

# Condition and structure of meadow vegetation in the floodplain area of the Bolshoi Kinel River

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**Abstract.** This study aims to characterize the structural composition of little-studied riverine grassy landscapes, focusing on the vegetation of floodplain meadows. Botanical analysis of the vegetation was conducted on the territory of the floodplain of the Bolshoi Kinel River, Kinel'sky district, Samara region, using generally accepted geobotanical methods. The current state and composition of plant communities in the floodplain meadows of the Bolshoi Kinel River are described. The study reveals that various types of floodplain meadows were formed on the floodplain profile under the influence of environmental and natural factors, with three classes of meadow formations identified: real, steppe, and swampy. The real meadow formations predominate on the floodplain profile, characterized by a high number of plant associations and plant species. In contrast, the steppe meadow formations, common in the middle section of the floodplain, are less developed, as evidenced by the associative and species composition of the grass stand. Notably, the vegetation of swampy meadows requires a comprehensive and more detailed study, as the floodplain of the Bolshoi Kinel River is characterized by an abundance of swamps distributed throughout the entire profile.

## 1 Introduction

Important components of environmental protection are assessing the state and predicting possible changes in the composition of plant communities under the influence of various factors. Knowledge of the dynamics of flora and vegetation is important for assessing the ecological potential of the territory, preserving its biodiversity and rational use, in order to avoid degradation of the vegetation cover.

The state of the environment is an important indicator of the stability of the ecosystem as a whole [1,2]. In a changing climate, vegetation cover is being restructured; it becomes obvious that many plant species and ecosystems will not have time to adapt to changes in the external environment [3, 4].

Degradation of vegetation cover occurs not only under the influence of changing environmental and climatic factors, but also as a result of anthropogenic load, this leads to the replacement of natural communities with communities with a large participation of ruderal, poisonous or harmful plants [5,6,7]. Degradation of plant communities entails not

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only a decrease in the number and disappearance of some plant species, but also, as a consequence, entails a change in soil cover and can lead to salinization.

Floodplain meadows on the left bank of the Samara region occupy quite large areas and currently these territories are poorly studied from a geobotanical and ecological point of view.

Currently, there is a certain amount of information about the floodplain flora of the Volga River, but there is little information about the flora of its tributaries; therefore, conducting research to describe the modern floristic composition of the vegetation of floodplain meadows is relevant.

## **2 Materials and methods**

Botanical research on the grass stand was conducted through thorough route geobotanical studies conducted on floodplain meadows within the Bolshoi Kinel River floodplain in the Kinel'sky district of Samara region from 2020 to 2022. The structure of communities and the ratio of species were determined by projective cover on transverse ecological profiles of the floodplain at two times. The first period is the period of mass flowering of the grass stand (May - June), the second period is the period of regrowth of the grass stand (July - August). The projective cover was determined over the entire specified floodplain profile using test plots, the size of which was 1 m<sup>2</sup>, and expressed as a percentage, while the number of botanical groups was determined visually and quantitatively by weight using groups of test sheaves.

## **3 Results and discussion**

The territory of the Kinel'sky district belongs to the province of the High Trans-Volga region and is located in the Samara-Kinel'sky upland-plain region. It is located between the Samara and Bolshoi Kinel rivers. The space between these rivers is an open steppe plain lying at an altitude of 75-100 m, characterized by asymmetrical river valleys with well-developed terraces above the floodplain.

The Bolshoi Kinel River originates on the western slopes of General Syrt. Forest-steppe and steppe vegetation predominates in the river basin. The Bolshoi Kinel is a flat river, up to 405 km long. The river bed has a high-lying, two-sided floodplain, 2-8 km wide, narrowing in places, crossed by lakes and oxbow lakes.

The floodplain of the Bolshoi Kinel River has a different structure throughout its entire length, which is determined by the activity of the river and physical and geographical conditions, and is divided into 3 parts. In the upper reaches of the river, the floodplain is open meadow and has a length of approximately 200 km. This segment is characterized by the presence of two ecological floodplain zones: a riverbed zone in the form of a narrow strip and a well-developed central zone, which are flooded annually. The middle part of the floodplain, 150 km long, has a well-defined structure: riverbed, central and near-terrace zones. This part of the floodplain is characterized by elevation, so flooding occurs only in certain years due to severe floods. This part of the floodplain is characterized by shrub and forest vegetation. The lower floodplains, which are only 55 km long, are also characterized by clearly defined zoning and are flooded annually, resulting in swamping of this area.

The focus of our research is on the vegetation of floodplain meadows along the Bolshoi Kinel River and its central zones. Our goals are to analyze the current state of plant communities and predict potential changes under the influence of various factors. The Bolshoi Kinel River's floodplain is marked by diverse conditions, including its hydrological regime, alluviality, soil composition, and annual spring flooding duration. These conditions significantly impact the development and diversity of meadow vegetation. Within the study

area, we can identify three distinct types of floodplain meadows: true, steppe, and swampy meadows, each with characteristic plant formations.

Characteristic of the meadows of the Bolshoi Kinel River is the distribution of such types of cereal grasses as awnless brome, creeping wheatgrass, meadow foxtail, meadow fescue, meadow bluegrass, common bentgrass, white bentgrass and others. Of the leguminous crops, the most common are tuber-bearing china, meadow china, horned sweet grass, meadow clover, mountain clover, medium clover, mouse pea, white sweet clover, etc., some of which are dominant. The wide distribution of plants of the legume family is associated with the presence of carbonate soils.

