Geographic analysis of the flora of the Savelievsky floodplain forest of the Terek river valley

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Abstract. The geographical analysis of the flora is of great importance for substantiating its phytodiversity and understanding the processes of florogenesis. The article studies the composition and geographical elements of the flora of the Savelievsky floodplain forest of the Terek River valley (Chechen Republic), represented by 132 species of vascular plants from 119 genera and 55 families. By the number of genera and species, the dominant families are Asteraceae (14 genera and species), Rosaceae (12 and 13), Fabaceae (6 and 6), Ranunculaceae (4 and 6), Brassicaceae, Lamiaceae (5 and 5 each), Boraginaceae (4 and 4), Orchidaceae, Poaceae (3 and 4 each), Apiaceae, Liliaceae (3 and 3 each), Geraniaceae, Rubiaceae, Salicaceae (2 and 3 each). 7 families (Aceraceae, Apiaceae, Corylaceae, Convolvulaceae, Scrophulariaceae, Rhamnaceae, Cornaceae) contain 2 genera and 1 species, 26 families – 1 genus and species. In the studied flora, 6 geotypes and 17 geographic elements were identified. According to the prevailing geotypes and geoelements, the forest flora is characterized as general-Holarctic-boreal with the dominance in the geotypes of the Palaearctic and European geoelements, with noticeable participation of the geoelements of the binder and the drain-Mediterranean geotypes. The abundance of species of different geographical origin in the forest flora ensures its phyodiversity, the preservation of which is a necessary condition for the sustainable functioning of the ecosystem of the floodplain forest, which performs a complex of nature conservation functions.

1. Introduction
The flora of any territory is the result of complex processes in the history of the Earth, accompanied by the formation or destruction of relief, transgression or regression of the sea, climate change, glaciation, retreat of glaciers, speciation, and migration processes.

In a comprehensive study of the flora of a specific territory, it is important to consider not only the species, systematic and biomorphological composition, and other important aspects, but also the participation in its formation of species of different geographical origin – geo elements. Geographic analysis, based on the spectrum of geo elements, reflects their share of their participation in the flora of the studied territories, allowing to justify its biodiversity, territorial distribution of species, to designate the dominant geographical elements and, considering the geological history of the Earth, to
understand the possible paths of historical migration of species, to approach the correct understanding of the issues of phlorogenesis.

There are different approaches to classifying geographic elements. Some researchers – Wolf [1, 2], Walter, Straka [3]; Tolmachev, [4] and others consider them as a group of species with a similar type of area. Most of the others are Braun-Blauquet [5, 6]; Eig [7]; Davis [8]; Zohary [9]; Yurtsev, Kamelin [10] and others are based on the concept of phytochorions, the confinement of species ranges to certain floristic kingdoms, regions, provinces, etc.

The study was carried out to identify the geographical elements that form the phyto-diversity of the floodplain forest. The task of the study was to consider the species composition of flora and species of various geographic origin.

2. The object of the research and the methodology

Floristic research on the territory of the Savelievsky forest, we carried out during 2016–2018. For a detailed acquaintance with the flora, routes were developed covering from north to south and from west to east different areas and habitats of the Terek river floodplain in the vicinity of the village of Savelievskaya, Naursky district of the Chechen Republic. Field studies were carried out in different seasons of the year – early spring, summer, and autumn. All species of vascular plants growing during the observation period were recorded. To clarify the species, a 3-volume A.I. Galushko “Flora of the North Caucasus” [11] and the summary by S.K. Cherepanov [12].

In the geographical analysis of the flora, the system of geo elements by A.L. Takhtadzhyan [13], based on the botanical-geographical zoning of the Earth concerning the territory of Russia (Kamelin, 2004 [14]), modified by N.N. Portenier for the flora of the Caucasus [15].

When determining the geo elements of the studied flora, the works of N.N. Portenier [15], A.L. Ivanova [16], M.A. Taisumova, F.S. Omorkhadzhieva [17].

