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STUDYING THE DEVELOPMENT POTENTIAL OF TOURISM INDUSTRIES IN THE SOUTH ALTAI BY HYDROLOGICAL, CLIMATIC, GEOMORPHOLOGICAL WAY AND VISUALIZATION USING GIS

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Abstract: The article conducts a study of the current state of development of the natural and recreational potential of the Southern Altai. The problems that currently hinder the development of tourism sectors in this territory are considered and ways to solve them are proposed. With the accelerated growth of global tourism and recreation, demand for certain regions of Kazakhstan is increasing. The assessment of the natural and recreational potential of Southern Altai was carried out taking into account the bioclimatic state of natural and recreational areas. When assessing the natural and recreational resources of the study area, our study assessed the shape of the relief, bioclimate, hydrology and flora. The results of the study allow us to propose specialized and multi-thematic routes connecting the main natural and cultural attractions of the main recreation areas for international and domestic tourists, as well as for educational and educational field programs and research trips. The study of the territorial and recreational potential of a mountainous region has its own characteristics, since, compared with plain territories, its knowledge is insufficient.

Keywords: recreation, GIS, tourism, landscape, bioclimate, relief, winter sports, recreational potential, activities

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INTRODUCTION

Altai is the most high-mountainous region of southern Siberia, stretching about 2000 km from west to east. It is distributed from northwest to southeast from the West Siberian Lowland to the Gobi Plain. Most of Altai's territory is located in Russia. The Kazakhstan part includes only the southwestern part of the Altai mountain system (Dzhanaleeva, 2016). The mountainous Altai region is located between 48° and 53° north latitude, and its Kazakh part is known as the Kazakh Altai. Kazakhstan Altai occupies approximately a tenth of the entire territory of the republic. It is part of a larger mountain system known as the Altai-Sayan Mountains, which stretches from the Zaisan Lowland to Lake Baikal. In the south, it is limited by the Kara Irtysh River and Lake Zaisan, and in the west by the Kalba ridge from Saryarka to the Shar River valley (Tokmagambetov, 1974) (Figure 1). The Southern Altai covered by our study extends between the Bukhtarma River in the north and the Zaisan River in the south, including the black Irtysh. The development of the tourism sector in this region of Southern Altai emphasizes the importance of our research aimed at developing the wise use of natural resources in the context of recreation. The purpose of our research work is to assess and map the level of favorableness of

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natural resources in natural and recreational zones of the Southern Altai Territory. In recent years, interest in mountain recreation has grown, and the influence of human activity on natural recreational complexes has increased, which emphasizes the need to organize recreational activities taking into account the environmental aspect and scientific understanding.

