Ecological and Phytocenological Characteristics of the Vegetation of the National Park "Buzuluksky Bor"

Z.N. Ryabinina¹, R.G. Kalyakina², G.V. Petrova², E.M. Anhalt², M.V. Rjabuchina¹

¹Federal Scientific Center for Biological Systems and Agricultural Technologies of the Russian Academy of Sciences, 29, 9th January st., Orenburg, 460014, Russia
²Chair “Forestry and forest park”, Orenburg State Agrarian University, 18, St. Cheluskinev, Orenburg 460014, Russia

kalyakina_railya@mail.ru

Abstract. The uniqueness of the territory of Buzuluksky Bor as an object of national and world natural heritage was first identified by outstanding domestic naturalists S.I. Korzhinsky. In historical terms, scientific research in Buzuluk pine forest has been carried out since the creation in the pinery of a scientific base - the pine forest experimental station named after A.P. Tolsky. Buzuluksky Bor's problems include: periodic droughts; forest fires over large areas; previous clear cutting; damage to forest crops by pests. On the territory of Buzuluksky Bor, 679 species of vascular plants belonging to 97 families and 353 genera grow (excluding producers), which makes 56% of the total number of species of the Orenburg region. The dominant breed Buzuluk pine forest is an Scotch pine. Buzuluksky Bor is bordered on almost all sides by a strip of deciduous forest, bordering a treeless steppe. About 40% of the area is currently occupied by pine, 21% by oak, 11% by maple, linden and alder, and about 28% by birch, aspen and other small-leaved species. According to V.N. Sukachev, the pine forests of the Buzuluksky Bor are represented by 17 types, which fall into four groups: a) lichen pine forests (Pineta cladinosa), b) mossy pine forests (Pineta pseudoherbosa), c) false grassy pine forests (Pineta pseudoherbosa), d) complex pine forests.

Key words: Dominant breed, coniferous massif, phytocenosis, vascular plants, type of forest

1. Introduction
The Buzuluk pine forest is located on the border of the Orenburg and Samara regions and is the most valuable coniferous massif of steppe and forest-steppe regions of the European part of Russia. The Borovka River divides it into two parts; the most interesting types of pine trees grow on the territory of the river terrace on the floristic composition [1-3]. A strip of deciduous forests - oak forests, poplar forests and alder forests - stretches along the course of the Borovka River, and some aspen and birch forests are scattered throughout the pine forest. A feature of pine forest is its microclimate, which is characterized by increased air humidity - ideal for ferns and mosses. Ferns are present in almost all types of forest of the Buzuluksky Bor, especially in mossy pine forests [4, 5].

Currently, the Buzuluksky Bor has the status of a national park, but this did not lead to a decrease in the anthropogenic press - the number of recreants exceeds 100 thousand per year, a railway running through the territory, an ammunition depot, famous for the fire at the arsenal, which led to uncontrolled explosions in 2012 and a significant number of drilled oil wells - all these symptoms of massive anthropogenic pressure dramatically increase the risk of catastrophic developments, since...
Forest fires are the most vulnerable. So, during the period from 1990 to 2007, 637 fires were recorded in the forest with an area of 0.1 ha (1990) to 208 ha (1996), in the vast majority of cases the cause of the fire is the human factor. Plantations of Buzuluk pine forest relate mainly to the 1st and 2nd classes of fire hazard, crown fires have been repeatedly passed in the past, so for the period from 1760 to 1980, large crown fires covered 79,445 ha., therefore, the pine forest belongs to the “extraordinary category” in terms of relative combustibility, and to the “highest category” in the area of fires. In addition, this forest grows in the territory of the nuclear test impact zone at the Totsky training ground on September 14, 1956. (according to some estimates, the bomb power is about 40 kilotons), the landfill is located forty kilometers from the city of Buzuluk, i.e. the pine forest was exposed to radiation pollution (according to the same estimates that exceeded the Chernobyl), the effects and consequences of which on this biogeocenosis have not been studied in detail. In 1953, exploration of oil and gas fields began in the Buzuluk pine forest, at first by small drilling, then from 1959 by deep drilling [6, 7].

