USE OF MACROPHYTE ASSEMBLAGES FOR THE ECOLOGICAL EVALUATION OF TWO COASTAL LAGOONS OF GREECE ACCORDING TO WFD 2000/60/EC

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Abstract: The investigation of aquatic macrophyte assemblages in two coastal lagoons of western Greece and the application of Ecological Evaluation Index (EEI) in order to evaluate the ecological quality of the two water bodies in the light of WFD 2000/60/EC was the main purpose of this study. Data of water parameters was collected and macrophytes coverage was analyzed by using cluster analysis, Simper analysis and the EEI. The lagoons showed significant differences in several physicochemical parameters. Twenty six taxa were identified in both lagoons, eleven were found exclusively in Kotychi lagoon, seven only in Prokopos lagoon and eight taxa were common for both wetlands. The angiosperm *Ruppia cirrhosa* dominated both lagoons but was associated with different taxa in each lagoon. Extensive proliferation of green algae was recorded in Kotychi, but not in Prokopos. Diversity indices were generally low and showed no significant differences between the studied lagoons. The application of EEI, a well-documented index for the Mediterranean eco-region, classified Kotychi lagoon in Moderate quality class and Prokopos lagoon in Good quality class, reflecting the pressures acting in their watersheds. In view of the present results, management measures should be undertaken, especially for Kotychi lagoon.

Keywords: aquatic macrophytes, ecological evaluation, ecological status, index - EEI, transitional waters, Water Framework Directive.

Introduction:

In the past decades, there has been considerable interest in the development of meaningful indices to express, evaluate and monitor the ecological quality of aquatic ecosystems (Fano et al. 2003). The European Union adopted the concept of ecological quality in the Water Framework Directive (2000/60/EC) by using biological communities as Quality Elements to evaluate the ecological status and according to Annex V of the directive, macrophytes, phytoplankton, benthic invertebrate fauna and fish are the four biological quality elements (BQEs) to be used in assessing the ecological status of transitional and coastal water bodies. The innovative approach of WFD was the driving force for the development and establishment of several biotic indexes based on aquatic macrophytes (Orfanidis et al. 2001; Romero et al. 2005;

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Sfriso et al. 2007; Austoni et al. 2007) or benthic invertebrates (Borja et al. 2003; Simboura and Zenetos 2002).

Submerged aquatic macrophytes (macroalgae, angiosperms) represent key structural and functional components of many coastal ecosystems (Orfanidis et al. 2008) regulating fluxes of energy and matter (Wetzel 1975). They have morphological, physiological and life cycle adaptations for coping with the large and frequent changes of salinity and water regime (Menendez and Comin 2000), which along with nutrient availability, influence macrophyte growth and distribution (Khedr 1997). As primary producers being at the base of the food web, but also as mostly sessile organisms, aquatic macrophytes respond directly to changes of abiotic and biotic environment and thus represent sensitive bioindicators of its changes (Orfanidis et al. 2003). Therefore the study of macrophyte communities is considered useful in order to analyze changes in water quality and that is why they represent one of the key biological elements used in the ecological evaluation of any transitional or coastal water body in the framework of WFD (Ballesteros et al. 2007).

Ecological Evaluation Index - EEI (Orfanidis et al. 2001) is a multimetric scale-based biotic index that was developed for the evaluation of the ecological status of transitional and coastal waters in accordance with the WFD, using benthic macrophytic communities as Quality Elements. The index is based on the principle that anthropogenic stress shifts the ecosystem from pristine state where perennial, late-successional species like *Ruppia* spp., *Zostera* spp., *Cystoseira* spp. are dominant, to degraded state where opportunistic species like *Ulva* spp., *Cladophora* spp., *Chaetomorpha* spp. dominate, a pattern well documented (Schramm and Nienhuis 1996; Berglund et al. 2003; Arevalo et al. 2007; Pinedo et al. 2007). This pattern can be explained from species competition abilities under abundant and limiting nutrient conditions and it is in accordance with the classical theory of r- and K- selection, whereas late successional species present low growth rates and reproductive potential, while opportunistic species show high growth rates and reproductive potential (Orfanidis et al. 2007).

According to Orfanidis et al. (2001), all benthic macrophytes species recorded, are classified in two distinct functional groups: Ecological Stage Group I (ESG I = late successional species) and Ecological Stage Group II (ESG II = opportunistic species), that do not require any advanced knowledge in macroalgae and seagrass taxonomy. The overall aim is to quantify the percentage of absolute abundance (in means of coverage) of each functional group.

