

Rare species of bayrachny forests of the south of the European part of Russia

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Abstract. The article presents the results of long-term research of ravine oak forests of the Rostov region. The term 'bayrack' (ravine) forest is associated with the growing of forests of this type on the slopes of ravines in the forest-steppe zone. The conducted ecological and floral classification showed a high syntaxonomic diversity of ravine oak forests of the region. Forest communities are represented by 6 associations: *Scorzonero ensifoliae-Quercetum* Sokolova ex Semenishchenkov 2020; *Vicio pisiformis-Quercetum roboris* Semenishchenkov 2012; *Pyro pyrastris-Quercetum roboris* Poluyanov 2012; *Chamaecytiso ruthenici-Quercetum roboris* Poluyanov 2012; *Fritillario ruthenici-Quercetum roboris* Onyschenko, Dyakova et Karpenko ex Goncharenko in Goncharenko et al. 2020, *Melico pictae-Ulmetum minoris* ass. nov. prov. from 2 classes: *Carpino-Fagetea*, *Quercetea pubescentis* and 2 unions: *Aceri campestris-Quercion roboris* and *Scutellario altissimae-Quercion roboris*. There are 67 rare plant species listed in the Red Books of the Rostov [1], Volgograd [2] and Voronezh [3] regions in the communities of these associations. Oak forests in the south of the European part of Russia significantly increase the biological diversity not only of the Don region, but also of the entire steppe zone of the country.

Oak forests in the south of the European part of the country are unique and rare ecosystems. All of them have been preserved only in specially protected natural areas, as well as in gully-beam systems (most of them are also protected). In the conditions of the steppe zone, it is the beams that are favorable forms of relief for the growth of the forest. The border location (on the border of natural zones, plains and hills) of the communities contributed to the development of high biological diversity. Taking into account the historical data on the distribution of forests in the south of the European part of the country: - the constant presence of thermophilic submediterranean: *Buglossoides purpuro-caeruleum*, *Carex michelii*, *Dictamnus albus*, *Ligustrum vulgare*, *Melica picta*; - south-siberian (*Campanula glomerata*, *Carex pallescens*, *Fragaria viridis*, *Origanum vulgare*, *Rubus caesius*, *Veratrum lobelianum*) species; - conclusions of Yu. D. Kleopov [4]: "The forests of the typological group under consideration, i.e. the forests of the "quercetalian order" *Quercetalia*, fall into two groups: western forests saturated with the subsurface type (before the Don River) and eastern forests-devoid of subsurface inhabitants, with a wide participation of South Siberian species"; it can be concluded that the forests of the southern

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European part of the country were a corridor between the forests of the Caucasus, Crimea and the forests of the European part of Russia.

The material for the work was geobotanical descriptions: 470 – author's, from the northern and central districts of Rostov (for 2007-2021), Bobrovsky, Bogucharovsky and Kantemirovsky-Voronezh (2021), Alekseevsky, Kumylzhensky and Nekhaevsky-Volgograd region; (2011, 2018, 2021) and 777 – G. M. Zozulin (1960-1980s, the same regions). All geobotanical descriptions were entered into the TURBOWIN database [5]. The syntaxonomy is based on the ecological and floristic classification of the Brown-Blanke direction [6-10]. According to the ecological conditions, the ravine oak forests of the studied territory are divided into mesophytic and thermophytic. The first ones occupy the northern slopes and the bottom of the large beam systems of the northern regions of all regions (Fig. 1). They correspond to the union *Aceri campestris-Quercion* Bulokhov et Solomeshch in Bulokhov et Semenishchenkov 2015, which unites Central Russian mesophytic broad-leaved forests without the participation of spruce. The remaining oak forests are thermophilic. For a long time, thermophilic forests of the European part of Russia, as well as Ukraine, were referred to the union *Aceri tatarici-Quercion* Zólyomy 1957, due to the weak study of thermophilic oak forests in the south of the European part of the country. Studies of oak forests of the forest-steppe zone (Voronezh, Kursk, Belgorod region, [7, 8] showed significant floral and ecological differences. Thus, the union *Scutellario altissimae-Quercion roboris* was identified, which unites the subxerophilic oak forests of the Pontic region of Ukraine and the south of Russia, found in the steppe zone and the southern part of the forest-steppe zone. Communities of thermophilic oak forests of the studied territory also correspond to this union (Table 1). They are common in the gullies up to the lower reaches of the Don River, and are also noted in the western and central regions of the Volgograd Region and in the above-mentioned regions of the Voronezh Region (Fig. 1).

