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## Taxonomic and typological features of the flora of the “Small Pinewood” ecological path in the “Lower Kama” National Park (Tatarstan)

Elena Aleksandrovna Afonina\*

Department of Biology and Ecology, Faculty of Biology, Elabuga Institute, Kazan Federal University, 89 Kazanskaya Street, Yelabuga, Tatarstan, 423604, Russia.

\*Corresponding author

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### Abstract

The article deals with the taxonomic and eco-coenotic composition of the flora of “Small Pinewood” ecological path in the “Lower Kama” National Park (Tatarstan). Author analyzes the distribution of plants by the type of habitat, life forms, and eco-coenotic groups; presents data on the most prevalent families and analyzes the adventitious fraction of flora; identifies the most rare biormorphes composing flora, and evaluates the condition of the flora.

**Keywords:** Taxonomic and eco-coenotic analysis of the flora; adventitious flora.

To identify the floristic composition and study all types of plant habitats in “Small Pinewood” ecological path, the author used the traditional route-guided method [1,2]. The taxonomic and typological analysis of the flora was carried out by the usual technique, typical for this type of botanical works [3-6]. In the course of the study, the author composed the floristic list indicating the phases of plant development, their location and growth conditions. In some cases, the number of species at a particular location and their condition were indicated.

Human impact on the biosphere has acquired a global character, and its proportions and pace continue to increase. As a result of both direct and indirect anthropogenic impacts, many biological species disappear, or their populations are at a critical limit that jeopardizes the capability of the species reproduction [7, p. 364].

The problem of biodiversity is relevant to the Lower Kama region. This region is one of the unique phytocoenotic areas in the Republic of Tatarstan. Here are the southern boundaries of the taiga and the boreal species that stipulate broad range and diversity of flora and vegetation of the region. Despite the broad range of flora and diversity of plant communities, this region is still poorly studied. There are little reliable data on the rare and relict species, as well as information about the

dynamics of the phytocoenosis under expanding anthropogenic landscape, features, and ecology of boreal species at the boundary area.

“Lower Kama” National Park (hereafter NP) is situated within the territory of the Yelabuga District of the Republic of Tatarstan. Subject to the provisions on the national parks, its task is to create conditions for tourism; therefore, the organization of ecological routes and paths is one of the ways to solve the problems of nature protection and rational use of natural resources. This contributes to the culture of human relationships with nature, produces environmental standards of conduct of population in the natural environment.

Small Pinewood is a forestland, which is a part of the Yelabuga forestry, which has an area of 1284 ha. It has the status of a specially protected functional area of the park. On the southern edge of the Small Pinewood, there is the famous spring called Saint Spring of Panteleimon the Healer. Spring water is considered curative, curing diseases, and giving health. Every year, on August 9, which is the day of Saint Panteleimon, the Orthodox Church conducts the rite of worship at the Saint Spring. The spring is also known by Shishkin’s painting “Saint Spring near Yelabuga” (1886). In the area of the famous spring, there is a viewing point and a paved parking lot [8]. At the site of the old peat-bogs, there are water-sick

biocenoses adjacent to the spring. This place is extensively visited by residents of Yelabuga, as well as tourists and holiday-makers.

One can get to the spring by a country road, as well as the "Small Pinewood" ecological path. Ecological path starts from Catherine Road (Old Chelnynskaya Road) and ends at the Saint Spring. Catherine road was built about 300 years ago; it is paved with rubble stone (a type of limestone). Tours on the "Small Pinewood" ecological path are held from April to October. A route takes 45 min (with stops). Maximum load limit in terms of the number of visitors is not more than two groups per day (42-48 visitors in total) [8].

"Small Pinewood" ecological and educational hiking route (ecological path) with the length of 1.3 km familiarizes the visitors with different types of forests. These include complex pine forests, cowberry pine forests, pine forests with moss fir-trees, aspen woods, and poplar forest reach in herbs. Environmental stops are made at the most interesting and informative biological objects. The whole route is provided with pictures and names of animals and plants. Signs and signposts, as well as rest spots, were made by the National Park staff in 1997 along the route of a forest path leading to the Saint Spring, which was used by people for a very long time. Ecological path is universal in terms of conducting scientific research, environmental education, and tourism.

