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FLORISTIC DIVERSITY, VEGETATION STRUCTURE AND GIS-BASED TAXONOMIC ANALYSIS OF THE ZAGATALA STATE NATURE RESERVE (AZERBAIJAN)

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Abstract

This article presents the results of floristic, geobotanical, systematic and ecological studies conducted during expeditions to the Zagatala State Nature Reserve and surrounding areas in 2022–2025, along with a GIS-based analysis of these results. The investigation of species composition in the study areas allowed for the assessment of current floral biodiversity, revealing a total of 1109 species of higher spore-bearing, gymnosperm, and flowering plants belonging to 505 genera and 112 families. The total species richness recorded in this study (1109 species) is higher than previous reports from the reserve, which documented 900–1000 species. Analysis of life forms showed that perennial herbs dominate the flora, comprising 714 species (64.38%), followed by annual herbs with 127 species (11.45%), trees with 76 species (6.85%), shrubs with 73 species (6.58%), and biennial herbs with 60 species (5.41%). Additional life form categories including annual-biennial herbs, biennial-perennial herbs, undershrubs, tree-shrub forms, subshrubs, and lianas account for 21 (1.89%), 12 (1.08%), 10 (0.90%), 7 (0.63%), 6 (0.54%), and 3 (0.29%) species, respectively, together comprising all 1109 species (100%). Precise GPS coordinates were recorded for new localities within the study area. A total of 65 species (including higher spore-bearing, gymnosperm, and flowering plants) belonging to 56 genera and 36 families are included in the third edition of the Red Book of Azerbaijan. A priority issue for the reserve is the conservation of drought-resistant, soil-protective, and climate-resort important mountain meadows and forests in different zones of the northeastern part of the Greater Caucasus, along with the sustainable utilization of the richness of the area's vegetation for international biological research.

Key words: Flora; Vegetation cover; DEM; GIS; Nature reserve; New records

Introduction

The Zagatala State Nature Reserve located at elevations ranging from 650 to 3646 m above sea level, is one of the oldest protected areas in Azerbaijan. Established in 1929 within the administrative territories of the Zagatala and Balakan districts, the reserve is situated on the eastern part of the southern slope of the central Greater Caucasus Mountain range and covers an area of 47.349 hectares (Gadzhiev, 1970; Museyibov, 1998; Ministry of Ecology and Natural Resources of Azerbaijan Republic, n.d.).

The primary purpose of establishing the reserve was to preserve the irreplaceable soil-protective and water-regulating functions of these forests, as well as to conserve the natural complexes, flora and fauna of the southern slope of the Greater Caucasus. Previous floristic studies have documented 900–1000 plant species within the reserve (Gadzhiev, 1970; Nabiyeva *et al*., 2025), establishing it as one of the most botanically diverse protected areas in the Caucasus. Online biodiversity databases similarly report approximately 1000 species occurring within the reserve boundaries.

The first studies of the reserve's flora (1935) are associated with the renowned botanist I.N. Beideman. In later years, the forest flora of the southern slopes of the Greater Caucasus was studied by L.I. Prilipko, and the soil cover was investigated by H.A. Aliyev (Aliev, 1994). A scientific research department was established in the reserve in 1950 (Gadzhiev, 1962). Geobotanical studies conducted between 1952 and 1954 are linked to Academician Vahid Hajiyev. During 1994–1997, the reserve's flora was documented as including 974 species belonging to 465 genera in 152 families (Gadzhiev, 1970). In 2008, the reserve's territory was expanded from 23,844 ha to 47,349 ha using lands from the Zagatala and Balakan forest protection and restoration enterprises.

The territory comprises forests, subalpine and alpine meadows, and steep high-altitude rocky landscapes. The lower and middle mountain belts (800–2200 m) are dominated by beech, hornbeam and oak forests. With increasing elevation, these forests are gradually replaced by subalpine open woodlands, followed by subalpine meadows (around 2400 m), alpine meadows (up to 3200 m), and finally subnival and nival zones (Gadzhiev, 1970; Aliev, 1994).

The Mazimchay, Balakanchay and Katekhchay rivers, originating in the Greater Caucasus, flow through the reserve and are distinguished by their abundant water resources. The mountainous terrain is deeply dissected by valleys and rocky riverbanks. The main rivers have formed spectacular waterfalls, reaching heights of 15–20 meters,

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and impassable gorges in the middle-mountain zone. The soil cover mainly consists of primitive mountain-meadow, mountain-meadow, mountain-meadow-forest, and brown forest soil types (Aliyev, 1994).

As a result of relentless anthropogenic impacts on nature, the soil and vegetation cover have been disrupted and degraded. Due to both natural and human-induced factors, it is essential to systematize and clarify the flora of the area, determine the status of rare and threatened species to preserve their gene pool, and study their floristic-systematic, botanical-geographical, and ecological characteristics (Richardson *et al*., 2000; Nabiyeva *et al*., 2025; Tedoradze *et al*., 2023). Recent environmental studies also underscore the importance of documenting invasive plant species and their spatial distribution in protected areas (Aliyeva & Hasanov, 2018).

