

## Natural heritage: Provision of cultural ecosystem services from the Malyovitsa Range of the Rila National Park

Mladen Silvestriev, Bilyana Borisova \*<sup>id</sup>, Radenka Mitova <sup>id</sup>

Faculty of Geology and Geography, Sofia University “St. Kliment Ohridski”, Sofia, Bulgaria

\*Corresponding author: bilyana.borissova@gmail.com

### ABSTRACT

#### Key words:

Bulgaria, high mountain landscapes, recreational assessment, tourism

Nature-based tourism and recreation are attracting attention today as the most favourable form of direct connection between people and nature, and as a very successful tool to motivate people to protect their natural heritage. This study aims to develop and test a methodology to assess the potential of an acknowledged natural heritage site in Bulgaria - Malyovitsa Range and Urdini Cirque in ‘Rila’ National Park to provide cultural ecosystem services. A holistic approach is applied, using landscapes as the main territorial unit, and source of information. For the purpose of practicing representative types of mountain tourism: ‘mountain hiking’, ‘nature education’ tourism, ‘ski touring’ and ‘mountaineering’ a total of 15 ecosystem services were assessed based on 25 biophysical and social indicators. ‘Primary forest landscapes on moraine materials’ and ‘Primary landscapes with mugo pine on igneous rocks’ receive the highest score. Based on the results obtained, an assessment of the mainstream activity - access to mountain hiking provided by the landscapes was carried out and two touristic routes with very high potential to deliver this service were identified. The results of the study are directed towards the responsible parties in support of the natural heritage conservation in Rila National Park through sustainable management the potential to provide cultural (recreational) ecosystem services. The research was conducted within the scientific programme of the project “Conceptualization, Flexible Methodology, and a Pilot Geospatial Platform for Access of the Bulgarian Natural Heritage to the European Digital Single Market of Knowledge and Information Services” within the project BG05M2OP001-1.001-0001 Establishment and Development of “Heritage BG” Centre of Excellence (Operational Program “Science and Education for Intelligent Growth”, priority Axis 1 “Research and technological development”).

Article processing

Submitted: 02 August 2021

Accepted: 23 October 2021

Published: 29 December 2021

Academic editor: Stoyan Nedkov

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### 1. Introduction

Contemporary challenges related to the quality of the human living environment - climate change, urbanization, air and water pollution, and high labour intensity - make the need for meaningful human recreation increasingly relevant. This topic best corresponds to the opportunities for practicing nature-based tourism and recreation in natural environment - an irreplaceable source of resources of critical importance to human physical and mental health (Frumkin et al. 2017). At the same time, recreational and tourism activities are now seen as a tool for maintaining and protecting the natural environment (Winter et al. 2020; Loureiro et al. 2021) and as a direct link between society and its natural heritage (Brooks 2012).

In this study natural heritage is interpreted as "a geospatial natural element of the social-ecological system that carries material and spiritual benefits of enduring, sustainable significance for past, present and future generations" (Scientific Report 2019, Heritage BG Project: Nedkov et al., 2021a). Today, more than ever, society's concern for natural heritage is a promising topic for interdisciplinary scientific interactions and broad societal cooperation in the field of conservation policy as well as recreation and tourism. The concept of natural capital and ecosystem services (ES) offers a new perspective on society's dependencies on nature and its heritage (MEA 2005). One



perspective for analysing this interaction is the cultural perspective in assessing the social significance of natural heritage, perceived as the intangible benefits derived from ecosystems, including spiritual enrichment, cognitive development, recreation, entertainment. Cultural ecosystem services (CES) are intangible benefits that people derive from ecosystems (Fish et al. 2016) in the form of aesthetic enjoyment of beautiful scenery, cultural, intellectual and spiritual inspiration, a sense of belonging to a place, moral satisfaction from being in a natural environment, enjoyment of recreational activities and ecotourism. Natural heritage provides a wide range of ecosystem benefits to society (Osipova et al. 2014; Nedkov et al., 2021b; Zhiyanski et al., 2021), and activities such as recreation, various types of tourism, scientific and educational initiatives that provide direct contact between humans and nature.

Europe's mountain areas are among the most outstanding representatives of the continent's natural heritage (Drexler et al. 2016). Mountain areas support a diversity of natural landscapes that offer opportunities for a wide range of recreational activities with proven positive effect for the human health. However, these systems are characterised by increasing dynamics in the natural processes and are particularly vulnerable to the ongoing land use and climate change (Catalan et al. 2017). High mountain landscapes are of particular importance - established conservation sites with important significance in terms of biodiversity and geodiversity conservation, ecological monitoring and geocological forecasting. Most of them today have the significance of natural heritage of key importance for the local population (Chakraborty 2020). High mountain landscapes support distinctive elements of modern glacial or post-glacial topography and climate and, on this basis, have specific recreational potential.

Recreational potential is defined as the ability of an area to form a comprehensive recreational product and to develop economically viable tourism (Evrev et al. 2003). Nature is a significant part of the recreational potential of a specific place and is a necessary condition and a key factor for the development and practice of, if not all, at least most tourist and recreational activities. (Marinov 1997). Also, it has the power of an outdoor attraction that motivates people to make a choice for their trip or holiday (Marinov 1997). Nature and natural components individually or as a whole are considered as key resources for the development of tourism and touristic products (Apostolov 2003; Markov and Apostolov 2008). In Bulgaria, the recreational and tourist potential was subject of analyses and assessments in the 1970s and 1980s in connection to the intensive development of tourism and recreation in the country. The focus was mainly on natural recreational resources (Evrev et al. 2003). The same authors note that in spite of numerous improvements on the matter, recreational assessments in Bulgaria still face a number of unresolved scientific, practical and methodological issues. Since the beginning of the twentieth century, the assessment of the recreational potential of territories was subject of scientific research (Apostolov 2003). To date despite the large number of analyses on the topic in the scientific literature, a wide variety of specific evaluation objectives, methodological solutions, criteria and indicators are revealed. In the recent years, in connection with the emergence of the concept of sustainable tourism development, attention is paid to the issue of protection of natural resources and their wise use and utilization. Recreational assessments have become a suitable analytical basis and a basis for informed decision-making. Concepts such as nature-based tourism (Valentine 1992), ecotourism (Ceballos-Lascurain 1987) and geotourism (Hose 1995) are increasingly turning tourism into an ethical tool for nature and natural heritage protection. This requires the development of a fundamentally new approach to recreation assessments that aims to conserve natural

resources 'through' tourism rather than the opposing approaches of conservation 'for' or 'by' tourism. In the context of cultural ecosystem services valuation, the ecosystem services approach shows significant potential in this regard and appears particularly useful in upland management (Schirpke et al. 2020). The outcomes on the application of this approach presented in Nedkov et al. 2018 and Ihtimanski et al. 2020 give promising results.

This study interprets the concept of tourism as an activity that people do in for leisure (Vodenska and Assenova 2011). We focus on popular recreational and hiking activities practiced in high mountain conditions. Among these, 'mountain hiking' stands out as a form of direct human contact with nature through active one-day or multi-day movement in a mountain environment along a defined route (Popova 1993; Kandilarov and Machirski 2003). 'Nature education' tourism' and outdoor recreation have direct links to the mountain landscapes diversity and their natural heritage elements that bring knowledge to people. They can be supported by biotic or abiotic features of the landscapes, which can form thematic cognitive routes - geological, geomorphological, hydrological, floristic, faunistic, etc. (Vassileva 2010). Among the more specific types of tourism in the high mountains are 'mountaineering' and 'ski-touring', which become very popular in Bulgaria. Mountaineering is defined as the activity of climbing mountains using special equipment and techniques on rock, ice or snow (<https://www.yourdictionary.com/mountaineering>). This activity involves overcoming difficult terrain in harsh weather conditions. Mountaineering is a purposeful and complex motor-mental activity in conditions of natural environment to climb mountains to achieve physical and inner-functional improvement and to satisfy specific emotional and cognitive needs (Malchev et al. 2011). According to the same authors, such definition is close to The European Sports Charter (1992, Article 2) and the definition of the term 'sport'. Mountaineering has a competitive character, expressed in the race to climb objects of varying degrees of difficulty, but can also be practiced as a hobby. Ski touring is skiing in mountainous areas outside designated ski areas (Volken et al. 2007). It is a combination of cross-country skiing, alpine skiing and telemark skiing. People seeking contact with primary nature and strong sensations practice this activity.

The aim of this study is to reveal the recreational potential of high mountain landscapes by assessing their inherent cultural ecosystem services for the practice of the following selected activities - mountain hiking, 'nature education' tourism, mountaineering and ski touring. An acknowledged site of the Bulgarian natural heritage network - Rila National Park, in the part of Malyovitsa Range and Urduin Cirque Lake was selected as a test area. Due to its distinct alpine relief, this northwestern part of Rila offers excellent conditions for the practice of tourism and recreation. Rila Mountain have a symbolic significance for Bulgarian mountaineering.

