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THE SIBERIAN BRANCH OF
THE RUSSIAN ACADEMY OF SCIENCES
DIVISION OF SCIENCE, EDUCATION AND EXPERT ASSESSMENT**

**EDUCATIONAL COMPLEX
“POINT OF FUTURE”**

**RUSSIAN-CHINESE ECOLOGICAL BELT:
SCHOOL PROJECTS ON ECOLOGY**

Irkutsk, 2023

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Конференция «Russian-Chinese Ecological Belt» проведена в соответствии с Планом междисциплинарных мероприятий Сибирского отделения РАН на 2021 год.

Having held a scientific and practical conference of schoolchildren Russian-Chinese Ecological Belt, "Point of the Future" has gained experience in organizing international events.

Teachers and children were inspired to create and implement research projects in collaboration with peers from other educational institutions. This broadens the horizons of schoolchildren, opens up opportunities for fruitful communication, activates cognitive interest.

Sergey V. Chemezov, Chairman of the Board of Guardians

It is important for us that at the scientific and practical conference of schoolchildren Russian-Chinese Ecological Belt at the "Point of the Future", children voiced their views on "adult" environmental issues, raised topics relevant on a global scale; shared the ideas of scientists and their knowledge in the field of chemistry, in relation to solving environmental problems. There was real scientific intercultural communication. It is noteworthy that the conference was held in the Year of Science and Technology in the Russian Federation. This underlines the importance of measures to preserve the surrounding world and natural resources in conditions of increasing environmental stress.

Albert Al. Avdolyan, Investor of the "New House" Foundation

The international research school conference and forum are sure to be an effective bridge connecting school project work and fundamental science research at institutes on global environmental problems such as climate change, deforestation, extinction of some species of flora and fauna, environmental pollution...

This scientific collaboration will enable Chinese and Russian students to get to know each other better, effectively exchanging research experience and practice. Studying urgent ecological problems by students will result in significant joint benefits for the future high-quality life of new generations.

Aleksey Al. Levchuk, Director a. i., Irkutsk Scientific Center SB RAS, Ph.D. (Technical Sciences)

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Введение

Благотворительный фонд «Новый Дом» (президент – Ирина Владимировна Белянова), являясь основателем Образовательного комплекса «Точка будущего», с 2020 года поддерживает и развивает научно-исследовательское направление деятельности частного образовательного учреждения: организована работа научно-методического совета образовательного комплекса, центра профессионального развития, формируется профильное обучение для всех категорий обучающихся, в том числе в виде познавательных и научно-исследовательских проектов в рамках реализуемой идеи «жизненного проектирования».

Образовательный комплекс «Точка будущего» как ресурсный центр, площадка для развития компетенций обучающихся и учителей, приглашает к сотрудничеству образовательные учреждения города Иркутска, региона для решения важных профессиональных задач. Исследовательская работа школьников, ее организация и реализация, входит в спектр актуальных направлений деятельности учебных учреждений, поэтому в образовательном комплексе организована научно-практическая конференция с международным участием «*Russian-Chinese Ecological Belt*» (07 октября 2021 г.) и разработан, проведен ежегодный проектно-исследовательский форум «*Точка научного старта*» (10–11 апреля 2023 г.). Мероприятия прошли при поддержке Министерства образования Иркутской области, Сибирского отделения Российской академии наук и Генерального консульства КНР в Иркутске.

Близость к великому озеру Байкал, проживание на богатой лесами, недрами территории Сибири помогает школьникам осознать уникальность задач сохранения природных богатств родной земли, а школьные тьюторы, кураторы, учителя в ходе подготовки к мероприятиям обозначили актуальные экологические проблемы в качестве проблемных вопросов проектных работ. Научные сотрудники из Иркутского научного центра Сибирского отделения Российской академии наук (отдел научно образовательной деятельности и экспертной оценки) совместно с педагогами образовательного комплекса стали научными наставниками и экспертами организованных мероприятий.

Научно-практическая конференция с международным участием «*Russian-Chinese Ecological Belt*» и проектно-исследовательский форум «*Точка научного старта*» – важные промежуточные этапы проектно-исследовательской работы школьников и начало профессионального поиска обучающихся. Участники и их наставники получили внешнюю экспертизу проектов от приглашенных высококвалифицированных специалистов

Института географии имени В.Б. Сочавы СО РАН, Байкальского музея СО РАН, службы государственного экологического надзора Иркутской области. Представленные экспертные мнения имеют большое значение для развития навыков научного поиска и проектных умений учащихся.

Международный статус научно-практической конференции «*Russian-Chinese Ecological Belt*» был обозначен участием школьников из Китайской Народной Республики. Прозвучавшие доклады китайских школьников подчеркивают заинтересованность российской и китайской сторон в совместной исследовательской работе по актуальным проблемам экологии и природопользования. Взаимопонимание и сотрудничество образовательных учреждений является мощной перспективной основой формирования государственной политики в части укрепления связей с зарубежными странами в сфере науки и образования.

