REPORT

(Biological Monitoring)

THE STATE OF POPULATIONS OF TWO GLOBALLY THREATENED CRAYFISH SPECIES *ASTACUS ASTACUS* AND *AUSTROPOTAMOBIUS TORRENTIUM* IN THE LAKES OF PRESPA, OHRID AND RIVERS OF THE SHEBENIK - JABLLANICE NATIONAL PARK, ALBANIA

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Executive Summary

In the freshwaters of our country, there are no complete studies about crayfish of the species *Astacus astacus* (Linnaeus, 1758) and *Austropotamobius torrentium* (Schrank, 1803), although they are reported as globally threatened. In the Albanian part of the Ohrid and Preps lakes, studies have been conducted sporadic and mainly by foreign researchers.

This complete one-year study (2023-2024), realized by Organization " Biologist of Albanian" includes 7 monitoring stations on Lake Ohrid, 5 monitoring stations on Great Prespa Lake, 2 monitoring stations on Small Prespa Lake as well as 2 monitoring stations on Qarrishta River in the National Park Shebenik. At the beginning of this study, questionnaires completed by 92 residents of the areas under study provided great help. The applied methodology is that of baited traps known as "Li Ni-Trap" (Westman et al., 1978).

In parallel with the monitoring of crayfish with traps, measurements of water parameters such as pH, T, Conductivity, PPM and dissolved oxygen were carried out. The study showed that the species *A. astacus* was found only in the Great Prespa and Ohrid lakes, while not in the other areas. The species *A. torrentium* was not detected in any of these water body. In Lake Ohrid, *A. astacus* was detected in four of seven monitoring stations in the Lin - Piskupat- Udenisht - Memelisht area, while in Great Prespa Lake it was detected in three of five stations in the Kallamas - Gollomboc – Pustec area.

The measured water parameters were within the optimum values for the growth of the species not directly affecting the absence or reduction of the number of individuals. The decrease in the number of individuals found in the areas where it is evident is related to the decrease in the amount of rainfall, which has led to the displacement of their natural habitat deeper, change of habitat as result of urbanization and water pollution. Their proposal in the Red List of Albanian Flora and Fauna as well as the update of their status in the IUCN will oblige Albanian institutions to include monitoring of the *A. astacus* species in the management plans of the areas where they are found.

The status of crayfish in the region

A European range of the genera Astacus and Austropotamobius is presented with a total of 5 species: *Astacus astacus, Astacus leptodactylus, Astacus pachypus, Austropotamobius torrentium, and Austropotamobius pallipes* (Trožić-Borovac, 2011). According to Holdich (2002), while two of the four European crayfish species found in the Balkan Peninsula—*A. astacus* and *A. torrentium* are believed to be present in Albania, no studies on their distribution have been published to date, to the best of our knowledge.
Pârvulescu *et al*. (2011), asserts that crayfish taxa are vulnerable to various threats, including overexploitation, habitat modifications, water pollution, increasing pressure from invasive crayfish species, and the crayfish plague. Over the past few decades, there have been marked

declines in stone crayfish populations throughout their distribution range in Europe (Kouba *et al*., 2014). This increases the need for full studies of them and in our country. As noted by Lindqvist & Lathi (1983) noble crayfish engage in mating during autumn, and the duration of their life cycle is affected by the climate and habitat in which they live. The breeding season commences with a drop in temperature in autumn, while the maturation of testes and ovaries occurs between July and September (Lindqvist & Lathi 1983).

From the Genus Astacus the noble crayfish *Astacus astacus* (Linnaeus, 1758) is a widely distributed species in Europe, attributed to both its native presence in the region and introductions in various areas (Souty-Grosset *et al*., 2006). It has a "*vulnerable*" status according to the IUCN (Edsman *et al*., 2010). According to Holdich *et al*. (2009) and Kouba *et al*. (2014), the noble crayfish (*Astacus astacus*) is the most widespread indigenous crayfish species in Europe. Its range includes central and northern parts of the continent, covering the basins of the North Sea, Baltic Sea, Black Sea, Adriatic Sea, and the Balkan Peninsula.

The assumption regarding *A. astacus* presence in Albania has primarily been based on records from Tran's boundary water bodies outside the country (Mrugała *et al*. 2017). According to a publication by Czech Republic hydrobiologists (Mrugała *et al*., 2017), between 2004 and 2015, several ichthyologic studies comprehensively covering the watercourses of all major rivers in Albania also investigated the presence of crayfish species. The noble crayfish, *Astacus astacus*, was found at two locations in Ohrid Lake. In addition to observations in Ohrid Lake and the upper section of the Devoll River, the population of *A. astacus* has also been found in the Albanian part of Prespa Lake (Đuretanović *et al*., 2017). Furthermore, earlier studies have consistently reported the presence of *A. astacus* in trans boundary water bodies in neighboring countries and in several streams near Albania (Mrugała *et al*., 2017).

Specie *Austropotamobius torrentium* (Schrank, 1803) is classified as "data deficient" by the IUCN (Füreder *et al*., 2010) and is recognized as a "priority species" under the Habitats Directive (European Communities, 1992). It has also been reported to be present in Albania (Subchev, 2011). According to Subchev (2011), a specimen was collected from the northern part of the country in 2003, specifically from the Fan i Madh River. The presence of *Austropotamobius torrentium* in the Montenegrin part of the Skadar Lake basin (Trontelj et al., 2005) and widely present in northern Greece, where its western distribution extends to the area around the city of Kastoria, close to the Albanian border (Koutrakis *et al*. (2007) We believe that this species will continue to live in Albania as well.

Conservation policies for *Astacus astacus* and *Austropotamobius torrentium* include: The Bern Convention (1982) and the EU Habitats Directive (1992) include the protection of these species as part of the sensitive freshwater fauna.

In Albania, fauna is protected by the Biodiversity Protection Law (No. 9587, 2006), which defines measures to preserve species and their habitats, as well as the National Biodiversity Strategy (2016-2020) which aims to monitor and restore habitats waters where these species are found naturally.

The lack of complete data for Albania in the IUCN classifying the species *A. astacus* as "Presence uncertain" and the species *A. torrentium* with the classification "Data deficient" (fig. 1) justified this study.