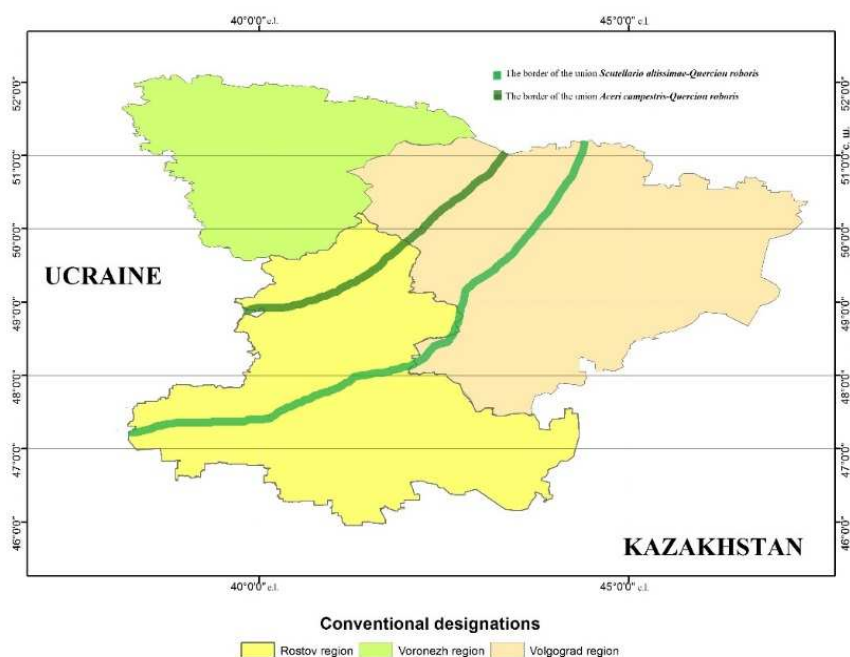


Fig. 1. Distribution of communities of unions *Aceri campestris-Quercion roboris* and *Scutellario altissimae-Quercion roboris* in the study area

Table 1. Abbreviated differential table of the associations of unions *Aceri campestris-Quercion roboris* and *Scutellario altissimae-Quercion roboris*