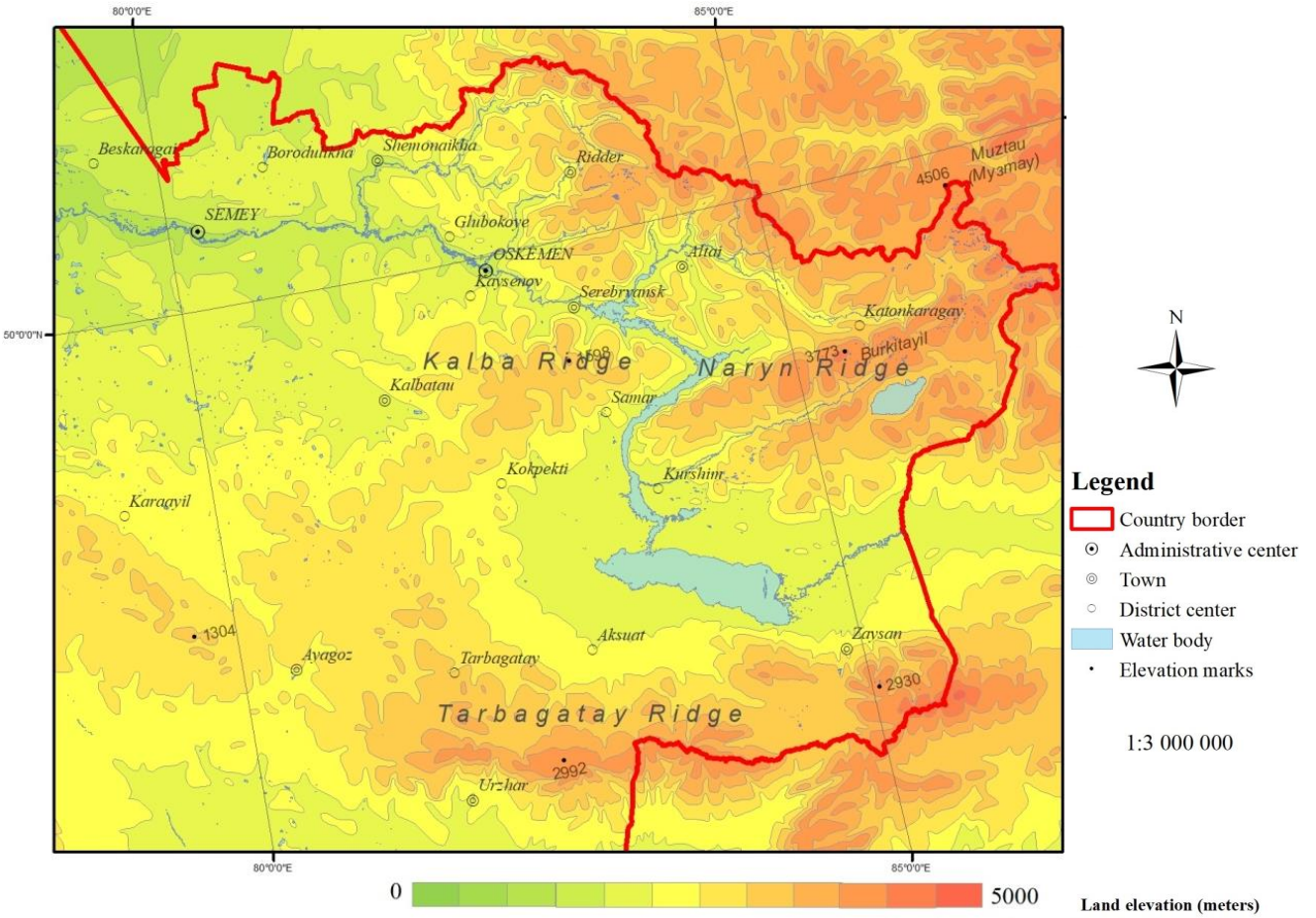

Figure 1. Hypsometric map of East Kazakhstan Region (National Atlas of the Republic of Kazakhstan, 2010)

The boundaries of Southern Altai and Rudny Altai are determined by climatic zonality, lying between the arid steppe zone and the semi-desert zone, coinciding with the "great belt of the European-Asian continent". The climatic features of Southern Altai are determined both by altitudinal zones and by the influence of humid north-west winds from the Atlantic Ocean, which bring precipitation. The air temperature in a mountain zone depends on the altitude above sea level and the terrain, such as mountain slopes and peaks, according to Voeikov's principle (Oldfield, 2016).

Southern Altai is characterized by a winter temperature inversion associated with buzzing waves and orographic features. Katon-Karagay (1068 m) is located on a mountain slope, ideal for air currents, and the settlement of Orlovka (1081 m) is concentrated on all sides in a deep lowland, surrounded by mountains. Although both of these stations are at the same altitude, the settlement of Orlovka is 10°C colder in January, and 1°C colder in July, than in Katon-Karagai. The rivers of Southern Altai are distinguished by an abundance of water with high humidity. All rivers have a mountainous, flood character, and a rocky bottom. Depending on its regime, we classify it as the "Altai" type. Eastern Kazakhstan has a high resource potential for tourism. This part of the country also has high mountain landscapes and water bodies for active tourism. Water bodies are used for a wide variety of outdoor recreational activities, including kayaking, water biking, water motorsports, sailing, windsurfing, scuba diving and iceboating (Lewandowicz et al., 2022). Water tourism is less popular in East Kazakhstan too (Folgado-Fernández et al., 2018).

MATERIALS AND RESEARCH METHOD

Considering the above and the growing number of publications in the field of tourism geography, we realized the fact that research on tourism in mountainous regions is still small and insufficient for the development of tourism in these regions (Deac et al., 2019; Herman et al., 2019; Ilieș et al., 2018, 2020). The assessment of the natural and recreational potential of Southern Altai was carried out taking into account the bioclimatic state of natural and recreational areas. When assessing the natural and recreational resources of the study area, our study assessed the shape of the relief, bioclimate, hydrology and flora (Kuskov, 2005). Each resource was grouped by degree of favorability in accordance with the obtained indicators (Kolotova, 1999). According to the indicator of recreational assessment of the terrain, indicated in the textbook by "Recreational use of territories and forest protection", we classify them as "ideally suitable" for organizing any kind of recreation in the area of the region in our study (Table 1) (Nefedova, 1980).

Table 1. Scale of recreational assessment of the area (Nefedova, 1980)

No	Terrain class	Relief characteristics
1	Very favorable	Mountain, foothill: mountain-ridge and erosion
2	Favorable	Rough, intersecting stepped, eroded
3	Satisfactorily	Wavy, slightly intersecting
4	Not favorable	Plain-undulating
5	Extremely unfavorable	Plain and mountain (highest mountain peaks)

For the purpose of a complete analysis of the geomorphological state of the relief in the study area, the absolute height of the relief and indicators of its section were obtained (Semenikhina, 2002) (Table 2).

The last indicator is described in detail in morphometry - horizontal and vertical cutting of the relief, verticality of the slopes (Kolotova, 1999). When assessing the bioclimate of Southern Altai, the methodology of Rusanov (1973), Yegorina (2016a), Sukhova (2015) is used. In the monograph by Sukhova, research was carried out for the regions of Kazakhstan and Russia (Sukhova, 2015). In the works of Yegorina A.V., indicators of weather stations located in the territory of Southern Altai were obtained (Yegorina, 2016a). A complex indicator is used that determines the influence of the Southern Altai climate on the human body - a class of weather moments as the main indicators. The methodology of Rusanov (1973) was applied, and data from the weather stations Markakol, Katon-Karagay, Orlovka, Zaisan, Boran, Kurchum were obtained. In the integral assessment of the bioclimate of Southern Altai, the weather class was combined into 4 groups: favorable, relatively favorable, unfavorable, extremely unfavorable. Favorable weather conditions become ideal for efficient work and relaxation in clear skies (Dmitriyev et al., 2021).

