Chorological classification approach for species and ecosystem conservation practice

T V Rogova, M V Kozevnikova, V E Prokhorov and N O Timofeeva
Institute of Environmental Sciences, Kazan Federal University, 18 Kremlyovskaya str, Kazan 420008, Russia
E-mail: tatiana.rogova@kpfu.ru

Abstract. The habitat type allocation approach based on the EUNIS Habitat Classification and the JUICE version 7 software is used for the conservation of species and ecosystem biodiversity. Using the vegetation plots of the Vegetation Database of Tatarstan, included in the EVA (European Vegetation Archive) and GIVD (Global Index of Vegetation-plots Databases) types of habitats of dry meadows and steppes are distinguished by differing compositions of the leading families composing their flora – Asteraceae, Fabaceae, Poaceae and Rosaceae. Е12а – Semi-dry perennial calcareous grassland, and Е12б - Perennial calcareous grassland and basic steppes were identified. The selected group of relevés that do not correspond to any of the EUNIS types can be considered specific for ecotone forest-steppe landscapes of the southeast of the Republic of Tatarstan. In all types of studied habitats, rare and protected plant species are noted, most of which are South-East-European-Asian species.

1. Introduction
The provisions of the Sustainable Development Concept and the role of biological diversity in providing ecosystem services require new methodological approaches in solving modern problems of biodiversity conservation. In the context of intensive use of landscapes, the successful conservation of species and ecosystems depends not only on knowledge of the distribution of rare and endangered species of plants, animals and fungi in certain areas, but also understanding the relationship of biological species to the ecological conditions of their habitats [1]. Traditionally used species conservation through publication and management of Red Data Books for specific territories is already successful in protecting rare and endangered species. It is much more difficult to identify and ensure the preservation of the entire cenotic and ecosystem diversity. Fragmentation of vegetation cover and successive disruption of communities by land use make it difficult to assess the extent of these changes and preserve natural features [2].

The presence of modern electronic databases of relevé, accumulating information on both rare species and all species forming the community, greatly facilitate preserving cenotic diversity. The inclusion of such databases in the structure of regional and global Databases and in GIS layers, facilitates conservation of ecosystem diversity [3, 4]. Different classification approaches used to identify plant communities and build classification systems helps solve the problem. However, even the ecological approach using the Braun-Blanquet method for floristic classification of vegetation, which is widely used in world practice, does not give a clear picture of the association of individual syntaxonomic units of the system, especially of high ranks. In addition, such ecological approaches do
not capture ecotopological conditions, and accordingly they do not facilitate the practical task of preserving the biological diversity of a particular landscape [5]. On the other hand, there are methods of landscape-ecological analysis and identification of territorial units, based primarily on knowledge of the abiotic environment and its influence on the biotic communities [6]. The landscape approach is most convenient for the purposes of ecological mapping and land use optimization based on it, but it does not imply any concern about conservation of the entire biological diversity of the landscape and, especially, its structural units of low rank. In addition, the species of plants, animals and fungi "read" the ecological conditions of landscape in their own way and scale.

In the practice of biodiversity conservation in recent decades, a new direction has successfully developed in European countries, based on the classification of habitat types, both natural and anthropogenic [7, 8, 9]. For the territory of Europe, EUNIS (European Nature Information System) Habitat Classification has been developed, which is successfully applied not only in EU countries, but also in the Russian regions participating in the European Emerald Network project (Emerald Book of Russian Federation) [10].

2. Material and methods

For the Republic of Tatarstan, an attempt was made to identify habitat types of vascular plant species, based on the EUNIS Habitat Classification approach using the vegetation plots of the Vegetation Database of Tatarstan, included in the EVA (European Vegetation Archive) and GIVD (Global Index of Vegetation-plots Databases, ID: EU-RU-011). Relevés of herbaceous dry grassland communities were noted, mainly in the forest-steppe landscapes of Zavolzhje, Republic of Tatarstan in the southeast of the Russian Plain [11]. Selection of plots was based on the presence of indicator species, determined expertly. The sample, including 92 plots, was subjected to the clusterization procedure by the similarity of species composition. Using the JUICE software version 7.0 [12] the selected relevés were compared and assessed with the types of the EUNIS Habitat Classification and syntaxons of the Braun-Blanquet floristic classification. The floristic structure of the clusters was analyzed based on the leading families rate, life forms rate, and a list of rare and protected plant species.

