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Relationships between flora of the European mountains and the East-European lowlands

Victor PARFENOV

1. INTRODUCTION

Species of mountainous origin are characteristic to the composition of the flora of some European countries in the lowlands northeast of the Alps. All these species originate from the European mountainous systems and are characterized by similar Pleistocene histories of colonization of their respective refuges on the plains, where they represent relicts of previously dominating floristic complexes. The distribution of mountain species on the plains testifies that there are genetic floristic relations of plain regions to the mountains of the Central Europe. Identification and investigation of mountainous relations are of great importance to comprehend the history of formation and development of flora and vegetation in the Pleistocene and Holocene period on the plain territories. In this regard, the comprehensive study of genesis of current distribution and peculiar growth features of mountainous species in the plain circumstances of Eastern Europe is to be regarded as rather important and actual subject.

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2. MATERIAL AND METHODS

The present paper represents a comprehensive study of European flora. Materials of long-term floristical and geobotanical investigations (from 1960 to 1986) on the territory of Byelorussia, which is to be regarded as an extreme distribution of the investigated species to the east, constitute its main part. We have thoroughly elucidated flora of forest, meadow, meadow-marsh, synanthropic communities and agrophytocenosis. Phytogeographic peculiarities of mountainous species distribution in the lowlands have been studied on the basis of reconnoitring and comprehensive route methods in combination with stationary experimental investigations. We have also applied general methodology to study flora in respect to geobotanical aspects and analyse phytocenotical and soil-hydrological conditions. Ecological, phytocenotical and biological peculiar features of mountainous species have been studied on the test sites.

The analysis of our investigations has been expanded on the basis of generalizations of scientific results made in the works of such authorities as PACZOSKI (1897, 1899, 1900, 1910), SZAFER (1930) and POLYANSKAYA (1931).

3. RESULTS AND DISCUSSION

3.1. PROBLEMS OF THE MOUNTAINOUS ELEMENT AND SOME APPROACHES

In order to elucidate mountainous European relationships of flora in the plains and their influence it is necessary to completely clarify the term 'mountainous element', because botanists and geographers employ this term rather loosely: geographically and genetically. Here, we regard the mountainous element as a unit of geographical analysis of flora.

The comparative analysis of plant distribution in three-dimensional space (latitude, longitude, altitude) reveals generally two types of species:

1) Plants, which are distributed exclusively on the plains or also in the mountains, or plants which are distributed on the plains and also also at lower altitudes in the mountains.
2) Plants, which are distributed exclusively in the mountains or more often in the mountains than on the plains (PAWLOWSKA 1959).

The second group of plants has attracted the attention of botanists and geogra-

phers for a long time, as it is of great interest due to its chorological, ecological, phytocenotic and evolutional aspects. As species of the second group exhibit similarity in distribution, we may regard this group as a geographical element of flora. However, the intermittent preponderance of the species in various mountainous regions brings no light for better comprehension of the essence of the mountainous geographical element.

Among the first to note the growth of alpine plants in close proximity to the Alps was HEER (see SZAFER 1930). Later some West European botanists (JEROSCH 1903, WALTER 1927 et al.) have shown that some alpine species are distributed not only in the prealpine regions but in other mountains of the alpine folding system and also on the plains expanding to the north from these mountains. At the same time the term 'alpine species' is interpreted in different ways by some investigators. Some botanists (WALTER and ALEKKIN 1936, JEROSCH 1903, STEFFEN 1931, PAWLOWSKA 1959, MEUSEL et al. 1965) identify a species as alpine if it mainly occurs above timberline, others (HRYNIEWIECKI 1933, TROLL 1959 [see MEUSEL et al. 1965]) suppose that a species may be specified as alpine if it is distributed in the alpine region.

WANGERIN (1919) and WANGERIN (1932) distinguished the mountainous element in the flora of the northern German lowland. They considered this element as a group of species restricted in its distribution by the forest belts in medium altitudes in Germany. The mountainous floral element was specified also by STEFFEN (1931) who expanded this element by including species which were concomitant to beech.

