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DEGRADATION PROCESSES CAUSED BY THE IMPACT OF ANTHROPOGENIC FACTORS ON THE ECOSYSTEM OF TUSHETI PROTECTED AREAS

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Abstract
Tusheti protected areas, which include Tusheti National Park, nature reserve and protected landscape, are one of the largest and most diverse not only in Georgia, but also in Europe. The purpose of its creation is to protect the unique nature that is characteristic of these places and preserve the cultural heritage.
Based on the research, we studied the diversity of the ecosystems of the protected areas of Tusheti, and described which species are most widely distributed on the territory of Shenako, on arable and uncultivated areas. Based on the research conducted by us in 2023, we can conclude that the unsustainable use of pastures and forests in the protected areas of Tusheti (for example, the village of Shenakoo) leads to soil erosion, degradation, desertification and loss of biodiversity. In the area, which years ago was used for agricultural activities and later became a pasture, the natural regeneration stopped. The enhanced erosion process prevented the restoration of habitats. The use of the area for grazing has had a negative impact on wildlife and the spatial distribution of species. There is excessive grazing, replacement of autochthonous plant species with non-autochthonous ones, and soil erosion caused by technogenic causes. As a result, the biodiversity of ecosystems in the Shenako0 area is reduced. Desertification is increasing and fertile soil layers are reduced due to erosion events. Degradation processes caused by the impact of anthropogenic factors on the ecosystem of the protected areas of Tusheti are observed.

Keywords: Protected areas of Tusheti, anthropogenic factors, ecosystem.

Introduction

Tusheti is located in the north-eastern part of Georgia. Across the main ridge of the Caucasus, on its northern slope. Tusheti is bordered by Dagestan to the east, Pshavi and Khevsureti to the west, Chechnya to the north, and Kakheti to the south. The protected landscape of Tusheti was created in 2003 and includes all villages of Tusheti. One of the main goals of its creation is to stop the degradation of unique ecosystems, individual components of nature, restore, etc. The

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terrain of Tusheti is quite difficult. The morphological appearance of the terrain is formed by the impact of river erosion.

Unsustainable use of pastures and forests in Tusheti leads to erosion, degradation, desertification and loss of biodiversity. Ecosystems of Tusheti mountain are also experiencing the process of degradation caused by the impact of anthropogenic factors. There is excessive grazing, replacement of autochthonous plant species with non-autochthonous ones, and soil erosion caused by technogenic causes. As a result, the biodiversity of Tusheti ecosystems is reduced. Desertification is increasing and fertile soil layers are reduced due to erosion events.

At present, the actual problem is the preservation of the unique landscapes of Tusheti Mountain, protection of ecosystems, conservation of rich flora and fauna, development of ecotourism, preservation of traditional agricultural activities, reduction of negative effects of anthropogenic factors on the environment.

Research Methods

The method of determining the similarity of species diversity in research plots; the method of determining the occurrence of species; the Projective coverage determination method.

Results and Discussion:

The aim of our research was to study and describe which species are the most widespread in the arable and uncultivated areas of the Shenako village. Shenako village is located in eastern Georgia, Tusheti, at 2080 meters above sea level. Our research included the collection and processing of data from field studies conducted by us, existing literature on the biodiversity of Tusheti ecosystems, and studies conducted by governmental and non-governmental environmental organizations. Studies on the biodiversity of protected areas in Tusheti have been conducted by the non-governmental organization NACRES and GIZ. Within the framework of the "Protected Areas Development Project" (GEF/WB), the main phytocenoses were identified and their distribution maps were created. A floristic and faunal inventory was conducted and species important for monitoring were identified. Even though new material has been collected, old data have been supplemented and verified, the study of the biodiversity of Tusheti is still only at the initial stage. The reason for this is that Tusheti is a rather difficult region in terms of conducting field research. The working period in the region is very short and limited due to accessibility.

