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SHOWCASES

What has changed in Mount Elbrus' landscape since the first expedition two centuries ago? An in situ assessment along the same route reveals symptoms of the shifting baseline syndrome

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Abstract
Mount Elbrus is the highest mountain in Europe; its height is 5642 m. The first ascent up to the peak took place in 1829. We repeated the original route aiming at artifacts search and environmental changes observation. We found that overgrazing and deforestation resulted in the extermination of wildlife on the slopes. That remains unnoticed due to the *shifting baseline syndrome*: the change in the accepted environmental norms along with human generations change. In the past, the slopes were characterized as open areas, but they still contained a portion of arboreal vegetation, the game animals were abundant; nowadays, an open area is a habitat reminding a shortcut lawn. Conservation and restoration measures are neither implemented nor planned. Climbing popularity draws attention away from environmental problems.

Keywords Open area · Elbrus · Deforestation · Overgrazing · Shifting baseline syndrome · Wildlife · Tourism

1 Introduction: how to characterize the normal state of landscape?

Defining the 'normal' state of nature is a significant challenge in modern socio-ecological research and economic activities (Ureta et al. 2020). Human transformation of natural landscapes has been ongoing for thousands of years, making it difficult to define what nature was once considered 'normal' and how to characterize its desired state today. Even in well-studied regions like Europe, this task is challenging. Thousands of years ago, Europe was predominantly forested, but deforestation has steadily advanced into modern times (Holmgren and Scheffer 2017; Kaplan et al. 2009). As a result, restoring a maximum level of tree cover may seem like the norm. However, tens of thousands of years ago, Europe was home to numerous large herbivores, which indicates that vast areas were open spaces. Most of these herbivores became extinct around 10,000 BCE, marking the boundary between the Pleistocene and Holocene (Pillans and Gibbard 2012). While climate change is traditionally seen as the cause of their extinction, the hypothesis of human-driven overkill, initially suggested by J.B. Lamarck, is gaining increasing support (Lemoine et al. 2023; Svenning et al. 2024). If we consider human-driven overkill as a contributing factor, the steppes inhabited by large animals might represent the 'norm'. Consequently, the concept of Pleistocene rewilding—restoring landscapes and ecosystems to their Pleistocene conditions—has garnered interest (Donlan et al. 2006; Lundgren et al. 2020). However, estimating this norm is complicated by the *shifting baseline syndrome*. This syndrome suggests that people typically base their perceptions

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of nature on conditions from the past two or three generations, with little knowledge of the more distant past. As a result, returning to ecological indicators from several hundred years ago can seem uncertain, and Pleistocene rewilding is often perceived as extraordinary or even unrealistic (Rubenstein et al. 2006). The concept of the *shifting baseline syndrome*, introduced in fisheries science (Pauly 1995), has since been applied to other areas such as forests, landscapes, and vulnerable species (Papworth et al. 2009; Soga and Gaston 2018). Because past environmental states are often poorly documented, research opportunities to examine this syndrome are limited. However, when these opportunities do arise, they can yield valuable insights. One such opportunity emerged during an expedition to Mount Elbrus in the Caucasus. The first expedition to the summit occurred in 1829, and we recently retraced its route, documenting the current state of nature. By comparing our findings with reports from the original expedition and analyzing recent literature, we hypothesized that this situation could offer insights into the shifting baseline syndrome over a period of 200 years. Specifically, we explored whether perceptions of the 'normal' natural state on Mount Elbrus' slopes have changed and how this shift has impacted socio-ecological practices. These questions are of interest to a wide audience, including researchers, local residents, and visitors. Given that Mount Elbrus has been visited by thousands of people from around the world, the information gathered there holds both local and international relevance. This study also serves as a foundation for discussing broader trends in environmental transformation, particularly in mountainous areas.

2 Materials and methods: Mount Elbrus, its research in the past and now

With an altitude of 5642 m, Mount Elbrus in the western Caucasus (N 43° 20′ E 42° 26′) is the highest point of Europe. Its foothills gradually transition into plains to the north; while, mountain ranges lie to the south. The mountain and its surrounding areas are protected within Prielbrusye National Park (OOPT Rossii 2023). Mount Elbrus is popular among climbers and has several camps and visitor facilities (Russia Travel 2023). There is a route over northern slopes overlapping the one taken by the first expedition, which took place in commemoration of a remarkable event: In 1828, the inhabitants of the surrounding area accepted citizenship of the Russian Empire after many wars. Next year general of the cavalry George Emmanuel organized an expedition to this territory. There were scientists from different fields, in particular, physics, geology, biology, and philology, as well as a brigade of about 1000 soldiers. A part of the expedition approached Elbrus and established a camp on the altitude 2500 m. Small group climbed farther and stopped on the altitude 3800 at glacier's edge. Both sites are still in use by mountaineers for camps. The location of the first one was named 'Emmanuel's glade' after the pathfinders leader. Only one participant of the first expedition, Kilar Hashirov, a local, reached the summit. The scientists examined the slopes up to the glacier's edge (Kupffer 1830; De Besse 1838; Lenz 1897). The reports of the expedition and other relevant documents were recently collected (Hashirov 2019) and these drew fresh public attention to the expedition and inspired its repeat in 2020 and 2021 with the aim of searching for artifacts and describing the environment. We took part in it.