3. Result and discussions

From the sample of 92 plots, we identified 7 clusters. According to EUNIS Habitat Classification, the most significant relevés correspond to the type of ecotope E1 – Dry grassland. Among them most represented habitat was E12 – Perennial calcareous grassland and basic steppes (29 plots); E12a – Semi-dry perennial calcareous grassland (6 plots) and E12b – Perennial calcareous grassland and basic steppes (23 plots). From the group of Dry grassland habitats, one relevé is assigned to type E1lf – Continental-dry-rocky-steppic-grassland-and-dwarf-scrub-on-chalk-outcrops-specialists and one relevé to type F3lf – Low steppic scrub. It’s very important to note that 56 plots were not assigned to any type of habitats, and a few were assigned to X06 – Artemisietea vulgaris. According to the classification of Braun-Blanquet, most of the relevés refer to the class Festuco-Brometea.

The dependence of these indices on the specificity of the ecotope can be traced to the structure of the species composition of communities in different habitats, which in turn is based on the range of leading families and by proportions of life forms [13]. In general, for the landscapes of the eastern regions of the European part of Russia (the Republic of Tatarstan, the Ulyanovsk region, the Volga-Ural region), the flora spectrum is characterized by the predominance of the first triad of families - Asteraceae, Poaceae, Fabaceae (table 1). For the more western regions (for example, the Moscow region) flora spectrum is characterized Asteraceae, Poaceae, Rosaceae. The high position of the Rosaceae family testifies to the similarity of the flora composition with the western floras of forest landscapes; the high position of the Fabaceae family characterizes the species composition of the more southeastern areas. Based on these general patterns, it can be argued that the habitat E12b–Perennial calcareous grassland and basic steppes exhibit features of a more xerophilous southeastern flora, in which the Fabaceae occupy the second position, and the Rosaceae move to the 4th place. Habitat E12a - Semi-dry perennial calcareous grassland reflect a more mesophytic character of
species composition, in which *Rosaceae* go to second place and *Fabaceae* to the fourth. The flora composition of a large group of plots (56), not identified by JUICE classification to any of the types of habitats, is more consistent with western forest-steppe landscapes, with a more xerophytic character of the flora in comparison with the western floras, as evidenced by the position of *Rosaceae* in the first triad of the family spectrum and *Fabaceae* in the third position following the *Rosaceae*. A fairly high participation of the phanerophytes (up to 10%) and chamaephytes (up to 11%) in their flora also indicate the forest-steppe features of these vegetation plots and the habitat as a whole. In habitat *E12b – Perennial calcareous grassland and basic steppes*, the share of phanerophytes is not more than 1%, with a large participation of chamaephytes, which indicates more dry habitat conditions.

**Table 1.** Floristic composition (first five families) of studied habitats and regions of the European part of Russia.

| Distribution area | Moscow region | East of European part of Russia | Ulyanovskiy region | Volga-Ural region |
|-------------------|---------------|---------------------------------|--------------------|------------------|
| Tatarstan *E12a*  | Asteraceae    | Asteraceae                       | Asteraceae         | Asteraceae       |
| Tatarstan *E12b*  | Asteraceae    | Poaceae                         | Fabaceae           | Asteraceae       |
| Not identified plots | Asteraceae  | Rosaceae                       | Poaceae           | Poaceae          |
| Fabaceae          | Poaceae       | Rosaceae                       | Poaceae           | Poaceae          |
| Rosaceae          | Fabaceae      | Poaceae                         | Cyperaceae         | Rosaceae         |
| Cyperaceae        | Brassicaceae  | Lamiaece                       | Brassic.           | Brassicaceae     |

**Table 2.** The proportion of Eastern European, East-European-Asian and endemic species of flora (%) of Not identified plots.