Table 2. Grouping of natural systems by geomorphological indicators (Bredikhin, 2004)

Absolute relief height (m)		Angles of inclination of the earth's surface (in degrees)		Vertical cutting of relief (m)		Horizontal cutting of the relief (km)	Recreational suitability assessment
Rest *	Tourism**	Rest *	Tourism**	Rest *	Tourism**		
>1500	0-500	12-30; >30	0-3; 3-6	>800	<300	>2.5	Extremely unfavorable (1 point)
1000-1500	500-1000	6-12	6-12	600-800	300-600	2.5-1.2	Relatively favorable (2 points)
500-1000	1000-1500	3-6	12-30	300-600	600-800	1.2-0.8	Favorable (3-4 points)
0-500	>1500	0-3	30-45	<300	>800	<0.8300	Very favorable (5 points)
Note * - medical and recreational holidays; * * - sports tourism							

According to Panizza and Piacente (1993, 2003) and Quaranta (1993), geomorphological sites (or geomorphological assets) are defined as geomorphological landforms and processes that have acquired a scenic/aesthetic, scientific, cultural/historical and/or a social/economic value due to human perception of geological, geomorphological, historical and social factors. This process is called optimization (Pralong and Reynard, 2005). From a tourist and recreational point of view, these four different values may be considered as exclusive components of the tourist value of a geomorphological site. All tourist goods, services and infrastructure created from geomorphological landforms and processes result from the use of this value and its four components, which is understood in terms of degree and modality of exploitation.

ArcGIS 10.1 (ESRI Inc.) was used to perform the comprehensive assessment work in this article. With its help, the necessary manipulations with digital cartographic data were carried out, as well as satellite images were created to develop a geographic information system (GIS) and conduct deep spatial analysis based on the data of this system (Zhensikbayeva et al., 2023). As initial GIS data, vector layers of a digital map at a scale of 1:1,500,000 (waterworks, border) of the DCW world map were used (Digital Chart of the World), as well as a digital elevation model with a step of 500 m of the SRTM project (Shuttle Radar Topography mission). In ArcGIS, the boundaries of natural and recreational areas have been digitized and a geobase of the research zone has appeared. Based on a quantitative relief model, a set of quantitative thematic maps of significant morphometric indicators was created (Waiyausuri et al., 2023).

RESEARCH RESULTS

According to the methodological complex of the research work, we examined the systems of recreation development in the study area using 3 different (climatic, hydrological and geomorphological) methods and mapped them through geographic information systems. The climatic conditions of the East Kazakhstan region are varied due to its geographical location. According to scientists' research, the region is located at the junction of 3 climate types: Mongolian, Central Asian and West Siberian, as well as lowland steppes and Altai and Saur Tarbagatai mountain regions (Yegorina, 2015).

The Southern Altai territory has enormous opportunities for recreation. During the coldest months of the winter season, the minimum average temperature in January is -27°C in the village of Orlovka and -26°C in Markakol, which makes these places unsuitable for stay. However, at altitudes from 1000 m to 3000 m, where the wind often blows on the mountain slopes, the average January temperature is -13°C and -15°C. These areas are areas for winter sports, tourism and mountaineering. Winter tourism is associated with seasonal sports, recreation, and activities that depend substantially on the sufficient snow cover (Keukenov et al., 2023). Many researchers have studied this type of tourism (Abegg, 2007; Breiling, 1999; Song, 2022; Tang, 2022). To assess the influence of the climate of Southern Altai on the human body, a complex indicator was used, based on the methodology of V.I. Rusanov, where the classification of weather conditions plays a key role.

In the integral assessment of the bioclimate of Southern Altai, the weather class was combined into 4 groups: favorable, relatively favorable, unfavorable, extremely unfavorable (Sukhova et al., 2014; Chlachula, 2019a).

According to this grouping, we classify the Katonkaragay district as a relatively favorable one, and the Kurchum natural and recreational territory as a favorable group. One of the natural recreational areas where the bioclimatic conditions for recreational activities in the summer and semi-desert months are favorable are Markakol and Kurchum (Figure 4).

In the natural and recreational areas of Kurchum and Markakol, there is usually no very hot weather in summer (classes I and II). The atmosphere here is pleasant (class III) and cool (class IV), and it always feels cold at night (class V). The summer season lasts approximately 80-85 days, the average temperature from June to August is 14°C, and the number of frost-free days varies from 60 to 70. The first half of the autumn season is usually warm with light winds, while the second half is cold and rainy. The annual precipitation is 450-500 mm. The climatic features of Southern Altai are varied. The main criterion for a favorable climate is the regulation of heat exchange between humans and the environment, which depends on various factors such as temperature, air humidity, wind speed and intensity of solar radiation. The classification of the favorableness of swimming in the summer was determined by V.I. Rusanov, and the grouping of weather conditions according to the level of weathering and heat regulation systems is carried out based on the functional level of weathering. An assessment of the bioclimatic conditions of Southern Altai was carried out taking into account landscape features and factors of their formation.

The grouping of favorable, relatively favorable, unfavorable, and very unfavorable weather conditions is classified as weathering class, and heat control systems are classified into soft, medium, hard, and very hard functional levels. Indicators of favorable bioclimatic conditions (maximum permissible concentration MPC) favorable weather is characterized by the ratio of the number of days in the warm and cold seasons or the number of favorable weather conditions in the volume of the year. An assessment was made using the landscape methodology for grouping the bioclimate of the Southern Altai Territory, which lies in the transboundary zone.

Based on the zoning of favorable indicators of bioclimatic conditions, the landscape features of the study area and the factors of their formation were taken into account. In this regard, an integral bioclimatic assessment was carried out taking into account the bioclimatic indicators of the mountain landscapes of Southern Altai (Figure 2).