Targeted floristic studies of the flora in NP are conducted by teachers and students of the biological faculty of the Yelabuga State Pedagogical Institute (currently Yelabuga Institute of Kazan (Volga) Federal University), since the founding of the National Park in 1993.

During the field seasons of 2010-2013, we studied the flora of the "Small Pinewood" ecological path to assess its composition and condition.

As part of this flora we found 132 species of plants, which belong to 102 genera and 44 families, accounting for 18.9% of the flora of the NP.

Section *Equisetophyta* is represented by one species (*Equisetum sylvaticum* L.), section *Pinophyta* – by two species, section *Polypodiophyta* – by four species, and section *Magnoliophyta* – by 125 species, of which 110 species are bilobed.

The basis of the flora, as everywhere in the temperate Holarctic regions, consists of flowering plants (94.7%), which are dominated

by the bilobed species (83.3%). Although systematic diversity of tracheophyte spore plants and coniferous plants in the flora is not essential and all together they make up 5.3% of the total number of species, they play an important role in terms of providing vegetation cover, being the dominants of plant communities. This applies primarily to the coniferous plants and pteridophytes.

The families of *Asteraceae*, *Rosaceae*, and *Poaceae* occupy the first three places in the spectrum of ecological path. The spectrum of the leading families of tracheophyte plants in general is typical of the Holarctic floral reign [9, p. 153]. The most part of the Holarctic region, except of some areas in the Arctic, deserts, and high mountains, is occupied by *Asteraceae* and *Poaceae*, which hold the first two places. The third family of *Rosaceae*, in terms of the type diversity, characterizes flora as central European [10, p. 418]. The first ten families comprise 84 species, accounting for 63.6% of total species composition and 64 kinds, which is 62.7% of the total number of genera. This confirms the boreal nature of the flora in the studied area.

Family-generic spectrum is also typical for this kind of floras.

Generic spectrum, drawn up in order of descending the number of species in the genus, is the following: *Potentilla* and *Viola*, each include four species (3%); *Vicia*, *Geranium*, *Veronica* include three species (2.3%); and other genera include one to two species. A large number of species in the *Potentilla* and *Veronica* genera bring this flora to the Middle European species, while the enrichment by species of the *Vicia* genus indicates a more southerly location of the flora growth territory and depletion of boreal component that is associated with recreational load [3, p. 143].

Nevertheless, flora of the "Small Pinewood" ecological path is a typical temperate boreal and is characterized by the taxonomic diversity usual for Holarctic floras.

Here dominant are herbaceous plants (80.3%), predominantly *polycarpics* (63.6%). This is typical of other temperate-boreal flora. Long rhizomatous (17.4%), short rhizomatous (13.6%), and tap-root (12.1%) polycarpic plants are dominant. Tap-root plants include *Agrimonia eupatoria* L., *Hieracium umbellatum* L., *Potentilla argentea* L., and others; long rhizomatous plants include *Veronica chamaedrys* L.,

*Elytrigia repens* (L.) Nevski, *Stachys sylvatica* L., and others; and short rhizomatous plants include *Artemisia absinthium* L., *Geranium pratense* L., *Solidago virgaurea* L. This demonstrates that the flora is represented by both forest and meadow species.

In the formation of the flora noticeable role belongs to monocarpic herbs that make up 16.7%, of which 7.6% are biennial plants. A high percentage of monocarpic plants, especially biennials, indicate the favorable conditions for plant growth and development.

Pretty much part of the flora is represented by tree herbs and subtree herbs (19.7%). Erect deciduary trees (8.3%) and shrubs (7.6%) are represented the most fully.

Sub-shrubs (*Rubus caesius* L.), herbaceous horsetails (*Equisetum sylvaticum* L.), evergreen trees (*Pinus sylvestris* L. and *Picea x fennica* (Regel) Kom.), evergreen plants (*Vaccinium vitis-idaea* L.), deciduous shrubs (*Vaccinium myrtillus* L.), tussock grasses (*Carex contigua* Hoppe), raceme-root (*Epilobium hirsutum* L., *Plantago major* L.), and tuber-forming (*Scrophularia nodosa* L., *Stachys palustris* L.) polycarpics are among the most rare biomorphes.