In contrast to the 'alpine' concept of the mountainous element, many modern researchers (OKSNER 1974, LAZARENKO 1956, MAKAREVICH 1963, TRASS 1970, PITERANS 1982, GOLUBKOVA 1983, SIDELNIKOVA 1985, KUDRATOV 1984) define it as a group of species related in their distribution to the forest belts of Holarctic mountains. They point out that species of the mountainous element are preferably shade-requiring plants with high air moisture demand. MAKAREVICH (1963) subdivides species of mountainous element into two ecological types: 1) the type related to beech and beech-spruce forests, 2) the type related only to spruce forests. KLEOPOV (1938) and MALYSHEV (1965) ascribe plant species growing in the highest forest and subalpine belts in the Central European mountains to 'mountainous-European' type of geoelement.

MALINOVSKY (1980), studying high Mountain flora of the Ukrainian Carpathians, distinguishes alpine, arctic-alpine, mountainous, boreal-mountainous, nemoral-mountainous, nemoral, arid and azonal geographic elements. As he notes, the alpine species are distributed in the alpine and, partially, subalpine

belts, and mountainous species are preferably found in the open cenosis of forest and subalpine belts, meadows, shrubs, marshes and rocks. According to this concept, the boreal-mountainous element includes species which are distributed in the boreal zone, in the southern latitudes they are found in the mountains, highest mountainous forest belt, partially in the elfin woodland and rarely on the rocks and meadows of the subalpine belt; nemoral-mountainous species are distributed in the mountainous oak and beech woods, rarely in the pre-mountain areas and pre-mountain plains of the nemoral zone.

Besides such approaches to the 'mountainous element' this term is interpreted rather loosely. Therefore, species prevalent in the mountains of Central Europe and rare on the adjoining territories are often regarded as mountainous element as well. The author of this hypothesis is SZAFER (1930), his idea has been accepted and supported by other Polish scientists (WALAS 1938, PAWLOWSKI 1948, 1959, CZUBINSKI 1950, KORNAS 1955, 1957, GRODZINSKA and PANCER-KOTEJOWA 1960, STUCHLIKOWA and STUCHLIK 1962, POLAKOWSKI 1963, JASIEWICZ 1965, IZDEBSKI 1967, FIJALKOWSKI 1972, TOWPASZ 1974, GRODZINSKA 1975, GLAZEK 1976). All these scientists subdivide the species of the mountainous element into species of alpine, subalpine, timberline and also mountain species, characteristic of all mountainous belts.

Analysis of various viewpoints on the mountainous geographic element of flora makes it possible to conclude that there are two methodological approaches in comprehending of mountainous element: 1) relatively parochial and 2) extensive. In the first case, the mountainous element includes species growing in the one to two belts of Holarctic mountains, in the second, species growing preferably in the mountainous belts.

In our investigation we support the second viewpoint which seems most substantiated as alpine and subalpine vegetation have no analogue on the plains, and the mountainous forest belts also differ in specific ecological conditions. Therefore, the concept of the mountainous element involves species of alpine, subalpine, boreal-mountainous and nemoral-mountainous subelements. Moreover, taking into account the loose relation of some species to definite altitude belts, we distinguish (out of species of the Central European mountainous geographic element found in Byelorussia) the subalpine-mountainous-forest subelement, which includes species distributed in the subalpine belt as well as in the open habitats of the forest belt.

It is rather important to define the principle on the basis of which we specify geographic elements of flora. As it becomes clear from the analysis of the viewpoints of the supporters of relatively parochial and extensive approaches

to the mountainous geographic element, the regional and zonal principle of mountainous element specification takes place in both cases but in different ways. As noted by many of the above-mentioned researchers, the main principle of specification of the mountainous element is zonal; however, while the subdividing element into subelements or variants, the zonal system becomes regional and zonal.

