The current state of forest stands under anthropogenic impacts on the example of the Orenburg Urals

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Abstract. The article presents the results of monitoring the state of forest stands in the Orenburg region. The proportion of planted areas with impaired and lost resistance is significant. The main reasons for the weakening and death of forests were forest fires (71.1%), adverse weather conditions and soil and climatic factors (11.9%), as well as forest diseases (9.4%). The dry climate and intense anthropogenic impacts bring forest fires to a dominant position in the loss of forest stands in the Orenburg region as a whole. An analysis of the forest fire data of the region shows that the frequency of fires is on average 10 cases per 100 ha of forests per year; the maximum number of fires is 25, and the largest area covered by the fire is up to 450 ha (2010). Recommendations are given on preventing anthropogenic impact on the soil and vegetation cover of forest censoses of the Orenburg region. One of the main sources of anthropogenic impact on forest ecosystems is mining. The complex impact of oil and gas production and refining processes will be manifested for a long time.

1. Introduction
The article presents the results of monitoring the state of forest stands in the Orenburg region. The proportion of planted areas with impaired and lost resistance is significant. The main reasons for the weakening and death of forests were forest fires (71.1%), adverse weather conditions and soil and climatic factors (11.9%), as well as forest diseases (9.4%). The dry climate and intense anthropogenic impacts bring forest fires to a dominant position in the loss of forest stands in the Orenburg region as a whole. An analysis of the forest fire data of the region shows that the frequency of fires is on average 10 cases per 100 ha of forests per year; the maximum number of fires is 25, and the largest area covered by the fire is up to 450 ha (2010) [1]. Recommendations are given on preventing anthropogenic impact on the soil and vegetation cover of forest censoses of the Orenburg region.

The state of the environment is one of the most acute socio-economic problems that directly or indirectly affect the interests of each person. One of the main sources of anthropogenic impact is mining. The consequences of this type of environmental management are characterized by significant inertia. The complex impact of oil and gas production and refining processes will be manifested for a
long time. That is why today it is impossible to postpone efforts to improve it so that the environmental crisis does not develop into an environmental catastrophe [2-6].

2. Materials and methods
Territories with low forest cover, which include the Orenburg Urals, are experiencing the most severe pressure from climatic conditions due to their location in the middle of the continent, which has formed an extreme sharply continental climate. Such conditions limit the amount of precipitation and form a high degree of temperature difference from +42 to -42 °C. In such conditions, the Orenburg Urals has a forest cover of 0.4%, therefore, forestry and land reclamation measures are part of the adaptive landscape farming system. Creating an ecological framework for forest biocenoses is a very complex and costly business [7-10].

In 1948, in the Orenburg region there were only 100 thousand hectares of forests and shrubs. According to the "Stalin Plan" in Orenburg until 1965 it was planned to create about 330 thousand hectares of protective forest stands, including 48 thousand hectares in Buzuluk pine forest. Currently, in the Orenburg region, the forested area is 558.3 thousand ha. Of these, 92 thousand hectares are agroforestry plantations [11-15].

The importance of forest cenoses for this territory is difficult to overestimate. This is a barrier to the onset of desertification by western Kazakhstan, it is a mitigation of climate, and a barrier to the transfer of pollution from industrial centers of the Orenburg region to the center of Russia. Currently, in the Orenburg region there is a decrease in the forest fund for anthropogenic reasons.

Ecological problems of conservation of forest cenoses are in contradiction with the trends of economic activities of the Orenburg region [15-21].

One-third of the forest fund (about 190 thousand hectares) has been leased out for a long time. At this point in the Orenburg region there are 215 leases of forest land.

On the forest fund areas of the Orenburg region of 128 hectares is leased for the operation of communication lines, power, oil and gas pipelines, roads and other linear objects. In addition, about 62 hectares of forests were leased for the construction of water wells, water pipelines and other hydraulic structures. Also, on the lands of the forest fund of the Orenburg region, work is underway on the geological study of mineral resources and the development of mineral deposits. For these purposes, about 170 hectares of forests were leased (according to the Ministry of Forestry and Hunting of the Orenburg Region).

Monitoring of forest stands allows obtaining real data on their ecological status. For example, monitoring the state of forest stands indicates that Kvarkeno forestry is among the top ten forest districts where the largest forest area with unsatisfactory sanitary conditions is observed (in 2012 - 3,500 ha, including 2600 ha of dead). Since 2012, the loss of woody vegetation is proceeding rapidly. The largest areas of plantations with impaired and lost resistance due to weakening and death are located in eight more areas of the region.

Using the example of Kvarkeno forestry and studying the causes, we can say that forest fires account for 2730.2 ha of forest area; for adverse weather conditions and soil-climatic factors - 451.2 ha and forest diseases - 357.4 ha (Figure 1).

![Figure 1. Area of plantations with impaired and lost stability for the main reasons for their weakening and death in 2012, ha.](image-url)
In 2012, forest stands were lost for the above reasons on an area of 177.7 hectares. The main causes of forest deaths (71%) were forest fires in 2012 and forest fires of past years. This leads to the accumulation of stands with impaired and lost resistance (Fig. 2).

The main adverse weather conditions and soil and climatic factors, the impact of which led to the weakening and death of forests in the Kvarkeno forestry, are: drought and a change in groundwater level (Table 1). For 2013 it is projected to increase forest area, exposed to adverse climatic conditions, up to 350 hectares.

The weakening of the general vitality of plants immediately leads to the appearance of diseases. We observed a bacterial disease of birch caused by the phytopathogenic bacterium *Erwinia multivora* (wet necrosis), which causes a high degree of damage to the stands.