The main purpose of this study was to investigate the macrophyte communities and moreover to utilize them as bioindicators, in order to evaluate the ecological status of two coastal lagoons by applying EEI, a well-documented and widely used index for the implementation of WFD (2000/60/EC) in Mediterranean coastal and transitional waters.

Materials and methods:

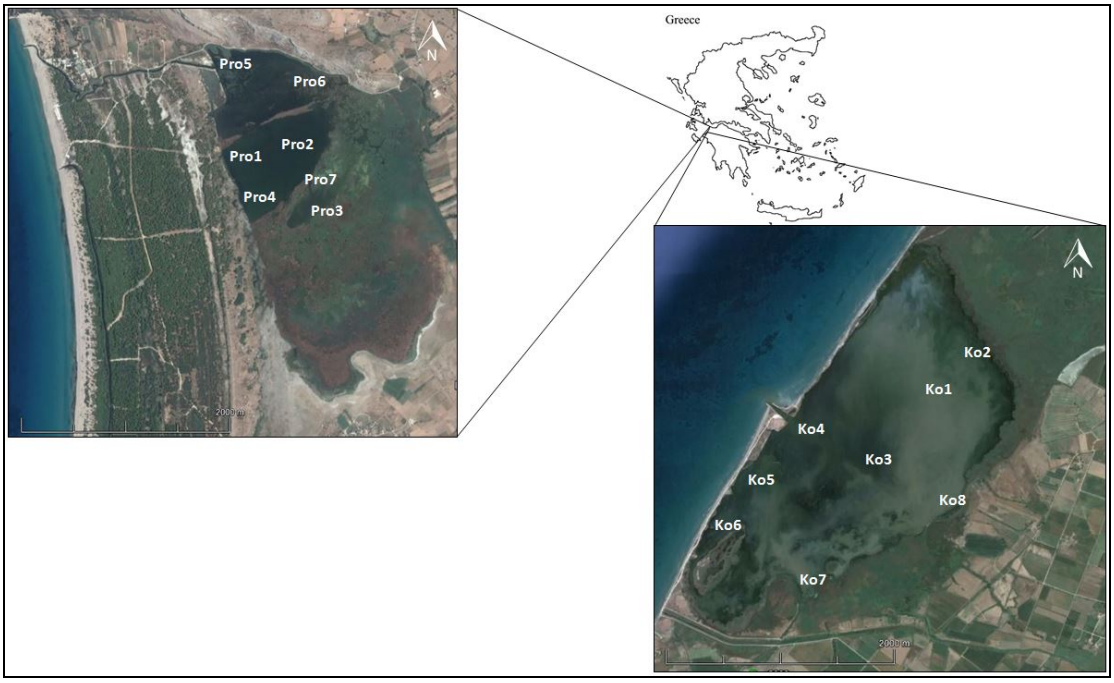
Study area

The current study was contacted in two coastal lagoons of Greece situated at the northeast edge of Peloponnisos, Kotychi and Prokopos lagoons (Fig. 1). As a part of the wider protected area of Strofilia, these lagoons are listed in the RAMSAR treaty and NATURA 2000 network, as habitats of international importance, characterized by high diversity and ecological value.

Kotychi lagoon is an oval shaped brackish lagoon, situated a few kilometers north of cape Kyllini. It covers an area of approximately 800 ha and is the largest lagoon in Peloponnisos. Its surface presents strong seasonal fluctuations (710-850 ha) depending on the annual rainfall. Kotychi lagoon is fed by considerable quantities of fresh water input from several small streams mainly in its southern and eastern sides. The lagoon is isolated from the sea by an

elongated sand strip on the west part of the wetland. At the center of this strip, an opening almost 200 m long and 30 m wide, links the lagoon to the Ionian Sea. Strong spatial and temporal fluctuations of salinity and depth are observed in the lagoon and are considered to play a key role for the synthesis of aquatic vegetation (Tziortzis 2008). The construction of Pinios river dam in the late 60's and the consequent change in land use from non-irrigated to irrigated, have reasonably affected the hydrological conditions of the lagoon. The nutrients and the sedimentation of suspended material have led to increased suspended solids and lower light penetration (Kalivas et al. 2003). Kotychi is also affected by extensive aquaculture activities taking place throughout the year in the lagoon.

