m depth in a semi–enclosed gulf in the eastern side of Chalkidiki Peninsula (Thracian Sea) with an area covering 4.45 $km^2$. The second AR is located in the strait between the islands Kos and Kalymnos at 20–50 m depth (hereafter Kalymnos) with an area covering 9 $km^2$. The third AR is placed at Preveza (hereafter Preveza) close to the town of Parga (Ionian Sea) 3 km north of the Acherontas' river mouth, at 30–45 m depth with an area covering 5.37 $km^2$. Ierissos receives inland freshwater from Strymon and Richios rivers, as well as from local and seasonal streams [26]. Freshwater influxes at Preveza are considered low to moderate while no freshwater input has been recorded in the Kalymnos area.

### 2.2. Environmental Factors

#### 2.2.1. Sea Surface Temperature and Chlorophyll-$\alpha$

Satellite-derived sea surface temperature (SST) and chlorophyll-$\alpha$ (chl-$\alpha$) concentration were determined using a MODerate–resolution Imaging Spectroradiometer (MODIS). For each parameter, a total of 144 images corresponding to a 12-year period (2003–2014) were used. The data was grouped in order to examine their seasonal variation in winter (DJF), spring (MAM), summer (JJA), and autumn (SON). For the calculation of SST and chl-$\alpha$ concentration, radiometric corrections, georeferencing, land mask, and cloud contamination were performed. ArcGIS$^{TM}$ 10.1 software system was used for the processing, displaying, analysis, and quality control of the MODIS data.

#### 2.2.2. In Situ Environmental Parameters

Water physical parameters (e.g., temperature, salinity, density, and chl-$\alpha$) were measured using a Conductivity–Temperature–Depth (CTD) probe manufactured by Seabird (brand name SBE 19).

Measurements were taken throughout the entire water column at 16 stations within each studied area. Concentrations of chl-$\alpha$ were determined by collecting water samples from five depths (surface, 5 m, 10 m, 20 m, and bottom) using a Niskin bottle. For the analysis, 1000 mL of water samples were filtered through 47 mm diameter GF/F glass fiber filters. All filters were placed into 15 mL test tubes, in 10 mL solution of acetone 90% and $MgCO_3$ 10%, and were stored overnight in a dark place at 4 °C. Subsequently, the test tubes were centrifuged at 3000 rpm for 30 min and chl-$\alpha$ determination was achieved following the trichromatic methodology according to Standard Methods (APHA, 1988). The beam attenuation at four wavelengths (750, 664, 647, and 630 nm) for each sample was measured using a HITACHI U-2001 spectrophotometer.

### *2.3. Macrofauna Data Analysis*

#### 2.3.1. Macrofauna Collection

Macrofauna samples were collected seasonally during the years 2013 and 2014 from all three ARs. The samples were collected randomly by divers using a quadrat sampler (20 cm × 20 cm) by scraping off the communities growing on the concrete modules. All samples were later sieved (0.5 mm) and preserved in 10% formalin. Macrofauna was counted and identified at the lowest taxonomic level possible using an optical stereoscope. Overall, 3 or 4 replicates (19 samples) were collected from Ierissos, 5 or 6 replicates (31 samples) from Kalymnos, and 3–6 replicates (19 samples) from Preveza.

#### 2.3.2. Community Structure and Diversity

The number of species found in each sample and area was summed up and analyzed with univariate methods using SPSS statistic 22 software. A nonparametric (Mann–Whitney) test was used for pairwise comparisons to examine differences between the examined taxa, the area, the year, and the season. Also, differences in macrofauna abundance were tested by one-way ANOVA after verifying the homogeneity of variances with Levene's test. Biocoenotic methods such as DIVERSE were employed to analyze the data using the PRIMER 6 package [27]. The Frequency ($F$) and diversity indices such as Shannon–Wiener ($H'$) and Pielou's evenness ($J'$) based on $\log_2$ were calculated.

#### 2.3.3. Analysis of Similarity

SIMPER analysis was applied to identify the contribution (%) of each species to the overall dissimilarity within and between sites and years. The data was also analyzed for abundance using cluster and multidimensional scaling (MDS) techniques, based on Bray–Curtis dissimilarity and square root numerical abundances using the PRIMER 6 package [27]. The significance of the multivariate results was assessed using an ANOSIM test. The BIOENV procedure was used to investigate which environmental parameters are related to the biotic pattern observed (MDS plot) and the degree of this relation. The best subset of variables determined by BIOENV was subjected to a constrained type of cluster analysis (LINKTREE) on the same set of faunal resemblance in order to describe the biological–environment correlation. The dendrogram was constructed by successive binary partitions of biotic community samples.

## 3. Results

### *3.1. Environmental Factors*

#### 3.1.1. Sea Surface Temperature and Chl-$\alpha$

The relatively long record (12 years) of satellite-derived data allows for the visualization of the SST and chl-$\alpha$ seasonal pattern of the study sites. The spatial variation of SST is clearly evident (Figure 1). Ierissos is on average exposed to lower water temperature. The seasonal minimum occurs in winter (mean ± SD, 13.4 ± 1.5 °C, range = 10.3 to 16.8 °C), and is about three to four degrees lower compared to Preveza and Kalymnos (16 and 17.7 °C, respectively). The only season in which the thermal conditions are comparable among the three ARs is the summer period with an average of 24–26 °C (Figure 1c). Preveza AR is the only one to be exposed to relatively warmer conditions throughout the seasonal cycle with the mean ranging between 18 °C in the winter and 26 °C in the summer (Figure 1).