The repeat expedition took place in July, as the original did. We specified the route of the first expedition examining the reports by its participants, walked along the route of pathfinders on the Elbrus mount, and examined a part of the territory outside it. Climbing to the mount, we described the surrounding habitats. We revealed the relatively uniform plots of land within visible area. In addition to the direct observation, filming with drones and a stratospheric probe by GoPro4 and GoProMax cameras was shot. The probe moved north-eastwards first, i.e., along the rout of the expedition, but then moved to the east. Combining the results of observations with aerial pictures, we drew up a scheme of the habitats of the northern slopes of Mount Elbrus. In addition to the description of habitats, we recorded and photographed vertebrates or their traces. They were considered the most significant indicator of the state of the environment: Since they require a relatively large space, their presence reflects ecosystems covering other animals and plants. Threatened species are especially informative in this respect.

To compare our findings with historical conditions, we reviewed all reports from the first expedition, extracting any descriptions relevant to the environmental assessment. We then compared our observations to those of the early explorers, focusing on factors such as vertebrate species, vegetation, grazing patterns, and the condition of water bodies. We tried to describe not only the change of environment, but also the human attitude to it, i.e., to find out, what ecological problems were pointed out by researchers and other visitors, what do they now about past condition of the area at the Mount, do they consider the current situation normal. To fulfill this task we examined the scientific literature, the blogs by tourists and documents of relevant institutions. The scientific publications with the keyword 'Elbrus' in the titles and abstracts were identified in the Russian science citation index (2023) and Scopus (2023). Their topics were analyzed, the articles focusing on the description of the flora, fauna, and the environmental problems at the Elbrus mount were revealed. Additionally, we reviewed recent reports (2021–2023) from popular travel websites (Elbrus Tours 2023; Otzovik 2023; Russia Travel 2023; Turister 2023) and interviewed mountain visitors about their views on the

environment. The information about the activities of the Prielbrusye National Park was collected from their website, the official website of the Ministry of Natural Resources of Russia, and databases on protected areas of Russia (MNR 2023; Nationalny Park Prielbrusie 2023; OOPT Rossii 2023).

3 Results

3.1 Surveys of the slopes of Elbrus

The original expedition participants documented their camp locations, dates, and distances covered, with Lieutenant Shcherbachev's report (September 12, 1829) providing the clearest details (Hashirov 2019, pp. 165–193). By comparing this with modern maps, we determined that their route nearly matches the road used today (Table 1, Fig. 1). Our survey confirmed that the contemporary climbing path

Table 1 Identification of camp sites of the first expedition to Elbrus on the foothills

No	Location description	Date	Co-ordinates
1	Expedition reached Kasaut (Hasaut) river from the north	2.07	43° 41′ N 42° 39′ E
2	Foot of Bermamyt mount in the Kasaut valley	4.07	43° 41′ N 42° 29′ E
3	Burguldaukh senth site, about 12 km southwards from Bermamyt	5.07	43° 35′ N 42° 31′ E
4	Ungenshli (Ingeshli) river, 4.5 km southwards from Burguldaukh sent site	6.07	43° 32′ N 42° 30′ E
5	Tuzluk mount	8.07	43° 28′ N 42° 31′ E