Figure no. 1 Kotychi and Prokopos lagoons, situated at the northwest edge of Peloponnisos, Greece.



Prokopos lagoon is a smaller wetland located north of Kotychi lagoon and covers a total area of 150 ha. It is connected to the Ionian Sea on the west, by a long narrow channel stretching 2300 m long and 2.5 m wide. Prokopos is separated in three distinct ponds (Palades, Cheirovolia, Mikrolimni), all connected together by wide channels. The lagoon receives significant fresh water inflows, mostly from the southeast part of the lagoon and it is considered to have lower salinity values and significantly deeper water compared to Kotychi (Tziortzis 2008). Human pressures, mainly intensive agriculture in the catchment area and extensive aquaculture by local fishermen co-operations, are considerably lower than in Kotychi.

Sampling

The studied lagoons were visited monthly during the period March - October in 2006 and 2007. A total of 15 representative sampling stations were selected taking into account morphological and hydrological

characteristics. Eight sampling sites were selected in Kotychi lagoon (Ko1-Ko8) and seven were chosen in Prokopos lagoon (Pro1-Pro7).

Physicochemical parameters such as depth, transparency, salinity, pH, temperature and dissolved oxygen concentration were measured monthly in all sampling sites, using the appropriate field sensors (WTW instruments). Water samples were collected using plastic bottles (vol. 1L) and were transferred within one hour, cool preserved, to the laboratory. The samples were then filtered using Whatmann GF/F filters, to determine photosynthetic pigments (Chlorophyll-a, mg/m^3). Nutrient concentration of nitrogen and phosphorus (nitrate and SRP) were determined following standard A.P.H.A. methods (A.P.H.A. 1989).

Sampling of benthic macrophytes was destructive using a metal hand-held box (50 x 50 x 30 cm, width x length x height) which was vertically pushed through the vegetation and sediment. At stations with obvious patchiness of benthic vegetation, repeated samples were taken in order to have a representative sample. Samples were then transferred in the laboratory and carefully washed in tap water, removing remaining organic debris and sediment. Macrophytes were then carefully sorted and identified to functional group level and as far as possible to species level, using a stereoscope and a microscope. For the estimation of the percentage of coverage, a 50x50 cm container divided in 100 squares each was used. Each taxon abundance was estimated separately, by calculating its vertical projection % coverage.

Analysis of data

Benthic macrophyte communities were studied using various metrics; Species number, Richness (d), Pielou eveness (J') and Shannon-Wiever diversity index (H') were calculated. Community structure in each lagoon was described using Cluster analysis (group average), while species contributing most to the dissimilarity among ordination clusters of sites, were investigated using SIMPER analysis (Carr 1997). All of the above calculations were performed using PRIMER v.5.0 software package. One-way Analysis of Variance (SPSS v.15) was also used in order to compare physicochemical parameters measured in the lagoons and spot possible significant differences between them.

The EEI was calculated according to Orfanidis et al. (2001, 2003) based on the concept of morphological and functional groups (Littler and Littler 1980). As seen on Tab. 2, the species recorded were assigned into two Ecological Stage Groups (ESG I and ESG II). Each sampling site was classified using the matrix proposed by Orfanidis et al. (2001) which utilizes a cross-comparison of the coverage of ESG I and ESG II coverage at each site (Fig. 2). Then a numerical value was assigned that corresponds to each ecological status category (Bad = 2, Low = 4, Moderate = 6, Good = 8 and High = 10). The coverage of each ESG was averaged over all seasons and the overall ecological status of the wetland was finally evaluated.

Results and discussion:

Physicochemical characteristics

One-way ANOVA test showed significant differences between most of the physicochemical variables measured in both lagoons. Depth, Transparency/Depth, pH, salinity, phosphates and chlorophyll-a concentration showed significant differences (Tab. 1).

Description and structural analysis of communities

The list of macrophyte species recorded in Kotychi and Prokopos lagoons along with their distribution in ESG I and ESG II, are presented in Table 2. A total of twenty six (26) taxa were identified in both lagoons (7 spermatophytes, 2 Charophytes and 17

Macroalgae). Eleven (11) of these taxa were recorded exclusively in Kotychi lagoon, seven (7) were found only in Prokopos lagoon and eight (8) were common species for both wetlands.

