Information and measuring systems for the protection of natural ecosystems in the Arctic regions of Yakutia

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Abstract. Ways to stabilize the ecological situation for the protection of natural ecosystems in the context of global warming is becoming an urgent issue today. Within the framework of this article, an urgent problem related to environmental problems in the Arctic is considered. The introduction formulates in more detail the purpose of the article, which is to create information-measuring systems for environmental monitoring in the Arctic regions of Yakutia. To date, this category includes 13 different municipalities of the republic. The main part is paid attention to areas that have serious environmental problems. At the same time, specific examples of information-measuring systems of other regions are considered in more detail, key requirements for these systems are highlighted. The conclusion concludes that today much more effort is required to monitor the environment. However, this process requires close cooperation between the government, scientific institutions and industrial companies.

1 Introduction

In the 21st century The Arctic and regions of the Arctic zone are becoming more and more the sphere of global interests of many countries of the world every year [1].

As a result of the ever-increasing interest in the Arctic, including its raw materials, the territories of industrial development of the Arctic will increase and have an increasing impact on the territories of traditional residence and traditional economic activities of the indigenous peoples of the North [2].

The Arctic territories of Yakutia are the focus of various landscapes and ecosystems. There are flat tundras with a huge number of lakes, deltas of large rivers, vast plateaus and mountain systems of the Verkhoyansk and Polusny ridges, Chekanovsky and Pronchishchev ridges, arctic deserts and islands of the Arctic Ocean [3].

The prospective socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) is based on three possible development vectors - industrial-transit, socio-ecological and new Arctic economy, which must be implemented simultaneously, the scenarios determine various configurations for the implementation of these vectors [4].

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2 Problem statement

The problem of climate change, which leads to quite significant changes in the climatic characteristics of our planet, these include the decline in the population of Arctic animals, habitat change and pollution of the waters of the North Seas. In addition, the average air temperature in the Arctic zone is rising by half a degree or 1 degree, which in fact means moving towards the north. Due to the fact that the landscape characteristics of the territory are changing, the territory, which begins to acquire various pests, will stop much to the north. There are a number of international organizations today that focus on the tasks and problems of environmental monitoring, in addition to everything that was said to the Russian Federation, issues and problems of sustainable development are considered.

Currently, ecologically unfavorable areas of the Arctic zone in the Republic of Sakha (Yakutia) form the so-called Yano-Indigirka impact zone [5].

In some areas (for example, the city of Srednekolymsk), respondents associated environmental problems such as floods with the thawing of permafrost [6].

A significant contribution to environmental pollution is made by seaports, vehicles - the sea and river fleet, oil bases and ships. Bottom sediments of port complexes in the coastal bays of the Arctic seas are characterized by a high level of concentration of petroleum hydrocarbons [7].

Production and consumption wastes have a great negative impact: firstly, they occupy large areas; secondly, they are underused raw materials; thirdly, they are a dangerous source of environmental pollution [8].

Active industrial development of Yakutia requires preventive monitoring of the environment. For example, the Ust-Yansky region contains a large number of toxic components. The Ministry of Nature Protection has drawn up design estimates for the removal of scrap metal from 13 Arctic regions. One of the positive examples of the effective response of the ministry is that as a result of the examination, the original plans of the Tas-Yuryakh oil and gas production company were changed. Last year, a flash mob was organized to clean up the river.

As ecologists note, the development of alluvial deposits "causes a sharp intensification of solifluction processes, expressed in an increase in several times the depth of seasonal thawing, a significant increase in the temperature of surface waters, the amplitude of temperatures of rocks, their weathering rate, which causes an activation of the supply of chemicals from flow to the surface of rocks, their further migration and accumulation of toxic elements in the soil and vegetation cover of adjacent territories" [9].

3 Findings

The Arctic zone of the Russian Federation and the Republic of Sakha (Yakutia) includes the territories of 13 polar and circumpolar regions: Abysky ulus (district), Allaikhov ulus (district), Anabarsky national (Dolgan-Evenki) ulus (district), Bulunsky ulus (district), Verkhnekolymsky ulus (district), Verkhoyansky district, Zhigansky national Evenki district, Momsky district, Nizhnekolymsky district, Oleneksky Evenki national district, Srednekolymsky ulus (district), Ust-Yansky ulus (district), Eveno-Bytantaisky national ulus (district) of the Republic of Sakha (Yakutia)) [10].