In terms of feeding, all the plants are autotrophic.

The flora is dominated by hemicryptophytes (60.68%) and phanerophytes (17.4%). Meso- and nanophanerophytes are dominated in equal amounts. These include *Euonymus verrucosa* Scop., *Corylus avellana* L., *Ulmus laevis* Pall., *Acer platanoides* L., and others. According to C. Raunkiaer [11], spectrum of the flora life forms in general is very typical to the temperate zone, dominated by hemicryptophytes. The large number of phanerophytes is associated with woody vegetation. Slightly higher number of chamephytes (7.6%) indicates a variety of environmental conditions [10, p. 423]. Presence of therophytes (6.8%) is due to the adventitious species. Availability of cryptophytes (only geophytes) and therophytes confirms the anthropogenic disturbance of the substrate. Geophytes include *Stachys palustris* L., *Bromopsis inermis* (Leyss.) Holub., *Elytrigia repens* (L.) Nevski, and others.

In relation to the habitat, we should note dominated terrestrial species (130 species, or 98.5%). Other species have adapted to life on the water-logged and periodically flooded substrates. These include *Mentha arvensis* L., *Stachys palustris* L., and others.

With respect to the seasonal rhythm of vegetation we selected 97 summer green plant species (73.5%), 31 summer-wintergreen species (23.5%), and four types of evergreen species (3%).

In terms of phytocoenotic confinement, tracheophyte plants are dominated by meadow (48.4%) and forest (40.2%) species. Nemoral species associated with deciduous forests account for 18.9%, while boreal (taiga) species account for 12.2%; other species grow in the forests of various types. Nemoral species include *Aegopodium podagraria* L., *Glechoma hederacea* L., *Lapsana communis* L., *Viola mirabilis* L., and others. Boreal species include *Calamagrostis arundinacea* (L.) Roth, *Luzula pilosa* (L.) Willd., *Rubus saxatilis* L., and others. Neutrophil flora accounts for 9.1%. Other species are associated with places of high moisture (*Agrostis gigantea* Roth and *Carex ovalis* Good). Based on the analysis of the coenotic optimum, we can conclude that the studied area has a large variety of conditions for plant growth.

Identification of species areas showed that most of the plant species belong to the Euro-West Asian (33.3%), the Euro-Asian (19.7%), and Holarctic (14.4%) types. Hemi cosmopolitans are 1.5% of the flora. These include *Pteridium aquilinum* (L.) Kuhn and *Potentilla anserina* L.

Most species of flora, accounting for 75 species (56.8%), are frequently occurred. Another 46 species (34.8%) are occurred sporadically, eight species (6.1%) are occurred occasionally and rarely, whereas other species are very rare in the flora of Tatarstan. These include *Vicia cassubika* L., *Sisymbrium strictissimum* L., and *Diplazium sibiricum* (Turcz. ex G. Kunze) Kurata [12]. Kashubian pea is occurred as single species, whereas other types grow in small groups.

Adventive fraction of flora includes six species out of six genera and six families, accounting for 4.5% of the total number of species. These species came from the Eastern Mediterranean (*Bunias orientalis* L.), as well as from North America (*Acer negundo* L., *Conyza sanadensis* (L.) Cronq.).

Analysis of the flora showed that in terms of the immigration time, 50% of species belong to archeophytes and the same proportion belongs to kenophytes. In terms of immigration method, kenophytes are dominated. In terms of the degree of naturalization, 83.3% of the species are agriophytes.

The conducted study showed that the species composition of the flora of the "Small Pinewood" ecological path is rich and varied enough, indicating the stability of the existing plant cenosis. Anthropogenic impact on this area is essential, especially in the summer, on weekends, and public holidays, though visitors are mostly moved by road and path network.

### Conclusion

Summarizing the above, we can note the following:

1. Outreach and awareness-building work should be carried out among the population.
2. An inventory of species wealth should be carried out every 5-10 years.
3. Permanent test sites, providing monitoring of the preliminary selected objects, should be laid in the disturbed areas and especially valuable habitats, as well as the reference areas.

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