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Mathematics In Ecology

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Annotation: The current environmental situation in the world poses an important task for humans - the preservation of ecological living conditions in the biosphere. Currently, the issue of optimizing the urban environment as a human habitat is extremely relevant. Each of us, without hesitation, will answer the questions in the affirmative: “Do you want to breathe clean air, see green trees from the window of your house, trust clean water straight from the tap?” This means that most people are convinced that the quality of life is in direct, close connection with the quality of their environment.
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Introduction

The reason for the poor environmental climate may be the geographical location of the city and the industrial enterprises in it.

Every person is concerned about the state of the environment, since the fate of humanity depends on it. Of course, alone we are not able to avert the threat to human civilization, but we cannot help but see the impending disaster and not think about it. After all, an environmental disaster is not a speculative picture of some distant future, but the consequences of what exists at the moment and in the midst of which we live.

Greening education means the formation of a new worldview and a new approach to activities based on the formation of humanitarian and environmental values. Mathematics is one of the subjects that is not yet sufficiently connected with ecology, and yet these sciences are closely intertwined. But we must not forget that the greening of mathematics makes it possible to trace the process of development of human knowledge in time and space.

First of all, ecology is associated with mathematics and mathematical statistics, as it widely uses the methods of these sciences. The description of numerous connections between natural components is best described through a mathematical apparatus, therefore ecology is one of the most “mathematized” branches of biology.

Models and methods of mathematical ecology

Ecology is a developing interdisciplinary field of knowledge, including ideas from almost all sciences about the interactions of living organisms, including humans, with the environment.At the same time, environmental education and upbringing of all segments of the population is of great importance, since it is impossible to solve the problem of environmental protection only by specialists. Environmental problems must be solved at each stage of industrial production in conjunction with other tasks, and this is only possible if environmental knowledge becomes an integral part of the worldview of engineers, technologists and other specialists. The main task of ecology at the present stage is a detailed study by quantitative methods of the fundamentals of the structure and functioning of natural and man-made systems, the search for general patterns relating to a wide range of specific situations. The achievements of mathematics, physics, and chemistry had a great influence on ecology. In turn, ecology poses new challenges for these sciences.

The mathematical discipline that studies models of environmental objects and processes and methods for their study is called mathematical ecology. Its formation is very significant from a methodological point of view. Where should the construction of any mathematical model begin? What is its main content? The mathematical model takes into account, first of all, those restrictions and selection principles that distinguish realistically possible changes from those that are permissible. Such principles are conservation laws.

The same is true in ecology. Balance relationships in a formalized description of ecological and evolutionary principles are essentially nothing more than the laws of conservation of masses. Balance sheets contain a lot of important and interesting information. A mathematical model made up of these relationships describes the general properties of a set of possible states and their change over time.

One of the main problems of mathematical ecology is the problem of ecosystem stability.[2] An ecosystem is “sustainable” or “stable” if the relative abundance of different species either remains the same over a sufficiently long time or regularly returns to the same ratio. It is clear that sustainability in this sense is a relative property, not an absolute one; no ecosystem can remain stable for an infinitely long time, but some are more stable than others.

Environmental monitoring (observation, assessment and forecast of the state of the environment) is an important applied aspect of mathematics. In the field of implementation of environmental monitoring, in order to draw conclusions about possible changes in the state of the biosphere as a whole, data from a wide observation system covering all environments on a global scale, a thorough analysis and forecast of the state of the natural environment are required. New tasks put forward for mathematics (especially in the field of modeling and statistics) are the selection of information, its storage, optimization of the observation network and modeling of environmental processes to predict them. Translating most environmental problems into mathematical language is quite difficult. This is explained by the fact that ecological processes from the point of view of formalism are less studied than, for example, physical and chemical ones. Therefore, mathematical models of such processes cannot be subject to the requirements of adequacy and accuracy that are characteristic for modeling problems in natural science.To create ecosystem models, methods of system-wide analysis are used[2]. First, individual structural characteristics, living and inert components, examples of living ones are isolated from the system - trophic levels, species, age or sex groups, the interaction of these components determines the behavior of the entire system. Then the nature of the processes in which each element is involved is established.

Mathematical statistics in environmental studies

Mathematical statistics is the science of quantitative analysis, determining the characteristics of mass phenomena in nature and society. Statistics have acquired particular importance in assessing the degree of anthropogenic influence on the environment, studying the states of populations, species, biocenoses, artificial and natural ecosystems, their tolerance, productivity and sustainability. Biometrics is successfully used in the processing and analysis of environmental monitoring data, for forecasting and modeling phenomena and processes. Statistical methods are used in cases where aggregates rather than individual units are studied. A prerequisite for the correct application of methods of mathematical statistics is the qualitative homogeneity of the material being studied.