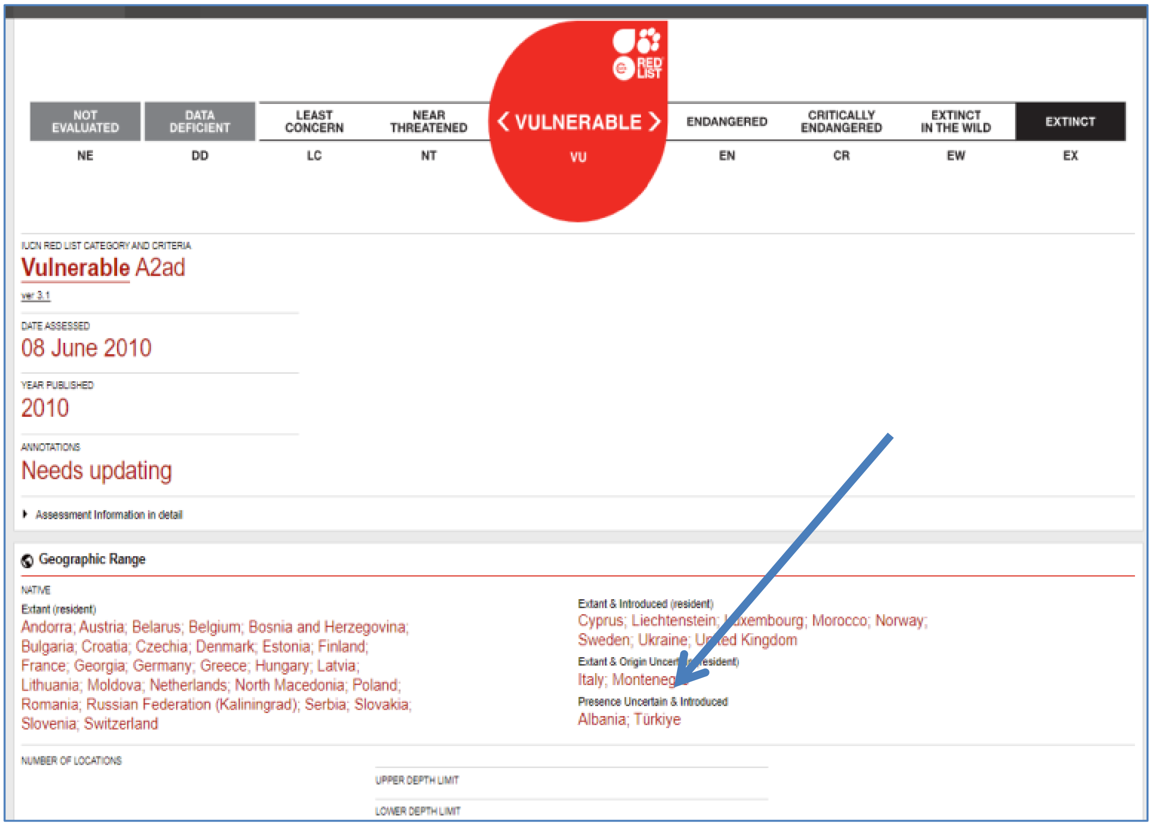


Figure 1. Classification of species *A. astacus* in IUCN Red List for Albania

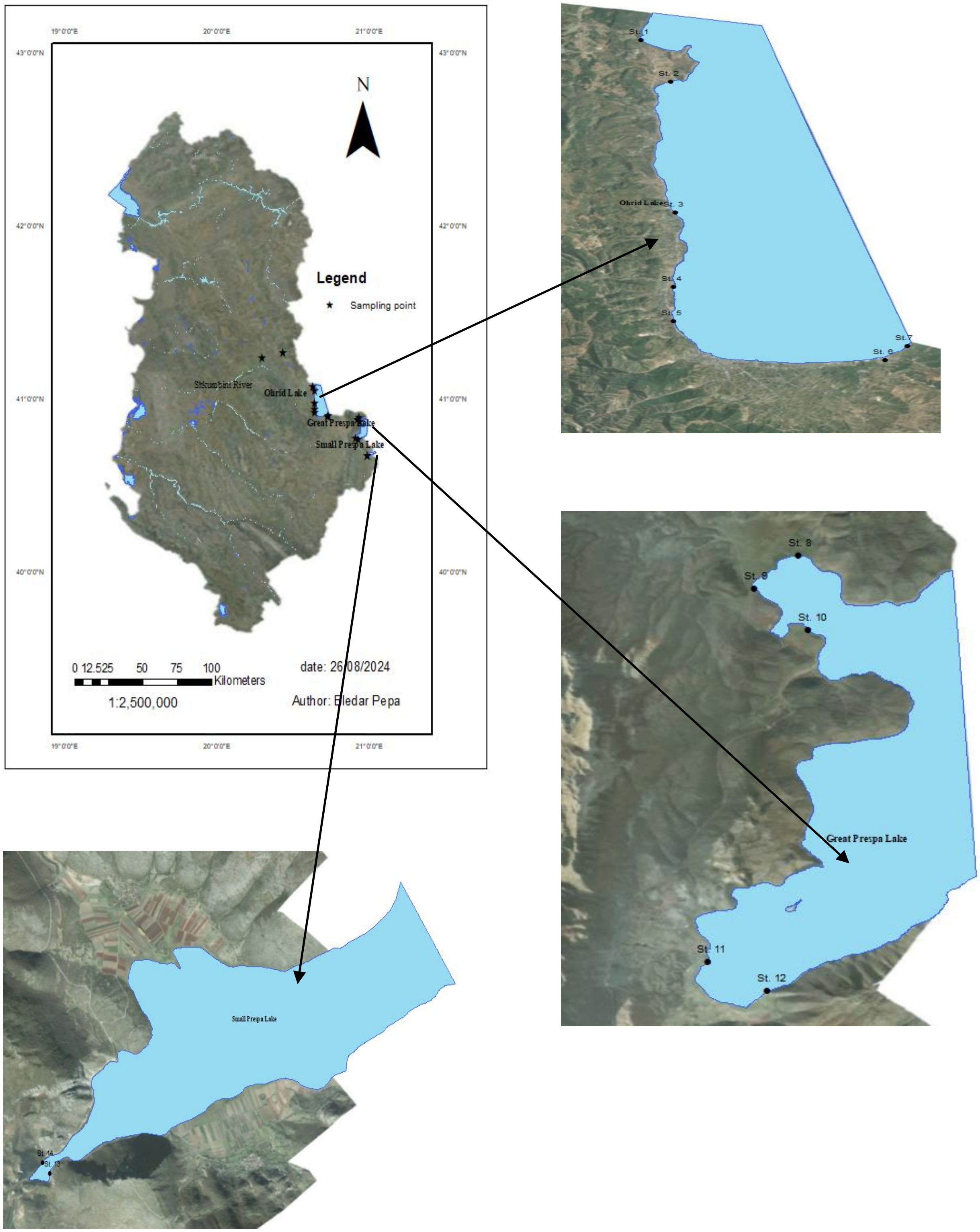
The above sporadic data about these two species serve as an impetus to have more complete information about the presence of these species in the lakes of Ohrid, Prespa and the two rivers of the Shebenik National Park. The reports of fishermen and residents about their presence justify participation in this one-year study in these water bodies.