As TRASS (1970) has noted, the zonal principle of classification may not be applied to all species. Thus, in his opinion, representatives of azonal elements (including alpine and mountainous) are not consistent with this principle. OKSNER (1974) also pointed out that some corrections must be made in the zonal classification of geographical elements in the plant groups with stricter requirements to climate moisture than of heat exchange (mountainous species may be referred to this group). Taking into account all these specific factors when we deal with species of the Central European mountainous geographic elements as in Byelorussia, we classify the latter on the basis of the regional and zonal principle.

In the process of determining the relation of a number of Byelorussian flora species to the Central European mountainous geographic element, an extensive literature study enabled us to make an analysis of their distribution and of the ecological and phytocenotic conditions of growth in various zones of their ranges. Comprehensive study of works containing such information has shown that, when researchers (Polish scientists) support principally the same position in the identification of the mountainous geographic element, the lists of species they refer to this element are quite different from each other. This especially concerns species of mountainous forest belts. The reason lies not only in the fact that certain species are absent in the flora of the territory discussed, but in the relatively poor specificity of the ecological conditions of the medium altitude of the mountainous belts. Therefore, the 'mountainous' characteristic of some species is not so apparent (TRASS 1968). The almost complete absence of scientific information in literature on changes of the phytocenotic role of these species within a range complicates the identification of the species of the Central European mountainous geographical element.

The first attempt to reveal the mountainous element of Byelorussian flora applying analysis according to zonal principle was made by POLYANSKAYA (1931). While geographically analysing Byelorussian flora, we did not identify the mountainous element, but rather treated species of the Central European mountainous geographical element in the framework of the Central European subelement of the European geographical element.

The Central European mountainous geographical element which we have identified (BLAZHEVICH 1986) in the composition of Byelorussian flora is represented by species of nemoral-mountainous, boreal-mountainous and subalpine-mountainous-forest subelements. The nemoral-mountainous subelement is constituted of *Allium ursinum* L., *Aposeris foetida* (L.) Less., *Aruncus vulgaris* Rafin., *Astrantia major* L., *Festuca altissima* All., *Geranium phaeum* L., *Hordelymus europaeus* (L.) Harz., *Isopyrum thalictroides* L., *Laserpitium latifolium* L., *Lunaria rediviva* L., *Phyteuma nigrum* F.W. Schmidt, *Pleurospermum austriacum* (L.) Hoffm., *Ribes alpinum* L., *Ribes lucidum* L., *Senecio rivularis* (Wald. et Kit.) DC.; the boreal-mountainous subelement is represented by *Abies alba* Mill., *Alnus incana* Moench, *Trifolium spadiceum* L.; the subalpine-mountainous-forest subelement includes *Ajuga pyramidalis* L., *Arnica montana* L., *Carex davalliana* Sm., *Lathyrus laevigatus* (Wald. et Kit.) Gren., *Swertia perennis* L., *Tofieldia calyculata* (L.) Wahlb.

It is necessary to point out that according to some assumptions (KLEOPOV and OKSNER 1935, POPOV 1949) populations of the same species in the mountains and plains differ morphologically from each other.

3.2. SIMILARITY OF PHYSICAL AND GEOGRAPHICAL CONDITIONS IN THE MOUNTAINS AND PLAINS OF EUROPE

A comparative analysis of the main physical and geographical factors of the Byelorussian and the Central European mountains reflects the definite similarities and differences. At the same time, the relief is not to be analysed because it is quite clear that we are dealing with landscapes of mountains and plains. However, it is necessary to note that 30% of the Byelorussian territory is highlands which, as well as the mountains, are characterized by a higher diversity of ecotopes in comparison with lowlands and plains.