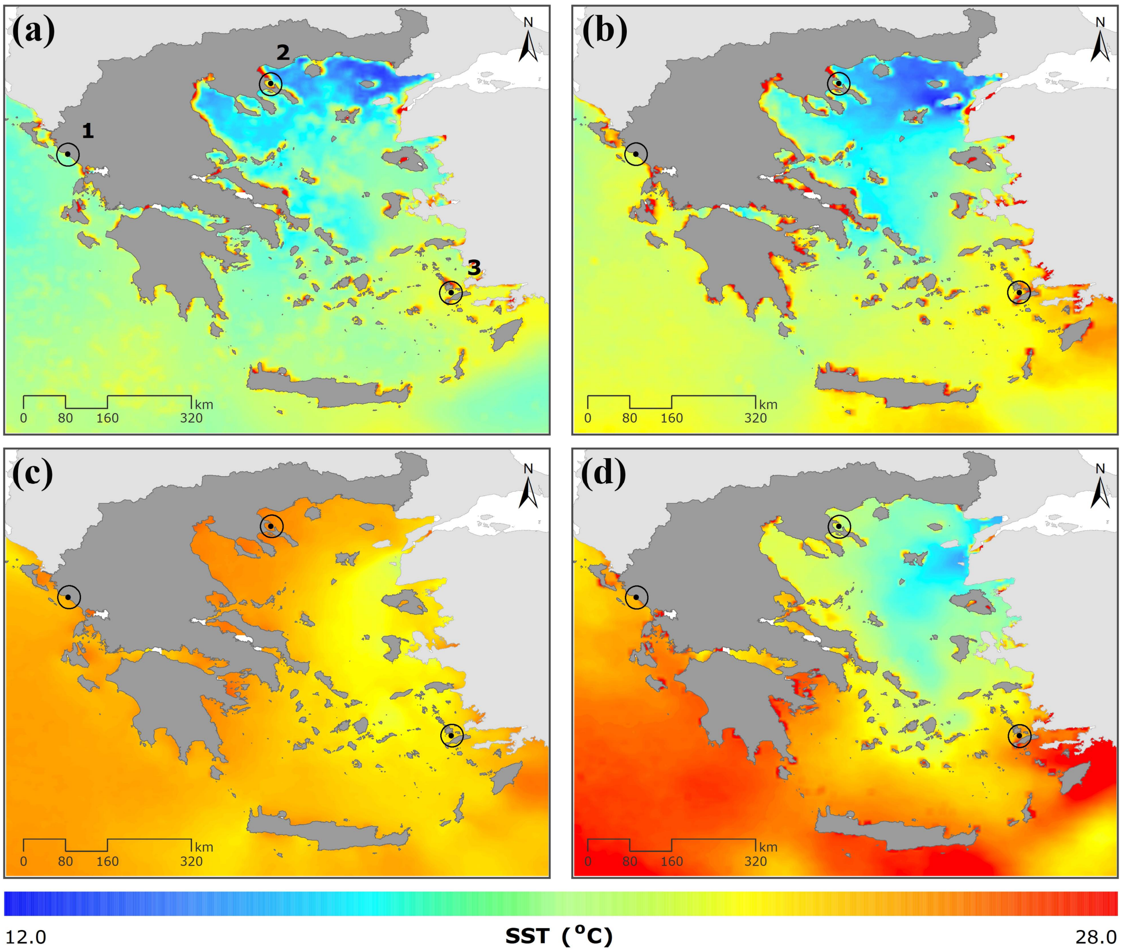


**Figure 1.** Satellite-derived sea surface temperature seasonal mean (SST) (2003–2014) and location of the artificial reefs. (**a**) Winter; (**b**) Spring; (**c**) Summer; (**d**) Autumn; 1: Preveza; 2: Ierissos; 3: Kalymnos.

The seasonal variations of chl-*α* concentration indicate that Ierissos is under higher chl-*α* concentration throughout the entire seasonal cycle compared to the other AR (Figure 2). The highest concentrations in Ierissos are found in spring (mean ± SD, 0.99 ± 0.01 mg/m$^3$, range = 0.23 to 2.56 mg/m$^3$) while the lowest are in summer (0.30 ± 0.16 mg/m$^3$, range = 0.14 to 0.95 mg/m$^3$). In contrast, Preveza and Kalymnos show consistently lower seasonal chl-*α* concentrations. The maximum mean concentrations found during winter at Preveza and Kalymnos (0.39 ± 0.11 mg/m$^3$ and 0.26 ± 0.04 mg/m$^3$, respectively) are still low when compared to that at Ierissos.