![Figure 2. Area of stands with disturbed and lost forest resilience during the decade of drought.](image)

| The cause of weakening and death | Damaged rock | The total area of stands weakened by factors, ha | The area of plantations that died under the influence of factors, ha |
|---------------------------------|--------------|-----------------------------------------------|--------------------------------------------------|
| Groundwater Level Change        | Aspen, pine  | 259                                           | 259                                              |
| Drought                         | Birch        | 2,7                                           | 0                                                |
| Drought                         | Pine         | 158,6                                         | 0                                                |
| Waterlogging due to climatic factors | Birch      | 30,9                                          | 0                                                |
| Total                           |              | 451,2                                         | 259                                              |

In terms of the degree of damage, this disease is second in the region after the Dutch elm disease, which is common in the northern regions of the region. By the end of 2012 stands area with broken and lost resistance in the foci of forest disease was 357.4 ha. The most susceptible to this disease were pure, middle-aged and ripening, medium stand density and medium growth quality plantations of birch. The least susceptible to forest diseases are single species stand, ripe and overripe, high-density and medium growth quality birch forests.

The dry climate and intense anthropogenic impacts bring forest fires to a dominant position in the loss of forest stands in the Orenburg region as a whole.

Distribution of forest fires during the fire season is uneven. The beginning of the fire season occurs in April and lasts until October. Especially many fires occur in May with low humidity and a relatively
small amount of precipitation, which hardly moisturizes the dried grass of last year. But if spring fires, according to some researchers, even to a weak degree contribute to soil fertilization, and therefore forest regeneration, then summer-autumn fires are detrimental to forest ecosystems.

According to the types and intensity of separation of forest fires in the Kvarkeno region, ground fire prevails, which, in conditions of a moisture deficit in the Orenburg region, lead to weakening and drying out of plantings in subsequent years. Crowning fires also occur, in which forest stands die in the same year.

An analysis of the data on the burning of forests in the district over the years shows that the frequency of fires is on average 10 cases per 100 ha of forests per year; the maximum number of fires is 25, and the largest area covered by the fire is up to 450 ha (2010). The distribution of forest area covered by fires and the number of fires over the past three decades are presented in graphs (Fig. 3, 4).

As we can see, the number and area of forest fires varies from year to year, but in general there is an increase in both the number and area of fires.

In order to completely prevent anthropogenic impact on the environment and, first of all, to protect the land cover, in particular forest cenoses, the following measures are recommended:

- choose a rational network of access roads in order to prevent the negative impact of protective forest strips on woody vegetation located on the territory of human economic activity;
- movement of vehicles exclusively on the designated road network;
- mandatory compliance with the boundaries of the territory allotted for economic activity;
• organization of places for temporary storage of solid waste and their regular removal from the territories of economic activity;
• separate removal of fertile soil layers and their storage without loss of quality in a storing bunker until the end of construction work in areas of economic activity.

At the end of the work, it is necessary to carry out rehabilitation of lands. During rehabilitation of lands, the type and direction of recultivation is determined in accordance with the requirements of state standard no 17.5.1.02. In all cases, according to the requirement of state standard no 17.5.1.01-83, the rehabilitation of deteriorated lands is carried out in two stages - technical and biological.

When performing technical rehabilitation, it is necessary:
a) dismantle and remove existing auxiliary structures;
b) level the reclaimed surface;
c) apply previously removed potentially fertile and fertile soil layer to the planned surface with a uniform layer;
d) carry out the final planning of the surface of the soil cover of the site or the right of way.

The finishing land leveling should be carried out by machines with low specific ground pressure to avoid overconsolidation of the surface of the reclaimed layer. When preparing the site, a deep nonmoldboard loosening of the compacted horizon should be made to create favorable conditions for the development of plant root systems.

During the rehabilitation of pipeline routes in floodplain areas, as well as in the presence of nearby gullies, a drainage and drainage network is constructed, if necessary, so that the pipeline route does not become a watercourse for melt and storm water and does not become a hotbed of linear soil erosion. If there are hydraulic structures in the restoration zone, it is recommended to arrange their bottom and sides.

Work on technical rehabilitation should be completed within a year after completion of construction work.

After the completion of the technical phase, the biological stage of rehabilitation is carried out:
a) mineral fertilizers are introduced to improve the nutritional regime of soils (superphosphate, complex fertilizers, potassium sulfate);
b) organic fertilizers are introduced to increase the content of organic matter and increase the microbiological activity of soils;
c) annual, perennial grasses, cereals and legumes are sown (in fodder crop rotations) for the restoration or formation of the root layer and its enrichment with organic substances.

3. Conclusion

Thus, thanks to ongoing organizational and technical measures, landscape-plant complexes will represent a virtually unbroken system. In order to minimize the possible adverse effect on the vegetation, the complex of preventive (precautionary) measures:
1. Exclude the passage of equipment off-road in areas with natural vegetation.
2. Maximize the use of eco-efficient technology.
3. It is imperative to equip drainage pit with waterproofing corresponding to the type of terrain of the construction area and the depth of groundwater.
4. Carry out work related to the use of chemical reagents so that areas with woody vegetation, and especially floodplain forests, remain on the leeward side.
5. At the end of the work - to reclaim disturbed areas of land, which will reduce the timing of the reversal of vegetation in these areas.
6. To speed up the process of restoration of the vegetation cover, it is recommended to sow a mixture of perennial herbs and shrubs. Planting material used for rehabilitation should be tested, as well as genetically belonging to the species of local populations. Species should quickly acclimatize, be resistant to adverse microclimate conditions and negative physical and chemical soil conditions, have a well-developed root system, and be capable of symbiosis with microorganisms.
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