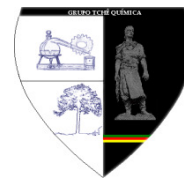# ESPECIFICIDADES RECREATIVAS E BIOCLIMÁTICAS DE PAISAGENS DA ALTAI CENTRAL E DO SUDESTE

RECREATION AND BIOCLIMATIC SPECIFICS OF LANDSCAPES OF THE CENTRAL AND SOUTH-EASTERN ALTAI

РЕКРЕАЦИОННО-БИОКЛИМАТИЧЕСКАЯ СПЕЦИФИКА ЛАНДШАФТОВ ЦЕНТРАЛЬНОГО И ЮГО-ВОСТОЧНОГО АЛТАЯ

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RESUMO

A região de Altai é um dos centros turísticos e recreativos mais populares da Rússia, que se desenvolve dinamicamente. Portanto, uma análise das especificidades recreativas e bioclimáticas das paisagens do Altai Central e do Sudeste foi realizada. Para avaliar os bioclimas das paisagens e sua sistematização de acordo com as condições de formação das diversas classes de clima que afetam a vida humana, foram levados em conta os princípios da climatologia moderna: integridade e subordinação; o cumprimento destes princípios significa uma consideração integrada dos fatores climáticos, realização das pesquisas em múltiplas escalas. Os autores obtiveram a tipificação dos bioclimas das paisagens do território montanhoso de acordo com o grau de conforto para atividades turísticas e recreativas. Os autores estudaram as condições extremas ou extremamente desconfortáveis: a zona de taiga superior, as paisagens de floresta montanhosa e taiga montanhosa de média altitude, as paisagens com condições bioclimáticas agudamente desconfortáveis no inverno e desconfortáveis no verão, os territórios com condições bioclimáticas desconfortáveis e moderadamente desconfortáveis, bem como as paisagens com condições bioclimáticas muito confortáveis e moderadamente confortáveis. Foi estabelecido que as condições bioclimáticas são os fatores limitantes no desenvolvimento de atividades turísticas e recreativas no território da Altai Central e do Sudeste.

Palavras-chave: recreação; tipos de bioclima; paisagens; classes de clima; conforto.

ABSTRACT

The Altai region is one of the most popular and dynamically developing tourist and recreation centers of

Russia. Therefore, an analysis of the recreational and bioclimatic specifics of the landscapes of the Central and South-Eastern Altai was carried out. To assess the bioclimates of landscapes and their systematization according to the conditions of formation of various classes of weather affecting human life, the principles of modern climatology were taken into account: integrity and subordination; compliance with these principles means integrated consideration of climatic factors, conducting multi-scale research. The authors obtained a typification of the bioclimates of landscapes of a mountainous territory according to the steppe of their comfort for tourist and recreational activities. The authors studied extreme or extremely uncomfortable conditions: upper taiga zone, mountain-forest, and mountain-taiga landscapes middle mountains, landscapes with acute uncomfortable bioclimatic conditions in the winter and uncomfortable summer, the territory with uncomfortable and moderately uncomfortable bioclimatic conditions, to landscapes with favorable or moderately comfortable bioclimatic conditions. It has been established that bioclimatic conditions are the limiting factors in the development of tourist and recreational activities in the territory of Central and South-Eastern Altai.

Keywords: recreation; types of bioclimate; landscapes; weather classes; comfort.

АННОТАЦИЯ

Алтайский регион – один из самых популярных и динамично развивающихся туристско-рекреационных центров России. Поэтому в работе проведен анализ рекреационно-биоклиматической специфики ландшафтов Центрального и Юго-Восточного Алтая. Для оценки биоклиматов ландшафтов и их систематизации по условиям формирования различных классов погод, влияющих на жизнедеятельность человека, были учтены принципы современной климатологии: целостность и соподчинение; соблюдение этих принципов означает комплексный учет климатических факторов, проведение разномасштабных исследований. Авторами была получена типизация биоклиматов ландшафтов горной территории по степи их комфортности для туристско-рекреационной деятельности. Авторами изучены экстремальные или крайне дискомфортные условия: верхнетаежный пояс; горно-лесные и горно-таежные ландшафты среднегорий; ландшафты с остро дискомфортными биоклиматическими условиями зимой и дискомфортными летом; территории с дискомфортными и умеренно-дискомфортными биоклиматическими условиями. Установлено, что биоклиматические условия являются лимитирующим факторов в развитии туристско-рекреационной деятельности на территории Центрального и Юго-Восточного Алтая.