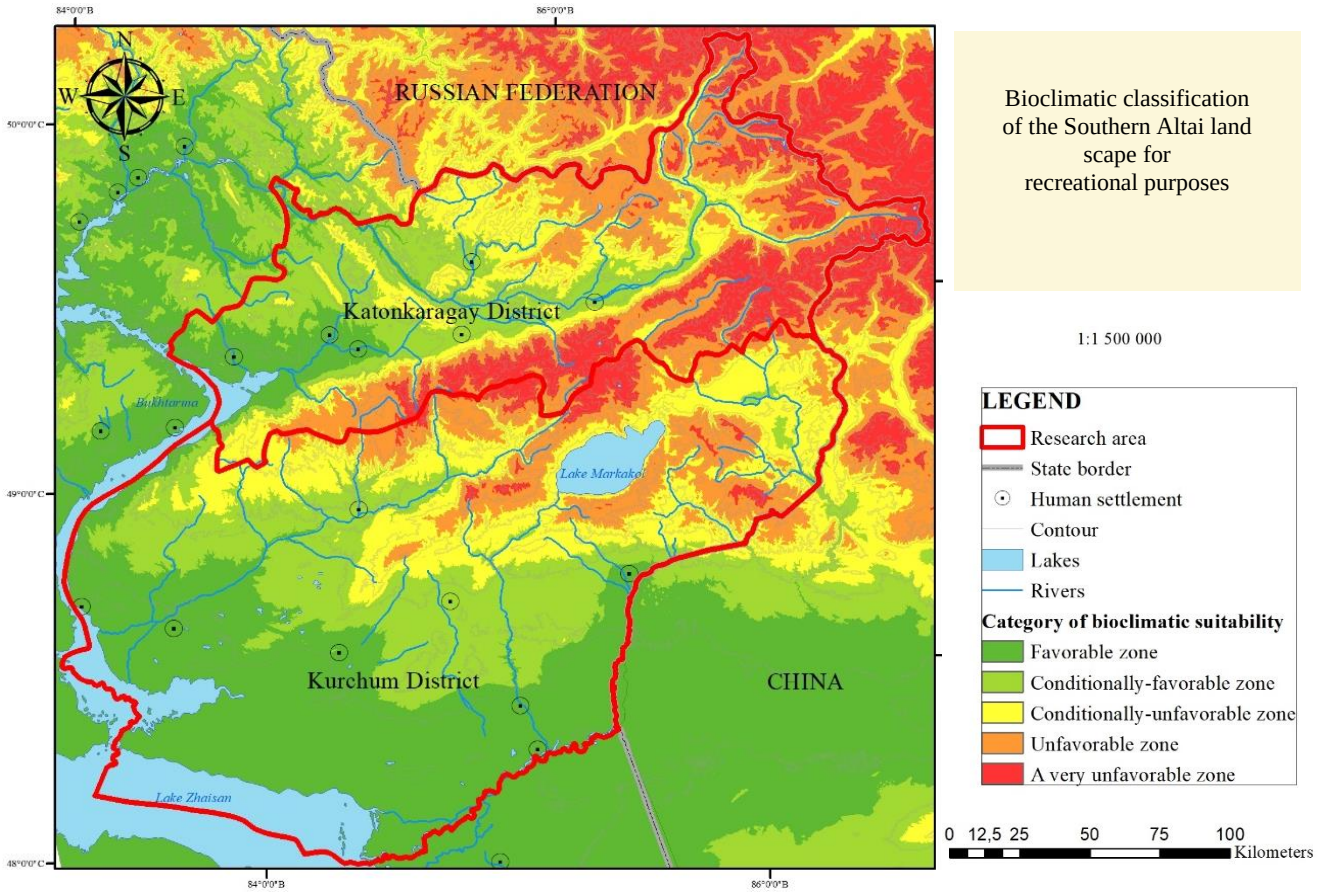

Figure 2. Bioclimatic classification of the Southern Altai landscape for recreational purposes (Zhensikbayeva et al., 2018)

Within the framework of integral bioclimatic indicators, we categorize Southern Altai into the following recreational and climatic zones (Zhensikbayeva et al., 2018):

1. High comfort zone. It is characterized by comfortable and moderately severe winters and warm, humid summers. This group includes flat areas of low mountains, steppe and forest-steppe landscapes. Atmospheric pressure - 1000-960 hPa. The relative temperature in January is 12°C. In winter there is a lot of snow. During the winter months, the average frosty weather is about 35%, warm weather is 35-40% and frosty weather is 10-20%. In summer, favorable weather is 35-40%, 10-15% is warm weather, 3-5% is warm dry weather, 5-7% is hot humid weather. The heat deficit in July is 139.6-209.4 W/m2. The bioclimatic suitability index is 0.65-0.70 in winter, 0.70-0.80 in summer.

2. The middle transition is a favorable zone. It has moderately cold winters and cool summers. We include the valleys of the Kurchum River, lake basins of low mountains and the middle mountain zone with an altitude of 500-1000 m above sea level. Atmospheric pressure 907-960 hPa. The relative temperature in January is -15°C. Foehn wind gusts are frequent in this area. In winter, moderate-severe weather is 30-50%, 30-40% is warm weather and 10-15% is moderate temperature. During the winter months, days with lower temperatures do not exceed 25%. Very severe weather is not noticeable. Approximately 5-7% hot weather is repeated in June and September, approximately 20% favorable weather. In summer the weather is sometimes hot and dry. The frequency of warm weather is 15-20% (Kabdrakhmanova et al., 2019).