Region	The South of the European part of Russia							Central Russian upland		
	66	53	14	36	14	10	10	23	18	
Number of descriptions	1	2	3	4	5	6	7	8	9	
Syntaxon	1	2	3	4	5	6	7	8	9	
<i>Quercus robur</i>	A	V	V	V	V	V	V	V	V	
<i>Quercus robur</i>	B	II	II	.	III	.	.	II	III	II
Diagnostic species ass. <i>Melico pictae-Ulmetum minoris</i>										
<i>Ulmus minor</i>	A2	V	II	III	III	III	IV	.	.	.
<i>Melica picta</i>	C	IV	III	III	II	III	.	.	.	.
<i>Aristolochia clematitis</i>	C	III	II	II	II	I	.	.	.	.
<i>Ulmus minor</i>	A	II	I	.	I	.	.	.	.	.
Diagnostic species ass. <i>Vicio pisiformis-Quercetum roboris</i>										
<i>Vicia pisiformis</i>	C	I	V	I	I	I	.	V	.	I
<i>Brachypodium sylvaticum</i>	C	II	III	I	II	.	IV	IV	.	.
<i>Phlomis tuberosa</i>	C	I	III	II	II	II	.	IV	.	I
<i>Carex rhizina</i>	C	.	II	.	.	.	.	V	.	.
Diagnostic species ass. <i>Chamaecytiso ruthenici-Quercetum roboris</i>										
<i>Calamagrostis epigeios</i>	C	.	.	IV	I	I	.	.	IV	II
<i>Chamaecytis ruthenicus</i>	B	I	I	V	I	I	.	.	V	I
<i>Malus sylvestris</i>	A2	I	I	III	I	.	V	II	I	II
<i>Calamagrostis arundinacea</i>	C	.	.	.	.	.	.	.	IV	II
<i>Moehringia trinervia</i>	C	.	.	I	.	.	.	.	III	I
<i>Peucedanum oreoselinum</i>	C	.	I	I	.	.	.	.	V	.
<i>Hieracium umbellatum</i>	C	.	.	I	.	.	.	.	IV	.
<i>Valeriana rossica</i>	C	.	.	.	.	.	.	.	III	.
Diagnostic species ass. <i>Pyro pyrastris-Quercetum roboris</i>										
<i>Pyrus pyrastrer</i>	B	II	II	II	V	III	V	IV	IV	IV
<i>Pyrus pyrastrer</i>	A	I	II	.	IV	I	.	.	IV	.
<i>Astragalus glycyphyllos</i>	C	I	I	I	III	I	.	V	.	V
<i>Brachypodium pinnatum</i>	C	.	.	.	.	.	.	.	II	IV
<i>Campanula rapunculoides</i>	C	.	I	.	II	.	.	.	I	V
Diagnostic species ass. <i>Fritillario ruthenici-Quercetum roboris</i>										
<i>Fritillaria ruthenica</i>	C	I	I	I	.	V	.	.	.	.
<i>Cerasus fruticosa</i>	B	.	I	II	I	II	.	.	.	.
Diagnostic species ass. <i>Scorzonero ensifoliae-Quercetum</i>										
<i>Scorzonera ensifolia</i>	C	.	.	.	.	.	V	.	.	.
<i>Vincetoxicum hirundinaria</i>	C	I	I	II	I	.	V	IV	I	III
<i>Viola suavis</i>	C	I	I	I	I	II	V	.	.	.
<i>Galeopsis tetrahit</i>	C	I	I	.	.	.	V	.	.	.
<i>Campanula rapunculus</i>	C	I	I	.	I	.	III	.	.	.
<i>Poa angustifolia</i>	C	II	I	II	.	.	V	.	I	II
<i>Daucus carota</i>	C	I	.	I	.	.	V	.	.	.
Diagnostic species union <i>Aceri campestris-Quercion roboris</i>										
<i>Fraxinus excelsior</i>	F	V	I	I	II	III	.	II	.	.
<i>Acer campestre</i>	A2	V	II	I	III	.	I	V	.	II
<i>Acer campestre</i>	A	III	.	.	I	III	.	.	.	.
<i>Fraxinus excelsior</i>	A2	II	I	I	I	I	I	III	.	.
<i>Swida sanguinea</i>	B	II	I	.	I	I	.	II	.	I
<i>Euonymus europaea</i>	B	I	III	I	II	II	.	V	.	II

