

IMPACT OF TOURISM ON PRISTINE HABITATS AT THE AVACHINSKY PASS (KAMCHATKA), A WORLD HERITAGE SITE

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ABSTRACT. The volcanoes of Kamchatka are a World Heritage Site. They are of aesthetic, conservation, and scientific value; therefore, they must be protected from negative anthropogenic influences. However, according to the recent assessment by the International Union for Conservation of Nature, this site inspires significant concern. A similar viewpoint was also expressed in the local press. A part of the site, Avachinsky Pass, inspires a particular concern. This is a place between the volcanoes Koryaksky and Avachinsky. An excessive number of visitors was considered the main threat because it resulted in the trampling of soil and the extirpation of threatened animals. We performed a survey of the Avachinsky Pass aiming to estimate its state. Based on aerial pictures and observation we composed a scheme of habitats over the area around Avachinsky Pass revealing the disturbed plots of land. Moreover, we registered vertebrates considering them as biological indicators. It became clear that tourism has a significant impact on the state of the Avachinsky Pass, but the affected area is relatively small. Despite a large number of visitors, the survey revealed high biodiversity. We registered 19 species of birds and 9 species of mammals. Among them, black-capped marmots are especially informative as they have a settled way of life; they do occur on the Pass. The absence of grazing and logging contributes to the conservation of elfin forests and other plant communities on the slopes making the object resistant to anthropogenic impacts. Off-road vehicles pose the biggest threat to bare-ground revegetation.

KEYWORDS: biodiversity, habitats, Kamchatka, mammals, mountains, tourists

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INTRODUCTION

World Heritage Sites work as an effective measure of environmental conservation as they cover particularly picturesque landscapes, habitats of threatened species, and areas of high biodiversity (Osipova et al. 2017). Several sites are tourist attractions and their role in this respect is continuously increasing (Bak et al. 2019; Job et al. 2017; Li et al. 2008; Yang et al. 2019). However, tourism can have a significant negative impact on the environment (Cherkasova et al. 2022; Newsome et al. 2002; Pickering and Hill 2007; Sun and Walsh 1998; Zhong et al. 2011). One of the heritage sites negatively affected by tourism is «Volcanoes of Kamchatka». According to the assessment of the International Union for the Conservation of Nature, it is of significant concern (Osipova et al. 2017), which is also shared by the local press. Recently it was claimed that a part of the site is in a “crisis” (Nenasheva et al. 2020). This means that off-road movements by vehicles, development, trampling soil and plants, and the extirpation of animals are progressing in Avachinsky Pass, an area on the slopes of two volcanoes. Therefore, the necessity to conduct a survey aimed at assessing of the Avachinsky Pass state became evident. We completed this work in 2021. We focused primarily on biodiversity, we found out what animals and plants occur there, and analyzed them as biological indicators. These data represent interest not only in respect of the “local crisis”, but in the context of discussing the normal state of mountain ecosystems, the anthropogenic impact on them, and the organization of tourism in protected wildlife areas.

Study area, methods

Avachinsky Pass is a strip of land between Avachinsky and Koryaksky volcanoes. The first one is 2741 m high, the second - 3456 m. Both volcanoes are active. Avachinsky is one of the most active volcanoes in Kamchatka: fifteen eruptions have been recorded since 1737, the last one happened in 1991. The eruptions of Koryaksky have been less frequent; only three eruptions have been registered so far, the last one occurred in 2008. On the upper point of the Pass, a picturesque mountain with rocks on the top is located. It is called Verbliud, which means “camel” because of the hump-looking two peaks. It is assumed that the mountain is either a result of the Koryaksky volcano's extrusive activity (when the protruding viscous lava piled on the surface and subsequently solidified) or the result of a strong eruption of Avachinsky volcano¹.