The characteristics of a number of the climatic elements of Byelorussia are similar to the characteristics of the belt of pre-mountain oak woods, beech and spruce altitudinal vegetation belts of the Central European mountains. Mean annual temperatures (January and July), duration of periods with temperature higher than 0° (+5°) and (+10°) represent correlated characteristics, but characteristics of all mentioned climatic elements in the pre-mountain oak and spruce woods belt are higher, respectively lower in Byelorussia. Characteristics of these elements are even lower in subalpine and alpine belts. Characteristics of climatic elements of Byelorussia and mountainous beech woods are

very close in spite of warmer winter and cooler summer in the beech wood. Annual precipitation is higher in all altitudinal belts of the Central European mountains than in Byelorussia. It is likely that precipitation in some regions of the pre-mountain oak belt is equal to the amount of precipitation of the Republic's highlands. In this respect, the moisture coefficient during the warm season in the pre-mountain oak wood, e.g. Ukrainian Carpathians, is close to the moisture coefficient of the highlands of the Byelorussian ridge, particularly in the Novogrudskaya highland.

Soil formation, as known, is dependent on the climate. Brown forest soils are typical of the Central European zone and prevail in the mountains. Dernopodzolic soils dominate in Byelorussia and brown forest soils are fragmentarily distributed in the western part of Byelorussia, where there is a maximum impact of transitional climate.

Forests of the geobotanical subzones of Byelorussia, to a certain extent, (without species composition) are analogous to forests of the same altitudinal belts of the Central European mountains: broad-leaved pine forests, prevailing in the south of the Republic, give place to oak and dark coniferous woods (in the same manner broad-leaved forests give place to spruce forests in the mountains of Central Europe).

The presence of certain edificators (*Picea abies* (L.) Karst., *Carpinus betulus* L., *Quercus robur* L.) and subedificators (*Acer platanoides* L., *Tilia cordata* Mill., *Ulmus glabra* Huds., *Fraxinus excelsior* L.) in the forests of Byelorussia and in the mountains of Central Europe makes it possible to suppose that phytocenotic conditions of Byelorussian forests, to some extent, are comparable with the conditions of forest communities of the mountains of the mentioned region.

Similarities in the main physical and geographical factors of Byelorussia and the mountains of Central Europe, revealed in the process of their comparison, are explained by the fact that Byelorussia (the greater part of its territory) and the mountains of Central Europe are situated in the zone of transitional climate (from marine to continental); differences are caused by the fact that Byelorussia lies on the extreme eastern boundary of the influence exerted by this type of climate.

As a whole, species of the Central European mountainous element in the European part of the USSR, as demonstrated in literature, are distributed mainly in the zone of transitional climate, restricted to the North and South by the borderlines of the warm moist climatic zone with a temperate mild winter. Within the boundaries of the zone the majority of the analysed species is not

found in the Polessye, which is rather close to forest-steppe zone according to the hydrothermic regime and differs through specific edaphic conditions (wide distribution of sandy soils and peat lowlands).
The basic physical and geographical factors of the mountains of Central Europe are definitely similar to these characteristics not only in Byelorussia, but in other regions of the European part of the USSR. It is this similarity that determines the possibility of individuals of the Central European mountainous element species to develop in this region. Differences in the basic physical and geographical factors occurring within the European part of the USSR determine the peculiarities of the distribution of these species.