To fulfill the research objective, the present study sets the following main tasks: 1. To establish a criteria base for assessment that is in accordance with the functions of the high mountain landscapes and corresponds to the requirements for the practice of the above mentioned types of tourism; 2. To test the methodology on high mountain landscapes, which at the same time have the significance of a representative natural heritage site of Bulgaria and an established tourist destination; 3. To analyse the opportunities for optimization and combination of tourist routes that give access to a wider and more diverse range of ecosystem services. The study was conducted between November 2019 and September 2020. Field verification was implemented in July and August 2020. The results are directed towards the responsible parties in support of natural heritage conservation of Rila National Park through sustainable management of the potential to provide cultural (recreational) ecosystem services.

## 2. Methods and materials

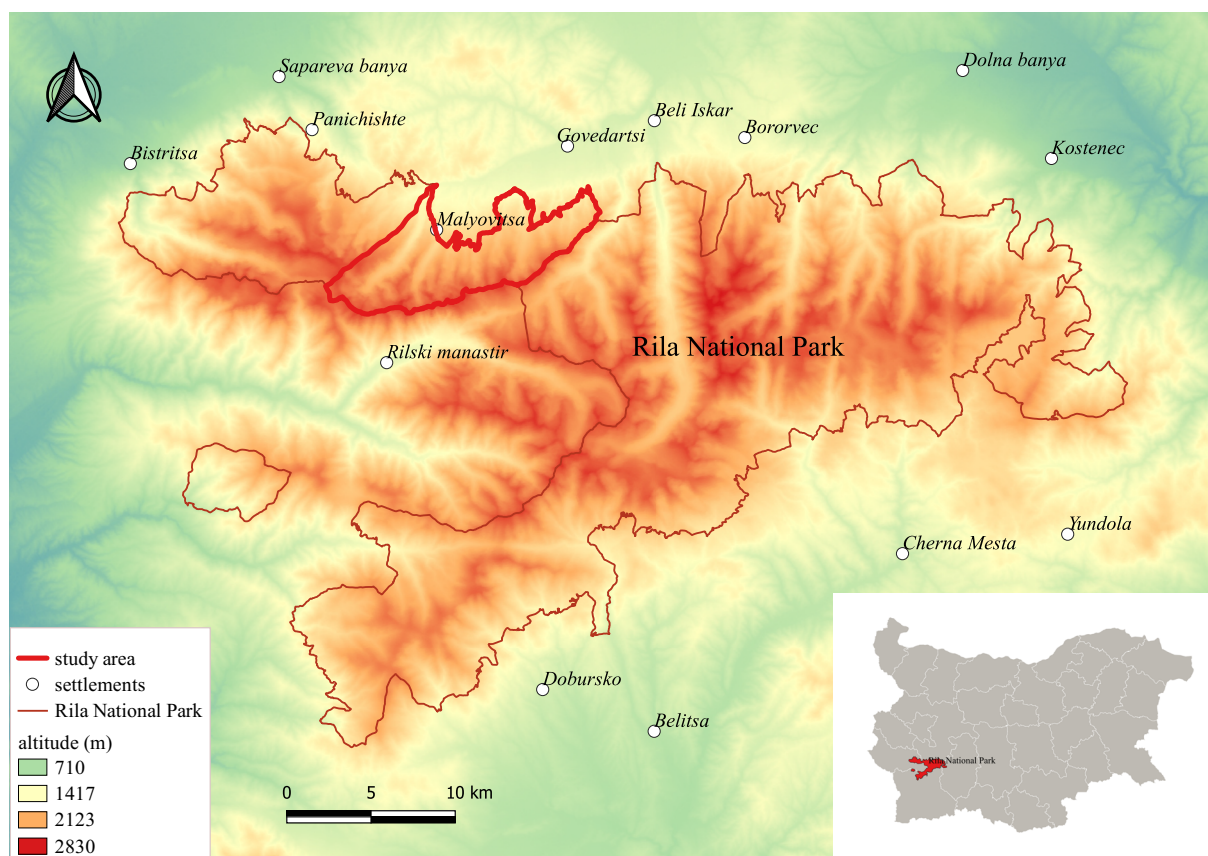
### 2.1. Study area

The study area falls entirely within the boundaries of the Rila National Park (Rila NP), declared a protected area in 1992 in accordance with Bulgarian legislation for nature protection. In 1999, the park was reclassified as a 'National Park' - IUCN category II, according to the Bulgarian Protected Areas Act (1998). The Park covers an area of 81 046.0 hectares in Rila Mountain (the highest peak on the Balkan Peninsula - Musala 2925 m). The nature reserves 'Parangalitsa', 'Central Rila Reserve', 'Ibar' and 'Skakavitsa' (IUCN, category I) are located in its range. To the west the territory of the National Park is adjacent to the Nature Park 'Rila Monastery' and one of the most significant monuments of the cultural heritage of Bulgaria, and a UNESCO World Heritage Site - Rila Monastery (founded in the 10th century). Rila mountain is associated to traditions in the development of mountain resorts in Bulgaria, such as 'Borovets' resort. The Bulgarian Tourist Union (BTS) assists in the maintenance of the dominant part of the tourist huts and routes.

The object of the present study is part of Northwest Rila mountain and represents landscapes from the northern macroslope of Malyovitsa Range and Urdin Cirque: a total area of 55 km and altitudes ranging from 1410 m a.s.l. to 2731 m a.s.l. (at Mt. Golyam Kupa, which is the highest peak in the Malyovitsa Range) (Fig. 1). More than 90% of the territory falls in the high mountain hypsometric level above 1600 m. This territory is among the most popular and established mountain touristic destinations in Bulgaria and is part of a protected area. The area is distinguished by its alpine relief, abundant water resources and centuries-old forests of spruce (*Picea abies*), Balkan pine (*Pinus peuce*) and white pine (*Pinus sylvestris*).

The geodiversity is significant and has impressive forms of glacial relief such as the cirques Urdin, Malyovishki, Malomalyovishki, Elenski, Strashno ezero, Lopushnitskiy; Malyovitsa and Petlite carlings; the valleys of the Urdina and Malyovishka rivers. There is also a number of post-glacial forms actively remodelled by modern cryogenic processes: rock glaciers (in the cirque below Lovnitsa Peak, between Golyam Kupa Peak and Strange Lake, below Popovokapskiy Pass at the valley of Dolna Preka Reka, at the foot of Lopushki Peak and west of Mt. Mechit) and stone seas (at the feet of Kupa Peak and Mt. Lovnitsa, Mt. Kamilata and Mt. Malka Malyovitsa). The study area includes 18 glacial lakes, which are located in the altitudinal range 2000-2500 m above sea level, the highest being Lake Elenino (2472 m). The landscape attractiveness is complemented by the waterfalls around the area Gorni Kuki in the valley of Urdina River and the hanging valleys at some of the cirques.

In biogeographic context, the study area includes coniferous forest, subalpine mugo pine and juniper scrub area (between 2100 m and 2500 m a.s.l.) and the alpine grassland area (2500 m to 2731 m a.s.l.). The territory covers Rila protected area BG 0000495 (both Directives) of the European ecological network Natura 2000 and is distinguished by significant biodiversity. Rila National Park covers 13 habitats out of a total of 23 habitats (Assenov et al. 2015), including habitats No: 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea, 3260 Water courses of plain to montane levels with the *Ranunculus fluitans* and *Callitriche-Batrachion* vegetation, 4060 Alpine and Boreal heaths, 4070 Bushes with *Pinus mugo* and *Rhododendron hirsutum*, 6150 Siliceous alpine and boreal grassland, 6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas, 6520 Mountain hay meadows, 8110 Siliceous scree of the montane to snow level, 91BA Moesian silver fir



**Figure 1.** Study area: part from the northern macroslope of the Malyovitsa Range and the Urdin Cirque, 'Rila' National Park.

forests, 91CA Rhodopide and Balkan Range Scots pine forests, 91DO Bog woodland, 9410 Acidophilous Picea forests of the montane to alpine levels (Vaccinio-Piceetea), 95AO High oro-Mediterranean pine forest.

Rila is an object of scientific interest in a very wide range of studies in the field of geology, geomorphology, climatology and complex geographical research, associated with the names of prominent Bulgarian scientists: G. Bonchev, Zh. Radev, P. Deliradev, I. Ivanov, M. Glovnya. The area has been studied by Raev (1983); Baltakov & Mladenova (1989); Gikov & Dimitrov (2009, 2010); Gachev (2011); Dimitrov & Velchev (2012); Kuhlemann et al. (2013); Assenov et al. (2015), Gikov (2019), etc. The first recreational assessment of natural complexes in Bulgaria refers to Rila mountain (Petrov 1983). In a series of publications, Sinnyovsky (2014a, 2014b and 2015) and Tsvetkova (2019) study the northern part of Rila from the perspective of geoheritage and insist on the designation of this part of the mountain as a geopark in order to conduct geoconservation activities and to develop geotourism.

