Ichthyofauna Of Paravani And Saghamo Lakes: An Updated Appraisal

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Saghamo (surface area 4.8 km²) and Paravani (surface area 37.5 km²) lakes are located in Javakheti upland at an altitude of 2000–2100 m. The distance between them is just 10 km and is connected with the river Paravani. Since ancient time Javakheti was known for its rich fish stocks and until recently Paravani and Saghamo lakes had significant importance in commercial fisheries point of view. The aims of the proposed study were twofold: to determine the modern fish community composition of Saghamo and Paravani lakes; to assess some population parameters of the fish species. Fish samples were collected from Saghamo and Paravani Lake, during 2014-2016 years (3 seasons) by gill nets. Totally 8 fish species with 1122 (809 from Saghamo and 313 from Paravani) individuals were collected. The results has shown that fish species diversity and population structure has changed compering to historical data. Several species (*Cyprinus carpio*, *Rutilus rutilus*) which were inhabiting this lakes are not appearing nowadays. In spite of Paravani lake is several times bigger than Saghamo lake, an ichthyofauna of Saghamo lake is more diverse and fish population are more stable.

Keywords: *fish, highlands, lakes, Georgia*

Javakheti plateau is located in South Georgia, surrounded by Trialeti range from the north, and by Javakheti range from the east. Georgian-Turkish and Georgian-Armenian borders represent the southern margins of the region, while the Mtkvari Gorge is its western limit (Maruashvili, 1970). Saghamo (surface area 4.8 km²) and Paravani (surface area 37.5 km²) lakes are located in Javakheti upland at altitude 2000–2100 m. The distance between them is just 10 km and is connected with the river Paravani. Since ancient time Javakheti was known for its rich fish stocks (Berdzenishvili et al., 2000) and until recently Paravani and Saghamo lakes had significant importance in commercial fisheries point of view. However, Javakheti wetland ecosystems in general, have been heavily affected by the introduction of alien species from 30th of XX century and other anthropogenic factors (Macharashvili et al. 2004). The most significant factors include an invasion of gibel carp (*Carassius gibelio*) which gain a dominant position in all lentic ecosystems of Javakheti and unregulated overfishing which supposedly destroying the fish communities.

Unfortunately, except a few study (Japoshvili, 2012, Pipoyan,Eghoyan,Arakelyan, 2013) during the Last 40 years, systematic study of Javakheti lakes was not conducted and updated information on fish fauna does not exist. Hence, it is very important to investigate the community composition of fishes and reveal trends of their population dynamics in order to assess ecosystem health and create a bases for sustainable management and conservation (European Community, 2000; King, 2007).

The aims of the proposed study were twofold: to determine the modern fish community composition of Saghamo and Paravani lakes; to assess some population parameters of the fish species (such as, species diversity, relative abundance, sex ratio, age structure etc).

Fish samples were collected from Saghamo and Paravani Lake, during 2014-2016 years (3 seasons) by gill nets (80 cm length, 1.5 m heigh, mesh size 15-36 mm). Totally 8 fish species with 1122 (809 from Saghamo and 313 from Paravani) individuals were collected (Table 1). Each specimen was investigated in a field and in a laboratory (Kottelat and Freyhof, 2007; Ninua, Japoshvili and Bochorishvili,.2013). Sex, length and weight were determined at the field. In the laboratory fish main morphometric features were examined. Scale were used for age determination. At the field was measured water temperature, depth and transparency. Chemical parameters, such as: dissolved, oxygen, electricity, mineralization were measured by multifunctional instrument (EXTECH – ExStik EC 500 and ExStikDO600).

Database was created in MS Excel, statistical analyses was conducting using Microsoft excel.

Species diversity were calculating according to Shannon's index. Equal distribution of species by Shannon's evenness index. Similarities among the lakes by species composition was calculated by Jaccard index. Sex ration was estimated by binomial test (Table 2, 3) (Murphy and Willis, 1996).