Благодарим всех участников-авторов исследовательских проектов, представленных в сборнике материалов мероприятий, и желаем им дальнейших успехов в учебно-познавательной и научной деятельности!

*С наилучшими пожеланиями,
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Section 1. Ecology of Lake Baikal

UDC 574.5

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NEGATIVE IMPACT OF THE HYDROELECTRIC POWER STATIONS ON THE ECOSYSTEM OF BAIKAL

Keywords: *Baikal, pollution, hydroelectric power station, ecosystem.*

Lake Baikal is the deepest lake in the world containing fresh water. It is in the list of UNESCO's World Heritage Sites. Lake Baikal is considered to be the pure clear "heart of Siberia". Everyone dreams of visiting this place to see the lake's natural beauty, to visit reserves or to look at rare animals and plants. But can people do these things if factories or hydroelectric power stations are built here? What will happen if people stop taking care of animals' lives and stop preserving the purity of its waters? The answer is evident. The flora and fauna will consequently die and the waters of Lake Baikal will be getting dirty day by day. People must not let it happen!

How does the construction of a hydroelectric power station affect the ecosystem of the lake? How to prevent the pollution of Lake Baikal? This is what our project is about.

The hypothesis is as follows: we suppose that the work of the hydroelectric power stations has a negative impact on the ecosystem of Lake Baikal.

The goal of the project is to examine the degree of negative impact of the hydroelectric power stations on the ecosystem of Baikal.

The objectives are:

- to get information about the biogeocenosis of Lake Baikal;
- to research the direct impact of the hydroelectric power stations on the ecosystem of the lake;
- to present the received information in the form of an article;
- to organize class periods about the topic.

The methods of the research are study, analysis of the received data.

Lake Baikal is one of the greatest lakes in the world, containing the largest number of endemics (over 1000 types) and plenty of different kinds of flora and fauna (over 2600 species) living in freshwater ponds of the Earth. 336 rivers

flow into Lake Baikal, but only one flows out – the Angara. Lake Baikal and its catchment basin belong to unique geosystems of the world. The Baikal is located in the central part of Eastern Siberia, not far from the conditional geographic centre of Asia. The lake is considered to be a World Heritage Site.

Unfortunately, the ecological situation of Lake Baikal is getting worse and worse each year because of deforestation, uncontrolled mass tourism, poaching and water pollution with different wastes. Also, hydroelectric power stations harm Baikal's ecosystem.

A hydroelectric power station has surely been the main, the safest and the cheapest source of electricity for many years. In spite of this fact, it poses a serious danger for the environment. For example, during the construction of dams and filling the reservoirs with water, there can happen the destruction of plants and animals' habitat, caused by dehydration or drying out of the tributaries of rivers and streams. So, due to the lack of water, many lakes, which are the typical habitat of the Mongolian toad, have dried up and the species is threatened with extinction.

In addition, reservoirs detain or slow down organic matter brought in by water streams. When it decays, a significant amount of greenhouse gases are emitted.

The reservoirs raise air humidity, promote change in air condition in the coastal area. Also, they contribute to the temperature and ice conditions of the drain. All of these facts lead to the change in environmental conditions, which affects the economic activity of the population and the life of animals. In addition, low water temperatures shift the timing of spawning, increase the period of incubation of eggs of spring-spawning fish and its death, first of all, associated with its palatability by other fish. The increased temperature background in winter disrupts the natural conditions for wintering fish.

The main damage for fisheries as a result of water discharge through the hydroelectric power station is due to the following three factors:

- the fish's deaths as a result of the drift from the reservoir through the working units and the weir dam;
- the loss of offspring of the fish;
- the death of food organisms for fish as a result of removal from the reservoir with the flow of water through the hydroelectric power station.

So, one of the reasons for the decrease in a number of the Baikal sturgeon was the reduction in spawning areas due to the construction of the hydroelectric power stations.

Water spills and discharges from hydraulic structures often lead to the fact that soil from polluted areas is washed into the lake. Chemical fertilizers and residues of organic matter, together with the soil, also get into the water. It has a detrimental effect on the condition of the inhabitants of the lake, including sponges, which are biofilters of the reservoir.

To encourage people to think about solving the important environmental problem, we have written a scientific article and posted it in the portal “Gorod” and also on our school’s website.

We decided to educate the younger generation about the ecological problem of Lake Baikal because we live near this magnificent cultural heritage and are much worried about its future. We have organized class periods about the topic for the students of 8-10 grades.