## 2.2. Procedure

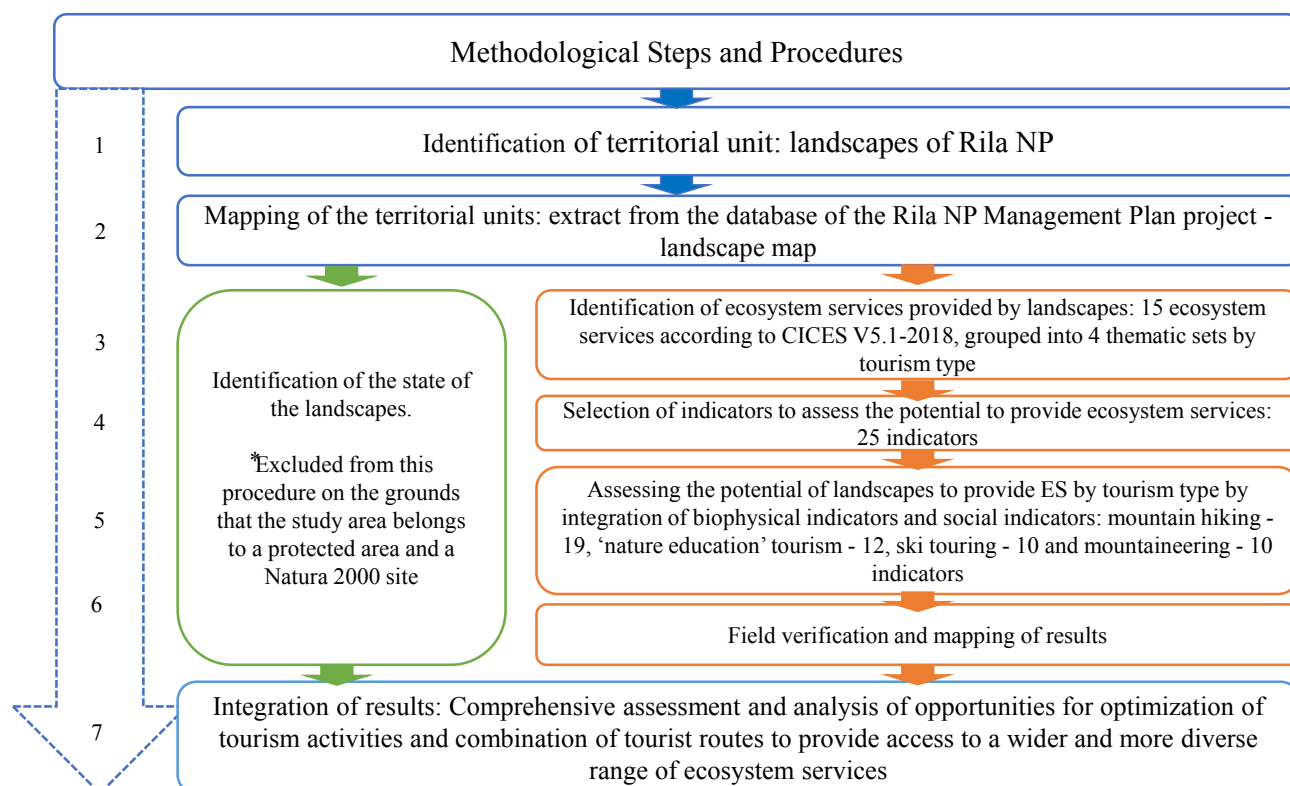
The methodological approach applied in the study is entirely subordinated to the subject of the assessment: the potential of the high mountain landscapes - natural heritage sites of Bulgaria, to provide recreational benefits to the society. This is realized through ecosystem approach. The results of the assessment are oriented towards the management bodies of Rila National Park and the tourism actors - tourist operators, trekking organizers, and mountain recreationists. The study adheres to the Analytical Framework for Mapping and Assessment of Ecosystems and their Services (MAES 2013), where the implementation of the assessment is further influenced by important research decisions with a tailored approach to the study area (Fig. 2), based on the arguments below.

### 2.2.1. Territorial unit - source of information

A holistic approach is applied, using landscapes as the main territorial unit, source of information and object of assessment, as complete natural complexes formed under the influence of both zonal and azonal factors. Landscapes have clearly defined spatial boundaries, which in the existing mountainous conditions with high dynamics of natural processes, imply greater precision in the assessment of their structure and functions derived. We use information from the landscape variety database of Rila National Park and analyses of contemporary landscape diversity (Gikov 2019). Additionally, the study refers to the publication of Assenov et al. (2015) on biodiversity of Rila National Park, where the hierarchical relationships of landscapes with the ecosystems and habitats present on the territory are commented.

The assessment methodology was applied at the landscape sub-unit level, aiming a high degree of information about the results and subsequent spatial analysis for tourism practice purposes.

The landscape diversity of the study area is differentiated to 1 class, 2 types, 8 units and 17 sub-units of landscapes (Table 1, Fig. 3). The largest proportion of landscapes corresponds to the subalpine shrubland vegetation belt in a diversity of 9 sub-units. The bedrock (igneous, metamorphic rocks, moraine materials) and combinations with mugo pine or secondary herbaceous vegetation determine the landscapes. This belt also contains heavily altered anthropogenic landscapes, a consequence of a wildfire in 2000. The second largest landscape unit covers coniferous forests, where 4 sub-units are presented. The bedrock and the anthropogenic induced changes, expressed by clear-cut logging and the emergence of secondary grass landscapes determined the diversity. The alpine herbaceous vegetation belt is represented by 4 natural or slightly modified landscape sub-units. The presence of grass vegetation or bare rock with chasmophytic vegetation determines the landscape diversity.

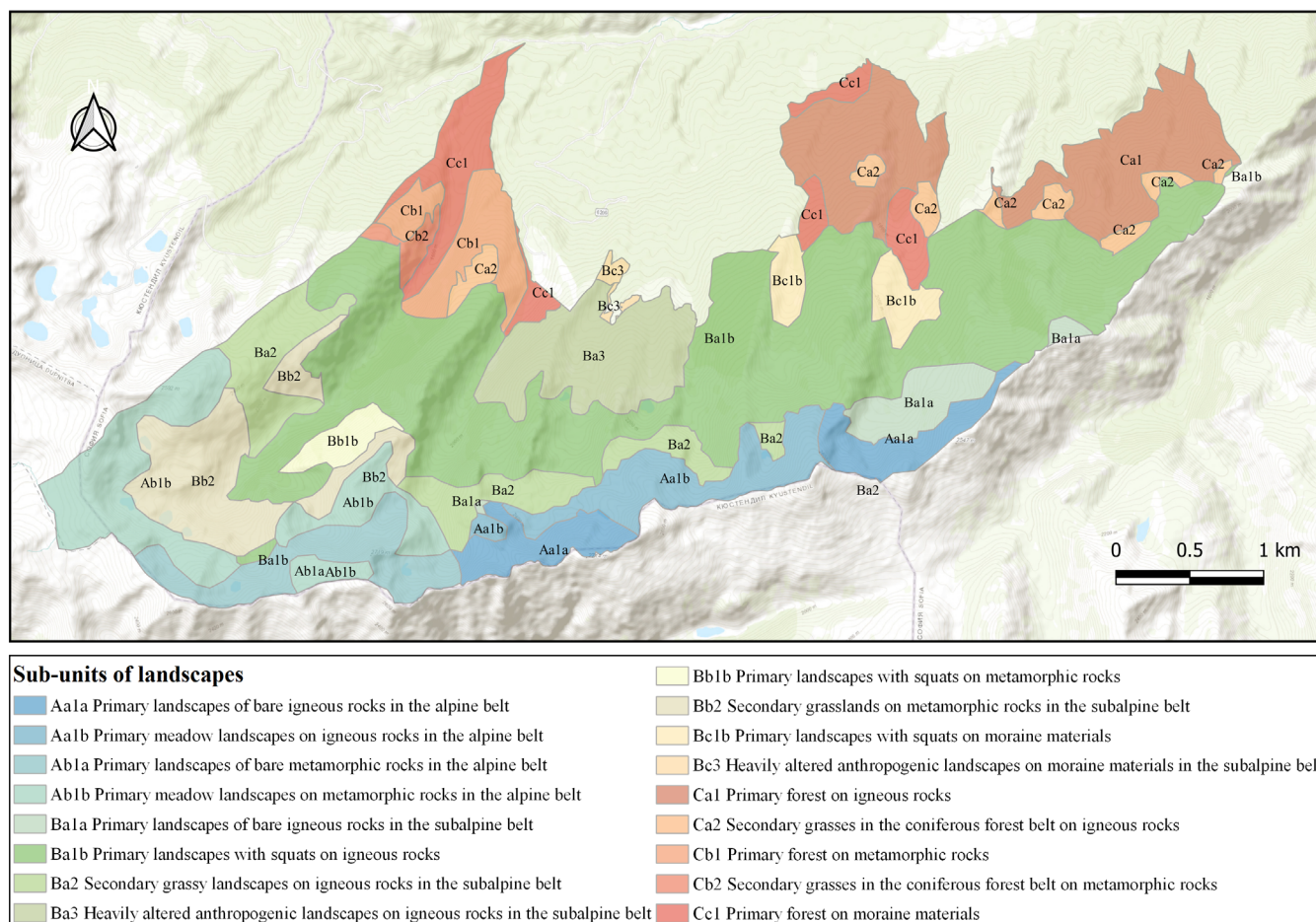


**Figure 2.** Methodological scheme: Cultural Ecosystem Services form the Natural Heritage of the Malyovitsa Range, 'Rila' National Park.