Figure no. 2 Matrix as proposed by Orfanidis et al. (2001) for the evaluation of the ESG according to the classification of WFD.

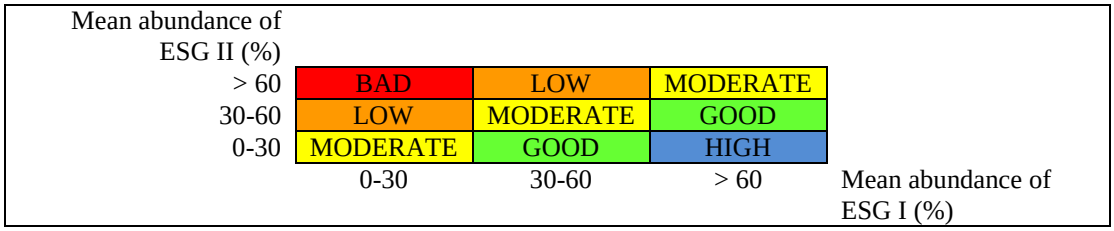


Table no. 1 Mean values of main physicochemical variables measured in Koychi and Prokopos lagoons.

	Depth (m)	Trans/ Depth	T (°C)	pH	DO (mg/l)	Salinity (psu)	PO_4^{-2} (µg/l)	NO_3^- (µg/l)	Chl-a (mg/l)
Kotychi	0.47	0.91	22.4	8.6	7.7	16.9	64.8	88.6	7.2
Prokopos	0.98	0.55	23.2	8.4	6.4	12.9	21.4	58.8	20.4
Sig.	0.000	0.000	0.313	0.008	0.17	0.009	0.000	0.149	0.000

The range of ecological indices of macrophytic communities such as Number of species, Richness (d), Evenness (J'), and Shannon diversity (H') in each lagoon were also calculated (Tab. 3). The number of species recorded in each station ranged from 1 to 5 in both lagoons, but in general, no significant differences were found between the studied areas concerning these biotic indices.

An analysis of the contribution of each taxon using SIMPER analysis, showed that nine taxa contributed cumulatively by 90% to the macrophytic communities (Tab. 4). Although the angiosperms *Ruppia cirrhosa* and *Potamogeton pectinatus* were the most abundant species in both lagoons contributing cumulatively to almost 50 %, they were also the species contributing most to the average dissimilarity between the communities. The angiosperm *Najas marina* ssp. *armata* contributed significantly in Prokopos but was completely absent in Kotychi lagoon and, in contrast, the green algae *Ulva lactuca* was abundant in Kotychi but was never recorded in Prokopos lagoon.

Bray-Curtis similarity cluster analysis was performed independently for the two lagoons, based on the average macrophyte abundance at each station (Fig. 3, Annexes). At about 55 % similarity, three groups were identified at Kotychi lagoon: Ko7 and Ko8 formed the first group dominated by *Potamogeton pectinatus* and *Cladophora* spp, while Ko3 and Ko4 formed the second group dominated by the chlorophyte *Ulva lactuca* and the angiosperm *Ruppia cirrhosa* in lower numbers. Stations Ko1, Ko2, Ko5 and Ko6 formed the third group where *Ruppia cirrhosa* prevailed. In Ko2 *Ruppia cirrhosa* was also associated with *Potamogeton pectinatus*. In Prokopos lagoon and at about 50 % of similarity, three groups were also identified: the first group consisted of stations Pro5 and Pro6 where the angiosperm *Ruppia cirrhosa* had the upper hand accompanied by the rhodophyte *Polysiphonia* sp. The second group consisted

of stations Pro1 and Pro4 whereas *Potamogeton pectinatus* was abundant, while stations Pro2, Pro3 and Pro7 formed the third group where *Najas marina* ssp. *armata* and *Zanichellia palustris* var. *pedicellata* dominated. In Pro2 and Pro3 *Najas marina* ssp. *armata* prevailed, while *Zanichellia palustris* var. *pedicellata* dominated in Pro7.