Cattle grazing is the most important traditional activity for the Tushetians. It poses a significant threat to the landscape, habitats, and biodiversity. Consequently, pasture degradation and erosion on the protected landscape of Tusheti became an important issue (according to the local population, it is at the same time one of the main problems of Tusheti).

We conducted research in 2023 to determine the floristic diversity in the areas of the village of Shenako. Sampling took place at 1 site (village). 1 former arable field and 1 uncultivated territory were taken as the object of research. The size of the sampling square was taken as 1 m^2. This square size corresponds to the habitat types common in the study area and the task set for the study. In order to determine how accurately the floristic diversity of the study area was

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reflected in the sample taken, an additional experiment was conducted. In particular, the diversity of species on a randomly selected plot was compared with the number of individuals of the species represented on these plots. The size of the square in this case was also 1 m^2. This sampling took place in habitats represented at different sites. The diversity of species present in the study area was predicted based on the mentioned sample size.

Sufficiency of sample size and floristic diversity in the study area were evaluated by the "Species rarefaction" parameter. Rarefaction is expressed in the form of a curve, where the number of species is presented as a function of collected samples (studied plots).

Research material by plots

Description of research plots

Plot No. 1.1. **Shenakoho village**

200 m away from the village there is a former arable meadow, which was plowed about 55 years ago and barley is planted. Currently,it is used for pasture.

- area: 969 m^2(51X 19∂)
- coordinates: N 42.37253^0, E 45.66667^0 .
- ა∂ს. height: 1881 m
- Exposure: SE
- Slope inclination: 400
- Grass height:
  Up to the flower - max. 35 cm, min. 10 cm
  Up to the leaf - max. 10 cm, min. 2 cm
  The main part of the grass is collected in a layer of 2-3 cm.

Table №1 **Projective cover**

Plot №	Green mass (%)	Detritus (%)	Soil (%)	Stone (%)
1.1	50	3	2	45
1.1	32	30	3	35
1.1	40	15	20	25
1.1	35	10	40	15
1.1	30	5	50	15
1.1	70	5	5	20
1.1	40	10	40	10
1.1	35	15	25	25
1.1	50	15	20	15
1.1	20	60	5	15

Plant species

- **Grain** - *Agrostis capillaris, Festuca caucasica;*
- ***Legumes*** - *Coronilla orientalis, Lotus caucasicus, Trifolium pratense, Trifolium arvense, Trifolium repens, Medicago lupulina.*
- **Herbs** - *Achillea millefolium, Cirsium ketzkhovelii, Carlina vulgaris, Euphorbia squamosa, Erigeron caucasicus,Erigeron uniflorus, Erigeron canadensis, Fragaria viridis, Fragaria vesca, Gnaphalium supinum, Gentiana gelida ,Hieracium pillosella, Hieracium hoppeanum, Hypericum polygonifolium, Hieracium verruculatum, Lamium album, Sedum involucratum, Sideritis comosa, Saxifraga tridactylites, Scabiosa columbaria, Stachys anua, Salvia verticillata, Plantago saxatilis, Plantago caucasica, Potentilla crantzii, Potentilla recta, Potentilla ruprechtii, Polygala alpicola, Verbascum thapsus, Verbascum gossypinum, Medicago lupulina.*

Plot № 1.2 Village Shenako

A natural (uncultivated) meadow, which has never been cultivated, is located next to a former arable meadow, 200 m from the village. It is used for grazing.

- Area: 1140m^2 (60 X 19ð)
- Coordinates: N 42.37205^0, E 45.66647^0 .
- ა.ზ.ს. height: 1881 m
- Exposure: SE
- Slope inclination 50^0
- Grass height:
  - ✓ Up to the flower - max. 35 ს.cm, min. 8 cm
  - ✓ Up to the leaf - max. 10 cm, min. 2 cm
  - ✓ The main part of the grass is collected in a layer of 2 cm.