**Table 1.** Landscape classification of the study area (MPP Rila NP 2014-2025).

Landscape classification of the Rila NP (MPP Rila NP 2014-2025)									
Class	Type	Sub-type index		Genus	Units Index		Sub-units Index		Aggregate index
Mountainous	Cold humid	Alpine grassland belt	A	Periglacial and relict glacial	Igneous rocks	a	Primary landscapes of bare rock	1a	Aa1a
							Primary landscapes with meadows	1b	Aa1b
					Metamorphic rocks	b	Primary landscapes of bare rock	1a	Ab1a
							Primary landscapes with meadows	1b	Ab1b
		Subalpine shrub belt	B		Igneous rocks	a	Primary landscapes of bare rock	1a	Ba1a
							Primary landscapes with mugo pine	1b	Ba1b
							Secondary grassland landscapes	2	Ba2
							Strongly modified landscapes	3	Ba3
		Metamorphic rocks	b		Primary landscapes with mugo pine	1b	Bb1b		
					Secondary grassland landscapes	2	Bb2		
	Moraine materials	c	Primary landscapes with mugo pine	1b	Bc1b				
			Strongly modified landscapes	3	Bc3				
	Cool humid	Coniferous forest belt	C	Erosion - denudation	Igneous rocks	a	Primary forest landscapes	1	Ca1
							Secondary grassland landscapes	2	Ca2
					Metamorphic rocks	b	Primary forest landscapes	1	Cb1
							Secondary grassland landscapes	2	Cb2
				Erosion - denudation and relict glacial	Moraine materials	c	Primary forest landscapes	1	Cc1



**Figure 3.** Landscape map of the study area (based on data from MPP RilaNP, 2015–2024).

### 2.2.2. Identifying the cultural ecosystem services provided by landscapes

Bulgaria's National Methodological Framework for Mapping and Assessment of Ecosystems and their Services (Executive Environment Agency-ExEA) was applied to areas outside Natura 2000. In preparation for this study, the methodological decisions, and the results of the studies on the main ecosystem types in Bulgaria (ExEA) were reviewed, and the information from them was accepted only as indicative for the assessment of both the status of ecosystems and their derived services in the study area. To identify the types of cultural ecosystem services, the Common International Classification of Ecosystem Services (CICES V5.1) is applied (Haines-Young & Potschin 2018). The selection of the services and their thematic grouping (Table 2) is consistent with the functions and characteristics of the landscapes that are necessary for the practice of the selected types of tourism and recreation: 'mountain hiking', 'nature education' tourism, 'ski touring' and 'mountaineering'.

### 2.2.3 Selection of indicators and parameters to assess the potential of landscapes to provide cultural ecosystem services

The total number of 25 indicators developed to assess the CES provided by landscapes for the practice of the four activities considered were selected. The selection of indicators for different types of tourism is specific and aims at reflecting their distinctive

requirements: mountain hiking - 19 indicators, 'nature education' tourism - 12, ski touring - 10 and mountaineering - 10 (Table 3). A 4-point rating scale is applied where the score '0' indicates no potential, the score '1' corresponds to low potential, '2' to moderate and '3' to high potential for provision. The rating scale is consistent to the available data. A reduced binary scale ('presence' or 'absence') is applied in cases of scarce information or when the use of a detailed scale is not applicable. Composite indicators such as 'topography', 'climate' and 'potential for hazard events' were also used, calculated as an average of the values of the applied sub-indicators. For the objectivity of the assessment of the landscape potential, the following indicators are additionally taken into account: 'Unfavourable/risky phenomena in the landscapes hindering the tourist activity', and 'the Circumstances of recreational utilization as obligatory infrastructural conditions for the realization of the tourist activity'. The final score is formed as the sum of the scores obtained for specific indicator and is reclassified to 4 grades: 'low', 'medium', 'high' and 'very high potential' of the landscape to provide cultural ecosystem services. The reclassification scale is unique in terms of type of tourism and number of indicators applied for the assessment.

The study applies an integrated approach of combining biophysical and social indicators for assessment. Biophysical indicators are used to reflect the contribution of landscape features such as topography, climate, bio- and geodiversity, landscape naturalness. In the process of development of specific parameters and assessment scale,

**Table 2.** Thematic sets of cultural ecosystem services provided by high mountain landscapes (codes after CICES V5.1, 2018).

Thematic sets, №	Cultural ecosystem services provided by high mountain landscapes (Codes after CICES V5.1, 2018)
<b>Sets of cultural ecosystem services necessary for the practice of mountain hiking</b>	
1	Landscape features conducive to human health, recovery, enjoyment, through active and passive interactions with the natural environment through tourism, sport, and recreation (3.1.1.1.; 3.1.1.2.; 6.1.1.1.)
2	Landscape features and processes of scientific value (3.1.2.1.; 6.1.2.1.)
3	Landscape features and processes of cognitive and educational value (3.1.2.2.; 6.1.2.1)
4	Landscape features with cultural significance - history, traditions, crafts (3.1.2.3.)
5	Landscape features of attraction or aesthetic value - a source of entertainment and inspiration for hobby, art and culture (3.1.2.4.; 3.2.1.3;)
6	Landscape features with symbolic, spiritual and religious significance (3.2.1.1.; 3.2.1.2.; 6.2.1.1.)
7	Landscape features valued as natural heritage (3.2.2.1.; 3.2.2.2.; 6.2.2.1)
<b>Sets of cultural ecosystem services necessary for the practice of 'nature education' tourism</b>	
1	Landscape features that allow active or passive physical interactions (6.1.1.1.)
2	Landscape features and processes of cognitive and educational value (3.1.2.2.; 6.1.2.1)
3	Landscape features with cultural significance - history, traditions, crafts (3.1.2.3.)
4	Landscape features with symbolic, spiritual and religious significance (3.2.1.1.; 3.2.1.2.; 6.2.1.1.)
<b>Sets of cultural ecosystem services necessary for the practice of ski touring</b>	
1	Landscape features conducive to human health, recovery, enjoyment, through active and passive interactions with the natural environment through tourism, sport, and recreation (3.1.1.1.; 3.1.1.2.; 6.1.1.1.)
2	Landscape features of attraction or aesthetic value - a source of entertainment and inspiration for hobby, art and culture (3.1.2.4.; 3.2.1.3.)
<b>Sets of cultural ecosystem services necessary for the practice of mountaineering</b>	
1	Landscape features conducive to human health, recovery, enjoyment, through active and passive interactions with the natural environment through tourism, sport, and recreation (3.1.1.1.; 3.1.1.2.; 6.1.1.1.)
2	Landscape features of attraction or aesthetic value - a source of entertainment and inspiration for hobby, art and culture (3.1.2.4.; 3.2.1.3;)

established approaches and methods for recreational assessment in Bulgarian practice were adapted: specialized methodology for assessment of natural recreational resources (Popova 1993) and methodology for analysis and assessment of recreational resources (Tishkov 1984). Social assessment indicators have been applied to reflect preferences for visiting natural and cultural landscape features and their degree of popularity for tourism activity.

Main source of information is data derived from the project "Management Plan of Rila National Park - Compendium of Abiotic

Factors", and the study "The biodiversity of Rila National Park" (Assenov et al. 2015). In addition, topographic map (M 1:50 000) - map sheet K-34-71-B, Map of North-western Rila (M 1:25 000), Geological map of Bulgaria (M 1:100 000) (Marinova 1991) and Tourist map Rila (M 1:50 000), the Red Book of the Republic of Bulgaria, as well as thematic scientific publications and specialized Internet sites were used (Table 3). Information was gathered in direct field observations to assess landscape elements with cognitive values and aesthetics.