Table no. 2 List of species recorded in Kotychi and Prokopos lagoon and the functional group they belong, according to Orfanidis et al. (2001, 2003)

Species	Kotychi	Prokopos	ESG
Phaeophyta			
Ectocapus sp.	+		II
Rhodophyta			
Ceramium siliquosum (Kutzing) var. *siliquosum*	+		II
Gracilaria gracilis (Stackhouse)	+		II
Gracilariopsis longissima (S.G. Gmelin)	+		II
Hypnae musciformis (Wuffen) J.V. Lamoroux	+	+	II
Polysiphonia sp. L.	+	+	II
Chlorophyta			
Cladophora glomerata (L.) Kutzing	+	+	II
Cladophora dalmatica Kutzing	+		II
Cladophora sp.	+	+	II
Chaetomorpha linum (O.F. Muller) Kutzing	+	+	II
Chaetomorpha ligustica Kutzing	+		II
Chaetomorpha sp.		+	II
Rhizoclonium tortuosum (Dillwyn) Kutzing		+	II
Ulva compressa L.		+	II
Ulva flexuosa (Wulf.)		+	II
Ulva lactuca L.	+		
Ulva prolifera (O.F.Muller)	+	+	II
Charophyta			
Chara vulgaris L.	+		I
Lamprothamnium papulosum J. Groves	+		I
Spermatophyta			
Lemna gibba L.	+		II
Lemna minor L.		+	II
Najas marina L. subs. *armata* (H. Lindb.) Horn		+	I
Potamogeton pectinatus L.	+	+	I
Ruppia cirrhosa (Petagna) Grande	+	+	I
Zanichellia palustris L. subs. *pedicellata*		+	I
Zostera noltii Hornemann	+		I

Functional analysis of communities

Out of twenty-six taxa identified in both lagoons, only eight of them were classified in ESG I. The majority of taxa (eighteen) was assigned to ESG II (Tab. 2). Nevertheless, despite the low number of late successional taxa, their abundance was significantly higher compared to the abundance of opportunistic taxa (Tab. 5, Annexes).

The application of EEI revealed significant differences between the two study areas. Both lagoons showed seasonal variation of ESC due to shifts in their macrophytic communities (Tabs. 5, 6 and Fig. 4, Annexes). Kotychi lagoon showed higher average abundance of taxa belonging to ESG I in four out of eight stations (Ko1,

Ko2, Ko5, Ko6), while Prokopos lagoon showed higher average abundance of ESG I taxa in all but one stations (Pro6). Stations Ko1, Ko5, Ko6 and Ko2 were classified in Good and High quality class respectively. Stations Ko7 and Ko8 were evaluated as Moderate while stations Ko3 and Ko4 were classified as Low quality. In Prokopos lagoon, stations Pro1, Pro4 and Pro7 were evaluated as High quality, stations Pro2 and Pro3 were classified in Good quality status. Station Pro5 and Pro 6 were classified as Moderate and Low quality respectively (Fig. 4, Annexes). Overall, Kotychi lagoon was classified in Moderate ecological status class while Prokopos lagoon was classified in High ecological status class.

Table no. 3 Biotic indices: variations of number of species, richness d', evenness J' and diversity H' of each lagoon.

		Number of species	Richness (d)	Eveness (J')	Shannon diversity (H')
Ko	range	1-5	0-0.98	0.09-1	0-1.2
	mean	2.5	0.35	0.53	0.44
Pro	range	1-5	0-1.03	0.15-1	0-1.36
	mean	2.38	0.34	0.54	0.44

Table no. 4 SIMPER analysis showing average abundance of taxa and contribution to average dissimilarity.

Average dissimilarity = 84,82					
	Kotychi Lagoon	Prokopos Lagoon			
Species	Average Abundance	Average Abundance	Average Dissimilarity	Contribution %	Cumulative %
Ruppia cirrhosa	31.38	19.32	24.53	28.91	28.91
Potamogeton pectinatus	11.1	19.3	16.77	19.77	48.69
Najas marina ssp. *armata*	0	13.77	8.81	10.39	59.08
Cladophora sp.	9.73	4.03	8.19	9.66	68.73
Ulva lactuca	13	0	7.78	9.17	77.91
Cladophora glomerata	4.84	3.93	5.07	5.98	83.89
Polysiphonia sp.	0	5.41	2.76	3.26	87.14
Zanichellia palustris ssp. *pedicellata*	0	3.39	2.32	2.73	89.88
Ulva laetevirens	2.43	0	1.75	2.07	91.95
Gracilaria gracilis	2.22	0.84	1.61	1.9	93.84
Chaetomorpha linum	1.11	1.19	1.29	1.53	95.37

Conclusions:

The analysis of taxonomic, structural and functional characteristics of the phytobenthic communities in the studied lagoons, provided the appropriate metrics for their ecological quality classification according to the WFD mandate. The floral community in