The frequency of such weather conditions in field pits is 10-20%. In March, the frequency of open days in the basins is 30-40%. As the temperature drops, the number of cloudy days increases by 15-20%. The indicator of favorable bioclimatic condition is 0.25-0.27. Main geographical location: lowland mountains of the Narym plateau (south of the Akozensky slope of the lowland mountains), Kurchum hilly-elevated territorial and recreational systems.

Intermountain basins in steppe landscapes transition from favorable weather to sharply cold temperatures in June and September. Moderate cold weather prevails in the landscape of intermountain basins in the summer. Average favorable weather is 20-25%, moderate cold is about 30%, severe cold is 20-30%. The frequency of warm weather is 5-10%. The sum of temperatures above 10°C is 1100-1500°C, the duration of the number of frost-free days is 80-90 days. In July, the heat deficit ranges from -209.4 to -383.9 W/m2, which is typical for a moderately cold climate. The indicator of favorable bioclimatic conditions is 0.30-0.40 in winter and about 0.50 in summer. The number of days with favorable and relatively favorable weather for recreation is 280-300. Bad weather - winter frosts, rainy summer - 60-70 days.

3. Cold Transition is a favorable zone that includes mountainous areas located at an altitude of about 1500 m. It is characterized by harsh winters and cool summers. Medium mountain basins are common in this zone, found in desert and arid steppe landscapes. Atmospheric pressure in this zone ranges from 967 to 800 hPa. The climate of these basins is characterized by two main features: firstly, dryness contributes to the formation of semi-desert landscapes, and secondly, the severity of the winter season. In January the average temperature is around -30°C (-35°C), and the sum of temperatures below 10°C ranges from 3000 to 3800°C. In the semi-desert landscapes of Southern Altai in November and March, the number of days with air temperature favorable for humans is 20-25, relatively favorable - 60-65 and unfavorable - 60-70 days. The indicator of favorable bioclimatic conditions ranges from 0.05 to 0.04, and the number of days without frost ranges from 60 to 65 days. The indicator of favorable bioclimatic conditions in the summer season ranges from 0.30 to 0.40. The Narym Plateau is dominated by low mountains (Akozensky sloping low mountains), the slopes of the high-mountain lake basin Markakol.

4. The zone of cold discomfort includes the basins of South-Eastern Altai, where they are characterized by excessively harsh winters and cool summers. The average temperature in the winter months here is around -17°C (-19°C) and the average July temperature is between 10 and 13°C. In this zone, favorable and relatively favorable weather for tourism activities lasts about 200-250 days a year. Annual precipitation varies from 900-1000 mm to 300-400 mm. In the territorial and recreational systems of this zone there are the Katon-Karagai high-mountain Orkashty uplifts, the Markakol high-mountain lake basins and the Kara-Kabak strongly dissected slopes of the middle mountains.

5. There is discomfort. We include mountain zones that cover an altitude of 1500-2500 m (Orlovka, Markakol, etc.). This zone is characterized by harsh winters and cool summers. The average temperature in July is 6-8°C. During the day the air temperature rises by 15-17°C, at night it drops by 2-3°C. Meteorological factors that impede the development of recreational activities in the highlands in winter include heavy snowfall, blizzards, fog, uneven snow cover avalanche danger, etc.

6. Zone of severe discomfort. We include mountainous areas that cover an altitude of more than 2500 m (above the snow line). This zone is characterized by very harsh winters and very cold summers (Yegorina, 2016).

The mountainous terrain of the territory, microclimate, springs, rocks, rock paintings, fossilized remains of ancient animals, Saki mounds, and karst caves allow the development of a variety of recreational activities. It is possible to develop types of active tourism: sports (skiing) (Ilies et al., 2018), educational and scientific (geological, zoological, botanical, historical), safari travel (hunting and fishing), environmental and other types of tourism (Chlachula et al., 2021).

The swampy banks of rivers and lakes in Southern Altai and the abundance of waterfowl and wild animals make it possible to organize sport fishing and hunting. The duration of the swimming season in reservoirs and rivers of the Irtysh basin, depending on the altitude of the area above sea level, climatic conditions, hydrological regime and depth, is no more than 2-2.5 months. Considering that the swimming season, according to the generally accepted opinion of physiologists, begins only when the water temperature reaches +17ºC, due to the low temperature in the middle reaches of large rivers in the region, a favorable period for swimming occurs only in their lower reaches and only in July-August (Yegorina, 2002).

Table 3. Degree of acceptability of assessment of water resources of Southern Altai (Kolotova, 1999)

Indicators	Degree of favorability		
	Favorable 1	Average favorability 2	Unfavorable 3
Water temperature	18-24 ^{0}C	16-17^{0}C; 25-26^{0}C	16^{0}C below; 26^{0}C higher
Sanitary and hygienic condition	clean, no sources of pollution	The water purification process itself helps get rid of sources of pollution.	High MPC content (maximum permissible concentration), contaminated water

When assessing the recreational potential of the territory, an assessment of hydrological natural resources was given. The hydro resources of Southern Altai are favorable for the development of an active form of tourism. When assessing

water bodies, the following indicators are taken as a basis: width, depth, temperature regime of the shallow zone, immersion seasons - for the rivers of Southern Altai, the favorable period is June, July, August.

Based on the methodology for assessing water bodies the degree of acceptability of assessing the water resources of Southern Altai was determined (Table 3) (Kolotova, 1999).

