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Degradation and restoration of mountain pastures

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Abstract. The destructions which occur in the mountain phytocenosis reduce the adaptive capabilities of plant formation, as a result their productivity, longevity and resistance to adverse factors decrease. The species previously typical of indigenous communities do not find ecological niches. They are on the verge of extinction. This contributes to the degradation of species composition. Various secondary communities become widespread, the whole complex of existence in which differs from the conditions of indigenous communities. In order to study the state of mountain vegetation, phytocenoses were monitored and assessed, taking into account the presence of leguminous components. Vegetation monitoring was carried with regard to the vertical zonation, where the plant species and their disappearance were determined under the influence of anthropogenic and zoogenic factors. The areas with high degradation were determined, where the amount of plant formation increased and the diversity of valuable grass and bean cultures decreased, depending on anthropogenic factors. It was found that the early spring period nutrition of growing plants with the biological product Nikfan promotes the increase in the fodder mass of plants, ensuring their growth and full development. In our experiments, the doses of the biological product in a concentration of 0.1% were justified, creating favorable conditions for the development and growth rate of crops and beans.

1. Introduction

In the process of evolution, which took millions of years, the organism of animals acquired the ability to satisfy the need for all nutrients from the elements contained in green plants. The high efficiency of grazing is reasoned by the presence of nutrients in plants necessary for animal body in a natural expedient combination - from complex nitrogenous substances to amides, carbohydrates, stimulants, growth and physiologically active substances [1, 2].

Mountain grasslands, which are excellent as summer pastures for sheep and partially dairy cattle, horses and other species of animals, have long been the economic basis of life of the mountain peoples of the North Caucasus. These lands provided the indigenous population not only with food (meat,



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milk, etc.), partly with technical raw materials (hides, wool), but also with up to 80% of the consumed energy resources provided by the muscular power of draft animals (bulls, horses). However, the lack of necessary facilities for life, underemployment and low living standards led to the migration of mountaineers to plane areas, reducing the population of the mountains by 90% or more [3,4].

The Republic of Alania is a mountainous republic. Therefore, the republic's environmental safety and sustainable development of geocomplexes are determined by the geodynamic features of the modern relief, the intensity of endogenous and exogenous processes and other conditions, as well as anthropogenic influence.

Agricultural lands of the republic remain in unsatisfactory condition, the soil becomes less and less fertile (a small amount of humus layer), unlimited grazing, excessive loads of heavy machinery and anthropogenic impacts lead to the degradation of mountain phytocenoses and agricultural lands [5].

Various research institutions are engaged in the preservation of slope pastures and biodiversity conservation. According to scientists, the most effective way to preserve natural phytocenoses is the application of mineral fertilizers [6, 7]. However, this method is practically not used, since the process of the application of mineral fertilizers has negative environmental consequences, high costs and labor intensity. Therefore, it is necessary to develop new alternative methods to preserve biodiversity and restore natural phytocenoses.

The alternative way to provide plants with the nutrients are biologically active preparations and local, zeolite-containing agro-ores, which are of particular relevance [8, 9]. The lands previously assigned to collective and state farms were depersonalized. The land has lost its owner; the traditional systems of farming and animal husbandry have been lost. All these facts lead to a steady decline in economic management against the background of land degradation [10].

The results of reconnaissance, semi-stationary and route surveys showed that, despite a sharp decrease in livestock grazed on mountain pastures, compared to the 80s (the time of the previous geobotanical survey), the degradation processes of the soil and vegetation cover are progressively increasing and the quality of fodder decreases sharply [11].

High-mountain subalpine and alpine meadows, previously intensively used for free-mountain (summer) livestock keeping, are now used by 15–20%. Fodder lands are overgrown with low-value weeds and poisonous plants (azalea), the processes of overfilling progress, which leads to a sharp reduction in the species composition due to the loss of valuable fodder grasses [12].

It is known that the anthropogenic impact on the natural environment reached enormous proportions. The issue of biodiversity preservation is one of the main problems of environmental protection and ecology.

Due to not only anthropogenic, but also zoogenic impacts, mountain phytocenoses are in a critical situation. It is known that under the influence of anthropogenic and zoogenic factors, the existing vegetation cover changes significantly. The changes in the phytocenoses of mountain meadows and pastures are increasing. The changes in natural factors affect secondary communities formed from fluctuations. As a result, the number of species decreases.

The purpose of the research is to study the problem of the reduction of biodiversity in the territory of the Republic of North Ossetia-Alania. In order to achieve this purpose, it was necessary to solve the following tasks:

1. To study the current state of the vegetation of mountain pastures;
2. To assess mountain phytocenoses;
3. To justify recommendations for the restoration of the ecological state of pastures of slope lands.

The destructions which occur in the mountain phytocenosis reduce the adaptive capabilities of plant formation. As a result their productivity, longevity and resistance to adverse factors decrease [13]. The species previously typical of indigenous communities do not find ecological niches. They are on the verge of extinction. The variety of ecological conditions determines the different quantitative and qualitative ratio of plants within plant communities in different altitudinal belts.