Kotychi lagoon was dominated by *Ruppia cirrhosa*, a very common and very tolerant species in salinity fluctuations (Verhoeven 1980; Menendez et al. 2002), characteristic of many coastal areas of Greece (Nicolaidou et al. 2005; Christia et al. 2011), such as Agiasma lagoon in Eastern Macedonia (Orfanidis et al. 2008), Tsoukalio, Rodia, Logarou, Papas and Messolonghi lagoons in Western Greece (Christia and Papastergiadou 2007). Prokopos also showed high abundance in *Ruppia cirrhosa* in stations close to the inlet of the sea, but *Potamogeton pectinatus* and *Najas marina* ssp. *armata* were also present in high abundances in stations closer to the inflow of freshwater, implying that lower salinity values might be the driving force for these differences, as often reported in literature (Menendez et al. 2002; Casagranda and Boudouresque 2007; Obrador et al. 2007; Shili et al. 2007).

Macrophyte diversity indices showed no significant differences between two lagoons. Number of species and Shannon diversity index were as expected low, a typical finding in brackish water systems (Remane and Schleper 1971; Obrador et al. 2007), since these ecosystems are naturally stressed dew to abrupt changes in environmental conditions (Menendez et al. 2002; Curiel et al. 2004; Reizopoulou and Nicolaidou 2004). Both indices were comparable to other Greek and Mediterranean lagoons (Nikolaidou et al. 2005; Orfanidis et al. 2008).

Ecological Evaluation Index, the national assessment index, used by Greece and other Mediterranean countries for the assessment of coastal and transitional waters quality status during the two intercalibration exercises (2004-2008 and 2009-2012) and therefore its response to pressures and applicability in the Mediterranean ecoregion and especially in Greece, has been thoroughly tested. The application of the index in Kotychi and Prokopos lagoons, verified the impact of human pressures on both water bodies, mainly due to agriculture activity. Kotychi lagoon seems to be mostly affected according to EEI. *Ruppia cirrhosa* showed the highest abundance values in both lagoons but extensive floating mats of the green algae *Ulva lactuca* and *Cladophora spp.* were also present in Kotychi, especially in the summer period. It is well-documented that increased nutrient values in such ecosystems, in combination with high temperatures and increased solar radiation, cause a shift of the macrophytic community from late successional angiosperms to opportunistic seaweeds (Duarte 1995; Menendez and Comin 2000; Sfriso et al. 2003), which in turn culminates to dystrophic crisis with extensive algal blooms, severe anoxia phenomena and mass killings of both fish and invertebrate fauna (Schramm and Nienhuis 1996; Sfriso et al. 2003). Such events have been recorded in Greek lagoons such as Papas, Aetoliko, Vassova and Gialova lagoon (Koutsoubas et al. 2000; Reizopoulou and Nikolaidou 2004; Karyotis et al. 2006). As observed in Kotychi lagoon, the coexistence of late successional and opportunistic species (high species number - intermediate disturbance hypothesis of Connel (1978) forms communities that are indicative of intermediate conditions (Orlando-Bonaca et al. 2008). High abundances of opportunistic species in Kotychi lagoon could be related to higher values of phosphorus which is a well-known limiting factor for algae growth is aquatic ecosystems (Kormas and Nicolaidou 2001; De Casabianca et al. 2002; Obrador et al. 2007). Since classified in Moderate status, Kotychi lagoon does not fulfill the key principle of WFD, in contrast to Prokopos lagoon which was classified in Good ecological status. Prokopos was less impacted by agriculture activities, despite the fact that it is more confined from the sea compared to Kotychi. The dominance of angiosperms was evident during the whole sampling period, even in the summer season, and proliferation of chlorophytes and other opportunistic species was not observed in general. Low abundance of such species could be attributed to lower phosphorus concentrations compared to Kotychi but also to higher concentrations of Chl-a observed,

which seems to successfully suppress the accumulation of opportunistic species.

Finally, no accordance was found between diversity indices and functional indices. This confirms previews statements that species diversity indices are not appropriate to be used as indicators of water quality status (Thiebaut et al. 2002; Panayiotides et al. 2004; Orfanidis et al. 2007; Orfanidis et al. 2008).