Study area

The study area includes the lakes of Prespa, Ohrid, as well as the rivers of the Shebenik National Park. 7 monitoring stations were selected in the lake line of Ohrid Lake, 5 stations in Great Prespa Lake, 2 stations in Small Prespa and 2 stations in Shebenik National Park. The sampling stations (Tab. 1) are according to the coordinates in the table below as well as the illustrative map (Map 1).

Table 1. Sampling stations and respective coordinates

No. Station	Name Station	Latitude	Longitude
St. 1	Lin	41.07213	20.62835
St. 2	Erlin Park, Lin	41.04986	20.63974
St. 3	Udenisht	40.96393	20.64607
St. 4	Memelisht	40.93349	20.64122
St. 5	Gur i Kuq Station	40.92209	20.64151
St. 6	Drilon	40.90189	20.72227
St.7	Tushemisht	40.90116	20.71371
St. 8	Kallamas	40.88387	20.92434
St. 9	Gorica	40.86189	20.94099
St. 10	Gollomboç	40.7895	20.90823
St. 11	Pustec	40.76638	20.91859
St. 12	Zaroshka	40.76831	20.9264
St. 13	Tren Village 1	40.67400	20.99742
St. 14	Tren Village 2	40.68922	21.01108
St. 15	Allaj	41.22809	20.2936
St. 16	Qarrishta	41.26592	20.44122



Map 1. Sampling point in the Ohrid Lake, Great Prespa Lake, Small Prespa Lake and in the N.P Shebenik.

Monitoring methodology

In our study with focus sampling of crayfish noble crayfish (*Astacus astacus*) and stone crayfish (*Austropotamobius torrentium*) in lakes and river we are consulting with sampling and monitoring protocols developed in different countries like in Sweden (Edsman and Söderbäck 1999), United Kingdom (Peay, 2003), Poland (Stru¿yñski, 2015) and UW-Madison Center for Limnology, 2007.

Based on the protocol suggested by: Larson & Olden, 2016 *"Field Sampling Techniques for Crayfish";* Stru¿yñski, 2015 entitled "*The noble crayfish, Astacus astacus (Linnaeus, 1758) – In: Monitoring Animal Species. A Practical Guide. Part IV*" and " Protocol for Wisconsin Crayfish Sampling, WAV Version 2007" the aim of this contribution is to detect presence/absence and to estimates the status of the two crayfish species: noble crayfish (*Astacus astacus*) and stone crayfish (*Austropotamobius torrentium*), using the baited trap in the deep water.

Site Selection: We took into consideration two ecosystem types, including lakes and rivers. In lakes the preferred method of sampling was to collect crayfish along two transects on opposite sides of the lake. The sites were visited during eight months and usually traps were exposed along the shorelines, under stones or tree roots. The traps were distributed every evening and collected in the morning where they stayed in the water for approximately 10-12 hours.

Setting of traps

In stream and river: According to methodology we set 5-10 traps at each sample site.Traps should be at least 10 meters apart from each other at water depths of 0.5 to 3.0 meters.

In lakes: The number of traps will depend on habitat and trap availability. 10 traps are recommended for lakes (5 per transect at a distance of 10 m from each other).

Choosing a high number of monitoring stations and a high monitoring frequency is important to capture a comprehensive, accurate, and representative understanding of environmental conditions, especially when monitoring biodiversity, water quality, or ecological health. Some approach is: increased spatial coverage, higher temporal resolution: improved data accuracy and reliability, better detection of emerging issues and support for policy and conservation efforts.

We used LiNi traps (Westman *et al*., 1978) made of nylon net with a mesh of 0.5 cm on both sides; there were openings as well as a place for fixing the bait. Their dimensions were length 60 cm, diameter 20 cm, funnel opening 5 cm.

Results

Summary of data on individuals collected in Lake Ohrid

Only *Astacus astacus* species was found in the monitoring habitats of Ohrid Lake. During our recent survey of crayfish populations were collected in total 92 individuals. We found for all stations in the first station 22 crayfish individuals, second station18 individuals and in the third station 43 individuals. In the other four stations, no crayfish individuals were found. The largest number of individuals was registered in June, while the smallest number was registered in December. The male-female ratio for crayfish was 61:3.

In the Lin - Memelisht segment, where the water substrate and environmental conditions are more favorable, there is a distribution of crayfish populations, while in the other part the substrate is mainly sandy and unfavorable. In the stations where crayfish individuals were not found, the possible factor that influenced their absence could be urbanization, especially in the Drilon area, as well as the presence of dams from the mine in Gur i Kuq Station. Mining waste, on the other hand, can have a major impact on water quality through contamination with heavy metals and other toxic substances that are released during the mineral extraction and processing processes. The presence of pollutants has created unsuitable conditions for the life of crayfish, causing environmental stress and reducing biodiversity in these areas. In the month of June, the higher temperature and abundant food resources have stimulated the activity and reproduction of crayfish, resulting in the largest number of individuals. While in December, low temperatures have reduced the activity and the number of recorded crayfish. The male-to-female ratio of 61:3 may reflect a natural disproportion in the population or seasonal changes in the behavior and availability of the different sexes (Map 2), (Tab. 2), (Fig. 1, 2).

Frequency of monitoring

The monitoring frequency was carried out in a period of 8 months from October 2023 to July 2024.