While doing this project we have learned about Lake Baikal’s ecosystem and how the hydroelectric power stations affect it. We’ve found out that the hydroelectric power stations destroy the lake’s biogeocenosis. Thus, we have confirmed our hypothesis and approved that the work of the hydroelectric power stations negatively affects the ecosystem of the lake.

Therefore, we believe that the construction of hydroelectric power stations on the rivers flowing into Lake Baikal must be strictly prohibited because it hurts the biogeocenosis of Lake Baikal.

We want to end our presentation with the following words: Christ could walk on water. If river pollution does not stop, everyone will be able to walk on water soon.

UDC 574.5

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LAKE BAIKAL PELAGIC PHYTOPLANKTON

Keywords: *phytoplankton, pollution, aquatic environment, food chain.*

Now plankton is actively used as an indicator of the state of water ecological systems and their changes both under the influence of pollution and as a result of climatic shifts. Therefore, it is very important to know what types of living organisms make up the plankton community of Lake Baikal.

Phytoplankton is the basis of the food chain for all Baikal organisms, because it creates the primary production. The variety and biomass of zooplankton, as well as fish and the final link, the seal, will depend on the amount of phytoplankton.

Phytoplankton are microscopic organisms, the main producers of organic matter and oxygen in water bodies and streams. It is a valuable food for invertebrates and juvenile fish and takes an active part in the processes of self-purification and formation of water quality. In 1959, O.M. Kozhova published the

list of species of Baikal phytoplankton, including 99 species of planktonic algae accompanied by a brief description of the biology of the most common forms.

Phytoplankton nutrition is quite diverse. However, photosynthesis is a common factor among all phytoplankton groups.

They require solar energy for photosynthesis. Their dependence on sunlight limits their life in the photic zone (the area in which sunlight can enter the aquatic environment). Most of them are marine, but some live in freshwater.

– There are various groups of phytoplankton in Lake Baikal. The order of blue-green algae includes 43 species and 7 varieties from 2 classes: *Chroococceae* and *Hormogoneae*. The most common species are *Anabaena lemmermannii*, *Anabaena scheremetievi*, *Anabaena flos-aguae*, *Lyngbia sp.* *Aphanizomenon flos-aguae* *Gloeocapsa sp.*

– Golden algae in Lake Baikal are represented by four species: *Cryptomonas marssonii*, *Rhodomonas pusilla*, one of which (*Tetrasporopsis reticulata* S. Meyer) is endemic to Lake Baikal.

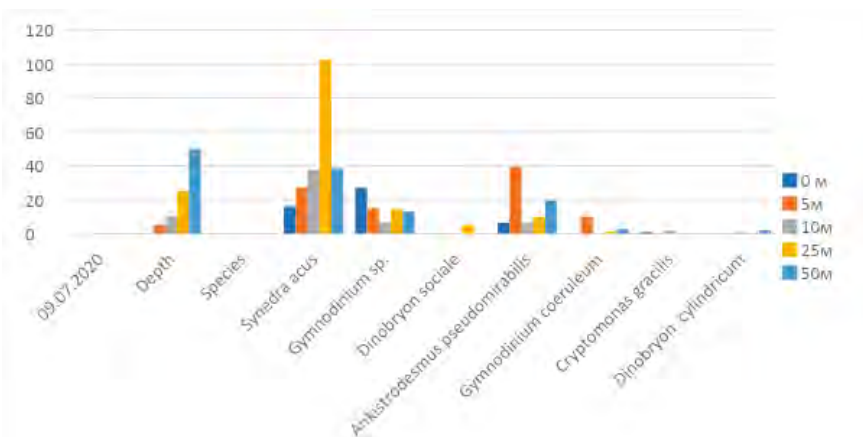
– The most common diatoms are: *Aulacoseira*, *Cyclotella*, *Stephanodiscus*, *Synedra*, *Asterionella Formosa*.

– The materials used were: a glass slide, a pipette for collecting from samples, samples (date 09/07/2020), binoculars, special tables for counting.

– To study phytoplankton, we took four samples from 5 depths: 0, 5, 10, 25 and 50 meters at the pelagic station of point number 1 of Lake Baikal, Bolshie koty. Thanks to the microscope, we were able to take a closer look at the plankton, we took photographs and used them to count certain species at different depths.