Ecological processes are modeled by mathematical ecology. That is, with the help of mathematics it is possible to predict what changes will occur in nature after a change in the environmental situation.

Monitoring services act as a measuring system for these parameters. Let us highlight and consider the main mathematical methods used in ecology.

The first method is the correlation method. In ecological studies, it is often necessary to answer the question of what is the strength and nature of the relationship between the characteristics being studied. For this purpose, in mathematical statistics there is a correlation coefficient, which evaluates the strength of the relationship between quantitative characteristics. Thus, in accordance with the law of ecological correlation in an ecosystem, as in any other integral formation, all its components are functionally consistent with each other. The loss of one part of the system inevitably leads to the exclusion of all other parts of the system closely connected with it and a functional change in the whole within the framework of the law of internal dynamic equilibrium.

The second method, the Student distribution, is a one-parameter family of absolutely continuous distributions. The Student distribution is important for statistical analysis. Using this distribution, you can evaluate the truth of a certain experiment. To do this, it is necessary to consider the possible causes of errors that could affect the measured value.

The next method is the Leopold matrix. Using mathematical modeling, you can derive the desired properties when changing the characteristics of the model. So, using the Leopold matrix, you can understand how harmful a person's impact is on the environment. This matrix is an impact table that includes a vertical list of possible actions (emission of pollutants into the atmosphere, construction of industrial buildings and structures, etc.), and a horizontal list of many potential impact indicators.

The first matrices listed 100 actions affecting the environment horizontally and 88 environmental characteristics vertically. The impact corresponding to the intersection of each action and each factor is described in terms of its amplitude and importance. These characteristics actually serve to determine environmental pollution.

The measure of the significance of an individual human action in each specific case is called importance. The measure of overall level is called amplitude. For example, harmful emissions into the atmosphere change or adversely affect the environment and, thus, emissions can affect different groups of animal life and lead to various mutations or even the extinction of some populations.

Assessment of air and land surface pollution

An important practical task of mathematical ecology is the calculation of the spread of pollution from existing enterprises and planning the possible location of industrial enterprises in compliance with sanitary standards.

The process of distribution of industrial emissions occurs due to their transfer by air masses and diffusion caused by turbulent air pulsations. If you observe a smoke plume from a factory chimney, you will notice that this plume is entrained by the air flow and gradually swells as it moves away from the source due to small-scale turbulence. The torch has the shape of a cone, elongated in the direction of the movement of air masses. Then the torch breaks up into isolated vortex formations, carried away to great distances from the source.

Almost all impurities eventually settle on the Earth's surface sooner or later, heavy ones under the influence of the gravitational field, light ones as a result of the diffusion process. Impurities consisting of large particles soon begin to sink under the influence of gravity in accordance with Stokes' law. Gaseous impurities such as oxides represent the light fraction and are especially dangerous for the environment.

Fluctuations in the wind direction over a long period of time - about a year - are of great importance in the theory of pollution spread. During such a period, air masses that carry impurities away from the source repeatedly change direction and speed. Statistically, such long-term changes are described by a special diagram called a wind rose, in which the magnitude of the vector is proportional to the number of repeating events associated with the movements of air masses in a given direction. The maximums of the wind rose diagram correspond to the prevailing winds in a given area. This information is the starting point for planning new industrial facilities. When assessing acceptable pollution from enterprises located among a large number of environmentally significant areas (settlements, recreation areas, agricultural, forest lands, etc.), pollution from existing enterprises in the region should also be taken into account. [1]

The assessment of pollution of the atmosphere and underlying surface by passive and active impurities is carried out using mathematical models built on the basis of partial differential aerodynamic equations, as well as their finite-difference approximations.

In Russia, a great contribution to this direction was made by the work of the school of academician G.I. Marchuk. Models of this type are widely used in Europe and the USA in resolving lawsuits brought by the population or local authorities against industrial enterprises in connection with certain damages. To assess the damage caused using mathematical modeling, an examination is carried out, as a result of which the amount of the fine that the polluting enterprise is obliged to pay to state or local authorities is quantified. Such measures turned out to be very effective and led to the almost universal introduction of cleaning technologies in developed countries.

Models of the transfer of pollutants, in this type of model, are associated with the procedure for calculating the main functional of the problem, which can represent the total number of deposited impurities, the sanitary hazard of impurities, include damage to public health, agricultural land, forests, soil, costs of environmental restoration and other indicators. In simplified versions, the response function method is widely used.

