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MACROZOOBENTHIC ASSEMBLAGE IN TWO AQUATIC COASTAL ECOSYSTEMS OF ALBANIA

SUMMARY

The composition and structure of the macrozoobenthic community in two Albanian coastal brackish basins were studied during 2007-2008. The benthic macrofauna was collected from soft bottom substrates at 4 littoral stations in Kune lagoon and at 5 stations in Butrinti coastal lake. The main hydrological parameters were recorded at each sampling time. The macrozoobenthic community structure was described as species richness, abundance, diversity, and evenness. A multivariate analysis was performed to discriminate between coastal ecosystems, sampling sites and seasons. Kune is a small shallow, euryhaline lagoon, where a total of 42 *taxa* were collected, the majority of which are common inhabiting the marine sheltered muddy-sands bottoms. Butrinti is a coastal lake with a permanent stratification of the water column, notwithstanding it is widely influenced by the sea, this affecting even the areas remote from the mouth and encouraging the entry of a high number of marine larvae. In this coastal lake, 49 *taxa* of benthic macroinvertebrates were collected.

INTRODUCTION

The politico-economic changes in Albania in the 1990s have had a drastic impact on the country's aquatic ecosystems, the most exposed and unprotected being particularly subject to overuse and/or abuse of territory and natural resources (Cullhaj *et al.*, 2005). In this context, data concerning the ecological status of transitional water ecosystems remain scarce and irregularly known, despite the necessity of such information for the sustainable management and conservation purposes of aquatic ecosystems (Barnes, 1991; Peja *et al.*, 1996; Cognetti and Maltagliati, 2008; Munari and Mistri, 2008).

In the framework of the INTERREG III (2000-2006) aimed at the development of aquaculture in the Albanian coastal ecosystems, an Italian-Albanian project (Technical assistance project forthe establishment and management od international center of marine sciences in Albania) was carried out in order to: a) investigate the structure and distribution of benthic fauna and their relationships to environmental variables in natural ecosystems; b) assess the ecological quality status of the ecosystems which may be exploited for fishing and aquaculture, according to the Water Framework Directive 2000/60/EC (EC, 2000). Two coastal brackish water ecosystems were studied, Kune lagoon and Butrinti lake. They are characterized by a large variability of environmental conditions and are different for site-specific environmental conditions.

The studies on the macrozoobenthos of Albanian lagoons are relatively new and the level of knowledge is limited. Majority of the studies has been carried out about mollusks and some ecological aspects (Beqiraj, 2001; 2003; 2004; Beqiraj and Sulejmani, 2003; Nonnis Marzano *et al.,* 2003; Beqiraj and Laknori, 2006; Beqiraj *et al.*, 2007).

The objective of the present reserch is to investigate the structure and distribution of the benthic fauna and improve knowledge on the biodiversity in transitional water bodies also for conservation and productive purposes.

MATERIALS AND METHODS

Study area

The lagoon of Kune (Fig. 1a) is situated along the northern Albanian coastline and covers an area of 250 ha with an average depth of 1 m (maximum depth, 3 m); it is a part of the diversified lagoon complex Kune-Merxhani-Kenella, 1165 ha wide, located north of Drini mouth (PHARE, 2002). Kune is connected to the sea by one tide channel assuring the seawater exchanges, while many freshwater inputs are guaranteed by diffuse and variable entrances.

The Butrinti coastal lake (Fig. 1b) covers an area of 1630 ha along the southern coast of Albania and it is connected to the Ionian Sea by the Vivieri tide-channel, this being 3.6 km long, 80-160 m wide and 6 m deep. At high tide more than 2.5 million m^3 of sea water enter the lake (Pano, 1984). This coastal lake is characterized by an average depth of 15 m (maximum depth, 21 m) and a persistent stratification of the water layers, with anoxic conditions below 7-8 m. Possible anoxic crises also reach the surface layers. A great quantity of freshwater is carried into the lake from the river Bistrica at North; other freshwater inputs are supplied by the Reza channel from the Bufi lake and by diffuse underground springs.

