

Some Bioclimatic Indices of the Health Resort-Tourist Complex of Bazaleti Lake (Georgia)

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Abstract

The data about equivalent-effective temperature of air (EET), content of light ions in air and chemical composition of water in Bazaleti Lake (Eastern Georgia) are represented. It is shown that in the hottest months (July, August) in Bazaleti Lake in comparison with Tbilisi the more comfortable for human health thermal conditions is observed. The content of light ions in air in Bazaleti Lake and in the limits of several hundred meters from it is above minimally necessary for the health of people, whereas in Dusheti ions concentration is less minimally necessary. The data about the chemical composition of water in the lake and in the spring, which is located in several kilometers from the lake, do not indicate the essential deflections from the standards for the drinking water.

Key words: Equivalent Effective Temperature, water chemical content, light ions, health resort- tourist potential

Introduction

For the complex characteristic of the health resort-tourist resources of localities in recent years is accepted conducting their certification. Special attention is paid also to the level of the pollution of environment, including air and waters [1, 2].

In Georgia similar systematized works was not carried out, although there are many works on the description of the fundamental characteristics of health resort-tourist resources. In particular, in recent years for different regions of Georgia studies of such important for the health of people bioclimatic characteristics as: air temperature [3,4], air Equivalent-Effective Temperature [4-11], Tourism Climate Index [12-16], light ions concentration in air [4, 16-22], surface ozone concentration [4, 23] etc., are carried out.

The bioclimatic properties of locality, and especially health resort-tourist zones, are frequently characterized by so-called equivalent-effective temperature of air (EET). EET is the combination simultaneously observed air temperature, relative humidity and wind speed, expressed by the conditional value of temperature, which creates the same sensation of heat as stagnant air at a relative humidity 100% and a specific temperature. EET create the same heat-sensation as stagnant air at a relative humidity 100% and a specific temperature. Six basic

gradations of EET are separated: $< 1^{\circ}$ - Sharply coldly, $1-8^{\circ}$ - Coldly, $9-16^{\circ}$ - Moderately coldly, $17-22^{\circ}$ - Comfortably, $23-27^{\circ}$ - Warmly, $> 27^{\circ}$ - Hotly [8, 10, 24, 25].

The content of light ions in the atmosphere (n_+ - positive ions concentration, n_- - negative ions concentration) plays important role in molding of the physiological state of population. If sum light ions concentration $n_{+/-}$ is $< 600 \text{ cm}^{-3}$ ($n_+ = 300$, $n_- = 300$, less than the minimum level), their physiological action on the human organism is the following: fatigue, weakening attention, retarding of reactions, worsening in the memory, headache, the disturbance of the regime of blood pressure, etc. When $n_{+/-}$ is $1000-8000 \text{ cm}^{-3}$ ($n_+ = 400-3000$, $n_- = 600-5000$, minimally necessary – optimum levels) their physiological action on the human organism is positive and has sanitation- preventive and therapeutic effect: optimization of blood pressure, positive influence on the course of the diseases of respiratory organs, bronchial asthma, antiseptic action, etc. [4,16].

The data about air equivalent-effective temperature, light ions concentration and water chemical content for the Bazaleti Lake (Eastern Georgia) are presented below.

The region of studies, material and methods

The Bazaleti Lake (Lat. 42.037° N, Lon. 44.679° E, Alt. 879 m a.s.l.) is a lake in eastern Georgia some 60 km northwest of the nation's capital Tbilisi and 5 km south of the town of Dusheti. It is used for fish culture, irrigation and recreation. The nearby village and the historical district around the lake are also known as Bazaleti. The surface area of the lake is 1.22 km^2 and its maximum depth is 7 m. (fig. 1, 2).

The area around the lake housed a flourishing medieval town and is surrounded by many legends. In 1626, the Battle of Bazaleti between two rival Georgian factions took place there.

Currently, the area is a popular recreational area served by a modern tourist complex. It is known that Bazaleti Lake has an outflow but it has not been discovered. Locals claim that the water recirculates. They tell a story about a bull which was drowned in the lake and was later found in a well in the nearby village. According to local legend, a golden-haired child is lying in a golden crib on the bottom of the lake. The lake was formed from his mother's tears. The story is retold in a Georgian poem.

