

ANNOTATION

on the dissertation work by Koibakova Symbat Elamanovna on the topic «Complex study of the water area and assessment of the state of soils in the coastal zone of the Cape Peschany using remote sensing data», presented for the degree of Doctor of Philosophy (PhD) in the specialty 6D060800 - Ecology

Relevance of the research topic.

On August 12, 2018, in Aktau, at the Summit of the heads of five Caspian countries (Kazakhstan, Russia, Turkmenistan, Azerbaijan and Iran), a historic convention on the legal status of the Caspian Sea was adopted. This served as the beginning for a new stage of international cooperation with the aim of transitioning to sustainable and safe eco-development of the Caspian region.

A multimodal transport hub, the Kuryk ferry complex, was put into operation, as an important link for the entire transport and logistics system of the Trans-Caspian International Corridor and access to the Caucasus and Europe. Oil, grain, and consumer goods are exported.

Ferry communication is carried out only with Azerbaijan so far. The intensification of oil production, as well as the growth of cargo transportation, requires a serious attitude to environmental safety issues in the water area of the new port and especially in the coastal zone of the Cape Peschany.

On the one hand, the Cape Peschany is a strategic object of intensive nature management with the Karagiye-Karakol state reserve.

On the other hand, this cape is of interest because of its location between the Karagiye and Aschysor depressions on land, and the Derbent in the sea. The depth of the sea at the Cape Peschany determined the choice of location for the Kuryk ferry complex, with the prospect of building a shipbuilding and ship repair plant.

In 1950, marine geological work in the Caspian Sea, under the supervision of Klenova M., discovered a previously unknown large element of the bottom relief in the middle part of the sea. This was a seamount that stretches from the Cape Peschany to the southwest for 180 km, to a depth of 350-400 m.

Studies have established that in the middle part of the Caspian Sea, both in winter and in summer, there is a cyclonic circulation of waters with their movement to the south near the western coast, and to the north near the eastern coast of the Cape Peschany. This region of the Caspian Sea is interesting from a hydrophysical point of view since cold anomalies of water temperature (upwelling) are observed here. Thus, abrupt changes in the hydrological characteristics of the sea associated with intense upwelling occur in the coastal strip up to 20 km wide. It remains to add that over the past three decades, there are no measurement data on the sea currents of the Caspian Sea within the Mangistau region.

State environmental monitoring on the shelf and in the coastal zone of the Caspian Sea using remote sensing of the Earth, at the regional level, was carried out in 2008-2011. The studies covered oil fields in the water area and coastal zone of the Caspian Sea. Measurements of sea currents were not included in the

projects, monitoring of the state of soils and vegetation in the coastal zone of the Cape Peschany was not carried out.

In this regard, obtaining and analyzing data from field measurements of the speed of sea currents in the water area, and studying the state of soils and vegetation in the coastal zone of the Cape Peschany are relevant and timely.

Research purpose. Comprehensive studies based on hydrological and hydrochemical measurements of sea currents on the shelf and ecological monitoring of soils and vegetation in the coastal zone of the Cape Peschany using data from remote sensing of the Earth.

Research objectives:

- obtaining new high-resolution data on sea currents in the area of the Cape Peschany and their variability due to climatic conditions;
- obtaining new data on the thermohaline structure of waters (vertical profiles of temperature, salinity and chlorophyll fluorescence, constructed from the data of CTD probing using the SBE Sea Cat 19 plus probe);
- use of composite maps of the Earth in true colors of MODIS-Terra to study the presence of upwelling processes in the area of the Cape Peschany;
- analysis of the total chemical contamination of soils with heavy metals and metalloids arsenic at the Cape Peschany and the territory of the reserve;
- using data from Landsat 7 T1 and 8 T1.2, Sentinel-2 L2A satellites for the analysis of the state of soils and vegetation in the coastal zone of the Cape Peschany;
- drawing up a map-scheme of ecological monitoring of soils and vegetation conditions using Google Earth, SAS Planet, ArcGIS programs;
- development of a heliomed and a device for desalination of seawater for the sustainable development of farms engaged in growing vegetables;
- approbation and introduction of a solar desalination device of sea water, for irrigation of crops of farms and sustainable development of agriculture.