Month	October 2023	November 2023	December 2023	January 2024	February 2024	Mars 2024	April 2024	May 2024	June 2024	July 2024
Monitoring	X	X	X			X	X	X	X	X

Table 2: The number of individuals collected in Ohrid Lake

Session	Month	Ohrid Lake							M	F	Total Month
		St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7			
Autumn 2023	October	2	2	4	1	0	0	0	9	0	9
	November	1	2	4	0	0	0	0	6	1	7
Winter 2023	December	0	0	3	0	0	0	0	3	0	3
Spring 2024	March	2	1	4	1	0	0	0	7	1	8
	April	3	2	4	1	0	0	0	9	1	10
	May	3	2	9	1	0	0	0	14	0	15
Summer 2024	June	4	3	7	1	0	0	0	15	0	15
	July	7	6	9	3	0	0	0	26	0	25
	Total St.	22	18	43	9	0	0	0			
	Total lake								**89**	**3**	**92**

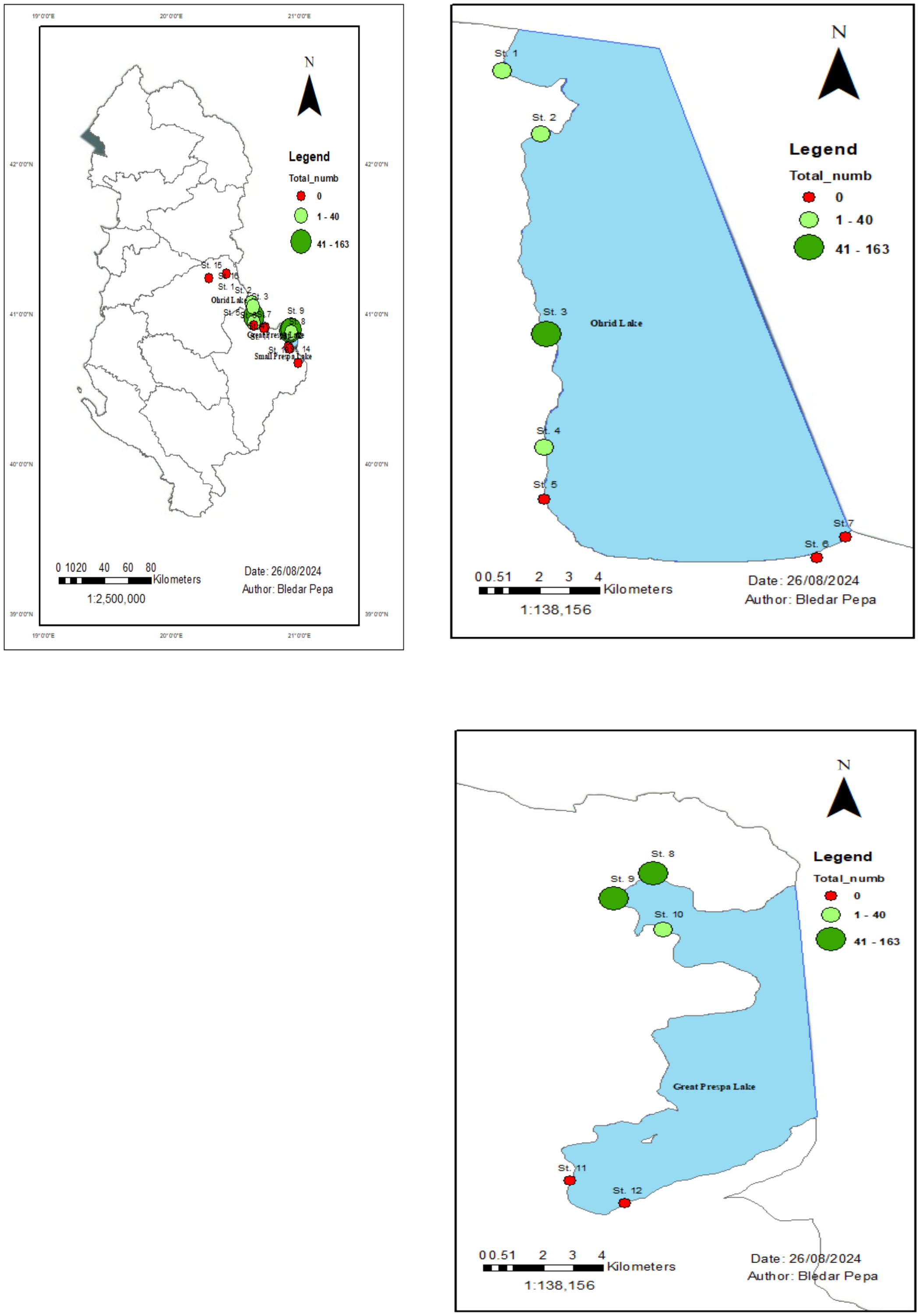
Summary of data on individuals collected in Lake Great Prespa

Only *Astacus astacus* species was found in the water body of Prespa Lake. During the monitoring of the crayfish population at 5 stations were found a total of 137 crayfish individuals at the first station, 163 individuals at the second station and 40 individuals at the third station. No individuals were found in the other two stations. The largest number of individuals was registered in June, while the smallest number was registered in December. The male-female ratio for crayfish was 333:7.

A possible reason for the lack of crayfish at the stations 11 (Pustec) and 12 (Zaroshka) could be the unsuitable substrate with psamal and lymal character. Another possible reason for the decrease in the number of crayfish caught in Prespa is the drastic withdrawal of lake water, which has affected the destruction of the suitable substrate for crayfish. The decrease in the amount of snowfall has affected the decrease in the water level This destruction of the substrate has created unfavorable conditions for their life and reproduction, negatively affecting the crayfish population in these areas (Map 2), (Tab.3) (Fig. 1, 2).

Table 3. The number of individuals collected in Prespa Lake

Session	Month	Prespa Lake					M	F	Total Month
		St. 8	St. 9	St. 10	St. 11	St. 12			
Autumn 2023	October	9	16	5	0	0	29	1	30
	November	10	13	3	0	0	26	0	26
Winter 2023	December	6	9	4	0	0	19	0	19
Spring 2024	March	17	22	5	0	0	43	1	44
	April	20	20	3	0	0	40	1	43
	May	24	25	5	0	0	52	2	54
Summer 2024	June	23	26	7	0	0	54	2	56
	July	28	32	8	0	0	67	1	68
	Total St.	137	163	40	0	0			
	Total lake						**333**	**7**	**340**



Map 2. Distribution of the total number of individuals caught according to stations

In the Small Prespa, no crayfish species were found. The conversion of Small Prespa into a marsh had negative consequences for the population of animals such as crayfish (Map 2). Habitat change is the main reason that led to the disappearance of crayfish in the marsh. Given that such marshes are unfavorable structures for crayfish, no environments where monitoring could be carried out were found.

In the Qarrishta River as well as the Rapun River as part of the Shebenik National Park, no one of crayfish was found during the 8-month monitoring. In these rivers, movement was carried out in transects that covered almost the entire length of the rivers and no traces of them were found.