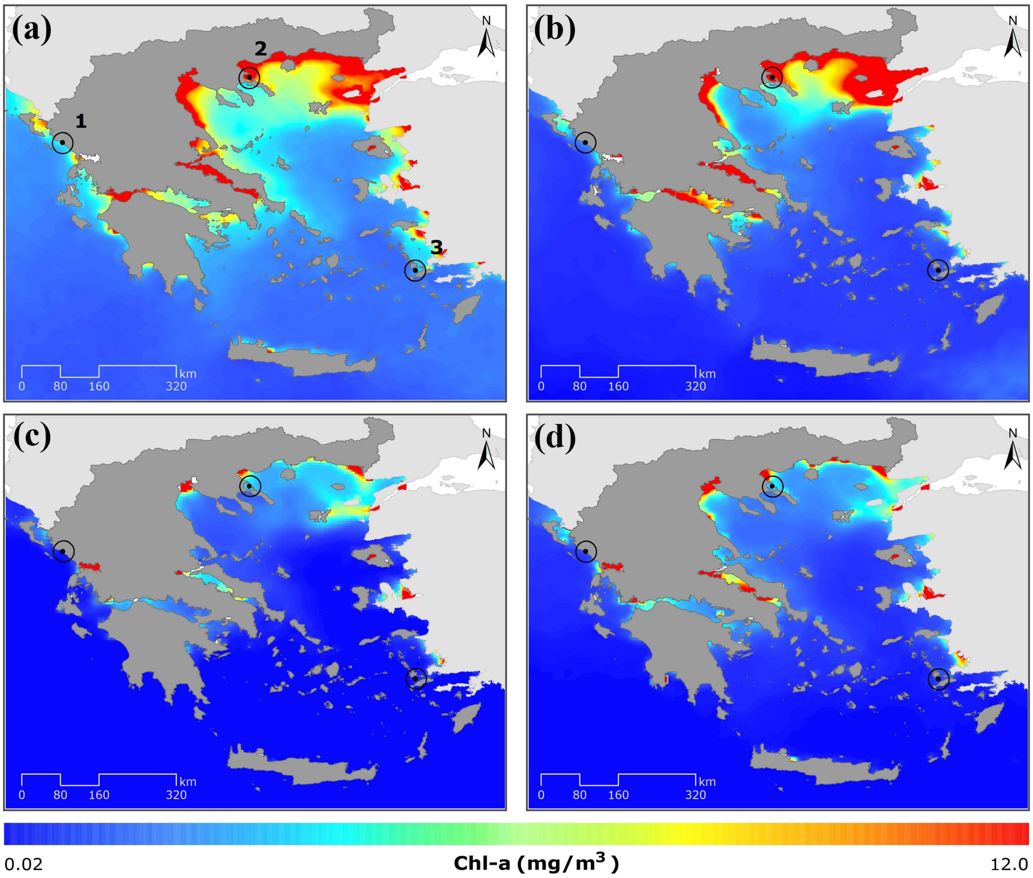


**Figure 2.** Satellite-derived chlorophyll-*α* (chl-*α*) seasonal means (2003–2014) and location of the artificial reefs. (**a**) Winter; (**b**) Spring; (**c**) Summer; (**d**) Autumn; 1: Preveza; 2: Ierissos; 3: Kalymnos.

#### 3.1.2. In Situ Environmental Parameters

The average values for temperature, salinity, water density, and chl-*α* concentration regarding all study sites are given in the supplementary material (Table S1).

The results clearly show that Ierissos is subjected to greater seasonal variations compared to Preveza and especially Kalymnos (Figure 3). Ierissos receives an excessive amount of continental freshwater and the less saline Black Sea water. Preveza is only partly influenced by freshwater influx, and it is strongly related to the minimum surface salinity recorded during spring 2013, 2014. Quite the opposite, Kalymnos is characterized by high salinity as it only receives the saline and warmer Levantine water and the Water-Modified Atlantic water (MAW). More specifically, the MAW is a type of water commonly found in the Eastern Mediterranean. It originates from Atlantic waters entering the Mediterranean from the Strait of Gibraltar and is transported to the Ionian Sea via the Atlantic–Ionian current. Consequently, a strong halocline characterizes Ierissos throughout the year while it is very weak in Preveza and completely absent in Kalymnos.

The highest chl-*α* concentrations in Ierissos during spring 2013, 2014 are highly associated with the influx of freshwater. It is noteworthy that the chl-*α* concentration in Kalymnos during winter 2014 was recorded closed to 0 (Figure 3).