<i>Acer campestre</i>	B	I	I	I	III	I	.	.	.	.
<i>Fraxinus excelsior</i>	B	I	.	I	.	.	.	.	.	.
Diagnostic species union <i>Scutellario altissimae-Quercion roboris</i>										
<i>Crataegus rhipidophylla</i>	B	II	II	III	V	II	V	V	.	IV
<i>Scutellaria altissima</i>	C	II	I	I	II	I	.	.	.	.
<i>Lamium maculatum</i>	C	I	I	.	II	.	.	.	.	.
<i>Acer tataricum</i>	B	I	V	IV	V	V	V	V	V	I
<i>Dictamnus caucasicus</i>	C	.	II	I	I	I	.	.	.	.
Diagnostic species order <i>Carpinetalia betuli</i> and class <i>Carpino-Fagetea</i>										
<i>Stellaria holostea</i>	C	V	I	III	II	II	.	V	.	II
<i>Geum urbanum</i>	C	V	IV	II	V	III	V	IV	III	III
<i>Dactylis glomerata</i>	C	III	V	II	IV	III	II	II	.	III
<i>Poa nemoralis</i>	C	III	II	III	II	IV	I	V	III	IV
<i>Convallaria majalis</i>	C	III	II	II	II	I	V	III	III	II
<i>Tilia cordata</i>	A	III	I	I	I	I	.	.	I	.
<i>Viola mirabilis</i>	C	III	II	I	II	I	.	.	I	III
<i>Aegopodium podagraria</i>	C	III	I	.	I	.	V	.	I	III
<i>Campanula trachelium</i>	C	II	II	I	I	I	V	.	.	II
<i>Tilia cordata</i>	A2	II	I	I	.	I	.	IV	II	.
<i>Lathyrus vernus</i>	C	II	I	.	.	.	.	II	.	III
<i>Anthriscus sylvestris</i>	C	II	I	.	II	II	.	II	II	III
<i>Glechoma hederacea</i>	C	I	I	II	I	.	I	III	II	I
<i>Pulmonaria obscura</i>	C	I	I	I	I	.	II	III	.	III
<i>Acer platanoides</i>	A	I	I	I	I	I	.	.	.	.
<i>Stachys sylvatica</i>	C	I	I	I	I	I	.	.	.	I
<i>Carex muricata</i>	C	I	II	I	I	I	.	.	.	.
<i>Populus tremula</i>	A2	I	I	II	I	.	.	.	II	II
<i>Heracleum sibiricum</i>	C	I	I	.	I	.	II	.	I	II
<i>Platanthera chlorantha</i>	C	I	I	I	.	.	.	.	.	.
<i>Corylus avellana</i>	B	I	.	I	.	.	.	.	I	II
<i>Scrophularia nodosa</i>	C	I	I	.	I	I	I	II	II	IV
<i>Cystopteris fragilis</i>	C	I	I	.	.	I	.	.	.	.
<i>Asarum europaeum</i>	C	I	.	.	.	.	.	.	.	II
<i>Scilla siberica</i>	C	I	.	.	I	III	.	.	.	.
<i>Corydalis bulbosa</i>	C	I	.	.	.	III	.	.	.	.
<i>Polygonatum multiflorum</i>	C	I	.	I	I	I	.	.	.	II
<i>Corydalis marschalliana</i>	C	I	I	I	.	II	.	.	.	.
<i>Acer platanoides</i>	A2	I	.	.	.	.	.	V	II	I
<i>Anemone ranunculoides</i>	A	I	.	.	.	II	.	.	.	.
Diagnostic species order <i>Quercetalia pubescenti-petraea</i> and class <i>Quercetea pubescentis</i>										
<i>Euonymus verrucosa</i>	B	V	V	III	V	V	V	V	V	II
<i>Polygonatum odoratum</i>	C	II	IV	III	III	III	III	II	V	I
<i>Chelidonium majus</i>	C	II	I	.	III	III	V	.	.	.
<i>Viola hirta</i>	C	II	II	II	II	II	III	IV	I	III
<i>Vincetoxicum scandens</i>	C	II	III	I	II	II	II	.	.	.
<i>Agrimonia eupatoria</i>	C	I	II	III	III	I	V	IV	.	IV
<i>Hypericum perforatum</i>	C	I	II	I	I	II	II	V	.	IV
<i>Euphorbia semivillosa</i>	C	I	I	II	II	II	III	.	.	.
<i>Elymus caninus</i>	C	I	I	I	I	I	I	.	.	.
<i>Pyrethrum corymbosum</i>	C	I	III	II	I	II	.	.	I	IV
<i>Prunus spinosa</i>	B	I	II	II	V	III	.	IV	.	II

<i>Lactuca chaixii</i>	C	I	II	II	III	IV	.	.	.	.
<i>Thalictrum minus</i>	C	I	II	II	II	III	.	.	.	.
<i>Clinopodium vulgare</i>	C	I	II	III	I	I	.	III	III	V
<i>Campanula bononiensis</i>	C	I	I	II	II	II	.	.	.	.
<i>Asparagus officinalis</i>	C	I	I	II	II	I	.	.	.	I
<i>Campanula persicifolia</i>	C	I	I	II	I	I	.	.	V	IV
<i>Origanum vulgare</i>	C	I	I	II	I	I	.	.	I	II
<i>Lathyrus pisiformis</i>	C	I	I	I	I	I	.	.	.	.
<i>Stachys officinalis</i>	C	I	I	I	I	I	.	III	IV	V
<i>Lapsana communis</i>	C	I	I	I	I	I	.	.	.	.
<i>Rhamnus cathartica</i>	B	I	II	II	II	.	.	III	I	II
<i>Vicia tenuifolia</i>	C	I	I	II	I	.	.	.	.	I
<i>Lactuca quercina</i>	C	I	I	I	I	.	.	.	.	II
<i>Pulmonaria mollis</i>	C	I	I	.	.	.	.	.	.	.
<i>Laser trilobium</i>	C	I	I	.	.	.	.	.	.	.
<i>Ligustrum vulgare</i>	B	.	I	I	I	II	.	.	.	.
<i>Asparagus tenuifolius</i>	C	.	I	I	I	I	.	.	.	.
<i>Genista tinctoria</i>	C	.	I	II	.	.	.	.	.	II
<i>Vicia cracca</i>	C	.	I	.	I	.	I	.	.	I