As reflected in the table, the sanitary and hygienic condition of water plays a key role in the development of tourism in the region. Also an important factor to evaluate is the coastline and the presence of shallow water, since not all visitors can swim. We have determined the assessment of large lakes located on the territory of Southern Altai (Table 4).

Table 4. Assessment of water resources of Southern Altai (Yegorina, 2011)

River names	Hydrological description		Recreational services					
	catchment area per km2	average annual water consumption based on m/3sec	therapeutic bathing	sunbathing and air bathing	fishing on the river bank	unorganized rest	water tourism	Hunting birds that live in water
Buqtyrma	15600	25.7	+	+	+	+	+	at the mouth
Ak Berel	1050	26.6	+	+	+	+	+	downstream
Naryn	2040	9.31	+	+	+	+	+	downstream
Kalzhyr	3200	21.9	+	+	+	+	+	at the mouth
Kurshim	5890	60.8	+	+	+	+	+	at the mouth
Karakaba	3040	-	+	+	+	+	+	in the middle reaches

Lake Markakol, the general water resources of Southern Altai do not provide favorable conditions for the creation of beaches. Due to the fact that the swimming season, according to the generally accepted opinion of physiologists, begins only at a water temperature of +17ºC, due to low water temperatures in large lakes in the region, the favorable period for swimming is reduced only to their lower reaches and only in July-August (Sukhova et al., 2016; Chlachula, 2007). The results of the study show that the depth of the lake waters of the Southern Altai is more than 3 meters and the presence of weak waves up to 3 hammers create favorable conditions for the development of sailing (yachting) (Yegorina, 2011).

The rivers of Southern Altai, such as Bukhtarma, Kalzhyr, Kurchum, Kara Irtysh, are widely used for the development of extreme rafting (rafting), beach recreation, sun and water treatments, swimming and boating. Hydrological and recreational characteristics of large rivers in Southern Altai are presented in Table 4 (Kaisina, 2015). The region also has several groups of waterfalls on rivers such as Kokkol, Yazevoe, Arasan, which are popular tourist attractions.

CONCLUSION

In conclusion, it is noted that by grouping the relief, bioclimate, water resources and vegetation cover, the specialization of various regions was determined and 8 main types of recreational activities were identified: environmental, cultural-historical, medical and recreational, skiing, ethnographic, sports, alpine and educational. This will diversify the region's tourism offer and ensure the sustainability of its potential (Chlachula, 2011; 2019b). Within the study region, 8 different types of recreational activities (RAC) were identified and determined by the optimization method: environmental, cultural-historical, medical and recreational, skiing, ethnographic, sports, alpine and educational (Caisová et al., 2010).

Each of these types of recreational activities requires certain characteristics of natural complexes. Therefore, several indicators presented in Table 5 need to be taken into account to determine suitable areas (Oyungerel, 2004).

Table 5. Assessment of recreational activity cycle indicators (Chernykh, 1988)

Types of recreational tourism	Leading types of recreational activities	Evaluation indicators
Mountain tourism (climbing, sports)	Mountaineering and mountaineering, Rock climbing	compliance with sports standards: absolute heights, relief cutting depth, slope steepness, snow depth, glacier distribution
Cultural-historical	walking tours, bus tours, museum visits, educational events	concentration and diversity of archaeological sites, the presence of museums, ethnographic groups
Alpine	downhill skiing, winter slides, ski instruction	snow thickness and duration, slope stability, climate comfort
Medical and recreational	Hiking, walk (terrenkur), swimming	climate comfort, availability of health resort services, variety of water bodies
Sports	Hiking, sports training, active games, hunting	River system frequency, annual flow, horizontal section
Cognitive	Expeditions, horse riding, road trip	presence and condition of roads, density of the river network, presence of water bodies, vertical and horizontal cutting
Ecological	scientific competitions, participation in environmental events, participation in local festivals, information and educational events, excursions in environmental areas	Preservation of natural heritage sites, the presence of endemic plant species, rare plant communities, protected areas
Ethnographic	learning handicrafts, participating in public holidays, visiting holy places, creative activities	with religious and ethnic diversity, the presence of museums, the development of crafts
For all types of tourism		presence of natural monuments, large water bodies, level of forest cover, waterlogging

We consider it appropriate to separately consider this aspect for each of the natural and recreational areas of Southern Altai. This made it possible to identify the features of recreational development in each area (Figure 3).

