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AN INVENTORY OF INVERTEBRATE FAUNA OF ALBANIA AND MACEDONIA LAKES

ABSTRACT

The results of faunal studies carried out in the last 13 years (2005-2017) are reported, regarding 52 different water sites in Albania and Republic of Macedonia. Lakes (natural and artificial), and ponds (temporary and perennial) have been investigated. A total of 155 *taxa* have been identified in the plankton, and a particular detail has been devoted to Crustacea, which were subdivided in 101 *taxa*. Many Cladocera (31 species) and Copepoda (36 species) were new at least for one of the two Countries. Eight genera are here reported for the first time for the whole geographic area. The present investigation contributes to fill in the gap existing among Albania and Macedonia due to a different attention paid to the fauna of the two Countries, with Cladocera more studied in Albania and Copepoda more studied in Macedonia. High mountain lakes, however, have been scarcely considered in the past faunal studies, and their faunal assemblages contributed noteworthy to the knowledge of the regional biodiversity.

INTRODUCTION

Faunal studies are based on ancient scientific tradition, but they never exhaust their efficacy due the continuous variation of biodiversity and/or the continuous updating of technologies addressed to collect and study biological material. In addition, even some geographic parts of otherwise well known territories could be poor studied or even ignored from a particular point of view.

The invertebrate fauna of Albanian freshwaters is one of the less studied of Europe. Macedonia, on the other hand, concentrated studies on particular *taxa*

and/or lakes (e.g., lake Ohrid). Parenzan (1931) was the first to attempt a faunal list of planktonic invertebrates (only Cladocera) in five large lakes of Albania, and Petkowsky (1987) dedicated his life to the study of Macedonian freshwater invertebrates. Recently (Shehu *et al*., 2009; Alfonso *et al*., 2011; 2014), a series of studies have been carried out on the zooplankton of selected sites, which allow both the updating of the situation and the comparison of different collections. Bledzki and Ryback (2016) in a review of European planktonic crustaceans, assigned to Albania and Macedonia a total of 104 species (54 Cladocera, 24 Calanoida, 25 Cyclopoida) distributed in 51 different genera. The Albanian species richness is however different from the Macedonian one, according to the crustacean group considered. In fact, Cladocera dominate the Albanian list with 41 species against 21 species of Copepoda; these, on the contrary, are more abundant than Cladocera in Macedonia (46 vs 23 species) (Tab. 1). As regarding the studied sites, lake Ohrid is undoubtedly one of the best studied environment of the planet (Albrecht and Wilke, 2008), with 121 entomostracan Crustacea, although mostly benthic species, with a considerable portion of endemism. Reducing the analysis to just the planktonic species (because these are the object of the present paper), the species list of lake Ohrid reduces to 21 species that cannot be considered as satisfactorily representative of the whole geographic area (Albania and Macedonia) which hosts the lake.

The unbalanced data set of Albania and Macedonia could be the result of a more intense investigative effort of different zoologists (experts of Cladocera in Albania, experts of Copepoda in Macedonia) with the necessity to project further studies to close the gap. Both the Countries, however, host a huge number of small water bodies (mainly those in alpine situation) which started to be studied only recently (Shehu *et al*., 2009).

The comparison of the Dardano-Illirian fauna (giving this name to the Albanian Macedonian area here considered) with that of the rest of Europe, and the comparison of unexplored sites with the well studied ones, will both give basis for understanding origins and affinities of the studied faunal assemblages.

MATERIAL AND METHODS

A total of 52 water sites have been visited from 2005 to 2017 in the territories of the South and East Albania, and the North West Republic of Macedonia (Fig. 1, Tab. 2) from 0 (Zvernec, Albania) up to 2435 m (upper Black lake, Rep. Macedonia) above the sea level. The geographic area interested is comprised between 39°55’22” - 42°04’30” Latitude N, and 19°24’30” – 20°47’36” Longitude E. Most of the water bodies have been interested by more than one visit and/or by more than one sample collection in the same date, for a total number of 120 samples. The plankton has been collected by means a plankton net of 200 µm mesh-size.