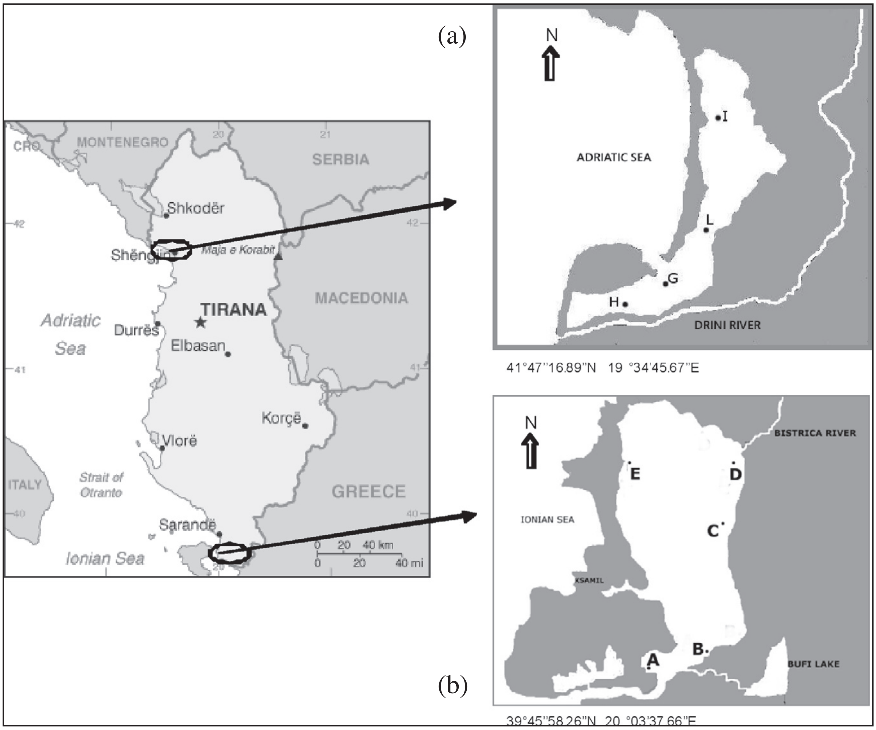

Fig. 1 - Geographical position and maps of the study area. In the maps, the sampling sites are reported for the Kune lagoon (a) and Butrinti coastal lake (b).

SAMPLING AND DATA ANALYSIS

Soft bottom samples were collected by means a Van Veen grab (bottom surface 0,1 m^2) from a boat: in the Kune lagoon samples were collected at 4 sites (G, H, I, L) in April and in August 2008, and in the Butrinti coastal lake at 5 sites (A, B ,C, D, E) in November 2007, April and August 2008. For each site 2 replicates were collected at about 2 m depth for a total of 16 samples in Kune and 30 in Butrinti (Fig.1a, 1b). The macrozoobenthos was sieved through a 1 mm. In the laboratory, the macroinvertebrates were sorted, identified at the species level and counted.Water parameters, such as dissolved Oxygen, temperature, pH, were recorded at each site in the field by a multiparameric probe (Oxy Guard Handy Gamma) and salinity was measured by a salinometer. The values of the abiotic water variables were measured down to a depth of 1m during the morning and in the early afternoon, at each station. The taxonomic benthic macroinvertebrate community structures were described through the species richness (S), abundance (N. individuals 0,2 m^{-2}), the index of species diversity (H'; Shannon and Weaver, 1948), and eveness (E; Pielou, 1969). A 3 entries table: species-stations-months was compiled with abundance data (seasonal average of specimens) and was submitted to Analysis of Correspondences (Benzecrì, 1973).

RESULTS

In the Kune lagoon a total of 1069 specimens were collected and attributed to 42 benthic macroinvertebrate *taxa*, 33 of which identified at the species level. The list of *taxa* with abundance data (number of specimens for sample) is reported in Table 1.

Annelida and Crustacea were the dominant taxonomic groups in terms of abundance and species richness with 441 specimens and 15 species, and 285 specimens and 8 species respectively, followed by Mollusca (172 specimens), larvae of Chironomidae (100 specimens) and Foronids (71 specimens of the single species *Phoronis psammofila*). Among Annelida, the Polychaeta *Aonides oxycephala* and *Paradoneis lyra*, common in coastal seawaters, were the dominant species together with *Caulleriella bioculata* and *Heteromastus filiformis*, both typical of organic enriched situations. Crustacea were mostly represented by Amphipoda *Gammarus aequicauda*, frequently found in environments influenced by freshwater, *Ericthonius brasiliensis* and *Dexamine spinosa* typical of coastal hard substrates with vegetable coverage. The most abundant Mollusca were *Scrobicularia plana* (Bivalvia) which lives in muddy sediments and can tolerate wide salinity ranges, *Pirenella conica* (Gastropoda) typical of brackish ecosystem sediments, and *Cyclope neritea* (Gastropoda) often living in sheltered coastal environments.

Species richness and diversity varied among stations and seasons, as shown in Fig. 2, with the lowest values in the inner stations and a consistent peak in number of species and individuals in the station G in spring. In such station, Diversity showed the highest values in both the seasons, progressively decreasing from the mouth to the inner stations. The low value of Eveness in station G in spring, together with the high values of species richness and abundance didn't show examples of dominace of one or few species; on the contrary, the reduced Diversity values in the stations I and L were due to the high abundance of the species *S. plana* and the larvae of Chironomidae.