Avachinsky and Koryaksky volcanoes are called “home volcanoes” for Petropavlovsk-Kamchatsky, the main city of Kamchatka. They are an important attraction for the locals and numerous tourists. Several thousand of them visit the Pass and volcanoes every year, and this number continuously increases. This site is popular all year round. In summer, hikers and volcano-climbers visit the Pass for its picturesque views. In winter, it attracts skiers and snowboarders². The Pass is a part of the protected area Nalychevo Nature Park. The access to the Pass used to be restricted, but since 2020 it has been declared a free-access area. This decision raised concerns among scientists (Nenasheva et al. 2020). The way to the volcanoes passes through the Sukhaya River valley (its name means “dry”). During the season of intense snowmelt, the mud slurry runs through it, but afterwards the river dries out and its bottom is used as a road. The source of the river is located

at the Verbliud mountain; therefore, it is accessible by car (Chernomorets et al. 2010). The use of vehicles in the Pass is forbidden, but this ban is often violated.

Most studies conducted in this area are devoted to the monitoring of the activity of Avachinsky and Koryaksky volcanoes because of the high motivation of local authorities to predict possible volcanic catastrophes that may affect Petropavlovsk-Kamchatsky (Girina et al. 2019). However, biodiversity also attracts attention: several botanical researches have been performed at these volcanoes over the past decades. A list of local flora was their main result; it includes 235 species of vascular plants (Yakubov et al. 2001). No similar species count has been made for animals, but three animal species were studied at the Pass: black-capped marmot (*Marmota camtschatica*), North American ground squirrel (*Spermophilus parryii*), and red fox (*Vulpes vulpes*). The first was seldom encountered; their disturbance by visitors was pointed out (Zykov 2017; Nenasheva et al. 2020). The other two species, on the contrary, tend to become synanthropic at the Pass; they often occur near houses and roads.

For our survey of the Pass, we used a method of direct investigation. The walk routes were arranged in such a way that they crossed various biotopes and gave a comprehensive vision of the territory. We described the vegetation, recorded birds, mammals or their traces (since there were numerous plots covered by snow, the footprints were well visible) and the signs of human activities. Special attention was paid to black-capped marmots as their settlements are relatively stationary and therefore, they serve as a tourism impact indicator. Combining the results of the survey with the aerial photos (Google and Sentinel-2) and cartographic materials we composed a map of habitats. Identification of habitats was carried out in accordance with the guidelines summarized by V.K. Zhuchkova and E.M. Rakovskaya (2004). The observations were carried out from June 23 to June 27, and then from September 11 to 22, 2021.

Results

The routes covered an area of 816 hectares. We surveyed a part of the Sukhaya river valley, the slopes around, the Pass itself, the Verbliud mountain, a part of the slopes of Avachinsky and Koriaksky volcanoes. Eight kinds of habitats have been identified: open ground areas without vegetation, plots with sparse pioneer vegetation (plants cover 3-5% of the surface), plots with pioneer vegetation (about 20%), stony tundra, grassy tundra, disturbed meadow tundra, sparse elfin woodland, disturbed communities dominated by ruderal species. These plots form a “mosaic” in which small plots with different patterns of vegetation alternate, the performed routes covered all of them (Fig. 1, Fig. 2, Table 1).

There are several buildings at the Pass – tourist bases and control posts. A part of surrounding plots of land were either trampled or covered by ruderal vegetation; littered plots also occurred there. Total area of such plots was 31.7 hectares. Moreover, traces of vehicles, trails and other evidence of touristic activity were found on the open ground areas, plots with pioneer vegetation located on the bottom of the Sukhaya River, around Verbliud mountain and at the narrowest section of the Pass (Fig. 1). Such traces are almost absent at the slopes of the Sukhaya River valley. Verbliud mountain was the center of attraction of visitors; it was covered by a network of trails. The top of the mountain

¹Special protected natural areas of Russia [Online]. (2005). Available from: <http://oopt.aari.ru/ref/597> (Accessed: 17th of February 2022)

²Kamchatka Volcanoes Nature Park [Online]. (2011). Available from: <http://vulcanikamchatki.ru/> (Accessed: 15th of February 2022)

was trampled, vegetation was absent at the area of 700 m². There are also trails to the tops of volcanoes, but they are not numerous and do not cover a significant area.