Distribution of individuals according to Radar Plotting, Box Plot and Time Series Plot in both lakes

From the processing with *Radar Plotting*, it can be seen that the largest distribution of the number of individuals collected in the two lakes where *A. astacus* is found is in the two stations, St. 8 (Kallamas- Prespa Lake) and St. 9 (Gollomboc – Prespa Lake) for both the warm and cold periods (Fig. 2)

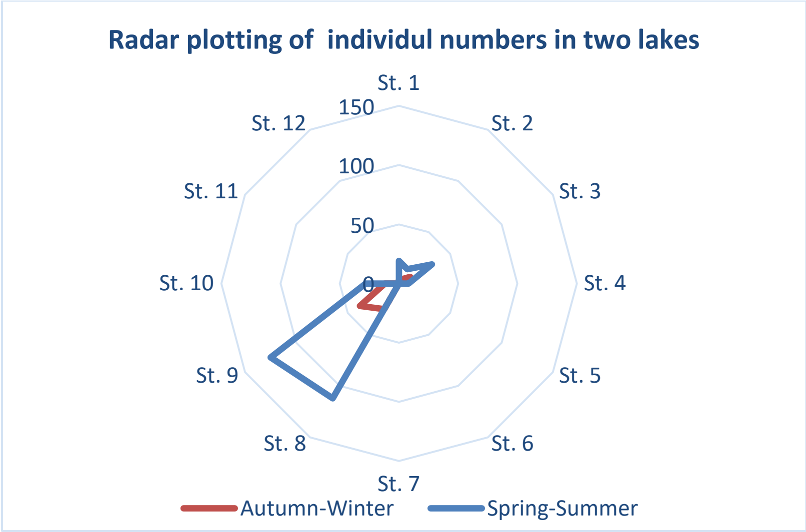


Figure 2. Distribution of individuals according to Radar Plotting

In the same trend as the figure above, the *Time Series Plots* is given below, where it can be seen that for each monitoring month, station 3, which belongs to Lake Ohrid, as well as Station 8 and 9, which belong to Lake Prespa, have the highest number large of individuals. The peak of the largest number of individuals is found in the summer period in the month of July (Fig. 3).

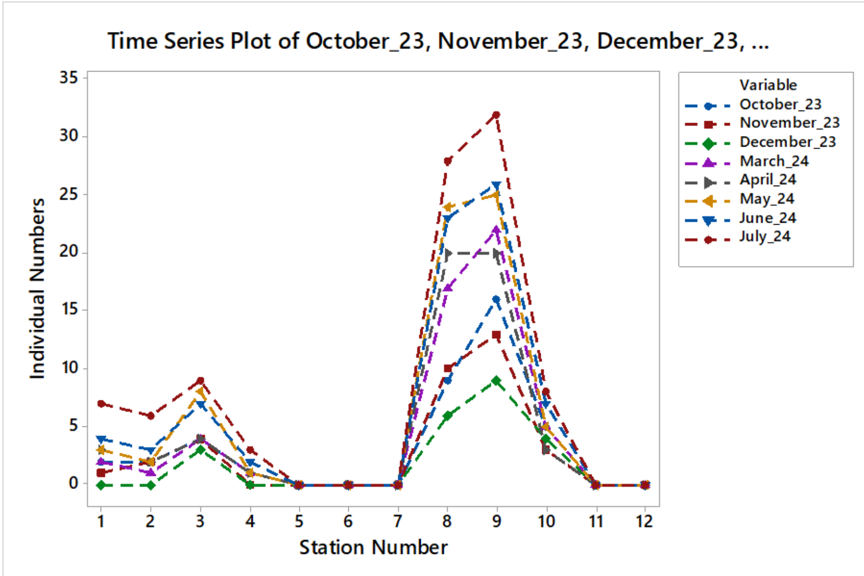


Figure 3. Monthly distribution of individuals according to Time Series Plot

Result from the habitat assessment

As can be seen from Table 4, a visual assessment, only in two stations of Lake Ohrid (St 5 and St 6) there is point pollution which refers to the dumps of the chrome ore processing mine in Guri i Kuq as well as the causes from business units in the Tushemisht area in the Drilon swamp. In all other stations the pollution is diffuse. In the river stations of the Shebenik Park area no type of pollution is visually observed. With the exception of station 6 (Tushemisht) and station 12 (Zaroshke), the benthic structure appeared suitable for the existence of crayfish in them. During the monitoring period, no changes in the habitat structure were observed that could justify the absence of crayfish.

Table 4: Data collected from the assessment forms for Lake Ohrid

Lake	**Assessment parameters**	**St. 1**	**St. 2**	**St. 3**	**St. 4**	**St. 5**	**St. 6**	**St. 7**
Ohrid lake	The structure of benthos	Megalithal	Megalithal	Mesolithal	Mesolithal	Microlithal	Psamal	Microlithal
	The change of habitat during the year	No	No	No	No	No	No	No
	Point/nonpoint pollution	Non point	Non point	Non point	Non point	Point	Point	Non Point
Great Prespa Lake	**Assessment parameters**	**St. 8**	**St. 9**	**St. 10**	**St. 11**	**St. 12**	-	-
	The structure of benthos	Mesolithal	Mesolithal	Mesolithal	Microlithal	Psamal		
	The change of habitat during the year	No	No	No	No	No		
	Point/nonpoint pollution	Non point	Non point	Non point	Non point	Non point		

Results and discussion obtained from questionnaires

The study with 92 questionnaires in 14 villages of Great Prespa Lake, Little Prespa Lake, Ohrid Lake, Qarrishta River and Rapuni River in Shebenik-Jablanica National Park has provided a clear look at the knowledge and situation of the species crayfish in these areas (Tab. 5). In completing these questionnaires, the following groups were interviewed: 12 professional fishermen, 18 amateur fishermen and 62 residents who live near water areas. In the three study areas, residents only knew about the species *A. astacus*, which is caught with fishing nets in Lake Ohrid and in Great Prespa. Its names include "crab" and "lake crab". According to the fishermen, the number of crayfish caught in the net is decreasing, especially within the last 10 years. In the part of Small Prespa and in the Shebenik Park there is no trace of these crayfish. In the Rapuni River, crayfish were reported to be present 35 years ago, while in the Qarrishta River they were never reported to be present according to their estimates.

According to the comments of fishermen and residents, the reason for their decline is the point and non-point pollution in the Pogradec lake as well as the loss of their habitat as a result of the drop in the water level due to the decrease in the amount of precipitation in Great Prespa . Water withdrawal has dropped at least 8 meters in the last 10 years.

In the area of Great Prespa, the species caught was once used in traditional cuisine and was marketable, but today it no longer exists in this form. These discoveries provide a clear perspective on the changes in the populations of these aquatic creatures in these regions and suggest the need for care and conservation measures in accordance with the conditions and protection of the environment in which they live. All the response for question is positioned in the table of annex.