In the Butrinti lake a total of 2672 specimens were collected and attributed to 49 taxa (Table 2). Crustacea and Annelida were the dominant taxonomic groups in terms of abundance and species richness with 1785 specimens and 17 species, and 689 specimens and 18 species respectively. Among Crustacea the most abundant species were *Corophium insidiosum*, *Gammarus insensibilis*, *G. aequicauda* and *C. acherusicum,* commonly living

Table 1 - List of *taxa* and relative abundance (number of individuals $0.2m^{-2}$) in the Kune lagoon sampling sites and seasons.

		SEASON OF SAMPLING	Spring 2008				Summer 2008			
		STATIONS	G	H	I	L	G	H	I	L
CNIDARIA	Anthozoa	*Paranemonia cinerea* (Contarini, 1884)	5							
NEMERTEA				17	2	5	1		3	1
MOLLUSCA	Gastropoda	*Cyclope neritea* (Linneo, 1758)		2	5	4		3	8	3
		Hydrobiidae gen. sp.							3	
		Nassarius nitidus(Jeffreys, 1867)					2			
		Nassarius pygmaeus(Lamarck, 1862)	1							
		Pirenella conica(Blainville,1826)		3			23	32	1	1
	Bivalvia	*Cerastoderma glaucum*(Poiret, 1768)						1	1	
		Ruditapes decussatus(Linneo, 1758)	2							
		Scrobicularia plana(Da Costa, 1778)	5	2	12	21		11		22
		Venerupis aurea(Gmelin,1791)	4							
ANNELLIDA	Oligochaeta						49			
	Polychaeta	*Aonides oxycephala*(Sars, 1862)	38	88	7		5			
		Armandia cirrhosa(Filippi, 1867)	1							
		Capitella capitata(Fabricus, 1780)	10							
		Caulleriella bioculata(Keferstein, 1862)	21				6		1	
		Chaetozone gibber Woodham e Chambers, 1994					2			
		Heteromastus filiformis(Claparede, 1864)	19	19	7		11	8		
		Clymenura clypeata(Saint-Joseph, 1894)				1				
		Lumbrineris latreilli Audoin &Milne-Edwards,1834					1			
		Minuspio cirrifera Wiren, 1893	6							
		Nephtys hombergi Savign, 1818	1				2			
		Nereiphylla rubiginosa(Saint-Joseph, 1888)		3	1					
		Owenia fusiformis Delle Chiaje,1841	2							
		Paradoneis lyra (Southern,1914)					6	124		
		Platynereis dumerilii(Audoin &Milne-Edwards,1833)	1							
		Spio filicornis(O. F. Muller, 1766)	1							
CRUSTACEA	Isopoda	*Cyathura carinata* (Kroyer, 1924)		1				1		
	Amphipoda	*Dexamine spinosa*(Montagu, 1813)	18							
		Ericthonius brasiliensis(Dana, 1855)	164	1					1	1
		Ericthonius undet	3							
		Gammarus aequicauda(Martynov,1931)	1		17	4			1	3
		Gammarus insensibilis Stock, 1966								3
		Gammarus undet	1			3				3
		Gammaridae juv.			7	4				
		Melita palmata (Montagu, 1804)	3	1		10				
		Microdeutopus algicola Della Valle, 1893	7	8						
		Microdeutopus ind.	4			2				
		Perioculodes aequimanus (Kossman, 1880)	12							
	Decapoda	undet	1							
INSECTA	Diptera	Chironomidae sp.			12	74			6	8
PHORONIDA		*Phoronis psammophila* Cori, 1889	2	10	11			5	43	