We recorded the traces of hare (*Lepus timidus*), bear (*Ursus arctos*), fox (*Vulpes vulpes*), wolf (*Canis lupus*), snow sheep (*Ovis nivicola*), wolverine (*Gulo gulo*), lynx (*Lynx lynx*); observed and photographed marmot, fox, bear, and ground squirrels. We failed in our attempts to record small rodents and insectivores, finding neither holes nor traces, and only observing domestic mouse (*Mus musculus*) near the buildings. Mammals occurred mostly on the slopes of the river valley. Ground squirrels were numerous; they concentrated at the dry bottom of the river next to the road and houses; they were hardly afraid of humans and eagerly took the food offered by visitors. The other mammals did not approach the houses, but some of them were registered at the frequently visited plots located at the center of the Pass. It turned out that a settlement of marmots exists on the top of Verbliud mountain and nearby. Snow sheep were also registered on the mountain; their traces were found on the highest point, which is the main attraction for tourists.

As for the birds, 19 species have been recorded: Lesser Sand Plover (*Charadrius mongolus*), Common Cuckoo (*Cuculus canorus*), Rock Ptarmigan (*Lagopus muta*), Common Raven (*Corvus corax*), Kamchatka Leaf Warbler (*Phylloscopus examinandus*), Siberian Rubythroat (*Luscinia calliope*), Northern Red-flanked Bluetail (*Tarsiger cyanurus*), Brown-headed Thrush (*Turdus chrysolaus*), Olive-backed Pipit (*Anthus hodgsoni*), Buff-bellied Pipit (*Anthus rubescens*), Grey Wagtail (*Motacilla cinerea*), Oriental Greenfinch (*Chloris sinica*), Brambling (*Fringilla montifringilla*), Common Redpoll (*Acanthis flammea*), Common Rosefinch (*Carpodacus erythrinus*), Pine Grosbeak (*Pinicola nucleator*), Asian Rosyfinch (*Leucosticte arctoa*), Grey Bunting (*Ocyris variabilis*), Snow Bunting (*Plectrophenax nivalis*). The birds occurred over the whole surveyed area including the central part with scarce vegetation. One bird species, Lesser Sand Plover, prefers this very habitat. Although near the Verbliud mountain the plant cover is so poor, that even this bird is absent.



Fig. 1. Habitats of the Avachinsky Pass: a) open ground areas without vegetation (with Verbliud mountain in the background); b) plots with sparse pioneer vegetation (with traces of vehicles); c) plots with pioneer vegetation; d) stony tundra; e) grassy tundra; f) disturbed meadow tundra; g) sparse elfin woodland; h) disturbed communities dominated by ruderal species