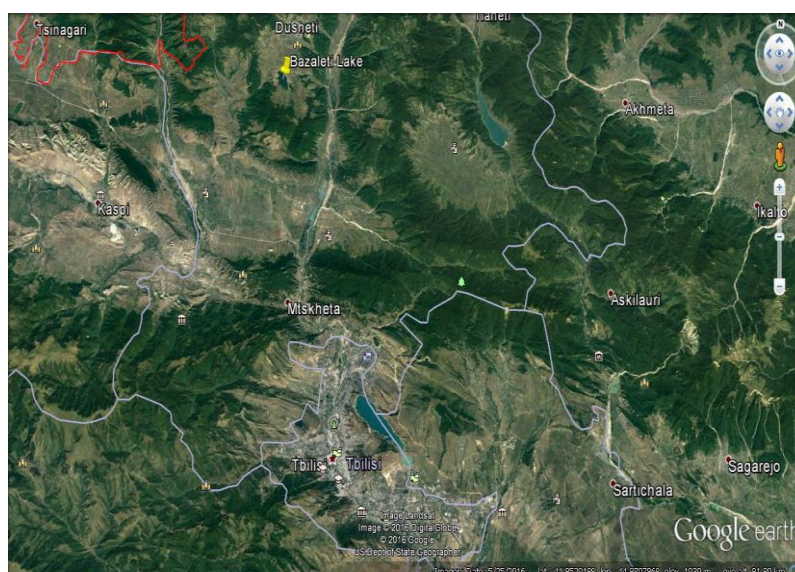


Fig. 1. Location Bazaleti Lake relative to Tbilisi.



Fig 2. Bazaleti Lake.

For the EET calculation data of Hydrometeorological Service of Georgia about the monthly average values of the air temperature, relative humidity and wind speed was used. Values of EET were calculated according to the formula, represented in [24, 25].

Light ions concentration (cm^{-3}) measurements with the aid of the portable ions counter of the production of firm “AlphaLab, Inc.” are conducted.

The chemical analysis of water is executed on the chromatograph Shimadzu – HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC).

Results and discussion

Information about EET in day hour in Tbilisi and Bazaleti Lake in table 1 is presented. Information about chemical composition of water in Bazaleti Lake and spring near lake in table 2 is presented.

Table 1

EET in day hours in Tbilisi and Bazaleti Lake

Month	Tbilisi		Bazaleti Lake	
	EET, grad	EET, heat-sensation	EET, grad	EET, heat-sensation
1	1.4	Coldly	-3.2	Sharply coldly
2	2.1	Coldly	-2.3	Sharply coldly
3	6.7	Coldly	3.2	Coldly
4	13.6	Moderately coldly	10.5	Moderately coldly
5	18.4	Comfortably	15.3	Moderately coldly
6	21.6	Comfortably	18.7	Comfortably
7	24.4	Warmly	21.9	Comfortably
8	23.9	Warmly	21.3	Comfortably
9	20.6	Comfortably	17.9	Comfortably
10	15.2	Moderately coldly	12.3	Moderately coldly
11	9.6	Moderately coldly	6.4	Coldly
12	4.3	Coldly	0.3	Sharply coldly

As follows from table 1 the values of EET in Tbilisi varied from 1.4° (January, gradation - "Coldly ") to 24.4° (July, gradation - "Warmly"). Values of EET in Bazaleti Lake varied from -3.2° (January, gradation - "Sharply coldly") to 21.9° (July, gradation - "Comfortably"). In Tbilisi monthly average in day hours values of EET with gradation "Comfortably" in May, June and September, in Bazaleti Lake – from June to September are observed. Thus, in the hottest months (July and August) in the Bazaleti Lake in comparison with Tbilisi comfortable for the health of people thermal conditions is observed.

The single measurements of the light ions concentration in air near the Bazaleti Lake and in Dusheti in summer 2015 showed the following:

- Near the lake, the sky is clear, wind speed is 1-2 m/sec: $n_+ = 1400 - 1470$ (average -1435) cm^{-3} , $n_- = 1860 - 1960$ (average -1910) cm^{-3} , $n_{+/-} = 3260 - 3430$ (average - 3345) cm^{-3} .
- 300 meters from the lake: $n_+ = 570 - 640$ (average - 605) cm^{-3} , $n_- = 1780 - 1820$ (average - 1800) cm^{-3} , $n_{+/-} = 2350 - 2460$ (average -2405) cm^{-3} .
- Dusheti: $n_+ = 530 - 640$ (average -585) cm^{-3} , $n_- = 210 - 280$ (average -245) cm^{-3} , $n_{+/-} = 740 - 920$ (average -830) cm^{-3} .

As these measurements showed, near the lake and in the limits of several hundred meters from it the summary concentration of light ions in air changes from 2405 cm^{-3} to 3345 cm^{-3} (higher than minimally necessary level). In this case, the concentration of negative ions exceeds the concentration of positive (so-called "waterfall effect" caused by hydro-ionization [21]).

In Dusheti the summary concentration of light ions in air is equal 830 cm^{-3} (less than minimally necessary level). In this case the concentration of positive ions exceeds the concentration of negative, which usually is observed in the places, where the formation of ions mainly occurs due to gamma-radiation of soil, radon and cosmic radiation.