Chronic anthropogenic impact, which has sharply increased at present, worsens the sustainability of this natural object; there are objective reasons to believe that the Buzuluksky Bor is close to a state of environmental disaster. Symptoms of this condition should be considered insufficiency, and in a number of forest types - the lack of natural regeneration, the presence of foci of the pine fungus, foci of mass reproduction of pests, including black barbel, as well as the presence of uphill mortality not only in overripe, but also in ripening stands [8].

Floristic studies of the Buzuluksky Bor, despite the long-standing start of research, the dynamics and diverse approach in the field of geobotany and phytocenology, have not yet received an unambiguous solution. This is due not only to the biological characteristics of the growing species and the variety of habitat conditions, but also to a fundamentally different methodological approach to the collection, systematization and processing of experimental data. Floristic studies are the basis for environmental monitoring, determining the current state and forecasting, and developing measures to minimize the negative impact.

Purpose of the Study

In connection with the foregoing, it becomes important to study the phytocenological features of the vegetation of the Buzuluksky Bor national park.

2. Materials and methods

The vegetation cover of the Buzuluksky Bor was studied by us during different vegetation periods. When studying in the field, a continuous floristic inspection of the territory was carried out. A detailed description of the vegetation was concentrated on the territory of natural monuments and in the places where rare plant species grow. The vegetation cover was identified, lists of flora species were compiled, which took into account: the generative state of plants, their height, abundance of populations, living conditions, environmental conditions and anthropogenic stress. To assess the abundance of the species, eye-counting was used according to the Drude scale [9-12].

3. Results and Discussion

The uniqueness of the floristic composition of the Buzuluk pine forest is primarily associated with the location of this forest in the steppe zone, as well as its landscape structure, which affects the formation of floristic diversity. The most complete classification of boron types in connection with their development was made by academician V.N. Sukachev, who identified here 17 types of pine plantations and 4 deciduous. Based on the classification of V.N. Sukachev, we have studied and described the main types of forests.

1. Lichen pine forests develop in the zone of the most pronounced dune landscape on the tops of the dunes. This group of forests is characterized by a variety of epigeous lichens.

2. Mossy pine forests are represented by several types of forests, located on a more humidified substrate, unlike the previous group, they occupy slope landscapes and floodplain terraces. Representatives of bryophytes dominate in the grassland, representatives of mesophilic forbs are found.
3. False grass pine forests occupy gentle hills, actively developing in depressions. In this group of forests, the grassy layer is floristically more diverse. The undergrowth is represented by steppe shrubs.

4. Complex pine forests differ from the previous ones in that in addition to the pine, other species that form the second tier play an important role in the addition of the tree layer. Such pine forests are confined to flat places or shallow depressions between the dunes. By the presence of certain species such types of forests are distinguished as linden pine, oak-linden pine, bracken-oak pine.

5. Oak forests are dominated by common oak in the tree layer and are represented by four main types: linden-pine oak, linden-spindle tree oak, grass-pine oak and bracken oak. Oak forests occupy gentle slopes facing south and level places already almost outside the pine forest basin. They are genetically related to pine trees. The grass cover in these forests is dense, ferns abound.

6. The group of types of soft breeds is represented by birch forests, aspen forests and alder forests. These tree species tend to lower relief forms, creating special conditions for the development of unique grassy vegetation.

It should be noted that grassy vegetation is developed in the pine forest: steppe plots, a large number of meadows and glades composed of various species of perennial herbaceous plants.

A huge role in the formation of the floristic diversity of the territory belongs to the edge effect (Table 1).