In connection with transport and logistics factors, it was decided to make zoning into 7 zones: the first included Anabarsky and Olenyoksky, the second Zhigansky and Bulunsky, the third Eveno-Bytanstaysky and Verkhoyansky, the fourth Ust-Yansky and Allaikhovsky, the fifth Nizhnekolymsky and Srednekolymsky, and finally, in the sixth, the three nearest districts - Abysky, Momsky and Verkhnekolymsky districts.
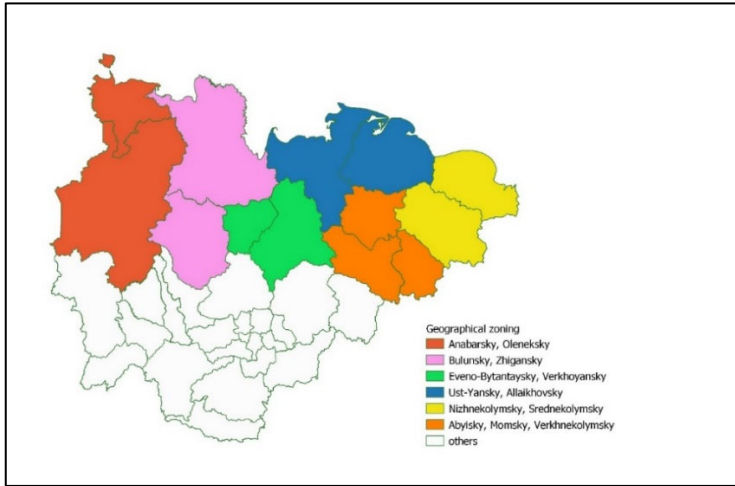
Fig. 1. Zoning of information-measuring systems during environmental monitoring in the Arctic regions of Yakutia.

Based on the selected zones, a regression analysis of the estimated number of ecological stations and the area of areas was compiled. If we justify the choice of quantity, then the red zone is western, with it there are more taiga zones, vegetation is larger and industry is developed accordingly it needs only 6 stations at least. Further, the pink and green zones central in it will have 4 stations, and finally in the blue and yellow zones 2 stations are enough, since they lack mining and other industry, as well as less vegetation.

Table 1. Planned quantity of information-measuring systems.

№	Zones	Area of zones, sq.km	Planned quantity of information-measuring systems
1	Anabarsky and Olenyoksky	373 700	6
2	Bulunsky and Zhigansky	363 800	4
3	Eveno-Bytanstaysky and Verkhoyansky	186 400	4
4	Ust-Yansky and Allaikhovsky	227 600	2
5	Nizhnekolymsky and Srednekolymsky	212 300	4
6	Abysky, Momsky and Verkhnekolymsky districts	241 800	2

Regression analysis of constraints showed the following results, which are seen in Table 2.

Table 2. Regression statistics.

№	Regression indicators	Regression values
1	Multiple R	0.57
2	R-square	0.32
3	Normalized R-square	0.15
4	Standard error	74161.22
5	Observations	6

Based on the results of the studies, a graphical representation of the results of regression analysis were compiled (Figure 2).
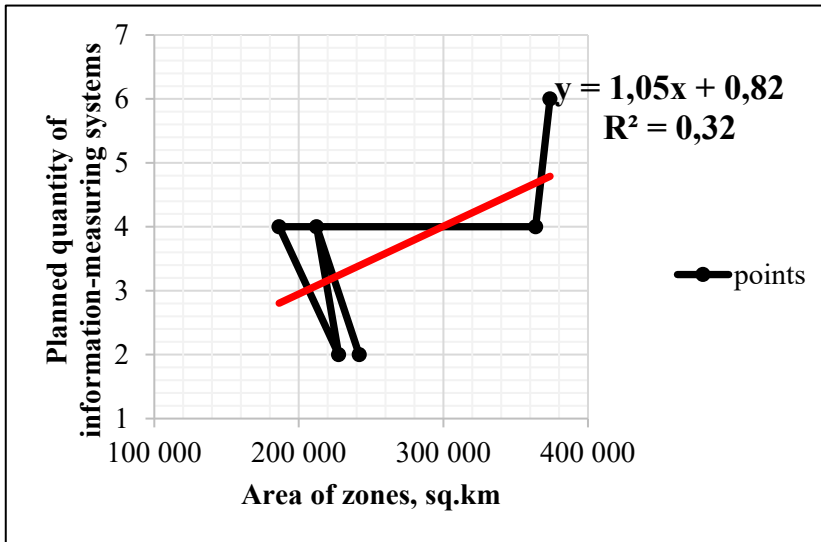

