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ASSESSING THE STATUS OF ENDANGERED INVERTEBRATES FROM THE ANCIENT LAKE OHRID: THE GASTROPOD *CHILOPYRGULA STURANYI*

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Abstract - Lake Ohrid is the oldest and deepest lake on the Balkan Peninsula and one of the five oldest lakes in the world. Two of the most striking attributes of the species of the Lake's fauna, especially the fauna of gastropods, are the high level of biological diversity as well as a high percentage of endemism. The main subject of interest in our research was to follow the distribution and density of the endemic gastropod species *Chilopyrgula sturanyi*. For this purpose different depth points of the transect Hydrobiological Institute-Radozda as well as other littoral points on the northwestern part of Lake Ohrid, were investigated. The results showed maximum density in the population of *Chilopyrgula sturanyi* in the muddy lakebed covered by *Chara tomentosa.* The minimum density in population was recorded on the lakebed with gravel. Specimens of *Chilopyrgula sturanyi* were not recorded at the depth of 50 m, where the lakebed is covered by a sandy-muddy substrate.

Key words: Gastropoda, Lake Ohrid, *Chilopyrgula sturanyi,* status, distribution, density

INTRODUCTION

Stanković (1960, p. 185) pointed out that "this (Gastropoda) is certainly the most important group of Lake Ohrid's animal population, especially because of its extraordinary endemism". According to the literature data (Albrecht and Wilke, 2008) 72 gastropod species have been listed, out of which 56 (78%) are endemic. Strong et al. (2008) noted 72 gastropod species, out of which 55 are endemic.

Chilopyrgula sturanyi (Fig. 1) is an endemic and dominant species of the Ohrid prosobranch gastropods that populate the lake and its surrounding springs. Vertical and horizontal distributions are very important characteristics for gastropods in each aquatic ecosystem.

Likewise, the presence or absence of gastropod species on particular substrates may be used in defining the basic characteristics of habitats, and vice versa, the characteristics of a habitat may be used in estimating the qualitative composition of gastropod fauna, especially in stable aquatic ecosystems such as Lake Ohrid. Regarding the vertical distribution of the Gastropoda in Lake Ohrid, it is important to note that they mainly settle in the littoral and sublittoral zones, reaching the highest densities and diversity in these zones. Moreover, these two depth zones, due to the heterogeneity of the life conditions (substrate heterogeneity, presence of macrophytes) create specific and optimal conditions for the gastropods.

MATERIALS AND METHODS

The results presented in this paper were obtained by research that was performed in two different periods: the first research regarding the vertical distribution of *Chilopyrgula sturanyi* was undertaken during 2008/09 in the transect HBI-Radozda. Samples were

Fig. 1. *Chilopyrgula sturanyi* from Lake Ohrid, Macedonia

taken from the littoral and sublittoral zones on this profile. The second, during the summer 2009, was to determine the horizontal distribution of this species and samples were taken from different depth points (0.5, 1, 3, 5, 10 and 15 m) from four localities: Radozda (41°06.472'N; 20°38.255'W), Livadiste (41° 7'15"N; 20°38'31"W), Kalista (41°08.985'N; 20°39.137'W) and Struga (41°09.574'N; 20°40. 830'W) from the northwest littoral region of Lake Ohrid.

The samples were collected using standard limnological methods for benthic material, according to Lind (1985), Wetzel and Likens (1979) and Dillon (2006). For both vertical and horizontal distribution research, a grab (type Van Veen) of 225 cm^2 (15 x 15 cm) was used. The densities represent the number of individuals per m^2.

RESULTS AND DISCUSSION

Fig. 2 represents the density variations on a monthly level in the littoral and sublittoral zones for the period 2008/09. The density values of *Chilopyrgula sturanyi* in the sublittoral region were much lower than in the littoral. In the littoral zone the maximum density was recorded in April 2009 with 1337 individuals (ind)·m^{-2}, while minimum density in June (44 ind·m^{-2}). Unlike in the littoral, in the sublittoral zone the representatives of this species were not constantly present. The maximum density value in this zone was reached in August with 133 ind·m^{-2}. Fig. 3 shows the vertical distribution of *Chilopyrgula sturanyi* in the littoral and sublittoral zones in the transect HBI-Radozda.

The highest total density of *Chilopyrgula sturanyi* was recorded at 5 m depth with 1998 ind·m^{-2}, where the lakebed is covered with an exuberant distribution of macrophyte species of Characeae, while *Chara tomentosa* predominates. At 40 m depth in the sublitoral zone (the lakebed is muddy with fine yellow-reddish sand), the density decreases to 44 ind·m^{-2}, while at other depths the density varies from 88 to 1577 ind·m^{-2}. Representatives of this species were not found at 50 m depth, where the lakebed is firmly sandy-muddy. Many authors (Polinski, 1929; Stankovic, 1960; Radoman, 1983), including our results on distribution in the northwestern part of the littoral region of Lake Ohrid, stress the fact that *Chilopyrgula sturanyi*, often or exceptionally, is found in the deepest parts of the littoral zone (5-20 m).