| Formation Group | Association | Associations |
|-----------------|-------------|--------------|
| Common pine forest (Pinus sylvestris L.) | Fern pine wood | European wild ginger high delphinium bracken pinery (Pinus sylvestris – Asarum europaeum + Delphinium elatum + Pteridium aquilinum)
| | | Nettle bellflower bracken pinery (Pinus sylvestris – Campanula trachelium + Pteridium aquilinum) |
| Lime-mossy pine wood | Linden dicranum millipede ptilium crest bracken pinery (Pinus sylvestris – Tilia cordata + Dicranum polysetum + Ptilium crist-a-castrensis + Pteridium aquilinum) |
| Grass mossy pine wood | Multifloral Smolevnikovo brachycetium polytrich male dryopteris pinery (Pinus sylvestris – Silene multiflora + Brachythecium salebrosum + Polytrichum juniperium + Dryopteris filixmas) |
| Birch-mossy pine wood | Birch lesser wintergreen plagiommnus brachycetic pinery (Pinus sylvestris – Betula pendula + Pyrola minor + Plagiommium cuspidatum + Brachythecium salebrosum) |
| Complex pine forests (Pinus sylvestris L.) | Linden pine wood | Linden male fern pinery (Pinus sylvestris – Tilia cordata + Dryopteris filixmas) |
| | Oak-lime pine wood | Oak linden-bracken pinery (Pinus sylvestris – Tilia cordata + Quercus robur + Pteridium aquilinum) |
| | Bracken-oak pine wood | Oak-bracken pinery (Pinus sylvestris – Quercus robur + Pteridium aquilinum) |
| | | Oak cinnamon rose bracken pinery (Pinus sylvestris – Quercus robur + Rosa majalis + Pteridium aquilinum) |
Grassy lowland pine wood
Floodplain pine wood
Common oak forests (Quercus robur L.)
Linden-pine oak wood
Linden-spindle tree oak wood
Grass-pine oak wood
Bracken oak wood

| Species                                                  |
|----------------------------------------------------------|
| Greater celandine-teliperis pinery (Pinus sylvestris - Chelodionum majus + Dryopteris filixmas) |
| Solomon's seal teliperis pinery (Pinus sylvestris - Polygonatum odoratum + Dryopteris filixmas) |
| Strawberry-common fragile fern pinery (Pinus sylvestris - Fragaria vesca + Cystopteris fragilis) |
| Oregano-bracken pinery (Pinus sylvestris - Origanum vulgare + Pteridium aquilinum) |
| Field-mint-teliperis pinery (Pinus sylvestris - Mentha arvensis + Dryopteris filixmas) |
| Pine-lime candle larkspur-bracken oakery (Quercus robur-Tilia cordata + Pinus sylvestris + Delphinium elatum + Pteridium aquilinum) |
| Linden-euonymous bracken oakery (Quercus robur-Tilia cordata + Euonymus verrucosa + Pteridium aquilinum) |
| Linden-euonymous male fern oakery (Quercus robur - Euonymus verrucosa + Dryopteris filixmas) |
| Pine bush grass-bracken oakery (Quercus robur - Pinus sylvestris + Calamagrostis epiégeos + Pteridium aquilinum) |
| Oregano-bracken oakery (Quercus robur - Origanum vulgare + Pteridium aquilinum) |
| Ground elder bracken oakery (Quercus robur - Aegopodium podagraria + Pteridium aquilinum) |

In addition to natural biotopes, there are a large number of sites in the forest where the vegetation cover is in the form of burning, cutting areas, areas with preserved oil wells, forest plantations. Such modified habitats are practically not restored to their original state. Many annual ruderal species are inhabited here, which, although they are part of the modern pine forest flora, are not an indicator of the species richness of the territory. In the cutting areas, the floristic composition of the indigenous plants in such territories is completely replaced by synanthroil species. The floral composition of the plantings is poor, it includes no more than 3-5 species of vascular plants.

679 species of vascular plants belonging to 97 families and 353 genera (excluding producers) are grown on the territory of the Buzuluksky Bor, which makes 56% of the total number of species in the Orenburg region. The leading families in the number of species are Asteraceae (121), Roaseae (66), Fabaceae (57), Rosaceae (42), Caryophyllaceae (44), Brassicaceae (37), Sururecae (36), Scrophulariaceae (35), Lamiaeae (34), Ranunculaceae (29), the greatest number of species is represented by the genera: Carex (27), Viola (15), Veronica (14), Ranunculus (12). Potentilla, Astragalus, Galium, Artemisia (11 species), Centaurea, Campanula, Dianthus (10 species).