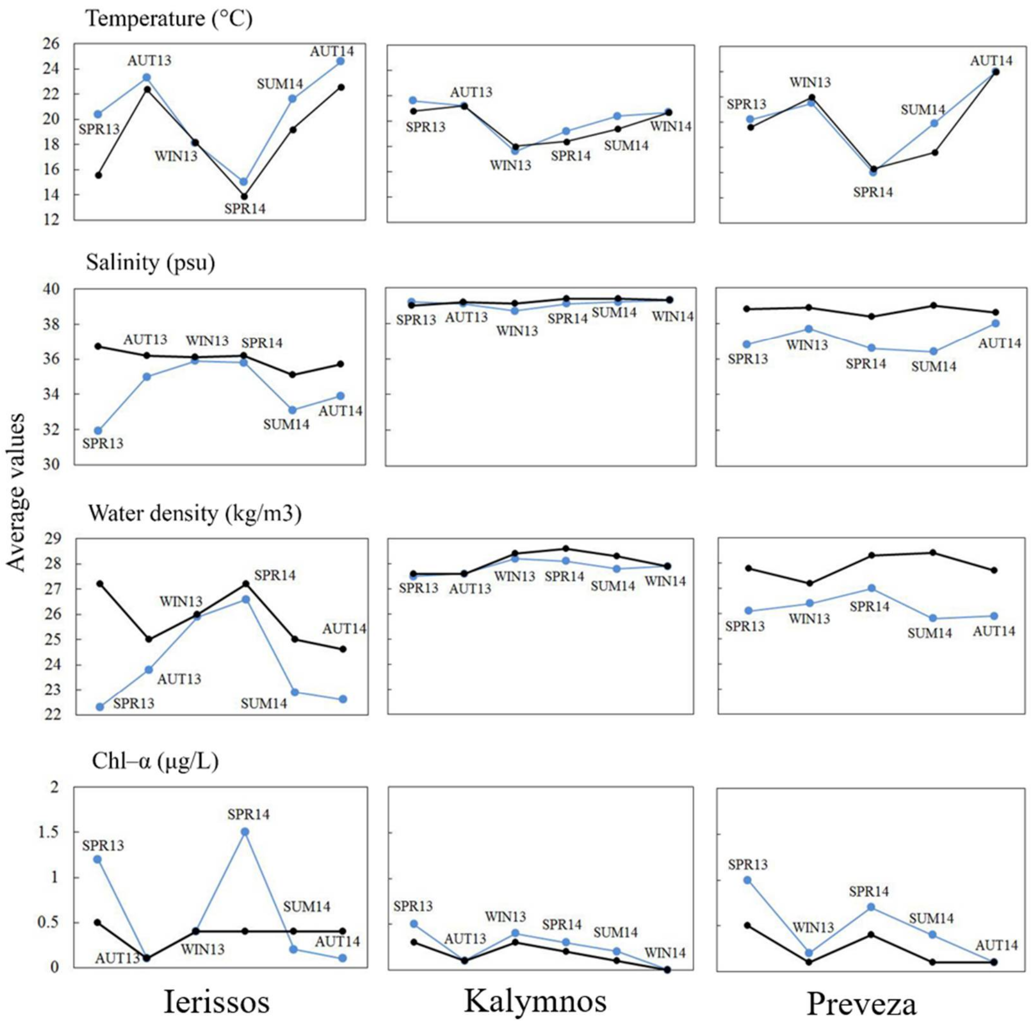


**Figure 3.** In situ environmental parameters for the three artificial reefs. Spring: SRR; Summer: SUM; Autumn: AUT; Winter: WIN; 13 and 14 indicate the years 2013 and 2014 respectively; Blue: Surface layer data; Black: Water column data.

## *3.2. Macrofauna Data Analysis*

### 3.2.1. Community Structure

Kalymnos is the most diverse AR with 80 species, followed by Ierissos with 69 and Preveza with 43 species (Table S2). In all areas the dominant major taxonomic groups were gastropods (43%), followed by Annelida (37%), bivalves (8.9%), and Arthropoda (6.8%). The common species present in all AR were the bivalves *Bittium latreillii*, *Hiatella arctica*, *Modiolus adriaticus*, the polychaetes *Syllis hyalina*, and the crustacean *Dexamine spinosa*. The pairwise comparisons showed no statistically significant seasonal effect ($p > 0.05$) related to the community composition and diversity.

Overall, 2235 individuals were counted and identified, belonging to 117 species and 38 families (Table S2). The results show that the ARs are dominated by the same phyla but the community structure varies between the areas. Ierissos is heavily colonized by serpulid polychaetes while Kalymnos is dominated by the gastropod *B. latreillii*. On the other hand, Preveza is characterized by distinctive fluctuations between the two taxa (Figure 4).

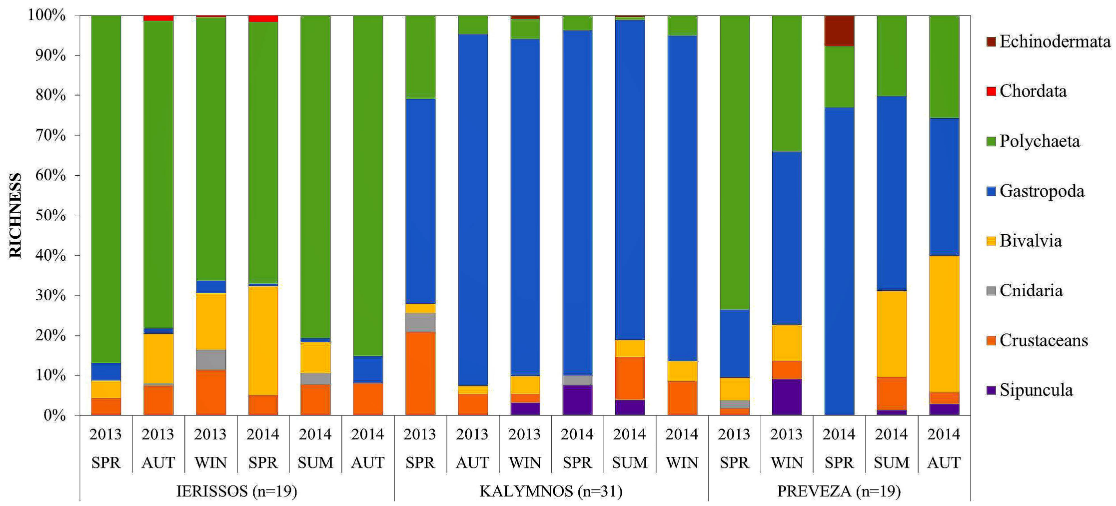


**Figure 4.** Richness of individuals (%) per season, year, and sampling site. Spring: SPR; Summer: SUM; Autumn: AUT; Winter: WIN; n: Total number of samples.