Material and Methods

Research area: The Zagatala district is located in the northwestern part of the Republic of Azerbaijan, on the southern slopes of the Greater Caucasus in the Qanikh-Ayrichay valley. It borders Georgia to the South, the Republic of Dagestan to the North and the Balakan and Qakh districts to the West and East. The climate is mild in the lowlands and cold in the mountains. The mean January temperature ranges from –1°C in the lowlands to −10°C in the mountains, while the mean July temperature varies from +24°C to +5°C, respectively. Annual precipitation ranges from 600 to 1600 mm (Gadzhiev, 1970; Aliyeva & Hasanov, 2018; World Weather Online2024). The highest point is Mount Guton, at 3648 m. The dense forest cover of the area accounts for 5% of the country's total forest resources. The relief map of the study area was prepared based on the Digital Elevation Model (DEM) from the OpenTopography portal (https://portal. opentopography.org/dataCatalog) (Fig. 1).

Data sources: The subject of the study is the flora and vegetation of the ZSNR and its surrounding areas. During the investigation of species composition, reference was made to the works of Serebryakov (1964), Yaroshenko (1961), Ramenskii (1971), Sukachev (1975), Sochava (1950), Flora of Azerbaijan, Vols. I–VIII (1950–1961), Grossheim's Flora of the Caucasus (1949), and Askerov (2016). The research employed floristic, geobotanical, systematic and ecological approaches, including data from expeditions, permanent plots, semi-permanent plots and phenological observations.

Geographic information systems-based methods: Geographic Information Systems (GIS) analysis was carried out using ArcGIS Pro 3.6 (Esri Inc., Redlands, CA, USA). The Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) with a spatial resolution of 30 m (1 arc-second) was utilized for elevation analysis and cartographic visualization of the study area, sourced from the OpenTopography scientific portal (OpenTopography, n.d.; Nandigam *et al*., 2017). Field-collected georeferenced occurrence points were projected to the WGS 1984 UTM Zone 39N coordinate system prior to analysis. To assess the spatial distribution density of the recorded invasive species (*Paulownia tomentosa* and *Buddleja davidii*), a Kernel Density Estimation (KDE) analysis was performed using the Kernel Density tool. The search radius was set to 5,000 m with an output cell size of 500 m, applying the Planar method. Density values were classified into five equal intervals to visualize gradients from low to high occurrence density (Silverman, 1986).

Results and Discussion

Flora spectrum of the area: Based on literature sources, herbarium materials, field data, newly recorded findings and recent systematic revisions, the plant species distributed in the study area were verified and the flora spectrum of the area was compiled (Table 1).

The flora of the ZSNR and its surrounding areas comprises 112 families and 505 genera, with a total of 1109 higher plants encompassing spore-bearing plants, gymnosperms, and angiosperms. Taxonomic nomenclature was verified in accordance with modern classifications (World Flora Online; Plants of the World Online).

Among the 112 families, the 16 largest account for 282 genera (55.84%) and 685 species (61.77%) of the total flora (Fig. 2). *Asteraceae* Giseke is the dominant family in terms of both genera (58 genera; 11.49%) and species (119 species; 10.73%), followed by *Apiaceae* Juss. (30 genera; 46 species), *Poaceae* Barnhart (29 genera; 54 species), *Rosaceae* Juss. (25 genera; 73 species), *Brassicaceae* Burnett (26 genera; 45 species), *Lamiaceae* Martinov (22 genera; 47 species), *Fabaceae* Juss. (16 genera; 70 species) and *Caryophyllaceae* Juss. (16 genera; 52 species). Thirty-two families are represented by a single genus and a single species. Species within the 505 genera are unevenly distributed (Table 2).

The genus with the highest number of species is *Campanula* L. with 22 species, followed by *Veronica* L. and *Trifolium* Tourn. ex L. (16 species each), *Carex* L. and *Alchemilla* L. (14 species each) and *Cerastium* L. (13 species). In total, the 15 leading genera (2.97%) comprise 187 species (16.86%), while the remaining 480 genera account for 901 species (81.24%).

Analysis of the flora according to life forms: As illustrated in the diagram (Fig. 3), the flora of the study area is predominantly composed of perennial herbs, which comprise 714 species (64.38%). In terms of species richness, other life forms are represented as follows: annual herbs by 127 species (11.45%), trees by 76 species (6.85%), shrubs by 73 species (6.58%), and biennial herbs by 60 species (5.41%). Additional life form categories include annual-biennial herbs with 21 species (1.89%), biennial-perennial herbs with 12 species (1.08%), undershrubs with 10 species (0.90%), tree-shrub transitional forms with 7 species (0.63%), subshrubs with 6 species (0.54%) and lianas with 3 species (0.29%). Together, these 11 life form categories account for the full complement of 1109 species (100%). The dominance of perennial herbaceous species reflects the ecological diversity and habitat heterogeneity of the reserve, particularly across its forest, meadow and subalpine ecosystems (Fig. 3).