Object of research. Sea water in the water area and soil cover in the coastal zone of the Cape Peschany in the area of the Kuryk ferry complex.

Subject of scientific research is a comprehensive study of the processes of hydrological, hydrochemical characteristics of water in the marine part, analysis of the ecological state of soils and vegetation in the coastal zone of the cape.

Research is carried out based on field observations of sea currents and ecological and chemical analyzes of water and soils, using satellite data.

Initial materials and research methods. The dissertation is based on the data of our own field studies and participation in the expedition «Caspian Sea 2019» and the project with Kazakhstan Agency of Applied Ecology, carried out in the period from 2018 to 2020, on the territory of the Mangistau region in the Cape Peschaniy and port of Kuryk.

Marine part. To study the water area of the sea, the shipboard equipment of the Institute of Oceanology named after Shirshov was used. Vertical CTD sounding was carried out at four sea stations; seawater sampling was carried out in accordance with ГОСТ 17.1.5.05-85.

The «ЭММА» complex was used to measure temperature, water salinity, and hydro-optical characteristics. Hydrophysical measurements of vertical profiles of temperature, dissolved oxygen concentration and turbidity were carried out using a SBE Sea Cat 19 plus probe. A portable weather station GILL GMX500 was used to record weather conditions.

Coastal zone. Modern physicochemical instrumental methods were used to study soils. Soil samples were analyzed using a HACH DR-2400 laboratory spectrophotometer (USA) and a MGA-915 atomic absorption spectrometer (Russia). Water extraction of soil samples was carried out by the standard potentiometric method using a MP 220 pH meter (Mettler Toledo, Switzerland).

Methods of geographic information systems. To create map-schemes of field studies and the sensitivity of the coastal zone, GIS products were used: ArcGIS 10.0 by the American company ESRI. Editing of map-schemes was performed using Corel Draw 11 and Paint programs (Windows XP).

To compile the sensitivity maps of the coastal zone in the study area, cloudless multispectral satellite images of the Landsat-8 satellite with a resolution of 20 m were used. Thematic processing of images was performed using the raster GIS IDRISI (Clark University, USA).

Statistical processing of research results was carried out in the environment of the analytical software interface Statistica 10. The choice of the analysis method using the statistics of the Kruskal-Wallis ANOVA test was determined by a small volume of research samples.

Scientific novelty of the research:

- for the first time, environmental monitoring of the water area of the Cape Peschany and the coastal zone in the area of the Kuryk multimodal transport hub was carried out;
- for the first time, high-resolution data were obtained on sea currents at the Cape Peschany and their variability on a scale from synoptic to seasonal under current climate change conditions;
- for the first time, data on the three-dimensional structure of thermohaline fields in the study area and its relationship with the current regime were obtained;
- a solar system for desalination of sea water was developed and implemented, which is confirmed by a patent of the Republic of Kazakhstan.

The main provisions for the defense:

- new high-resolution data on sea currents in the area of the Cape Peschany, and their variability on a scale from synoptic to seasonal under current climate change conditions;
- new data on the three-dimensional structure of thermohaline fields in the study area and its relationship between thermohaline fields and the regime of water currents;
- analysis of the total chemical contamination of soils with heavy metals and metalloids arsenic at the Cape Peschany and the territory of the reserve;
- the results of using satellite data to analyze the state of soils and vegetation in the coastal zone of the Cape Peschany;

- map-schemes for assessing the state of soils and vegetation and comparative analysis of the lands of farms adjacent to the territory of the port of Kuryk;

- a developed desalter, in which the distillation of seawater heated by solar energy is carried out by cooling it with cold deep water of the Caspian Sea.

The theoretical significance of the research is the acquisition of data on the three-dimensional structure of thermohaline fields, refined depending on the flow regimes in the study area.