Regarding the dominant phyla presented in the areas, polychaetes ($F = 19.569$, $p = 0.001$) and gastropods ($F = 14.388$, $p = 0.001$) differ significantly between the ARs, while Arthropoda ($F = 3.228$, $p = 0.070$) and bivalves ($F = 1.393$, $p = 0.281$) did not show any significant differences. For within-site temporal variations, polychaetes in Kalymnos were the only group that showed a significant difference, with higher abundance in 2013 compared with in 2014 ($F = 37.803$, $p < 0.04$) (Figure 5).

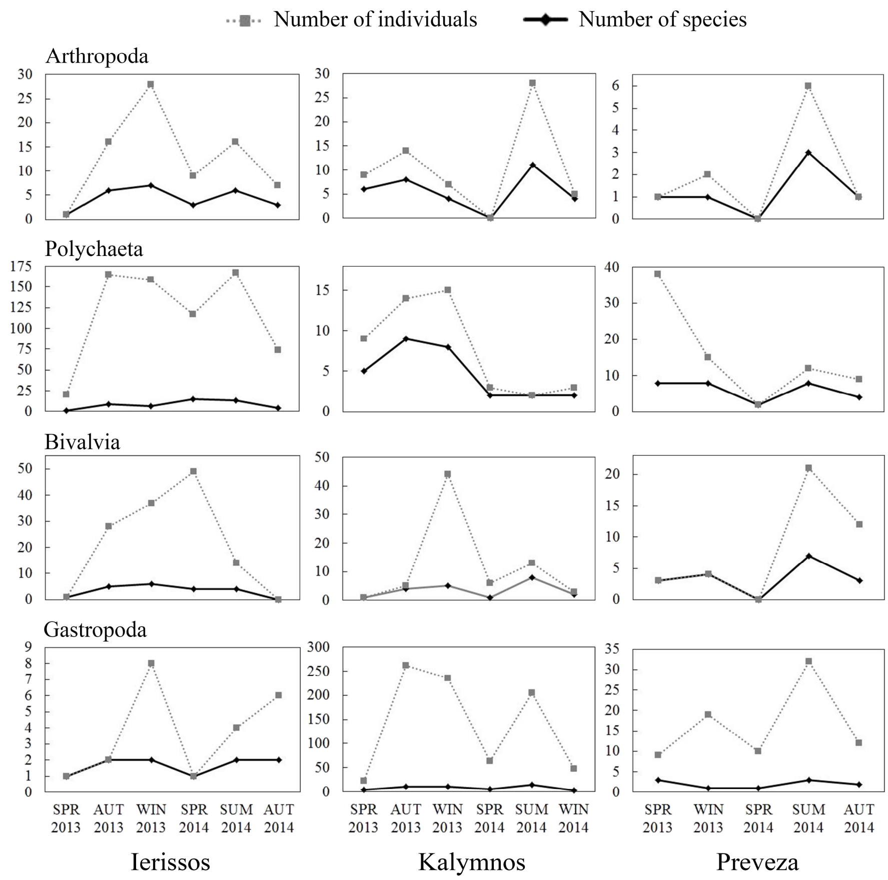


**Figure 5.** Number of species and individuals of the dominant taxa for the three artificial reefs, seasonally. Spring: SPR; Summer: SUM; Autumn: AUT; Winter: WIN.

### 3.2.2. Diversity

The diversity indices $H'$ and $J'$ are known to be biased by cumulative abundance of a single taxon/family/species within a dataset. Therefore, the indices were recalculated excluding dominant taxa, such as Serpulidae and *B. latreillii*, which were found in high abundance (Table S3). The three ARs are characterized by a high number of individuals but a low number of species and this is reflected in the low values for the Shannon–Wiener index. Evenness ($J'$) was similar in all three ARs (from 0.94 to 1 (Figure 6)).