3. Analysis and results of the research

Scientific publications [18–20] describe the flora and vegetation of the floodplain forests of the Terek River valley. Information about the investigated Savelievsky part of the forest is contained in the article by Y.S. Gapaeva, M.U. Umarova, M.A. Taisumova [21].

In the flora of the studied floodplain forest, 132 species of vascular plants belonging to 117 genera and 55 families were identified. By the number of genera and species, the most represented are the families Asteraceae (14 genera and the same number of species), Rosaceae (12 and 13, respectively), Fabaceae (6 and 6), Ranunculaceae (4 and 6), Brassicaceae, Lamiaceae (5 genera and species ), Boraginaceae (4 and 4), Orchidaceae, Poaceae (3 and 4), Apiaceae, Liliaceae (3 and 3), Geraniaceae, Rubiaceae, Salicaceae (2 and 3), 7 families contain 2 genera with 1 species in each. 26 families include only one genus and one species. During geographical analysis in the studied flora, we identified 6 geotypes with 17 geo elements:

- **I. Plur-regional – 6 (4.55 %) species**
  1. Plur-regional. Includes species widespread in 2 or more floristic kingdoms, with areas beyond the Holarctic kingdom: Bidens tripartita L., Capsella bursa-pastoris (L.) Medik., Chenopodium album L., Abutilon theophrastii Medik., Plantago lanceolata L., Phragmites communis Trin. A total of 6 (4.55 %) species.

- **II. Holarctic – 41 (31.06 %) species**
  2. Holarctic. Species found in all (or almost all) areas of the Holarctic kingdom: Equisetum pratense Ehrh., Phalacronema annuum (L.) Dumort. [Erigeron annuus (L.) Pers., Stenactis annua (L.) Cass.], Humulus lupulus L., Stellararia media (L.) Vill., Poa pratensis L., Ranunculus repens L., Thalictrum minus L., Fragaria vesca L., Galium aparine L – 9 species (6.82 %).

3. Palaeartic. Species with ranges covering the temperate and subtropical regions of the Holarctic Kingdom of the Old World without definite confinement to one of the subkingdoms: Daucus carota L., Falcaria vulgaris Bernh., Carduus crispus L., Cichorium intybus L., Inula helenium L., Senecio vernalis Waldst. et Kit., Thlaspi arvense L., Corylus avellana L., Alliaria officinalis Andrz. ex Bieb.
Cardamine impatiens L., Amoria repens (L.) C. (Trifolium repens L.), Medicago lupulina L., Melilotus officinalis L. Pall., Erodium cicutarium L. Her., Glechoma hederacea L., Lythrum salicaria L., Platanthera bifolia L. Rich., Plantago major L., Prunella vulgaris L., Calamagrostis arundinacea L., Poa bulbosa L., Rumex confertus Willd., Frangula alnus Mill., Rhamnus cathartica L., Rosa canina L., Potentilla reptans L., Rubus caesius L., Salix alba L., Salix caprea L., Euphrasia pectinata, Ulmus suberosa Moench, Urtica dioica L. 32 species in total (24.24%)

- III. Boreal – 50 (37.88 %) species

4. Euro-Siberian. Species common in the Eurasian part of the Circumboreal region, absent in the New World: Solidago virgaurea L., Geranium sylvaticum L., Clinopodium vulgare L., Circaea lutetiana L., Listera ovata L., Rumex acetosa L. Total 6 species (4.55%). 5. Takhtadzhyan A.L. Floristic division of land. M.: Education, 1974. S. 117–143.

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- IV. Ancient Mediterranean – 14 (10.6 %) species

11. Common ancient Mediterranean. Species widespread in the Mediterranean and Irano-Turan regions of the Ancient Mediterranean Kingdom (Takhtadzhyan, 1978): Carthamus lanatus L., Cornus mas L., Swida australis (C.A. Mey.) Pojark. ex Grossh. (Thelycrania australis auct.), Euphorbia falcata L., Ranunculus meyerianus Rupr., Cydonia oblonga Mill., Mespilus germanica L., Prunus divaricata Ledeb., Veronica persica Poir. There are 9 (6.82 %) species in total.

