

On the origin of mountain steppes of Armenia

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FAJVUŠ G. M. (1996): On the origin of mountain steppes of Armenia. – Thaiszia - J. Bot., Košice, 5: 153-158. – ISSN 1210-0420.

ABSTRACT: A history of steppes of Armenia is given in the paper. On the base of literature data and results of investigations of Armenian steppe flora and vegetation the time and place of their origin are proposed and the ways of their development are outlined.

KEYWORDS: Flora of Armenia, mountain steppes, history of origin of flora.

Introduction

Mountain steppes are one of the most characteristic vegetation types in Southern Transcaucasia and the whole Armenian Highlands. They are widespread in all floristic regions of Armenia in medium mountain belt - on volcanic plateau and on forest-free slopes of mountain ridges. The flora of mountain steppes of Armenia contains 1163 species of 381 genera and 66 families of vascular plants (FAJVUŠ 1991, 1992). For such small territory (the whole area of the republic is less than 30,000 square kilometres, and the area of the steppes - about 4,000 square kilometres) this number is very high. On the one hand this flora consists of elements of quite different origin, and on the other hand - the steppes of Armenia, especially the *Stipa*-type, have a great resemblance with those of Southern Russia. Apparently, it was one of reasons, why, as far as the place and time of their origin are concerned, different botanists had very different, often diametrically opposite opinions.

KUZNECOV (1909, 1915) proposed that the whole Pontic steppes (steppes of Southern Russia) developed from the steppes of Mountain Daghestan and Armenia (centres of xerophilous floras in the Caucasus), and are of post-tertiary origin. GROSSGEJM (1936) and MAGAKJIAN (1939) mentions that the steppes of Southern Russia and SW Asia had parallel development. Later GROSSGEJM (1948) reviewed his opinion and proposed an idea that in Tertiary period there was one great steppe region in the SW Asia, in the East Caucasus and in the Southern Russia. LAVRENKO (1954) is of the opinion that there was a communication between the steppes of Transcaucasia and Southern Russia, probably in Pleistocene. Owing to this relations the steppes of Asia

Minor had the great significance in the development of the steppes of Southern Russia and the whole Euroasiatic steppe region. SOSNOVSKIJ (1943) supposed that Caucasian steppes have SW Asian origin, but they developed in Post-Glacial period only. TACHTADŽAN (1946) mentions that mountain ridges which reach from Mediterranean to North Mongolia, are the original region of formation of steppe vegetation. In his opinion the steppes are of Tertiary age, but main types of steppe vegetation developed only in the Glacial and Postglacial period. KECCHOVELI (1958) and GULIŠAŠVILI et al. (1975) proposed an idea that in the whole the Transcaucasian steppes are of the secondary origin and are formed after destruction of forests due to antropogenous factor.

Results and discussion

Studies of the steppe flora genesis of the region revealed that the autochthonous tendency was prevailing in formation of Armenian steppe flora, but with rather great significance of migration processes. It was shown that the steppe flora of Armenia is mainly of Ancient Mediterranean origin, and the main part of this flora consists of Middle East, especially Armeno-Iranian species (FAJVUŠ 1991, 1992).

Now on the base of results of my investigations and analysis of literature data I shall try to show the probable picture of origin and the ways of development of Armenian steppes.

According to a new idea (CIBILEV 1990), the most typical steppes are formed in inner parts of continents and their size is directly proportional to the size of the continent. I think it supposes an enormous area with arid climate in Eurasian continent. But in my opinion, arid regions can also be formed on the sufficiently large mountain islands occurring in today Armenian Highland already in Carboniferous period. Arid regions existed on the Earth, probably during the whole history and arid vegetation, consisting of phytocoenoses of perennial herbaceous xerophytic ferns, developed probably already in Carboniferous period. But as paleobotanist KRIŠTOFOVIČ (1936) showed, modern vegetation of Eurasia and of the whole Earth is the derivative of Cretaceous flora as the most ancient one and still similar enough to modern stage of development of Plant World; all the modern different types of vegetation developed from plants, inhabiting Eurasia in the end of Cretaceous period.