Note: Symbols: The tiers of the stand: A - the first, A2-the second, B-shrub, C-grass. Constancy classes: I-1-20%, II-21-40%, III-41-60, IV-61-80, V-80-100%.

Forest communities of bayrachny forests began their formation at the end of the Early Holocene [11], so there are many relict species here: *Allium lineare* L., *Arum nordmannii* Scott., *Jasione montana* L., *Juniperus Sabina* L., *Ophioglossum vulgatum* L., *Ornithogalum boucheanum* (Kunth) Asch. и др. Due to the borderline position of the forest distribution area, many species found themselves on the border of the range: *Acer platanoides* L., *Adenophora lilifolia* (L.) A. DC., *Anthericum ramosum* L., *Archangelica officinalis* (Moench) Hoffm., *Asarum europaeum* L., *Bulbocodium versicolor* (Ker-Gawler) Spreng., *Campanula trachelium* L., *Cephalanthera damasonium* (Mill.) Druce, *Coccyganthe flos-cuculi* (L.) Fourr., *Dryopteris carthusiana* (Vill.) H.P.Fuchs, *Equisetum fluviatile* L., *Epipactis helleborine* (L.) Crantz, *Laser trilobium* (L.) Borkh., *Lathyrus niger* (L.) Bernh., *Lychnis chalcedonica* L., *Mercurialis perennis* L.. The peculiarities of the formation, geographical location, and climatic conditions contributed to the formation of endemic species here: *Aegonychon purpureo-caeruleum* (L.) Holub, *Delphinium sergii* Wissjul. (*D. schmalhauseni* auct. non Albov.), *Dictamnus gymnostylis* Steven, *Cotoneaster alaunicus* Golitsin и др. In addition to the above, rare species are noted: *Adonis volgensis* DC. [*Chrysocyanthus volgensis* (DC.) Holub], *Anemone sylvestris* L., *Anemonoides ranunculoides* (L.) Holub, *Asplenium ruta-muraria* L., *A. trichomanes* L., *Athyrium filix-femina* (L.) Roth, *Campanula altaica* Ledeb., *C. macrostachya* Waldst. & Kit. ex Willd., *C. trachelium* L., *Clematis integrifolia* L., *Corydalis marschalliana* (Pall. ex Willd.) Pers., *C. solida* (L.) Clairv., *Delphinium puniceum* Pall, *Dryopteris filix-mas* (L.) Schott, *Echium russicum* J. F. Gmel., *Equisetum telmateia* Ehrh., *Eriosynaphe longifolia* (Fisch. ex Spreng.) DC, *Fritillaria ruthenica* Wikstr., *Galatella angustissima* (Tausch) Novopokr., *Hyacinthella leucophaea* (C. Koch) Schur., *Maianthemum bifolium* (L.) F.W. Schmidt, *Muscari neglectum* Guss., *Neottia nidus-avis* (L.) Rich., *Paeonia tenuifolia* L., *Paris quadrifolia* L., *Pedicularis dasystachys* Schrenk, *Platanthera bifolia* (L.) Rich., *P. chlorantha* (Cust.) Reichenb, *Prangos trifida* (Mill.) Herrnst. & Heyn, *Primula veris* L., *Pteridium latiusculum* (Desv.) Hieron. ex Fries, *Polygonatum multiflorum* Stev., *Pulmonaria mollis* Wulf. ex Hornem., *P. obscura* Dumort., *Pulsatilla patens* (L.) Mill., *P. pratensis* (L.) Mill. s. l. м, *Scilla siberica* Haw., *Symphytum tauricum* Willd., *Ulmus glabra*

Huds., *Vinca herbacea* Waldst. Et Kit., *Vincetoxicum rossicum* (Kleop.) Barbar. (*Cynanchum rossicum* Kleop.).

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