Fig. 2. Graphical presentation of the results of regression analysis (compiled by the author).

As for the rest of the regions: in St. Petersburg there are 25 posts of information-measuring systems, though in some the visualization of monitoring is lame, but at least measurements are made there, and in St. Petersburg there is an automated system for monitoring atmospheric pollution. They have a large number of measurements in a large number of parameters and have mobile laboratory laboratories, and in principle they have a well-organized collection of information.

In Orenburg and Astrakhan there is industrial environmental monitoring, based on technological characteristics, they measure the state of the environment. There are 56 systems in Moscow, since this city is the capital, the largest number is concentrated in it.

The main requirements for the data of information-measuring systems are the reliability of the results, the reliability of the operation and the reliability of the results of the system, which are subject to legal regulations.

There are two types of environmental monitoring: bioindication is an assessment of the state of the environment using living organisms of indicator types, as well as instrumental monitoring, where specialized equipment is needed.

4 Discussion

As part of the discussion, it is necessary to discuss what alternative methods and methods exist, as well as their advantages and disadvantages, in order to analyze them to choose the best method. This discussion can be held in conjunction with the government, scientific institutions and industrial companies. The issue is also topical in the Arctic regions, in the conditions of taiga ecosystems, it acquires additional relevance.

The created regression model should also be discussed whether it can be used as a predictive model and what disadvantages are there. Any advice and wishes will be taken into account in the following works and studies. The following studies will focus on the collection of field materials, thorough statistical processing of data, SWOT analysis and the use of

modern end-to-end digital and tools, for example, programs on statistics: Past, Jasp, Spss, Statistica.

This topic is devoted to the works of the authors: Norton B G, Wurtzebach Z, Schultz C, Patten D T, Perni Á, Martínez-Paz J M, Karl-Göran S H C F, Devillers R, Salzman J, BenDor T K, Whigham D F, Mitsch W J, Wilson R F, Harrison T M, Pardo T A, Cook M, Georgiadis G, Palumbi S R, Gómez-Baggethun E, Bakhtadze N, Reyers B, Stoneham G, Rennings K, Robertson M, Scott J M, Costanza R, Sierra C A, Sutter L, Albrecht M, Jeanneret P et al.

5 Conclusion

In matters of environmental safety, a systematic approach is needed.

Environmental monitoring should be carried out in close cooperation, cooperation between the government, industrial companies, scientific institutions and the public. It is necessary to form and ensure the functioning of a territorial system for monitoring the state of the environment, timely informing state authorities, local governments and the population about the environmental situation, as well as stabilizing the environmental situation in the region. Only in this case it will be possible to avoid ecological disasters and preserve nature in an ecologically safe state.

The decision taken in the form of the allocation of 6 zones for the creation in them of one information-measuring system for environmental monitoring in the Arctic regions will significantly reduce the negative environmental impact on these regions and in the Arctic as a whole.

Water is a valuable resource, so care must be taken to ensure that this valuable resource is not polluted. As for the waste, they can get into the soil. Therefore, it is necessary to carry out educational activities in these areas. Those persons who pollute the environment must be reported to the inspectors of Rosprirodnadzor or Rospotrebnadzor. This recommendation is one of the most important.

These environmental conditions should not be created in inaccessible areas. In Yakutia, year-round transport accessibility is very low. About 70% of roads are winter roads, that is, in spring and autumn, most territories are cut off from land transport. This problem has existed for many years.

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