Ключевые слова: *рекреация; типы биоклимата; ландшафты; классы погоды; комфортность*.

INTRODUCTION

One of the main problems of development of tourist and recreational activities in the territory of the South-Eastern and Central Altai, along with poor infrastructure, is the lack of information about tourist resources and their effective use. Of all the recreational resources, climatic resources are of paramount importance, since they determine the spatial organization, time constraints and the specifics of recreation (Harms *et al.*, 2016; Koroteeva *et al.*, 2016; Garms *et al.*, 2017). Assessment of climate as a life-supporting factor requires taking into account the many parameters, the combination of which determines the integral effect of its impact on humans (Pröbstl-Haider *et al.*, 2015). In this regard, the term "bioclimate" is currently used – it is a combination of climate characteristics that determine its complex effect on the human body in a certain territory (Sukhova and Rusanov, 2004; Sukhova and Garms, 2014; Altayeva *et al.*,

2017; Yergobek *et al.*, 2018).

On the territory of the Republic of Altai, a large number of nature monuments have been identified (Rudnick *et al.*, 2012; Weyland and Laterra, 2014). These include water bodies (lakes, rivers, waterfalls), botanical (relict plants, plants listed in the Red Book), complex (certain types of natural-territorial complexes), geological (outcrops, rocks, peaks, karst arches, epigenetic valleys).

Mountain Altai is a unique natural complex in its recreational riches. This is a wonderful combination of picturesque mountain landscapes with various types of climate, characterized by an abundance of sunlight and increased ultraviolet radiation (Alagador *et al.*, 2016; Vos *et al.*, 2008; Kukkala and Moilanen, 2017). The territory of the Republic of Altai has magnificent forests and medicinal plants, mineral springs and healing air. Almost all groups of recreational resources are reflected in the Altai: medical, aesthetic,

recreational, sports.

Altai is an attractive tourist site that amazes with a variety of natural and ethnocultural conditions, a wide range of recreational niches and offers (Belcher, 2013; Taranu *et al.*, 2017). However, uncontrolled tourism currently leads, on the one hand, to the depletion of recreational lands, on the other – to the irrational use of recreational resources, the state and quality of which largely depends on natural and climatic conditions (Alagador *et al.*, 2014; Tabor and Williams, 2010; Mokany *et al.*, 2015). The observed climate changes are very important and are already accompanied by a significant ecosystem response, since it is the ratio of heat and moisture that determines the formation of the landscape type, its bioproductivity, the direction of geoecological processes, as well as the recreational value and capacity (Chuvieco *et al.*, 2013; Raffaelli and White, 2013; Butterfield *et al.*, 2016). Currently, for the effective planning of tourist and recreational activities and attracting investment, along with the inventory and assessment of the natural recreational resources of the region, it is absolutely necessary to take into account the influence of the climatic situation (Park and Davis, 2017). In this regard, the study on the assessment of recreational resources, taking into account the observed changes in natural climatic conditions is relevant and timely, will allow to correctly take into account the climate component in the management of the Altai mountain region (Zhuravleva *et al.*, 2018).

The purpose of this study is to assess the bioclimate of the study area for recreational purposes. The area distribution of bioclimate types in the study area is presented in Figure 1.

The basis of the assessment of landscape bioclimates and systematization of landscapes according to the conditions for the formation of various classes of weather affecting human life activity are based on the principles of modern climatology: integrity and subordination; compliance with these principles means integrated consideration of climatic factors, conducting multi-scale research.