The practical significance of the work lies in the fact that the obtained results of long-term measurements of the sea currents at the Cape Peschany can be used by specialists of the ports «Kuryk» and «ERSAI LLC».

The results of environmental monitoring of soils can be used by specialists of the Regional Department of Natural Resources and Rational Nature Management of the Mangistau region

The developed solar desalinator can be used by farms on the territory of Kuryk ferry complex to desalt sea and underground water for irrigation of vegetables and fruit trees. This is confirmed by the acts of production tests and the introduction of a solar desalination plant.

Personal contribution of the author. The dissertation is the result of the research conducted by Koibakova S.E. during the period of 2018-2020. The author has independently set a goal, defined the tasks and research plan on a comprehensive study of the marine part and environmental monitoring of the state of soils and soil cover in the coastal zone of the Cape Peschany in the area of the Kuryk ferry complex.

Experimental studies have been carried out to substantiate the efficiency of the developed solar seawater desalination plant. The analysis and generalization of research and experimental results of the work have been conducted.

Communication of work with other research projects.

The dissertation was carried out with the participation of the doctoral student Koibakova S.E:

- in the joint expedition «Caspian Sea-2019» in July 26-29, 2019 of the Department of Ecology and Geology of the Caspian State University of Technology and Engineering named after Yessenov, and scientists of the Institute of Oceanology named after Shirshov RAS RF (supervisor: Doctor of Geology, Corresponding Member of RAS Zavyalov P.O.)

- in the project: contract № 42/19 dated 27.09.2019, between the Kazakhstan Agency of Applied Ecology and the Caspian State University of Technology and Engineering named after Yessenov, for the implementation of research work: «The current state of the coastal strip of the northeastern Caspian within the boundaries of the Mangistau region» (supervisor: Doctor of Technical Sciences, Professor Kenzhetayev G. Zh.), within the framework of the Contract № UII63264 dated 10.09.2018 between the North Caspian Operating Company and the Kazakhstan Agency of Applied Ecology.

Implementation of research results. The work related to the implementation was carried out with the direct participation of the author. The

results of the dissertation have been introduced and will be used by farms for desalting sea and groundwater at the Cape Peschany (implementation act dated 13.05.2019). The results of the dissertation were introduced into the educational process of the Department of Ecology and Geology, Faculty of Engineering, Caspian State University of Technology and Engineering named after Yessenov. Based on the results, the textbook “Monitoring of the coastal zones of the Caspian Sea” was prepared.

Approbation of work. The research results were reported and discussed at international scientific and practical conferences: the International Scientific and Practical Conference «Development of science and technology in the development of Kazakhstan's mineral resources dedicated to the 90th anniversary of academician Yessenov Sh.» (Aktau, 2017), the International Scientific and Practical Conference within the framework of the Program for the Modernization of Public Consciousness «Rukhani zhangyru» (Aktau, November 29, 2018), the International Scientific and Practical Conference «Geology and oil and gas potential of the West Siberian mega-basin» (experience and innovations) (Tyumen, Russia, November 5-8, 2018), International Scientific-practical Conference of students, graduates and young scientists «New technologies for the oil and gas region» (Tyumen, Russia, May 15-17, 2019). The main provisions of the dissertation in 2019-2020 were heard at the scientific and technical council of the Faculty of Engineering, at the meetings of the Department of Ecology and Geology, as well as at the seminar of the Regional Department of Natural Resources and Rational Nature Management of the Mangistau region.

Publication of research results. Based on the materials of the dissertation, 17 scientific works were published, of which: 3 articles were published in journals recommended by the Committee for Quality Assurance in Education and Science of the MES of the RK; 2 publications in journals included in the Scopus database. The rest of the articles are in collections of international scientific and scientific-practical conferences. Received a patent of the Republic of Kazakhstan for invention № 33969 dated 16.10.2019.

Volume and structure of work. The dissertation consists of an introduction, 4 chapters, a conclusion, 3 appendices, a bibliography of 174 titles. The work is presented on 136 pages of computer text, illustrated with 66 figures, 16 tables and 3 appendices.