Table 1.
Phytoplankton abundance table

09.07.2020	abundance, 1000 indiv/l				
Depth	0	5	10	25	50
Species					
<i>Synedra acus</i>	16,04	27,25	37,86	102,4	38,4
<i>Gymnodinium sp.</i>	26,98	15,09	6,72	14,4	13
<i>Dinobryon sociale</i>				5,03	
<i>Ankistrodesmus pseudomirabilis</i>	6,38	39,21	6,55	9,71	19,43
<i>Gymnodinium coeruleum</i>		9,8		1,04	2,63
<i>Cryptomonas gracilis</i>	0,91	0,19	1,63		
<i>Dinobryon cylindricum</i>			0,81		2,04



Based on the diagram, we can conclude that:

1. In the sample of 0 m, the species *Gymnodinium sp* has the largest abundance
2. In a sample of 5 m, the species *Ankistrodesmus pseudomirabilis* has the highest abundance
3. In a sample of 10 m, the species *Synedra acus* has the highest abundance.
4. In a sample of 25 m, the species *Synedra acus* has the largest abundance.
5. In the sample of 50 m, the species *Synedra acus* also has the highest abundance.

Moreover, the sample of 50 m contains the largest number of organisms.

Using the literature, we learned how important phytoplankton is for Baikal. Using the materials available to us, we were able to see phytoplankton ourselves and take photographs. We also gained knowledge about the amount of phytoplankton at different depths.



Section 2. Chemistry

UDC 502.51

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ASSESSMENT OF THE IMPACT OF HUMAN ACTIVITY ON THE COASTAL ZONE OF THE CHERTUGEEVSKY BAY

Keywords: hydroelectric power station, reservoir, ecology, pollutants, hydrochemical composition, water resources.

Currently, one of the most common problems is the problem of the ecology of water resources. Clean water is gradually becoming the “number one commodity” in the world and, according to some forecasts, will be the best-selling product in the next decade. The following lines from the work of Friedrich Engels “Dialectic of Nature” have not lost their relevance and have acquired an even deeper meaning: “Let us not, however, be too deluded by our victories over nature. For every such victory, it takes revenge on us. Each of these victories, however, has, first of all, the consequences that we expected, but in the second and third turn, completely different, unforeseen consequences that very often destroy the significance of the first one.”

The example of this is the construction of the Irkutsk Hydroelectric Power Station (HPS) and the reservoir of the same name formed by it on the Angara River, which subsequently had a significant impact on the adjacent territory.

The construction of the Irkutsk HPS began in 1950 and was completed in 1958. The HPS is a riverbed station with a combined HPS building. The capacity of the HPS is 662.4 MW, the average annual output is 4.1 billion kWh.

The pressure structures of the hydroelectric power station (the length of the pressure front is 2.73 km) form a large Irkutsk reservoir, which includes Lake Baikal, the level of which was raised by 1.46 m. The total volume of the Angara part of the reservoir is 2.5 km³, the useful one is 0.45 km³ and it carries out daily flow regulation, while the useful volume of the Baikal section is 46.4 km³ (99% of the total volume), which makes it possible to ensure deep multi-year and annual flow regulation and equal operation of not only the Irkutsk HPS, but also the entire cascade of Angara power plants [2].

Currently, Lake Baikal is under the close attention of ecologists, hydrochemists, biologists who monitor the state of the lake and develop programs to protect the Baikal ecosystem.

It is possible to identify some environmental problems associated with the Irkutsk reservoir:

- severe water pollution of the reservoir associated with the operation of a great number of large and small vessels and the discharge of untreated water from gardening sites and dachas;
- pollution caused by stagnant phenomena and water blooming, as well as rotting of residual wood;
- intensive development of the coastal zone and the development of the coastline, which leads to a decrease in the quality of the soil composition.

At the moment, it is advisable to conduct an environmental assessment of the coastal zone of the Irkutsk reservoir.

The purpose of the research is to study the hydrochemical composition of the waters of the coastal zone of the Chertugeevsky Bay of the Irkutsk reservoir. Hydrochemical observations were carried out at three points: in the area of the installation of the icebreaker Angara, in the area of the river berth “Rocket” and the shore of the village Green Land.

As a result of the research of ecologists, it was found that in the surface waters of the Irkutsk reservoir, at the sampling points, the concentrations of pollutants did not exceed the standards established for water bodies of fisheries significance. Anthropogenic garbage is distributed throughout the bay, represented by plastic bottles, rebar, scraps of ropes and iron cans. The results of the analyses at the sampling points are shown in Table 1.

Table 1.
Results of analyses of water from sampling points

Name of the component to be defined [5]	maximum permissible concentration [3, 4] of pollutants, mg/dm ³	Mass concentration, mg/dm ³		
		Angara Icebreaker	River berth «Rocket»	Shore of the village Green Land
pH	6,5-8,5	7,6	7,65	7,63
Chloride ion	300	7,4	10,8	6,6
Sulfate ion	100	13,2	11,8	10,4
Nitrate ion	45	0,48	0,22	0,18
Phosphate ion	0,2	0,01	0,02	0,01
General iron	0,3	0,08	0,31	0,25
Biochemical oxygen consumption ₅	2	1,78	2,09	2,07
Chemical oxygen consumption	5	3,39	7,54	6,89
Petroleum products	0,05	0,082	0,104	0,98
Surfactants	0,3	0,022	0,016	0,019
Phenol	0,01	0,004	0,004	0,003

The table of observations of the hydrochemical composition of surface water shows that phenols were registered in the observation point of the icebreaker Angara, exceeding the permissible standards in average annual values. Phenols, being one of the most common pollutants, most likely enter the surface water with the effluents of enterprises. They are chemically unstable and undergo active decomposition in an aqueous environment.