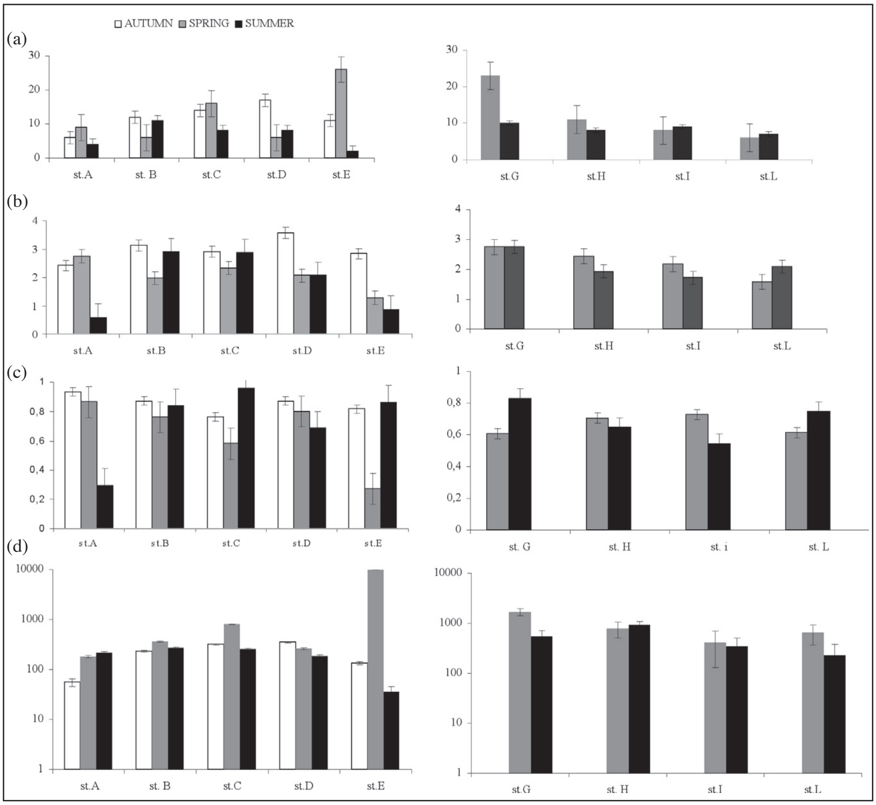

Fig. 2 - Number of species (a), diversity (b), evenness (c) and density (d) of the benthic communities in the Butrinti coastal lake (st. A, B, C, D, E) and those of Kune lagoon (st. G, H, I, L).

in sheltered coastal areas and in the fouling. Nineteen species of Polychaeta were collected, among them the most abundant being *Hydroides dianthus, Nereis pelagica*, *Minuspio cirrifera, Prionospio fallax, Heteromastus filiformis,* all being common in marine biotopes with low rates of water hydrodynamics. Mollusca were mostly represented by *Ceritium vulgatum* and juveniles of this genus. No typical alolimnobic and oligoaline species were found in this coastal lake.

Species richness showed seasonal fluctuations typically recorded in lagoon ecosystems, with peaks in spring and minima in summer, evidenced in stations A, C, and E, while opposite trends were observed in stations B and D. Seasonal trends in Diversity were comparable to those of species richness in the stations A, B and D, matched by the corresponding high values of Eveness; on the other hand, at the stations C and E the trends of Diversity and Eveness evidenced a higher patchiness in the species distribution.

Table 2 - List of *taxa* and relative abundance (number of individuals $0.2m^{-2}$) in the Butrinti sampling sites and seasons.

		SEASON OF SAMPLING	**autumn07**					**spring08**					**summer08**				
		STATIONS	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
MOLLUSCA	Gastropoda	*Cerithium vulgatum* Bruguière, 1792			4	3		11		6		1	2	1		3	2
		Cerithium juv							26	2	23		39	10		16	
		Cyclope neritea (Linneo, 1758)	1		1			2				2				1	
		Hexaplex trunculus (Linneo, 1758)					1										
		Hydrobidae gen. sp.		1			1					7					
		Muricidae gen.sp.	2									1	1				
		Nassarius nitidus (Jeffreys, 1867)			1						5	1		1		1	
		Nassarius juv					3										
	Bivalvia	*Loripes lacteus* (Linneo, 1758)				3	1										
		Mytilaster juv Linneo, 1758										6					
		Modiolus barbatus										1					
		Petricola lithophaga (Retzius, 1786)			1												
		Ruditapes decussats (Linneo, 1758)													3		
ANNELIDA	Polychaeta	*Glycera alba* (O.F. Muller, 1776)															
		Glyceridae juv		1				1	1	3				1			
		Harmothoe imbricata (Linneo,1767)					1			1							
		Heteromastus filiformis (Claparede, 1864)	3			5											
		Hydroides dianthus (Verrill, 1873)		11	24	5	9	6	6	1	10	2	1	2			
		Minuspio cirrifera Wiren, 1893		1	4		2			21		127		15	10		
		Nainereis laevigata						6	25	27	1	114		2		13	
		Nephtys hombergi Savign y, 1818	3			7	3								1		
		Nereis pelagica Linneo, 1758			5		2				11	1					5
		Nereis juv		5			1	3	1	1		28			12		
		Platynereis dumerilii (Audoin &Milne-,1833)			4					1		4		10			
		Pectinaria koreni (Malmagren, 1866)								5		19				1	
		Polycirrus sp. Grube, 1850								3							
		Polydora ciliata (Johnston, 1838)								1							
		Pomatocerus triqueter (Linneo,1767)														1	
		Prionospio fallax Soderstorm, 1920	1	3	1	7						1					
		Sabellaria spinulosa Leuckart, 1848		5	2	2	3	1	12			6		5			
		Serpula concharum (Langerhans, 1880)			4							6		5			
		Serpula vermicularis (Linneo,1767)		8	10	1				1					1		
		Syllidia armata Quatrefages, 1865		4													
		Syllis gracilis Grube, 1840				2				2	2	1					
		Syllis juv										1			9		
CRUSTACEA	Isopoda	*Cyathura carinata* (Kroyer, 1847)			1			5		1					6	1	
		Gnathia sp.		3													
	Amphipoda	*Corophium acutum* Chevreux, 1908	1			1						1					
		Corophium acherusicum A. Costa, 1851						1		85							
		Corophium insidiosum Crawford, 1937										1565					
		Corophium sp.										1					
		Ericthonius brasiliensis (Dana, 1855)				2											
		Gammarus aequicauda (Martynov,1931)				6											
		Gammarus insensibilis Stock, 1966				18						15					
		Leptocheirus pilosus Zaddach, 1844										22					
		Melita palmata (Montagu, 1804)												2			
		Microdeutopus sp. A. Costa, 1853													10		
	Decapoda	*Athanas nitescens* (Leach, 1814)										2					
		Atyaephyra desmaresti				1						1					
		Brachynotus foresti Zariquiey Alvarez, 1968				1											
		Brachynotus gemmellari (Rizza, 1839)		3		3											
		Hippolyte holthuisi Zariquiey Alvarez, 1953				2						17			8		
		Processa acutirostris Nouvel & Holthius		1													
ECHINODERMATA	Ophiuroidea	*Amphipholis squamata*			1												