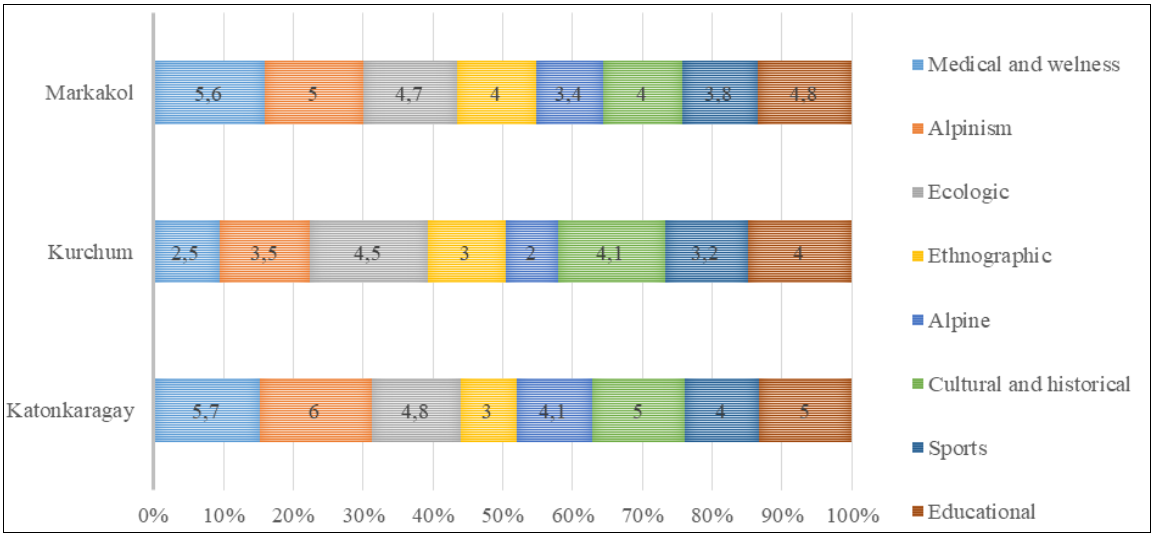

Figure 3. Cycles of recreational activity in natural and recreational areas of Southern Altai (Vinokurov, 2006)

Basically, the entire South Altai region can offer any type of tourism activity. According to the criteria of the International Tourism Business, there are key regions in the region that have the potential for the development of international tourism. Natural and recreational area Markakol: This area, covering the area around Lake Markakol, is characterized by an impressive landscape, and immaculate nature and attracts significant attention to tourism development. Here the number of sunny hours per year can reach 2,500, and in summer the air temperature is lower than in other parts of Kazakhstan. This climate creates favorable conditions for a varied summer holiday. Summer in the Bukhtarma region is characterized by a warm climate, clear skies, and only a weak wind from the northeast creates small waves on the water surface. The water remains warm throughout the long swimming season (Lukyanets, 2008).

The natural and recreational area of Katon-Karagay: The beautiful green landscapes of Katon-Karagay can satisfy the most sophisticated tastes of tourists, including residents. Mount Belukha gives this area a special grandeur and helps raise it to an international level. In the Katon-Karagay area, all types of recreation are available - from relaxing to active, including visiting mineral springs, active recreation in the mountains or winter activities. The average daily air temperature in the northern foothills is on average 5-8 degrees lower than in the south, which makes them cooler even in summer. During winter, the area is cold with high humidity, and north and west winds bring precipitation. In the northern foothills, the snow lasts longer and its layer is thicker than in the southern foothills. When developing tourism infrastructure, it is necessary to take into account these differences in temperature and wind conditions, and recreation centers, including winter ones, are best located in the southern part of the plain (Yegorina et al., 2016b; Zhensikbayeva et al., 2017).

The results of the study make it possible to propose specialized and multi-thematic routes connecting the main natural and cultural attractions of the main recreation areas for international and domestic tourists, as well as for educational and educational field programs and research trips for specialists (geographers, geologists, gemologists, biologists, archaeologists). The timing of visits is predetermined by seasonality with the possibility of year-round observation of nature. The end of spring - the beginning of autumn is the best time for travel and recreation. The nearest airport (Ust-Kamenogorsk) is located at a reasonable distance from the regional centers of the region (212 km to Kurchum; 330 km to Katon-Karagay) with air connections to Zaisan (1-hour flight). Local villages in the travel area, offering regular or occasional accommodation as well as visitor centers, are within easy reach (20–50 km). The quality of accommodation and individual travel services may vary significantly between individual tour operators (Zhensikbayeva et al., 2018).

Well-managed natural geo/ecotourism and proper management of tourism space can ultimately play an important role in sustainable socio-economic planning balanced by the regional administration of this peripheral and largely undeveloped mountainous region. At the same time, precautions should be taken to prevent or at least reduce the undesirable consequences of the expansion of commercial tourism, which may cause degrading cultural changes among the pastoral communities of Altai, despite the economic benefits. Thus, when creating the main stationary regional recreational facilities, it is necessary to take into account a priori the social impact of the tourism industry (Zhensikbayeva et al., 2018).

Comprehensive analysis of complex geological and geomorphological data, complemented by biotic and cultural data, personal experience and knowledge gained from reconnaissance expeditions and study tours, confirms the great potential of the area for sustainable rural tourism, as well as national and international travel.

Having analyzed the nature of the main tourist and recreational zones identified as a result of the biogeographical model, we propose a wide range of visitor activities. These include residential holidays with the usual adventure sports excursions including mountaineering, rafting, kayaking and paragliding. Natural and large artificial lakes (Lake Zaysan and Bukhtarma Reservoir, respectively) offer beautiful beaches and picturesque bays along several hundred kilometers of coastline, suitable for swimming, yachting and fishing (Figure 4). In winter, the snow-covered mountain terrain offers prime conditions for cross-country skiing and wildlife viewing. These trips can be combined with specialized local history and ethnological trips of travelers to traditional Kazakh rural settlements.