**Table 3.** Criteria base: CES for mountain hiking, 'nature education' tourism, ski touring and mountaineering.

Assessment of the high mountain landscapes potential for provision of cultural ecosystem services for mountain hiking, 'nature education' tourism, ski touring and mountaineering: Criteria base									
Indicator	Parameters and units	Score Scale				Source of information	Application of the evaluation indicator by type of tourism		
		Score 0	Score 1	Score 2	Score 3		Hiking	Nature education tourism	Ski touring
Indicators and parameters for assessing landscape characteristics conducive to human health, recovery, enjoyment through active and passive interactions with the natural environment through tourism, sport and recreation (3.1.1.1.; 3.1.1.2; 6.1.1.1.)									
Relief (a+b+c ...)/n	a. Altitude, m (After Tishkov 1984)	N/A	>2500	2000-2500	1400-2000		✓	✓	✓
	b. Slope, degrees, (Difficulty level after <a href="http://intothewild.bg/">http://intothewild.bg/</a> )	N/A	20°	10-20°	≤10°		✓	✓	
			30-40°	25-30°	<25°				✓
	c. River network density, km/km <sup>2</sup>	N/A	2-2.5	1-2	0.5-1		✓	✓	✓
	d. Depth of river valleys, m/km <sup>2</sup>	N/A	400-600	300-400	200-300		✓	✓	✓
	e. Presence of rocky peaks, walls and cliffs, number	N/A	<3	3-5	5				✓
f. Opportunities for alpine traverses, number (After Mialchev et al 2011)	Absence	1	2	2				✓	
Climate (a+b)/2	a. Wind speed, m/s	N/A	>4 m/s	2-4 m/s	< 2 m/s		✓	✓	✓
	b. Depth of snow cover, cm	N/A	< 50 cm	50-80 cm	> 80 cm				✓
Climate comfort	Thermal comfort index (After National Institute of Meteorology and Hydrology, average annual rate)	N/A	Cold, < 0°C	Moderate cold, 0-2°C	Cool, > 2°C		✓	✓	✓



Medicinal plants	Presence/absence	Absence	N/A	Presence	N/A	MPP Rila NP Appendix 1.14	✓		
Phytoncide activity of vegetation	Vegetation type	Absence of vegetation	Another type	Juniper shrub	Coniferous forest	Todorova et al 2017; Assenov et al 2015	✓		
Landscape naturalness	Degree of anthropogenisation	N/A	Modified	Semi-natural	Primary	MPP Rila NP - Compendium of Abiotic Factors: 1.19.1	✓		
Indicators and parameters for landscape features and processes of scientific value (3.1.2.1.; 6.1.2.1.)									
Research activity	Number of scientific publications	Absence	1-2	3	≥ 4	Literature review of landscape studies for the last 10 years	✓		
Habitat diversity	Number of habitats present in the landscape	N/A	1	2	≥ 3	Habitat map, Rila NP (Assenov et al 2015); Information system Natura 2000	✓		
Indicators and parameters for landscape features and processes that have cognitive and educational value (3.1.2.2.; 6.1.2.1)									
Representative biodiversity	Endemics and relicts, presence	Absence	N/A	Presence	N/A	MPP Rila NP Appendix 1.14, 1.15; the Red Book of the Republic of Bulgaria, v.3	✓	✓	
Representative geodiversity	Glacial and post-glacial complexes, coverage (%)	Absence	≤ 30%	30-70 %	>70 %	Field observations; Glovnya 1963; MPP Rila NP geomorphological map 1.9.2	✓	✓	
Fauna	Unique and rare faunal species of great aesthetic value	Absence	N/A	Presence	N/A	MPP Rila NP fauna map 1.15		✓	
Indicators and parameters for landscape features with cultural significance - history, traditions, crafts (3.1.2.3.)									
Areas with historical significance	Presence	Absence	N/A	Presence	N/A	Hristophorov 1962; Sinyovsky et al 2017	✓	✓	
Indicators and parameters for landscape features with attractiveness or aesthetic value - a source of entertainment and inspiration for hobby, art and culture (3.1.2.4.; 3.2.1.3)									
Landscape uniqueness	Repeatability in the national scale, Degree	N/A	Non-distinctive	Typical	Distinctive		✓	✓	
Scenery	Contrast to the country's typical anthropogenic environment, Degree	N/A	Low	Medium	Large	Visual assessment during field observations	✓	✓	✓
Panoramic view	Degree	N/A	Low	Medium	Large		✓	✓	✓

Ski route through the landscape	Extent of popularity	N/A	Unpopular	Popular	Much popular	MPP Rila NP Appendix 1.16.7 Alpinism Visual assessment during field observations; www.climbingguidebg.com	✓
Climbing sectors in the landscape	Uniqueness of the climbing area, degree of national repeatability	no	Non-distinctive	Typical	Distinctive	climbingguidebg.com www.climbingguidebg.com	✓
Climbing objects in the landscape	Extent of popularity	N/A	unpopular	popular	much popular	climbingguidebg.com	✓

Indicators and parameters for landscape features with symbolic, spiritual and religious significance (3.2.1.1.; 3.2.1.2.; 6.2.1.1.)

Sites of symbolic, spiritual and religious significance	Presence	Absence	-	Presence	-	Reference active travel sites	✓
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Indicators and parameters for landscape features to be assessed as natural heritage (3.2.2.1.; 3.2.2.2.; 6.2.2.1)

Natural heritage	Protected areas (Protected Areas Act of the Republic of Bulgaria) and protected sites (Natura 2000), number	no	Only a fragment is present	1	≥2	National Ecological Network, EEA	✓
Potential for risk events - avalanches, landslides, extreme temperatures (a+b+c)/3	a. Avalanche hazard, grade	no	Significant	moderate	limited	Velev 2010; NIMH.	✓
	b. Unstable rock foundation, grade	N/A	Unstable	Partially unstable	Stable	Mountain Rescue Service.	✓
	c. Temperature, °C, Wind Chill Index	N/A	< -11 °C	- 5 to -11 °C	4 to - 5°C	MPP Rila NP; field observations; climbingguide.com	✓

Indicators and parameters for unfavourable/risky phenomena in the landscapes, hindering tourist activity

Indicators and parameters for recreational utilization - additional necessary conditions for the realization of the tourist activity

Accessibility	Marked and unmarked (unofficial) paths, number	no	1	2	≥3		✓
Reference points	Shelters and huts with adjacent infrastructure (sanitation, communications, electricity)	Absence	-	Presence	-	MPP Rila NP Appendix 1.16.7 – 1; 1.16.7 – 2, Tourist map	✓
Routes with educational value	Presence	Absence	-	Presence	-		✓
Opportunities for practicing	Secured climbing sectors in the landscape, number	no	<10	10-30	>30	https://www.climbingguidebg.com/	✓

### 2.2.4. Mapping the potential of landscapes to provide cultural ecosystem services

All assessments and mapping were carried out within the boundaries of the landscape sub-units as main spatial units. Field observations were used to verify the results. Data processing and result visualization was performed by software QGIS 3,14 π "Pi". The graphic materials were prepared by ASTER GDEM V3, World Topographic Map (ESRI) and Open Street Map (OSM).

## 3. Results

The results of the landscape sub-type assessment are summarised by cultural ecosystem services thematic sets. The results are presented in tabular form (See supplementary file) and the final overall assessment is visualised in map charts by tourism type.

### 3.1. Assessment of landscapes to provide cultural ecosystem services for mountain hiking

The data show very good overall results (Fig. 4) reclassified to 4 levels according to the potential to provide cultural ecosystem services: very high potential (with a score above 40: Cc1, Aa1a, Ab1a, Ba1b and Ca1), high potential (score between 35 and 40: Cb1, Ba2, Bb2, Bc1b, Ab1b, Cb1 and Aa1b), medium potential (score between 35 and 30: Ca2, Cb2, Ba1a, Bb1b and Bc3) and low potential (score below 30: Ba3).

Primary forest landscapes on moraine materials (Cc1, Fig. 3) scored the highest (score 43.1), which is primarily explained by good permeability, favourable climatic conditions and high phytocidic activity of coniferous vegetation. Elements of geodiversity of interest to tourists are also present. The risk of adverse natural phenomena is lower than in the other areas assessed. The path network is well developed. The group of landscape sub-units with the highest scores also includes Primary landscapes on bare igneous rocks and on bare metamorphic rocks in the alpine belt (Aa1a, Ab1a) and Primary landscapes with mugo pine on igneous rocks (Ba1b): Distinguished by high natural beauty, geodiversity, and a wide range of tourist routes.

The lowest score marks highly altered anthropogenic landscapes on igneous rocks in the subalpine belt (Ba3) as result from the disturbance of the landscapes after the massive wildfire in 2000. Another reason is the lower recreational service - lack of basic accommodation infrastructure and few hiking trails.

### 3.2. Assessment of landscapes to provide cultural ecosystem services for mountain 'nature education' tourism

The results are reclassified to three groups of landscapes with different potential to provide cultural ecosystem services (Fig. 5): very high potential (with a score above 20: Ca1, Cc1, Cb2 and Ba1b), high potential (with a score between 15 and 20: Cb1, Ca2, Bc1b, Ba2, Bb2, Aa1a, Ab1a, Aa1b and Ab1b), medium potential (with a score between 12 and 15: Ba1a, Bb1b, Ba3 and Bc3). Four sub-units of landscapes have a very high potential to provide cultural ecosystem services. Three of these are in the forest belt (Ca1, Cc1, Cb2), with favourable topography and climate, limited potential for adverse natural events and good recreational service. In subtype Cc1, in the valley of the Urdina River, the botanical route "Plant Friends" begins, further increases its final score. The fourth landscape subtype with the highest potential is in the subalpine area - primary landscapes with mugo pine on igneous rocks. The historic site of Kaiser's Road is located here. Four sub-units of landscapes from the subalpine belt fall into the medium potential group. Among them, the lowest ranked are Ba3 - highly modified anthropogenic landscapes on

igneous rocks, which have low recreational service and less potential for scientific and educational activities.