3.3. ECOLOGICALLY, PHYTOCENOTICALLY AND BIOLOGICALLY PECULIAR FEATURES OF MOUNTAINOUS SPECIES GROWING ON A PLAIN

In our opinion, the prevalence of species of the mountainous element in the highlands of the Byelorussian range is explained firstly by high humidity of this part of the Republic in comparison with the rest of the territory. This factor is rather significant for the viability of investigated species because in the mountainous zone of the range they grow under conditions of higher humidity than in Byelorussia.
The coefficient of humidity in pre-mountainous oak woods during the warm season is 1.1-1.7 (according to IVANOV 1957), while in the beech and spruce forests it is 2.0-2.3 and 2.5-4.2, respectively. The coefficient value is close to 1.0 in the Northern agroclimatic province of Byelorussia, while in the Central province it is 0.87-0.90, but in the Novogrudskaya highland and the Southern province the coefficient is 1.0-1.2 and 0.8, respectively. Soils characterized by rather high natural fertility and broken relief creating more ecotopes than in the plains favour the growth of the Central European mountainous species on the highlands of the Byelorussian range.
The common ranges of well-known species of the Central Europe mountainous geographical element in Byelorussia are characterized by disjunction and 'island' habitats beyond the regions of their continuous distribution. In Byelorussia all Central European mountainous species are found in the boundary zones of their ranges on the plain and they are regarded as rare. Their habitats are more often found in the highlands of the Byelorussian range. Ecotopes, related to analysed species, are characterized by certain ecological and phytocenotic peculiarities.

Information on mountainous species distribution reveals that four apparently known species are found on the plains of Predpolessye: *Arnica montana*, *Carex davalliana*, *Lathyrus laevigatus*, *Tofieldia calyculata* and four species in the highlands of the Byelorussian range (*Arnica montana*, *Lathyrus laevigatus*, *Swertia perennis*, *Tofieldia calyculata*), two species in Poozerye (*Arnica montana*, *Lathyrus laevigatus*) and one species in Polessye (*Arnica montana*).

The presence of one population in Byelorussia (*Carex davalliana*) makes it possible to consider it as a unique species. *Swertia perennis* and *Tofieldia calyculata* are included in the group of very rare species, while *Lathyrus laevigatus* and *Arnica montana* are included in the groups of rather rare and rare species, respectively.

Based on distribution data of the Central European mountainous species in Byelorussia, it is possible to conclude that the majority prefers the plains of Predpolessye (in the Belovezhskaya Puscha: *Aruncus vulgaris*, *Geranium phaeum*, *Hordelymus europaeus*, *Isopyrum thalictroides* and *Lathyrus laevigatus*, in the Velensky Reserve: *Carex davalliana*, *Phyteuma nigrum*, and *Senecio rivularis*). The total number of habitats of the Central European mountainous species in the highlands of the Byelorussian range significantly outnumbers on the plains of Predpolessye. It is necessary to note that species, found in some geomorphological provinces of the Republic have more numerous populations in the highlands.

Summarizing the information on peculiarities of the current distribution of species of Central European mountainous geographical element in Byelorussia, we may conclude that the centre of their distribution in the Republic is the highlands of the Byelorussian range.

The ecological and phytocenotic amplitude of species within the range is not constant, it is narrowed when the species approaches boundaries of the range (GREBNER 1914, CAJANDER 1903, 1909). The peculiar feature of the adaptive plant behaviour has been substantiated while studying edificator woody plants, both near and within the boundaries of the forest zone. It has been established that within the forest zone under conditions of severe interspecific competition and climate, edificator species close to the boundaries of their are driven out in optimum ecotopes, where their individuals and populations are characterized by higher viability (GELTMAN 1973, 1982, GELTMAN et al. 1972, PARFENOV 1964, 1980, YURKEVICH and GELTMAN 1965, YURKEVICH et al 1971). Edificator species near and beyond the boundaries of the forest zone experience little competition from other edificators and are able to preserve their po-

sitions not only in the ecotopes with favourable combination of ecological factors (YURTSEV 1962, TOLMACHEV 1974), but in the less optimum ecotopes (GELTMAN 1982). In this case viability of their individuals and populations decreases.

The behaviour of grass plants on the boundaries of species ranges is yet to be studied. GORCHAKOWSKY (1968, 1972) has established that on the eastern extreme of distribution (the Urals). Grass plants which are concomitant of broad-leaved trees often grow beyond broad-leaved woods. SIMACHEV (1980) has shown that some rare or extinct 'boundary' species of Leningrad province exhibit high viability within a wide ecological and phytocenotic amplitude, while the others are associated with certain ecological and phytocenotic conditions where they also exhibit high viability. In order to estimate its value SIMACHEV suggested to use the following criteria: 1) complete life history of plants (complete ontogenesis), 2) age structure of populations and 3) width of ecological and phytocenotic amplitude. The first two criteria testify to the viability of populations which, as it is known, are the structural units of species. The ecological and phytocenotic amplitude of species is one of the integrating factors of species taken as a whole. As far as the use of ecological and phytocenotic amplitude as a criterion of viability, it is necessary to make some clarification. We may consider this amplitude wide or narrow in this or that zone of species range only when we make comparisons with its central zone where ecological and phytocenotic amplitude of species includes, as a rule, a great number of habitat types.