12. Zapadnodrevner Mediterranean. Species with ranges in all or most of the Mediterranean region, extending in the east into the western part of the Irano-Turan region: Periploca graeca L., Sambucus ebulus L., Linum austriacum L., Ficaria calthifolia Reichenb., Cruciata laeves Opiz (Galium cruciata (L.) Scop.). There are 5 (3.79 %) species in total.

- V. Binders – 16 (12.12 %) types

13. Sub-Caucasian. With the main range in the Caucasian province, partly overlapping the territory of the Euxin province of the Euro-Siberian region and the Armeno-Iranian province of the Iran-Turan province: Allium paradoxum (Bieb.) G. Don., Lonicera caprifolium L., Polygonatum orientale Desf. (P. petchianum (Bieb.) A. Dietr.), Malus orientalis Uglikz. Only 4 ( %) species.

14. Sub-Caucasian. With the main range in the Caucasian province, partly overlapping the territory of the Euxin province of the Euro-Siberian region and the Armeno-Iranian province of the Iran-Turan province: Allium paradoxum (Bieb.) G. Don., Lonicera caprifolium L., Polygonatum orientale Desf. (P. petchianum (Bieb.) A. Dietr.), Malus orientalis Uglikz. Only 4 ( %) species.

15. Subpontic. Includes species with a predominance of range in the steppe and forest-steppe regions of the European and predominantly western regions of the Euxin province of the European-
Siberian region, the eastern regions of the Illyrian province, the Central Anatolian and Eastern Mediterranean provinces of the Mediterranean region: Vincetoxicum laxum (Bartl.) Gren. et Godr., Taraxacum officinalis L., Corydalis marschalliana (Pall. ex Willd.) Pers. A total of 3 (2.27\%) species.

16. Subturan. It combines species whose ranges cover the forest-steppe and steppes of the East European and West Siberian provinces of the Euro-Siberian region and the northern part of the Turan province of the Iran-Turan region: Sium sisaroidum DC., Iris pseudonotha Galushko, Tulipa biebersteiniana Schult. et Schult. fil., Thesium arvense Horvatovszky. There are 4 (3.03\%) species in total.

- VI. Adventive – 6 (4.55\%) species

17. Adventive. Includes species introduced by humans from other geographic areas: Negundo aceroides Moench., Erigeron cannadensis L., Amorpha fruticosa L., Gleditschia triacanthos L., Morus nigra L., Ailanthus altissima (Mill.) Swingle. There are 6 (4.55\%) species in total.

For the convenience of comparative analysis, the geo elements of the flora are summarized in Table 1.

It can be seen from the above data that the leading place in the flora of the studied floodplain forest is occupied by geo elements of the boreal geotype (37.12\% of the flora), among which the European geo elements (12.88\% of the studied flora) are significantly dominant. Equally, but half as often (6.82\% each), represented by the Euro-Caucasian and Caucasian. The second place in the flora (3b, 06\%) is occupied by geo elements of the general Holarctic geotype, among which the Palaearctic ones more than three times prevail over the Holarctic ones (24.24 and 6.82 \%, respectively). Geo elements of the ancient Mediterranean and binding geotypes (10.6 and 12.12 \%, respectively) take approximately equal part in the forest flora; in the first of them, the common ancient Mediterranean geo elements (64.29 \%) predominate, in the connecting geotype, sub-Mediterranean (31.25 \%) and somewhat weaker (25 \% each) sub-Caucasian and sub-Turanian.

In the smallest amount, but equally (4.55 \% each), there are geo elements of pluriregional and (4.55 \% each) adventive geotypes.

According to the prevailing geotypes and geo elements, the flora of the Savelievsky floodplain forest can be considered general-Holarctic-boreal (90 species – 68.18 of the entire studied flora) with dominance in the geotypes of the Palaearctic (24.24 \%) and European geo elements (12.88 \%) with noticeable participation of binder geo elements (12.12 \%) and Mediterranean drainage geotypes (10.60 \%).