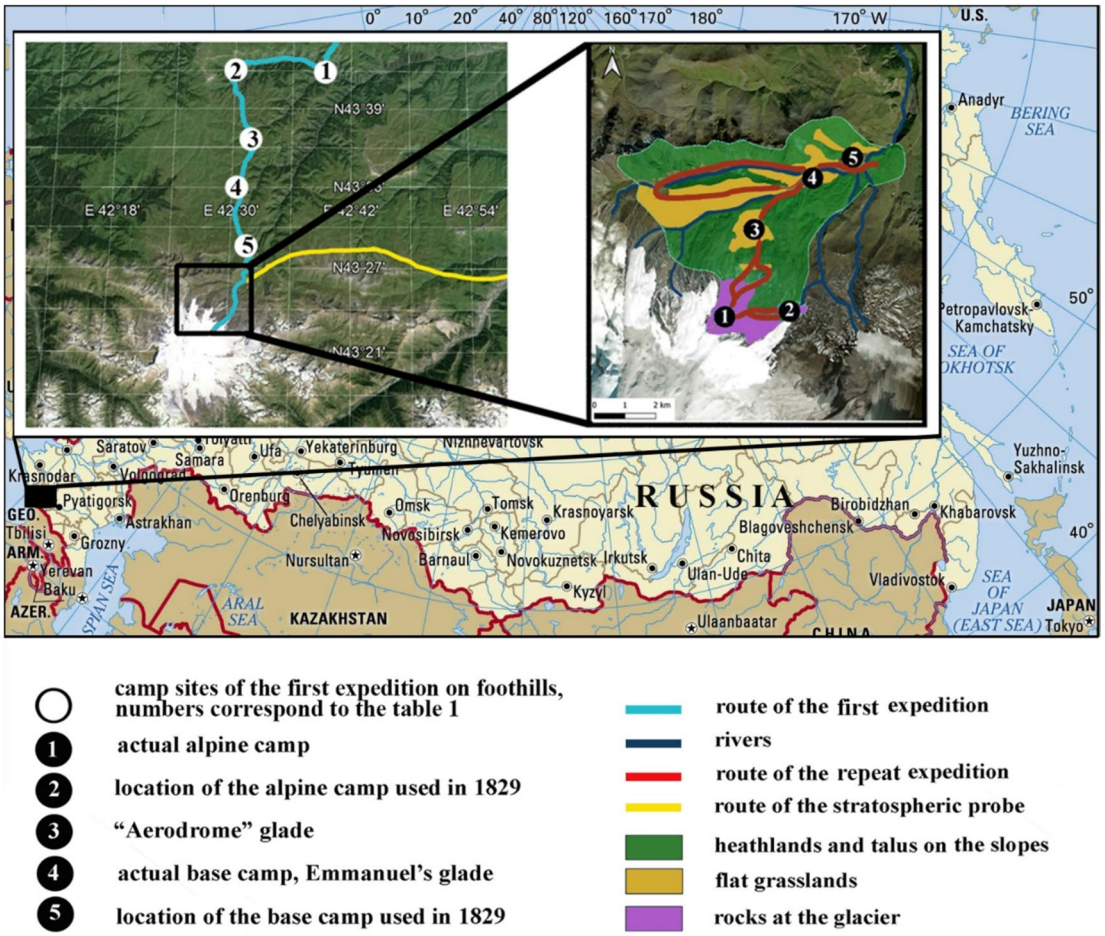

Fig. 1 Scheme of surveyed territory

largely follows the original explorers' course, indicated by numbered markers on Fig. 1. We discovered historical artifacts, such as a 'pentagram' carved by the first expedition members in a high-altitude camp. To supplement our survey, we explored an adjacent area along a nearby river (Fig. 1) to gain a broader understanding of the environmental conditions. One could see a plot of 3.500 hectares from the route on the slopes of Elbrus (Fig. 1). It was an open space without a single tree (Fig. 2). The cows, horses, and sheep, or their traces were observed up to 3000 m above sea level. The major part of livestock concentrated in the relatively flat grasslands, but it goes along the slopes up to the maximum. Most of the land resembled a shortcut lawn with some occasional inclusions of clumps of nettle (*Urtica dioica*), thistle (*Cirsium obvallatum*), hellebore (*Veratrum lobelianum*), and other inappropriate for livestock feeding plants. Throughout such a pasture, patches of desertification occur, i.e., the plots without vegetation and soil. The vegetation differed from a 'lawn' only on the steepest stony slopes. There were small bushes of Caucasian rhododendron (*Rhododendron caucasicum*) and others (about 30 cm high), as well as lichens apart from grasses. Above 3000 m, the grass cover was non-continuous; the number of plants gradually reduced with the increase in altitude. The stratospheric probe showed that all northern slopes of Elbrus hardly differ from the observed plots of land.

Survey of animals resulted in the discovery of only one remarkable object: An alpine lizard (*Darevskia alpina*), which is a vulnerable species (Tuniyev et al. 2009). This species represents a great interest. It belongs to the group of rocky lizards of the Caucasus; which are famous among zoologists because they reproduce by parthenogenesis. This was the first case discovered among reptiles. We found two specimens on a steep slope near the glade Aerodrome (No 3 in Fig. 1). As for the other vertebrates, 13 species of birds and 2 species of mammals were recorded. Only one species of these groups—the mountain Caucasian ground squirrel (*Spermophilus musicus*)—occur over most of the observed territory, i.e., plots of the pastures. A fox (*Vulpes vulpes*) was observed once; it was happened near the alpine camp. Both species are synanthropic in the surveyed territory, they often feed in garbage dumps, are little afraid of humans; some ground squirrels used to approach tourists, since tourists often feed them. Birds were also observed mainly near the camps (Table 2). Almost all registered species are common; they are classified as 'least concern' in the IUCN red list. There is only one exception. It is the eastern imperial eagle (*Aquila heliaca*), but the surveyed area is only part of its habitat; forests or at least a few trees are needed for its stable existence (BirdLife International 2019); and therefore, it cannot be fully asserted that eagles constantly inhabit the studied area. Its presence hardly changes the general picture of animal world: small numbers of representatives of the most tolerant to anthropogenic pressure species inhabit the mount.

