THE INFLUENCE OF CLIMATIC CHANGES ON THE INTENSITY OF EROSION PROCESSES IN THE ARID ZONE OF THE CHECHEN REPUBLIC

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Abstract

Arid ecosystems of the Chechen Republic change their appearance under the influence of various conditions and especially climatic ones. Sometimes such changes are formed only on the increase or, conversely, the decrease of one or another association of herbs or cereals in associations without causing a radical change of vegetation cover. However, often the impact of changed climatic conditions is so strong that a sharp change of associations takes place: the grasshopper ecosystem turns into a white–field ecosystem or, conversely, white-field-type associations become completely typical. The speed of such processes varies, as does the duration of ongoing climatic changes: sometimes they are temporary, and after a few years the original picture is restored, but often they turn out to be permanent. Therefore, the purpose of these studies is to show how the vegetation cover changes under the influence of climatic changes. Vegetation changes under the influence of temperature fluctuations and changes in the intensity of precipitation are shown. The results of the work will be useful in the development of agroforestry measures in the arid zone of the Chechen Republic.

Keywords: Chechen Republic, arid zone, climatic conditions, vegetation, dry winds, climate variability

I. Introduction

The arid zone of the Chechen Republic is located in the south–west of the Tersk–Kum lowland, dominated mainly by semi-desert landscapes, and is characterized by a high degree of variability of climatic conditions. The increase in the continentality of the climate has been occurring since the middle of the twentieth century. This leads to a change of plant associations, the processes of desertification are activated. Currently, this process has intensified, climatic conditions contribute to the expansion of the area of arid landscape complexes with appropriate vegetation cover. Therefore, the assessment of vegetation changes in arid landscapes under the influence of climatic conditions is not only of theoretical, but also of practical interest.

The development of the vegetation cover of the arid zone of the Chechen Republic occurs in climatic conditions characterized by a very small amount of precipitation less than 300 mm per year, and a significantly high temperature regime (more than +260 C average values for the summer period), high values of solar radiation and a number of marine transgressions of the Caspian Sea, in connection with which plant associations have formed on saline soils.

The currently available information and significant material about the nature and distribution of vegetation has accumulated as a result of research by a number of botanists. Of these, P.V. Novopokrovsky (1922, 1925-1926), S.A. Vinogradov, G.A. Tolchin (1932), S.E. Rozhenets-Kucherovskaya (1925), A.D. Gozhev (1930), S.M. Borisov (1946) should be noted.

II. Methods

The object of our field research was the vegetation cover of the arid zone of the Chechen Republic. Semi-desert landscape complexes occupy a ridge marine accumulative plain with a slight slope to the northeast with heights of 5-100 m above sea level. Large arrays of open sands are located in the central and north-eastern part.

Our own research on the degradation of vegetation cover and the changes of their associations under the influence of climate change was carried out near the Baklazan tract (5 key sites). Field studies were conducted mainly by the route method. When studying the vegetation cover, we used generally accepted geobotanical techniques.

Geobotanical descriptions of plant communities and their characteristic shifts were carried out at each site on five sites measuring 100 m2. To determine the phytomas, 8 experimental sites were randomly laid at each site. Studies have shown that the main degradation process developing in arid ecosystems is climatic emptying, which leads to a decrease in the productivity of vegetation cover, an increase in the area of exposed sands, significantly reduces the reproducible functions of natural components of ecosystems of the arid zone.

III. Results

The climatic conditions of the arid zone of the Chechen Republic are characterized by significant continentality, which is expressed primarily in the sharp temperature differences of individual months and seasons. If in winter the average monthly temperatures can decrease in Naurskaya to – 100 and below, with an absolute minimum to -400 , and summer temperatures here can reach + 270 in July, at the same time in the Pritersky sand massif, summer temperature maxima can reach more than 300 with an absolute maximum of +430. [1, 2]

Summer heats cause evaporation in large volumes, further increased by frequent dry winds, and winter periods with little or no snow in recent years, with a strong decrease in temperature, can lead to deep freezing of the soil. It should be noted that sharp temperature jumps in the spring and autumn periods, which are often accompanied by frosts, are very unfavorable for vegetation cover [1, 3].

Winter frosts have a depressing effect on the aboveground parts of white acacia (Robinia pseudoacia), gleditchia (Gleditschia treacantos) and mulberry (Morus alha), which are renewed in spring in the form of root growth, but apricot (Armeniaca vulgaris) tolerates winter frosts well. In addition, the development of plants in the arid zone is influenced by spring and, to a lesser extent, autumn frosts. The timing of the onset of both spring and autumn frosts in some years is highly susceptible to significant fluctuations.

As a rule, the last spring frosts occur at the end of April, and the first autumn frosts at the end of October, however, recent changes in climatic indicators have greatly shifted these dates.