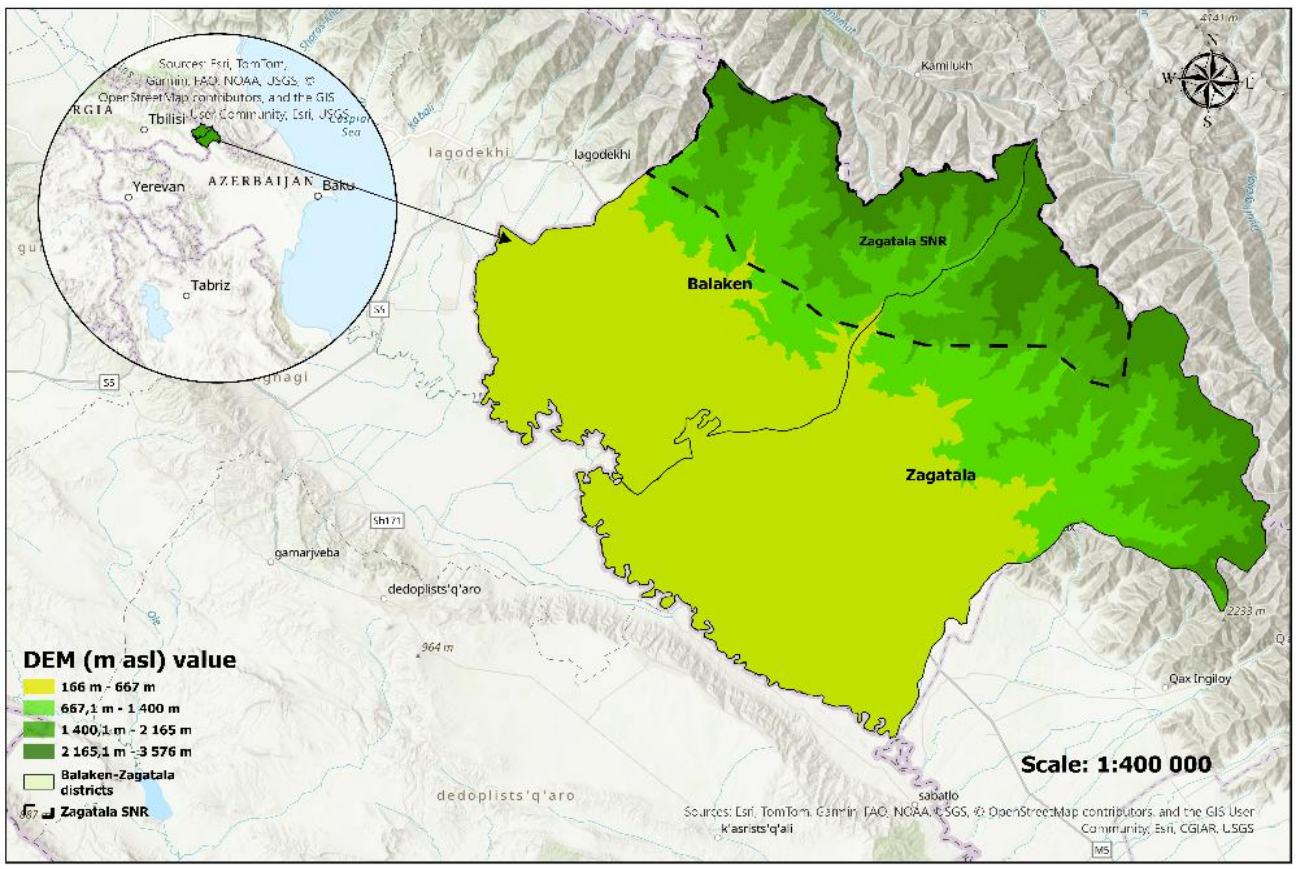

Fig. 1. Digital Elevation Model of the Balakan–Zagatala districts and the ZSNR.

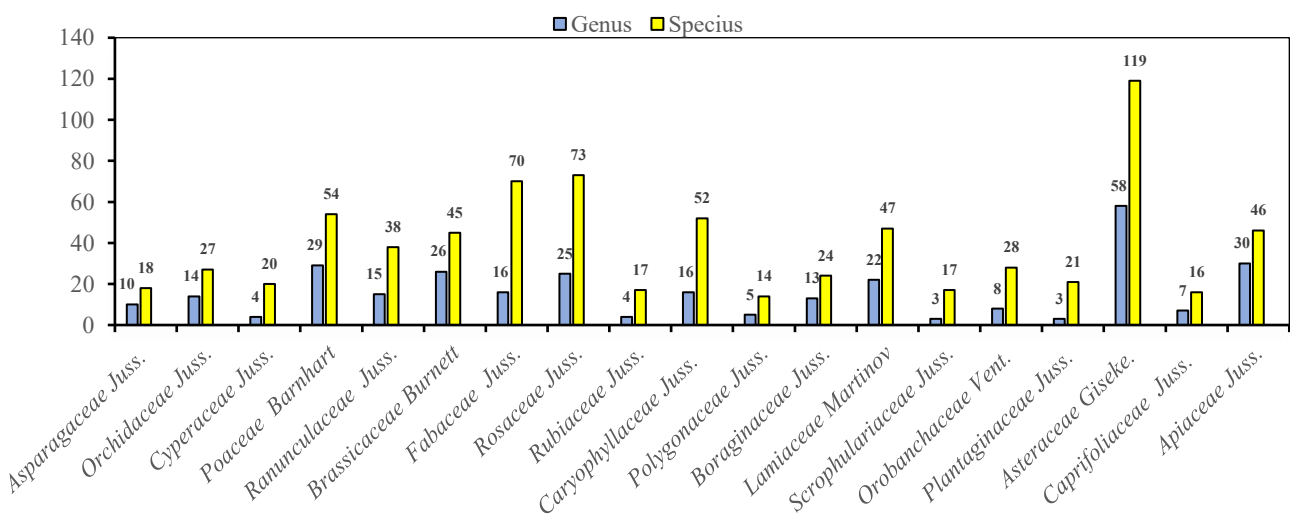

Fig. 2. Distribution of genera and species among the major families in the flora of the area.