### 3.3. Assessment of landscapes to provide cultural ecosystem services for ski touring

A three-level scale was applied to group the final results (Fig. 6): very high potential (with a score above 20: Ca1, Cc1, Ba1b, Ba2, Bb2, Aa1a, Ab1a, Aa1b and Ab1b), high potential (with a score between 15 and 20: Cb1, Ca2, Cb2, Bc1b, Ba3 and Bc3), medium potential (with a score between 12 and 15: Ba1a and Bb1b).

Analysis of the results for this activity shows that more than half of the landscape sub-units (9 in total) fall into the very high potential group (score above 20). Among them are landscapes of the Alpine belt, where the main ski routes in the area pass. In these landscapes, the indicators of snow cover, landscape uniqueness, panoramic views and popularity of the ski route have the highest rates. Subalpine landscapes also belong to this group based on good performance on the indicators of climatic comfort, wind speed and landscape features with attractiveness or aesthetic value. The landscapes with highest scoring are primary landscapes with mugo pine on igneous rocks. Here the presence of the 'Malyovitsa' hut and the high number of ski routes have an additional weight. In the Boreal Belt, two (of the five landscape sub-units) have very high potential (Ca1, Cc1). This could be explained by the recreational services and better climatic comfort. The landscape sub-units with the lowest potential are Ba1a and Bb1b due to the presence of steep slopes and small territorial extent.

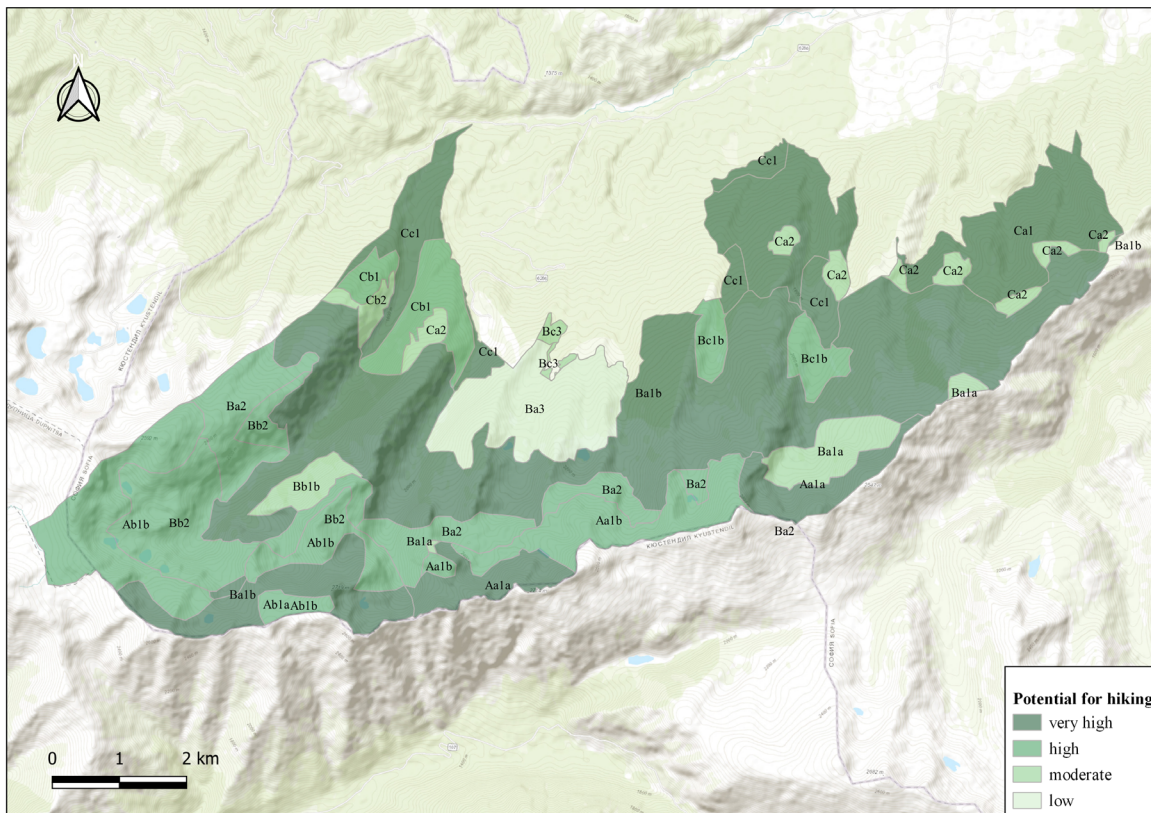
### 3.4. Assessment of landscapes to provide cultural ecosystem services for mountaineering

Scores are reclassified to a three-level scale in the following values (Fig. 7): high potential (with a score above 17: Aa1a, Ab1a, Ba1b and Cb1), medium potential (with a score between 14 and 16: Cc1, Ca2, Cb2 and Ba2), low potential (with a score below 14: Ca1, Ba1a, Bb1b, Bc1b, Bb2, Ba3, Bc3, Aa1b and Ab1b). Due to the specific requirements for the practice of this activity, only four sub-units of the assessed landscapes are identified as areas with very high potential. The rest of the landscapes are of subsidiary importance.

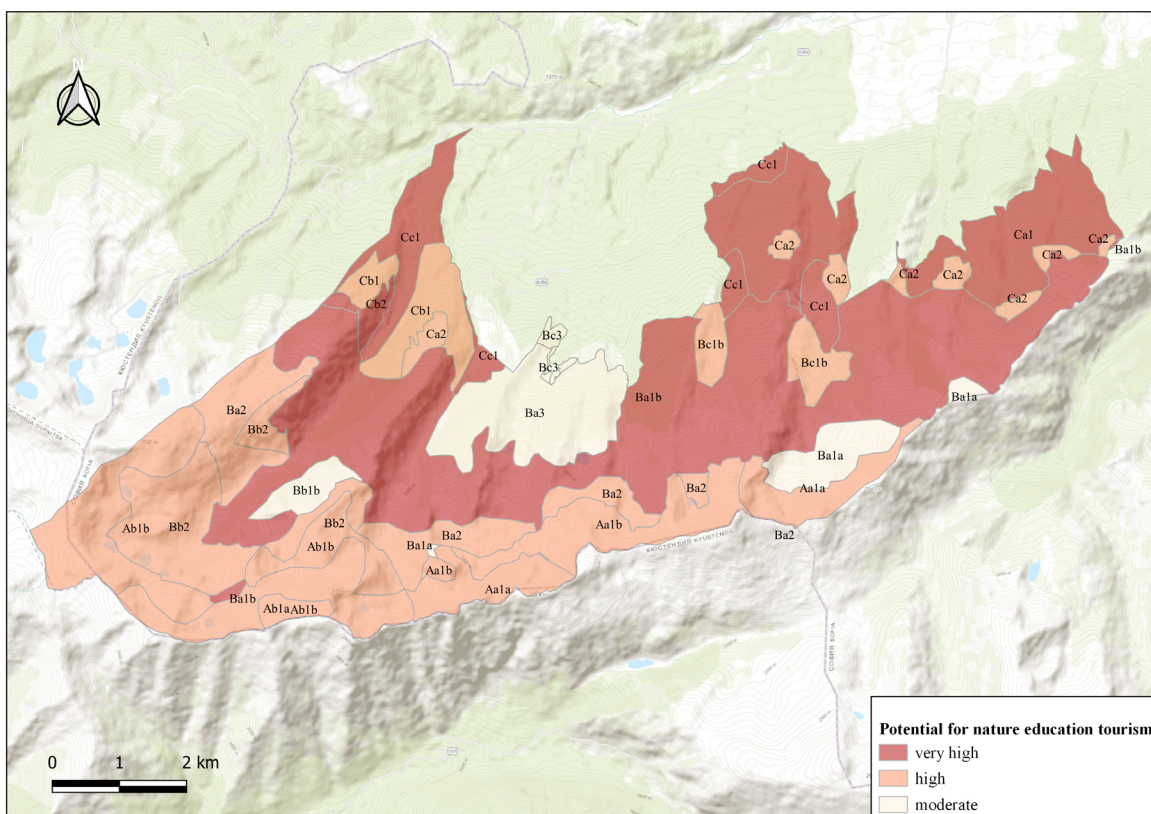
### 3.5. Integrated assessment of high mountain landscapes to provide cultural ecosystem services for tourism practice

For the purposes of the integrated assessment, the results for landscape sub-species from all selected tourism activities were summed and reclassified (Fig. 8, Table 4) as follows: very high potential (with a score above 100: Cc1, Ba1b, Aa1a and Ab1a), high potential (with a score between 85 and 100: Ca1, Cb1, Ca2, Cb2, Bc1b, Ba2, Bb2, Aa1b and Ab1b), medium potential (with a score between 70 and 85: Ba1a, Bb1b, Ba3 and Bc3).