Rare plants for both the steppe and forest zones grow on the territory of the Buzuluk pine forest. Moreover, for some species, Buzuluk pine forest is the only habitat in the Orenburg region, among them Diphasiastrum complanatum (L) Holub, (Diphasiastrum obleate - inhabitant of green-moss pine forests), Cyripedium macranthon Sw. (Venus slipper large-flowered - found in broad-leaved and light coniferous forests), Neottiante napellus (L.) Schlechter (Neotiante napellus - along light green-moss, dead-cover, low-grass coniferous and mixed forests), Drosera rotundifolia L. (Dewdrop rotundifolia - representative of the flora of sphagnum bogs).

65 species of mosses grow in the moss cover of the Buzuluk pine forest. In lichen pine forests, Polytrichum piliferum, Ceratodon purpureus, Brachythecium albicans, Bryum caespitum, Syntricia ruralis dominate in the moss cover. Polytrichum juniperium grows in the most shaded places in the recesses. Mossy pine trees are located in depressions or around wetlands. Moss cover is much better developed here, the predominant species are: Dicranum polysetum, Dicranum scoparium, mixed with Ptilium cristacastensis, as well as Hylocomium splendens, Pleurozium Schreberi, Polytrichum juniperium. Complex pine forests are distinguished by the fact that, in addition to Pinus sylvestris L., other species of tree-shrub vegetation are also included, for example, Porulys L., Ulmus L., Betula L.
The undergrowth is rare, consists of Chamaecytisus ruthenicus, Euonymus verrucosa, Berberis vulgaris. Of the mosses, Polytrichum juniperium, Dicranum scoparium, Dicranum polysetum, Plagiomnium cuspidatum, Brachythecium salebrosum and other species predominate.

Buzuluksky Bor is a particularly valuable, largest forest area of the region. On the territory close to the Borovka River, the most interesting types of pine trees grow in floristic composition; therefore, the largest number of ferns grows in floodplain pine forests and in grassy lowland pine forests. In the Buzulk pine forest, tree-forming species, in addition to Pinus silvestris L., are: Quercus robur, Tilia cordata, Acer platanoides, Sorbus aucuparia, Padus avium, etc. In the Buzuluksky Bor, in addition to floodplain pine forests, the following main types can be distinguished: lichen pine forests, mossy pine forests and complex pine forests. Lichen pine forests are quite widespread in the Buzuluksky Bor. The lichen cover is well developed, consists of species of the genus Cladonia s.l. Lichen cover is well developed, consists of species of the genus Ceratodon s.l. In these pine forests it is always very dry and therefore mosses and ferns are found in small quantities. The moss cover is dominated by: Polytrichum piliferum, Ceratodon purpureus, Brachythecium albicans, Bryum caespiticium, Syntricia ruralis. In the most shaded areas in the hollows grows Polytrichum juniperium.

Mossy pine forests are relatively rare. They are located in depressions or around wetlands. Moss cover is much better developed here than in the previous type of pine forest. The ground cover of mosses in these forests is not continuous; it is located in small spots. The predominant species are: Dicranum polysetum, Dicranum scoparium. Of the ferns noted here: Pteridium aquilinum, Dryopteris filixmas, Dryopteris cristata, Dryopteris carthusiana, Cystopteris fragilis. The projective cover of ferns in these pine forests reaches up to 80–90%. Complex pine forests are distinguished by the fact that, in addition to Pinus sylvestris L., their stand includes other species: Populus L., Ulmus L., Betula L. The undergrowth is rare, consists of Chamaecytisus ruthenicus, Euonymus verrucosa, Berberis vulgaris. In this type of pine forest, the moss cover is less developed. Here prevail: Polytrichum juniperium, Dicranum polysetum, Dicranum scoparium, Plagiomnium cuspidatum, Brachythecium salebrosum and etc. The following species grow from ferns in complex pine forests: Dryopteris filixmas, Cystopteris fragilis, Pteridium aquilinum and Thelypteris palustris. In some types of complex pine forests, such as bracken-oak pine forest, floodplain pine forest and lowland grass pine forest, the projective cover of ferns reaches 70–80%. So, the vegetation of Buzuluksky Bor is distinguished by species diversity and the presence of spore plants (ferns and mosses) in almost all types of forests, and in most cases, these spore plants dominate the plant communities of Buzuluk pine forest.