Table 2

The chemical composition of water in Bazaleti Lake and in spring near lake

Chemical composition	Concentration, Mg/L		The norms of drinking water, not are more Mg/L	Norms of irrigation water, not are more Mg/L
	Bazaleti Lake	Spring		
<i>Ffluorides (F)</i>	0.839	1.476	0,7	
<i>Chlorides (Cl)</i>	6.248	19.692	250	
<i>Nitrites (NO₂)</i>	0.010	0.132	0,2	
<i>Bromine (Br)</i>	0.112	0.156		0.1
<i>Nitrates (NO₃)</i>	0.143	63.24	50	
<i>Phosphates (PO₄)</i>	1.617	4.83		
<i>Sulphates (SO₄)</i>	8.353	31.554	250	
<i>Lithium (Li)</i>	0.011	0.024		0.3
<i>Natrium (Na)</i>	12.678	16.230	200	
<i>Amonium (NH₄)</i>	0.000	0.000		0.39
<i>Potassium (K)</i>	3.139	0.700		
<i>Magnesium (Mg)</i>	25.541	59.376	85	
<i>Calcium (Ca)</i>	17.681	20.624	140	

As it follows from table 2 that both samples of water (water from the Bazaleti Lake and water from the spring, located on the road, in 3.8 km to the east of lake, at the height of 711 meters a.s.l.), in comparison with the norms of drinking water, a comparatively high concentration of fluorine is noted. In the water from the spring the values of nitrates are high, while in the lake they are very insignificant. In the lake and in the spring water the concentration of such parameters as chlorides, sulfates, and also sodium and calcium is considerably lower than the tolerance levels. As far as the maximum permissible concentration of the parameters of water, which can be used for the irrigation, is concerned, in both samples is noted small exceeding of the content of bromine, and lithium also of ammonium in the limits of standard [26].

Conclusion

In Georgia in recent years health resort-tourist industry is intensively developed. One of the places for the organization for people of leisure and tourism is Bazaleti Lake. Comfortable thermal conditions in the day hours here from June through September are observed. The preliminary data of the measurements of the content of light ions in air showed, that in the calm weather near the lake and its environments the ionization level of air above minimally of necessary, that favourably for the health of people.

At present vigorously is developed the infrastructure around the lake, which facilitates the use of this place for leisure and tourism the year round. Therefore it is important to maximally use bioclimatic resources of lake for expanding its health resort-tourist potential. In connection with this in the future, in particular, is expedient conducting the more detailed analyses of the distribution of the concentration of light ions near the lake and in its environments under the varied conditions of weather for the designation of places for their use for prevention, reducing and therapeutic purposes.

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ბაზალეთის ტბის საკურორტო - ტურისტული კომპლექსის ზოგიერთი ბიოკლიმატური მახასიათებელი

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რეზიუმე

მოყვანილია მონაცემები ბაზალეთის ტბის მახლობლად ჰაერის ეკვივალენტურ-ეფექტური ტემპერატურის (ეეტ), ჰაერში მსუბუქი იონების შემცველობის და ბაზალეთის ტბის წყლის ქიმიური შემადგენლობის შესახებ. ნაჩვენებია, რომ თბილისთან შედარებით წლის ყველაზე ცხელი თვეების (ივლისი, აგვისტო) დროს ბაზალეთის ტბაზე დაიკვირვება ადამიანის ჯანმრთელობისთვის უფრო კომფორტული თერმული რეჟიმი. მსუბუქი იონების შემცველობა ტბაზე და რამოდენიმე ასეული მეტრის რადიუსში ადამიანის ჯანმრთელობისთვის მინიმალურად საჭირო ნორმაზე მეტია, მაშინ როდესაც დუშეთში იონების კონცენტრაცია მინიმალურ საჭიროზე ნაკლებია. მონაცემები ბაზალეთის ტბის წყალსა და რამოდენიმე კილომეტრში მდებარე წყაროს წყლის ქიმიური შემადგენლობის შესახებ არ უჩვენებენ არსებით გადახრას სასმელი წყლის ნორმებიდან

Некоторые биоклиматические показатели курортно - туристического комплекса озера Базалети (Грузия)

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Резюме

Представлены данные об эквивалентно-эффективной температуре воздуха (ЕЕТ), содержании легких ионов в воздухе и химическом составе воды озера Базалети (Восточная Грузия). Показано, что в самые жаркие месяцы (июль, август) на озере Базалети по сравнению с Тбилиси наблюдается более комфортный для здоровья человека термический режим. Содержание легких ионов на озере Базалети и в пределах нескольких сотен метров выше минимально необходимой для здоровья людей нормы, тогда как в Душети концентрация ионов ниже минимально необходимой. Данные о химическом составе воды в озере и в роднике, находящемся в нескольких километрах от озера, не указывают на существенные отклонения от норм для питьевой воды.