The meadow agroecosystem, which is a biogeocenosis, in which the main role is played by the phytocenosis and the acting anthropogenic factor, due to its photosynthetic ability, accumulates solar energy not only in the aboveground, but also in the underground mass, having a great effect on the increase of soil fertility. As a community of perennial herbaceous species, meadows play a huge role

in ecology. Natural pastures and hayfields, as the most important component of the biosphere, have not only fodder resources, but also determine the state of land resources, soil fertility, genetic diversity of flora and fauna as well as the quality of human environment. The state of grassland ecosystems determines not only their economic importance, but also their ecological functions. Meadow communities are especially important in the mountainous zone, where natural phytocenoses undergoes strong stress effects.

Phytocenoses are influenced by extreme climatic conditions, which intensify the manifestation of the negative impact of anthropogenic and zoogenic factors [14]. The shortage of usable land in the foothill areas has increasing pressure on mountain valleys, where there is a danger of water erosion.

Biodiversity is extremely important among the problems of nature protection and ecology. The mountainous regions of the republic are a valuable source of biological diversity, but in recent years they have undergone significant changes. Nowadays they are undergoing anthropogenic destruction, leading to the disappearance of valuable plant species. The species which managed to survive are unproductive [15]. Fodder grasses of mountain phytocenoses are especially affected by these adverse conditions. The human impact on meadow communities has become so powerful that they have lost their resistance to the processes of anthropogenic transformation and are losing the most important property of self-restoration. The areas of valuable grasses are decreasing, which disrupts the interconnection of the natural system. Intensive and irrational use of natural fodder lands led to a wide spread of degraded processes in the mountainous zone. The urgent problem is the study of the biodiversity of plant communities in the Caucasus region. In this regard, the task of a comprehensive inventory survey of natural fodder lands is of particular importance taking into account their economically valuable features.

2. Research methods

The assessment of the state of the pastures was carried out according to the number of plant communities. During the period of plant formation regrowth in spring according to the density of sod, in the phase of budding and flowering of the bulk of grassland vegetation, where the percentage of bean in a satisfactory condition should be at least 5%, and before winter, according to the presence of grass species with rhizome-p-bush type tillering.

The method was carried out as follows. During the period of grass regrowth, the integrity of the tied sod was noted in spring. The destruction of sod in 5-10% is estimated at 3 points, that is, a relatively satisfactory situation. The destruction of sod in 15–25% was assessed as an ecological emergency, and more than 30% were defined as an ecological disaster.

The degree of sod density fully depends on the development of grasses. The better the plants of meadows and pastures develop, the denser the sod and the more stable the ecosystem. The presence of dense sod is not only a barrier against wind and water erosion, but also the indicator of an important heat regulator. The soil thaws more slowly in the spring and freezes later in the fall due to the sod. Therefore, in grass mixtures, plants withstand cold winter temperatures better and stand longer than some single-species crops. The change in the cover occurs as a result of natural and anthropogenic impact on vegetation of various types, the main of which is mechanical destruction of the phytocenosis (grazing, recreation, etc.) and chemical impact, leading to a change in the vital state of species populations through the changes in metabolic processes and water balance. During the period of budding and flowering of the mass of meadow grasses, a visual assessment of the species composition is carried out. In the presence of 5–10% of bean family grasses (clover, alfalfa, birdsfoot, sainfoin, goat's rue, vetch, etc.), depending on the mountain belts, the pastures were assessed as satisfactory.

In order to study the biodiversity of vegetation, the territories were selected at altitudes in the range of 1000–1850 m above sea level with various types of exploitation.

Meadows, less exposed to anthropogenic impact near the Saniban Pass (to the Suargom Gorge), served as a control ones. Here, a site at an altitude of 1820-1850 m above sea level studied on the slope of the southwestern exposure with a steepness of 30–50 °.

Due to the vigorous activity of plants, their accumulation activity increases and heavy metals, nitrates and radionuclides in the soil decrease. At the same time, the quality indicators of fodder plants increase.

3. Research results

As a result of our studies to assess the ecological state of natural forage lands in the mountainous zone, it was revealed that the floristic composition of herb vegetation in the sites of the control variant (without grazing) and anthropogenic impact was sharply different. At altitudes of 1820–1850 m above sea level (control), species of grass, legumes and herbage were noted. There are many chamomile wormwood, Marshall's umbula, grass-leaved goat (*Asteraceae* family), vetch, sainfoin (legumes), Transcaucasian woodworm, hare's ear (*Umbelliferae* family), Sibthorp's mytnik, small rattle (bellflower family), bellflower, sweet plantain (plantains), fluffy larkspur (family of buttercups - cruciform gentian (gentian family) and large-cup (primroses family). Single plants are represented by Caucasian small-petals, pink pyrethrum (aster family), low-stemless umbellate, Eastern *Astrodaucus*, Russian mountaineer (*Syliderein* family), bloodworm, Markovitz campion (carnation family), Russian blush and forget-me-not family (cruciferous family). In the control site, plants of the legume family (9 species) and grass (4 species) are presented in sufficient numbers. There are valuable fodder plants such as timothy grass, awnless bonfire and thin-legged Caucasian presented in sufficient amounts. During the determination of the mass of hay harvest at an altitude of 1820-1850 m above sea level (Southwestern exposure near the pass) the following indicators were established: the average mass of hay harvest was 1490 g per 1 m², including: the average weight of legumes - 480 g per 1 m², grass - 240 g per 1 m², herbage - 770 g per 1 m² (Table 1).