The results has shown that fish species diversity and population structure (Figure 1; Figure 2) has changed compering to historical data. For example one of the dominant species in the Saghamo lake is an invasive *Carassius gibelio*. Several species (*Cyprinus carpio*, *Rutilus rutilus*) which were inhabiting this lakes are not appearing nowadays. According to locals' information, they have not seen these species (in addition with *Salmo trutta fario*) for a long time and it is possible that they become extinct locally.

Shannon's diversity index showed that fish species diversity in Saghamo lake (n=809; H=1.3) is higher than that in Paravani lake (n=313; H=0.68). The results of Shannon's evenness index showed that species are distributed more even in Saghamo lake (J=0.2), than in Paravani lake (J=0.12). Fish fauna in both of lakes are similar.

Table 1 Quantitative data of Saghamo and Paravani fishes

Species	Latin names	Lake and number of individuals		
		Saghamo	Paravani	Sum
Schneider	*Alburnoides bipunctatus*	150	262	412
Kura barbel	*Barbus lacetra cyri*	1	1	2
Khramulya	*Capoeta capoeta*	98	20	118
Gibel carp	*Carassius gibelio*	135	1	136
European vendace	*Coregonus albula*	5	10	15
Kura gudgeon	*Romanogobio persus*	7	14	21
Trout	*Salmo trutta fario*	2	0	2
Chub	*Squalius cephalus*	411	5	416

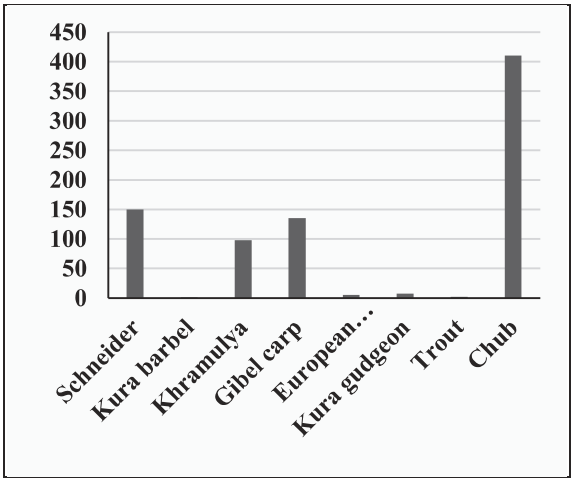

Figure 1. Quantity of fish in Saghamo Lake (2014-2016)

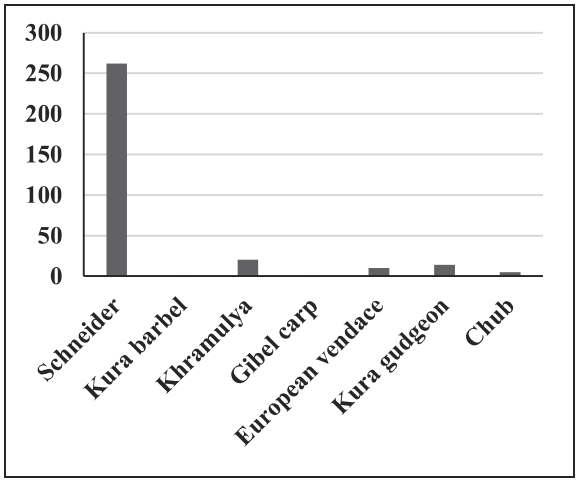

Figure 2. Quantity of fish in Paravani Lake (2015-2016).

In spite of Paravani lake is several times bigger than Saghamo lake, its ichthyofauna is poor. It may caused by uncontrolled fishing. It should be mentioned that around Paravani lake there are 6 villages located, and unsystematic fishing for its residents is a main activity. They often leave gill nets in the lake, which are staying there during the years and causes additional mortality of fishes. Comparing ichthyiofauna of Saghamo lake to Paravani lake, which is not under the human impact, are more diverse and their population are more stable.

