ANNOTATION

for the academic degree of Doctor of Philosophy (PhD)
The specialty 6D060800 (8D05201) – «Ecology»
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on the topic of dissertation work

«Conservation of biodiversity of flora and fauna in the area of the Caspian plant cement at the Mela Shetpe deposit Yuzhnoye in the mountainous Mangystau»

The relevance of research.

This paper examines the ecological condition of the Caspian Cement Plant territory, located within the Mangistau mountain-arid zone, with a particular focus on the Shetpe-Southern Chalk quarry. The study is relevant due to the increased anthropogenic pressure on the region's natural ecosystems, resulting in part from the development of cement production, which is accompanied by emissions of dust, solid particles, and gaseous pollutants that negatively impact components of the biosphere.

The purpose of this study is to conduct a comprehensive assessment of the impact of industrial activities, including boron mining, on the state of flora and fauna, using modern methods of remote sensing and geographic information system (GIS) technologies. Special attention is given to the analysis of vegetation cover, as it serves as a sensitive indicator of environmental changes under anthropogenic influence.

During the study, physico-chemical analyses of environmental components were carried out, the degree of ecosystem transformation was assessed, and the main factors affecting the stability of geosystems under mining conditions were identified. It was established that intensive industrial activity contributes to the degradation of vegetation cover and a reduction in biological diversity.

Based on the results obtained, scientifically grounded recommendations have been developed to reduce anthropogenic pressure, restore natural ecosystems, and preserve the region's biodiversity. The findings of this study can be applied in implementing environmental protection measures, including within the framework of national environmental programs.

Purpose of research.

Assessment of the ecological condition of the territory of the Caspian cement plant located at Shetpe, a Southern boron quarry in the mountainous region of Mangystau, and identification of the impact of industrial activity on biodiversity.

The main objectives of research:

- study of ecosystem components in the research area;
- determination of the impact of industrial emissions from the Caspian cement plant on the environment and biodiversity;
- assessment of the state of biodiversity of flora and fauna in the study area using methods of analysis and mapping in geographic information systems (GIS);

- substantiation of the necessity and ecological and technological effectiveness of triangular corrugated basin solar distillers to reduce the anthropogenic impact of the industrial activities of the Caspian cement plant on biodiversity.

Object of research: The impact of the Caspian Cement Plant, located at the Shetpe-Southern Boron quarry, on biodiversity has been studied. It has been determined that the plant's coordinates are 44.168° E, 52.116° N, with an elevation of 160–180 meters above sea level.

Subject of research: the impact of the ecological condition of the Caspian cement Plant's territory on the biodiversity of flora and fauna.

Research methods:

The expedition studies were conducted in the summer and autumn using the route exploration method, based on passing a certain section of the route and preliminary study and observation of the area to collect information. In the course of field research, herbarium specimens and photographic materials were collected, as well as species lists of the flora of the studied region were compiled.

The locations of the plants were determined using GPS devices. Micrographs of plant anatomical structures were obtained using a MEIJI microscope equipped with a CAM V500B 6M video camera (1.5 megapixels, 1440 × 1080 pixels resolution). Statistical processing of morphometric parameters was performed according to the methodology of G.F. Lakin, while A.I. Tolmachev's methods were applied for biological and ecological analysis. The accepted species names are based on data from the Plants of the World Online (POWO) database. To determine the taxonomic affiliation of the species, fundamental scientific works were consulted, including Flora of the USSR edited by V.L. Komarov, Flora of Kazakhstan under the guidance of N.V. Pavlov, and J.E. Nurmakhambetov's study Results of a Comprehensive Expedition to South Ustyurt (Assessment of Biodiversity). Species verification was carried out using iNaturalist platforms, birds.kz, mammals.kz, Plantarium and POWO. Satellite images from Landsat 5, Landsat 8 and Landsat 9 were used to assess the condition of the vegetation cover. The spatial resolution of these images was 15-30 meters, depending on the spectral channels used. All remote sensing data was obtained from official NASA open sources. The components of the environment, particularly the content of heavy metals in soil and vegetation, were analyzed using atomic absorption spectrometry (AAS) with plasma atomization (MGA 915). Additionally, the methodology for calculating the concentration of harmful substances in atmospheric air from industrial emissions (OND-86) was applied. For comprehensive spatial analysis, the unified software package Prism-District version 3.0 and the atmospheric calculation program SANZONE, which includes modules for determining sanitary protection zones (program for calculating atmospheric pollution – PCAP), were used. Statistical data processing was conducted using the analytical software interface Statistica 10. Cartographic schemes of the study area were developed using satellite imagery and GIS programs (Google Maps, ArcGIS, MapInfo Professional v.12), while the processing of maps and diagrams was carried out with CorelDRAW 11 graphics software. Cartographic

materials were produced using GIS software products, including MapInfo Professional v.10.2 and SAS.Planet 160707.