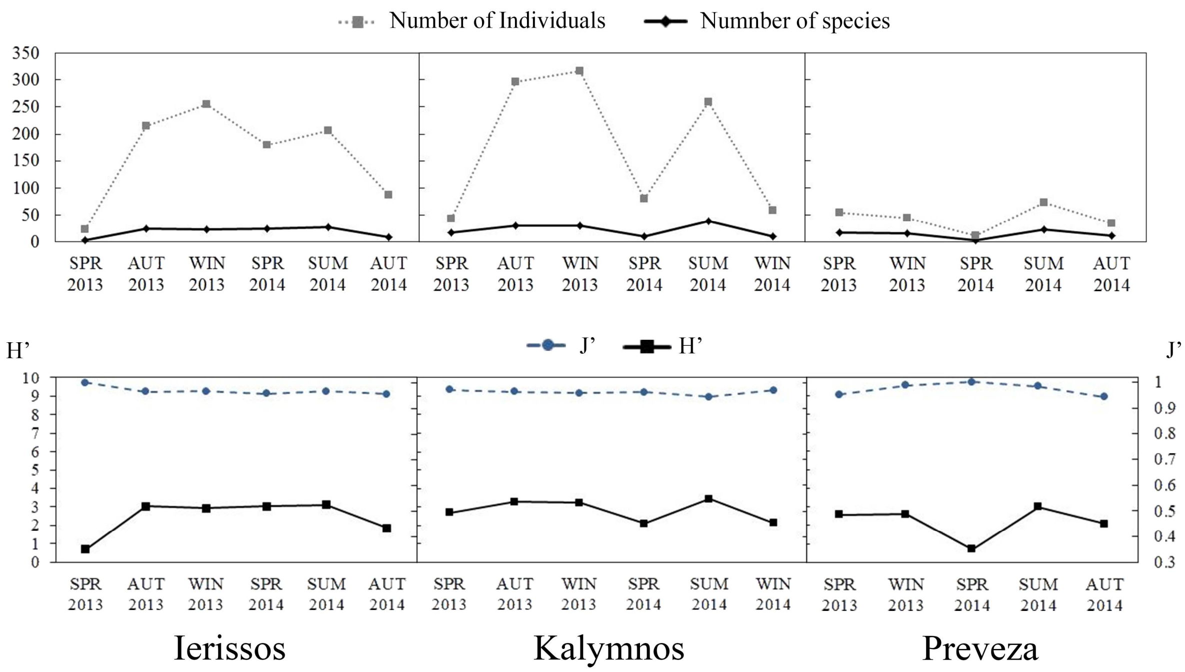


**Figure 6.** Total abundance of all taxa per area (top); biocoenotic parameters and diversity indices according to location, season, and year (bottom). Pielou's evenness: $J'$ and Shannon–Wiener index: $H'$; Spring: SPR; Summer: SUM; Autumn: AUT; Winter: WIN.

### 3.2.3. Analysis of Similarity

Polychaetes from the family Serpulidae and the gastropod *B. latreillii* were identified as the family and species with the highest contribution to the overall dissimilarity. The gastropods *Cerithium vulgatum*, *Jujubinus exasperatus*, and *Rissoa violacea*; the bivalves *Coralliophaga lithophagella*, *Hiatella rugosa*, and *Musculus costulatus*; the crustacean *Gnathia phallonajopsis*; and the polychaetes *Lysidice ninetta*, *Haplosyllis spongicola* and *Nereididae* were also recognized as significant contributors to the overall dissimilarity within and between sites and years (Table S3).

Nonmetric MDS indicated two groups: Ierissos as the first group and Kalymnos and Preveza as the second (Figure 7). Ierissos is clearly separated from the other two sampling sites at about 20% similarity. Also, one-way ANOSIM showed a discrimination between the three groups (R = 0.704, $p < 0.1$) with Ierissos being once more separated from the other two sites, supporting the MDS results. Additional pairwise tests revealed significant differences between Ierissos and Kalymnos (R = 0.804, $p < 0.1$) and between Ierissos and Preveza (R = 0.843, $p < 0.1$).

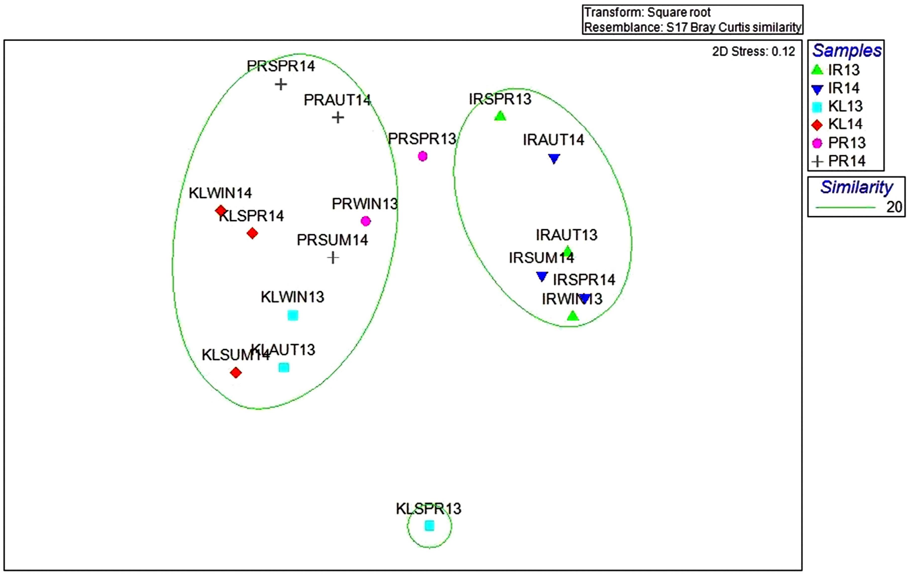


**Figure 7.** Nonmetric multidimensional analysis (MDS). Ierissos: IR; Kalymnos: KL; Preveza: PR; Spring: SPR; Summer: SUM; Autumn: AUT; Winter: WIN; 13 and 14 indicate the years 2013 and 2014, respectively.

The BIOENV procedure indicated that salinity is the environmental factor most affecting the macrobenthic community structure ($r = 0.534$). According to the LINKTREE routine, the community in Ierissos differs from the other two areas due to differences in water column salinity (Figure 8: point A). The low diversity recorded in Ierissos in 2013 (Figure 5) could potentially be associated with higher salinity and temperature (Figure 8: Point B; Figure 3). At a lower dissimilarity, Preveza and Kalymnos are divided due to the differences in surface salinity (Figure 8: Point D). In addition, Kalymnos in spring 2013 is distinguished from the rest of the samplings due to lower salinity and water density, and higher temperature and chl-$\alpha$ concentration—a finding that might explain the higher polychaete abundance during that year (Figure 8: Point G; Figures 3 and 5). The rest of the points (C, E, H, F) have very low dissimilarity indices, making the grouping of the corresponding surveys not very significant.