Four sub-units - Cc1, Ba1b, Aa1a and Ab1a - participate in the group of landscapes with very high overall potential. With the highest score among them are primary forest landscapes on moraine materials (Cc1): the landscape is rated with very high potential for hiking, nature exploration and ski touring, and with medium potential for mountaineering. These results are due to the favourable relief and climatic features, geodiversity, biodiversity, low risk of adverse natural phenomena and, finally, good recreational services. Primary landscapes with mugo pine on igneous rocks (Ba1b) also mark very high scores: this sub-type is 'universal' for the practice of the tourism activities considered, falling into the groups of landscapes with very high potential. The next two sub-units: primary landscapes of bare igneous (Aa1a) and bare metamorphic rocks in the alpine belt (Ab1a), offer the best landscape features distinguished by attractiveness or aesthetic values. The group with



**Figure 4.** Potential of landscape sub-units in the Malyovitsa Rila to provide cultural ecosystem services for mountain hiking.



**Figure 5.** Potential of landscape sub-units in the Malyovitsa Rila to provide cultural ecosystem services for mountain 'nature education' tourism.



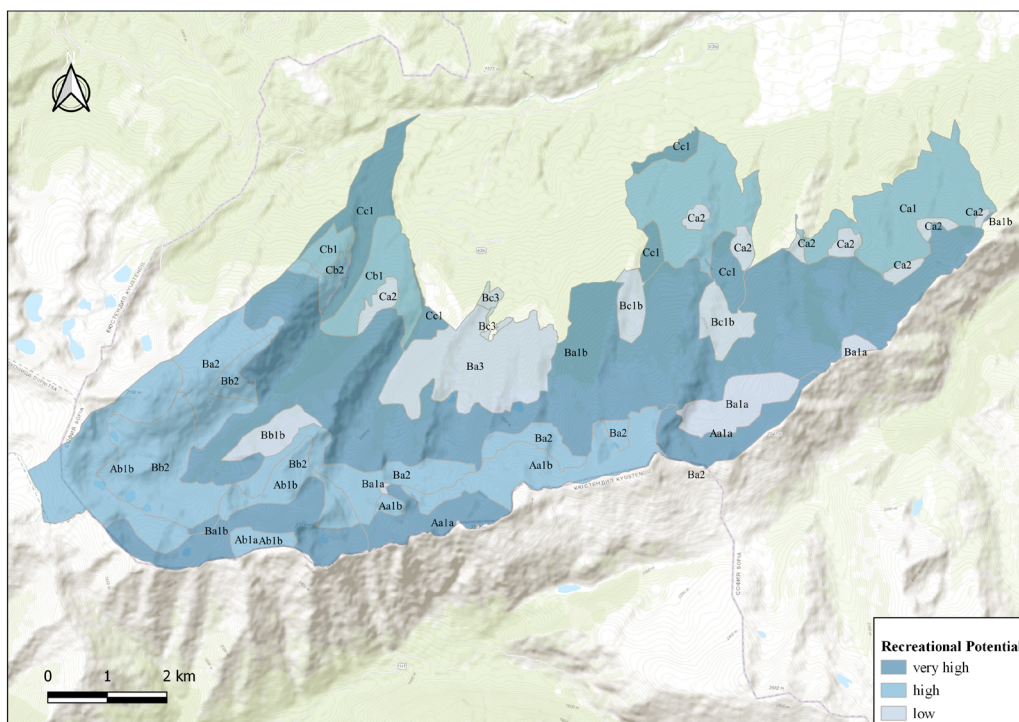


**Table 4.** Integrated assessment of high mountain landscape potential of Malyovitsa Range for providing CES.

Integrated assessment of high mountain landscape potential of Malyovitsa Range for providing cultural ecosystem services					
Landscape subtype	Types of tourist activities				Summary score
	Mountain hiking	'Nature education' tourism	Ski touring	Mountaineering	
Ca1	40,1	23,1	21,35	13,6	98,15
Cb1	36,6	18,6	17,85	17,6	90,65
Cc1	43,1	25,1	22,1	15,6	105,9
Ca2	32,75	17,75	17,75	15	83,25
Cb2	34,75	20,75	17,75	19	92,25
Ba1a	32,35	14,35	14,35	11,2	72,25
Ba1b	40,75	22,75	22,75	19,6	105,85
Bb1b	32,5	13,5	14,5	11,6	72,1
Bc1b	35,6	16,6	15,85	12,2	80,25
Ba2	37,25	16,25	22,5	14,6	90,6
Bb2	38,5	17,5	20,75	12,6	89,35
Ba3	27,6	12,85	19,85	12,2	72,5
Bc3	30,85	14,85	16,1	12,2	74
Aa1a	41,05	19,05	23,3	19,6	103
Ab1a	40,8	18,8	22,8	17,6	100
Aa1b	36,1	16,1	20,35	12,9	85,45
Ab1b	37,1	16,1	20,35	12,9	86,45

**potential to provide cultural ecosystem services**

very high potential (Score above 100)      high potential (Score between 85 and 100)      medium potential (Score between 70 and 85)



**Figure 8.** Integrated assessment of high mountain landscape recreational potential of Malyovitsa Range for providing CES.



high potential includes four forest landscapes, three subalpine and two alpine. All landscapes show favourable potential for the practice of each of the activities addressed.

With the lowest score are primary landscapes with mugo pine on metamorphic rocks (Bb1b), which occur on the slopes of Zeleni Ridge and Kalbura Ridge. The main reason is the steep slopes of the topographic surface. The primary landscapes of bare igneous rocks in the subalpine belt (Ba1a) are similarly low ranked. The potential of highly altered anthropogenic landscapes on igneous rocks and on moraine materials is low, explained by the disturbances in their spatial extent and low recreational facilities.

#### 4. Discussion

The results show the territory's high potential for alpine tourism. A more precise assessment could increase the number of social indicators to correctly reflect the tourist preferences. The user feedback is particularly important and could provide to the park management valuable information for planning of: adequate management of the tourist load on the territory; diversification of the types of activities, incl. specialized routes with differentiated physical exertion for tourists; providing visitors with wider and more importantly informed access to ecosystem services; and last but not least - motivating visitors to protect the natural heritage.

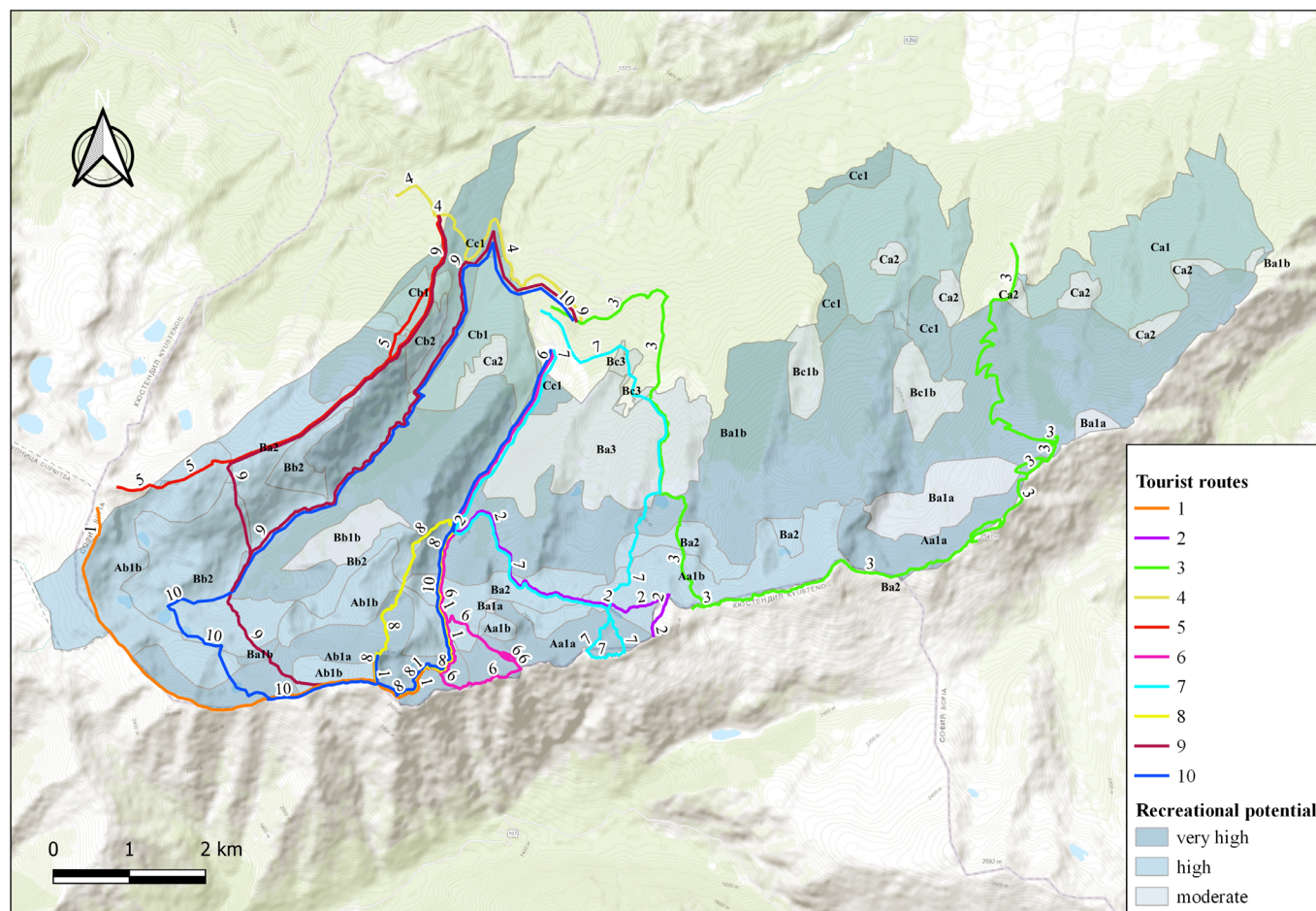
The analysis of the results enables a discussion and evaluation of the tourist routes in the study area for the mainstream activity

