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O 7. ECOLOGICAL CHARACTERIZATION OF THE SMALL LAKES IN ALBANIA

Spase Shumka[1*], Bledar Pepa[2]

[1]*Agriacultural University of Tirana, Tirana, Albania*
[2]*University "I. Qemali", Vlora, Albania*

E-mail: *sshumka@ubt.edu.al*

ABSTRACT: Small water bodies compared to larger lentic freshwater ecosystems, are characterized by a lower area/perimeter ratio that emphasizes the contribution of ecotonal zones to their metabolism and functioning, maximizing the importance of their role as biogeochemical reactors, the small water ecosystems are shallow (not more than 20 m deep) and small lentic water bodies ranging in area between 1 m^2 and several ha (≤10 ha), including small lakes, pools, ponds, and wetlands, both perennial and temporary, with an artificial or natural origin. Due to the geographical position, geological settings and climatic conditions Albania is distinguished by water resource riches. The entire county watershed is 43 905 km^2, while only 65% is within the national borders. Before 1960, wetlands covered more than 2300 km^2, equal to about 8% of the Albanian territory. Large reclamations processes for agricultural purposes strongly reduced the total area of the wetlands since then to less than half. Nevertheless, more than 1300 aquatic sites are still scattered throughout the country: marine habitats, coastal lagoons, fluvial deltas, rivers, springs, lakes and ponds. Wetlands cover a total surface of 970 km^2, equal to about 3% of the whole national territory. The lakes, the coastal lagoons and the reservoirs represent the largest part of these aquatic habitats. All these ecosystems are distinguished by significant diversity of sensitive habitats and species, which so far are understudied and remain extremely vulnerable due significant impact. The impacts are referred to agriculture, tourism development, including nutrient loading and contamination, facing a rapid increase of non-native species invasion and climate change.

Keywords: *Small Lakes, Ecology, Temperate, Mediterranean, Lagoons*

INTRODUCTION

Currently the vulnerability of the freshwater ecosystems is assessed through the fact that 29% of the species they host, are at risk of extinction - Red List of Threatened Species™ (n = 25 007) (IUCN, 2013). The most notable reasons of such a situation lies on the combination of pollution, unsustainable land use, overutilization of freshwater resources, anthropogenic disruption of hydrological habitat connectivity and introduction of alien species (Mantyka-Pringle et al., 2014). Similarly, to the global scale, these threats remain active within Albanian freshwater ecosystems including small water bodies (SWB). The climate change is assessed to significantly contribute to the biodiversity deterioration and the projections remains very unoptimistic (Markovic et al., 2014).
In general due to land use changes particularly before the 1990s, the standing water bodies including the small ones in Albania were subject of intensive anthropogenic influence, while both natural and human made ones constitute some 650 lentic freshwater environments within the country (Cullaj *et al*., 2005; Shumka and Miho, 2006; Shuka *et al*., 2009; Skarbøvik *et al*., 2012). They still are under the intensive human pressure mostly due to agriculture, tourism development, including nutrient loading and contamination, facing a rapid increase of non-native species invasion and climate change (Shumka *et al*., 2008). The subjects of this survey are the carstic lakes of Dumrea region, situated at the central part of Albania. The lakes spatial configuration is generally circular or oval, while their lengths vary from 15-20 m to 1400-1500 m. The largest surface has the Çestia lake with 96.8 ha, followed by Seferani lake with 87.5 ha, 65.5 ha Merhoja, Dega 37.4 ha, 27.4 ha Paraska and Belshi 26.9 ha (Naço *et al*., 2012). Total surface of all lakes of Dumrea is approximately 645 ha, thus constituting about 3% of the total area of the entire region. Stability of water volume in lakes depends mainly on rainfall regime and the relationship between the size of the watershed and the lake surface, with the exception of Belshi Lake, which has a watershed, 18 times greater than the surface of the lake (k = 18), other large lakes have this ratio small: k = 6.3 Çestia, k = 5.8 Seferaj, k = 5.3 Dega, k = 3.4 Merhoja. This is the reason why in the dry period of the year, some small lakes dry up, while in the big lakes, small amplitude of water level

observed during the year. Area of the watershed for Çestia Lake is 5.5 km^2, 4.7km^2 Seferaj, 2.1 km^2 Merhoja, 1.9 km^2 Paraska, 3.7 km^2 Belshi (Naço *et al*., 2012). The dissolved oxygen content was oscillating from 5.8 – 7.15 mg/l respectively for Lake Dega and Seferani.

MATERIAL AND METHODS

This contribution is based on different surveys covered in the period of 2014-2020. The morphometric features and associated ecological particularities of selected SWB of different origin were analyzed and presented in Table 1. The zooplankton data are based on collections made from 2014-2020 in the open part of the water bodies. Samples were collected with 5-L Ruttner sampler, filtered in situ through a sieve (45 µm mesh- size) or using a hand-held plankton net (45 µm mesh-size, mouth diameter, 30 cm), and preserved with 4% formaldehyde.