The river Kyzylkol and several small streams flow through the surveyed territory. Their banks are affected by erosion (Fig. 2). Ravines are expanding, and water levels rise sharply during rainstorms and periods of rapid glacier melt, worsening erosion and causing frequent flooding. The flooding gets worse. It causes a lot of damage, for example, a pedestrian bridge was washed away during the period of our expedition. The grazing takes place at the coastlines with no restrictions, despite the Water Code of Russia provisions regulating the water protection zones along the river banks, where grazing is not allowed.

Participants' reports from the original expedition contained limited information for direct environmental comparison, as their interests lay elsewhere—primarily in documenting the ascent, studying local inhabitants, and mineral prospecting. However, some records allow us to appreciate the 'shift' in the state of nature (Table 3). At the beginning of

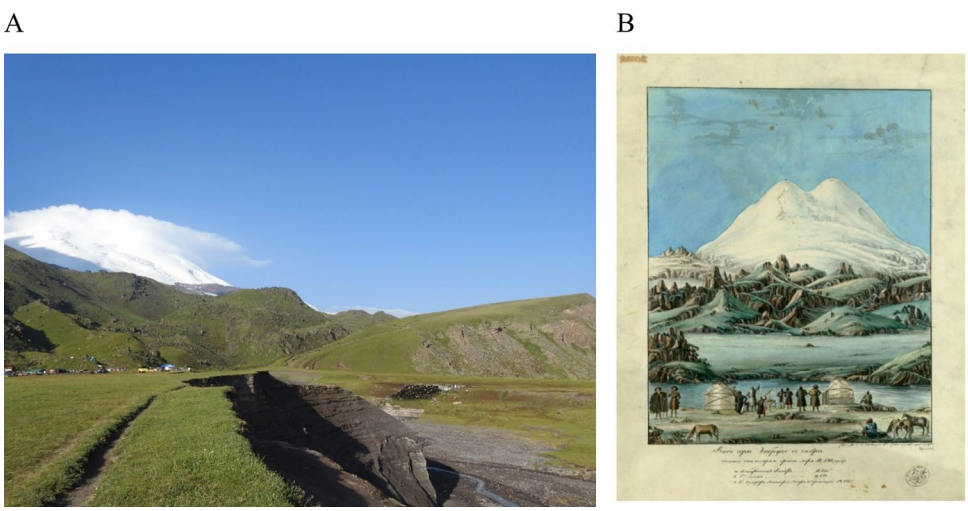

Fig. 2 A location under study (No 4, Fig. 1): **A** Elbrus mount, Emmanuel's glade with a camp, Kyzylkol River, an enclosure with sheep. **B** picture by an ensign Gorshkov (first name was not indicated) (1829)

Table 2 Bird species recorded on the slopes of Elbrus

Species	IUCN category	Number of individuals, details of observation, habitat
Wallcreeper *Tichodroma muraria*	LC	1 individual in the gorge at the Emmanuel's glade
Mistle Thrush *Turdus viscivorus*	LC	2 individuals, Aerodrom glade
Ring Ouzel *Turdus torquatus*	LC	About 10 individuals, Emmanuel's glade, Aerodrom glade
White Wagtail *Motacilla alba*	LC	1 individual, coast of the Kazykkol river
Lesser Whitethroat *Sylvia curruca*	LC	1 individual, Emmanuel's glade
Alpine Accentor *Prunella collaris*	LC	2 individuals, Emmanuel's glade
Mountain Chiffchaff *Phylloscopus sindianus*	LC	1 individual, Emmanuel's glade
Meadow Pipit *Anthus pratensis*	LC	1 individual, coast of the Kazykkol river
Black Redstart *Phoenicurus ochruros*	LC	2 individuals, Emmanuel's glade
Yellow-billed Chough *Pyrrhocorax graculus*	LC	About 30 individuals at the alpine camp
Caucasian Snowcock *Tetraogallus caucasicus*	LC	Scat of 1 individual in the shrub ticket between Emmanuel's and Aerodrom glades
Eastern Imperial Eagle *Aquila heliaca*	VU	1 individual on high altitude
Griffon Vulture *Gyps fulvus*	LC	1 individual high on altitude

Table 3 'Shift' in the state of the northern slopes and foothills of Elbrus

Marks of the state of environment	Past		Present
	Information from expedition performed in 1829	Source	
Vertebrates	Abundance of game	Kupffer (1830, p. 20)	Low diversity of mammals and birds, absence of large mammals
Vegetation	Tall, dense grass, enough to build huts for overnight stays Open area, lack of trees Firewood and wood to build huts was available A small forest near Elbrus	Kupffer (1830, p. 15), Besse (1838, p. 63) Kupffer (1839, p. 10), Lenz (1897, p. 5) Besse (1838, p. 63, 75) Besse (1838, p. 76)	'Lawn', a small number of trees on the steep slopes; building huts and getting firewood for several hundred persons every day during several weeks is hardly possible
Grazing	Moderate temporal use during hot season	Kupffer (1830, p. 22)	Overgrazing
State of the shores of water bodies	Not reported	–	Strong ground erosion and washout of soil
Desertification	Not reported	–	Ravins and pathces of desertification are progressing

the nineteenth century years ago, the slopes and approaches to Elbrus were also open space, but it was completely different from what it is now. Instead of a 'lawn' there were meadows with abundant tall grass, which contained some proportion of woody vegetation. It was not directly near the camp, but it was noticeable on the approaches (Table 3, Figs. 2, 3). The early reports conveyed admiration for the landscape, noting the rich grass, water sources, flowers, and abundant game.