The analysis of the data allows us to make a preliminary conclusion about the sources of this pollutant, which are most likely associated with enterprises located within the city.

As for other pollutants, organic substances according to COD, organic substances according to BPK5, and petroleum products were registered in the maximum value in the area of the river berth. According to the complex of indicators, the water of the reservoir in all observation points can be characterized by class 1, that is, “conditionally pure”.

The analysis of the results of the research showed that human activities in the area under consideration have an impact on the environment corresponding to the production and technological process.

Increased values of such indicators as the concentration of easily oxidizing organic matter and volatile phenols indicate a dominant contribution to the pollution of household and surface wastewater. Given that a large number of water users and other sources of pollution are located at the sampling points, it can be assumed that the concentration of the studied indicators will remain at least at this level if efforts are not made to clean up the water. In this regard, it is necessary to conduct a landscape survey on the entire water area, on the basis of which it will be possible to assess the change in the area of landscape complexes and develop scientifically based solutions for the formation of a comprehensive environmental safety system, as well as to analyze the ecological state of water body sections, and to identify the main problems of their high-level chemical contamination.

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STUDY OF THE MAIN IONIC AND GAS COMPOSITION OF WATER FROM VARIOUS SOURCES

Keywords: *water, groundwater, drinking water, toxicity, concentration.*

Water is a very common substance on the Earth. People use water from rivers, lakes and groundwater for various purposes. Large volumes of water are consumed in industry. A lot of water is spent on household needs.

When it comes to water use, we always come across the concept of “water quality”. This means that the water can be different. And what is the difference between one kind of water and another? The concept of water means an aqueous solution of mineral and organic compounds. The total amount and ratio of these substances determines the quality of water, its toxicity and the possibility of using it in everyday life and for drinking. Therefore, determining the composition of water is an urgent task.

Purpose: to study the composition of water from various water bodies and determine their quality.

Tasks:

1. Find out what composition natural water has.
2. Analyze water samples from various water sources.
3. Compare the experimentally obtained data on the composition of water with sanitary standards.

Hypothesis: water from different sources differs in its composition.

Research subject: composition of water.

Research object: water

Analysis of water samples was carried out in the laboratory of the Institute of Geochemistry of the Siberian Branch of the Russian Academy of Sciences. Titrimetric, photometric, absorption research methods were used for this.

To study the ionic and gas composition of water, samples were taken from various sources. River water was taken from the bank of the Angara River below the dam of the hydroelectric power station (A-1) and in the Kaya River below the Pervomaysky district (K-1). We took underground water samples from a well 54 m deep in the village of Novo-Irkutsk (W-1). We also examined tap water from school No. 24 (Shk-1).

At the sampling site, the parameters assessed were color, odor, transparency, temperature and pH. The color and clarity of the water were assessed visually. The temperature was measured with a thermometer with 0.1 C graduation, pH was

measured with a portable pH meter. It was found that water from all sources has no color and odor. It is transparent, it has pH from 6.5 to 7.2, water temperature ranges from 0.1 до 10.2°C.

In the selected samples, the mass concentration of oxygen (O₂), carbon dioxide (CO₂) and the main ions of bicarbonate ions, chloride ions, sulfate ions, calcium, magnesium, sodium, potassium ions (HCO₃⁻, Cl⁻, SO₄²⁻, Ca²⁺, Mg²⁺, K⁺, Na⁺) was determined.

It was found that the highest oxygen content is observed in the tap water of school No. 24, the lowest - in the water of the well of the Novo-Irkutsk settlement. Most of the carbon dioxide is observed in the well of Novo-Irkutsk settlement, least of all in the Kaya River.

The maximum concentration of calcium was detected in the water of the Kaya River. In the water of the Angara River and in the tap water of school No. 24, the concentrations of most of the main ions are almost the same and have minimum values among all the samples studied.

The concentration of ions in the water of the sources was compared with the maximum permissible norms (MPC), established for drinking water. The content of oxygen and carbon dioxide, as well as bicarbonate ion, in drinking water is not standardized. In most cases, the content of the studied components was significantly lower than the MPC.

