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A PRELIMINARY PLAN FOR THE STUDY OF ZOOPLANKTON IN THE GULF OF VLORË (ALBANIA)

RIASSUNTO

Il Golfo di Vlorë è l'unico mare "interno" della costa albanese. Presenta una profondità massima di 55 m ed è separato dal Canale d'Otranto dalla penisola Karaburun. Il sito è di particolare interesse per la nascente economia peschereccia albanese, rappresentando un sito nursery naturale sia per le specie pelagiche che per quelle rivierasche.

Un survey sulla distribuzione e la composizione dello zooplankton è stato organizzato a scopo dimostrativo, nell'ambito del progetto per la fondazione di un Dipartimento di Ecologia (all'interno del Protocollo di Cooperazione Scientifica e Culturale tra Italia e Albania) presso l'Università di Vlorë.

La campagna di prelievo è stata organizzata in una sola data (26 Giugno 2003). L'area è stata suddivisa in 7 stazioni di campionamento (6 nel Golfo, 1 nel Canale d'Otranto). I campioni sono stati prelevati per trascinamento di retini da plancton in acqua. In ciascuna stazione sono stati usati due retini a differente maglia (50 e 200 μm), per un totale di 14 campioni.

La composizione di specie, la loro abbondanza, e la distribuzione spaziale sono state studiate statisticamente. Un totale di 94 categorie tassonomiche è stato riconosciuto nei campioni. Solo per 34 di loro si è potuti giungere a livello di specie, a causa della abbondante presenza di stadi larvali. Copepoda (43 categorie) e Tintinnina (16 categorie) erano i gruppi più rappresentati. Le differenze tra le stazioni del Golfo sono risultate inferiori di quelle con la stazione esterna (canale d'Otranto).

La presenza di uova e larve di pesci (soprattutto appartenenti al gen. *Engraulis*) è stata documentata. Anche larve di Stomatopoda sono state raccolte, a testimonianza del potenziale ruolo di nursery per specie economicamente importanti della baia.

La composizione del plancton ha consentito di separare le stazioni (1 e 2) a Nord (ricche di veliger di *Bivalvia*) come influenzate dalla presenza dei piani

sabbiosi. L'abbondanza di *Acartia italica*, *Paracartia latisetosa*, *Centropages kroyeri*, e *Oithona nana*, ci ha consentito di individuare nella stazione 6 il polo di maggiore confinamento.

SUMMARY

The Gulf of Vlorë is the only internal sea of the Albanian coastline. It has a maximum depth of 55 m and it is separated from the Otranto Channel by the Peninsula Karaburun. The site is of paramount interest for the Albanian fishing, being a natural nursery for many fish species of economic importance.

In the framework of a plan for the foundation of a Department of Ecology at the Technological University of Vlorë, a first demonstrative survey on the zooplankton composition and distribution has been carried out in the Gulf of Vlorë, to standardise investigation methods.

The demonstrative survey was performed on a single date (June 2003), on 7 different sampling stations (six in the Gulf of Vlorë, one in the Otranto Channel), on the superficial water layer, and with two different mesh sized nets (50 and 200 µm, for a total of 14 samples) to collect micro and meso-zooplankton.

Species composition, abundance, and distribution were statistically studied (Analysis of Variance). A total of 94 categories were recognised. Only 34 of them were recognised at the species level, due to the abundance of larval stages. Copepoda (43 categories) and Tintinnina (16 categories) were the most representative components. Differences between the "Gulf" stations were less significant than those resulting from the comparison with the "Otranto Channel" station. The presence of fish larvae and eggs (with the genus *Engraulis* well recognisable) was recorded. Also stomatopod larvae (erichteus of Squillidae) were found, which contributed to affirm the potential role of this inlet as nursery area.

The confinement degree of stations was described on the basis of indicator species belonging to the copepod families Acartiidae (Calanoida) and Oithonidae (Cyclopoida), and of the body size of adults belonging to different copepod populations of the same genus (*Centropages*). Station 2 showed the highest number of zooplankton categories (61), and the co-presence of *Acartia clausi*, *Paracartia latisetosa*, *Centropages kroyeri*, and *Oithona nana*, which allowed to define it as the most confined station.