MATERIALS AND METHODS

The main indicator of climate affecting human well-being is a complex indicator — classes of weather of the moment, identified in accordance with the method of V. I. Rusanov (Rusanov, 1973; Rusanov, 2000). For the integral assessment of the Altai bioclimate in accordance with the author's method (Sukhova and Rusanov, 2004), the weather classes were combined into four groups: with favorable, relatively favorable, unfavorable and extremely unfavorable weather. Favorable weather corresponds to the most optimal working and outdoor conditions. They include weather classes at positive temperatures — the second (warm), the third (comfortable), the fourth (moderately cold), with negative temperatures – the eighth (mild) and ninth (moderately severe) classes, the sixth – at positive temperatures. With these classes of weather, the voltage of the thermoregulation systems is in the range from minimum to weak. Relatively favorable weather at positive temperatures is represented by the fifth class (cold), at negative temperatures – the tenth class, including severe weather. With both classes, the functional voltage of the human thermoregulation systems is average (Rabe *et al.,* 2018; Richards and Friess, 2015). The weather of the sixth grade — sharply cold, the eleventh grade — very severe and first grade — hot, dry weather is related to adverse weather. These weathers cause a strong degree of stress in human thermoregulation systems (however, whether of the sixth grade observed at negative temperatures is relatively warm and is considered favorable). Unfavorable weather leads to the appearance of discomfort in a person. When the weather of the eleventh class is normalized work in the open air. Extreme weather is included in the group of extremely adverse weather. This is the weather of the seventh grade (hot and humid) and twelfth grade (extremely severe). Under extremely unfavorable weather conditions, work in the open air is impossible and any recreational activity is excluded. An indicator of the favorable bioclimatic conditions (PBBCU) is a coefficient representing the ratio of weather favorable to the total number of days in the period – month, season (Sukhova and Garms, 2014). To distinguish categories of landscapes by degree of comfort, we proposed the following criteria: heat deficiency in the human body in July, atmospheric pressure, conditional temperature in January, favorable indicators of bioclimatic conditions (representing the ratio of the number of days with favorable weather to the number of days in a period) winter (December – January) and summer (June – August) periods. The lack of heat in the human body is calculated according to the frequency of occurrence of weather classes in accordance with the method of V. I. Rusanova. The magnitude of the excess or deficiency of

heat in the human body indicates a deviation of the heat exchange of the human body with the environment from the optimal physiological state. The greater the deviation, the more intense the physiological processes involved in thermoregulation. These deviations reflect the thermal state of a person, his sensation of heat and determine the need for clothing (Sukhova and Rusanov, 2004; Rusanov, 2000). The decrease in atmospheric pressure with altitude and the associated body functions. Conditional temperature takes into account air temperature and wind speed, which characterizes the rate of cooling of the human body (Brewer *et al.*, 2018). The indicator of favorable bioclimatic conditions (IFBC) reflects the impact on the human body of the entire complex of weather conditions in the aggregate: temperature and humidity, wind speed and cloudiness. Considering the lack of heat in the human body, atmospheric pressure, conditional January temperature, indicators of favorable bioclimatic conditions, the following categories of comfort have been identified: extreme, acutely uncomfortable, uncomfortable, moderately uncomfortable, moderately comfortable, comfortable bioclimate. In order to take into account the critical parameters of climatic conditions, in addition to the above bioclimatic indicators, various climatic indicators were used in assessing landscape bioclimates. These are the sums of temperatures for a period with a temperature above 10 °C and below –10 °C, the duration of periods with a temperature above 10 °C and frost-free. Thus, on the basis of the landscape-indicator method, a factor-integral bioclimatic assessment of mountain landscapes was carried out, taking into account the indicators: bioclimatic (NEET, UT, heat deficiency, etc.) and complex – obtained when classifying weather.

RESULTS AND DISCUSSION:

As a result of the assessment, a typification of the bioclimates of landscapes of the studied mountain territory was obtained according to the degree of their comfort for tourist and recreational activities (Geneletti, 2013; Marzetti and Brandolini, 2007). The landscapes of the Central and South-Eastern Altai are combined into groups, each of which is characterized by certain properties of bioclimates (Table 1, Figure 2).

Extreme or extremely uncomfortable conditions recreations are characteristic of highland landscapes – alpine and subalpine-meadow, tundra and Nival-glacial zone landscapes located above 1800 – 2000 m. In the high mountains, the severity of the weather is combined with lower atmospheric pressure.