A total of 65 species belonging to 56 genera and 36 families are included in the third edition of the Red Book of Azerbaijan (Fig. 4). The recorded species *Corylus colurna* L., *Hedera pastuchovii* Woronow, *Castanea sativa* Mill., *Pterocarya fraxinifolia* (Lam.) Spach, *Zelkova carpinifolia* (Pall.) Dippel, *Betula raddeana* Trautv., *Taxus baccata* L. and *Punica granatum* L. are relict species, whereas *Primula juliae* Kusnez., *Salix caprea* L., *Ficus carica* L. and others are endemic species. In total, 130 endemic plant species have been identified in the flora of the study area, of which 16 species (1.44%) are endemic to Azerbaijan and 114 species (10.28%) are Caucasian endemics.

New records for the Flora of Azerbaijan: During the conducted investigations, field-collected herbarium materials revealed plant taxa that had not been previously recorded in the literature for the Caucasus, Azerbaijan or the local flora. These represent new floristic records rather than taxonomically new species, as both taxa are well-known invasive plants in other regions. Their documentation here significantly contributes to the understanding of regional plant diversity and invasion dynamics.

GPS coordinates of several new localities were recorded during field investigations, and a distribution map of *Paulownia tomentosa* (Thunb.) Steud. was produced for the

studied areas. The species occurs at elevations of 640–1100 m in forests and along riverbanks, with 8–15 individuals observed at each location. Based on GPS data and KDE analysis, the highest occurrence density of invasive species is concentrated in the northern part of the Balakan–Zagatala districts, particularly along forest edges and river corridors within and adjacent to the Zagatala SNR (Fig. 5).

Buddleja davidii Franch. was recorded as a new floristic record for the Caucasus, Azerbaijan, and the local flora at an elevation of 670–700 m in a forested area. This shrub species is native primarily to East Asia and is recognized globally as an invasive plant. Its high ecological tolerance and broad adaptive capacity facilitate rapid spread in natural and semi-natural ecosystems (Richardson *et al*., 2000; Dommanget *et al*., 2025; Butterfly-bush (Buddleja davidii) distribution maps, n.d.).

Paulownia tomentosa (Thunb.) Steud. possesses strong natural regeneration ability and can resprout from its roots after cutting. Long-term observations by reserve personnel indicate that this species has progressively spread across various sections of the forest ecosystem over a 30-year period, exhibiting increasing population density and establishing itself in diverse phytocenoses. While its fast growth and regenerative capacity make it suitable for rapid forest restoration, its prolific seed production can lead to suppression of native plant species (Flynn *et al*., 2012; Tang & Carpenter, 1996; Jakubowski, 2022). These floristic findings have direct implications for conservation management: the spread of both invasive species warrants targeted monitoring and control strategies to protect the native vegetation of the reserve.

During the expeditions, hundreds of collected species were found to have medicinal significance, including *Campanula lactiflora* M.Bieb., *Gentiana cruciata* L., *Betonica grandiflora* K.Koch, *Aruncus dioicus* (Walter) Fernald, *Galanthus alpinus* Sosnowsky, *Rhododendron luteum* Sweet, *Veronica gentianoides* Vahl. and *Potentilla erecta* among others. The high concentration of medicinally significant and ornamental species, documented with precise GPS coordinates, forms the scientific basis for potential development of botanical trails and ecotourism routes within the reserve. Such initiatives would link floristic data directly to conservation and socioeconomic development goals, contributing to public health, recreation, and sustainable utilization of the area's biological resources.

Kernel Density Estimation analysis revealed that the highest occurrence density of invasive species is concentrated in the northern part of the Balaken–Zagatala districts, particularly along forest edges and river corridors within and adjacent to the ZSNR (Fig. 6).

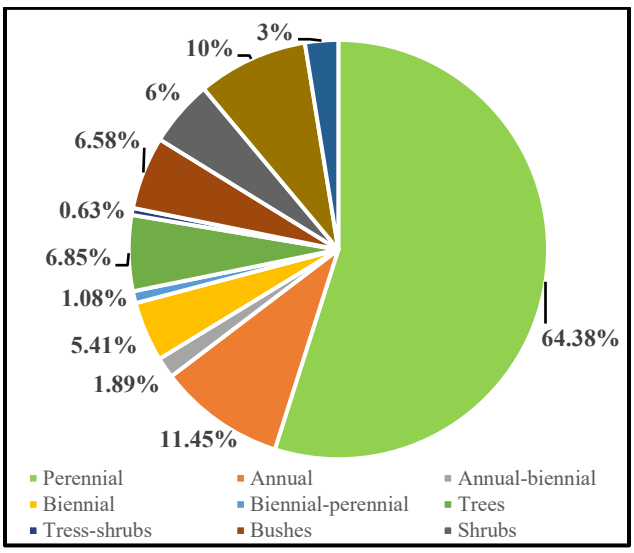

Fig. 3. Diagram of species life forms.