Table №2 **Projective cover**

Plot №	Green mass (%)	Detritus (%)	Soil (%)	Stone (%)
1.2	30	15	50	5
1.2	30	15	15	40
1.2	40	15	40	5
1.2	5	5	50	40
1.2	30	15	40	15
1.2	20	10	40	30
1.2	40	5	35	20
1.2	15	5	20	60
1.2	40	40	15	5
1.2	45	35	10	10

Plant species:

- ✓ **Grains**- *Agrostis capillaris , Koeleria macranthae;*
- ✓ **Legumes**- *Trifolium campestre, Trifolium repens;*
- ✓ **Herbs** - *Achillea millefolium, Cirsium ketzkhovelii, Campanula petrophila, Consolida orientalis, Camelina sylvestris, Dianthus discolor, Dianthus cretaceus, Erigeron caucasicus, Fragaria vesca, Gnaphalium supinum, Hieracium pillosella, Hieracium polygonifolium, Lamium album, Saxifraga tridactylites, Silene marcowiczii, Stachys anua, Plantago saxatilis, Plantago caucasica, Veronica caucasica,Verbascum thapsus, Verbascum gossypinum, Thymus caucasicus, Tripleurospermus caucasicum, Bupleum polyphyllum.*

Table №3 list and occurrence of species on arable and semi-arable lands

family	Species	Shenako arable	Shenako uncultivated	Family	Species	Shenako arable	Shenako
Rosaceae	*Alchimilla caucasica*	-	-	*Rosaceae*	*Potentilla ruprechtii*	+	-
Rosaceae	*Alchimilla divaricans*	-	-	*Polygalaceae*	*Polygala alpicola*	+	-
Compositae	*Achillea millefolium*	+	+	*Labiatae*	*Prunella vulgaris*	-	-
Gramineae	*Agrostis capillaris*	+	+	*Gramineae*	*Nardus stricta*	-	-
Compositae	*Anthemis iberica*	-	-	*Scrophulariaceae*	*Veronica sp.*	-	-
Compositae	*Anthemis dumetorum*	-	-	*Scrophulariaceae*	*Veronica filiformis*	-	-
Compositae	*Cirsium ketzkhovelii*	+	+	*Scrophulariaceae*	*Veronica schistosa*	-	-
Compositae	*Cirsium pugnax*	-	-	*Scrophulariaceae*	*Veronica petraea*	-	-
Compositae	*Cirsium sp.*	-	-	*Scrophulariaceae*	*Veronica caucasica*	-	+
Campanulaceae	*Campanula petrophila*	-	+	*Scrophulariaceae*	*Veronica perpusilla*	-	-
Campanulaceae	*Campanula arganensis*	-	-	*Scrophulariaceae*	*Veronica serpyllifolia*	-	-
Helleboraceae	*Consolida orientalis*	-	+	*Scrophulariaceae*	*Verbascum laxum*	-	-
Leguminosae	*Coronilla orientalis*	+	-	*Scrophulariaceae*	*Verbascum thapsus*	+	+
Cruciferae	*Camelina sylvestris*	-	+	*Scrophulariaceae*	*Verbascum gossypinum*	+	+
Cruciferae	*Cardamine hirsuta*	-	-	*Violaceae*	*Viola rupestris*	-	-
Compositae	*Carlina vulgaris*	+	-	*Labiatae*	*Thymus caucasicus*	-	+
Caryophyllaceae	*Dianthus discolor*	-	+	*Labiatae*	*Thymus collinus*	-	-
Caryophyllaceae	*Dianthus cretaceus*	-	+	*Leguminosae*	*Trifolium pratense*	+	-
Euphorbiaceae	*Euphorbia squamosa*	+	-	*Leguminosae*	*Trifolium arvense*	+	-
Compositae	*Erigeron caucasicus*	+	+	*Leguminosae*	*Trifolium campestre*	-	+
Compositae	*Erigeron uniflorus*	+	-	*Leguminosae*	*Trifolium ruprechtii*	-	-
Compositae	*Erigeron canadensis*	+	-	*Leguminosae*	*Trifolium repens*	+	-
Scrophulariaceae	*Euphrasia caucasica*	-	-	*Compositae*	*Taraxacum confusum*	-	-