3.2 Publications on Elbrus

Our search of the Russian Science Citation Index yielded 209 publications on Mount Elbrus: 53 on ice and snow, 27 on volcanism and seismic activity, 28 on other geological or geophysical processes, 25 on history, 36 on tourism, 7 on medicine, 13 on interdisciplinary issues unrelated to ecology, and only 19 focused on biology or environmental protection. Seven articles out of them were focused at the description of the flora, three—invertebrates, one—bacteria, one—garbage collection, two—pastures; one—the West Caucasian tur (*Capra caucasica*) in the context of parasitology, one—overgrowing of the talus (Fig. 4, Appendix 1). Altogether, there are about a dozen of publications where the analysis of environmental degradation was expected. However, none of them mentioned the devastation of the environment. The situation is similar while searching through the Scopus database. It contains 119 publications on Mount

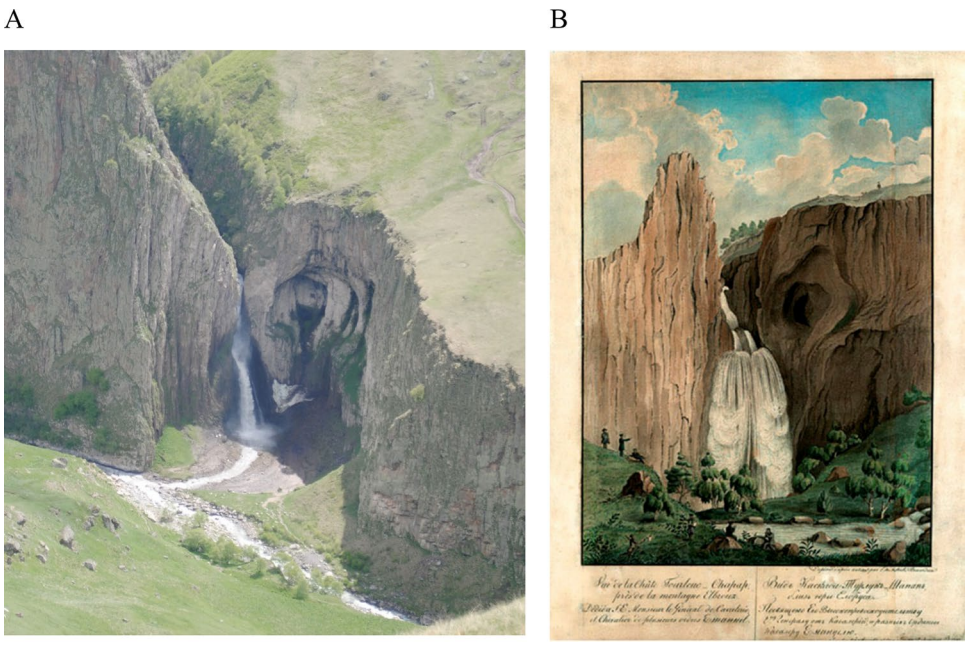

Fig. 3 Waterfall Karakaya-Su, 3 km from the foot of Elbrus. **A** Current view. **B** Picture by D. Bernardazzi (1829)