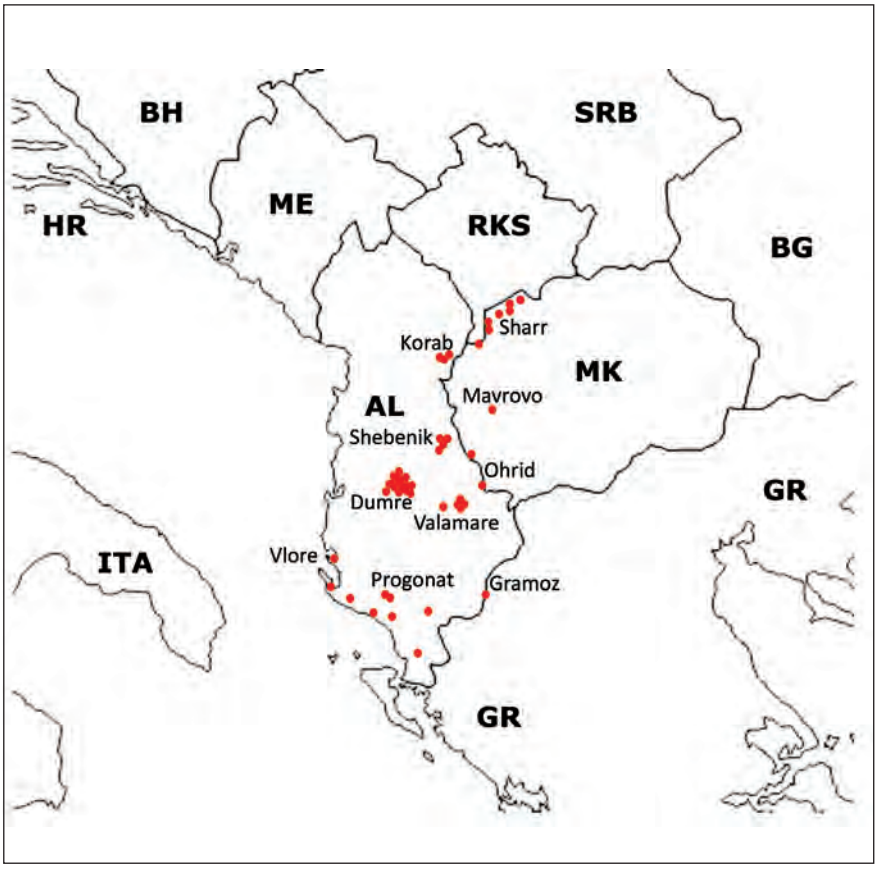
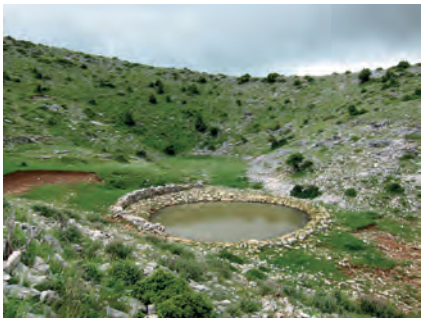


Fig. 1 distribution of sites in the Dardanian (Albania-Macedonia) region, with indication of the main geographic areas.

In many different occasions also a net of 80 µm has been used to collect small size specimens. This additional sampling effort has been organized for faunal purposes, i.e. to add Rotifera to the species list.

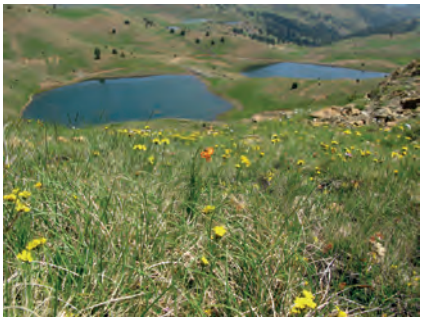
The recognition of specimens has been carried out at minimum taxonomic level possible (species) just to give a first faunal list of the investigated areas. The unavailability of literature for the same field of studies, and the finding of some novelties (species new for Europe as *Neodiaptomus schmackeri* reported by Alfonso *et al*., 2014), imposed to us a cautious identification of the available material avoiding any attribution of individuals to species not perfectly identifiable. In all these cases the species name has been avoided and substituted by "sp.". In all the cases, even the species name has not completed with the name of the descriptor, just to underline this caution and call for more specific investigations in the future.