Table 3 - Salinity, temperature and dissolved oxygen seasonal mean values (± SE) in sample stations of Butrinti and Kune.

Butrinti	S(‰)	T(°C)	O(mg l^{-1})		**Kune**	S(‰)	T(°C)	O(mg l^{-1})
st.A	26,33±0,96	19,57±0,94	7,40±1,57		st.G	37,10±0,37	22,50±1,10	6,00±1,73
st.B	16,33±0,46	20,00±0,94	7,03±1,53		st.H	38,50±1,88	23,50±0,93	6,90±1,72
st.C	19,33±0,15	19,47±0,98	6,93±1,52		st.I	36,50±3,85	24,60±0,83	7,25±1,90
st.D	25,33±0,40	20,33±0,80	7,07±1,53		st.L	34,00±2,91	25,10±0,82	7,30±1,91
st.E	22,00±0,56	17,73±0,82	7,73±1,61					

The mean salinity, temperature and dissolved oxygen seasonal values are reported for each environment in Table 3. In Kune the highest salinity values were recorded, ranging between 34-38‰ with maxima in the stations H and G. Salinity showed a wider range of values in Butrinti, ranging between 16-26‰ with highest values in the stations A and D and lowest values in station B. Smaller ranges in temperature and dissolved oxygen were observed in both Butrinti and Kune, where respectively varied between 17-20 °C and 22-25 °C and 6.9-7.7 and 6.0-7.3 mg l^{-1}. Similar results are available by literature data, save for the dissolved oxygen concentrations recorded during the dystrophic crises occurred in the previous study period (Peja *et al.*, 1996).

The ordination model obtained from the Correspondence Analysis is illustrated in Fig. 3 and 4 for station points and species points respectively. The first two factorial axes (CAI, CAII) accounted for 23.29% and the 19.14% of the total variance respectively. The species points and the station points formed a triangular cloud. The sites of Kune were located in the third and fourth quadrant: along the axis II stations G and H, close to the sea inlet, were opposed to stations I and L located in the inner part of the lagoon and the first ones were characterized by several marine species (*e.g. Nassarius pygmaeus, Owenia fusiformis, Loripes lacteus, Dexamine spinosa, Paradoneis lyra*) distributed near the positive pole, together with only few opportunistic species, such as *Capitella capitata, Caulleriella bioculata, Spio filicornis,* and the second ones by some typical oligoahaline species (*e.g. Cerastoderma glaucum, Scrobicularia plana, Gammarus aequicauda*) located near the negative pole. The station points of Butrinti occupated the positive pole along the axis I, which was characterized by a lot of species typical inhabiting the marine shallow coastal areas, such as: *Hydroides dianthus, Glycera alba, Syllidia armata, Nainereis laevigata, Pectinaria koreni,* while both brackish-water and saprobic species were lacking.

DISCUSSION AND CONCLUSIONS

The two Albanian brackish water systems showed different geomorphological and hydrological characteristics and macrobenthic communities. The multivariate analysis suggested ecological differences between the water systems, evidencing two well-separated point assemblages in the factorial space.

