

ANNOTATION

**for the dissertation work of Yelena Andreyevna Simanchuk on the topic:
“Studying the patterns of natural overgrowing of mining enterprises dumps in
the Kostanay region”, presented for the degree of Doctor of Philosophy (PhD) in
the educational program 8D05101 – Biology**

General description of work. The dissertation studied the natural overgrowth of dumps of mining enterprises in the Kostanay region. The phytocenotic composition, dynamics and patterns of syngeneses of plant communities on dumps, as well as the influence of edaphic factors, were analyzed. Ecological and phytocenological foundations for optimizing the natural overgrowth of dumps have been developed.

The relevance of research. The global environmental crisis, caused by excessive consumption and exploitation of natural resources by humans, is one of the most important problems of our time.

Anthropogenic activity in the process of mining leads to complex changes in natural landscapes, which include degradation of soil and vegetation cover, disruption of the structure of the lithogenic base and hydrological regime of the area. As a result of these changes, the natural landscape is transformed into a natural-technogenic one, more often into a completely technogenic one, and the restoration of disturbed ecosystems can take centuries. The 20th century was a period of unprecedented anthropogenic impact on nature. As a result of this impact, significant changes in the structure of the earth's landscapes have occurred on a global scale. Forest areas were partially or completely destroyed, and forested and forested meadow landscapes arose in their place. Territories such as forest-steppes and steppes are transformed into field and agricultural landscapes after plowing.

F.N. Milkov, the founder of landscape ecology, put forward a theory about the radical transformation of all landscapes of the Earth under the influence of anthropogenic activities. The large-scale transformation of landscapes has led to their new categorization - anthropogenic landscapes. Biogeocenology describes the phenomenon of catastrophic succession of biogeocenosis caused by anthropogenic impact. This is a sharp change in the community of living organisms, leading to the complete or partial death of biota and the formation of a new, unstable community.

The complete transformation of the landscape that occurs during the development of mineral deposits leads to serious negative consequences. When developing iron ore quarries, waste rock dumps are formed.

Dumps are artificial formations created as a result of storing rocks, overburden and other materials generated during mining. They are a striking example of a man-made landscape, which has specific characteristics that differ from natural landscapes.

Changes in the natural landscape under the influence of dumps are expressed in the transformation of the topography, the destruction of the fertile soil layer and land degradation, as well as the disappearance of natural vegetation.

Environmental pollution from dumps occurs in several directions. Dumps are a source of dust pollution, which negatively affects human health and the environment. Rain and melt water erode dumps, which leads to pollution of water bodies.

Geological processes associated with dumps include subsidence, which can lead to the formation of craters and sinkholes, as well as landslides, which pose a danger to people and infrastructure.

The scientific study of dumps is aimed at assessing their impact on various components of the environment and developing reclamation methods that will restore the natural landscape and reduce their negative impact.

Yu. A. Manakov as a result of studies of overburden dumps, distinguished 8 groups of ecotopes, differing in their ecological characteristics. These characteristics determine the degree of favorableness for life, which, in turn, affects the rate of overgrowth of these artificial landscapes.

The intensive extraction of minerals in Kazakhstan has led to the formation of vast technogenic landscapes. According to the land cadastre as of November 1, 2022, the area of disturbed lands in Kazakhstan is 244.8 thousand hectares. These territories are occupied by dumps of overburden and waste rocks, tailings, ash dumps, quarries, etc. The problem of land degradation is most acute in Mangystau (70.5 thousand hectares), Kostanay (40.4 thousand hectares) and Karaganda (33.2 thousand hectares) regions.

In addition to direct violation of the soil cover, the extraction and processing of minerals leads to the formation of significant volumes of industrial waste. As of January 1, 2023, 31.6 billion tons of waste have been accumulated in Kazakhstan, and this indicator increases by 1 billion tons annually. The leader in waste generation is non-ferrous metallurgy. Enterprises in this industry have accumulated over 22 billion tons of waste, which occupy 15 thousand hectares.

The study of phytocenoses in the technogenic environment is a current area of modern botany, which has practical significance for solving environmental problems. The influence of the technogenic environment on phytocenoses is multifaceted and manifests itself at different levels: morphogenesis - changes in the size, shape, and anatomy of plants occur; physiological and biochemical processes – disturbances in photosynthesis, respiration, water metabolism, accumulation of toxic substances are manifested; cenotic relationships – changes in the structure and composition of plant communities occur. In this regard, in 1967 V.V. Tarczewski singled out industrial botany from general botany as an independent scientific discipline, which emphasizes the importance of this area.

The first work on studying the processes of overgrowing of iron ore deposit dumps was carried out in the 70s of the 20th century. Separately, the dumps of the Sarbai mine were studied in the period from 1997 to 2003.

The purpose of the work was to study the features of overgrowing of dumps of different ages that are part of Sokolovsko-Sarbai Mining and Processing Production Association JSC (SSGPO JSC) and Kachary Ruda JSC. The research was conducted within the framework of the priority area of development of Kazakh science “Ecology, environment and rational use of natural resources”.

The topic of the dissertation research directly correlates with the tasks set within the framework of the National Priority “Establishing a diversified and innovation-driven economy”, “on *environmental protection while eliminating the consequences of subsoil use, the use of mining waste for the purposes of resource efficiency*”.

Also, the topic of the work finds potential practical application in the light of the “Strategy for achieving carbon neutrality of the Republic of Kazakhstan until 2060” through the restoration of degraded lands through forest reclamation of iron ore dumps and other post-technogenic territories.