Micro-zooplankton resulted more abundant in stations 1, and 2, along the North coast of the Gulf, owing this result essentially to Bivalvia (veliger), early stages of Oithonidae, and Tintinnina.

A plan for future studies has been proposed to monitor the presence (either in

space and in time) of economically important larvae to understand life cycle timing of their species in the Gulf of Vlorë.

INTRODUCTION

The zooplankton has never been studied in the Gulf of Vlorë (AL), the only semi-enclosed sea of Albania. To tell the truth, the entire Albanian planktonology is scantily developed, basing its knowledge mainly on the research carried out in the neighbouring open Southern Adriatic sea (see HURE and KRSNIC, 1998; HAJDERI, 1998; for copepods), or along the Italian coast, just in front of Albania (MOSCATELLO *et al.*, 2004). The zooplankton of confined and/or semi-enclosed areas, however, is different from that of open sea either in the quality of species or in their numeric abundance. From Albanian coast, only MIGLIETTA *et al.* (1997) reported a brief list of zooplankton species identified (as eggs) in bottom sediments from a confined brackish water lake (Butrint).

In the framework of a project for the institution of a Department of Ecology at the Vlorë University, a demonstrative study was carried out on the zooplankton of the Vlorë Bay, which constitutes the first faunal report of marine coastal plankton from this area.

MATERIALS AND METHODS

Micro- and meso-zooplankton were collected in the Vlorë Bay, only at one date (26 June 2003) in 7 different stations (1 outside the Bay, in the Otranto Canal, see Fig. 1) with two different mesh sized (50 and 200 μm) nets. The filtered volume of water for each sample (see Table 1) was assumed as sufficiently representative

Tab. I - Description (geographic coordinates) of sampling station positions, and filtered water (volume) for each sample (collected either with 50 or with 200 μm mesh sized net)

sampling stations	geographic coordinates		filtered water (m^3)	
	long E	lat N	(50 μm)	(200 μm)
1	19° 26' 55"	40° 27' 37"	0,98	8,00
2	19° 24' 29"	40° 27' 43"	0,98	8,00
3	19° 21' 12"	40° 26' 43"	0,98	8,00
4	19° 23' 34"	40° 24' 03"	0,98	8,00
5	19° 27' 02"	40° 24' 43"	0,98	8,00
6	19° 29' 10"	40° 26' 09"	0,98	8,00
7	19° 18' 33"	40° 24' 35"	0,98	8,00