Table 5. Summary table of questionnaire responses

Location	Great Prespa Lake, Small Prespa Lake, Ohrid Lake, Qarrishta River and Rapuni River in PK Shebenik - Jabllanicë
Number of villages	14
Resident of the area in question	92 inhabitants
Professional/amateur fisherman/ people	12 professional fishermen 18 amateur fishermen 62 residents of the area
Information on the degree of recognition and threat factors of the species by the inhabitants	
1. Do you recognize the two types of crabs in the picture below?	55 surveyors know only one type 37 surveyors know both types
2. If you know them, can you identify	• crab

them by what popular name do you call them?	• crayfish • Rak - Lin area • lake crabs
3. Do you have information on whether they are endangered species or not?	a) YES - 0 b) NO - 92 people c) I have no information-12 people
4. When was the last time you saw or heard of them in your local aquatic environment?	a) Within this year - 70 people b) Last year – 22 people c) A few years ago - 11 people
5. What was the environment that you saw or someone described their presence?	a) Lake (69 surveyors lake) b) stream c) stream -5 d) Water source e) To fishermen
6. Are they only prevalent in certain areas?	a) YES – 78people b) NO – 8 people c) I have no information - 6 people
7. What do you think is their favorite habitat?	a) Water resources b) Stream c) stream f) Lake - (67 surveyors lake) d) Other
8. In what season/month are they most visible in your area?	• Spring, in the months a) March, b) April, c) May – 38 people • Summer, in the months a) June, b) July, c) August - 54 people
9. Have you noticed changes in the number of crayfish found /caught recently?	a) YES – 77 people b) NO – 12 people c) I have no information - 3 people
10. What is the colour variation they present in the cases you have seen?	Open coffee, busy Coffee Yellow Grey
11. Have you seen their dead individuals (shells) near their aquatic environment?	a) YES – 10 people b) NO - 82 people c) I have no information - 5 people
12. Have you noticed any changes in the size or appearance of crayfish that have recently been caught in your area?	a) YES – 9 people b) NO – 76 people c) I have no information - 7 people
13. Are these crayfish consumed in traditional cuisine at home or in local restaurants?	a) YES – 14 People b) NO – 73 people c) I have no information - 5 people
14. Do the fishermen show the two types of crayfish caught?	a) YES – 7 people b) NO – 80 people c) I have no information - 3 people
15. What is their trade in price if so?	_____LEK/KG- no information
16. Select what factors do you think the populations of these crabs require?	a) Water pollution – 22 people b) Loss of habitat – 53 people c) Increase in water temperatures - 3 person d) Use as food - or people e) Other - 14 people: Lake level drop

17. Have you noticed any impact of human activities, such as water pollution in the environment where they meet, overfishing, etc., on the population of these crayfish?	a) YES - 54 people (waste water) b) NO – 38 people
18. Have you noticed any changes in the natural habitat of these crayfish (stream change, stream reduction, shoreline damage, erosion, etc.) in your area over the past few years?	a) YES – 71 people b) NO – 21 people c) If YES: specify the change: *The lake level drops, as a result the habitat changes.*
19. Has there been increased urbanization, tourism, new construction, roads, water infrastructure, or industrial development in your area that has affected natural crayfish habitats?	a) YES - 29 people b) NO – 63 people c) If YES: specify the change: *Tourism*
20. Have you seen activity that has changed the habitat of these crabs?	Yes: specify: a) shoreline alienation, b) river/lake bottom alienation. c) flow diversion, d) etc._____________: (Shore transfer: 2 people) b) NO - 38 people
21. Have there been climate changes recently and how has it affected the condition of their populations?	a) YES – 74 people b) NO – 4 people
22. Do you have any suggestions for measures that can be taken to protect or improve the condition of the populations of these crayfish in your area?	a) YES – 18 people b) NO – 64 people If YES: specify change: not fishing

Descriptive Statistics of measured water parameters

According to table 6, all the measured water parameters as average, minimum and maximum values are within the conditions that favor the normal growth of the *A. astacus* species. The big changes in the value of the variance in the number of individuals are because comparative stations with zero monitored individuals are taken into consideration (Tab. 6).

Table 6: Descriptive Statistics for Average Temperature**,** Conductivity (µS/cm), TDS (ppm), O_2 (mg/L), pH and individual numbers in two lakes (Great Prespa and Ohrid)

Variable	Lake	Mean	CV (%)	Minimum	Median	Maximum
Average Temperature	Ohrid	13.0	43.2	3.80	13.9	21.9
	Prespa Great	14.1	38.7	6.10	14.6	22.2
Conductivity (µS/cm)	Ohrid	237	21.0	165	231	301
	Prespa Great	244	17.2	183	262	291
TDS (ppm)	Ohrid	171	9.64	145	173	204
	Prespa Great	203	21.8	142	198	275

O_2 (mg/L)	Ohrid	8.66	4.29	8.00	8.65	9.20
	Prespa Great	8.40	2.97	7.60	8.40	8.70
pH	Ohrid	8.11	1.46	7.90	8.10	8.30
	Prespa Great	7.73	2.48	7.40	7.70	8.10
Individual numbers	Ohrid	3.29	147	0.00	0.00	16.0
	Prespa Great	17.0	136	0.00	7.00	67.0

Temperature range for crayfish *A. astacus*

During our monitoring, we have not found temperatures that are outside the critical conditions both in summer and winter (Fig. 4). The optimal temperature for *Astacus astacus* lies between 15°C and 25°C. These temperatures are ideal for growth, reproduction, and overall health. Temperatures above 28°C to 30°C are generally stressful for the species, and long-term exposure to such heat can lead to a decline in growth, impaired immune function, and potential death. On the lower end, temperatures below 4°C to 6°C can cause the crayfish to become lethargic, reducing feeding and growth. If temperatures drop much lower, the crayfish may experience cold-induced mortality, especially if they lack sufficient shelter during the winter.