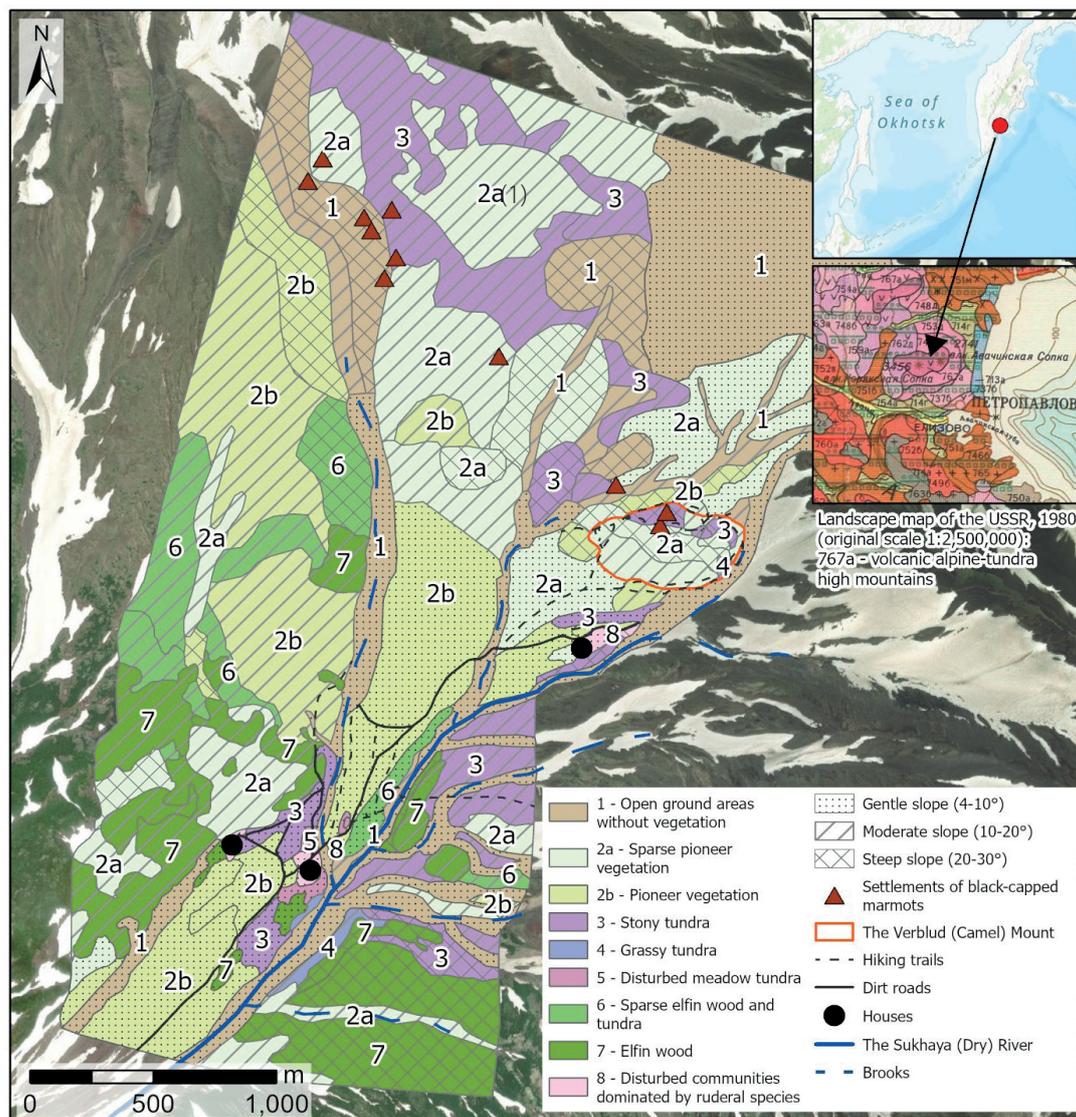


Fig. 2. Habitats of the Avachinsky Pass

Table 1. Composition of habitats on the Avachinsky Pass and length of performed routes by habitats

Habitat	Area, ha	Area, %	Route length, km	Habitat	Area, ha	Area, %	Route length, km
1 - Open ground areas without vegetation	144.3	17.3	11.5	5 - Disturbed meadow tundra	2.2	0.3	1.4
2a – Plots with sparse pioneer vegetation	229.1	27.5	12.1	6 - Sparse elfin wood and tundra	47.8	5.7	6.9
2b – Plots with pioneer vegetation	192.8	23.2	12.3	7 - Elfin wood	100.0	12.0	8.5
3 - Stony tundra	109.3	13.1	13.3	8 - Disturbed communities dominated by ruderal species	3.4	0.4	1.5
4 - Grassy tundra	3.4	0.4	1.5	Total	816.5	100	69.0

Discussion

The survey showed that the “crisis” can be attributed only to a part of the Pass. Most of the visitors try to use the available trails wishing to climb as high as possible, and they are hardly interested in anything else. Therefore, the actively visited zone turned out to be small. Animal presence also indicates this fact. In spite of the short period of the survey, we registered almost all species of birds and mammals that could be expected (Lobkov 1986; Smetanin 2011). The

presence of Lesser Sand Plover deserves special attention as it is an endangered species. It nests only in the Russian Far East. According to the IUCN assessment, it suffers from “myriad of threats at all stages of its migration cycle” (disturbance of mudflat loss, increase of human population at the coastline of Asia, direct extermination, windfarms, etc.). Negative impacts on nesting sites are also mentioned, although they are understudied (BirdLife International 2023). The other recorded bird species are not considered threatened, but half of them have negative population

trends because of the anthropogenic transformation of habitats (Table 2). The presence of such species is evidence of the rather good state of the environment on the Pass and its high conservation value. Such a diversity is rare for other Russian mountainous tourism destinations (like, for example, in Elbrus area or other peaks of Caucasus).