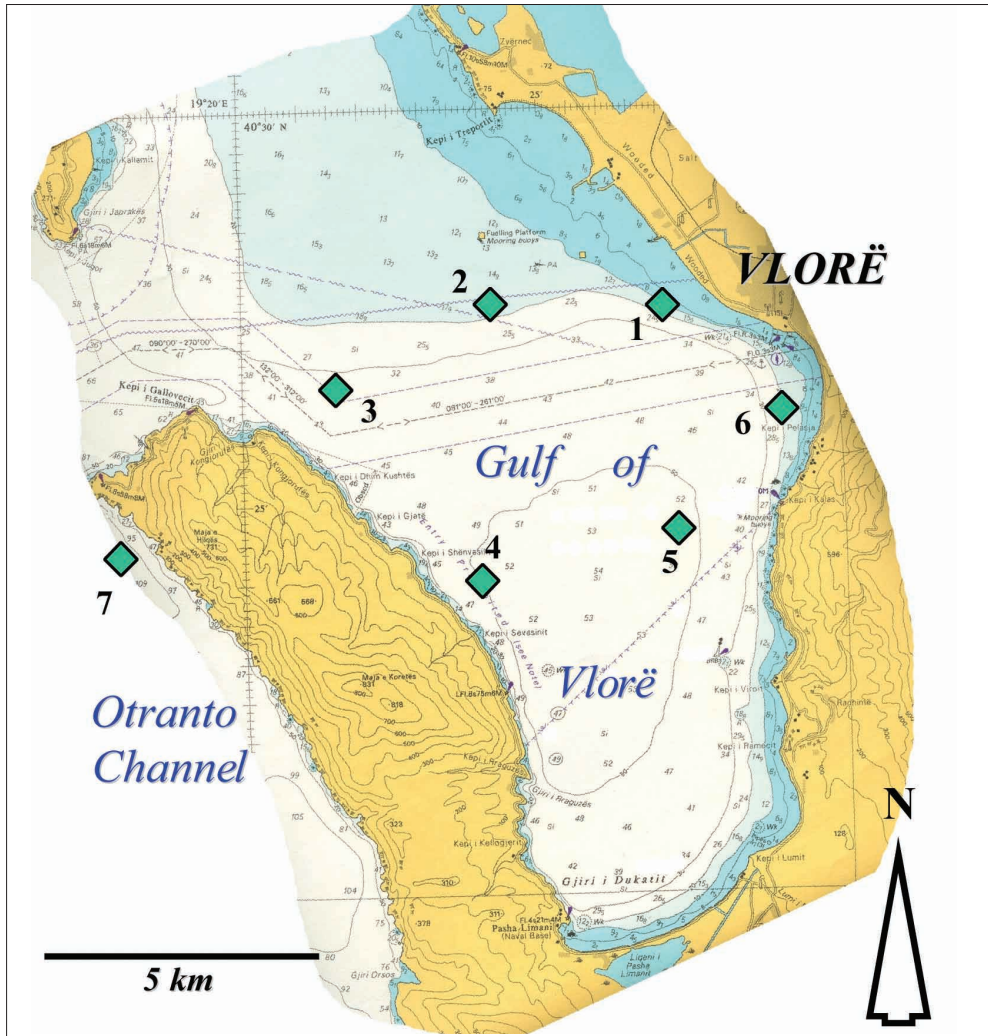


Fig. 1 - Distribution of sampling stations (indicated with numbers from 1 to 7) in the area studied.

of the environment in each station, and replicate collections were not executed. Samples (total, 14) were studied under the compound microscope, and specimens were grouped according to 94 categories. Abundance data from 50 µm and 200 µm net samples were not summarised, but the highest number was chosen (of the two) for each species (when it was represented in both samples). Not all categories were at the species level because in many cases (e. g., larval or juvenile stages) the species identification was not possible. A comparison of stations was carried out with an Analysis of Similarities for unreplicated data in primer (CLARKE and WARWICK, 1994).

RESULTS and DISCUSSION

The June zooplankton of the Vlorë Bay was represented by 94 categories (Tab. II). It was dominated by copepods (43) and tintinnids (16) with *Oithona* specimens at about the 50% of total numbers. Meroplankton was represented by 24 categories. All the species are here reported for the first time from the area, and they are all already reported from the Southern Adriatic sea, with the only exception of the Tintinnina *Acanthostomella conicoides*.

The studied area resulted well differentiated, because only 22 categories (23%) were ubiquitous (they were found in all the 7 stations). This result is more or less maintained even if the station 7 (the only one external to the Bay) was not considered (the ubiquitous categories, considering only the Bay stations, rise to 30). Among these representative categories, we found 5 Copepoda species (in order of abundance: *Oithona nana*, *Centropages kroyeri*, *Isias clavipes*, *Euterpina acutifrons*, *Temora stylifera*), 2 Cladocera (*Evadne spinifera*, *E. nordmanni*), and 2 Tintinnina (*Eutintinnus fraknoi*, *Tintinnopsis lindeni*).

Exclusive categories (typical of only one station) were 27, with 7 of them in the station 6, which resulted the most characterised.

Copepoda Acartiidae (6 categories), *Euterpina acutifrons* (nauplii and copepodids), and *Paracalanus* copepodids, typical components of semienclosed, coastal, environments, were completely absent from the outer station 7 (in the Otranto Channel).

Eggs and larvae of commercial fish species were well represented, witnessing the possible role of this Gulf as a nursery area. The co-occurrence of the copepod *Centropages kroyeri* with the fish *Engraulis encrasicolus* (eggs and larvae) has been found which could be of some interest: in other Mediterranean sites it seems that the fish searches for the copepod presence, for the choice of the spawning site and/or time, probably because the copepod is at feeding base of the early developmental stages of fishes (MAHJOUB *et al.*, 2005). The Gulf of Vlorë could be an ideal site for the study of these ecological interactions.