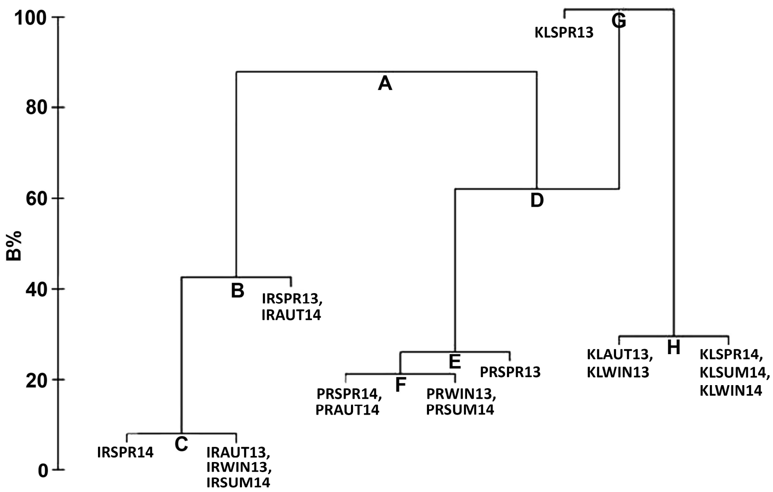


**Figure 8.** Dendrogram (LINKAGETREE) based on the physical parameters measured in the water column and the community structure on the artificial reefs. Ierissos: IR; Kalymnos: KL; Preveza: PR; Spring: SPR; Summer: SUM; Autumn: AUT; Winter: WIN; 13 and 14 indicate the years 2013 and 2014, respectively.

## 4. Discussion

For this study, a range of selected environmental parameters and methods were taken into consideration for describing the environmental parameters potentially affecting the community composition colonizing the ARs. In situ and satellite data were combined in the case of temperature and chl-$\alpha$. In situ data are very important since they can record short-term environmental anomalies locally. However, long-term data such as satellite data are also necessary in order to place the sparse short-term in situ data in a greater time scale. This is especially true in the case of late monitoring of an area, as in the presented study, when past environmental data are necessary to put the present data in context. Previous studies have stressed the importance of the combination of the two methods [28,29].

The ARs studied herein are mainly colonized by Annelida, Mollusca, and Arthropoda, which constitutes a common community composition pattern on Mediterranean hard substrate habitats and other ARs [13,30–33]. The information available regarding the fauna close to the ARs is very limited [34–44]. From the studies recording the fauna close to the reef areas, only the following 25 species are included in the present list: the arthropoda *L. spinicarpa*, *M. inaequipes*, and *P. hirtellus*; the bivalves *A. aculeata*, *A. tetragona*, *B. barbata*, *H. arctica*, *L. lima*, *L. lithophaga*, *M. costulatus*, *N. nucleus*, *O. edulis*, *S. gaederopus*, and *T. pubescens*; the gastropods *B. latreillii*, and *M. cristata*; the echinoderm *A. chiajei*; and the polychaetes *C. debile*, *E. viridis*, *H. spongicola*, *L. ninetta*, *L. unicornis*, *N. hombergii*, *P. aurantiacus* and *T. zebra*. The rest of the fauna recorded in this study should be considered as new records for the local fauna.

The three ARs are characterized by high numbers of individuals but low numbers of species; this is also reflected in the low Shannon–Wiener index values. The high evenness values together with the absence of seasonal correlation suggests that since the deployment of the ARs in 2005, the communities have reached a "stability" stage and have adapted to the local environmental conditions. This "stability" stage is characterized by minimal variations of the dominant taxa (e.g., Serpulidae, *B. latreilli*) throughout the seasonal cycle in each area. These results bear close resemblance to previous results recorded in Mediterranean [33].

Kalymnos was the most diverse area, followed by Ierissos and Preveza. The differences at Preveza are conspicuous with 47% and 38% fewer species compared with Kalymnos and Ierissos, respectively. The lower species richness and abundance recorded in Preveza could be attributed to the fact that the reef is located deeper than the other two, a factor which has been previously correlated with changes in community structure and diversity [13,45]. On the other hand, the differences regarding the samplings' time intervals could also play a role in this outcome. Kalymnos was sampled during winter instead of autumn 2014 and Preveza was not sampled in autumn 2013, all due to bad weather conditions. Since no significant seasonal effect was recorded, we believe that these differences do not affect the findings of this study. However, the season missing from Preveza might have also contributed to the differences in the diversity recorded in the area.

Despite the fact that no significant statistical correlation was detected between seasons and community composition, a common trend was still perceived in all areas, with summer and spring having the highest and lowest diversity values, respectively. The low diversity recorded in spring 2013 at Ierissos is related to higher values of salinity documented during that season. However, no similar correlation was identified for summer of the same area, or for the rest of the areas. Therefore, the reason for this pattern is mostly unclear and although it cannot be associated with the abiotic factors recorded in the areas, it could presumably be related to the reproductive strategies of the community [46,47].

The dominant groups recorded between the three areas are separated into two main groups: filter feeders (polychaetes, bivalves) and herbivores (gastropods). Their dominance in the different areas bears close relation to the environmental conditions prevailing in each area. For example, Ierissos receives a great amount of freshwater influx, producing an area with lower salinity and higher chl-$\alpha$ concentration compared to Kalymnos and Preveza. The distinctive environment of Ierissos is evidently reflected in the community composition, since polychaetes' diversity, richness, and distribution has been proven to correlate with higher chl-$\alpha$ concentration values and fresh water input [31,33,48].