A



B

C



D

E

F

Fig. 2 examples of water bodies of Albania and Macedonia. A, lake Dega (karstic), Dumre area; B, artificial water collection at Progonat highlands (1,350 m asl); C, artificial water collection at Jahl coastal site (Ionian coast, 280 m asl); D, alpine lakes at Valamare mountain (more than 2,000 m asl); E, alpine lake Gijstova on mount Gramoz (2,365 m asl); F, natural watershed Sheleguri (1,110 m asl) in the Gramshi area.

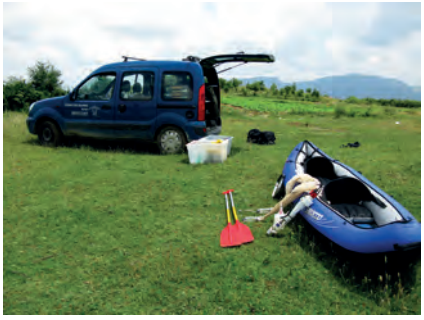
G

H

I

J

K



L

Fig. 2 continued. G, the deep lake Ohrid at Pogradec; H, spring of Syr I Kalter (Delvine District); I, Karstic lake at Hapave, mount Korab; J, alpine lake Karanicola (Sharr massif); K, alpine lake Bogovina (Sharr massif); L, equipment for the sample collection.

RESULTS

A total of 155 *taxa* have been recognized in the 120 samples collected in 52 water sites during a period of 13 years (2005-2017). The site most representative (lake Ohrid) hosted 34 *taxa*, and the second one (lake Bogovina) hosted 23 *taxa*. This evidently demonstrates as the fauna is spread in the studied area, and no one of the studied sites can represent the whole territory. On the other side, it does not exist a species widespread in all the sites, because the most diffused (*Bosmina longirostris*, Cladocera) has been found in only 22 sites.

A total of 75 species of planktonic Crustacea resulted new for at least one of the two Countries considered.

The Crustacea (planktonic) fauna of the considered geographic area, in detail, resulted composed by 101 *taxa*, with 47 Cladocera, 50 Copepoda, and not identified Anostraca, Ostracoda, Amphipoda, and Isopoda. Cladocera *Bosmina longirostris*, *Chydorus sphaericus*, and *Daphnia longispina*, were the most diffused being present in more than 15 water bodies. Among Copepoda, this result was reached by only *Mesocyclops leuckarti*. As regarding single water bodies, lakes Bogovina (Sharr massif, Rep. Macedonia), Merohjes (Dumre area, Albania), and Hapave (Korab massif, Albania) showed more *taxa* of coexisting planktonic Crustacea even than the lake Ohrid.

The site of Syr I kalter (Bistriza springs, southern Albania) gave only 1 crustacean.

In total, 27 of the 44 species of Cladocera and 31 of the 43 species of Copepoda were new for Albania fauna. 6 but 12 species of Cladocera and 11 but 20 species of Copepoda were new for Macedonia fauna. *Daphnia rosea*, *Acanthocyclops trajani*, *Metacyclops stammeri*, *Paracyclops fimbriatus*, *Paracyclops* sp.1, and *Tropocyclos* sp., were new for both Albania and Macedonia.

Among the not well identifiable species, *Daphnia dentifera* is to be considered. Even if well recognizable from morphology, it is a species of North America and *Daphnia* specialists should examine in detail the collected material to confirm this new species for European fauna.