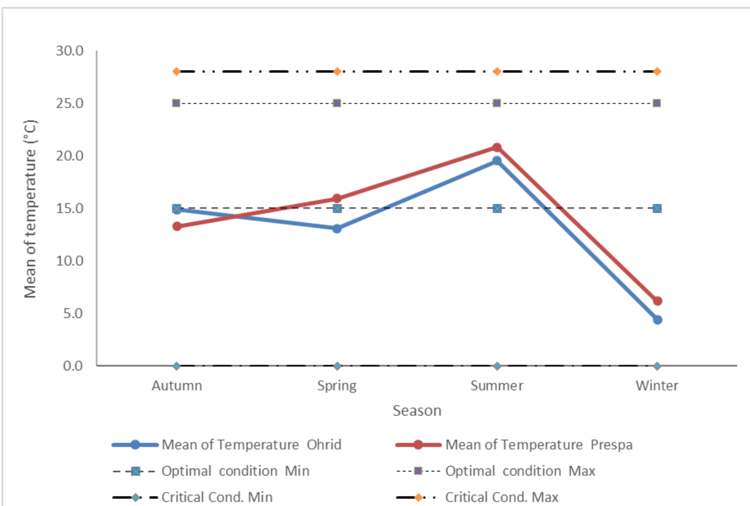


Figure 4. Average Temperature measured in both lakes and optimal condition for species *A. astacus*

Descriptive statistics of morphological traits of captured and measured individuals in two lakes (Great Prespa and Ohrid)

In a descriptive analysis of the morphometric parameters measured in the crayfish individuals caught, it is found that for Ohrid and Prespes lakes: their average sizes are respectively 11.4 cm and 10.1 cm; The width of the body is respectively 2.39 cm and 2.36 cm; the respective length of the abdomen is 3.59 and 4.34 cm; the respective length of antennas 5.53 cm and 6.30 cm; the respective length of the chelicerae 3.26 cm and 4.30 cm and the average length of the rostrum approximately 0.90 cm. The largest coefficient of variance is for the length of the chelicera, since the species present anisometric in this organ. Individuals caught in the lake of Prespa have a larger size, which is also reflected in the abdomen, antennae, and chelicera (Tab. 7).

Table 7: Descriptive Statistics of Height, Width, Abdomen, Antenna, Chelicera, and Rostrum

Variable	Lake	Total Count	Mean	CV %	Minimum	Median	Maximum
Height	Ohrid	92	11.04	11.98	7.80	11.10	13.60
	Great Prespa	340	10.01	16.31	5.50	9.80	14.90
Width	Ohrid	92	2.39	14.24	1.70	2.30	3.20
	Great Prespa	340	2.36	24.52	1.00	2.30	3.90
Abdomen	Ohrid	92	3.59	7.38	2.90	3.60	4.30
	Great Prespa	340	4.34	21.40	2.00	4.45	6.80
Antenna	Ohrid	92	5.53	5.82	4.80	5.50	6.10
	Great Prespa	340	6.30	24.02	3.00	6.40	9.30
Chelicera	Ohrid	92	3.26	8.06	2.70	3.30	3.90
	Great Prespa	340	4.30	43.05	0.60	4.70	8.60
Rostrum	Ohrid	92	0.90	17.37	0.45	0.90	1.25
	Great Prespa	340	0.90	22.48	0.25	0.88	1.35

Principal component analysis

As can be seen in the table 8 given in the figure 5 the pH component and dissolved oxygen (DO) are located in the same group or main component (PC1) because their changes go parallel. This can be justified as the increase in pH in winter occurs mainly due to the reduction of processes that add acids to the water, such as respiration and decomposition, and the increase in dissolved oxygen in the lake during winter occurs mainly due to the higher capacity of cold water to dissolve oxygen, reduced consumption by organisms and better water mixing that helps deliver oxygen to deeper layers.

Whereas, conductivity, temperature, TDS (dissolved solids) and number of individuals are in another group or principal component (PC2). The argument is that in winter, the decrease in conductivity is mainly due to a decrease in temperature that slows the movement of ions, an increase in fresh water from precipitation and snowmelt that contain few solutes, and a decrease in activities that increase conductivity, such as evaporation. And pollution, as well as TDS tends to decrease in winter due to fresh rainfall that brings cleaner water and due to the reduction of processes that normally add dissolved substances to water, such as evaporation, pollution and biological activities. The number of individuals decreases due to the inactivity of living things in winter. This separation indicates that there is a closer relationship between the parameters within each cluster.

Table 8. The results of the Principal Component Analysis of the Correlation Matrix

Eigenvalue	2.5125	1.0701
Proportion	0.419	0.178
Cumulative	0.419	0.597

Variable	PC1	PC2
Temperature Mes	**0.425**	**0.508**
Conductivity (µS/cm)	**0.365**	**0.308**
TDS (ppm)	**0.574**	0.011
O2(mg/L)	-0.322	**0.414**
pH	-0.348	**0.683**
Individual numbers	**0.364**	0.101

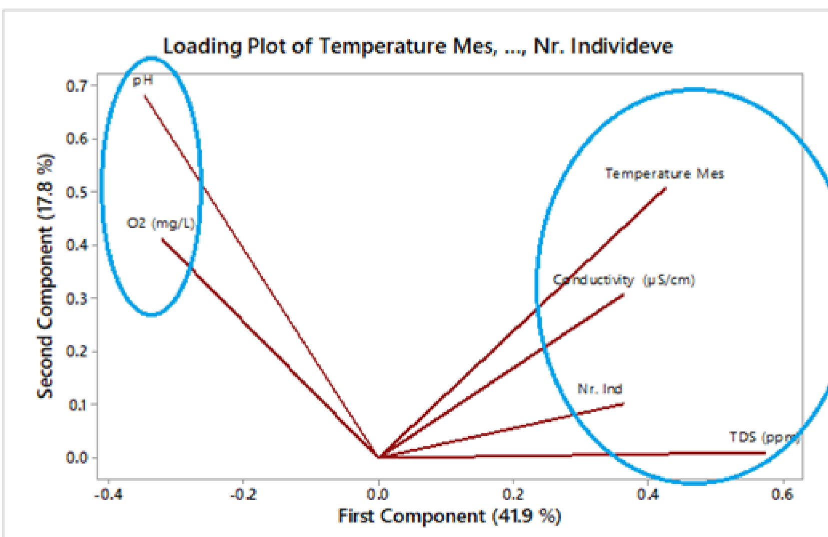


Figure 5. The diagram of the loading plot of two components (PCA of the Correlation Matrix)

Conclusions

The study on the monitoring of two species of crustaceans (*Astacus astacus* and *Austropotamobius torrentium*) reached some important conclusions regarding the status of these species in the region of Prespa and Ohrid lakes, as well as in some other areas.

Presence of Species: Only the species *Astacus astacus* was identified in the region, while *Austropotamobius torrentium* was not found in the study conducted. *A. astacus* is present in Lake Great Prespa and Ohrid Lake, but not in Small Prespa Lake and in the rivers Qarrishta and Rapun, part of Shebenik National Park.

Geographical Extent: In Lake Ohrid, *A. astacus* was found only in 4 out of 7 monitoring stations, while in Great Prespa Lake it was present in 3 out of 5 stations. Physico-chemical water parameters, such as temperature and quality, are within the tolerance values for this species in both lakes.