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POLLUTION OF THE ANGARA RIVER BASIN BY WASTEWATER

Keywords: *water pollution, wastewater, integrated treatment systems.*

The Angara River has its source in Lake Baikal. Previously it was always renowned for the purity of its waters. But in recent decades the Angara basin has undergone catastrophic changes. Anthropogenic and technogenic impacts are the main cause of the current environmental problems. Construction of hydroelectric power plants and dams, industrial effluents, ingress of oil products into the water – all this has dealt a serious blow to the Angara and caused many environmental problems.

The vastness of the Angara River and other peculiarities of the river led to active construction of hydroelectric power plants (Irkutsk, Bratsk, Ust-Ilim and Boguchanskaya), which became one of the sources of pollution of the river. As a result of the construction of a cascade of hydroelectric power stations over a considerable length (about 890 km), the river has turned into a chain of lake-like low-flow reservoirs, which has reduced the flow and water exchange in the river and reduced the self-purification capacity of the river.

Industrial plants located on the banks of the Angara River discharge huge quantities of industrial effluents into the water. The wastewater treatment plants designed to purify them fail to cope with this task. Thousands of tons of pollutants flow into the Angara river. The main part of industrial wastewater is generated

- from thermal power plants;
- from the pulp and paper and hydrolysis industries;
- chemical and petrochemical industries.

We found out that the priority pollutants of wastewater include: organic substances, mercury, copper compounds, nitrites, phenols, oil products, lead and nitrates.

The environmental situation is aggravated by the extremely inefficient operation of the vast majority of wastewater treatment plants in cities. A large amount of poorly treated municipal wastewater enters water bodies.

For example, in October 2018, an oil slick about 400 metres long formed on the surface of the Angara River in the Usolsk district. The oil spill came from a pipe of the bankrupt company Russol LLC in Usolie-Sibirskoye. As a result, the water intakes of the towns of Usolie-Sibirskoye and Svirsk, as well as other settlements located downstream of the river, were threatened with pollution.

In January 2020, there was a discharge of untreated effluent from the left bank sewage treatment plant in Irkutsk. Untreated liquid was discharged in large quantities into the Angara River from a pipe located under water, and the reason for the discharge was a malfunction of the treatment facilities operated by the municipal enterprise Vodokanal.

Scientists, Rospotrebnadzor and the Hydrometeorological Service are studying the water for both chemical and microbiological indicators. The State Report “On the State of Sanitary and Epidemiological Welfare of the Population in the Irkutsk Region in 2020” presents the results of monitoring of water bodies. A decrease in exceeding hygienic standards has been noted for chemical, microbiological and parasitological indicators for three years. This is a good sign, which indicates that the environmental situation has improved slightly. However, it is necessary to continue working in this direction and take measures to further improve water quality. This is important for public health and the preservation of biodiversity in the region.

Alternative sources of energy, such as solar and wind energy, need to be developed to solve the problem of hydroelectricity. To combat oil pollution,

controls and supervision of oil transportation and storage need to be increased, and the use of minimal risk technologies is mandatory. To combat eutrophication, pollutant emissions must be reduced and active efforts must be made to protect and restore natural habitats, and controls on the construction of septic tanks in the private sector and by small and medium-sized businesses (including tourism) must be strengthened. To combat pollution from the pulp industry, it is necessary to use fewer chemicals in paper production and to develop efficient waste management and recycling technologies.

Great attention must be paid to upgrading the wastewater treatment plant in order to avoid pollution of the Angara River with wastewater. The wastewater treatment plant has a long and thorough treatment process: first there is mechanical filtration, then chemical treatment, but still half of the untreated water, in which waste remains, goes into the Angara River. At the moment there are already projects that can improve the treatment and replace the liquid chlorine used in chemical treatment with ultraviolet, which is installed in trays and under the influence of ultraviolet all pathogenic microflora is killed.

Irkutsk’s sewage system consists of two sewage treatment plant complexes: the right bank and the left bank. In the right bank complex sewage treatment systems, work is going on actively, unlike in the left bank part of the city, where the treatment facilities have almost reached their capacity limit. They were built according to the technology of the 70s and were designed for treatment of 170 thousand cubic meters of water per day. Even now the average daily flow of wastewater is 155-160 thousand cubic meters, and in periods when it melts snow or rains, the actual load sharply increases. Given the growing population in Irkutsk, the construction of new housing complexes on the left bank of Irkutsk and the consequent increase in wastewater volumes, a comprehensive upgrade of these treatment systems is planned for the coming years.

