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MOUNTAIN MEADOW PHYTOCENOSES UNDER TECHNOGENIC IMPACT IN THE ANDEAN RANGE, CHECHEN REPUBLIC

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Abstract

The article presents the findings of a study conducted on mountain-meadow phytocenoses in the subalpine landscapes of Harami Pass, located in the Andi Range of the Chechen Republic. The study focused on understanding the impact of anthropogenic factors, particularly intensive livestock grazing, on the floristic and ecological structure of these phytocenoses. The research, conducted by the authors in 2011 and 2022, revealed the current floristic composition of the landscapes under investigation, which includes a minimum of 60 species of higher vascular plants. Human activity, especially in terms of vegetation cover, has significantly altered the natural landscape components of this region. Subalpine landscapes are of considerable importance not only for preserving the region's biodiversity, serving as habitats for typical zonal cenoses and rare taxa but also for their significant tourism potential. This study aimed to highlight the unique regional characteristics of the studied plant communities, influenced by geographical, ecological, and cenotic factors, as well as human economic activities. It was suggested that the current state of vegetation in the study area is influenced by various factors, including its geographical location, ecological conditions, and the degree of degradation and anthropogenic disturbances affecting the soil and vegetation cover. The study found that as grazing intensity increased, there was a weakening of phytocenotic relationships within the natural community, leading to the degradation of herbage organization and the loss of species that were less resistant to grazing, including valuable plant species.

Keywords: Harami pass, mountain meadows, pastures, phytocenosis

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1. Introduction

Animal husbandry has a long history in the North Caucasian region, known for its well-developed natural fodder lands (Belous et al., 2021). However, the shortage of pastures in the area has led to the overuse of haylands, resulting in a significant decline in the quality and species composition of their herbage, which is now overrun with less palatable grasses (Abuzov & Kazakov, 2020). This process has accelerated over time, causing the loss of structural and functional characteristics in many subalpine meadows (Gusev & Shpilevskaya, 2020). These challenges are exacerbated by the acute shortage of pastures and hayfields and the concurrent destruction of the high mountain biome, often with insufficient consideration of biodiversity preservation (Belous et al., 2020).

Mountain meadow phytocenoses, as vulnerable biological systems, are constantly influenced by a complex interplay of external and internal factors that shape their structural and species composition dynamics (Uligova et al., 2019). Mountain grazing lands are a vital part of the natural, economic, and cultural heritage but are highly susceptible to climate change and land use alterations, necessitating immediate adaptation and management strategies. These strategies should be informed by a comprehensive understanding of the distribution of mountain pastoral resources over time and space (Filippa et al., 2022).

Land degradation affects a significant portion of the world's land area and is expected to increase due to climate change and land use pressures (Lewińska et al., 2020). To preserve grasslands as a valuable natural resource, it is crucial to monitor aboveground green vegetation biomass and grassland composition while considering land use history (Lewińska et al., 2021).

The degradation of mountain meadow formations has been an ongoing process over the past century (Tsagaraeva et al., 2021). For instance, in 1953, Schiffers noted in his monograph that the low-mountain and foothill regions of the Grozny area, as well as the subalpine meadows of the Andiysky ridge, had suffered from unsystematic grazing, resulting in littering and erosion. Addressing overgrazing and erosion required comprehensive measures to restore the vegetation cover, with grazing regulation being a fundamental and essential step (Shiffers, 1953).

In regions where animal husbandry has been a traditional practice, relying on natural phytocenoses to feed freely grazing sheep and cattle, the predominant use of land has been for hayfields and pastures. This issue is particularly pressing in the Eastern Caucasus region, which includes Dagestan, Chechnya, and Ingushetia, where pasture degradation is not an uncommon occurrence.

Surprisingly, despite the long history of anthropogenic influence in this area, the study of the transformational changes in local meadows under the impact of human factors has not received sufficient attention in botanical literature. However, contemporary demands emphasize the need for a rigorous scientific approach to understanding the dynamics of natural communities to ensure the region's sustainable development (Pirogov, 2019).

We have addressed various aspects of studying pasture vegetation cover and the anthropogenic transformation of the modern flora and vegetation in this region and its adjacent areas in several scientific papers (Belous et al., 2020, 2021; Tretyakova et al., 2021).