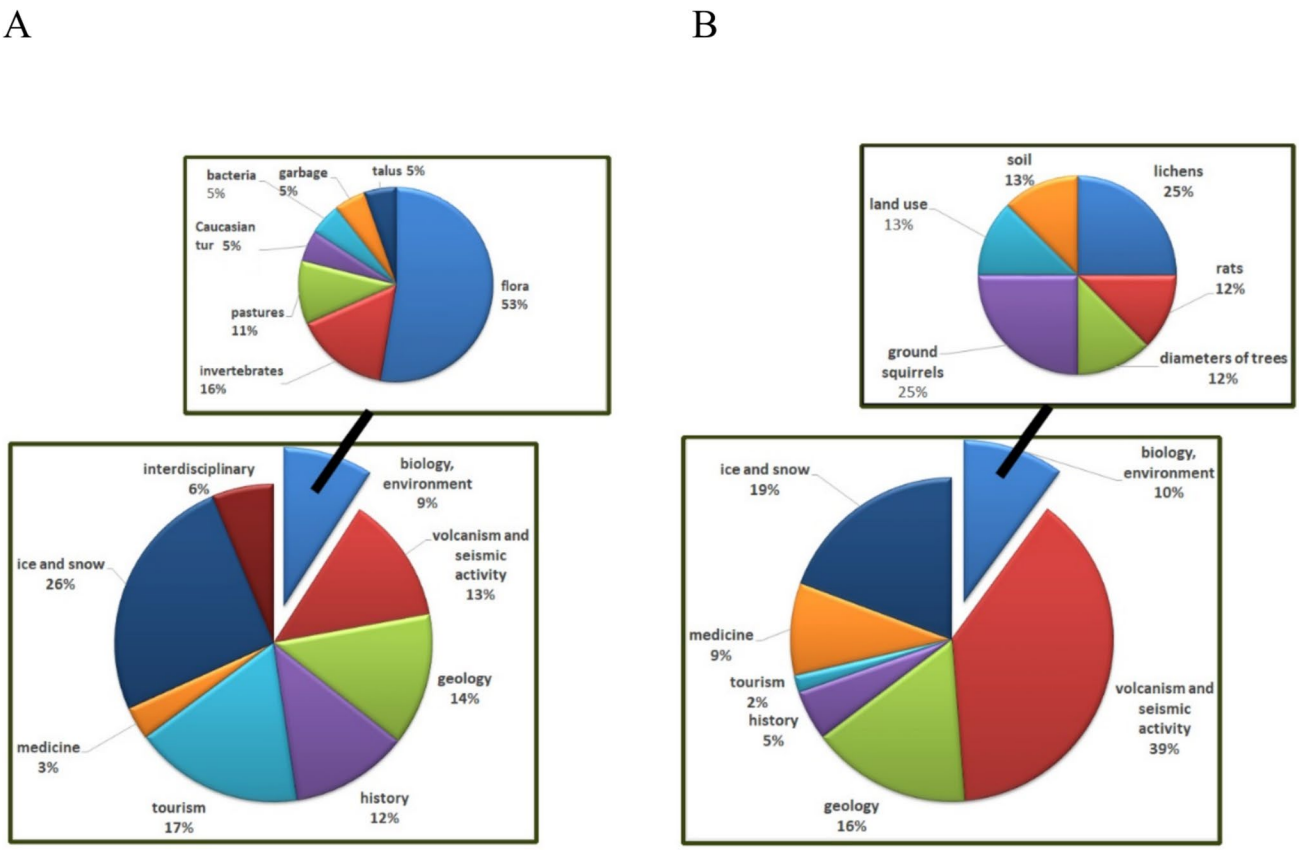

Fig. 4 Subjects of the publications on Elbrus: **A** Russian science citation index, **B** Scopus

Elbrus: 23 on ice and snow, 46 on volcanism, 19 on other geophysical processes, 6 on history, 2 on tourism, 11 on medicine, and 12 on biology or ecology. Two publications out of the last group studied lichens, one—rats, one—diameter of trees, two—ground squirrels, two–land use problems, two—soil formation (Fig. 4, Appendix 1). One could expect

an analysis of the environment in the last four articles, but they also did not show a catastrophic decline in biodiversity. Moreover, the Journal of Sustainable Development of Mountain Territories has been published in the Caucasus since 2009. It only has two articles on Mount Elbrus: One is on snow (Volodicheva et al. 2010), and the other one is on the development of infrastructure for mountain tourism (Zalihanov 2015). Documents of the Prielbrusye National Park and the relevant databases still do not contain information about the environmental problems (Nationalny park Prielbrusie 2023, MNR 2023; OOPT Rossii 2023). Even if some data on animals and plants present, they are vague and often doubtful as they facilitate an image of rich biodiversity.

A review of tourist sites also showed a lack of reports on environmental disasters. Among environmental problems, only garbage is occasionally mentioned. Most tourists focused on the mountain's scenic beauty and the pastoral lifestyle, paying little attention to the state of the environment. Climbing to the summit is their main goal, while everything else attracts little attention. In addition to climbing, some popularity is enjoyed by routes through the surrounding mountains, but even in this case, participants do not see anything abnormal in the surrounding area.