Kune is a small and shallow euhaline lagoon subiect to reduced fluctuations of abiotic variables; its waters are completely reshuffled by atmospheric agents, allowing the complete oxygenation of the bottom. The results of the multivariate analysis evidenced a pattern of benthic community, among which there were (a) a lot of marine species preferring the sheltered coastal areas, such as *Cyclope neritea, Nassarius nitidus, Ruditapes decussatus, Armandia cirrhosa, Nereiphylla rubiginosa, Gammarus insensibilis, Microdeutopus algicola*; (b) typical oligohaline species, common in brackish environments, such as *Pirenella conica, Cerastoderma glaucum, Scrobicularia plana, Cyathura carinata, Gammarus aequicauda*; (c) only few opporunistic species, *Capitella capitata, Heteromastus filiformis, Caulleriella bioculata,* which surprisingly were found near the lagoon inlet. The distribution of such species assemblages makes it possible to distinguish two main ecological sectors in the lagoon: the area interested by the sea water entrance in the southern part of the lagoon, characterized by most of the species and the highest abundances and diversity; and a inner confined zone in the northern part, colonized by a reduced number of species and by Chironomidae larvae, which generally tolerate anoxic conditions. Very low seasonal variations in the number of macrobenthic *taxa* and diversiy emerged, demonstrating a well-structurated benthic community, with a persistent composition, likely linked to a good degree of connettance (Pimm, 1984) in the lagoon. The peaks in number of *taxa* and specimens occurring at the southern area in spring may be attributed to the recruitment effect from the connected marine water areas, which mainly extended in such sector of the lagoon without expanding extensively inside the lagoon.

It is known that an indication of environmental stress can be derived by diversity values; thus Vincent *et al*. (2002) proposed a measure of ecological quality for transitional and coastal waters. In this regard, the lagoon of Kune is of “moderate” ecological quality, being $2 \leq H' \leq 3$ in all the stations in both spring and summer (except the stations I and L respectively in spring and summer).

Butrinti is a wide meromictic system with a permanent stratification of the waters; the surface, less salty layer extends up to 7-8 m in depth, over the more salty one. Such a stratification, together with suspended materials avoiding the penetration of the light, severely affects the life on the bottom, cutting off the oxygen availability from this zone (Peja *et al*., 1996).

Therefore the zoobenthic community has colonized only the shallow coastal bottoms hosting typically many marine species (*Cerithium vulgatum*, *Nassarius nitidus*, *Ruditapes decussatus*, *Glycera alba*, *Nepthys hombergii*, *Nereis pelagica*, *Platynereis dumerilii*, *Prionospio fallax*, *Sabellaria spinulosa*, *Serpula vermicularis*, *Hydroides dianthus, Corophium acherusicum*, *Brachinotus gemmellarii),* together with other species common inhabiting sheltered coastal areas (*Cyclope neritea*, *Loripes lacteus*, *Minuspio cirrifera*, *Nainereis laevigata*, *Cyathura carinata*, *Corophium insidiosum, Gammarus aequicauda*, *Melita palmata*). The alolimnobic elements characteristic of brackish environments and typical opportunistic species were lacking. Species richness and diversity showed variability between stations and seasons. The peaks in population richness and abundance due to the typical spring recruitment were evident in 3 of the 5 stations, while moderate variation in diversity and evenness were manifest in all the stations, stressing the persistent capability of the benthic community to tolerate the strong environmental variations occurring in brackish ecosystems (Guelorget and Perthuisot, 1992). The extremely high number of specimens recorded in the station E can be ascribed to the patchy distribution of some organisms, such as some Amphipoda, *Corophium insidiosum*, *C. acherusicum,* which aggregate in response to the patchiness of resources, represented by the algal and plant covering, in this case essentially *Zoosera noltii*. A clear difference in species richness and diversity from the mouth to the more confined zone of the lake, possibly corresponding to a confinement gradient (Guelorget and Perthuisot, 1992) was not observed in Butrinti. All the stations, except for a few limited seasonal variations, showed similar values in diversity and eveness. The influx of marine water combined with freshwaters (Bistrica river, Bufi Lake, subterranean springs) causes complex and balanced environmental conditions that support the proper functioning of the lake, at least in the surface layers. In terms of diversity values (according Vincent *et al*., 2002) also the Butrinti coastal lake is of "moderate" ecological quality, being $2 \leq H' \leq 3$ in all the stations in both spring and summer (save A in spring and E in spring and summer). The comparison with an other Albanian lagoon ecosystem, Karavasta, revealed a heterogeneous pattern of taxonomic composition of macroinvertebrates, being the benthic community of Karavasta the richest in term of number of species, which were distributed, indeed, in the most large wetland of Albania. In terms of species composition, a remarkable biodiversity in Albanian lagoons emerged, rejecting the hypothesis of homogeneity of benthic macrofauna in lagoon ecosystems, but demostrating a similar good ecological conditions in the investigated Albanian brackish systems (Beqiraj *et al*., 2007; Nonnis Marzano *et al*., 2003).