As mentioned above, in addition to the treatment system, great attention should be paid to the sources of water intake. For the city of Irkutsk, this is the Ershovsky water intake, which is located upstream of the Irkutskaya HPP dam. It is also under threat because in recent years, a large number of low-rise housing estates have been built along the right bank of the Irkutsk reservoir and a private sector is developing. Due to insufficient attention to local wastewater treatment systems, as well as septic tanks (facilities for mechanical wastewater treatment by sedimentation with anaerobic digestion) of private households, scientists have recorded changes in the composition of ground and coastal water on microbiological and hygienic indicators. Deterioration of water quality according to microbiological and hygienic indicators might cause eutrophication. Water eutrophication is a natural process in aquatic ecosystems, formed by the enrichment of nutrients produced by excess organic matter discharged into rivers and lakes as a result of human activities. But eutrophication also directly depends on anthropogenic impact. From the state report “On the State of Sanitary

and Epidemiological Welfare of the Population in the Irkutsk Region in 2020, we see that 31% of water samples from centralized systems of domestic and drinking water supply do not meet hygienic standards. An excess of indicators for the total number of coliform bacteria is recorded, which indicates fresh faecal contamination (Table 1).

Table 1.
Proportion of water samples exceeding hygienic standards in Irkutsk District

Ранжирование муниципальных образований Иркутской области по качеству питьевой воды централизованных систем хозяйственно-питьевого водоснабжения в 2020 году

№ п/п	Муниципальные образования	Доля проб воды с превышением гигиенических нормативов по санитарно-химическим показателям, %		Доля проб воды с превышением гигиенических нормативов по микробиологическим показателям, %	Ранг	Доля проб воды с превышением гигиенических нормативов по паразитологическим показателям, %
	Иркутская область	10,33		4,20		0
1.	Балаганский район	28,6	9	7,3	11	
2.	Бодайбинский район	13,5	21	6,3	14	
3.	Ангарский ГО	0,8	34	1,3	28	0
4.	Братский район	47,7	3	2,8	25	0
5.	Жигаловский район			9,4	7	
6.	Заларинский район	27,8	10	8,3	9	
7.	Зиминский район	4,6	27	0,6	33	0
8.	Иркутский район	31,9	8	8,2	10	0
9.	Казачинско-Ленский район	0,0	36	6,4	13	
10.	Катангский район	14,3	19	0,0	36	
11.	Качугский район	33,3	7	2,1	26	
12.	Киренский район	5,1	26	17,0	2	
13.	Куйтунский район	15,9	16	0,0	36	
14.	Мамско-Чуйский район	16,7	14	0,0	36	
15.	Нижнеилимский район	2,6	29	3,8	21	
16.	Нижнеудинский район	15,5	18	6,3	14	0
17.	Ольхонский район	8,3	23	3,4	22	
18.	Слюдянский район	0,0	36	0,8	32	0
19.	Тайшетский район	19,3	11	3,4	23	0
20.	Тулунский район	17,2	13	0,6	34	0
21.	Усольский район	15,8	17	5,8	16	0
22.	Усть-Илимский район	0,9	33	3,3	24	0
23.	Усть-Кутский район	8,9	22	5,1	19	
24.	Усть-Удинский район	42,9	4	5,6	17	

Pollution of the Angara River basin and groundwater has serious consequences for the river ecosystem and the environment. It also negatively affects the health of people who use water from the river for drinking, cooking and other household needs. To reduce the pollution of water systems, it is necessary to take measures to treat wastewater from industries and the public, as well as to introduce strict environmental regulations and standards. In addition, river water quality monitoring, further scientific research and improved waste management systems are needed to maintain the ecological sustainability of the Angara River basin.

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Section 3. Biology

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EXPERIMENT TO THE STUDY OF THE SYSTEMIC WASTEWATER TREATMENT USING CILIATES (PROTOZOA)

Keywords: *wastewater treatment, chemical pollution, protist.*

Purpose of the study: investigation of the reactions of laboratory cultures of freshwater ciliates to the chemical composition and complex pollution of natural environments (water, bottom sediments, soils) and industrial waste (sewage sludge, oil, chlorides, sludge after oil production), as well as the possibility of its adaptation to oil pollution and their use as a means of sewage treatment at wastewater treatment plants.

Research objectives:

1. To assess the state of some natural and artificial water facilities (rivers, lakes, ponds, sedimentation tanks) in the city of Irkutsk, using biotesting methods.
2. To study the toxicity of organogenic (peat) and mineral (loam) leachate filtrates of the bottom sections of the rivers of Irkutsk.
3. To determine the limits of resistance of freshwater ciliates to pH, salinity and water-soluble fraction of oil products under separate and combined action.
4. To investigate the possibility of adaptation of some types of ciliates to chemical pollution.

Environmental pollution is one of the global environmental problems of the modern world. Till present, analytical methods remain the main methods for assessing the ecological state of soils and water bodies. However, along with physicochemical methods, biological testing methods are increasingly being used, which makes it possible to assess the totality of the properties of the studied environment by the reactions of living organisms. To achieve the goal set, the study material is organisms that are widespread in the ecosystem, participating in the processes of self-purification of waters in natural conditions and have a short life cycle, which makes it possible to trace the results of the impact of damaging factors on the offspring. The protists (protozoa) meet these requirements. This choice is justified by the fact that, firstly, protists are typical representatives of the fauna of water bodies, soils and biological treatment facilities (activated sludge),

secondly, they are indicator species in assessing environmental pollution and, thirdly, ciliates are distinguished by rather high sensitivity to toxicants.