| Distribution area                          | *E12a* | *E12b* |
|--------------------------------------------|--------|--------|
| Eastern European                           | 2.1    | 1.8    |
| Eastern-European-Asian                     | 17.8   | 14.2   |
| Endemic of the Volga-Don interfluve and Zavolzhje | 0.5    | 0      |
| Endemic of Volga-Ural Region               | 0.2    | 0      |
| Endemic of the Middle Volga Region         | 0.5    | 0      |
| Endemic of the Southern Urals and Zavolzhje | 0.7    | 0      |

E12a – Semi-dry perennial calcareous grassland
E12b – Perennial calcareous grassland and basic steppes

The presence of relevés not attributed to any of the habitat types of the EUNIS Habitat Classification is most likely due to the vegetation cover ecotone in the conditions of the forest-steppe south-east landscapes of the Republic of Tatarstan, as well as the presence of plant species of the Eastern European and East-European-Asian ranges. Rare and protected plant species included in the Red Book of the Republic of Tatarstan [14] are identified in all types of studied habitats. The largest number of them was recorded in the habitat *E12b*. It is important to note that in the relevés of unidentified group of habitats there are also rare species of dry habitats, many of which have East European-Asian range and endemics (table 2). Among them are: *Astragalus henningii* (Stev.) Klok. (Endemic of the Volga-Don interfluve and Zavolzhje). *Astragalus zingeri* Korsh., *Asperula exasperata* V. Krecz. ex Klok. (Endemic of the Middle Volga Region). *Oxytropis hippolyti* Boriss., *Oxytropis spicata* (Pall.) O. & B. Fedtsch. (Endemic of the Southern Urals and Zavolzhje).
4. Conclusions
It is important to mention that ecological habitats in the south-eastern part of Republic of Tatarstan have distinct features because of the presence of eastern species; it is evident that more detailed investigations have to be done for new types habitat identification and determination of characteristic species for them. The questions of determining the flora composition of syntaxa of low ranks, unions, orders and associations remain open.

References
[1] Dengler J, Boch S, Filibeck G, Charucci A, Dembicz I, Guarino R, Henneberg B, Janisova M, Marceno C, Naginezhad A, Polchaninova N Y, Vassiliev K and Biurrun I 2016 Bulletin of the Eurasian Dry Grassland Group 32 13–30
[2] Rogova T V, Saveliev A A and Mukharamova S S 2005 Botanicheskiy Zhurnal 90(3) 450–460
[3] Schaminee J H J, Janssen J A M, Hennekens S M and Ozinga W A 2011 Plant Biosystems 145 85–90
[4] Dengler J, Oldeland J, Jansen F, Chytry M, Ewald J, Finckh M, Glockler F, Lopez-Gonzalez G, Peet R K and Schaminee J H J 2012 Biodiversity & Ecology 4 1–447
[5] Bruelheide H and Chytry M 2000 Journal of Vegetation Science 11 295–306
[6] Mucher C A, Klijn J A, Wascher D M, Schaminee J H J 2010 Ecological Indicators 10(1) 87–103
[7] Choimaa D, Welk E, Jager E J and Hauck M 2005 Flora 200 376–397
[8] Angelini P, Bianco P, Cardillo A, Francescato C and Oriolo G 2009 Schede descrittive degli habitat per la cartografia alla scala 1:50 000 (Roma) p 334
[9] Schaminee J H J, Chytry M, Hennekens S M, Mucina L, Rodwell J S, Tichy L 2012 Development of vegetation syntaxa crosswalks to EUNIS habitatata classification and related data sets. Final report EEA/NSV/12/001
[10] Emerald Book of Russian Federation. The territory of special conservation value of European Russia. Proposals for the identification P.1. 2011-2013. (Moscow) p 1–308
[11] Prokhorov V, Rogova T and Kozhevnikova M 2017 Phytocoenologia 47(3) 309–313
[12] Tichý L 2002 Journal of Vegetation Science 13 451–453
[13] Bakin O V, Rogova T V and Sitnikov A P 2000 Vascular Plants of Tatarstan (Kazan: Izd. Kazan. Univ.) p 496
[14] Red Book of Republic of Tatarstan (animals, plants, fungi), 3nd ed 2016 ed. Nazirov A A (Kazan) p 760