This study is actually the first attempt to assess the ecological quality of Kotychi and Prokopos lagoon under the light of WFD. Prokopos lagoon is in accordance with the main objective of the WFD of Good ecological status. But the failure of Kotychi lagoon to achieve the WFD target, highlights the need of adopting appropriate management measures, stretching to the river catchment area, in order to achieve the WFD environmental objectives.

Rezumat:

FOLOSIREA ASOCIAȚIILOR DE MACROFITE PENTRU EVALUAREA ECOLOGICĂ A DOUĂ LAGUNE DE COASTĂ DIN GRECIA POTRIVIT CU WFD 2000/60/EC

Scopul principal al acestui studiu a fost de a evalua calitatea ecologică din două zone acvatice în conformitate cu WFD 2000/60/EC, prin cercetarea asociațiilor de macrofite acvatice din două lagune costiere din partea de vest a Greciei și aplicarea Indexului de Evaluare Ecologică (EEI). Au fost recoltate probe pentru parametrii apei, iar răspândirea macrofitelor a fost analizată prin folosirea metodei grupurilor, SIMPER și EEI. Au fost identificate diferențe la mai mulți parametri fizico-chimici în cele două lagune. 26 de taxoni au fost semnalați în ambele lagune, 11 fiind găsiți exclusiv numai în laguna Kotychi, șapte în laguna Prokopos și opt taxoni sunt comuni pentru ambele zone umede. Dintre angiosperme, specia *Ruppia cirrhosa* este dominantă în ambele lagune, dar în asociație cu alți taxoni în fiecare lagună. Proliferarea excesivă a algelor verzi a fost înregistrată în laguna Kotychi, dar nu și în Prokopos. Indicii de diversitate sunt în general scăzuți și nu indică diferențe majore între cele două lagune studiate. Aplicarea EEI, un excelent index pentru eco-regiunea Mediteraneană, clasifică laguna Kotychi în clasa de calitate moderată, iar laguna Prokopos în clasa de calitate bună, ca o reflectare a presiunilor care acționează în cele două bazine acvatice. Ca urmare a acestor rezultate, se impune luarea unor măsuri de management, mai ales în zona lagunei Kotychi.

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Annexes:

Figure no. 3 Similarity cluster analysis of mean average coverage in Kotychi and Prokopos lagoons.