The presence in the investigated flora of geo elements of various geographic origin, which form its phytodiversity, is the result of long-term processes of phlorogenesis, taking place against the background of the geological history of the Earth, relief formation, climatic transformations, species-forming processes, historical migration of species, etc.

The studied flora is rich in economically useful plants. There are many relics and species in it that need protection. Of the protected species listed in the Red Data Book of the Chechen Republic [23], it contains Ophioglossum vulgatum, Allium paradoxum, Periploca graeca, Berberis vulgaris, Iris pseudonotha, Ornithogalum arcuatum, Tulipa biebersteiniana, Ortis nis ovatus Vitis sylvestris.

The presence of species of different geographical origin in the forest flora ensures its phytodiversity, the preservation of which is a necessary condition for the sustainable functioning of the ecosystem of the floodplain forest, which performs a complex of nature conservation functions.
Table 1. Geographical elements of the flora of the Savelievsky floodplain forest of the Terek river valley

| №  | Geotypes and geo elements of flora | Number of species | % of species in the flora of the forest | % of species in geotype |
|----|-----------------------------------|------------------|----------------------------------------|------------------------|
| I  | Plur-regional                      | 6                | 4,55                                   | 100                    |
|    | Plur-regional                      | 6                | 4,55                                   | 100                    |
| II | General Holarctic                  | 41               | 31,06                                  | 100                    |
|    | Holarctic                          | 9                | 6,82                                   | 21,95                  |
|    | Palaearctic                         | 32               | 24,24                                  | 78,05                  |
| III | Boreal                             | 49               | 37,12                                  | 100                    |
|    | Euro-Siberian                      | 6                | 4,55                                   | 12,25                  |
|    | Euro-Caucasian                     | 9                | 6,82                                   | 18,37                  |
|    | European                           | 17               | 12,88                                  | 34,69                  |
|    | Caucasian                           | 9                | 6,82                                   | 18,37                  |
|    | Euxinian                            | 2                | 1,52                                   | 4,08                   |
|    | Pontic-South Siberian              | 1                | 0,75                                   | 2,04                   |
|    | Pontic                              | 5                | 3,78                                   | 10,20                  |
| IV | Ancient Mediterranean              | 14               | 10,60                                  | 100                    |
|    | Ancient Mediterranean              | 9                | 6,82                                   | 64,29                  |
|    | Western Ancient Mediterranean      | 5                | 3,78                                   | 35,71                  |
| V  | Binders                            | 16               | 12,12                                  | 100                    |
|    | Sub-Mediterranean                  | 5                | 3,79                                   | 31,25                  |
|    | Sub-Caucasian                      | 4                | 3,03                                   | 25,00                  |
|    | Subpontic                           | 3                | 2,27                                   | 18,75                  |
|    | Subturan                            | 4                | 3,03                                   | 25,00                  |
| VI | Adventive                          | 6                | 4,55                                   | 100                    |
|    | Adventive                           | 6                | 4,55                                   | 100                    |
|    | Total                               | 132              | 100 %                                  |                        |

4. Conclusion
In the flora of the Savelievsky floodplain forest of the valley of the river, Terek identified 132 species of vascular plants belonging to 117 genera and 55 families. It is formed by representatives of various, geographically distant, or adjacent floras – 6 geotypes (pluriregional, general-Holarctic, boreal, ancient Mediterranean, dvazyushchy, adventive) with 17 geo elements.

According to the prevailing geotypes and geo elements, the flora is characterized by general Holarctic-boreal (90 species – 68.18 of the entire studied flora) with the dominance in the geotypes of the Palaearctic (24.24 %) and European geo elements (12.88 %) with noticeable participation of binder geo elements (12.12 %) and Mediterranean drainage geotypes (10.60 %). The flora is rich in resource-useful plants and relics of scientific interest. The complex protective functions of floodplain forests, a variety of species of different geographic origin, the presence of relics, and resource-significant groups of plants requires strict adherence to the environmental regime as a necessary condition for the preservation of phyto-diversity and sustainable functioning of ecosystems in the Terek River valley.

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