In the summer there is no frost-free period. Repeatability of weather with a negative temperature is 3-7%. Repeatability of cold and cold weather up to 60%. The average July temperature is 6-8 °C. During the day, the temperature rises to 15-17 °C, at night it is 2-3 °C. Low temperatures are combined with high relative humidity and strong cold wind. In winter, meteorological factors that reduce the recreational value of highlands include heavy snowfall, blizzards, fogs, uneven distribution of snow cover and high avalanche risk.

High mountain climate is manifested in an increase in colds and a general decrease in the immune properties of the body. Signs of altitude sickness do not appear at the same altitude level. In the Central Altai, in its western part at an altitude of 2300 m, in the South-Eastern Altai, respectively, from 3100 to 3500 m above sea level. It should be borne in mind that with a decrease in air temperature and an increase in wind speed, as well as an increase in physical activity. The altitude level at which the symptoms of altitude sickness may appear in a person may decrease.

During the year, the duration of the period when tourist activity is not limited to the weather is 150-180 days. The adverse weather is 130-140 days. Extremely unfavorable weather, in which all tourist events are celebrated, is only 60-65 days.

High mountains attract tourists with an abundance of multifaceted panoramas, colorful landscapes, the effect of conquering the heights. The summit and pre-summit landscapes of highlands are distinguished by a maximum external landscape diversity, which is ensured by a high altitude and a high degree of visibility of future plans. A variety of visible landscapes reaches its maximum, thanks to combinations of various landforms. Open landscapes with glaciers, snowfields, rocky peaks, and cliffs are especially attractive. Mountainous terrain allows you to quickly change the view of the reviews and the change of the landscape plan. However, the inaccessibility of high mountains and the severity of the climate, make their landscapes unsuitable for mass recreation. Highland areas are promising for the development of mountaineering, that is, for healthy and trained recreants.

Preventive measures in the highlands are composed of injury prevention, strict adherence to the rules of safety of movement.

Upper belt refers to a group of landscapes with uncomfortable conditions. It is located at an altitude of 1500 to 1800-2000 m. The acute discomfort of landscape bioclimates is determined by a decrease in atmospheric pressure and a shortage of heat, increasing with height. In the upper tier of the taiga belt, frosty weather is observed for 7 months. In April and October, they make up 40-45%. In winter, moderately frosty weather prevails. Due to the predominance of anticyclonic compression inversion, very frosty weather is uncharacteristic. The average temperature of the winter months is –17 – (-19) °C. Summer is cool. The average July temperature is from 10 to 13 °C. The sum of active temperatures from 500 to 800 °C. The frost-free period is practically absent. In contrast to the tundra landscapes, comfortable weather is present in the structure of weather climates (10–13%). Sharply cold weather is about 20%. The repeatability of favorable and relatively favorable weather for tourist activities ranges from 200 to 250 days, unfavorable weather from 70 to 100 days, extremely unfavorable weather conditions range from 15 to 30 days.

Acutely uncomfortable bioclimatic conditions are pre-critical and have a negative impact on human health.

In the upper taiga landscape belt, the timing of tourist routes is July-August. Bathing is impossible. The objects of tourism can be a variety of mountain taiga landscapes, injuries and overcooling of the body are dangerous.

Mountain-forest and mountain-taiga landscapes of middle lands with an absolute height of 1000 to 1500 m. The middle mountains are characterized by a large variety of climatic conditions. The annual amount of precipitation varies from 900-1000 mm to 300-400 mm. Widely different and the snow of winters. Depending on the nature of moistening, forest landscapes also differ. Blackened and dark coniferous middle mountains are spread in more humid areas and larch forests in more arid regions.

January temperature varies from –20 to (-28) °C. The sum of temperatures for a period with a temperature above 10 °C varies from 1100 to 800 °C. The average July temperature is 13-15 °C. The maximum temperature rises to 25 °C, the minimum drops to 3-4 °C.

The period with favorable and relatively favorable weather during the year varies from 270 to 300 days. Weather unfavorable for recreation is 70-120 days and extremely unfavorable weather from 5 to 15 days.

The objects of tourism are forest landscapes, caves. Tick bites, injuries, and worm infections are dangerous. Preventive measures consist of vaccination against tick-borne encephalitis, self-examination, and mutual examination during halts.