Global geological alterations were characteristic in Cretaceous period for recent region of SW Asia. At that time the original land was splitted and Africa was delimited from Laurasia (WEBERLING 1985, DERKUR & SONNENSCHNEIN 1990). As a result the Mediterranean sea Thetys greatly increased and in the place of recent Armenian Highlands and Iran only separate large islands existed. Evidently, on southern shore of the Thetys xerophilous savannahs with oasis's and riparian forests already existed at that time (SINICIN 1962).

At the beginning of Paleogene Laurasia splitted into North America and Eurasia, and Africa began to approach closely to Eurasia. As a result the Thetys was closed. Today's Armenia was situated in the middle of the Thetys. The evidence of this is the existence of ophiolites in Sevanside, that is a part of ophiolite joint, which separated Gondwana and Eurasia. Thus for example, a modern Daralaghez (Vaikh) in Armenia, which has very original flora, is a fragment of Gondwana (DERKUR & SONNENSCHNEIN 1990) being of southern origin.

On the transition of Cretaceous and Paleogene in the Central Asia a very varied complex of floristic types existed. The reduction of the Thetys was going from east, and this floristic complex moved to the west including its original elements (KAMELIN 1988).

In Neogene vast expansion of land, great orogenic processes and gradual decrease in temperature started. Probably in this period the main types of steppes of Central Asia are definitely formed (KAMELIN 1979). But in Armenia mixed forests dominated at this time (MANUKJAN 1977)(according to pollen spectra analysed) and only in the end of Miocene (Sarmatian) herbaceous plants became the dominant part of flora. If pre-steppe phytocoenoses existed at this time, they could occupy very small area. The most probably there were different derivatives of “pre-šibljak” (in the sense of KAMELIN 1965), which were paleoflorocoenotypes for the steppes. But already in Pliocene orogenesis resulting in rising of the Taurus and Zagros mountains caused the high intensification of climate aridization in Armenian Highlands. As TUMADŽANOV (1966) showed, having begun in the Miocene, dispersion of xerophytic Antasian species to the Great Caucasus continued, being particularly intense under the dry continental climatic conditions of Middle Pliocene. The route for the Antasian xerophytic floras to the Minor and the Great Caucasus might have been opened from the end of Miocene (Sarmat-Meotis) when the Caucasus became a large peninsula of Asia Minor. At that time there was no high mountain relief in the Caucasus. The intensive penetration of xerophytes continued in the Middle Pliocene as well.

In the Neogene in Middle East primary steppe phytocoenoses were already formed, naturally on some different paleofloristic basis, than in Central Asia. It was the flora of these steppes that laid foundation of modern steppes of Armenian Highlands. The Ancient Mediterranean element was the initial basis from which, due to active speciation, the numerous Armeno-Iranian, Armenian and Atropathenian species developed. Obviously, at the same time some North Mediterranean species began to spread on the Armenian Highlands which played an important part in development of South Russian steppes in future.

In the end of Neogene (Pliocene) in Armenia on forest-free places main types of steppe vegetation (grass-steppes, tragacantha-steppes, shrubs-steppes etc.) existed. Of course, now we cannot exactly characterize floristic composition of this “pre-steppes” - Armenian steppes of Pliocene. But there are very interesting indirect data. So, JABLOKOV-CHONZORIJAN (1961) on the base of the analysis of recent Coleoptera's fauna (especially phytophages-oligophages) of Armenian steppes showed, that these animals prefer species of plants from *Brassicaceae*, *Caryophyllaceae*, *Malvaceae*, *Fabaceae*, *Campanulaceae*, *Asteraceae*, *Lamiaceae* and *Apiaceae* families. We can suppose, that species of these families were the main components of “pre-steppes”. Modern steppes spectra, except *Poaceae* family, are very similar (FAJVUŠ 1991). *Gramineae* are one of the predominant families of the Armenian steppes now. The fact of “insignificant” role of cereals in “pre-steppes” can be explained only by conservativity of Lepidoptera in the whole along with hypothesis that activity of cereals in steppe phytocoenoses began to increase more later than they were formed. These facts confirm indirectly the time of formation of main types of the Armenian steppes, which are of later origin than other types of vegetation. Obviously in the end of Tertiary period all types of steppes were formed (on the base of elements from other types of vegetation - forests, savannahs, deserts etc.), but modern steppe dominants had not significant participation in these

ancient phytocoenoses. According to CVELEV (1976), cereals are formed apparently in the Cretaceous period, in the open spaces of the mountains above forest belt. I agree with this conception and can suppose that modern dominants of Armenian steppes played a small part in steppes on the whole period of history of this type of vegetation, but their potential possibilities and high activity in structure of phytocoenoses are displayed only in conditions of the Glacial and Postglacial periods.