Among the 94 recorded categories, ecological indicators of confinement (species which prefer enclosed areas and/or characterised by smallest size and high abundance) were recognised in stations 1, 2, and 6, which also showed the highest values of population density. In particular, copepods of the species *Paracartia latisetosa* (typical of confined waters) have been found abundant in station 6, which can be for this reason considered the most confined area among those studied.

The statistical analysis showed that the Bay stations grouped together and apart from the only external station (the 7) (Fig. 2). In the Bay, zooplankton of stations studied indicated other three situations which could be interpreted as:

- confined, with sandy coast, position (stations 1,2,3);
- confined, with rocky coast, position (stations 4,6);
- pelagic (station 5).

Even if the statistical comparison is not supported by a sufficient number of replicates per site (either in space and in time), we can consider that the sampling of zooplankton carried out by a net towing was well representative of the situation in each site. For this reason we are sure that the study gave us correct indications to organize, for the future, a sampling plan which will consider the possible (and perhaps evident) space-functional diversity of the Bay.

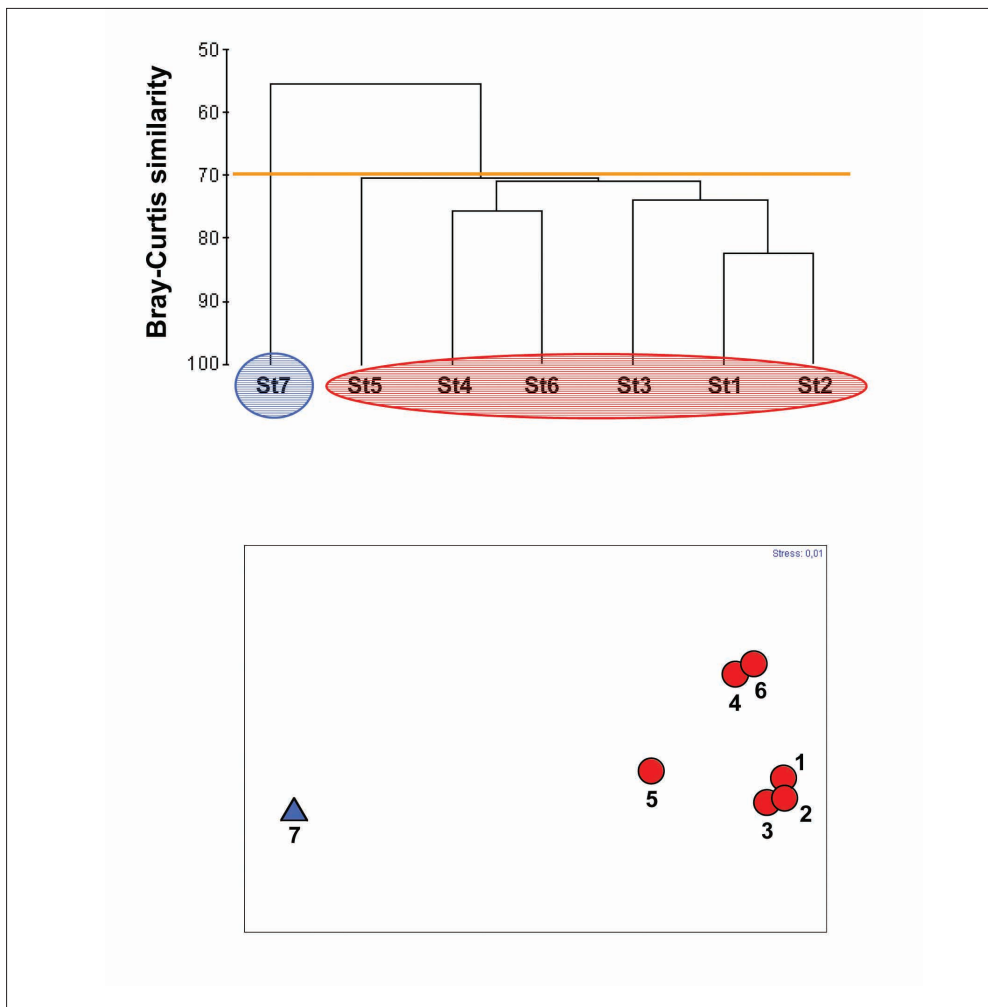


Fig. 2 - Clusterization and nMDS plot of plankton distribution in the Gulf of Vlora. Matrix of 7 variables (stations) per 94. Data not transformed.