The extraordinary beauty of the landscapes on the slopes of the middle mountains, good visibility in combination with relatively favorable climatic conditions makes it possible to classify forest landscapes of the middle mountains to be very promising recreationally for routes of the increased category of complexity.

Forest landscapes of the middle mountains of Central Altai and a small part of the landscapes of the South-Eastern are also promising for winter tourism. The duration of favorable and relatively favorable weather in the direction of the upper belt of middle lands decreases from 300 to 230 days and the duration of weather restricting tourist activity increases from 60 – 70 days to 100 – 130 days. In the upper part of the forest belt is extremely unfavorable weather, in which any tourist activity is canceled, is 15-30 days.

Acutely uncomfortable climatic conditions are pre-critical, which have a negative impact on human health.

Landscapes with *acutely uncomfortable bioclimatic conditions in winter and uncomfortable in summer* are mid-mountain intermountain hollow semi-desert and dry-steppe landscapes. The bottoms of the depressions are in the range from 1500 to 2000 m. Atmospheric pressure is 967-800 hPa. The climate of these basins is characterized by two main features. First, the great dryness, which causes the formation of semi-desert landscapes. Secondly, the harsh severity of winter time. The conditional January temperature is –30 – (-35) ºC. The sum of temperatures for a period with a temperature below -10C makes 3000 – 3800 ºC. Frost coefficient exceeds 2.5. Even in the daytime, the prevailing weather is very severe, the frequency of which exceeds 50% and only 10% is moderately severe. At night, severe weather is around 60% and 15% is extremely severe.

During the cold period of the year, from

November to March, the number of days with weather favorable for thermoregulation of the human body in the semi-desert landscapes of the basins of the South-Eastern Altai is 20-25, relatively favorable 60-65 and unfavorable 60-70. An indicator of favorable bioclimatic conditions is 0.05 – 0.04.

The influence of meteorological conditions on the thermal state of a person is leveled by clothing that provides thermal comfort. Thermal insulation of clothing protects a person from hypothermia.

Unprotected from hypothermia remain the human respiratory system, heat loss which can lead to hypothermia, i.e. violation of thermoregulation and disease. In such cases, pathogenic microflora easily penetrates through the protective barrier of the respiratory tract.

A person in peace will lose through the respiratory organs in the basins of the South-Eastern Altai from 26 to 31 watts. When walking heat losses increase.

In March, the weather with positive temperatures is about 10%. In April, severe weather still accounts for about 10%, frosty – about 35%. In May, the frequency of sharply cold weather is 35–40%. Repeatability of the weather is comfortable and moderately cold – 10 – 20%. In the summer, clear anticyclonic weather is predominant, comfortable weather is –15– 20%, moderately cold and sharply cold weather is 50–60%. The sum of temperatures for a period with a temperature above 10 °C is 1000–1100 °C. The lack of heat -349 – (-383.9) W / m^2. The duration of the period with the sum of active temperatures 80 – 90 days. The duration of the frost-free period is 60-65 days. The indicator of favorable bioclimatic conditions in the summer months is 0.30 – 0.40.

The duration of the promotional period with favorable and relatively favorable weather is 220-230 days, unfavorable weather 110-120 days and 20-25 days there is extremely unfavorable weather, at which all recreational activities are canceled.

The objects of tourism in the basins are historical and archaeological monuments, interesting natural formations, geological structures, colorful landscapes of mountain framing. The presence of a developed road network allows the development of auto-tourism.

Uncomfortable and moderately uncomfortable bioclimatic conditions They are characteristic of steppe landscapes of intermountain valleys of middle lands with a height of 800–1,500 m. The atmospheric pressure is 880–933 hPa. Conventional January temperature -15 – (-22) ºC. The sum of temperatures for a period with a temperature below -10 ºC – 1800 – 2800 ºC. Frost coefficient 1.3 – 2.5. Steppe geocomplexes of intermountain valleys are characterized by the predominance of clear anticyclonic weather. In winter, the frequency of clear weather in the basins is 20–25 days per month.