In the flora of the Buzuluk boron, 20 species of plants are listed in the Red Books of the Russia, Orenburg and Samara Regions. Among the wild fruit, berry and medicinal plants growing within the Buzuluk pine forest, 43 species of vascular plants are classified. Of particular interest are the fruits of plant species such as Common raspberry (Rubus idaeus L.), Bird cherry (Padus avium Mill), Gray Blackberry (Rubus caesius L.), Wild strawberry (Fragaria vesca L.), etc.

Of the medicinal plants, the most popular are: Hypericum perforatum L., stinging nettle (Urtica dioica L.), oregano (Origanum vulgare L.), blackcurrant (Ribes nigrum L.), redcurrant (Ribes rubrum L.), Valerian officinalis L., heartwort (Leonurus cardiaca L.), English oak (Quercus robur L.).

A significant part of the Buzuluksky Bor plants are the most vulnerable part of the vegetation cover, and a decrease in the number of populations of these plants occurs mainly under the influence of human economic activity.

The total area of the forest fund is 111118 ha. The total area of the forest fund is 111118 ha. Including forest lands 98,075 ha (88.3%), non-forest 13043 ha (11.7%).

Forest crops created in the Buzuluk pine forest occupy 25422 ha (22.9%) of the area covered by forest vegetation. The area not covered by forest vegetation is 1971 ha (1.8%) of the total forest area and is represented mainly by glades, unforested cutting areas and open crops. The lost plantations occupy a small area of 27 hectares.

Non-forest lands are represented by hayfields - 2510 ha (2.3%), water surfaces cover 2333 ha (2.1%), roads and clearings - 1576 ha (1.4%), pastures 1274 ha (1.1%) and bogs 1196 ha (1.1%).
Hayfields and arable lands are used both for own forest management needs and for the local population.

Of the total number of prevailing species, the most common and highly growth class species are pine stands of natural and artificial origin. Low growth class have plantations of elm, poplar, willow.

The age structure of Buzuluk pine forests is dominated by ripe and mature stands of 46.9%, middle-aged ones make up 31.5%, young growths - 11.5%, maturing 10.1%. The total estimated stock of stands of the national park is 25915 thousand m3.

On the territory of Buzuluksky Bor rare plants grow, for the steppe and forest zone. For some species, Buzuluk pine forest is the only location in the Orenburg region. In addition to the above, rare species are found in the territory of the Buzuluk pinery: Lilium martagon L., Cypripedium calceolus L., Stipa pennata L., Cephalanthera rubra (L.) Rich., Orchis militaris L., Adonis vernalis L. Many species typical of Buzuluk pine forest are the most vulnerable. These include Ranunculus lingua L., Anemone sylvestris L., Anemonoides ranunculoides (L.) Holub., Pulsatilla patens (L.) Mill., Euonymus verrucosa Scop., Nuphar lutea (L.) Smith, Dianthus andrzejowskianus (Zapal.) Kulcz., Geranium robertianum L., Pyrola rotundifolia L., Dracophyllum ruyschiana L., Galium odoratum (L.) Scop., Antennaria dioica (L.) Gaertn. Endemic species (Fritillaria ruthenica Wikstr and Lathyrus litvinovii Iljin) are of some value. Analysis of the age structure of forest stands shows that as a result of destructive forest fires in a significant part of the territory, Buzuluksky Bor is man-made. The average density of pine forest stands is 0.43. Aspen (0.66) and linden (0.55) plantings have the highest average density. The relatively low average density of pine plantations (0.65) is primarily due to the negative impact on their growth and development of the pine fungus (low density in the foci of the disease). In general, the natural regeneration of pine in the Buzuluksky Bor is unsatisfactory, and in some types of forest is generally absent.

4. Conclusion
Changes in the environmental situation in Buzuluksky Bor are a negative factor. The reason for the development of an undesirable situation is not only an anthropogenic factor, but also natural fluctuations that are characteristic of any living ecosystem, in particular forest fires and entomopes 13-15. It is indisputable that the flora of this unique forest area needs constant monitoring, development, adoption and implementation of effective solutions to reduce the level of negative impact. Floristic studies conducted by us on the territory of the Buzuluk Bor allow us to consider the studied natural object as the most important element in the system of key botanical territories of the Volga-Ural region.

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