Pleistocene glaciation was of a special importance in the development of steppe vegetation. It were the Glacial and Postglacial periods which gave rise to the black-soil steppes of vast mountain volcanic plateau of the Armenian Highlands.

Probably, the Glacial period could not substantially change the floristic composition of the Armenian steppes thanks to intensification of speciation, because it is well known (KRIŠTOFOVIČ 1946, JABLOKOV-CHONZORIJAN 1959) that in fast changing conditions organisms have not time to adapt themselves and they are compelled to migrate or disappear. Obviously, in the Glacial period (and especially in interglacials) the floristic composition of steppes have changed thanks to migration of Boreal species here, and besides this some thermophilous species disappeared or migrated into other mountain belts. Of course, there are some refugia, where relict steppes exist. For example, the relict steppe in north-west Armenia with *Stipa pulcherrima*, *Asphodeline taurica*, *Centaurea tamanianiae* etc. (AGABABJAN & FAJVUŠ 1991). The same refugia existed in South Georgia as well as in the North Caucasus (ALTUCHOV & LITVINSKAJA 1989, CHINTIBIDZE 1990). Besides this, aridization of climate in the interglacials promotes speciation of xerophytes in Armenia and Daghestan and caused migration from East and West (WULF 1944).

The history of development of vegetation in Holocene is very interesting. At this time anthropogenous factor begins to influence vegetation. I must say, that some scientists are of the opinion, that the steppes of Transcaucasia were formed even only in Holocene mainly under the influence of anthropogenous activity (KECCHOVELI 1958, GULIŠAŠVILI et al. 1975). But this anthropogenous activity can not be the reason of the origin of new types of vegetation (TACHTADŽAN 1946), except, perhaps, for agrophytocoenoses. It can only change the correlation of areas of existing types. Besides this, in opinion of PIGNATTI & PIGNATTI (1984), in Mediterranean region anthropogenous activity can cause an increase of the floristic richness of primary phytocoenoses. Perhaps, this factor influenced floristic richness of the steppes of Armenia, which is the centre of ancient human culture.

Most probably, it were Glacial and Post-glacial periods that provided the best conditions for the mass migrations of Boreal and Pannonian-Pontic species to Transcaucasia, which now play an important role in the steppes of Southern Transcaucasia. Exactly at that time, most likely in the last ten thousands years great changes of vegetation types took place in the Armenian Highlands. Two thousand years ago large forest areas were growing even one degree southerly than at the present time. In the neighbourhood of the lakes Van, Zeribar and Urmia in Holocene the phryganoid vegetation was replaced by forest vegetation, then the steppe one (VAN ZEIST & BOTHEMA 1985). During the last two-three thousands years one can see clear tendency of decreasing of forest areas and increasing of steppe areas in the Armenian Highlands. In my opinion in the whole Holocene (except for last 400-500 years) big herbivorous animals could play more important part in these processes than anthropogenous activity

(of course, after influence of the climatic factors). The indirect evidence of this are the paleontological data from Armenia - exactly in the strata of the age of 2-3 thousand years a large amount of fossils of animals are found (MEŽLUMIJAN 1988).

Summary

Thus, having originated in the end of Paleogene in the mountains on the East shore of the Thetys, during Neogene the steppe vegetation of south-west Asia existed on not very large areas until glacial time, after which it began to broaden gradually and at the same time the Boreal and Pannono-Pontical elements began to play an important role. 2-3 thousand years ago these processes were accelerated and only during the last 1-2 hundred years human activity caused its expressive decrease.

Acknowledgement

I am grateful to Vlastimil Mikoláš (Botanical Garden of UPJŠ University, Košice), for his correction and improvement of paper.

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Received: 10 August 1993

Revised: 15 December 1995

Accepted: 10 January 1996