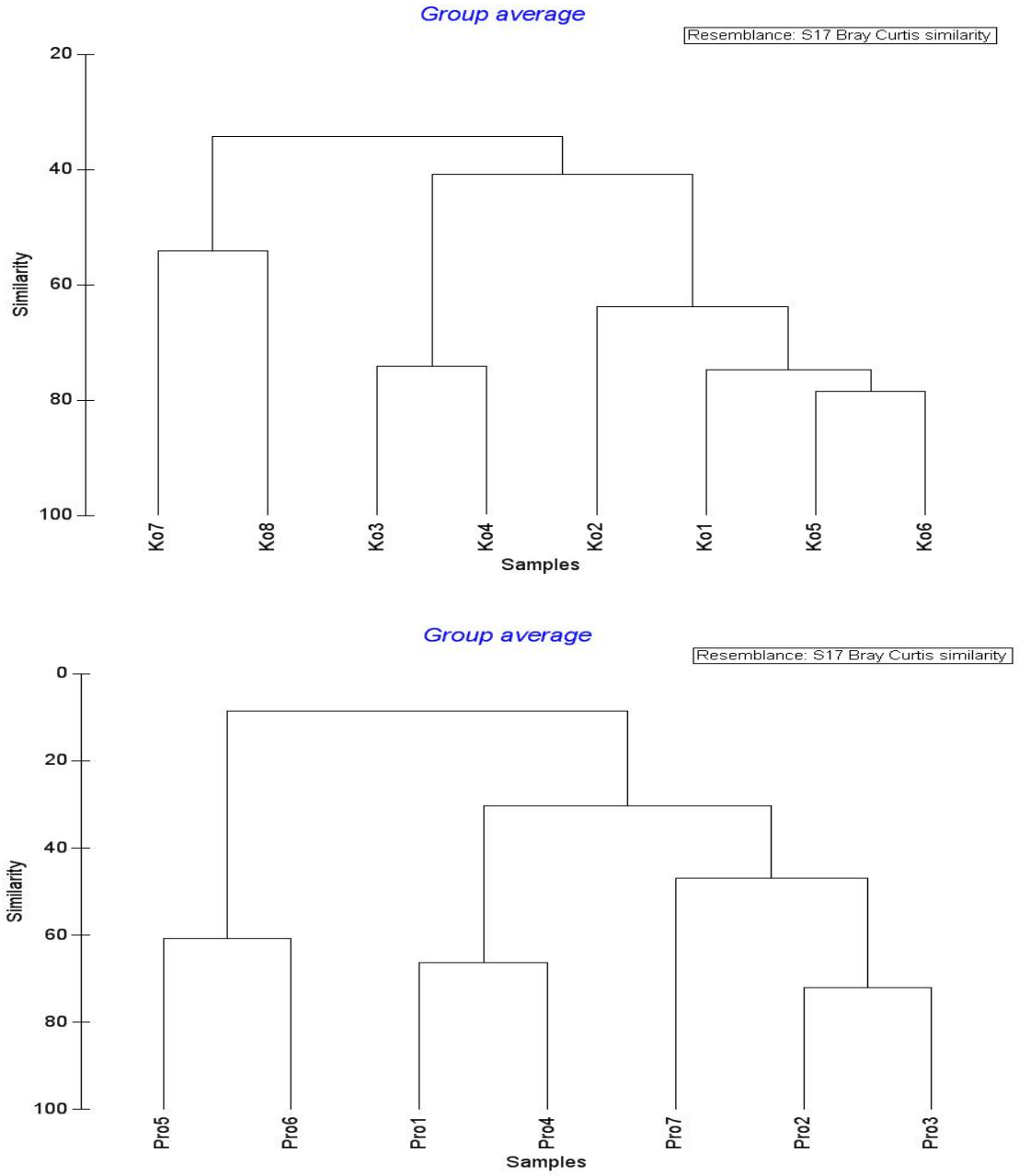

Table no. 5 Average abundance in means of % cover of ESG I and ESG II, in Kotychi lagoon stations and Ecological Evaluation index (EEI) assessment.

		Spring 06	Summer 06	Autumn 06	Spring 07	Summer 07	Autumn 07	Total	Status
Ko1	ESG I	78	51	2	25	88	87	55	GOOD
	ESG II	1	2	37	1	2	2	7	
Ko2	ESG I	58	70	59	90	86	89	75	HIGH
	ESG II	10	0	27	0	0	3	7	
Ko3	ESG I	46	36	40	6	0	18	24	LOW
	ESG II	43	16	67	30	6	91	42	
Ko4	ESG I	36	8	26	19	2	18	18	LOW
	ESG II	59	116	42	36	48	60	60	
Ko5	ESG I	78	88	39	53	75	14	58	GOOD
	ESG II	7	11	33	11	0	61	20	
Ko6	ESG I	88	79	27	58	53	10	52	GOOD
	ESG II	6	7	56	6	0	96	28	
Ko7	ESG I		13	40	53	38	37	36	MODERATE
	ESG II		119	47	6	6	59	47	
Ko8	ESG I				72	40	32	48	MODERATE
	ESG II				34	88	56	59	
Mean Total Coverage	ESG I							46	MODERATE
	ESG II							34	

Table no. 6 Average abundance in means of % cover of ESG I and ESG II in Prokopos lagoon stations and Ecological Evaluation index (EEI) assessment.

		Spring 06	Summer 06	Autumn 06	Spring 07	Summer 07	Autumn 07	Average	Status
Pro1	ESG I	81	63	59	51	58	79	65	HIGH
	ESG II	3	2	0	0	34	8	8	
Pro2	ESG I	101	45	6	12	65	2	38	GOOD
	ESG II	0	25	0	0	1	0	4	
Pro3	ESG I	81	69	13	34	90	0	48	GOOD
	ESG II	41	12	3	0	0	0	9	
Pro4	ESG I	177	88.3	44	39	48	66	77	HIGH
	ESG II	25	6	8	0	45	41	21	
Pro5	ESG I	88	27	32	39	88	63	56	MODERATE
	ESG II	52	51.8	15	1	32	107	43	
Pro6	ESG I				2	56	21	26	LOW
	ESG II				21	3	85	36	
Pro7	ESG I				81	139	0	73	HIGH
	ESG II				2	0	0	1	
Mean Total Coverage	ESG I							55	HIGH
	ESG II							17	

Figure no. 4 Mean average % cover of ESG I and ESG II and ecological evaluation at each station in Kotychi and Prokopos lagoons.