		1	2	3	4	5	6	7	
Copepoda	eggs Centropagidae	0	0	34	0	0	96	0	
	spiny eggs Calanoida	202	206	135	81	0	160	87	
	eggs Oithonidae	0	0	0	0	0	0	609	
	nauplii Acartiidae	269	376	270	190	25	288	0	
	nauplii Calanidae	0	0	0	54	50	96	0	
	nauplii Calanoida undet.	0	0	337	0	0	0	0	
	nauplii Centropagidae	539	1094	270	352	172	320	80	
	nauplii <i>Clausocalanus</i>	202	308	438	406	319	128	1189	
	nauplii <i>Euterpina</i>	169	171	304	595	100	512	0	
	nauplii <i>Labidocera</i>	438	35	0	54	50	96	0	
	nauplii Longipediidae	169	103	101	63	25	64	1	
	nauplii <i>Microsetella</i>	101	0	0	0	0	0	0	
	nauplii Oithonidae	7678	8034	5439	3407	3870	3712	2262	
	nauplii Oncaeidae	370	240	337	0	0	0	0	
	nauplii Pontellidae	10	3	1	7	21	7	30	
	nauplii Temoridae	101	103	0	108	0	0	203	
	copepodids Acartiidae	96	171	34	325	74	256	0	
	copepodids Calanoida undet	0	0	0	0	11	0	0	
	copepodids <i>Calocalanus</i>	0	0	0	27	0	0	0	
	copepodids Centropagidae	590	308	1001	735	182	1156	261	
	copepodids <i>Clausocalanus</i>	741	103	479	270	319	160	493	
	copepodids Corycaeidae	10	13	13	109	21	19	12	
	copepodids <i>Eucalanus</i>	0	35	0	27	0	32	29	
	copepodids <i>Microsetella</i>	0	0	0	0	0	32	0	
	copepodids Longipediidae	0	0	0	0	0	9	0	
	copepodids Oithonidae	2728	2427	2223	1055	2082	2400	5183	
	copepodids Oncaeidae	135	205	236	0	0	9	0	
	copepodids <i>Paracalanus</i>	68	0	0	0	0	0	0	
	copepodids Pontellidae	0	0	0	0	0	0	1	
	<i>Acartia clausi</i>	70	3	1	0	21	7	0	
	<i>Acartia italica</i>	0	0	0	0	0	7	0	
	<i>Centropages kroeyeri ponticus</i>	100	80	280	147	161	564	12	
	<i>Centropages typicus</i>	0	0	0	0	0	64	0	
	<i>Clausocalanus arcuicornis</i>	10	5	0	0	0	28	0	
	<i>Euterpina acutifrons</i>	172	106	310	108	71	163	0	
	<i>Isias clavipes</i>	50	5	91	602	128	743	1	
	<i>Oithona nana</i>	220	40	111	35	139	345	224	
	<i>Oithona plumifera</i>	0	0	0	0	0	32	0	
	<i>Paracalanus</i> sp	60	13	455	690	289	150	0	
	<i>Paracartia latisetosa</i>	0	1	7	5	0	103	0	
	<i>Pontella lobiancoi</i>	7	1	13	14	11	0	0	
	<i>Pteriacartia josephinae</i>	3	0	0	0	11	7	0	
	<i>Temora stylifera</i>	34	69	101	54	32	128	2	
Total	15140	14052	12852	9439	8184	11637	9983		
Cladocera	<i>Evadne spinifera</i>	240	43	143	385	437	376	240	
	<i>Evadne nordmanni</i>	20	3	39	21	11	38	8	
	<i>Penilia avirostris</i>	0	0	1	0	0	0	0	
	<i>Podon polyphemoides</i>	0	0	3	0	0	0	0	
	Total	260	46	186	406	448	414	248	
Cirripedia	nauplii Cirripedia Balanomorpha	0	3	0	2	0	9	0	