The ecological quality of Kune and Butrinti, indeed, is still acceptable; notwithstanding this, their situations are at a weak balance point. In the Kune

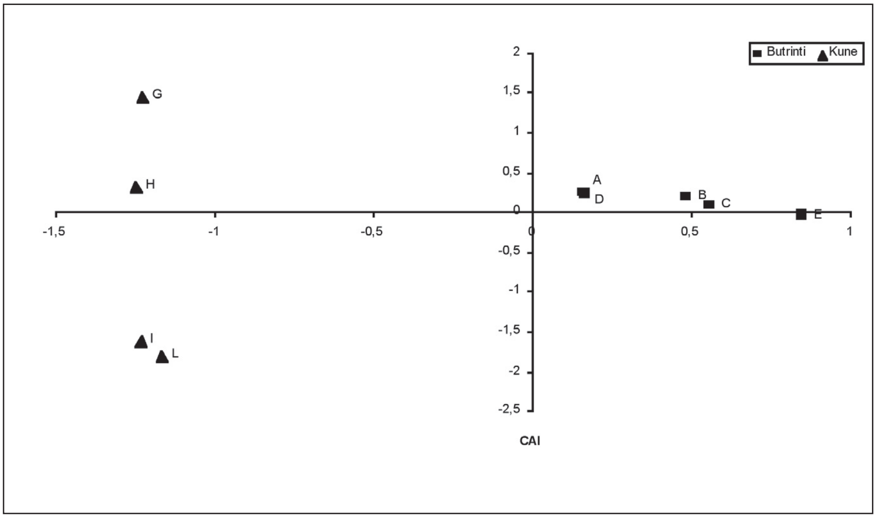

Fig. 3 - CA ordination model of the station-points of the Butrinti coastal lake (A,B,C,D,E) and the lagoon of Kune (G,H,I,L).

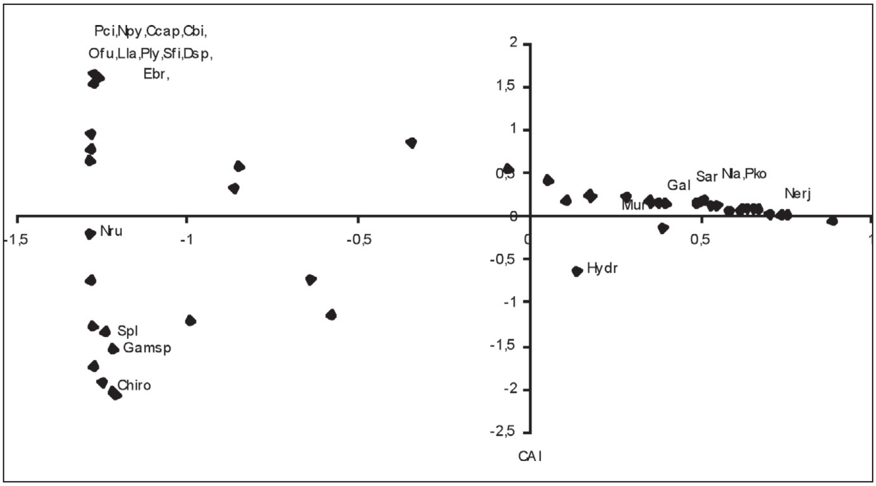

Fig. 4 - CA ordination model of the species-points. *Paranemonia cinerea* = Pci, Muricidae gen.sp. = Mur, *Nassarius pygmaeus* = Npy, *Loripes lacteus* = Lla, *Scrobicularia plana* = Spl, *Capitella capitata* = Ccap, *Caulleriella bioculata* = Cbi, *Glycera alba* = Gal, *Hydroides dianthus* = Hydr, *Naineris laevigata* = Nla, *Nereis* juv = Nerj, *Nereiphylla rubiginosa* = Nru, *Owenia fusiformis* = Ofu, *Paradoneis lyra* = Ply, *Pectinaria koreni* = Pko, *Syllidia armata* = Sar , *Spio filicornis* = Sfi, *Dexamine spinosa* = Dsp, *Ericthonius brasiliensis* = Ebr, Gammaridae sp = Gamsp, Chironomidae gen. sp. = Chiro

lagoon, the limited water exchanges with the sea guarantee a good degree of marinization only in the south part , but they are well-balanced with the freshwater inputs, which are not direct but diffuse. The hyperhaline levels reached in summer did not strictly affect the macrobenthic community, revealing the high capability of the population to resist to the strong variability of environmental parameters. In the Butrinti lake, the influx of the sea-water combined with the freshwater produced a complex and balanced environment spreading even to areas remote from the mouth.