The frosts of 1980 and 1982 during the flowering of tree species almost completely destroyed the forest strips of the arid zone, caused a delay in the leafing of trees for almost a month and were a prerequisite for the mass appearance of pests.

The number of meteorological risks affecting plants should also include the depth of soil freezing, the effect of which on vegetation is practically not traced by researchers. It is known that the depth of freezing of soils as a condition for the development of summer droughts due to the rapid rolling of spring meltwater, which does not have time to seep into the frozen soil. But it is impossible to limit the influence of frost only as an indirect causative agent of drought; one must think that its effect on plants is diverse. In recent years, the arid zone of the Chechen Republic has been characterized by few snowy or snowless winters.

So the winters of 2018/19, 2019/20, 2020/21, 2021/22 were practically snowless, and the snow cover appeared for a short time only at the end of January in early February. These snowless winters, although there were no severe frosts, affected the soil cover. As a result, the freezing of the soil reached almost 40 cm, which adversely affected the root system of perennial grasses, and they often fell out of plant communities, thereby impoverishing the richness of the plant world.

Not significant freezing in combination with strong dry and cold winds blowing during these months leads to winter drought and is often the cause of the death of young plantings in forest belts.

Probably, plants equally tolerate similar meteorological conditions. So, despite the fact that the tillering nodes of the grasshoppers and the tipchak are immersed in the soil, in cold, snowless winters, the soil is blown out of part of the sod and in the spring many, especially young, of these plants turn out to be dead. It is not surprising that under the influence of winter desiccation, cereals that have penetrated into the black-wormwood associations most often die, which weakly accumulate snow, which allows deep freezing of the soil.

Perhaps. that frost-breaking cracks also play a certain role in the death of plants. So in frosty years, at a depth of freezing of the soil of 40 cm, in the deeply frozen soil of the black wormwood covered with numerous cracks, you can find many dead segments of the rhizomes of the pinworm. It is possible that the effect of frost cannot be considered only negative. So, another [3] suggested that the same frost-breaking cracks can play a big role in enhancing water filtration into the soil.

The second manifestation of climate is an insignificant annual amount of atmospheric precipitation. A characteristic feature of precipitation in the summer months, when due to high evaporation they are almost useless for plants. Winter precipitation is low, winters, especially the last 30 years are snowless. The snow does not last more than a few days. The thickness of the snow cover does not exceed 5-10 cm. In some years, there may be severe blizzards and snowfalls. Snow melting, even in snowy winters, occurs very quickly, within 5-7 days. Meltwater quickly slides down and numerous small lakes remain in the depths for some time.

The changes caused in the vegetation cover by differences in the amount of atmospheric precipitation are manifested differently in the dry steppes and semi-deserts of the arid zone of the Chechen Republic. Grasshopper and typical ecosystems with soils relatively rich in organic substances and sufficiently washed, change their appearance and composition relatively weakly when meteorological elements change [4,5].

A different picture is observed in the zone of the Pritersky sand massif lying on sandy soils associated with a geologically younger territory. Here, both main groups of herbage – cereals and wormwood – are in an extremely unstable equilibrium, and any factor weakening one of these groups will immediately cause the victory of the second. As a result, changes in the moisture content of different years are particularly pronounced here (Fig. 1).

Stipa Joannis and Festúca valesiáca in arid ecosystems with an increase in the amount of precipitation is accompanied by an increase in the role of Stipa in the herbage. In tipchak communities, the value of thyrsa and kovylka increases sharply, increasing their abundance so much that the tipchak retreats to second place and the tipchak ecosystem turns into a tipchak – thyrsa or tipchak–kovylkovaya. Stipa, mainly Stipa Joannis, are beginning to occur more frequently in the others and kovylkov ecosystems. These changes occur relatively quickly, revealing in all Stipa species the ability to change their abundance and occupied area within 2-3 years. The content of Stipa Joannis increased from 30 to 60% during the hamid hamid period, more than doubled [6].

The second consequence of the increase in humidity is the increasing role of various grasses, in which the abundance of tall mesophilic plants – Filipendula hexapetala, Galium verum, Trifolium montanum, Salvia tesquicola, Lavatera thuringiaca, Vervascum lychnitis, Veronika langifola and a number of other species is rapidly increasing.

On the contrary, all conditions that weaken the accumulation of snow and interfere with the moistening of the soil will contribute to the development of droughts, and cause opposite changes in vegetation. The effect of drought on the vegetation cover of the grass and tipchak steppes is most clearly manifested in a sharp drop in productivity associated with a decrease in the density and height of plants. A rapid increase in air temperature, leading almost to the disappearance of spring, to a sharp transition from winter to summer, a rapid decrease in air humidity and the development of dry winds entail the same rapid burnout of arid ecosystems.