In order to reveal the width of the ecological and phytocenotic amplitude, many scientists who have studied the behaviour of woody edificator species within the forest zone and our investigators (BLAZHEVICH 1978, BLAZHEVICH and SHABLINSKY 1976) who are studying habitat conditions of species of the Central European mountainous element in Byelorussia have accepted the wood type as the basic typological unit. In our work this unit also includes types of habitat conditions characterized by certain ecotopes. Bearing this in mind, we have compared the amplitude of growth conditions of the investigated species on the boundaries of their ranges on the plain in Byelorussia and in the central mountainous zone (mountains of Central Europe).

Based on this information we consider that the ecological and phytocenotic conditions in the habitats of the Central-European mountainous species of Byelorussia provide high (I-st) and medium (II, IIb) rates of viability. Lowered (IIIa, IIIb) and low (IV, V) rates of population viability of the investigated species are caused by aggravation (in respect to requirements of certain spe-

cies) of phytocenotic conditions in the habitats as a result of natural and anthropogenic successions.

Summing up the obtained data on the viability of populations and the width of the ecological and phytocenotic amplitude of Central-European mountainous species in Byelorussia, it is reasonable to conclude that in spite of the fact that individuals of all of the Central-European mountainous species in the boundary zones of their ranges on the plain in Byelorussia are passing through a generative period of development and populations are characterized by effective self-maintenance that testifies to their high viability. Viability of the studied species is lowered, as their ecological and phytocenotic amplitude has become narrower in comparison with the central mountainous zone of species' ranges.

Making a complex estimation of the peculiarities of common ranges, current distribution, ecological and phytocenotic conditions of growth and biology of species of the Central European mountainous geographical element in Byelorussia and the historical development of vegetation, reflected in the works of Byelorussian paleobotanists (MAKHNACH 1971, MAKHNACH et al. 1981, VELICHKEVICH 1982), we consider that these species may be regarded as relicts on the territory of Byelorussia.

3.4. GENESIS AND MIGRATION OF MOUNTAINOUS SPECIES TO THE PLAINS

Based on viability conditions and distribution of mountainous species in Byelorussia and on extensive literature on this subject, we studied periods and routes of the species migration. In this regard, we have to take into account various geologic origins of the Byelorussian highlands, lakes, watersheds, paleogeographic conditions of climate during the formation of the relief and distribution of mountainous species. According to some important authors (MAKHNACH 1971, MINYAEV 1969), climatic conditions of the Likhvian interglaciation favoured the migration of species of western origin to the East. In this period, some mountainous species tended to appear on the territory of Byelorussia. The maximum Dnieper glaciation completely annihilated vegetative cover on its territory. Late phases of the Mikulin interglaciation represented a new stage of mountainous species migration. During this period they advanced together with spruce from the eastern Carpathians. The Valdai glaciation again caused annihilation of flora on some territory of Byelorussia, even to the South of the boundary of glacial cover, because the epoch of the Valdai

glaciation, especially its late stage, was the most severe period of Pleistocene. The Holocene periods (preboreal, atlantic and subatlantic) may be regarded as the most favourable for the appearance of mountainous species on the Byelorussian territory. Subsequent climatic changes, characterized by higher continentality and devastating man's impact on the forest, induced significant deforestation of the Byelorussian territory and a lower occurrence of broad-leaved trees. This phenomena entailed a lower presence of mountainous species in its composition.