The prevailing class of weather during the winter months is weather, which is assessed as severe and causes an average functional stress of the thermoregulation system, favorable weather is 30 – 40%. The adverse weather is very harsh and causes a very strong functional strain of the human thermoregulation systems. The recurrence of such weather in the steppe depressions is 10–20%. In the spring, the repeatability of weather types with positive temperatures increases. Already in March, the repeatability of clear weather reaches 35% in the basins. At the same time, the frequency of frost is high. Among such weather, there is mild and moderate frost with a frequency of 30 – 40%. With a decrease in air temperature, the repeatability and cloudy weather increases to 15–20%. In April, the prevailing weather is sharply cold, its frequency of occurrence is about 40%. About 20% is the repeatability of cold weather. Repeatability of weather with negative temperatures of 20 – 30%. At night, the repeatability of freezing weather increases to 80 – 90%. The value of the indicator of favorable bioclimatic conditions is 0.25-0.27. The climatic spring is expressed in the basins by the transition of the average daily temperature at 5 °C, which occurs in the last decade of April. In May, there is an alternation of invasions of Arctic air from the north and tropical from the south and southwest. Sunny warm weather gives way to cold and overcast with drizzling rain or even with snow. The recurrence of cloudy weather increases, the number of hours of sunshine decreases, the heating of the underlying surface slows down, and the increase in average daily temperature is delayed. There are often frosts. The amount of precipitation in comparison with April increases two to three times. In such periods sharply cold weather prevails. During May, the frequency of occurrence of this weather is 25–30%. Repeatability in May and cold cloudy weather is

high. However, bad weather is interspersed with warm anticyclonic weather. Repeatability of comfortable weather – 10 – 20%, moderately cold more than 20%.

The steppe landscapes of the intermontane basins in May and September are characterized by a similar frequency of weather. This weather is from comfortable to sharply cold. Weather with negative temperatures is not characteristic. For the landscapes of the intermontane basins in the summer months, some moderately cold weather is characteristic. On average, comfortable weather is 20–25%, moderately cold about 30%, sharply cold 20–30%. Repeatability of warm weather is from 5 to 10%. The sum of temperatures above 10 °C is 1100 – 1500 °C, the duration of the frost-free period is 80 – 90 days, the number of days with the sum of active temperatures is from 80 to 110 days. The lack of heat in July ranges from -209.4 to – 383.9 W / m², which corresponds to a moderately cold climate. The value of the bioclimatic indicator of climate favorableness in winter is 0.30–0.40, in summer it is about 0.50. The number of days with favorable weather and relatively favorable for recreation is 280-300. Duration of the period with biologically active UV radiation –220-230 days. The unfavorable weather is frosty in winter and rainy in summer is 60-70 days.

The unique natural resources of the Altai inner mountain basins interest both scientists and numerous tourists. On the territory of the basins and valleys of Central Altai, special ecological and scientific-educational routes can be laid that will satisfy the interests of ornithologists, entomologists, cavers and other specialists. The underworld is very interesting. These are the most beautiful caves, underground lakes, and rivers.

To landscapes with *precomfortable or moderately comfortable* bioclimatic conditions include steppe, forest-steppe and, in some areas, forest landscapes of the bottoms of valleys and lake basins in the lower part of the middle mountains, the elevation of which above sea level is 1000-1200 m. Atmospheric pressure is 907-960 hPa. These are valleys or parts of valleys of meridional orientation, characterized by high frequency of occurrence of foehn wind. Signs of foehn wind in these valleys are observed for about 100 days during the year, but the most characteristic is foehn wind for the cold period of the year. Fena imprint on all climatic indicators, they increase the air temperature. In contrast to the depressions, the coefficient of frost in these valleys is 0.40 – 0.60, i.e., the sum of temperatures for a period with a temperature below -10 °C is more than two times less than the sum of temperatures above 10 °C. The sum of temperatures below -10 ºC from 900 to 1500 ºC. The conditional January temperature is -15 – (-18) ºC.

Relative humidity in the winter months is reduced. Under the influence of hair dryers, snow evaporates, and the valleys fall into the category of light snow. A warm and dry hair dryer does not cause such an intense cooling of the human body as the general circulation wind. The presence of fans is reflected in the structure of weather classes. In the winter months, moderately severe weather prevails, it is 30–50%, mild weather makes up 30–40%, and 10–15% is the weather with positive temperatures. The recurrence of severe weather in the coldest months does not exceed 25%. The weather is very severe not observed.