Figure 1: *A site with degraded vegetation cover in the arid zone of the Chechen Republic*

Plants dry quickly, without having time to get out, and their height barely reaches a third of normal size. This burnout is especially pronounced in grasshopper and tipchak ecosystems, which generally differ in the low growth of grass, and in dry years remain so underdeveloped that haymaking is impossible, since the mower does not capture grass (Fig. 2).

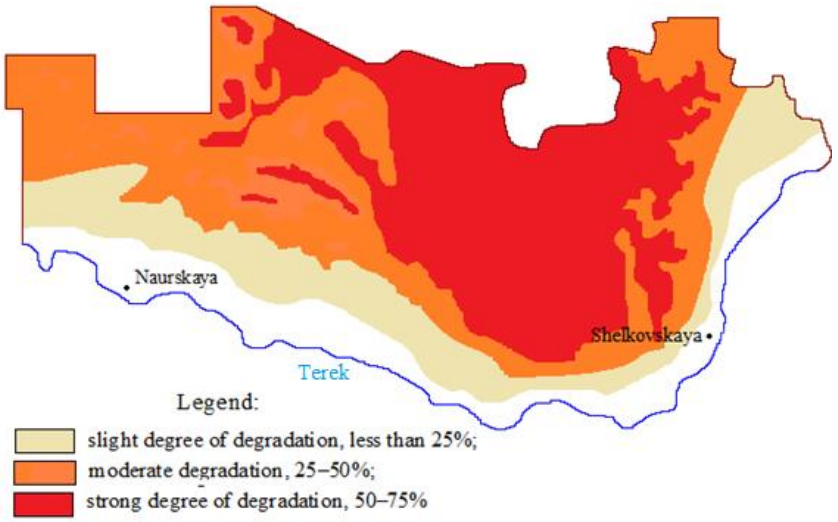

Figure 2: *Total indices of degradation of vegetation cover of the arid zone of the Chechen Republic*

Not only such moisture–loving species as Filipendula hexapetala, Lathyrus tuberosus, Viciacracca completely fall out of the herbage, but also ordinary steppe plants - Medicago falcata, Jurinea multiflora, Phlomis tuberose, Salvia tesquicola, Silene species, preserved only by single rare specimens. Even the ephemera and ephemeroids Androsace maxima, Erophila verna, Gagea

bulbifera, G. Pusilla, Tulipa Schrenkii, T. Biebersteiniana and others are reduced in number two to three times compared to normal years.

The projective coverage in carpet associations is reduced to 60%, and the true coverage is reduced to 35-40%. The species saturation drops catastrophically; only 5-7 species remain on 1 m2 instead of 19-25, the landscape becomes less colorful, more monotonous, significantly impoverished. Productivity is reduced by 2-3 times and in grasshopper ecosystems is only 4.5 – 5.0 kg/ha instead of the usual 10-12, and in grasshopper and tipchak ecosystems, complete cutting at the root gives only 2.0-2.5 kg/ha of dry mass.

Climatogenic changes should be understood as radical changes in vegetation cover associated with its evolution over a long time. But speaking about them, it is necessary at the same time to dwell on those temporary, usually short-lived, changes that are born of a difference in the meteorological situation.

IV. Discussion

The scientific and practical interest of botanists and geographers in the problem of changing vegetation cover, in particular under the influence of changes in climatic conditions, was caused by the intensification of desertification processes.

Andreev, S. G. (2012) the processes of desertification, which have been developing recently against the background of global warming in the Northern Hemisphere, characterized by an increase in the average annual surface air temperature on land, especially in arid inland regions, are considered [7].

Askarova, U. B. writes that desertification is a process of irreversible changes in soil and vegetation and a decrease in biological productivity. In what it is impossible not to agree [8].

Bratkov V.V., Hajibekov M.I., Ataev Z.V. (2008) It is customary to understand "climate changes" as long-term (over 10 years) directed or rhythmic changes in climatic conditions on the Earth as a whole or in its large regions. There are geological, historical and modern climate changes. Climate fluctuations are cyclical or quasi–cyclical changes with a period of tens and hundreds of years. "Variability of a meteorological element" means non-periodic changes in the values of a particular meteorological element in a given place. The variability of a meteorological element to one degree or another can be characterized by its average daily variability, average variability of average monthly values, etc. [9]

Borlikov, G.M. Describes the dynamics of desertification of Chernozem pastures in changing natural and anthropogenic conditions. Currently, an ecological balance is maintained in this zone of the south of the European part of Russia [10].

However, in our opinion, changing climatic conditions can make this region of Russia an ecological disaster zone.

Modern climatic conditions of arid landscape complexes tend to aridize. In all parts of the arid zone, there are significant changes in meteorological conditions: the intensity of atmospheric humidification, there is a significant change from year to year. We observe 2-3-year periods of aridity or moisture. In recent years, despite the general global trend of climate warming, in the arid zone of the Chechen Republic there has been a general tendency to maintain conditions humidification. However, summer precipitation practically does not reach the earth's surface due to the high degree of evaporation.

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