As for the mammals, even two relatively new species for the area under study have been noted, which are wolf and lynx. The wolves were uncommon in southern Kamchatka in the past (Valentsev and Snegur 2019). They invaded the peninsula from the north, and their existence is dependent from the reindeer (*Rangifer tarandus*) population. However, now they are spreading southwards even irrespective of reindeer. A similar situation concerns the lynx. This species appeared in Kamchatka only in the beginning of XX century, afterward it populated the peninsula more or less successfully (Valentsov and Mosolov 2004). Probably, several small unrecorded rodents or insectivores also occur on the Pass, although had they do, they are very small in numbers. They were not mentioned in the previous studies on the mammals of the Pass (Zykov 2017; Nenasheva et al. 2020). Mammals are rather numerous at the Pass as it is a crossroad of their migration routes: bears, foxes, lynxes, and hares pass it when moving from one valley to another, while snow sheep and marmots cross it moving across highlands. The latter species is relatively sedentary, but it still needs movements out of its settlements during periods of reproduction and dispersion of juveniles. Moreover, some marmots have a wandering lifestyle (Lebedko and Valentsev 2003). Although all recorded mammal species are not considered threatened in a global scale, at least two

of them, snow sheep and marmot, still inspire concerns. A part of their populations is already included in the Red Data Book of Russia (marmot of Transbaikalia and Chukotka, snow sheep of Putorana, Chukotka and Kodar mountains) (Brandler et al. 2021; Sipko and Poiarkov 2021) the others approach such status. They are declining in Kamchatka. It happens mostly because of continuous hunting. They are not numerous because of natural causes, but they are still considered game animals in Kamchatka (Fil and Mosolov 2010; Lebedko and Valentsev 2003). Moreover, in the northern part of Kamchatka, a deer-raising takes place, this also negatively influences them. Not only the deer but rather herders and their dogs either kill or disturb wild mammals. About 20 years ago, this factor weakened because the number of domestic reindeer decreased (Lebedko and Valentsev 2003). However, recently the local authorities encouraged the deer herding. For example, in 2021 more than 300 mln rubles (around 4,1 mln \$) were donated to the deer farmers⁴. Evidently, this increases the significance of the southern refuges for highland species. Although sometimes the marmots are disturbed at the Avachinsky Pass (Nenasheva et al. 2020; Zykov 2017), they still occur there, as well as the snow sheep. It gives rise to cautious optimism as it turns out that conservation of biodiversity is possible even in spite of the touristic attraction.

Regardless of the encouraging conclusion concerning the “crisis”, the negative impacts on the Pass are still significant. Amateur off-road motorcycle or jeep racing remains a critical concern. They try to move as far as possible considering such actions as “heroism”. It is not

Table 2. Recorded bird species and their conservation assessment according to the IUCN Red list of threatened species (2024)³

No	Species	Assessment in the IUCN red list of threatened species		No	Species	Assessment in the IUCN red list of threatened species	
		category	current population trend			category	current population trend
1	Lesser Sand Plover <i>Charadrius mongolus</i>	EN	decreasing	11	Grey Wagtail <i>Motacilla cinerea</i>	LC	stable
2	Common Cuckoo <i>Cuculus canorus</i>	LC	decreasing	12	Oriental Greenfinch <i>Chloris sinica</i>	LC	stable
3	Rock Ptarmigan <i>Lagopus muta</i>	LC	decreasing	13	Brambling <i>(Fringilla montifringilla)</i>	LC	decreasing
4	Common Raven <i>Corvus corax</i>	LC	increasing	14	Common Redpoll <i>Acanthis flammea</i>	LC	decreasing
5	Kamchatka Leaf Warbler <i>Phylloscopus examinandus</i>	LC	stable	15	Common Rosefinch <i>Carpodacus erythrinus</i>	LC	decreasing
6	Siberian Rubythroat <i>Luscinia calliope</i>	LC	stable	16	Pine Grosbeak <i>Pinicola enucleator</i>	LC	decreasing
7	Northern Red-flanked Bluetail <i>Tarsiger cyanurus</i>	LC	stable	17	Asian Rosy-finch <i>Leucosticte arctoa</i>	LC	decreasing
8	Brown-headed Thrush <i>Turdus chrysolaus</i>	LC	unknown	18	Grey Bunting <i>Emberiza variabilis</i>	LC	stable
9	Olive-backed Pipit <i>Anthus hodgsoni</i>	LC	stable	19	Snow Bunting <i>Plectrophenax nivalis</i>	LC	decreasing
10	Buff-bellied Pipit <i>Anthus rubescens</i>	LC	decreasing		-		-

