FLORA OF THE STANA PLATEAU, NORTHEASTERN BULGARIA

Dimcho ZAHARIEV, Monika TODOROVA

Konstantin Preslavsky University of Shumen
115 Universitetska Str., 9700 Shumen, Bulgaria
author email: d.zahariev@shu.bg

Corresponding author email: d.zahariev@shu.bg

Abstract

As a result of the field study of the flora of the Stana Plateau conducted in 2024-2025, a significant taxonomic diversity of spontaneously distributed vascular plants was established: 663 species, which belong to 356 genera and 74 families. In the taxonomic structure of the flora, the predominant part of the families and genera on the territory of the plateau are represented by a small number of lower taxa - from 1 to 4. The large number of floristic elements (44 in number) is due to the transitional natural-geographical location of the plateau. All possible life forms have been identified, with the predominant ones being those that are characteristic of forest habitats and anthropogenically influenced territories in the region. All possible biological types have been established in the composition of the flora, with perennial herbaceous plants prevailing, which are characteristic of all plant communities on the plateau. The economically valuable plant species on the plateau have a variety of uses: obtaining herbs, obtaining fruits, honey plants, and wood production. A large number of anthropophytes (370 species) and invasive alien plant species (17 species) have been identified, of which 3 species pose the greatest threat to the natural flora and arable land on the plateau. The number of ornamental plants and species grown as forest crops is significant, due to the use of the plateau for recreation near the town of Novi Pazar.

Key words**: **flora, taxonomic structure, phytogeographic structure, life forms, biological types, anthropophytes, invasive species

INTRODUCTION

The Stana Plateau is one of the high plateaus located in the Eastern Danube Plain on the territory of Bulgaria (Fig. 1). The relief is plateau-like, with the steepest slopes to the west towards the Kriva Reka valley, to the south towards the Provadiyska Reka valley and to the southeast towards the Zlatina River valley. To the northeast and north, the slopes smoothly connect with the neighboring Dobrudzhansko and Ludogorsko plateaus (Michev et al., 1980). The area of the Stana Plateau is 165.5 km2. The highest point is located at 440.9 m above sea level. A characteristic feature of the plateau is the lack of rock crowns and exposed rock massifs.

The majority of the plateau is made up of clayey limestones and marls. In addition to these, the following rock types are also common: limestones, clayey marls, loess, sandy loess, clayey loess.

In terms of soils, the largest area is occupied by leached chernozems (heavy sandy-clay), and the smallest area is occupied by gray forest, alluvial and alluvial-meadow soils. In addition to them, the following soil types are also widespread: rendzins (humus-carbonate), carbonate chernozems (sandy-clay), leached chernozems (eroded), podzolized (leached) chernozems and dark gray

forest soils (heavy sandy-clay), gray forest (medium and heavy sandy-clay).

Figure 1. Geographical location of the Stana Plateau

The main watershed between the rivers flowing to the Danube and the rivers flowing to the Black Sea runs along the ridge of the Stana Plateau. Two rivers originate from the plateau: Zlatina and Karamandere. Both rivers are rain-snow fed. Their maximum flow is in February-March, and their minimum is in August-September. Several small dams have been built on the territory of the Stana Plateau. All of them are located in the northern part of the plateau. The largest among them is the Dulapdere dam, east of the village of Preselka (Michev et al., 1980; Google Maps).

In floristic terms, the Stana Plateau belongs to the floristic region of North-eastern Bulgaria (Yordanov, 1963). Up to now, the flora of the plateau has not been studied.