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2. Problem Statement

The vegetation in the gently sloping mountain hollow of Harami thrives under favorable conditions, including ample moisture, well-aerated soil, and sufficient mineral nutrients. The local subalpine landscapes exhibit a certain degree of uniformity, and the composition of plant communities (phytocenoses) remains relatively consistent. However, our observations indicate that the mountain-meadow ecosystem in this pass faces considerable anthropogenic pressures, as noted in studies by Poymanov (2020) and Tretyakova et al. (2021).

The medium grass communities we studied, subject to light grazing, are characterized by their diversity, featuring two or three tiers of vegetation in a closed structure. The primary sod-forming plants in these communities are various grasses and forb species. It's challenging to pinpoint the dominance of any specific plant species within the extensive grass-forb vegetation cover. Phytocenoses in relatively undisturbed areas maintain a high species richness and consistently high projective cover (almost always close to 100%).

3. Research Questions

Our studies have shown that over the past period (for 11 years) the irregular pasture use of subalpine meadows in the area of the Harami Pass has led to a decrease in the average grass stand height and the degree of total projective cover. In 2022, it was only 30-40%.

4. Purpose of the Study

The area under consideration is a gently sloping depression within a well-drained slope, featuring exposed bedrock carbonate rocks. The predominant soil type is subalpine mountain-meadow soil, characterized as thin chernozem-like soil with a medium level of humus content. This soil has a compacted sod horizon (Ad) that is densely penetrated by the roots of living plants, occupying more than 5/6 of the entire soil horizon. The primary soil formation process in this local environment is sodding, occurring on a thin eluvium of calcareous rocks. The prevailing exposition in the area is southwestern.

Our reconnaissance studies, conducted in 2011 and 2022, focused on examining subalpine plant communities within the Harami Pass of the Andean Range. The study plots were located within the pass and exhibited variations in microrelief, soil composition, and the degree of human-induced impact on the plant communities. It's important to note that no dedicated stationary geobotanical surveys were conducted as part of this research, as mentioned in studies by Aliyev and Magomedov (2019) and Arkhipova et al. (2019).

5. Research Methods

The research aligns with the scientific themes of the working group of the International Association for Vegetation Sciences (IAVS) and the European Forum for Conservation and Livestock (EFNCP). The study drew its information from various sources, including legal documents and data from platforms like Palaearctic Grasslands, Eurasian Dry Grassland Group (EDGG), Eurasian Grassland

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Conferences, EDGG Field Workshops, vegetation-plot databases of Palaearctic grasslands, as well as analytical publications from Russia and China. In conducting this research, several methods were employed, including abstract-logical analysis, historical analysis, content analysis, comparisons, groupings, statistical analysis, and expert analysis. The Harami Pass, situated at coordinates 42.80707 N, 46.15946 E, with an elevation of 2177 meters above sea level, is a significant saddle-pass section. It serves as the divide between the valleys of the Kharachoy and Unsatlen rivers to the north of Lake Kezenoy-Am. Historically, this pass has been part of a caravan route, and it marks the border of Chechnya and Dagestan, facilitating the crossing of the mountain range and access between river valleys. Notably, the renowned soil scientist and geographer Dokuchaev, who traversed this route, made significant observations about the changing natural conditions and vegetation cover with increasing elevation. His observations led to the formulation of Dokuchaev's famous law on altitudinal zonality (altitude zonation) and the concept of natural zones in mountainous regions, which represents an altitudinal-zonal division of mountain landscapes.

6. Findings

The grass component within the meadow phytocenosis is primarily composed of two groups: loose sod-forming grasses (Hordeum violaceum Boiss. & A. Huet, Bromopsis variegata (M. Bieb.) Holub, Festuca pratensis Huds.) and short rhizome grasses (Agrostis planifolia K. Koch, Trisetum flavescens (L.) P. Beauv., Helictotrichon versicolor ssp. caucasicum (Holub) D. Lange). These grasses are arranged in descending order of abundance. Additionally, small sod grasses like Koeleria albovii Domin and Phleum pretense L. contribute to the community but in a less prominent role. Small sedges (Carex tristis M. Bieb, C. brevicollis DC.) are found sporadically and vary in abundance.