On the contrary, Kalymnos is characterized by high salinity, its environmental parameters are consistent, and its community composition has been considered relatively "stable" throughout the years. The only significant variation was documented in spring 2013 when polychaetes' contribution to the community composition was higher compared to the rest of the seasons and years. This community change might be related with the lower salinity values and higher chl-$\alpha$ concentration recorded during that season. This outcome furthers the correlation between polychaetes and chl-$\alpha$ concentration that has been recorded at Ierissos.

Preveza combines environmental characteristics from both Kalymnos and Ierissos. The area is partly influenced by freshwater influx, thus increasing the chl-$\alpha$ concentration during certain seasons (e.g., spring 2013, 2014), while it is also characterized by high water column salinity. This environmental fluctuation is also documented through the community variations with more polychaetes during spring 2013, when higher chl-$\alpha$ concentrations were also recorded. Interestingly, there was no increase of the polychaetes during spring 2014, despite the similarities in chl-$\alpha$ concentration values with spring 2013. The reason for this rather contradictory result is not entirely clear but the low temperature values recorded during that season could be responsible for this outcome.

Statistically, salinity was identified as the most important parameter affecting the community composition. Our findings clearly show a positive trend between gastropod presence and higher saline water, like in Kalymnos and during certain periods of higher salinity in Preveza. Nevertheless, the differences in salinity values recorded between the areas do not explain the low gastropod abundance at Ierissos [49]. This pattern could be associated with the algae community, which plays a significant role on benthic species distribution [13,31]. In fact, the presence of algae in Kalymnos and Preveza aligns with the presences of gastropods in the two areas (Patsalidou et al. Epibenthic communities on artificial reefs in Greece, Mediterranean Sea. Part II, (unpublished)).

It is also very likely that the high water turbidity in Ierissos and the surrounding areas (personal communication, [13]) possibly affects macroalgal (fleshy algae) development due to lower light penetration. Consequently, this affected development—especially that of grazers of turf (filamentous) algae and cyanobacteria—might influence the abundance of other groups, such as gastropods (e.g., [32]). Algal assemblages have also been proven to affect polychaete distribution and composition [48,50]. This demonstrates once more how water turbidity recorded at the Ierissos AR might create a cascade of effects on the community structure. On the other hand, water turbidity alone would not negatively affect polychaetes abundance as they are known to be tolerant against suspended solids [51]. On the contrary, turbidity bears organic particles which are considered to be a source of nutrients for filter feeders such as Serpulidae, which might offer further an explanation for their great abundance in Ierissos.

Finally, the results of this study can be used for future AR deployments. During the deployment of an AR, both ecological and economic aspects should be taken into consideration. The goal of the ARs is to not only enhance the local fauna and habitat conservation but also to offer economic benefits through fisheries and tourism, amongst others [52]. Therefore, the development of a successful management and monitoring program should not be taken lightly. A successful management and monitoring program should include science-based criteria, which requires collaboration between scientists and stakeholders [52,53]. Published data from the literature is necessary when examining the feasibility of placing an AR for a given purpose [54]. This is especially noticeable with data originating from post-deployment studies, like the present study. Such studies offer the opportunity of a glimpse into the future where one can follow the AR deployment backwards from the result (community composition) to the design (material, structure, and location). This provides helpful insights on improving future AR deployments by better understanding the outcome of the main parameters affecting the community composition on the ARs, such as design, material, and geographical location. Furthermore, the fact that the three ARs share a widely used material [7,33,55] and that they are located in contrasting environmental areas makes the results of this study more easily applicable on a greater geographical scale for future AR deployment in similar environmental areas.

## 5. Conclusions

The three ARs are characterized by low biodiversity, with Annelida, Mollusca, and Arthropoda being the dominant taxa in all three areas, a common community structure on hard substrates. The analyses revealed that each area holds a distinct community structure closely associated with the different environmental variables prevailing in the area. The results from this study not only provide new information for the local fauna, but also offer an explanatory description of the correlation between the community composition and the associated environmental parameters.

Salinity has been statistically identified as the primary factor affecting the epibenthic community. However, the results suggest that other parameters, such as chl-$\alpha$, temperature, and water clarity, also act synergistically and most probably cumulatively affecting the communities. Indeed, this conclusion is expected since ecosystem interactions and responses to environment factors are complex and cannot possibly be described by a single parameter (e.g., salinity). The small variation identified in community composition throughout the seasons suggests that the community has reached a "stability" stage and a good adaptation to the local environmental conditions.

Finally, as opposed to the majority of the studies conducted in the Mediterranean up to now, this study presents a multidimensional dataset including the overall species diversity while it highlights the spatio-temporal and environmental parameters affecting the community structure. Hence, these observations have important implications for improving the management, conservation, and design of future ARs. However, in order to investigate the dynamics affecting the development of communities on ARs, comparative studies at locations with contrasting environmental settings should be conducted at the beginning of an AR's deployment and followed by quantitative monitoring surveys with a medium- to long-term perspective.

**Supplementary Materials:** The following are available online at www.mdpi.com/2073-4441/10/4/347/s1. Table S1: Average values of the water physical parameters and chl-$\alpha$ concentration recorded at the water surface and water column for each area, Table S2: Taxa identified in sampling areas, Ierissos, Kalymnos, and Preveza during the years 2013, 2014, Table S3: Species/family contribution to 80% among-group average dissimilarity in the study sites during the two years of sampling (2013, 2014).

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