MATERIALS AND METHODS

The flora survey was conducted in 2024 and 2025. The route method was used. In determining the species affiliation of the plants identified during the fieldwork, the following specialized literature was used: Identifier of plants in Bulgaria (Delipavlov et al., 2011), Key to the native and foreign vascular plants in Bulgaria (Stoyanov et al., 2021; Stoyanov et al., 2022), Flora of the People's Republic of Bulgaria, volumes 1 to 9 (Yordanov, 1963-1979; Velchev, 1982, 1989) and Flora of the Republic of Bulgaria, volume 10 (Kozhukharov, 1995) and volume 11 (Peev, 2013). The author's Latin names of the species are according to The World Flora Online. The families are presented according to APG IV (Angiosperm Phylogeny Group, 2016).

The life forms are presented according to the system of Raunkiaer (1934). For their determination the following information sources were used: Flora of the People's Republic of Bulgaria, volumes 1 to 9 (Yordanov, 1963-1979; Velchev, 1982, 1989) and Flora of the Republic of Bulgaria, volume 10 (Kozhukharov, 1995) and volume 11 (Peev, 2013). The biological types and economically important species are according to Delipavlov et al. (2011), Stoyanov et al. (2021; 2022). The floral elements are according to Asyov et al. (2012). The anthropophytes are according to Stefanov and Kitanov (1962). The invasive species are determined according to Petrova et al. (2012).

RESULTS AND DISCUSSIONS

1. Taxonomic structure

As a result of the conducted study of the flora of the Stana Plateau, 663 species of spontaneously distributed vascular plants were identified, which belong to 356 genera and 74 families. This represents 16.16% of the species, 38.99% of the genera and 53.23% of the families of vascular plants in Bulgaria. In addition, 52 species grown as ornamental plants and 4

species as forest crops were also identified on the plateau.

A significant part of the families, 54 in number (72.97%), are represented by 1-4 genera. Only 20 of the families (27.03%) are represented by 5 or more genera. The following families have the most genera: Asteraceae (47), Poaceae (38), Apiaceae (25), Lamiaceae (24), Fabaceae (20), Brassicaceae (15), Rosaceae (14), Caryophyllaceae (10), Boraginaceae (9), Scrophulariaceae (9), Asparagaceae (8), Orchidaceae (8), and Caprifoliaceae (8).

Most families, 44 in number (59.46%) have 1–4 species. Only 30 (40.54%) of the families are represented by 5 or more species. The following families have the most species: Asteraceae (91), Poaceae (62), Lamiaceae (52), Fabaceae (46), and Rosaceae (35).

A large part of the genera, 331 in number (92.97%) on the territory of the Stana Plateau, is represented by 1-4 species. Only 25 genera (7.02%) include 5 or more species. The most numerous species are from the genera: *Carex* (10), *Allium* (8), *Rumex* (8), *Silene* (7), *Euphorbia* (7), *Salvia* (7), *Prunus* (7), *Galium* (7), and *Veronica* (7).

As a result of the study, a significant taxonomic diversity was established among vascular plants on the Stana Plateau. This can be explained by the diverse relief and no less diverse soil and climatic conditions, which is a prerequisite for the species diversity on the territory of the plateau.

2. Phytogeographic structure

The identified plant species can be attributed to 44 floristic elements. The significant diversity of floristic elements is determined by the specific natural and geographical conditions of the territory of the Stana Plateau. A significant part of the identified vascular plants belongs to the European-Asian floral element – 120 species (18.10%). In second place are the representatives of the European-Mediterranean floristic element with 101 species (15.23%). This is followed by the representatives of the sub-Mediterranean floristic element with 86 species (12.97%), as well as the European and Euro-Siberian floristic elements with 43 species each (6.48%) (Fig. 2).