Table 1. Characteristics of the plant formation (hay harvest at an altitude of 1800-1850 m above sea level)

Site №	plant formation altitude, cm	Mass of hay harvest, g/m ²			
		Total	Including		
			Bean	Grass	Herbage
1	30-25	1200	300	200	700
2	25-30	1000	400	200	400
3	45-65	1700	500	300	900
4	50-60	1750	750	300	700
5	40-60	1800	450	200	1150

According to Table 1, it can be seen that the bulk of the plant formation is composed of plants of the herbage group (51.7%) and exceeds other groups in weight by 2-3 times. At the same time, the amount of legumes is also high (from 25 to 44%), which indicates a good composition of the plant formation and is explained by less damage. A characteristic feature of all sites is the least presence of grass in plant formation. The condition of the vegetation cover and its height are satisfactory and determined by weather conditions.

At an altitude of 1350 m above sea level, an enclosed area with minimal anthropogenic impact, the following species are widespread: common yarrow, Marshall's pteroteca and wormwood (*Asteraceae* family), bluegrass (family of grass), five leaf grass (family *Rosaceae*), horse sorrel (buckwheat family), Lambert's bellflower (bellflower family). Plants with very abundant populations are especially spread. These are bristly slug (aster family), sickle and astragalus (leguminous family), whorled sage (labiate family), bruise bur (borage family)

At an altitude of 1350 m above sea level (Eastern exposure of Gornaya Saniba village) the following indicators were determined according to the mass of hay harvest: the average mass of hay harvest was 847 g per 1 m², including: the average mass of legumes - 320 g per 1 m², grass - 240 g per 1 m², herbage - 314 g per 1 m² (Table 2).

Table 2: Characteristics of the plant formation of Gornaya Saniba village
(altitude 1350 m above sea level)

Site №	plant formation altitude, cm	Mass of hay harvest, g/m ²			
		Total	Including		
			Bean	Grass	Herbage
1	50-70	1420	600	400	420
2	40-60	1000	400	200	400
3	35-50	700	100	300	300
4	20-30	600	300	100	200
5	50-70	650	200	200	250

Table 2 indicates that plants of the herbage group make up 30–43% of the plant formation, legumes - 14–50%, and grass - 17–43%. The number of leguminous plants as an indicator of the state of the plant formation indicates its good composition (on average 38%). Grass, as well as at the altitude interval 1800–1850 m above sea level, are present in smaller amounts.

At the altitude interval 1000-1350 m above sea level there are many species such as: common chicory, pyrethrum thyroid (aster family), Caucasian lily, variegated elm (legume family), bent, Caucasian bluegrass, Meyer's bluegrass and fluffy sheep (grass family). The plants of the Labiate family are in abundance in the herbage group: chickweed, long-leaved mint, common blackhead. Five leaf grasses prevail among Rosaceae family.

Table 3: Characteristics of pasture plant formation in Mayramadag village
(altitude 600-900 m above sea level)

Site №	plant formation altitude, cm	Mass of hay harvest, g/m ²			
		Total	Bean	Grass	Herbage
1	12-15	350	10	140	200
2	10-15	300	20	100	200
3	8-15	220	0	100	180
4	12-20	400	50	100	120
5	12-15	350	20	120	250
6	8-12	120	0	90	200
7	15-20	400	30	120	30
8	20-30	500	50	150	250
9	20-30	500	50	150	300
10	25-35	600	50	200	300
Average		374	29	127	218

According to Table 3 that the altitude of the plant formation decreases from 25–35 cm to 8 cm and the number of legumes decreases; the plant formation is dominated by plants from the herbage group (58%). The amount of legume plants greatly decreased (7.7%), which was associated with intensive use and damage. The plant formation was characterized by a low fodder quality.

As the most edible ones, legumes fall out of the plant formation and are replaced by plants from the grass family and the herbage group. In comparison with the sites located at high altitudes, the plant formation at the altitude interval of 600–900 m above sea level is used more intensively, which negatively affects the condition of the plant formation. The damaged plant formations turned out to be less resistant to unfavorable weather conditions and were severely affected by drought.

4. Conclusion

The research shows that there is a decrease in valuable fodder plants of legumes and grass on degraded pastures, taking into account the vertical zoning. The quality of the plant formation is determined by the presence of leguminous components. On degraded pastures there are more herbage and poisonous plants. In mountain meadows with a predominance of legumes, the level of valuable fodder plants is higher. In places with a large anthropogenic impact, the growth and development of plants slows

down, fodder and seed productivity decreases. In order to restore degraded pastures, it is necessary to reintroduce grasses reproducing the preserved legumes and grass components.

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