³IUCN Red list of threatened species [Online] Available from: (<https://www.iucnredlist.org>) (Accessed: 8th of March 2024)

⁴Government of Kamchatka Krai [Online]. (2001). Available from: <https://www.kamgov.ru/> (Accessed: 15th of February 2022)

clear, which measures would be helpful to manage these activities, because they can overcome any fences or other barriers that could potentially be installed on the way to the Pass. Uncontrolled intensive off-road racing causes degradation of vegetation and therefore intensification of erosion processes. Intensive erosion causes landslips, shallowing of the rivers, habitat loss, etc. Such a perspective is evidently highly undesirable. Meanwhile, vegetation cover at the Pass is sometimes completely destroyed by volcanic activity and revegetation evolves slowly even without human disturbance. Under such circumstances, off-road racing must be prevented (during hot season). Otherwise, it will intensify because of the general increase in the number of visitors. Recently, tourism has been encouraged by the local administration. According to the "Social and economic development strategy of Kamchatka up to 2025", Avachinsky's tourist attraction group is one of the recreation centers. The government plans to develop a "recreation tourism cluster" there (Government of Kamchatka Region 2001). Probably, the status of the World Heritage Site will contribute to these initiatives. It is known that such particularity can be used as an additional point of tourist attraction (Canale et al. 2019; Mariani and Guizzardi 2020). However, in this case, there are factors that are more important: proximity to Petropavlovsk-Kamchatsky and a good accessibility. Halaktyrsky Beach is an example of the nearest territory with similar problems of sustainable development. And just like with the Avachinsky Pass, the issue of the development of the territory as a tourist cluster is based on the creation of a sustainable infrastructure (Iurmanov et al. 2023). Further development of the studied territory should be carried out on the basis of the parity of interests of both nature conservation and tourism activities, which will preserve unique natural objects and tourist attractiveness.

It is interesting to point out that the Pass represents the natural or "normal" state of mountainous vegetation outside of the central disturbed zone. Usually, mountainous areas are affected by logging, grazing and overgrazing; therefore, open areas are being formed in the highlands. Wild ungulates also support them. Total deforestation and overgrazing are negative processes as they intensify soil erosion and landslips (Bitukov and Shagarov 2017).

However, the encroachment of bushes to the open areas (pastures) is often considered a negative process because it destroys the habitats of some species and decreases the ecosystem services (Brandt et al. 2013). In our case neither logging, nor grazing takes place, and the wild ungulates are almost absent. Snow sheep inhabit only the highest parts of the slopes, and their number is limited. In the lower zone, the ungulates are not present at all. Probably, they will appear in the near future, because the moose (*Alces alces*) have been recently introduced to south Kamchatka (Smetanin 2011), but no traces of them have been recorded at the Pass so far. As a result, the plants grow undisturbed. In a situation like this, usually the trees and shrubs form very dense thickets, open areas disappear, and the conservation value of such areas becomes doubtful (Popov et al. 2023). However, in the case under consideration, it does not happen, because the volcanoes reset to zero the vegetation from time to time. Below a highland zone with scarce vegetation, most of the slopes are covered by elfin trees, but they contain numerous gaps filled by small meadows, talus, and rocks. The revealed "mosaic" of various habitats can be considered a desirable optimum, which keeps the ground on the slopes and creates a suitable environment for various animals.

Conclusion

Tourism has affected Avachinsky Pass negatively, but presently its influence is spatially limited. Unlike most mountainous areas, grazing and tree cutting are not typical for the area; therefore, the Pass is relatively resistant to negative anthropogenic influence. Elfin forests and the other vegetation occupy large areas on the slopes; providing a natural protection from landslips and providing habitat for numerous animal species. In spite of the small size of the area affected by visitors, their impact still inspires concern. Within the most visited section of the pass, the plots covered by very scarce vegetation or without vegetation occupy 58%. Since tourists travel through these areas using a variety of vehicles (despite the ban), their overgrowth of vegetation occurs slowly. Meanwhile, the Pass is located at the source of a river. The vegetation loss increases the risk of landslides, which can be catastrophic. ■

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