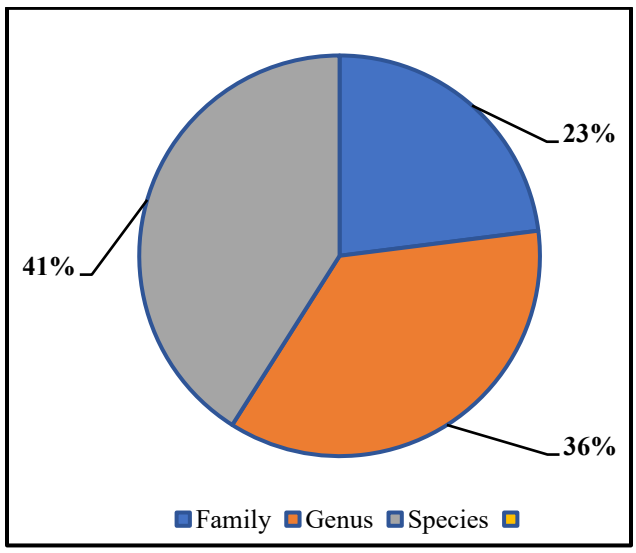

Fig. 4. Species included in the red book of Azerbaijan.

Conclusion

Based on the results of the conducted studies, the current state of the flora and vegetation of the ZSNR and its surrounding areas was investigated. According to the compiled taxonomic spectrum, the flora of the area comprises 1109 species of vascular plants, including higher spore-bearing plants, gymnosperms and angiosperms, belonging to 505 genera and 112 families. Asteraceae is the dominant family in terms of both genera and species richness. Taxonomic nomenclature was provided in accordance with World Flora Online and Plants of the World Online.

Analysis of life forms indicates that the flora of the study area is predominantly composed of perennial herbaceous plants (714 species; 64.38%). The full spectrum of 11 recognized life form categories accounts for all 1109 species (100%). A total of 65 species belonging to 56 genera and 36 families have been included in the third edition of the Red Data Book of Azerbaijan. During the research, precise GPS coordinates of newly identified localities were recorded.

Two invasive plant taxa, *Paulownia tomentosa* (Thunb.) Steud and *Buddleja davidii* are documented as new floristic records for Azerbaijan and the Caucasus. Their progressive spread, confirmed by KDE spatial analysis, represents a significant ecological finding with direct implications for conservation management. A total of 130 endemic species were identified, of which 16 are endemic to Azerbaijan and 114 are Caucasian endemics. The rich diversity of medicinal and ornamental plants documented with GPS data provides a scientific basis for future development of botanical trails and ecotourism initiatives linked to the reserve's biodiversity.

Table 1. Flora spectrum of the Zagatala SNR and surrounding areas.

	Family	Genus (505)	By total number, %	Species (1109)	Percentage of the total number
1.	*Lycopodiaceae* P.Beauv. ex Mirb. (=*Huperziaceae*)	1	0,2	1	0,09
2.	*Selaginellaceae* Willk.	1	0,2	1	0,09
3.	*Equisetaceae* Michx. ex DC.	1	0,2	4	0,36
4.	*Ophioglossaceae* Martinov (=Botrychiaceae Horan)	2	0,40	3	0,27
5.	*Pteridaceae* E.D.M Kirchn. (=*Sinopteridaceae; Cryptogrammaceae*)	4	0,79	4	0,36
6.	*Thelypteridaceae* Ching ex Pic.Serm.	2	0,40	2	0,18
7.	*Dennstaedtiaceae* Lotsy	1	0,2	1	0,09
8.	*Polypodiaceae* J. Presl & C. Presl	1	0,2	1	0,09
9.	*Onocleaceae* Pic. Serm. (=*Polypodiaceae*)	1	0,2	1	0,09
10.	*Aspleniaceae* Newman	2	0,40	10	0,90
11.	*Woodsiaceae* Herter	1	0,2	3	0,27
12.	*Cystopteridaceae* (Payer) Shmakov	2	0,40	2	0,18
13.	*Salviniaceae* Martinov	1	0,2	1	0,09
14.	*Dryopteridacea* R.-C.Ching.	2	0,40	8	0,72
15.	*Thelypterideaceae* Pic.Serm	1	0,2	1	0,09
16.	*Cupressaceae* Gray	3	0,59	3	0,27
17.	*Pinaceae* Spreng. ex Rudolphi	1	0,2	4	0,36
18.	*Taxaceae* Gray	1	0,2	1	0,09
19.	*Ephedraceae* Dumort	1	0,2	2	0,18
20.	*Aristolochiaceae* Juss.	1	0,2	1	0,09
21.	*Alismataceae* Vent.	1	0,2	2	0,18
22.	*Araceae* Juss.	1	0,2	2	0,18
23.	*Butomaceae* Mirb.	1	0,2	1	0,09
24.	*Zannichelliaceae* Dumort.	1	0,2	1	0,09
25.	*Juncaginaceae* Rich.	1	0,2	1	0,09
26.	*Potamogetonaceae* Bercht. & J. Presl	1	0,2	1	0,09
27.	*Dioscoreaceae* R.Br.	1	0,2	1	0,09
28.	*Zosteraceae* Dumort.	1	0,2	1	0,09
29.	*Liliaceae* Juss.	3	0,59	9	0,81
30.	*Colchicaceae* DC.	1	0,2	2	0,18
31.	*Smilacaceae* Vent.	1	0,2	1	0,09
32.	*Asparagaceae* Juss. (= Hyacinthaceae Batsch)	10	1,98	18	1,62
33.	*Melanthiaceae* Batsch ex Borkh.	1	0,2	1	0,09
34.	*Asphodelaceae* Juss.	2	0,40	2	0,18
35.	*Amaryllidaceae* J.St.-Hil. (=*Alliaceae*)	2	0,40	5	0,45
36.	*Iridaceae* Juss.	3	0,59	6	0,54
37.	*Cannaceae* Juss.	1	0,2	1	0,09
38.	*Orchidaceae* Juss.	14	2,77	27	2,43
39.	*Cyperaceae* Juss.	4	0,79	20	1,80
40.	*Juncaceae* Juss.	2	0,40	9	0,81
41.	*Poaceae* Barnhart	29	5,74	54	4,87
42.	*Berberidaceae* Juss.	1	0,2	2	0,18
43.	*Papaveraceae* Juss.	5	1,0	10	0,90
44.	*Ranunculaceae* Juss.	15	2,97	38	3,43
45.	*Platanaceae* T. Lestib.	1	0,2	1	0,09
46.	*Buxaceae* Dumort.	1	0,2	1	0,09
47.	*Crassulaceae* J.St.-Hil.	5	1,0	11	0,99
48.	*Paeoniaceae* Raf.	1	0,2	1	0,09
49.	*Saxifragaceae* Juss.	1	0,2	8	0,72
50.	*Celastraceae* R.Br.	2	0,40	6	0,54
51.	*Rutaceae* Juss.	1	0,2	1	0,09
52.	*Vitaceae* Juss.	1	0,2	1	0,09
53.	*Sapindaceae* Juss. (=*Aceraceae)*	1	0,2	8	0,72
54.	*Brassicaceae* Burnett	26	5,15	45	4,06
55.	*Fabaceae* Juss.	16	3,17	70	6,31
56.	*Staphyleaceae* Martinov	1	0,2	1	0,09