Onagraceae	*Epilobium gemmascens*	-	-	*Compositae*	*Taraxacum sp.*	-	-
Rosaceae	*Fragaria viridis*	+	-	*Compositae*	*Tripleurospermus caucasicum*	-	+
Rosaceae	*Fragaria vesca*	+	+	*Labiatae*	*Ziziphora puschkinii*	-	-
Gramineae	*Festuca ovina*	-	-	*Leguminosae*	*Medicago lupulina*	+	-
Gramineae	*Festuca caucasica*	+	-	*Labiatae*	*Mentha longifolia*	-	-
Compositae	*Gnaphalium supinum*	+	+	*Gramineae*	*Koeleria macranthae*	-	+
Compositae	*Gnaphalium caucasicum*	-	-	*Rosaceae*	*Sibbaldia parviflora*	-	-
Gentianaceae	*Gentiana gelida*	+	-	*Labiatae*	*Sideritis comosa*	+	-
Cruciferae	*Coronilla varia*	-	-	*Saxifragaceae*	*Saxifraga tridactylites*	+	+
Lamiaceae	*Hyssopus angustifolius*	-	-	*Garyophyllaceae*	*Silene marcowiczii*	-	+
Compositae	*Hieracium hypeuryum*	-	-	*Dipsacaceae*	*Scabiosa columbaria*	+	-
Compositae	*Hieracium sp.*	-	-	*Labiatae*	*Stachys anua*	+	+
Compositae	*Hieracium pillosella*	+	+	*Labiatae*	*Salvia verticillata*	+	-
Compositae	*Hieracium hoppeanum*	+	-	*Plantaginaceae*	*Plantago lanceolata*	-	-
Compositae	*Hieracium polygonifolium*	-	+	*Plantaginaceae*	*Plantago saxatilis*	+	+
Hypericaceae	*Hypericum polygonifolium*	+	-	*Plantaginaceae*	*Plantago caucasica*	+	+
Hypericaceae	*Hypericum montanum*	-	-	*Gramineae*	*Phleum montanum*	-	-
Compositae	*Hieracium verruculatum*	+	-	*Gramineae*	*Phleum alpinum*	-	-
Leguminosae	*Lotus caucasicus*	+	-	*Rosaceae*	*Potentilla crantzii*	+	-
Labiatae	*Lamium album*	+	+	*Rosaceae*	*Potentilla recta*	+	-
Leguminosae	*Onobrychis petraea*	-	-	*Umbelliferae*	*Bupleum polyphyllum*	-	+
Crassulaceae	*Sedum involucratum*	+	-	*Ranunculaceae*	*Ranunculis repens*	-	-

The most problems were found in areas that were previously used for agricultural activities and later became pastures. The natural regeneration processes in this area were affected by continuous grazing, which significantly hindered the restoration of habitats and intensified the erosion processes. Grazing has both direct and indirect effects on habitats, wildlife and the spatial distribution of species (some species are forced to move higher above sea level to avoid disturbance). Sometimes local shepherds graze their cattle in areas where this is prohibited; The main reason for this can be considered that the borders of the protected areas are not clearly marked everywhere. Some herders prefer to graze their cattle in or near the village rather than on traditional pastures on higher mountain slopes. This has a negative impact on the quality of life (both for locals and visitors), increases the risk of habitat degradation (increased eutrophication, replacement of the natural composition of plant species with nitrophilous species), changes the water regime and increases the risk of erosion in such areas.

Conclusion

Based on the research conducted by us in 2023, we can conclude that the unsustainable use of pastures and forests in the protected areas of Tusheti (for example, the Shenako village) leads to soil erosion, degradation, desertification and loss of biodiversity. In the area, which years ago was used for agricultural activities and later became a pasture, the natural regeneration stopped. The enhanced erosion process prevented the restoration of habitats. The use of the area for grazing has had a negative impact on wildlife and the spatial distribution of species. The processes of degradation caused by the impact of anthropogenic factors on the ecosystem of the protected areas of Tusheti are observed.

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