	cypris	3	1	0	0	11	3	1	
Malacostraca	zoa Euphausiacea	0	0	1	0	0	0	0	
	zoa Decapoda Brachyura	0	2	1	0	0	19	0	
	metanauplius Decapoda Natantia	0	3	1	0	0	9	0	
	zoa Decapoda Natantia	3	1	0	0	0	0	0	
	Isopoda undetermined	0	0	0	0	0	0	1	
	Erietheus Stomatopoda	3	1	1	0	0	0	0	
	undetermined	0	0	0	0	11	0	0	
Acari	<i>Globigerina</i> sp	0	1	0	5	11	0	3	
	Spumellariidae	337	171	169	216	123	192	0	
Protoctista	<i>Acanthostomella conicoideis</i>	573	35	34	81	74	0	0	
	<i>Epiplocylix acuminata</i>	0	0	0	163	0	32	0	
	<i>Eutimninus apertus</i>	0	0	0	0	0	64	0	
	<i>Eutimninus fraknoi</i>	236	445	135	270	221	96	261	
	<i>Eutimninus lusus-undae</i>	405	137	35	81	0	192	0	
	<i>Favella azorica</i>	0	0	0	0	0	0	29	
	<i>Favella serrata</i>	0	35	0	0	0	0	0	
	<i>Metacyclis jorgenseni</i>	169	69	0	54	0	224	0	
	<i>Rabdonella spiralis</i>	0	0	203	108	0	32	87	
	<i>Stenosemella nivalis</i>	34	0	0	0	0	0	0	
	<i>Tintinnopsis compressa</i>	1078	1025	169	216	833	288	0	
	<i>Tintinnopsis karajacensis</i>	169	137	0	0	0	0	0	
	<i>Tintinnopsis lindeni</i>	775	445	101	54	50	32	87	
	<i>Tintinnopsis tregouboffi</i>	0	0	34	0	0	0	0	
	<i>Undella clevei</i>	0	0	0	27	0	0	0	
	<i>Xystonella longicauda</i>	0	0	34	27	0	0	0	
	Hydrozoa	Hydromedusae indet	69	35	1	2	11	0	1
		Siphonophora	10	0	0	54	43	0	1
	Bryozoa	cyphonautes	10	1	0	109	0	3	16
Platyhelminthes	larva Muller	0	0	0	0	0	9	0	
	undetermined	34	2	34	27	11	19	1	
Chaetognatha	echinopluteus	0	10	34	0	21	0	0	
Echinodermata	ophiopluteus	3	0	0	0	0	0	0	
	<i>Oikopleura</i> sp.	40	69	69	54	74	96	29	
Urochordata	egg Osteichthyes undetermined	34	3	7	2	25	0	2	
	egg <i>Engraulis</i> spp	3	1	7	7	0	9	1	
	larvae Osteichthyes undetermined	34	1	2	5	0	3	0	
	Thecosomata Pteropoda <i>Creseis</i>	3	3	7	2	11	3	725	
Mollusca	veller Bivalvia	2593	2290	471	433	319	544	58	
	veller Gastropoda	876	926	182	1386	300	3704	264	
Polychaeta	trochophore Polychaeta	0	0	0	109	0	0	0	
	larvae Chaetopteridae	0	0	0	27	0	0	0	
	larvae Syllidae	0	0	0	82	0	0	4	
	larvae Spionidae	0	0	0	109	0	32	0	
	larvae Polychaeta undetermined	404	1	68	7	0	19	0	
	undetermined	0	35	0	0	0	0	29	
Nematoda	Total	7898	5888	1800	3719	2149	5633	1600	
Zooplankton total		23298	19986	14838	13564	10781	17684	11831	

Tab. II - List of zooplankton categories found in the samples collected in 7 different sites of the Vlorë area. Numbers indicate the abundance (referred to 1 m³ of water).

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