Research objectives:

1. To study the patterns of natural overgrowth of the surface of dumps under the influence of environmental factors and the duration of their existence.
2. To assess the direction and dynamics of natural overgrowth of the dumps of SSGPO JSC and Kachary Ruda JSC.
3. To study the species composition and features of the technogenic flora of the dumps.
4. To develop methodological recommendations for restoring the vegetation cover of dumps of mining enterprises in the Kostanay region.

The object of the study is represented by a complex of interacting natural and man-made ecological systems in the territory of activity of the mining enterprises of the Kostanay region, SSGPO JSC and Kachary Ruda JSC: these are landscapes, soil cover and vegetation.

The subject of the study is plant communities appearing on dumps. *The empirical material of the study* was: plant samples, soil samples.

Scientific novelty of this research is that for the first time a comprehensive botanical examination of dumps of different ages of SSGPO JSC and Kachary Ruda JSC was carried out; an analysis of the synanthropy of dump sites’ species was carried out; the patterns of overgrowing of dumps were studied depending on the age and properties of embryozems composing the dumps; the floristic composition of the dumps was analyzed, new species were found for the flora of the Kostanay region (*Rubus sachalinensis*, *Achillea* × *kasakhstanica*, *Bryonia alba*, *Chondrilla ambigua* and *Sorghum sudanense*); recommendations have been developed for the reclamation of iron ore dumps in the Kostanay region.

The practical value of the research is that the results obtained are used as the basis for the development of methodological recommendations for forest reclamation on the dumps of iron ore enterprises in the Kostanay region. During the work on the recommendations, optimal ways to reduce the load and restore ecosystems were selected, as close as possible to the natural bioecological and coenotic properties. Also, the developed electronic educational publication will be used during the training of undergraduates at the university. Mounted herbarium sheets are available for study in the collections of TOBYLKZ (KRU, Kazakhstan) and KUZ (Kuzbass Botanical Garden, Russia).

Theoretical significance. A comprehensive study of the flora of the dumps was carried out using three complementary trips. First, a systematic analysis was carried out with detailed identification of all plant species found in the studied dumps. Secondly, an in-depth analysis of the biological characteristics of species, including life forms and methods of seed dispersal, was carried out. Thirdly, an assessment was made of the influence of environmental factors on the distribution and characteristics of plants.

The research methodology was based on the works of such scientists as A.N. Kupriyanov. (2010, 2017), Manakov Yu.A. (2011, 2017), Konysbaeva D.T. (2003), Terekhova E.V. (1974, 1976), Fedotov V.I. (1978, 1985), Androkhanov V.A. (2000), Dolgopolova N.V. (2020), Noviyanto (2017), Hendrychová (2020), Chaplygina (2023) and others.

In accordance with the set goals, objectives and general logic and research procedure, it is advisable to use the following system **of methods** including:

- 1) general scientific methods: analysis, synthesis, generalization, induction, deduction, classification, literature review;
- 2) special methods: plant collection, herbarization, geobotanical description, parcel method, route-expedition method, general agrochemical analysis of soils, comparative analysis;
- 3) quantitative and qualitative methods of statistical processing.

Chemical analysis of soil samples was carried out in the accredited laboratory of Agrochemical Company DARKAN DALA LLP in the city of Kostanay (No. KZ.T.11.2383).

Provisions submitted for defense.

1. The flora of the dumps of the Sokolov, Sarbai and Kachar iron ore deposits includes 284 species belonging to 163 genera and 44 families

2. Succession processes on the dumps of the Sokolov, Sarbai and Kachar deposits are characterized by successive stages of phytocenotic development: pioneer grouping, group-thicket community, complex phytocenosis and procenosis.

3. The speed of syngenetic succession depends on a combination of factors. Among them, the lithogenic structure of overburden rocks plays a key role, and non-saline substrates are the most favorable for overgrowth. In this case, the age of the dumps plays a secondary role.

Personal contribution of the author: carrying out expeditionary work, performing geobotanical descriptions, analyzing existing literature, compiling a summary and its analysis, developing recommendations for forest reclamation, an electronic educational publication. This work represents an independent study by the author and is not part of any funded scientific projects.

Approbation of results. The materials presented in this dissertation have been published in 19 articles, including 1 article in an international peer-reviewed scientific journal included in the "Scopus" citation database; 4 articles in journals included in the list of the CQASHE MSHE RK; 3 articles with the status of "Conference paper" in the citation database "Web of Science".

The results of the research were introduced into production at SSGPO JSC during the development of the Reclamation Plan for the South-Western Automobile Dump of the Sarbai Deposit, as well as in the educational process during practical and laboratory classes in the disciplines: "Botany", "Plant Systematics", "Ecology", "Environment and biodiversity", "Modern issues of taxonomy of higher plants", "Modern problems of biology".

The dissertation materials were presented at international conferences: XV International Scientific and Practical Conference "Current Problems of Ecology", ISPC "Path to Science - 2023", XLIX ISPC of the Minor Academy of Sciences of the

Republic of Kazakhstan, II International Youth Scientific Forum “Problems of the Development of Natural Sciences and Education in context of sustainable development goals”, VIII ISPC “Ecological state of the natural environment and scientific and practical aspects of modern agricultural technologies”, ISPC “Baitursynov readings - 2024”.

The dissertation is presented on 160 pages. Consists of an introduction, 6 chapters, a conclusion, a list of sources used and 11 appendices. Contains 29 tables, 33 illustrations. The list of sources used includes 185 sources.