The benthic region of Lake Ohrid can be divided in three zones: littoral, sublittoral and profundal. The littoral habitat of lakes usually supports larger and more diverse populations of gastropod fauna than in the sublittoral and profundal habitats. The littoral habitat is also highly variable due to seasonal influences, riparian variation, and direct climatic effects producing high-energy areas (Mackie, 2001). Sitnikova and Shimaraev (2001) highlight the existence of any species based on two factors: food availability and the ability to successfully reproduce. Since the processes of vertical water circulation and sedimentation, i.e. food availability and turnover of food matter, are the most intense in the littoral, it is understandable why it is the richest in density of *Chilopyrgula sturanyi.*

Various factors of the water environment, such as temperature, chemistry, light intensity, move-

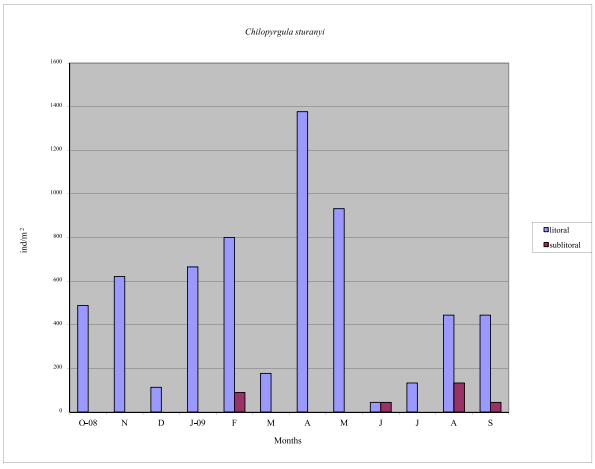

Fig. 2. Variations of *Chilopyrgula sturanyi* density in the littoral region in the transect HBI-Radozda, 2008/09.

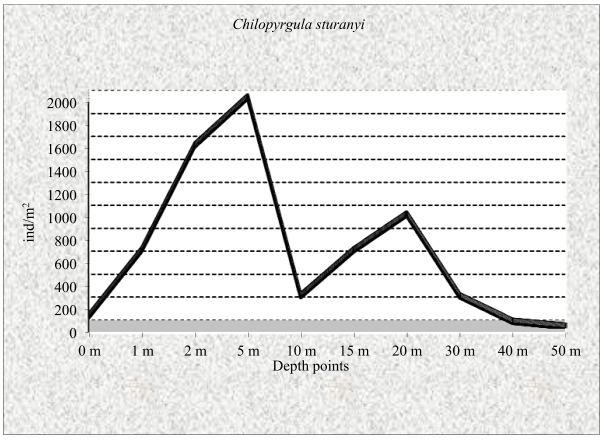

Fig. 3. Dynamics of the density of *Chilopyrgula sturanyi* at different depth points in the transect HBI-Radozda, Lake Ohrid.

ment or calmness of the water mass, and especially the lakebed substrate (with or without macrophyte vegetation) are known as factors playing a key role in the distribution of the benthic fauna of Lake Ohrid (Trajanovski, 2005; Trajanovski and Budzakoska-Gjoreska, 2006; Budzakoska-Gjoreska, 2005). Richness and diversity of habitats in the littoral are reflected in the density of the population of this species. The densest population of the particular species is always recorded in the littoral zone, i.e. on the lakebed where macrophyte vegetation develops.

Table 1. Population densities of *Chilopyrgula sturanyi* at different depths in the northwest littoral region of Lake Ohrid.

Localities Depth (m)	Radozda ind·m^{-2}	Livadiste	Kalista	Struga
0.5	-	-	-	-
1	-	-	-	-
3	222	-	266	176
5	44	132	-	220
10	-	444	900	89
15	44	44	44	132
Total:	310	620	1210	617

Table 2. Population densities of *Chilopyrgula sturanyi* in different habitats from the northwest littoral region of Lake Ohrid

Habitats	ind·m^{-2} of C. sturanyi
Gravel	0-89
Sand and mud	44-132
Sand and mud with submerse vegetation	44-266
Mud	22-132
Mud with detritus	0-133
Mud and sand with shells	44-89
Prairies of *Chara*	44-444
Mud with *Chara ceratophylla*	89-900
Shell zone	44-710
Potamogeton perfoliatus	22-89

According to the literature data, the vertical distribution of *Chilopyrgula sturanyi* in Lake Ohrid is limited up to the middle of the sublittoral zone. Polinski recorded this species at the interval between 5 and 30 m depth (Polinski, 1929). Snegarova (1954) states that this species inhabits both littoral and sublittoral zones of Lake Ohrid, but the highest densities are always registered in the shallow littoral near the Hydrobiological Institute. Moreover, Stanković (1960) registered this species in the littoral and sublittoral up to the depth of 30 m. In the research of Radoman (1983), *Chilopyrgula* was recorded in the littoral and sublitoral zones but no deeper than 40 m. This author also pointed out that this species inhabits the surrounding springs (Studencista, Bej Bunar and St. Naum) which supply the Lake with fresh water and formerly represent integral parts of the Lake. In our investigations, *Chilopyrgula sturanyi* was registered at depths from 2 to 15 m (in the investigated littoral localities), while in the researched transect

HBI-Radozda, vertical distribution started from the shallowest points down to 40 m depth, which overlaps with the research done by Radoman (Radoman, 1983). The highest densities always corresponded with the littoral zone (Fig. 3). Thus, the annual average value was 688.16 ind·m^{-2} which is far higher if compared to the average annual value recorded in the sublittoral, 25.83 ind·m^{-2}. Table 1 represents the density of *Chilopyrgula sturanyi* at different depths at different localities from the northwest littoral region of Lake Ohrid. The value of 1210 ind·m^{-2} recorded in the locality of Kalista represents the highest density value of them all (regarding horizontal littoral distribution). The lowest population density was recorded in the locality of Radozda, 310 ind·m^{-2}. Table 2 shows the population density according to different life condition, i.e. nature of the substrate. It is clear that the highest population densities (89-900 ind·m^{-2}) were recorded on the sandy-muddy lakebed (primarily muddy) covered by dense associations of *Chara tomentosa*. On the other hand, the lowest population densities were registered on the lakebed without macrophytes, covered by gravel and sand. The western shores are more diverse than previously thought. There is also growing evidence that the poorly studied regions at the north suffer comparatively higher anthropogenic pressure (Hauffe et al., 2009).

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