The most common large-stemmed herbs are: sour sorrel, crowned sickle, creeping buttercup, large plantain and common plantain, paniculata wormwood and others. In the described plant associations there are a total of 42 botanical families, uniting 226 species of angiosperms. The most common families in terms of the number of species are the following families: Asteraceae, Lamiaceae, Carnationaceae, Legumeaceae, Poaceae and Sedgeaceae.

In the floodplain of the Bolshoi Kinel River, there are 226 species of plants. Of these, 32 are prominent or co-prominent in meadow associations. The majority of these species are rhizomatous grasses and large-stemmed forbs. The Kinel floodplain is located at the mouth of the Bolshoi Kinel River and has a unique structure, which is reflected in the distribution of different types of meadows along its entire length. These natural meadows are the dominant type in the Kinel floodplain.

The formation of vegetation in floodplain meadows occurs under the influence of a complex of natural conditions and the nature of economic use. The degree of development of the grass stand varies due to the degree of alluviality, moisture, and the nature of the soil, associated with annual long-term or short-term flooding in the spring and periodic or constant floods in the summer and autumn. The diversity of natural conditions of the floodplain determines the diversity of grass stand.

The research yielded three categories of meadow formations, comprising 17 distinct groups of plant associations. The most prevalent groups are those of true meadows, followed by steppe meadows, which are less developed. Swampy meadows, on the other hand, are the least represented, with only two sources of plant associations. True meadows are widespread across all floodplain zones, often found in depressions with adequate soil moisture and a rich alluvial layer. The vegetation in these areas is characterized by 11 different formations, primarily consisting of cereals, sedges, and forbs. The composition of these formations varies, with cereals ranging from 10% to 58%, sedges from 9% to 43%, legumes from 2% to 16%, and forbs from 25% to 50%. The layering of these formations also varies, with the top tier ranging from 75 to 150 cm, the middle tier from 60 to 80 cm, and the bottom tier from 15 to 35 cm.

The key components that are common across all the formations in this area are as follows. Grasses: Meadow fescue; Awnless brome; Creeping wheatgrass; Meadow foxtail. These grasses are dominant due to the ecological conditions of the floodplain. Herbs: Dandelion; Forest fireweed; Asparagus officinalis; Columbine; Burnet; and many other herb species. Legumes: White sweet clover; Medicinal sweet clover; Meadow clover; Common sweet grass; Romanian alfalfa; Common alfalfa; Hop alfalfa; Meadow rank; Tuberous chin; Zinger's astragalus; Variegated elm. Sedges: Early sedge; Fox sedge; Black sedge. These sedges are also an integral part of the meadow community in this area.

The steppe meadows of the Bolshoi Kinel River floodplain are composed of 4 distinct plant formations. Two of these formations are dominated by forbs (herbaceous flowering plants), specifically mountain clover and mouse pea.

The bottom type of meadows is widespread on high, rarely flooded hills, with soddy-meadow soils in the central and near-terrace zones. In the middle part of the steppe meadows, dense grassy patches with a mix of forbs and legumes are common. The vegetation is

typically mesophytic (adapted to moderate moisture conditions), but there are also xerophytic (drought-tolerant) species present, such as grooved fescue, slender-legged fescue, thyme-flowered snakehead, tuberous sweet clover, gray-green hickory, steppe sage, and mouse pea.

In terms of percentage composition, grasses make up 5-21%, forbs 28-55%, and legumes 13-35% of the vegetation.

The grass stand has a tiered structure. The first tier consists of dense, bushy grasses and large-stemmed forbs, reaching a height of 60-80 cm. The second tier is composed of legumes and some forbs, not exceeding 35 cm in height. The third tier is dominated by low-growing forbs, ranging from 5 to 10 cm in height.

The floodplain of the Bolshoy Kinel River is also characterized by the presence of swamps and oxbow lakes, which support a distinct plant community. This is one of the largest and most studied groups of plant associations, located in low areas with long-term water stagnation and silt-marshy soils. The vegetation is dense, predominantly grassy, and can reach up to 180 cm in height. The main species involved in this formation include reed canarygrass, swamp bluegrass, fox sedge, soddy sedge, comfrey, and medicinal sedge. Legumes are typically absent from these swampy meadow communities.

## 4 Conclusion

The studies have shown that the study area is a relatively heterogeneous area in structure and degree of moisture, and therefore three classes of meadow formations have formed here, the predominant ones being the formations of true meadows, the less developed formations of steppe meadows, and the smallest ones being swampy meadows. The diversity of vegetation in the studied areas is estimated at 226 species of angiosperms, 32 of which are dominant, all species of the area are combined into 42 botanical families, while the projective cover is quite high with a predominance, among others, of grass-forb associations, in the grass of which there are most perennial mesophytes plants with a slight increase in the number of hygrophilic species in the lower areas of the floodplain, xerophytes are few in number and are found sporadically, this indicates the preservation of the normal mode of existence of floodplain vegetation and the high potential for self-reproduction of plant communities, despite the existing anthropogenic load. Currently, the condition of the floodplain meadows of the Bolshoi Kinel River is satisfactory. Based on the analysis of the state of plant communities in the floodplain of the Bolshoi Kinel River, it is possible to draw a conclusion about the number and diversity of species composition, the density of angiosperms growing here, which makes it possible to study the stability of this phytocenosis, which continues to exist in changing climatic conditions; the results obtained provide an opportunity for further monitoring the state of plant communities in a given area in order to assess the stability of the ecosystem. Since the preservation of floodplain vegetation contributes to the preservation of ecological balance in the Bolshoi Kinel River basin.

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