'mountain hiking' in terms of tourists' access to cultural ecosystem services provided by the landscapes. Considered routes (Table 5) indicated in: MPP Rila NP - Annex 1.16.7 - 2, the guidebooks "The Peaks of Rila - Guide to the High Mountain" (Grancharov 2000) and "Rila - Guidebook" (Raduchev 1981). These routes are assessed on the diversity of the landscapes they include and the potential of these landscapes to provide cultural ecosystem services. The final integrated assessment of the routes was formed from the assessment of landscapes for the 'mountain hiking' activity. On this basis, the routes were grouped according to the following levels of potential for CES provision (Table 5): routes with very high potential - with a score above 300, high potential (score between 200 and 299), medium (150 - 199), low potential - with a score below 149.

The most highly rated routes (No 9 and 10, Fig. 9) pass through a variety of landscape sub-units: three from the forest belt, three from the subalpine belt and two sub-units from the alpine belt. They offer remarkable panoramic views, rich diversity of plant species and geodiversity sites - the routes pass through the amphitheatrically situated Urdin Cirque and route No 10 additionally crosses the cirque below Mt. Malyovitsa. The routes rated with high potential (No 3, 5, 7, 8) are scenic: they cross the main ridge and offer access to numerous peaks, cirques and impressive panoramic views. As routes with medium potential are evaluated No. 1, 2, 6. The lower rating is mainly due to the fact that they pass through a smaller number of landscapes. However, we should note that routes 1 and 2 (the main tourist routes for Rila National Park) only partially pass through the

**Table 5.** Assessment of mountain hiking routes for tourists' access to CES.

Assessment of mountain hiking routes for tourists' access to cultural ecosystem services																		
Tourist route №	Sub-units of landscapes through which tourist routes pass																Cumulative assessment - potential of landscapes to provide CES	
	C	C	C	C	C	B	B	B	B	B	B	B	B	A	A	A		A
	a	b	c	a	b	a	a	b	c	a	b	a	c	a	b	a		b
	1	1	1	2	2	1	1	1	1	2	2	3	3	1	1	1		1
1																		155.90
2																		155.15
3																		245.95
4		√	√		√													114.45
5		√	√		√													262.10
6																		198.25
7																		213.60
8																		237.5
9		√	√		√													300.60
10		√	√		√													308.85
potential for providing cultural ecosystem services																		
Very high potential (Score above 300)				High potential (Score 200 - 299)				Medium potential (Score 150 - 199)				Low potential (Score below 149)						



**Figure 9.** Tourist routes and recreational potential of landscapes for tourist access to cultural ecosystem services.

territory. Only one route (No. 4) falls into the group of routes with low potential. The reason for the lower score is the limited number of landscapes (3), reduced to the extent of the forest belt.

The results of the analysis, including field observations, give us reason to indicate that the following actions are necessary to preserve the structure and function of landscapes to provide CES: Anti-erosion measures with special attention to hiking trails. For example, the section of the trail (to Mt Malyovitsa) above Elenino Lake needs serious strengthening. Here the tourist flow is very intensive, leading to severe erosion. Another vulnerable section of this trail is the one between Educational-tourist complex ‘Malyovitsa’ and ‘Malyovitsa’ Hut. The drainage measures taken here are not sufficient.

There is a need to increase the control of the park guards over visitors to ensure compliance with the park rules. In this context, we also highlight the need of taking measures to regulate tourist flow in sensitive landscapes. We consider it appropriate to discuss the introduction of visitor fees (which, in addition to being a means of regulating tourist flow, can be used to maintain the park area and tourist infrastructure) and to limit the number of visitors in areas with vulnerable ecosystems. The combination of different tourist routes in the practice of the tourist activities under consideration could contribute to a smooth distribution of the tourist flow: the highest load is on the main trail to Mt. Malyovitsa. This could be achieved by raising tourists' awareness of the different route options and diversifying the trail network.

## 5. Conclusion

This study presents the development and testing of a methodology to assess the recreational potential in the Malyovitsa Range and the Urđin Cirque of the ‘Rila’ National Park through the application of the ecosystem approach and the concept of cultural ecosystem services. The results show that the natural heritage in the study area underpins a rich range of landscape features that are conducive to the practice of nature-based tourism and recreation. The ecosystem approach supports the identification of representative cultural ecosystem/landscape services and provides a good information basis for the practical organisation of tourism activities from the perspective of the sustainability of human-nature relationships. The presented methodology builds on traditional methods in recreational assessment and provides a full and comprehensive disclosure of the natural recreational potential by: reflecting the relationship between natural and cultural heritage and their cumulative value; the relationship between the cultural ecosystem services provided and the needs of the visitors; reveals the opportunities for fully exploiting the potential and diversifying and improving the recreational product of the territory. The applied approach, based on criteria for valuation of the ecosystem services provided by the natural heritage, gives a sound basis for informed sustainable management decisions. To make the methodology even more precise in the future, it is necessary to broaden the criteria base, to look for indicators that are more relevant and to refine the assessment scales.



## Funding program

This research was funded by the BG05M20P001-1.001-0001 Project "Creation and development of "Heritage BG" Centre of Excellence", Operational Programme Science and Education for Smart Growth, Priority axis 1, Procedure BG05M20P001-1.001, Component 4 "New technologies in creative and recreation industries".

## Acknowledgments

The researchers would like to express special thanks to Alexander Gikov (Institute for Space Research and Technology - Bulgarian Academy of Sciences) for the explanations and the provided materials related to the landscape diversity of the territory.

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## ORCID

<https://orcid.org/0000-0002-3225-9514> - B. Borisova  
<https://orcid.org/0000-0003-1784-4413> - R. Mitova

## Supplementary materials

Suppl. material 1: Assessment of landscapes for providing cultural ecosystem services for mountain hiking  
 Authors: Silvestriev M, Borisova B, Mitova R  
 Data type: Table, .pdf  
 Brief description: The file contains tabular data presenting the results of the assessment of the potential of high mountain landscapes to provide cultural ecosystem services for four types of tourism: mountain hiking, 'nature education' tourism, ski touring and mountaineering.  
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 Size: 110 KB  
 Link: <https://doi.org/10.3897/jbgs.e72500.suppl1>

Suppl. material 2: Assessment of landscapes for providing cultural ecosystem services for mountain 'nature education' tourism  
 Authors: Silvestriev M, Borisova B, Mitova R  
 Data type: Table, .pdf  
 Brief description: The file contains tabular data presenting the results of the assessment of the potential of high mountain landscapes to provide cultural ecosystem services for four types of tourism: mountain hiking, 'nature education' tourism, ski touring and mountaineering.  
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 Size: 161 KB  
 Link: <https://doi.org/10.3897/jbgs.e72500.suppl2>

Suppl. material 3: Assessment of landscapes for providing cultural ecosystem services for ski touring  
 Authors: Silvestriev M, Borisova B, Mitova R  
 Data type: Table, .pdf  
 Brief description: The file contains tabular data presenting the results of the assessment of the potential of high mountain landscapes to provide cultural ecosystem services for four types of tourism: mountain hiking, 'nature education' tourism, ski touring and mountaineering.  
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 Size: 99 KB  
 Link: <https://doi.org/10.3897/jbgs.e72500.suppl3>

Suppl. material 4: Assessment of landscapes for providing cultural ecosystem services for mountaineering  
 Authors: Silvestriev M, Borisova B, Mitova R  
 Data type: Table, .pdf  
 Brief description: The file contains tabular data presenting the results of the assessment of the potential of high mountain landscapes to provide cultural ecosystem services for four types of tourism: mountain hiking, 'nature education' tourism, ski touring and mountaineering.  
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