The presence of subalpine tall herbs, with a somewhat reduced species composition, is not extensive in this area. Representatives of these tall herbs include Cephalaria gigantea (Ledeb.) Bobrov, Heracleum sibiricum L., and Veratrum album ssp. lobelianum (Bernh.) K. Richt. Alongside certain grasses like Hordeum violaceum, Bromopsis variegata, and Helictotrichon versicolor ssp. caucasicum (Holub) D. Lange, these tall herbs play a key role in forming a sparse upper layer of vegetation, with a height range of 120-130 cm. The primary layer of herbage remains relatively short, measuring 50-60 cm in height. These transitional forms of phytocenoses are referred to as "semi-high herbs," as described by Dolukhanov (1932) in his exploration of grass cover in the eastern part of the Lesser Caucasus mountains.

The high density of herbage in this area is attributed to typical species of perennial mesophytic forbs. Among these forbs, the hemicryptophyte group is the most abundant. Species in this group include Alchemilla caucasica Buser, Betonica macrantha K. Koch, Bistorta carnea (K. Koch) Kom., Campanula glomerata L., C. collina Sims, Carum carvi L., Huynhia pulchra (Willd. ex Roemer & Schultes) Greuter & Burdet, Leontodon caucasicus (M. Bieb.) Fisch., Myosotis alpestris F.W. Schmidt, Plantago atrata Hoppe, Polygala alpicola Rupr., Ranunculus oreophilus M. Bieb., Tragopogon reticulatus Boiss. & A. Huet, and Veronica gentianoides Vahl, among others. Additionally, Anthemis dumetorum Sosn., Campanula collina Sims, Gentianella biebersteinii (Bunge) Holub, Lythrum virgatum L., Minuartia oreina (Mattf.) Schischk., Primula ruprechtii Kusn., and Trollius ranunculinus (Sm.) Stearn contribute to the diverse flora of this area.

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In addition to the previously mentioned species, the area also features bulbous plants like Allium victorialis L., brush-rooted species such as Pedicularis condensata M. Bieb., cryptophytes, geophytes including Inula orientalis Lam. and Trollius ranunculinus (Sm.) Stearn, as well as root tuber plants like Gymnadenia conopsea (L.) R. Br. and Traunsteinera sphaerica (M. Bieb.) Schltr. A few legume species are present as well, including Anthyllis macrocephala Wender., Astragalus danicus Retz., Lotus caucasicus Kuprian. ex Juz., Onobrychis montana DC., Trifolium canescens Willd., T. trichocephalum M. Bieb., T. ambiguum M. Bieb., T. repens L., and Vicia tenuifolia Roth. The last two legumes tend to increase in abundance in areas frequented by grazing.

Furthermore, in weedy meadows that have been disturbed by grazing and in places where pasture utilization has been less successful, several species from the pasqual series are observed. These species include Artemisia vulgaris L., Veratrum album, Alchemilla orthotricha Rothm., A. persica Rothm., Cirsium chlorocomos Sommier & Levier, C. obvallatum (M. Bieb.) Fisch., C. vulgare (Savi) Ten., Pyrethrum parthenifolium Willd., Ranunculus caucasicus ssp. subleiocarpus (Sommier & Levier) P.H. Davis, Trifolium ambiguum, T. repens, Tussilago farfara L., Urtica dioica L., as well as occasional annual and juvenile plants like Atriplex sagittata Borkh., Euphrasia hirtella Jord. ex Reut., Cerastium holosteoides Fr., and others.

With the increase in grazing pressure, there is a weakening of phytocenotic relationships within the natural community. This results in the degradation of the organization of the grass stand and a loss of species that are less resistant to grazing, including many valuable plants. Consequently, due to reduced competition from zonal high-altitude species, the dominant position in the herbage is occupied mainly by secondary components—low-value plants with coarse, prickly leaves and stems that are resilient to grazing and have a high biotic potential.

7. Conclusion

The current state of the vegetation cover in the Harami Pass area clearly indicates that the increasing utilization of mountain meadows for fodder production, uncontrolled grazing, and the absence of pasture load regulation have led to rapid degradation of natural phytocenoses. This has resulted in a simplification of their structure and composition. Moreover, the vulnerability of these meadows to overgrazing has consistently transformed subalpine associations into secondary ones, altered by human activity and characterized by the loss of distinctive traits and rare plant species.

Pasqual digression, or the regression of pastures due to overuse, affects nearly all the surveyed areas, including those adjacent to the pass with subalpine vegetation. In some of these areas, the complexity of phytocenoses is reduced, and the plant composition includes more synanthropic (human-associated) species from lower vegetation zones. These observable changes represent significant and negative alterations in the structure of the subalpine meadow biome due to anthropogenic disturbances, particularly grazing.

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