Table1. Main fetaures of Small Lake Bodies (SLB)

SWE	Origin/ type of SLB	Protected area (PA)	Area (m^2)	Depth (Z_{max}, m)	Macrophyte coverage (%)	Macrophyte type	Fish presence
Lake of Rajca	Artificial/ Reservoir	NP Shebenik-Jabllanica	1800	9	5	S	0
Lake of Dragan	Natural/ Glacial	NP Shebenik-Jabllanica	600	3	90	S	0
Lake i Zi (Black)	Natural/ Glacial	Nature Park Korab Korritnik	4800	11	35	S	1
Lake of Valamara	Natural/ Glacial		800	14	0	0	0
Lake of Pernaska	Natural Lake		324700	6	10	S	1
Reservoir of Poloska	Artificial/ Reservoir		72000	9	30	E	1
Lake of Dega	Natural Lake	Nature Monument	308600	4.5	85	S	1
Lake of Dorbi	Natural Lake		105400	5	20	E	1
Reservoir of Fushe Studa	Artificial/ Reservoir	National Park Shebenik - Jabllanica	245000	14	5	S	1
Lake of Dushku	Natural/ Glacial		224000	16	45	E	1
Reservoir of Pretusha/reservoir	Artificial/ Reservoir		351000	12	10	S	1

RESULTS AND DISCUSSIONS

Zooplankton of the small lakes in Albania

The most wide spread species among Cladocera were *Bosmina longirostris*, *Chydorus sphaericus and Daphnia longispina,* while other present species were *Chydorus sp., Daphnia cucullata, Diaphanosoma brachyurum, Alona recrangula, Alona quadrangularis, Alonella nana, Alonella sp., Moina micrura, Ceriodaphnia reticulate, Simocephalus vetulus, Leptodora kindti*. Among Copepoda, *Mesocyclops leuckarti* has been found to be one of the most spread species. Other copepod species include *Arctodiaptomus salinus*, *Acanthocyclups vernalis*, *Cyclops abysorum*, *Eucyclops serrulatus*, *Macrocyclops focus*, and *Thermocyclops crassus*.
Rotifers were present via following species*: Anuraeopsis fissa, Ascomorpha ecaudis, Asplanchna priodonta, Brachionus calyciflorus, Brachionus quadridentatus, Cephalodella gibba, Epiphanes senta, Filinia longiseta, Kellicottia longispina, Keratella cochlearis, Keratella quadrata, Lecane lunaris, Ploesoma hudsoni, Polyartrhra sp., Synchaeta pectinata, Trichocerca similis.* They recorded significant spatial density variations between the two groups of lakes i.e. reservoirs vs. glacial lakes and this is affirmed by quantitative dominance of Rotifera *vs*. zooplankton comprising an important component at

these ecosystems. Rotifers and Cladocera dominance has been confirmed also on the large Skadar/Shkodra Lake (Shumka *et al*., 2018).
Zooplankton depicted differences in quantitative importance of species in relation to small lake type. So, in the glacial lakes of Valamara and Liqeni i Zi were dominated by Cyclopoida & Calanoida with *Cyclops abysorum*, *Eucyclops serrulatus* and *Acanthocyclups vernalis.* The man-made reservoirs and totally covered with vegetation Lake Dragani were dominated by Rotifera and Cladocera. It is worth to mention the quantitative importance of *Mesocyclops leuckarti* > *Keratella cochlearis* > *Ascomorpha ovalis* in the reservoirs with less than 10% vegetation cover, while in the rest of them *Keratella cochlearis* > *Mesocyclops leuckarti* > *Ascomorpha ovalis* > *Asplanchna priodonta* > *Polyarthra vulgaris*.

Table2. List of fish species which are present in Albanian SWB, their common and scientific and names, distribution, ecological requirements and diet strategy