Table 2. Summary table on sex ratio in Saghamo Lake

Species	n	M	F	p
Schneider	139	38	101	<0,001
European vendace	4	3	1	0,625
Khramulya	86	30	56	0,006
Gibel carp	131	62	69	0,6
Chub	404	295	109	<0,001

n, number of individuals; M, male; F, female; p, results after binomial test

Table 3. Summary table on sex ratio in Paravani Lake

Species	n	M	F	p
Schneider	232	90	142	<0,001
European vendace	10	8	2	0,109
Khramulya	19	11	8	0,647
Kura gudgeon	12	1	11	0,006

n, number of individuals; M, male; F, female; p, results after binomial test

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Paravani və Sağamo Göllərinin İxtiofaunası: Yenilənmiş Qiymətləndirmə

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Sağamo (səthinin sahəsi 4,8 km^2) və Paravani (səthinin sahəsi 37,5 km^2) Cavaxetiya yaylasında 2000-2100 m hündürlükdə yerləşən göllərdir. Onların arasında məsafə 10 km-dir və Paravani çayı ilə əlaqəlidir. Qədim zamanlardan bəri, Cavaxeti rayonu zəngin balıq ehtiyatları ilə tanınır və son vaxtlara qədər Paravani və Sağamo balıqçılıq əhəmiyyətli göllər idi. Təklif edilən araşdırmanın məqsədi: Sağami və Paravani göllərinin ixtiofaunasının mövcud tərkibini müəyyən edilməsi, balıq növlərinin bəzi parametrlərinin qiymətləndirilməsidir. Balıq nümunələri 2014-2016-cı illərdə 3 mövsüm üzrə göllərdən toplanmışdır. Tədqiqat zamanı 1122 nümunə (Sağamo gölündən 801 və Paravani gölündən 313 nümunə) toplanmış və cəmi 8 növ balıq qeyd edilmişdir,. Nəticələr göstərir ki, balıq növlərinin müxtəlifliyi və strukturu tarixi məlumatlardan fərqlənir. Göllərdə yaşayan bir neçə növ (*Cyprinus carpio, Rutilus rutilus*) hazırda tapılmamışdır. Paravani gölünün Sağamo gölündən bir neçə dəfə böyük olmasına baxmayaraq Sağamo gölünün ixtiofaunası daha zəngin və balıqların populyasiyaları daha stabildir.

Açar sözlər: *balıqlar, yüksək dağlıq, göllər, Gürcüstan*

Ихтиофауна озера Паравани и Сагамо: обновленная оценка

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Сагамо (площадь поверхности 4,8 км²) и Паравани (площадь поверхности 37,5 км ²) озера расположены на Джавахетинской нагорье на высоте 2000-2100 м. Расстояние между ними составляет всего 10 км и связано с рекой Паравани. С древних времен Джавахети был известен своими богатыми рыбными запасами, и до недавнего времени озера Паравани и Сагамо имели важное значение в коммерческом рыболовстве. Цель предлагаемого исследования был: определить современный состав рыбного сообщества озер Сагамо и Паравани; оценка некоторых параметров популяции видов рыб. Образцы рыбы были собраны из озера Сагамо и Паравани, в течение 2014-2016 годов (3 сезона) жаберными сетями. Было собрано всего 8 видов рыб, 1122 образца (809 из Сагамо и 313 из Паравани). Результаты показали, что разнообразие видов рыб и структура населения изменились в зависимости от исторических данных. Несколько видов (*Cyprinus carpio, Rutilus rutilus*), которые населяли эти озера, в настоящее время не встречается улове. Несмотря на то, что озеро Паравани в несколько раз больше чем озера Сагамо, ихтиофауна озера Сагамо более разнообразна, а популяция рыб более стабильна.

***Ключевые слова**: рыбы, высокогорье, озера, Грузия*