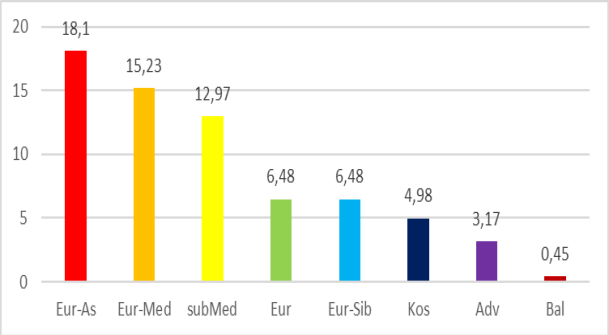

Figure 2. More important groups of floristic elements (data are in percentages)

In addition to the floristic elements with the largest number of species, important groups are cosmopolitan, adventive and endemic floristic elements. The cosmopolitans of the Stana plateau are 33 species (4.98%). In terms of adventive species – alien species that have become part of the flora of Bulgaria as a result of human activity, the flora of the Stana plateau is relatively well preserved – only 3.17% of all species are adventive. The endemic component of the flora of the Stana plateau is represented by only 4 species (0.60%) of Balkan endemics: *Achillea clypeolata* Sm., *Jurinea tzar-ferdinandi* Dav., *Knautia macedonica* Griseb., and *Salvia ringens* Sm.

3. Life forms

On the territory of the Stana plateau, life forms are represented by all groups (Fig. 3). The largest number is hemicrypto-

phytes (Ch) with 319 species (48.11%), followed by therophytes (Th) with 133 species (20.06%). Phanerophytes (Ph) and cryptophytes (Cr) are also represented by a relatively large number of species with 85 species (12.82%) and 66 species (9.95%), respectively. The number of species from the therophyte-hemicryptophyte (Th-H) group is small – 39 species (5.88%), and the least represented on the territory of the plateau are the chamaephytes (Ch) with 21 species (3.16%).

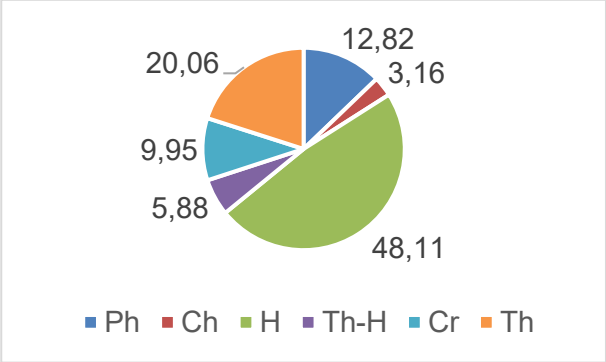

Figure 3. Distribution of species by life forms (data are in percentages)

4. Biological types

Among the identified plants, all biological types are represented, as well as possible transitions between them (Fig. 4).

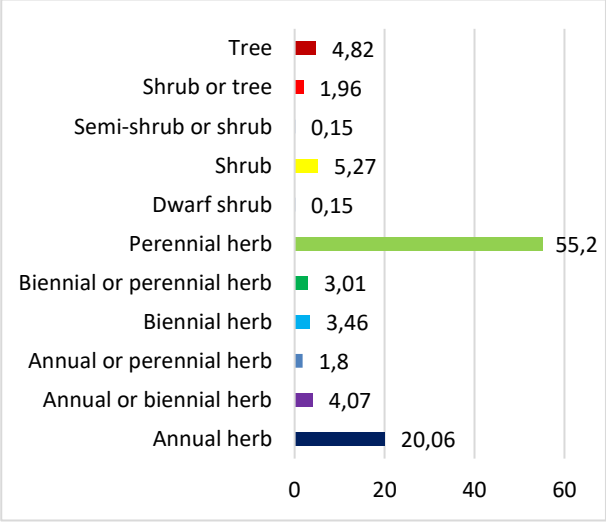

Figure 4. Distribution of species by biological type (data are in percentages)

Perennial herbaceous plants are predominant; they are represented by 366 species (55.20%). In second place are annual herbaceous plants with 133 species (20.06%). This is followed by shrubs with 35 species (5.27%) and trees with 32 species (4.82%). With a smaller number of species are biennial herbaceous plants, as well as transitional forms between the main biological types.

5. Economically valuable plant species

The economically valuable plant species established on the Stana Plateau have different uses: obtaining herbs, obtaining fruits, honey plants, wood production, and obtaining hay and providing pasture.