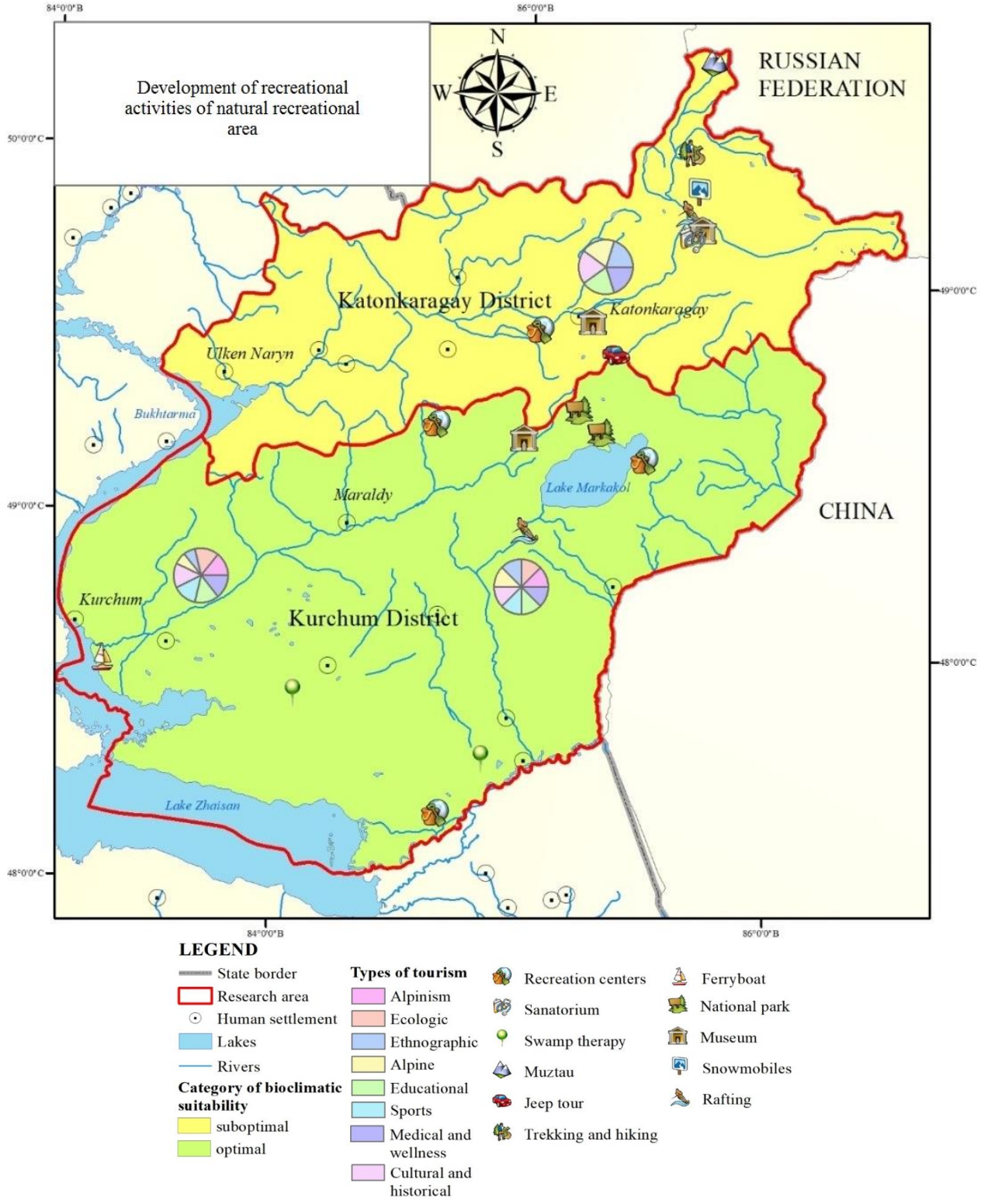

Figure 4. Development of recreational activities of natural recreational area (Zhensikbayeva et al., 2018)

In conclusion, we would like to show the current directions of recreational use in the Southern Altai NRA (Table 6) and the proposed optimization methods. During the 29th session of the UNESCO International Coordinating Council "Man and Biosphere program" (MAB) in Paris, the MAB Council approved the proposal to assign international status to the nature reserves of Kazakhstan. The UNESCO program includes, respectively, the Katon-Karagay National Park (Kazakhstan) and the Katunsky Nature Reserve (Altai Republic) in the international prestigious network of Kazakh-Russian border biosphere reserves called "Great Altai". International experts noted the close cooperation of scientists from Kazakhstan and Russia in the preparation of the "Great Altai" nomination, which became the first transboundary reserve in Asia. If such a transboundary protected area is created, this will allow optimizing defense and organizing effective monitoring of rare animals and natural processes (Vinokurov, 2006).

Table 6. Modern recreational features of the Southern Altai RRS

Recreational area	Functional region	Modern recreational use	Recreational use optimization paths
Katon-Karagai	Recreational and environmental activities	Mountaineering: Southern Altai ridges, Belukha peak, Berkutaul skiing; medical and recreational holidays at the Rakhmanovsky spring in the Katon-Karagai natural national park, fishing, excursion around Kanas through the Great Altai nature reserve (route 9 with a length of 503 km)	Development of culture and historical tourism on the territory of the checkpoint: creation of a cluster of the state historical and cultural reserve "Berel" and creation of eco-routes in the Kanas reserve.
Kurshim	Economic and recreational	Ecological routes of specially protected natural areas, beach, educational, active and recreational, cultural, historical, ethnographic tourism.	Creation of the necessary infrastructure for sports tourism. Development of eco-tourism in the region
Markakol	Recreational and economic	Medical and health tourism: Mynshunkur medicinal swamp, alpine skiing, transit, mountaineering, hunting and fishing tourism, ecological routes in the Markakolsky reserve and specially protected natural areas	Regulating the tourist flow, calculating the permissible recreational load, conducting environmental assessments of the relief and related measures

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