Ratios and Dimensions: The male to female sex ratio (M/F) is 96% in both lakes. The largest individuals are 14.9 cm and the smallest 5.50, both of which belong to Lake Prespes.

Changes in Population: Monitoring shows that the species is present throughout the year, with an increase in the number of individuals during the summer. In Prespa Lake, the number of individuals has decreased according to fishermen, probably as a result of the lowering of the water level and the displacement of the habitat to deeper areas. In Lake Ohrid, their habitats have moved to a depth of over 5 meters, which makes it difficult to catch them with traps, while they are easier to catch with nets.

Threats and Impacts: The species faces a number of threats, including changes in habitat due to climate change, mining, pollution from urban and agricultural areas. Fishing no longer poses a major threat, as fishermen usually return caught crayfish to the lake without harming the population.

Compared to other Balkan countries, Albania's efforts are still in the early stages. Research is growing, but much of the data about *Astacus astacus* and *Austropotamobius torrentium* are more detailed for countries like Croatia, Serbia, Bosnia (Jelić *et al*., (2016), Bulgaria and Greece (Marković *et al.*, (2019) and Romania Varga. *et al.*, (2017)**.** This study offer insights into how Albania compares to its Balkan neighbors regarding the conservation of *Astacus astacus* and *Austropotamobius torrentium* and shed light on the ongoing challenges in the region.

Proposals:

- Due to the absence of the species *A. astacus* in the red list of the Albanian Fauna and the complete lack of information about the species for Albania in the IUCN Red List, it will be proposed to these two institutions to include this species in these lists together with the sites where it meets.
- Proposal Albanian institutions to include frequent monitoring of the *A. astacus* in the Management Plans of the areas where they are found.
- Monitoring by the Regional Administration of Protected Areas (RAPA) and the Fisheries Management Organization with the aim of avoiding/minimizing damage to the species.
- Conducting studies by scientific researchers about the two species in other water bodies where they are claimed to be found, such as Lake Shkodra, the Drin, Mat, Fan Rivers, etc.

Acknowledgments:

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Annex

Values of physical and chemical parameters measured in the study

Month /Year	Lake/river	Station	*Average Temp*	*Conductivity (µS/cm)*	*TDS (ppm)*	*O2 (mg/L)*	*pH*
Spring 2024	Ohrid	St. 1	12.8	173	148	9.1	8.1
Spring	Ohrid	St. 2	12.8	184	167	9.2	8
Spring	Ohrid	St. 3	13.1	188	173	8.8	8.1
Spring	Ohrid	St. 4	13.4	280	181	8.8	8.1
Spring	Ohrid	St. 5	13.4	297	201	8.1	8.2
Spring	Ohrid	St. 6	12.6	231	175	8.4	8.1
Spring	Ohrid	St. 7	13.5	267	184	9.2	8.2
Spring	Prespa Great	St. 8	15.7	276	204	8.4	7.8
Spring	Prespa Great	St. 9	15.6	267	221	8.5	7.8
Spring	Prespa Great	St. 10	16.2	198	234	8.4	7.7
Spring	Prespa Great	St. 11	16.1	189	238	8.3	7.7
Spring	Prespa Great	St. 12	16.1	194	234	8.5	7.7
Summer 2024	Ohrid	St. 1	19.1	187	174	8.4	8.2
Summer	Ohrid	St. 2	19.6	197	162	8.4	8.2
Summer	Ohrid	St. 3	19.2	187	173	8.3	8.3

Summer	Ohrid	St. 4	19.2	298	178	9	8.3
Summer	Ohrid	St. 5	19.3	294	204	8.6	8.2
Summer	Ohrid	St. 6	18.4	286	186	8.3	7.9
Summer	Ohrid	St. 7	21.9	291	189	8	8.3
Summer	Prespa Great	St. 8	20.4	291	234	8.3	7.6
Summer	Prespa Great	St. 9	20.5	289	265	8.4	7.6
Summer	Prespa Great	St. 10	20.8	274	275	8.4	7.6
Summer	Prespa Great	St. 11	21.2	287	258	8.3	7.4
Summer	Prespa Great	St. 12	21.2	284	264	8.3	7.4
Autumn 2023	Ohrid	St. 1	14.2	224	152	9.2	8.2
Autumn	Ohrid	St. 2	14.4	187	154	9.2	8.2
Autumn	Ohrid	St. 3	15.2	190	163	8.9	8.1
Autumn	Ohrid	St. 4	15.3	298	167	8.7	8.1
Autumn	Ohrid	St. 5	15.3	301	188	8.8	8
Autumn	Ohrid	St. 6	14.2	230	169	8.1	7.9
Autumn	Ohrid	St. 7	15.5	270	195	8.3	8.1
Autumn	Prespa Great	St. 8	12.9	258	191	8	8.1
Autumn	Prespa Great	St. 9	13.1	283	178	8.6	8.1
Autumn	Prespa Great	St. 10	13.4	264	174	8.4	7.9
Autumn	Prespa Great	St. 11	13.5	194	154	8.5	7.9
Autumn	Prespa Great	St. 12	13.5	192	156	8.5	7.9
Winter 2023	Ohrid	St. 1	4.10	178	146	8.6	8.1
Winter	Ohrid	St. 2	4.1	165	145	8.8	8.1
Winter	Ohrid	St. 3	4.6	175	151	8.4	8.1
Winter	Ohrid	St. 4	4.7	285	160	8.4	7.9
Winter	Ohrid	St. 5	4.7	291	172	8.9	8
Winter	Ohrid	St. 6	3.8	224	154	8.4	7.9
Winter	Ohrid	St. 7	4.9	263	182	9.1	8.1
Winter	Prespa Great	St. 8	6.1	245	171	7.6	7.8
Winter	Prespa Great	St. 9	6.2	274	164	8.7	7.6
Winter	Prespa Great	St. 10	6.2	259	163	8.7	7.7
Winter	Prespa Great	St. 11	6.2	184	142	8.6	7.6
Winter	Prespa Great	St. 12	6.2	183	148	8.6	7.6

Photos of the species *Astacus astacus* taken during monitoring in Prespa Lake (Author: B. Pepa, 2024).

Photos of the species *Astacus astacus* taken during monitoring in Ohrid (Author: B. Pepa, 2024).

Photos of the species *Astacus astacus* taken during monitoring in Prespa Lake(Author: B. Pepa, 2024).

Photos of the species *Astacus astacus* taken during monitoring in Prespa Lake (Author: B. Pepa, 2024).

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