Table 1. Flora spectrum of the Zagatala SNR and surrounding areas.

	Family	Genus (505)	By total number, %	Species (1109)	Percentage of the total number
57.	*Cannabaceae* Martinov	3	0,59	4	0,36
58.	*Elaeagnaceae* Juss.	2	0,40	2	0,18
59.	*Moraceae* Gaudich.	1	0,2	2	0,18
60.	*Rhamnaceae* Juss.	3	0,59	4	0,36
61.	*Rosaceae* Juss.	25	4,95	73	6,58
62.	*Ulmaceae* Mirb.	**2**	0,40	5	0,45
63.	*Urticaceae* Juss.	2	0,40	3	0,27
64.	*Betulaceae* Gray	4	0,79	9	0,81
65.	*Fagaceae* Dumort.	3	0,59	6	0,54
66.	*Juglandaceae* DC. ex Perleb	2	0,40	2	0,18
67.	*Datiscaceae* Dumort.	1	0,2	1	0,09
68.	*Euphorbiaceae* Juss.	1	0,2	9	0,81
69.	*Hypericaceae* Juss.	1	0,2	4	0,36
70.	*Linaceae* DC. ex Perleb	1	0,2	6	0,54
71.	*Salicaceae* Mirb.	2	0,40	8	0,72
72.	*Violaceae* Batsch	1	0,2	5	0,45
73.	*Onagraceae* Juss.	2	0,40	8	0,72
74.	*Anacardiaceae* R.Br.	2	0,40	2	0,18
75.	*Lythraceae* J.St.-Hil. (= *Punicaceae*)	3	0,59	3	0,27
76.	*Cistaceae* Juss.	1	0,2	4	0,36
77.	*Thymelaeaceae* Juss.	2	0,40	3	0,27
78.	*Santalaceae* R.Br.	2	0,40	3	0,27
79.	*Amaranthaceae* Juss.	6	1,19	9	0,81
80.	*Phytolaccaceae* R.Br.	1	0,2	1	0,09
81.	*Caryophyllaceae* Juss.	16	3,17	52	4,69
82.	*Polygonaceae* Juss.	5	1,0	14	1,26
83.	*Hydrangeaceae* Dumort.	1	0,2	1	0,09
84.	*Balsaminaceae* A. Rich.	1	0,2	1	0,09
85.	*Ebenaceae* Gurke	1	0,2	1	0,09
86.	*Oleaceae* Hoffmans. & Link.	2	0,40	3	0,27
87.	*Polygalaceae* Hoffmans. & Link.	1	0,2	3	0,27
88.	*Ericaceae* Juss. = *Pyrolacaea*	6	1,19	10	0,90
89.	*Primulaceae* Batsch ex Borkh.	4	0,79	9	0,81
90.	*Gentianaceae* Juss.	4	0,79	13	1,17
91.	*Apocynaceae* Juss.	1	0,2	2	0,18
92.	*Rubiaceae* Juss.	4	0,79	17	1,54
93.	*Viburnaceae* Raf.	2	0,40	4	0,36
94.	*Boraginaceae* Juss.	13	2,57	24	2,16
95.	*Verbenaceae* J.St.-Hil.	1	0,2	1	0,09
96.	*Lamiaceae* Martinov	22	4,36	47	4,24
97.	*Solanaceae* Juss.	3	0,59	4	0,36
98.	*Scrophulariaceae* Juss.	3	0,59	17	1,53
99.	*Orobanchaceae* Vent.	8	1,58	28	2,52
100.	*Plantaginaceae* Juss.	3	0,59	21	1,89
101.	*Convolvulaceae* Juss. (= *Cuscutaceae*)	4	0,79	5	0,45
102.	*Asteraceae* Giseke.	58	11,5	119	10,73
103.	*Campanulaceae* Juss.	2	0,40	23	2,07
104.	*Geraniaceae* Juss.	1	0,2	11	0,99
105.	*Caprifoliaceae* Juss. (= *Dipsacaceae*)	7	1,40	16	1,44
106.	*Malvaceae* Juss. (= *Tiliaceae*)	4	0,79	10	0,90
107.	*Araliaceae* Juss.	1	0,2	1	0,09
108.	*Apiaceae* Juss.	30	5,94	46	4,15
109.	*Cornaceae* Bercht. ex J.Presl.	1	0,2	4	0,36
110.	*Tamaricacae* Link.	1	0,2	1	0,09
111.	*Paulowniaceae* Nakai	1	0,2	1	0,09
112.	*Oxalidaceae* R.Br.	1	0,2	1	0,09