This fact may be proved by a list of species, referred to in the works of PACZOSKI (1900) in respect to the Byelorussian territory, but which were not collected for dozens of years, in spite of the fact that reiterated floristic investigations have been undertaken (*Melampyrum silvaticum*, *Cirsium erisithales*, *Corydalis intermedia*, *Gagea pratensis*, *Gymnadenia odoratissima*, *Aposeris foetida*). We suppose that these species have lost their place in the composition of the Byelorussian flora due to various reasons and, firstly, due to the anthropogenic impact on nature.

Taking the mountainous species as an example and using the obtained data (PARFENOV 1979, 1980) and literature information (PACZOSKI 1900, SZAFER 1930, POLYANSKAYA 1931) on genetic relations between Byelorussian flora and flora of the eastern Carpathians and phytogeographic peculiarities of the current distribution of the European species, we outlined their historically possible migration routes on the territory of Byelorussia. The western migration route was initiated from the alpine-Sudeten-western Carpathians centre and extended in two directions (through northern Germany and Polish lowlands) on the territory of the western Byelorussia. This route is revealed in peculiarities of the current distribution of mountainous species (as already mentioned, we observe the density of mountainous species in the highlands and Belovezhskaya Puscha as well). *Abies alba*, *Hierochloe australis*, Hor*delymus europaeus*, *Allium ursinum*, *Dactylorhiza sambucina*, *Gladiolus palustris*, *Corydalis intermedia*, *Lunaria rediviva*, *Geranium phaeum*, *Swertia perennis*, *Ajuga pyramidalis*, *Arnica montana* and *Cirsium erisithales* likely penetrated to the Byelorussian territory via this route.

The south-western route initiated from mountainous and pre-mountainous regions of the eastern Carpathians and extended in several directions on the territory of Polessye through the Volyno-Podolskaya highland (SZAFER 1930). This supposition is proved by more significant current occurrence of mountainous species (the European species as well) in the eastern and southern parts of Polessye in comparison with its western and northern parts and their

several morphological and biological peculiarities. The data obtained while studying the structure of the population and the intraspecific changeability of *Picea abies* (PARFENOV 1964, 1971) may serve as the main evidence for this route of mountainous species migration to the territory of south eastern Polessye.

In Polessye, a form of *Picea abies*, found only in 'islands' habitats is very similar to that of the eastern Carpathians and is unified in a special variety (ssp. *acuminata* [G. Beck] Parf.). In the forests of eastern Polessye this subspecies makes up 84% and in western Polessye 30%. Via this route, *Gagea pratensis*, *Gymnadenia odoratissima*, *Ribes alpinum*, *R. lucidum*, *Daphne cneorum* and *Aposeris foetida* appeared on the territory of the Byelorussian Polessye. *Picea abies*, *Tofieldia calyculata*, *Cimicifuga foetida*, *Isopyrum thalictroides*, *Aruncus vulgaris*, *Trifolium spadiceum*, *Helianthemum nummularium*, *Astrantia major*, *Laserpitium latifolium*, *Cruciata glabra*, *Sambucus racemosa* and others grow along the whole Sudeten-Carpathian Bulge and for this reason their penetration is associated with these two routes.

SUMMARY

Species of the Central European mountainous geographical element have been specified in the composition of the flora of the plains. According to genesis these species are composed of nemoral-mountainous, boreal-mountainous and subalpine-mountainous-forest subelements. Growth of the Central European mountainous species on the plains is associated with close transitions from marine to continental climate and soil-hydrological conditions of ecotopes. There is a narrower ecological and phytocenotic amplitude in the plains than in the central mountainous zone. In the plains these species grow either close to the boundaries of their natural continuous distribution or in 'islands'. Due to this fact, the phytogeographical peculiarities (lowered viability, relictness and rarity) of these species, growing on the plains, predetermines their protective strategy in natural habitats. All of these species are included in the Red Data Book of rare and endangered plants and animals in Byelorussia.

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