Conclusion

Modern mathematical ecology is an interdisciplinary field that includes all kinds of methods for mathematical and computer description of ecological systems. The theoretical basis for describing interactions between species in ecosystems is population dynamics, which describes basic interactions and provides a qualitative picture of possible patterns of behavior of variables in the system. To analyze real ecosystems, system analysis is used, and the degree of integration of the model depends on both the object and the goals of the modeling. Modeling of many aquatic ecosystems, forest cenoses, and agroecosystems is an effective means of developing methods for optimal management of these systems. The construction of global models makes it possible to assess global and local changes in climate, temperature, and type of vegetation cover under different scenarios of human development.

REFERENCES:

1. Имомбердиев, С. С. (2023). Экологическое воспитание на уроках математики в средней школе. *Образование наука и инновационные идеи в мире*, 18(3), 46-52.
2. Riznichenko G.Yu., Rubin A.B. Mathematical models of biological production processes. M., 1993.

3. Bereshko I.N., Betin A.V. Mathematical models in ecology. Kharkov: Nat. aerospace University "Khark" aviation Institute", 2006. – 68 p.
4. Baymuradov, K., Zhabborova, T., Tuinazarova, I., Otakulov, B., & Egamkulov, A. (2021). Aquatic ecosystems of the lower reaches of the Zarafshan River. Diversity and ecological groups of molluscs. In E3S Web of Conferences (Vol. 262, p. 04009). EDP Sciences.
5. Боймуродов, Х., Эгамкулов, А., Хасанов, Н., Тўйназарова, И. И., Суяров, С., Жабборова, Т. Х., & Туреханов, Ф. (2020). Распределенные популяции colletopterum cyreum sogdianum. In Инженерные и информационные технологии, экономика и менеджмент в промышленности (pp. 18-19).
6. Tuynazarova, I. A. (2019). Toxic chemicals and their impact on the environment. Евразийское Научное Объединение, (10-4), 357-359.
7. Abdubokievna, T. I. (2020). Chemicals used in cotton agrocenosis and their harmful effects on the environment. International Engineering Journal For Research & Development, 5(6), 4-4.
8. Боймуродов, Х. Т., Хасанов, Н. Х., Туйназарова, И., Жабборова, Т. Х., Джалилов, Ф. С., & Уралов, У. Б. (2020). Современное состояние популляций редких и эндемичных видов двустворчатых моллюсков Узбекистана. In Новые вызовы в новой науке (pp. 263-267).
9. Туйназарова, И. А., & Джураева, О. Х. (2020). Охрана атмосферного воздуха от выбросов автозаправочных станций. In Арктика: современные подходы к производственной и экологической безопасности в нефтегазовом секторе (pp. 270-276).
10. Холматов, Б. Т., & Туйназарова, И. А. (2019). Загрязнения воздуха рабочих помещений на предприятиях автомобильного транспорта и оздоровление воздушной среды. Оказова Зарина Петровна, доктор, 478.
11. Имомбердиев, С. С. (2023). Математика дарсларида экологик компонентдан фойдаланишнинг аҳамияти. Мугаллим, 1(3), 186-191.

12. Имомбердиев, С. С. (2022). Основные направления работы с одарёнными детьми в начальной школе. European Journal of Interdisciplinary Research and Development, 10, 226-229.
13. Imomberdiyev, S. S. (2023). Use of Problems with Ecological Content in Mathematics Lessons in Primary Grades. Web of Teachers: Inderscience Research, 1(7), 36-39.
14. Sadinov, A., Rajabov, S., & Samieva, M. (2023). Improving waste recycling in Uzbekistan in digital technologies. In E3S Web of Conferences (Vol. 452, p. 05023). EDP Sciences.
15. Исаков, В. Ю., Исаков, М. Ю., & Мукимжонова, У. В. К. (2022). Микробиогенные элементы в системе «порода-почва-растение» на лугово-оазисных почвах западной Ферганы. Universum: химия и биология, (9-1 (99)), 45-50.
16. кизи Мукимджонова, У. В., Исаков, М. Ю., & Худжаева, Н. Т. (2022). Vigna sinensis, phaselous ayreus, arachhis hypogaea oʻsimliklar donlari va poyalarining organik tarkibi. Журнал химии товаров и народной медицины, 1(2), 185-202.
17. Oʻ GʻLI, R. I. M. (2022). Контурное взрывние при подземных горных работ. Scienceweb academic papers collection.