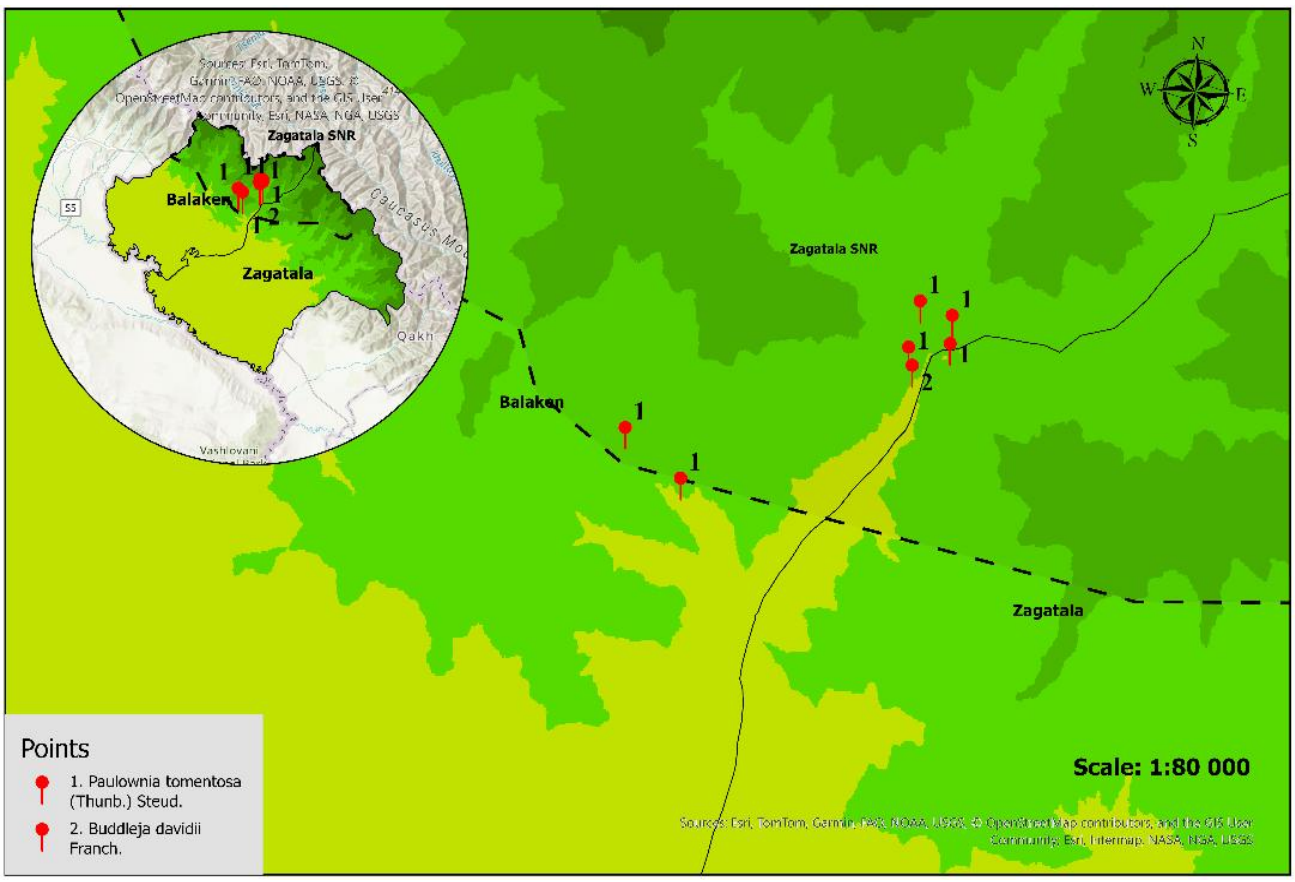

Fig. 5. Distribution of *Buddleja* and *Paulownia* species.