In May and September around 5–7% is the frequency of hot weather, about 20% is of comfortable weather. In the summer months, the weather is sometimes hot and dry. Repeatability of warm weather 15 – 20%. The repeatability of comfortable weather of 30% or more, sharply cold weather is very small (5 – 10%). The sum of temperatures above 10 °C is 1600–1800 °C; the number of days with an active temperature above 10 °C is 110–120. In July, the heat deficit is -209.4 – (-279.2) W / m². The indicator of favorable bioclimatic conditions in winter is 0.50 – 0.60, in summer 0.60 – 0.70.

CONCLUSIONS:

Tourism and health bioclimatic resources are designed for a healthy person, so the areas of tourist activity have a wide area of distribution. Since for a healthy person a wider range of comfort is wider, it is possible to consider as suitable for tourism not only weather favorable, but also relatively favorable. Only adverse weather allows us to estimate the duration of the period when tourist activities may be limited. The recurrence of extremely unfavorable weather indicates a possible cancellation of tourist and sports events. The value of the recreational resources of the Altai Republic is determined primarily by the natural and climatic conditions of the territory. A large number of sunny days per year, a low concentration of dust-like components

in the atmosphere of the valleys, the presence of a wide range of mountain climatic zones determines the territory of the republic as one of the potential recreational centers of the Russian Federation.

Landscape and climatic conditions are the most important objective conditions of human life. The mountainous terrain of the Altai extremely complicates these conditions. In terms of the scale of the influence of relief on the formation of climates, we have identified a number of forms. First, the climate is affected by the height of the mountains. The intensity of solar radiation increases with height, but the temperature and moisture content of the air decreases and the atmospheric pressure decreases. An indicator of climate change with height is landscape longline and high-altitude zone. Secondly, under the influence of mountains, changes occur in large-scale general circulation processes. In particular, the planetary altitude frontal zone is deformed, the direction of the channel flow of air masses from Central Asia to Western Siberia is in a certain way oriented. The forced rise of air masses on the leeward slopes increases the intensity of the process of condensation and precipitation, on the leeward slopes in the basins a "barrier shadow" effect is formed. In the cold period of the year, baric maxima sharply increase over the high-mountain basins. Macroclimates of large orographic systems of the Northern, Northeastern, Central Altai, etc., form under the influence of the interaction of mountains with the general circulation processes. Third, the meso-relief determines the peculiarities of local climates of valleys and basins. The conditions for the formation of phenes, which play an extremely important role in the climates of the valleys, depend on these properties of the relief; mountain-valley circulation; the intensity of the night cooling of the bottoms of the valleys relative to the slopes and other features of local climates.

Since landscapes are an "indicator" of climate, the landscape structure of Altai is associated with its climatic differentiation. Vertical climatic zone determines the layering and vertical zone landscapes. The prevailing categories of comfort in the study area are various modifications of the uncomfortable bioclimate. A comfortable and comfortable bioclimate is characteristic of landscapes that are spread over 5% of the territory while alternating with moderately uncomfortable in winter time in 3% of the total area. The prevailing type of bioclimate is extreme in winter, extremely uncomfortable in summer (61%), intermediate (22%) is moderately uncomfortable in winter and uncomfortable in summer. Thus, bioclimatic conditions are the limiting factors in the development of tourist and recreational activities in the territory of Central and South-Eastern Altai.

ACKNOWLEDGMENTS:

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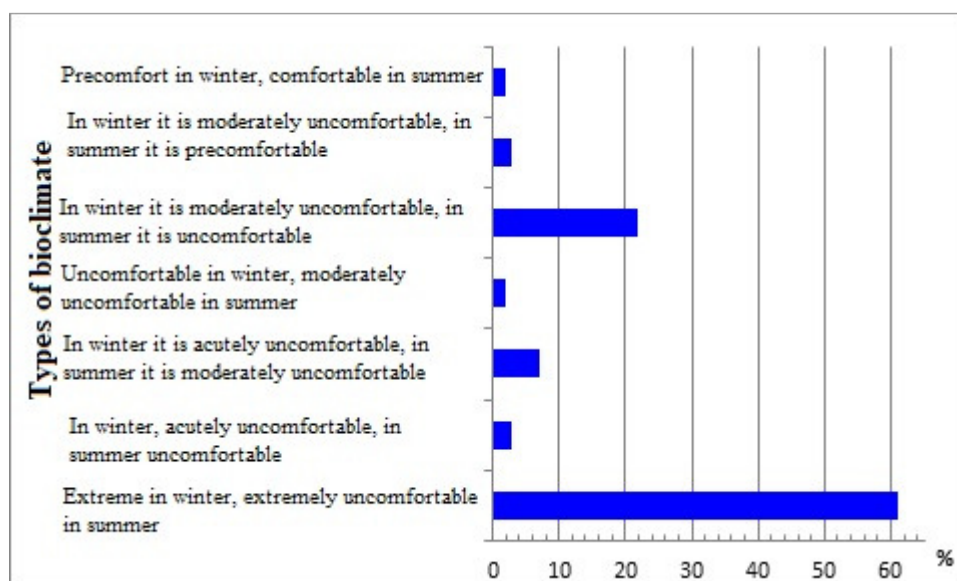
Figure 1. *Distribution of various types of bioclimates of landscapes of the Central and South-Eastern Altai*
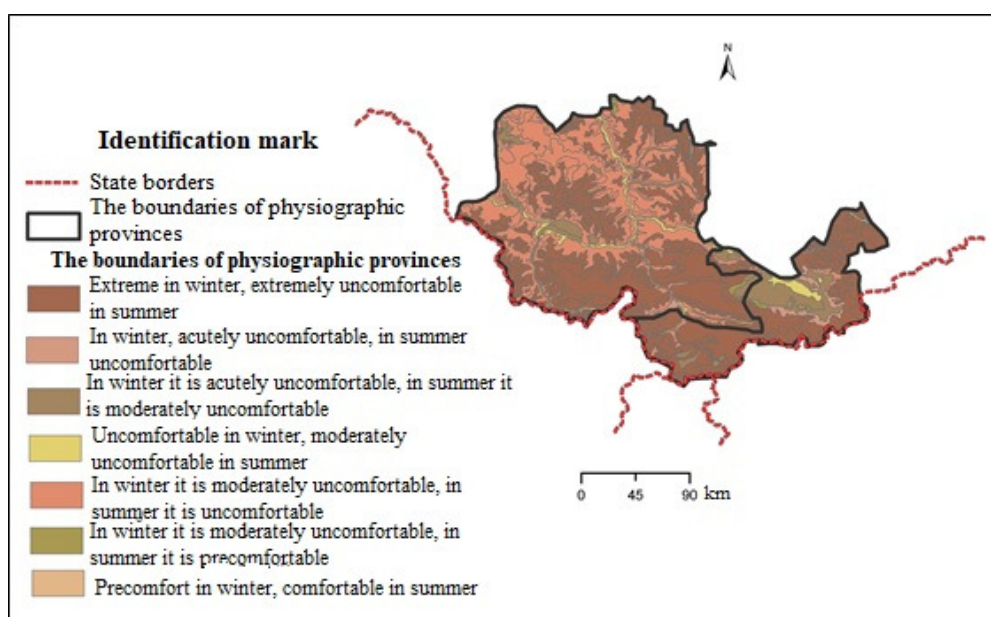

Figure 2. *Bioclimatic assessment of landscapes of the Central and South-Eastern Altai for tourist and recreational activities*

Table 1. *Bioclimatic landscape conditions for recreation (year)*

Landscapes	The number of days with weather				IFBC
	Favorable	Relatively favorable	not favorable	extremely unfavorable	
High mountain: Tundra	50-60	100-120	130-140	60-65	0,05-0.1
Middle mountain: forest (1500-2000m)	100-130	110-130	120-130	15-30	0,1-0.3
Forest (1000-1500 m)	130-180	120-140	70-120	5-15	0.3-0.5
Intermountain trough:					
Meadow-steppe	150-160	130-140	60-70	0-5	0.4-0.5
Steppe	160-170	120-130	50-60	0-2	0.5-0.55
Semi-desert	90-100	130-140	110-120	20-25	0.2-0.3