4 Discussion: unnoticed degradation of environment

On the northern slopes of Mount Elbrus, wildlife has been nearly eradicated due to overgrazing and deforestation. Soil erosion and water-induced washouts have also accelerated. Such issues are common globally (Ewane and Lee 2020; Su et al. 2015; Zhang et al. 2019), drawing attention from researchers and leading to the development of land restoration projects (Jin et al. 2019). However, on Mount Elbrus, this degradation has largely gone unrecognized, despite the substantial number of visitors each year. This clearly demonstrates the symptoms of the *shifting baseline syndrome* (Soga and Gaston 2018): increased tolerance for progressive environmental degradation; the use of inappropriate baseline data for conservation, restoration and management of nature; insufficient attention from environmental scientists; lack or scarcity of relevant historical data on nature; loss of interaction with the natural environment or short-term contact with nature. The northern slopes of Elbrus have been open for at least 200 years, making this condition seem 'normal'. Locals have hardly noticed the gradual degradation. In the past, the area featured tall grass and some arboreal vegetation, but now it resembles a closely cropped 'lawn'. Visitors, including scientists, tend to accept this current state as natural. However, even the conditions 200 years ago were likely already 'abnormal' because the area had been inhabited long before that time. Due to historical factors, the region became largely abandoned and sparsely populated several hundred years ago. By the time of the first expedition, local residents were primarily engaged in cattle breeding, hunting, and robbery (the latter was considered the main worthy occupation (Kupffer 1830, p. 4)). The expedition members described traces of stone buildings and noted the fertility of the soil, conducive to a settled population. Finds of Roman and Genoese objects were known at the time. The forests were probably cleared long before the nineteenth century, and biodiversity had also declined by then. Among the game mentioned are red deer (*Cervus elaphus*), bear (*Ursus arctos*) and roe deer (*Capreolus capreolus*). However, previously large animals were more diverse. European bison (*Bison bonasus*), at least, were found there, but in the nineteenth century they were already very rare and survived only in the neighboring, wilder territory (Tornau 1864, cit. from Tornau 2008, p. 246—253), and 100 years later they were completely exterminated, despite some conservation attempts (Plumb et al. 2020).

It seems easy to predict the following change in the studied area: The ravines and the patches of desertification will expand, floods will become stronger, washout of ground and erosion of soil will intensify. Finally, the glaciers will melt, the lack of water will show up, and the slopes will transform into deserts. Meanwhile, mudflows and other natural disasters will also intensify. All this would affect not only the peak of Elbrus but also the broader surrounding area, as runoff laden with silt flows downstream, shallowing rivers and degrading water quality. Recent studies on sediments in the rivers sourcing from Mount Elbrus glaciers confirm such a scenario partly (Vecchiato et al. 2020). They show that the sediment gravity flows have intensified for the past half-century. Similar problems in the future are relevant for the more popular among climbers and tourists southern slope of Mount Elbrus (Cherkasova et al. 2022). Global warming resulting in glacier melting is considered a primary reason for this, while environmental degradation is remained unnoticed. Territories where people lived for particularly long periods of time (e.g., Coa Valley in Portugal or the area around Mount Ararat in Armenia) also support the presented forecast for Elbrus as the mountain slopes often resemble deserts there (Popov 2016).

The popularity of Mount Elbrus among tourists has not contributed to conservation efforts but has instead diverted attention away from environmental issues. The ascent to the peak is seen as a romantic and heroic challenge, causing visitors to focus on the climb while overlooking the region's ecological problems. Once considered a difficult and dangerous endeavor, climbing the mountain has become routine. Modern equipment and established routes have turned it into a mass activity, accessible to nearly anyone. Although easier than in the past, the climb still poses risks, with around 20 fatalities reported each year

(Anonymous 2024). Given these factors, there is a clear need to prioritize ecotourism and other environmental initiatives, yet this has not happened. The following activities are recommended to overcome *shifting baseline syndrome*: restoration of the natural environment; monitoring and collecting data; reducing the extinction of species; education of the public (Soga and Gaston 2018, pp. 8–9 of 14). It is hardly questionable; the realization is still unclear, although. The present paper only contributes to the second item in the list. We faced mutual misunderstanding in the attempt of realization of the third and fourth ones. Local authorities perceived our estimate of the environment as resentment. Tourists did not understand at all what we were speaking about. Only recreational press and garbage are in the focus of the discussions about the state of the environment. These issues received quick feedback. The authorities are ready to intensify the management of the activities of tourists, raise the prices, organize the work on the collection of garbage, etc. However, the recreation and garbage influence only a small part of the mount slopes. The garbage is unpleasant, but this impact is insignificant compared to the total transformation of slopes into 'lawns'. Recreation even increased a little the biodiversity as the birds and mammals occur mainly at the camps, where the fences against livestock and sources of additional feeding are available, although this increase is insignificant. As for the first item, its realization is especially problematic. There is no information about the normal state of the mountain's slope. The estimates of the norm for the mountain areas vary. Overgrazing and deforestation are obviously abnormal (Zhang et al. 2019; Yan and Kasanin-Grubin 2019). Arboreal vegetation contributes to the stability of the ground and resists strong mudflows (Glade 2003). Deforestation causes an increase in sediment load in rivers (Restrepo et al. 2015). However, the encroachment of bushes into grasslands is considered a negative phenomenon as it exterminates endemic ecosystems and reduces ecosystem services (Brandt et al. 2013). In Europe, the mosaic of pastures and forests is considered normal (Garbarino et al. 2014). Usually, grazing is considered necessary to find a balance. However, grazing tends to transform into overgrazing, if it is a major occupation of local people (e.g., in Kyrgyzstan (Hoppe et al. 2016)). Probably, the above mentioned ideas of Pleistocene rewilding could offer a solution in such a situation, i.e., the organization of protected areas and introducing the survived representatives of megafauna. A variety of ungulates and predators will potentially balance the environment: The grasslands will prevail in such areas but arboreal vegetation will be also available; overgrazing will not take place as the impact of wild ungulates on grasslands is not as strong as that of domestic ones; while, predators will control the number of ungulates.