The two environment destiny is linked to future pressure of human activities. Sustainable management plans and practices combined with conservation policies are the key to ensure long term functioning to such ecosystems.

REFERENCES

Barnes R.S.K., 1991 – European estuaries and lagoons : a personal overview of problems and possibilities for conservation and management. *Aquatic Conservation Marine and Freshwater Ecosystems*, 1: 79-87.

Benzecrì J.P., 1973 - *L'Analyse des Données. L'analyse des Correspondances*. Dunod, Paris, 2: 628pp.

Beqiraj S., 2001 - Mollusca – Butakët. – Në "Biodiversiteti në ekosistemin bregdetar Delta e Vjosës – Laguna e Nartës". UNDP, GEF/SGP, SHBSH. Tiranë: 46–52.

Beqiraj S., 2003 - Të dhëna taksonomike dhe ekologjike për malakofaunën e Lagunës së Vilunit dhe karakteristika të habitateve të saj. Buletini Shkencor–Seria e Shkencave Natyrore. Universiteti i Shkodrës "Luigj Gurakuqi". Shkodër, **53**: 99–109.

Beqiraj S., 2004 - Assessment of the situation of malacofauna in Karavasta Lagoon. – in "Dinamica Ambientale delle Aree Umide della Fascia Costiera Albanese", Università degli Studi di Bari: 67–73.

Beqira S., Laknori O., 2006 - Vlerësim taksonomik dhe ekologjik i malakofaunës së Lagunës së Patokut. Buletini i Shkencave Natyrore – Universiteti i Shkodres, **56**: 129–144.

Beqiraj S., Pinna M., Basset A., Nikleka E., Fetahu E., Doka E., Ismailaj M., Barbone E., Sangiorgio F., Fedele. M., 2007 - Preliminary data on the macrozoobenthos of the Albanian coastal lagoons (lagoons of Patok, Karavasta, Narta). *Transitional Waters Bulletin*, 1: 37-43.

Beqiraj S., Sulejmani E., 2003 - Të dhëna taksonomike dhe ekologjike për malakofaunën e Lagunës së Karavastasë dhe karakteristika të habitateve të saj. Studime Biologjike. Tiranë: 97–110.

Cognetti G., Maltagliati F., 2008 - Perspectives on the ecological assessment of transitional water. *Marine Pollution Bulletin,* **56**: 607-608.

Cullaj A., Haskob A., Mihoc A., Schanzd F., Brandle H., Bachofenf R., 2005 - The quality of Albanian natural waters and the human impact. *Environment International,* 31: 133-146.

EC, 2000 – Directive of the European Parliament and of the Council 2000/60/EC Establishing a Framework for Community Action in the Field of Water Policy.

<http://europa.eu/eur-lex/pri/en/oj/dat/2000/l_327/1_32720001222en00010072.pdf>.

Guelorget O., Perthuisot J.P., 1992 - Paralic Ecosystem. Biological organization and functioning. *Vie Milieu,* 42(2): 215-251.

Munari C., Mistri M., 2008 – Biodiversity of soft-sediment benthic communities from Italian transitional waters. *Journal of. Biogeography* **35**: 1622-1637.

Nonnis Marzano C., Scalera Liaci L., Gristina M., Gravina F., Fianchini A., Pambuku A., Corriero G., 2003 - Distribuzione delle comunità macrobentoniche nel sistema lagunare di Karavasta. Atti: Salvaguardia e sviluppo sostenibile dell' area lagunare di Karavasta (Albania). Università degli studi di Bari. Edizioni dal Sud: 67-73.

Pano, N., 1984 - *Hydrology of the Albania*. Monograph. Institute of Hydrometeorology, Academy of Sciences, Tirana, Albania, (in Albanian): 424 pp.

Peja N., Vaso A., Miho A., Rakaj N., Crivelli A., 1996 - Characteristics of Albanian lagoons and their fisheries. *Fisheries research* **27**: 215-225.

PHARE, 2002 **-** *PHARE Programme Albania. Strategy for Albanian Lagoon Management*. Government of Albania, European Commission, Final Report, 155pp.

Pielou E.C., 1969 - An introduction to mathematical ecology. N.Y., Willey (ed), 325 pp.

Pimm S.I., 1984 - The complexity and stability of ecosystems. *Nature*, **307**: 321-326.

Shannon C.E., Weaver W., 1949 - *The mathematical theory of communication*. Urbana Illinois University press, 117 pp.

Vincent S., Heinrich H., Edwards A., Nygaard K., Haythornthwite J., 2002 - Guidance on Typology, classification and reference conditions for transitional and coastal waters. Commission Européenne, Cis Working Group 2.4 (coast): 119 pp.