Ancient Aeolian Landscapes of the South of Western Siberia: Issues of Protection and Nature Management

A O Kurasova

1Institute of Biology, Tomsk State University, Lenin Avenue 36, Tomsk, 634050, Russia

E-mail: kurasovalina@gmail.com

Abstract. One of the distinctive features of the West Siberian Plain is the wide distribution on its territory of cover sandy deposits, which act as parent rocks over a large area within the region for a wide range of climatic conditions. This feature of Western Siberia is due to geological and geomorphological conditions and the history of relief development in the Late Quaternary. Soils formed on sandy deposits play an important role in the sustainable functioning of the landscapes of the entire West Siberian region. This article discusses the issue of the protection of unique ancient aeolian landscapes on the example of the south of Western Siberia.

1. Introduction
Sandy massifs are widespread in the periglacial zone of Western Siberia. The Ob-Tomsk interfluve is characterized by a rather complex landscape structure. Within the territory of the interfluve, ancient aeolian landscapes are widespread, confined to drainage hollows and river terraces. Such landscapes are of great forest and water conservation significance, are under conditions of intense anthropogenic impact associated with urbanization processes, and, accordingly, need protection. Landscapes of sand massifs are also important sources of information to establish the characteristics of the climate, relief, vegetation and soil cover of the early postglacial. [Parnachev 2010].

The study area is located in the vicinity of the Seversk-Tomsk urban agglomeration, where more than 70% of the population of the Tomsk region (more than 680 thousand people) are concentrated. Currently, the urbanized area continues to grow; Suburban development is actively developing, the area of recreational areas is expanding. All this endangers the stable functioning of the natural complexes of the Ob-Tomsk interfluve. Pine forests of sand massifs need special protection, since they fulfill an important ecological function, fixing the tops of sand dunes and preventing unfavorable erosion processes, and also have the greatest aesthetic value, corresponding to the image of a classic pine forest. [Kulizhskiy et al, 2015].

2. Research area
Aeolian dune relief within the Ob-Tomsk interfluve is confined to ancient runoff troughs and low above-floodplain terraces of the Tom and Ob rivers [Kulishskiy 2015]. The dunes are up to 22 m high and are oriented from north-east to south-west. The upper part of the section of sediments composing aeolian forms is represented by well-sorted fine- and medium-grained quartz-feldspar sands with fine bedding. [Parnachev 2010].
Figure 1. Sandy sediments showing parent rocks for the Ob-Tomsk interfluve in a sandy quarry (near the village of Takhtamyshevo).

The soil cover of the sandy massifs of the Ob-Tomsk interfluve has been described in sufficient detail in a number of works [Dyukarev, Pologova, 2011, Kulizhsky et.al., 2015, Konstantinov et.al., 2018, Konstantinov et al., 2019]. The results of the above studies generally show that the territory under consideration is dominated by alfehumus soils: sod-podzols and sod-podburs. At the same time, the severity of the podzolic and alpha-humus processes directly depends on the position in the dune relief, hydrological conditions and can change significantly.

Figure 2. Typical vegetation in areas confined to the ancient aeolian relief.

The climate of the territory is continental. The average annual temperature is 0.6°C. The average annual precipitation is 550 mm, of which 300-350 are in the form of rain [Klimat, 1982]. Modern vegetation on aeolian landforms is represented by green moss and cowberry-green moss pine forests (Fig. 1), and the bottoms of depressions and large inter-dune depressions are often swampy.
Figure 3. Cutting-out for a sand pit in the area of distribution of dune relief in the vicinity of the village. Takhtamyshevo.

The study area is characterized by a long history of anthropogenic impact, as evidenced by the numerous archaeological sites confined to the sites of ancient aeolian relief [Barsukov, Bobrova, 2016].

3. Results and discussion

The quarry for sand extraction, in the vicinity of the village of Takhtamyshevo, has been developed over 17 years, especially over the past 5 years, the area has increased significantly (more than 2 times). Currently, the quarry continues to be used both for the extraction of sand.

Many works are devoted to the study of the developed quarries: the main reasons for desertification in the northern taiga, primary successes in overgrown quarries, and erosion processes are considered.

Figure 4. Development of a quarry in the vicinity of the village. Takhtamyshevo - space images, GoogleEarth.

In 1986 V.T. Trofimov identified the reasons for the waving of sandy sediments in the northern taiga of Western Siberia: forest fires destroying the lichen cover and forests; trampling of the lichen cover by herds of grazing deer; weak fixation of sands associated with sparse vegetation and lichen cover.

In recent decades (since the 90s), the main reason for the growth in the area of deforested areas is associated with the development of the oil and gas industry and human economic activities in Western Siberia. The main problematic characteristic of these territories is desertification, which is associated with the main industry, oil and gas production. There are the main ways to solve the ecological
problem of desertification in the northern taiga regions, such as [Sizov, 2015]: 1) methods of reclamation of areas of waving sand in northern taiga conditions; 2) aeolian landforms as a natural monument and objects of ecological tourism.

Primary successions are one of the objects of research in overgrown quarries. So, according to the research [Koronatova N.G. 2004], it was revealed that the type of succession (herbaceous, woody) depends on the depth of water occurrence, and the dusting of quarries with peat does not affect its rate. In the work of O.I. Suminoi the characteristics of the diversity of communities that are formed during the overgrowing of quarries are considered, and the reflection of the dynamic processes of restoration succession is considered.

Sand quarries are a promising source in the search for pale soils. The buried soils of sandy massifs are used to determine the age and assess the intensity of aeolian processes at the boundary of the Pleistocene and Holocene. Sand dunes are well studied in Central Europe: the Netherlands, northern Belgium, Denmark, northwestern Germany, and central Poland [Kaiser et.al., 2009]; low knowledge of paleosols is typical for the territories of European Russia, where individual paleosols have been found and described [Drenova 2000, 2011]. For the first time, for the territory of the Ob-Tomsk interfluve, pale soils were found, which were found on the walls of a quarry in the vicinity of the village. Takhtamyshevo [Konstantinov et.al., 2019].

Deforestation of pine forests is dangerous, as the renewal process will lead to a change in species. At present, productive pine forests, with the exception of the forest-park zone, are practically cut down. Prohibited mine felling, felling in the water protection zone of the water intake and in the vicinity of villages [Panchenko E. M., 2015].

4. Conclusions
Recreational activities, felling, fires, sand mining lead to the degradation of the vegetation and soil cover in the areas where ancient aeolian landscapes of high terraces and runoff hollows are spread. As a result of anthropogenic impact, sparse pine forests with a low projective cover of the ground cover are formed. Overexploitation may result in the emergence of vast mobile sandy areas, a decrease in biological diversity, and the risk of the development of erosion processes in the south of Western Siberia.

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