Family	Species	A - allohtonus, I - invasive	Ecological requirements (L - limnophilic, R - rheophilic, E - eurytopic)	Diet strategy (inse - insects, inve - invertebrates, omni - omnivore, pisc - piscivore, herb - herbivore, zoopl - zooplancton)
Centrarchidae	Pumpkinseed *Lepomis gibbosus* (Linnaeus, 1758)	A, I	L	inse/inve
Cobitidae	Ohrid spined loach *Cobitis ohridana* (Karaman, 1928)		R	inse/inve
Cyprinidae	Common bream *Abramis brama* (Linnaeus, 1758)		E	inve/inse
Cyprinidae	Bleak *Alburnus scoranza* (Heckel&Kner, 1858)		E	inve/inse
Cyprinidae	Bighead Carp *Aristichthys nobilis* (Richardson, 1845)	A		zoopl/herb
Cyprinidae	Prespa barbell Barbus prespensis (Karaman, 1924)			omni
Cyprinidae	Crucian carp *Carassius carassius* (Linnaeus, 1758)		E	omni
Cyprinidae	Prussian carp *Carassius gibelio* (Bloch, 1782)	A, I	E	omni
Cyprinidae	Grass Carp *Ctenopharingodon idella (Cuvier and Valenciennes, 1844)*	A		herb/inve
Cyprinidae	Common Carp *Cyprinus carpio* (Linnaeus, 1758)			omni
Cyprinidae	Silver carp *Hypophthalmichthys molitrix* (Valenciennes, 1844)	A		zoopl
Cyprinidae	Albanian roach *Pachychilon pictum* (Heckel&Kner, 1858)		R	omni
Cyprinidae	Stone moroko *Pseudorasbora parva* (Temminck & Schlegel, 1842)	A, I	E	zoopl/inve
Cyprinidae	European bitterling *Rhodeus amarus* (Bloch, 1782)		E	herb/inve
Cyprinidae	Rudd *Scardinius erythrophthalmus* (Linnaeus, 1758)			zoopl/herb
Cypinidae	Chub *Squalius platyceps* (Zupančič, Marić, Naseka & Bogutskaya, 2010)		R	omni
Percidae	European perch *Perca fluviatilis* (Linnaeus, 1758)		E	inse/inve/pisc
Percidae	Pikeperch *Sander lucioperca* (Linnaeus, 1758)		E	zoopl/pisc
Siluridae	Wels catfish *Silurus glanis(* Linnaeus, 1758)		E	pisc
Poeciliidae	Eastern mosquitofish *Gambusia holbrooki* (Girard, 1859)	A	E	inse

Fish community of the SWB

The specific biogeography setting of Albanian freshwater ecosystems (including SWB), from one side makes quite complicated the current spatial analyses of its fish assemblage, while from the other side give advantage of having high diversity. In the "New Map of Biogeographic Units for Freshwater Biodiversity Conservation" (Abell *et al.,* 2008) is part of the Western Adriatic unite.
The fish species diversity of the small lakes of Albania has been heavily affected by human intervention and they depend on the river basin (Table 2). After the 1970s, there was an intensive intervention through aquaculture development and promoting mostly Chinese stocks that were used even in natural lakes (including Lake Dushku, a glacial one part of our study). Various river systems of Albania are reported to harbor more than 85 species of fish, with numerous non-native ones (Rakaj, 1995). The natives species includes *Alburnus scoranza, Barbus prespensis, Gobio sp., Pachychilon pictum, Squalius platyceps,* etc. Poljakov *et al*. (1958) provided information on the presence of only two introduced species, *Gambusia holbrooki* and *Cyprinus carpio*, Rakaj (1995) reported for Albania the presence of altogether a total of 20 non-native species. The ten-fold increase in the number of exotic species was due to the importing of species for aquaculture, especially East Asian cyprinids and several salmonids

(Shumka et al., 2008). The most wide spread aliens include Stone moroko (*Pseudorasbora parva*), mosquito fish (*Gambusia holbrooki*); Prussian carp (*Carassius gibelio*), Asian cyprinids *Aristichthys nobilis*, *Hypophthalmichtys molitrix, Ctenopharyngodon idella, Parabramis pekinensis, Lepomis gibosus, Oncorhynchus mykiss, Tinca tinca,* etc. Presence of non-native species as *Carassius gibelio, Esox lucius*, *Pseudorasbora parva, Gimnocephalus cernua, Ameiurus nebulosus, Lepomis gibbosus, etc.,* are reported by Talevski et al. *(*2019*)* for the North Macedonian man-made water bodies.

Conservation challenges

The Albanian small water ecosystems are facing numerous threats, pressure and activities mostly accelerated due to intensive human intervention and land use changes. With this regard the habitat loss is a dominating feature. Further on a significant threat is caused due to interventions in hydraulic regime of the lake including temperate and glacial ones, particularly before the 1990s. Along with habitat disturbance the biological invasion is one of causes of biodiversity decline along with climate changes.

CONCLUSIONS

This assessment of selected SWB of Albanian with different origin and features revealed that these ecosystems are facing serious threats, pressure and activities mostly accelerated due to intensive human intervention and land use changes.
The proper protection and advancement of the SWB requires raising awareness about their ongoing innervations and their many beneficial functions to the human population. There is also a strong need for technical and political recognition of their importance for preserving a healthy and diverse aquatic environment.
Our findings from this assessment establish modest bases for improving current knowledge on SWBs in Albania through highlighting and syntheses of current data on their crucial role to supporting biodiversity and ecosystem services. Further on there is a need to stimulate interdisciplinary approaches and consider these valuable ecosystems within national support programs.

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