Tab. 1 genera and species of planktonic microcrustacea from Albania-Macedonia.
Two first columns on the left, from Bledzki and Ryback, 2016.
Two last columns on the right, present paper (in bold) shadowed numbers indicate the faunal novelties

	genus	species	Bledzki and Ryback, 2016			
			AL	MK	**AL**	**MK**
CLADOCERA	*Acroperus*	*harpae*	1		1	
	Alona	*guttata*	1		1	1
		quadrangularis	1			
		rustica			1	
		rectangula			1	
		smirnovi			1	
	Alonella	*excisa*	1		1	
		exigua	1			
		nana	1			
		pulchella			1	
		sp.			1	
	Alonopsis	*elongata*		1		
	Anchistropus	*emarginatus*	1			
	Biapertura	*affinis*			1	
	Bosmina	*longirostris*	1	1	1	1
	Camptocercus	*rectirostris*	1			
	Ceriodaphnia	*dubia*	1			
		pulchella			1	
		quadrangula			1	
		reticulata	1	1	1	1
		setosa			1	
		affinis	1			
	Chtenodaphnia	sp.			1	
	Chydorus	*piger*			1	
		sp.			1	
		sphaericus	1		1	1
	Coronatella	*rectangula*	1			
	Daphnia	*cucullata*	1		1	
		curvirostris			1	
		chevreuxi		1		1
		dentifera			1	
		dubia				1
		galeata		1	1	
		hyalina	1	1	1	
		longispina			1	

	parvula		1		
	pulex		1	1	
	pulicaria			1	
	rosea			1	1
Diaphanosoma	*brachyurum*	1	1	1	
	lacustris			1	
Disparalona	*rostrata*	1		1	
Eurycercus	*lamellatus*	1			
	sp.				1
Graptoleberis	*testudinaria*	1			
Ilyocryptus	*agilis*	1		1	
	sordidus	1			
Kurzia	*latissima*		1		
Lathonopsis	*australis*		1		
Leberis	*davidi*		1		
	diaphanus		1		
Leptodora	*kindtii*	1	1	1	1
Leydigia	*leydigi*	1	1		
	acanthocercoides	1			
Macrothrix	*hirsuticornis*	1		1	
	laticornis	1	1		1
Moina	*affinis*			1	
	brachiata		1	1	
	macrocopa			1	
	micrura	1		1	
	weissmanni	1			
Monospilus	*dispar*	1			
Ovalona	*tenuicaudis*	1			
Paralona	*pigra*			1	
Phreatalona	*protzi*	1	1		
	smirnovi		1		
Phryxura	sp.			1	
Pleuroxus	*laevis*	1		1	
	aduncus	1			
	trigonellus	1			
	truncatus	1			
Pseudochydorus	*globosus*	1			
Rhinchotalona	*falcata*	1			
Scapholeberis	*kingii*			1	
	mucronata	1			
	rammneri		1		
Sida	*crystallina*	1	1		
Simocephalus	*latirostris*			1	

		serrulatus	1		1	1
		vetulus		1	1	1
	Wlassiksia	sp.		1		
total Cladocera			**41**	**23**	**44**	**12**
CALANOIDA	*Acanthodiaptomus*	*denticornis*		1		
	Arctodiaptomus	*kerkyrensis*	1	1		
		laticeps	1			
		osmanus		1		
		pectinicornis		1		
		salinus			1	
		steindachneri	1	1	1	1
		stephanediesi	1	1		1
		alpinus		1		
		bacillifer		1		
		niethammeri		1		
	Diaptomus	*serbicus*		1		
	Eudiaptomus	*graciloides*			1	
		gracilis	1	1	1	
		drieschi	1			
		transylvanicus		1		
		vulgaris	1	1	1	
		zachariasi		1	1	
	Hemidiaptomus	*gurney*		1		
	Heterocope	*appendiculata*	1	1		
		saliens		1		
	Mixodiaptomus	*incrassatus*		1	1	
		kupelwieseri		1		
		laciniatus		1		
		tatricus	1	1	1	1
	Neodiaptomus	*schmackeri*			1	
	Neolovenula	*alluaudi*		1		
CYCLOPOIDA	*Acanthocyclops*	*capillaris*			1	
		robustus		1	1	
		venustus			1	
		vernalis		1	1	
		tatricus				1
		trajani			1	1
		sp. (small)			1	1
	Cryptocyclops	*bicolor*		1		
	Cyclops	*abyssorum*	1	1	1	
		ankyrae		1		
		bohater				1