The main purpose of medicinal plants is to obtain herbs from them. In sufficiently large quantities for industrial production of herbs are the following plants: *Achillea millefolium* L., *Crataegus monogyna* Jacq., *Fragaria vesca* L., *Cornus mas* L., *Corylus avellana* L, *Rosa canina* L., *Tilia tomentosa* Moench, Urtica dioica L., etc.

Forest fruits in industrial quantities can be obtained from the following species: *Crataegus monogyna* Jacq., *Fragaria vesca* L., *Rubus thyrsanthus* Focke, *Corylus avellana* L., *Rosa canina* L., etc.

Honey plants of economic importance are: *Tilia tomentosa* Moench and *Robinia pseudoacacia* L.

The following are mainly used as a source of wood: *Quercus cerris* L., *Carpinus betulus* L., *Carpinus orientalis* Mill., and *Tilia tomentosa* Moench. This group also includes specially created forest crops of *Pinus nigra* L.

The following are mainly used for hay production and pasture provision: *Bothriochloa ischaemum* (L.) Keng, *Chrysopogon gryllus* (L.) Trin., *Cynodon dactylon* (L.) Pers., *Poa compressa* L. and *Poa pratensis* L.

6. Anthropophytes

On the territory of the Stana plateau, anthropophytes among vascular plants are 399 species (60.18%). Among anthropophytes, perennial herbaceous plants predominate with 186 species (46.73%). In second place are annual herbaceous plants with 116 species (29.14%). Next are annual or biennial herbaceous plants with 23 species (5.77%). The remaining biological types are represented by a smaller number of species.

7. Invasive alien plant species

Near the settlements and road infrastructure, we identified 17 invasive alien plant species (2.56% of all species): *Acer negundo* L., *Ailanthus altissima* (Mill.) Swingle, *Amaranthus albus* L., *Amaranthus hybridus* L., *Amaranthus retroflexus* L., *Ambrosia artemisiifolia* L., *Datura stramonium* L., *Elaeagnus angustifolia* L., *Erigeron annuus* (L.) Pers., *Erigeron canadensis* L., *Galinsoga parviflora* Cav., *Laburnum anagyroides* Medik., *Lycium barbarum* L., *Robinia pseudoacacia* L., *Sorghum halepense* (L.) Pers., *Xanthium orientale* L., and *Xanthium spinosum* L. Of these, 4 species are trees, 1 species is a shrub, 1 species is a perennial herbaceous plant, 8 species are annual herbaceous plants, 1 species is an annual or biennial herbaceous plant, 1 species is a shrub or tree and 1 species is an annual or perennial herbaceous plant.

By origin (Petrova et al., 2012), invasive alien species are distributed as follows:

1. North America – 5 species: *Amaranthus albus* L., *Ambrosia artemisiifolia* L., *Erigeron annuus* (L.) Pers., *Erigeron canadensis* L., *Robinia pseudoacacia* L.
2. Tropical America – 1 species: *Amaranthus hybridus* L.
3. North and Tropical America - 3 species: *Acer negundo* L., *Amaranthus retroflexus* L., *Datura stramonium* L.
4. South America – 2 species: *Galinsoga parviflora* Cav., *Xanthium spinosum* L.
5. North and South America – 1 species: *Xanthium orientale* L.
6. Asia - 2 species: *Ailanthus altissima* (Mill.) Swingle, *Elaeagnus angustifolia* L., *Lycium barbarum* L.
7. Central Europe – 1 species: *Laburnum anagyroides* Medik.
8. Mediterranean Europe and Asia – 1 species: *Sorghum halepense* (L.) Pers.

The DAISIE (Delivering Alien Invasive Species Inventories for Europe) list of the most dangerous invasive alien species threatening biodiversity in Europe (http://www.europe-aliens.org/speciesThe Worst.do) includes two species: *Ailanthus altissima* (Mill.) Swingle and *Robinia pseudoacacia* L.