5 Conclusion

The surprising pervasiveness of shifting baseline syndrome.

Repeated surveys of Mount Elbrus reveal that *shifting baseline syndrome* is surprisingly widespread. For decades, visitors from around the world, along with the scientific community, have overlooked an ongoing ecological catastrophe: The once diverse mountain ecosystems have been largely replaced by a simple "lawn" with growing pockets of desertification. This situation seems "normal" to most people, and no significant conservation or restoration efforts have been implemented or planned. This case offers valuable lessons for developing effective ecological practices in mountain regions. Environmental education, a focus on environmental history, and studies of biodiversity and conservation should take precedence over mountaineering, recreation, and pastoralism. Without such efforts, environmental disasters will continue to worsen, affecting not only the mountains but also the surrounding areas.

Appendix 1

The publications on biology and environment based on the studies of Elbrus indexed in the Russian science citation index (A) and Scopus (B).

No	Topic	Reference
(A)		
1	Flora	Doroshina GY (2013) About the flora of mosses of highlands of Northern Caucasis. Novosti sistematiki nizshih rasteniy. 47: 310–317 (In Russian)
2		Ismailov AB, Urbanavichyus GP, Urbanavichene IN (2019) Particularities of altitude distribution of diversity of soil lichens in highlands of Central and Eastern Caucasis. Botanicheskiy vestnik Severnogo Kavkaza 2: 11–28 (In Russian)
3		Potemkin AD, Doroshina GY, Mihalenko VN (2018) Mosses on the top of Elbrus (Caucasis) and at the border of distribution in highlands. Novosti sistematiki nizshih rasteniy 52: 183–193 (In Russian)

No	Topic	Reference
4		Teunaev SM, Ivanov AL (2009) Analysis of endemism of flora of central elbrus floristic region (Severnyj Kavkaz). Vestnik Moskovsko gosudarstvennogo oblastnogo universiteta: 159–167 (In Russian)
5		Teunaev SM, Ivanov AL (2010) Analysis of endemism of flora of central elbrus floristic region (Severny Kavkaz). Vestnik Moskovskogo gosudarstvennogo oblastnogo universiteta: 1–9 (In Russian)
6		Cepkova NL, Abramova LM, Taumurzaeva IT (2011) About sintaxonomy of synathropic plants of Prielbrusie National Park. Izvestiya Kabardino-Balkarskogo nauchnogo centra RAN. 44: 49–56 (In Russian)
7		Teunaev SM (2011) Flora of central elbrus floristic region and its analysis (Severnyj Kavkaz). Stavropolsky gosudarstvenniy universitet, Stavropol. (In Russian)
8	invertebrates	Rapoport IB (2006) Species composition and abundance of earth worms of the family Lumbricidae in Prielbrusye National Park. In: Problemy ekologii gornyh territorij, KMK, Moscow, pp. 121–133. (In Russian)
9		Ayydov AA (2017) About the knowledge of stafilinids (Coleoptera, Staphylinidae) of Prieldrusie National park (Central'ny Kavkaz). Izvestiya Samarskogo nauchnogo centra Rossijskoy akademii nauk 2017. 19: 307–312 (In Russian)
10		Bittirova AA, Kumysheva YA, Vologirov AS, Mirzoeva AA, Mirzoeva NM, Bittirov AM (2019) Cestods of the family Taenidae (Ludwig, 1886) as a sanitary and epidemiological threat to the biosphere areas of Elbrus. Izvestiya vysshih uchebnyh zavedeniy. Severo-Kavkazskiy region. Seriya: Estestvennye nauki 2(202): 82–89 (In Russian)
11	bacteria	Zharchenko NP, Karaseva EV (2016) Diversity of bacteria of the western slope of Elbrus and snow of plateau Lago-Naki. In: Aktual'nye voprosy ekologii i ohrany prirody ekosistem yuzhnyh regionov Rossii i sopredel'nyh territoriy. Materialy XXIX Mezhregional'noy nauchno-prakticheskoj konferencii.. 126–128. (In Russian)
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Declarations

Competing interests No competing interests.

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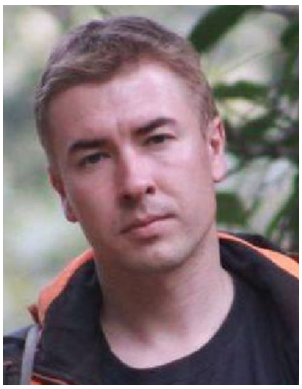

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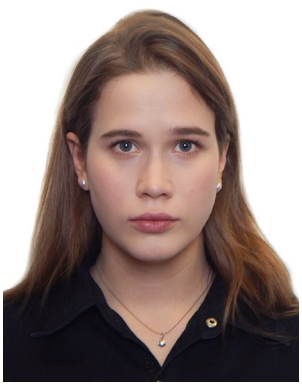

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