	furcifer		1		
	ochridanus	1	1	1	
	ricae			1	
	scutifer			1	
	strenuus			1	
	tatricus				1
	vicinus		1	1	
	sp.				1
Diacyclops	*bicuspidatus*	1	1	1	1
	bisetosus	1	1		
	crassicaudis		1		
	languidoides	1	1	1	1
	languidus	1	1		
Eucyclops	*macruroides*	1	1		
	porrectus	1	1		
	serrulatus	1	1	1	1
	speratus		1		
Macrocyclops	*albidus*			1	
	distinctus			1	
	fuscus	1		1	1
Megacyclops	*viridis*		1	1	1
	brachypus			1	
Mesocyclops	*leuckarti*	1	1	1	1
	gracilis		1	1	
	sp.			1	
Metacyclops	*minutus*		1		
	stammeri			1	1
	sp1			1	
	sp2			1	
Microcyclops	sp.			1	
Neoergasilus	*longispinosus*			1	
Ochridacyclops	*arndti*	1	1		
Paracyclops	*affinis*			1	
	fimbriatus			1	1
	sp1			1	1
	sp2			1	
Thermocyclops	*crassus*		1	1	1
	dybowskii		1		
Tropocyclops	sp.			1	1
total Copepoda		**21**	**46**	**43**	**20**
total planktonic Crustacea		**62**	**69**	**87**	**32**

DISCUSSION

The high number of faunal novelties (about the 75% of the collected Crustacea) clearly indicates the scant knowledge of Crustacea fauna both in Macedonia and Albania. The knowledge is not homogeneous in the two Countries, with Cladocera more studied in Albania and Copepoda more studied in Macedonia, but the impressive number of faunal novelties also declares the high biodiversity value of such habitats.

Before the present study, Cladocera of Albania were the best known group of planktonic micro-crustaceans, stemming from the first study of Parenzan (1931), who reported a total of 16 species (plus 9 varieties), belonging to 14 genera. Successive studies (see a synthesis in Bledzki and Ryback, 2016) updated the number of Albanian Cladocera to 41 species. In Macedonia, the known Cladocera species were only 23. The present study reports 44 species from Albanian lakes, with 27 species new for Albania (Tab. 1). This gives importance to the investigation carried out, but equally suggests that most of the fauna of this territory is still to be described. We suppose that this updating is mainly due to the consideration, in the present study, of mountain lakes (29, at more than 950 m above the sea level) not considered in preceding studies (devoted to low altitude, large lakes).

Macedonian lakes gave a smaller assemblage of Cladocera species (12) probably due to the smaller number of visited sites in the present report (9 vs 43 in Albania). This notwithstanding also from the Macedonian area came new species (and genera). This high percentage of novelties in Macedonian Cladocera is probably due also to the scant knowledge of this group, in Macedonia, other than because the high mountain lakes considered (as habitat, and as geographic area) were never studied before.

Contrarily to Cladocera, Copepoda (Calanoida and Cyclopoida) were more known from Macedonia (46 known species reported by Bledzki and Ryback, 2016) than from Albania (21 species). The 20 species here reported from Macedonia contain 11 species new for the Country, with two new genera (*Macrocyclops* and *Paracyclops*). We justify this result with the particularity of the studied habitats (alpine lakes) which were not considered in preceding studies. On the Albanian side, the larger sampling effort (43 lakes) and the scant knowledge of the *taxon*, probably justifies the 31 species (and 6 genera) new for the Country, comprising *Neodiaptomus schmackeri*, an Asian species recently reported from the Dumre area (Alfonso *et al*., 2014) and ignored in the recent review of Bledzki and Ryback (2016).

A more detailed analysis of the species distribution will be useful for understanding ecological groups (both of species, and of lakes) to give a help in management of nature.

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