The EPPO (European and Mediterranean Plant Protection Organization) list of invasive alien species (http://www.eppo.int/INVASIVE_PLANTS/ias_plants.htm) includes one species: *Ailanthus altissima* (Mill.) Swingle.

Of the listed invasive alien species, three species pose the greatest danger: *Ailanthus altissima* (Mill.) Swingle, *Robinia pseudoacacia* L. and *Xanthium orientale* L. The first two species are woody and are distributed in open grassy areas on the southern slopes of the plateau. The preferred habitats of these two species are erosion furrows. Their populations are characterized by rapidly increasing numbers. The third species is an annual herbaceous plant, which is widely distributed in arable areas and along the bottom of the dried-up dam to the village of Esenitsa.

8. Ornamental plants and forest crops

In addition to the spontaneously distributed vascular plants that are part of the flora of the Stana Plateau, we have identified 52 species of ornamental plants and 5 species grown as forest crops on its territory.

The ornamental plants are grown in the courtyards of the buildings in the "Stanata" area, visited for rest and recreation and located northeast of the town of Novi Pazar. The ornamental plants grown in the settlements on the territory of the Stana Plateau are not included in the list of spontaneously distributed species. Of this group of plants, 17 species are trees (e.g. *Abies alba* Mill., *Aesculus hippocastanum* L., *Betula pendula* Roth, and *Platycladus orientalis* (L.) Franco), 3 species are shrubs or small trees (*Cercis siliquastrum* L., *Mespilus germanica* L., and *Ziziphus jujuba* Mill.), 6 species are shrubs (*Clematis viticella* L., *Corylus avellana* L., *Euonymus japonicus* Thunb., *Ficus carica* L., *Mahonia aquifolium* (Pursh) Nutt., and *Opuntia humifusa* (Raf.) Raf.), 24 species are perennial herbaceous plants (e.g. *Alcea rosea* L., *Dianthus plumarius* L., *Geranium macrorrhizum* L., and *Tulipa gesnerana* L.), one species is an annual to biennial herbaceous plant (*Viola tricolor* var. *hortensis* DC.), and one species is an annual herbaceous plant (*Iberis umbellata* L.).

Forest plantations of *Pinus nigra* L. and *Quercus rubra* L. are specifically created as a source of wood. The plantations of Pinus nigra L. on the slopes of the plateau are also created to combat erosion, characteristic of the slopes of the Stana plateau. The remaining three species: *Fraxinus ornus* L., *Tamarix ramosissima* Ledeb. and *Tamarix tetrandra* Pall. ex M. Bieb. are afforested for anti-erosion purposes.

CONCLUSIONS

A significant taxonomic diversity of spontaneously distributed vascular plants has been established on the territory of the Stana plateau: 663 species from 356 genera and 74 families. In the taxonomic structure of the flora, the predominant part of the families and genera on the territory of the plateau are represented by a small number of lower taxa - from 1 to 4. The large number of established floral elements is due to the transitional natural and geographical location of the plateau.

All possible life forms have been established. Those life forms that are characteristic of forest habitats and anthropogenically influenced territories in the region predominate. Regarding the composition of the flora, all possible biological types have been established, with perennial herbaceous plants prevailing, which are characteristic of all plant communities on the plateau.

The economically valuable plant species on the territory of the plateau have a variety of applications: obtaining herbs, obtaining fruits, honey plants, wood production, and hay production. The high percentage of anthropophyte species is indicative of anthropogenic influence on the natural flora in the area. A large number of invasive alien plant species (17 species) have been identified, of which 3 species pose the greatest threat to the natural flora and arable land on the plateau. The number of ornamental plants and species grown as forest crops is significant, due to the use of the plateau for rest and recreation near the town of Novi Pazar.