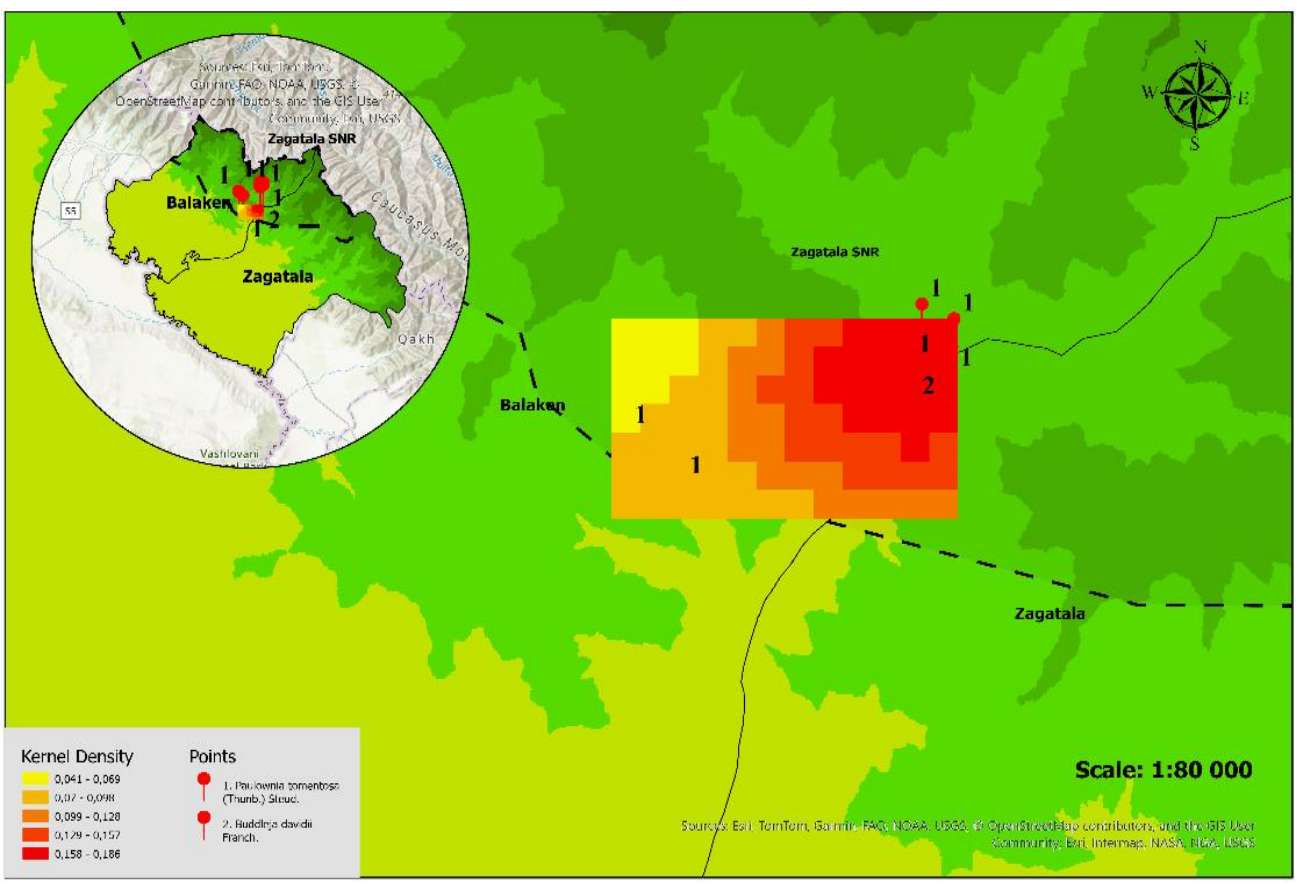

Fig. 6. Kernel Density Estimation of spatial distribution of invasive species (*Paulownia tomentosa* and *Buddleja davidii*) in the Balaken–Zagatala districts.

Table 2. Distribution of Species across major genera.

No.	Genus	Species	By % (1109)
1.	*Euphorbia* L.	9	0,81
2.	*Orobanche* L.	9	0,81
3.	*Carex* L.	14	1, 26
4.	*Ranunculus* L.	11	0,99
5.	*Trifolium* Tourn.ex L.	16	1,44
6.	*Astragalus* L.	11	0,99
7.	*Vicia* L.	11	0,99
8.	*Lathyrus* L.	10	0,90
9.	*Alchemilla* L.	14	1, 26
10.	*Cerastium* L.	13	1,17
11.	*Silene* L.	10	0,90
12.	*Galium* L.	12	1,08
13.	*Veronica* L.	16	1,44
14.	*Cirsium* Mill.	11	0,99
15.	*Campanula* L.	22	1,98

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Author's Contribution: F.Kh. Nabiyeva performed the statistical calculations, compiled the literature data, and carried out the taxonomic identification of species; G.F. Rzayeva conducted the field photography and contributed to the literature search; N.I. Sadigova prepared the GIS-based maps of the study area; F.F. Amrahova was responsible for manuscript writing, structural organization and formatting, and language editing, and led all correspondence with the journal, coordinating the submission, revision and galley-proof correction process. All authors read and approved the final manuscript.

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