Scientific novelty of the research:

1) For the first time, a scientific study has established the relationship between factors and indicators that negatively impact the biodiversity of the Shetpe-Southern Boron quarry and the Caspian cement Plant.

2) In the arid region, a qualitative assessment of the significance of flora and fauna biodiversity was conducted. Taking into account landscape stabilization factors, databases and digital maps of the biodiversity of the studied area and its "natural habitats" were created to support effective environmental management of the territory.

3) An ecological and technological assessment of biodiversity conservation measures has been carried out on the territory of the Shetpe-Southern Boron quarry and the Caspian cement plant.

4) A mobile solar installation for desalinating groundwater in arid regions has been proposed for the Shetpe-Southern Boron quarry and the Caspian Cement Plant to suppress dust, prevent secondary soil salinization, and protect metal structures from corrosion. The capacity of the desalination unit was further increased through the use of a second basin.

Provisions issued for the defense of dissertation work:

The results obtained in the course of research are confirmed by retrospective, gravimetric, atomic absorption, analytical methods and statistical processing of experimental data. Special certified methods, standard GOST RK, were used to perform planned research works and chemical laboratory experiments. The equipment and materials used in the research meet the requirements of the regulatory and technical documentation.

The main principle recommended for protection:

- results of environmental monitoring of atmospheric air pollution in the territory of the Caspian cement plant;
- assessment of the geoecological state of the soils of the Shetpe Southern Chalk Quarry and the cement plant area;
- database and digital maps of biodiversity, the results of studies of the impact of the Caspian cement plant on flora and fauna;
- in the area of the Shetpe-Southern Chalk quarry and cement plant, in order to suppress dust, prevent secondary salinization of the soil and prevent corrosion of metal products in arid regions, a mobile solar installation for desalination of groundwater was recommended.

Theoretical and practical significance of research results.

The results of scientifically based environmental monitoring, databases and digital maps of the biodiversity of the Shetpe Southern Chalk Quarry and Cement Plant region can be used by specialists of the Department of Natural Resources and Environmental Management of the Mangystau region. The developed mobile solar desalination plant can be used to desalinate underground salt water to suppress dust in the area of the quarry and the Caspian cement plant and prevent rapid failure of

metal products for the technical needs of the plant. This is confirmed by the production test reports.

Author's contribution. In the orientation studies, as well as production experiments, the author directly participated in the process, regulatory parameters and ensured the exact observance of the methodology. His active participation contributed to increasing the reliability of the data obtained and the quality of the conducted research.

Communication of work with other research works. Dissertation work within the framework of the state grant "Young Scientist" of the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan in 2023-2025. No. AP19175489 was implemented as part of the project «Scientific substantiation of ecological aspects of biodiversity conservation on the territory of Shetpe-Southern Chalk quarry using GIS technologies»

Approbation of work. The results of the study were reported at the IV International Scientific and Practical Conference "Industrial Technologies and Engineering" (M. Auezov South Kazakhstan University on October 26-27, 2018), the III International Conference Book Edition of the countries of the Commonwealth of Independent States "Best young scientist" -2021, (19-23), as well as in 2018 during a scientific internship at Yildiz Technical University, Turkey. In addition, the main provisions of the dissertation were widely discussed at the Academic Council of the Faculty of Engineering in 2024-2025, at meetings of the Department of Ecology and Geology.

Publications of research work: based on the materials of the dissertation, 8 works were published, including: 3 publication in journals included in the Scopus database, 3 articles in scientific publications recommended by the Committee for Quality Assurance in Science and Higher Education, the rest of the articles have been published in International scientific and practical conferences and the patent of the Republic of Kazakhstan for utility model No. 9128 dated 05/17/2024 «Basin type water desalination plant» was obtained.

Scope and structure of the dissertation: The dissertation consists of an introduction, 3 chapters, conclusions, appendices, and a bibliography comprising 135 titles. The work is presented on 159 pages with 41 drawings and 36 tables