ACKNOWLEDGEMENTS

This article is published with the financial support of Project No. RD-08-114/

05.02.2025 of the Konstantin Preslavsky University of Shumen.

REFERENCES

Angiosperm Phylogeny Group, (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV, *Botanical Journal of the Linnean Society*, 181, 1–20.

Asyov B., Petrova, A., Dimitrov, D., Vassilev, R., (2012). *Conspectus of the Bulgarian vascular flora. Distribution maps and floristic elements*, Sofia, BG: Bulgarian Biodiversity Foundation. https://www.cala-meo.com/read/00400823974a529171837.

DAISIE List of 100 of the Worst Invasive Alien Species in Europe. http://www.europe-aliens.org/speciesTheWorst.do.

Delipavlov, D., Cheshmedzhiev, I., Popova, M., Terziyski, D., Kovachev, I., (2011). *Identifier of plants in Bulgaria*, Plovdiv, BG: Academic Press of the Agricultural University (in Bulgarian).

European and Mediterranean Plant Protection Organization (EPPO). EPPO activities on Invasive Alien Plants. http://www.eppo.int/INVASIVE_PLANTS/ias_plants.htm.

Google Maps. https://www.google.com/maps

Kozhuharov, St. (editor), (1995). *Flora of the Republic of Bulgaria, Volume 10*, Sofia, BG: Prof. Marin Drinov Academic Publishing House (in Bulgarian).

Michev, N., Mihaylov, Ts., Vaptsarov, I., Kiradzhiev, Sv., (1980). *Geographical Dictionary of Bulgaria*, Sofia, BG: Nauka i izkustvo Publishing House (in Bulgarian).

Peev, D. (rep. ed.), (2013). *Flora of the Republic of Bulgaria, Volume 11*, Sofia, BG: Prof. Marin Drinov Academic Publishing House (in Bulgarian).

Peev, D. et al. (eds.), (2015). *Red Book of the Republic of Bulgaria. Volume 1. Plants and Mushrooms*, Sofia, BG: IBEI-BAS & MOEW, http://e-ecodb.bas.bg/rdb/en/vol1/

Petrova, A., Vladimirov, V., Georgiev, V., (2012). *Invasive alien plant species in Bulgaria*, Institute of Biodiversity and Ecosystem Research, Sofia, BG: Bulgarian Academy of Sciences.

Raunkiaer, C., (1934). *The Life forms of plants and statistical plant geography*, Oxford, GB: Clarendon Press.

Stefanov, B., Kitanov, B., (1962). *Cultigenous plants and cultigenous vegetation in Bulgaria*, Sofia, BG: Bulgarian Academy of Sciences (in Bulgarian).

Stoyanov, K., Raicheva, T., Cheshmedzhiev, I., (2021). *Key to the native and foreign vascular plants in Bulgaria*, Plovdiv, BG: Academic Publishing House of the Agrarian University (in Bulgarian).

Stoyanov, K., Raicheva, T., Cheshmedzhiev, I., (2022). *Key to the native and foreign vascular plants in Bulgaria*, Interactive extended and supplemented edition, Plovdiv, BG: Academic Publishing House of the Agrarian University, https://botanica.gallery/plantkeybg/app.html (in Bulgarian).

The World Flora Online, https://www.worldfloraonline.org/.

Velchev, V. (ed.), (1982). *Flora of the People's Republic of Bulgaria. Volume 8*, Sofia, BG: Publishing House of the Bulgarian Academy of Sciences (in Bulgarian).

Velchev, V. (ed.), (1989). *Flora of the People's Republic of Bulgaria. Volume 9*, Sofia, BG: Publishing House of the Bulgarian Academy of Sciences (in Bulgarian).

Yordanov, D. (ed. in chief), (1963-1979). *Flora of the People's Republic of Bulgaria. Volumes 1-7*, Sofia, BG: Publishing House of the Bulgarian Academy of Sciences (in Bulgarian).