The ciliates, as a type, are widespread in the water reservoirs of the world and have a high reproduction rate. Along with other protozoa, ciliates play a significant role in the trophic relationships of aquatic organisms and make up a significant proportion of the total productivity of water bodies. This applies to ciliates of both plankton and macrobenthos and periphyton.

The ciliates are one of the most widespread components of wastewater treatment plant biocenosis. Recent research has established that ciliates constitute the main group of protozoa in domestic and industrial wastewater treatment plants. Thus, the famous protistologist N.V. Mamaeva, has found about 80 species of organisms in the activated sludge of some industrial treatment facilities, of which 50 species were ciliates. Such a significant predominance of ciliates stimulated the study of their species composition, ecology and role in the process of biological purification. An equally important consequence of the filtration activity of ciliates is the clarification of purified water and the destruction of pathogenic bacteria. This role of ciliates has been experimentally proven by the works of some scientists.

The biofilters are biological wastewater treatment plants in which wastewater passes through filter material covered with active bio membrane. The use of biofilters allows wastewater to be filtered through the activated sludge feed material, and biofilm microorganisms adsorb and oxidize the impurities present in the water and use them as a source of nutrients and energy. Accordingly, biofilm growth occurs during operation of the biofilter. Part of it dies off and is removed from the device. The detached pieces of bio membrane are then deposited in a secondary clarifier.

The source of nutrition and energy for the vital activity of organisms of activated sludge is organic pollutants coming with the wasted water. Microorganisms of activated sludge with the help of enzymes, which are released by them, oxidize, break down these impurities in the presence of oxygen to simple inorganic compounds, ultimately to water and carbon dioxide. Part of organic matter is used to build new cells of microorganisms; the other part is used in life processes.

In biocenosis of aero tanks (biofilters), protozoa make up about 0.5-1% of the mass of activated sludge. They are represented by four main groups:

- 1) Sarcodes (Sarcodina): amoebae (*Amoeba limax*, *Amoeba proteus*), shell amoebae (genera *Arcella*, *Centropyxis*), naked amoeba (genus *Pelomyxa*).
- 2) Flagellates (*Mastigophora*, *Flagellata*): colorless flagellates (genera *Bodo*, *Peranema*).
- 3) Ciliated ciliates (*Ciliata*): free-floating (of the genera *Colpidium*, *Oxytricha*, *Paramecium*), gastric (*Aspidisca*), single attached (*Vorticella* surveys), colonial attached (of the genera *Epistylis*, *Opercularia*).
- 4) Sucking ciliates (*Suctorina*): *Acineta*, *Podophrya*, *Tokophrya*.

The protozoa, along with rotifers, water mites and nematodes, eating solitary floating bacteria, provide:

- 1) a decrease in the turbidity of effluents;
- 2) loosening of sludge;
- 3) increasing the efficiency of water treatment;
- 4) regulate the species and age composition of microorganisms, maintaining it at an optimal level.

In 24 hours, one ciliate passes through its body from 20 to 40 thousand bacteria. The protozoa are involved in the removal of non localized, dying microorganisms, as well as pathogenic ones.

To sum up, this work undoubtedly arouses scientific interest since these protozoa are both a cell and an entire organism at the same time. Without a comprehensive study of the biology of all the main ecological groups of marine and freshwater ciliates (microbenthos, plankton, periphyton), it is impossible to solve the problems of maintaining the purity and increasing the biological productivity of water bodies. In the ecological aspect, the study of ciliates (both marine and freshwater) and the assessment of their role in the reservoir are of great theoretical and practical interest.

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VARIABILITY OF MORPHOLOGICAL FEATURES IN THE YENISEI ANEMONE ENDEMIC TO SOUTHERN SIBERIA WITHIN A SINGLE POPULATION

Keywords: *variability, vulnerable species, anemone, diversity, generative shoot, moisture, deviation, sample, assess.*

Anemone jensisensis belongs to the genus *Anemone* L. – a genus of perennial herbaceous flowering plants of the Buttercup family, which includes more than 170 species. The Yenisei anemone is endemic to Siberia [2], with a limited range. It grows in the Kemerovo, Tomsk, Irkutsk regions, Krasnoyarsk Territory, etc. In the Irkutsk region the locations of the species are found at the east end of distribution. In addition, the species belongs to non-moral relics [2,3]. It grows in coniferous, mixed forests. It loves shade and moisture as well. Ephemeroïd, the Yenisei anemone, blooms in late May - early June. On the territory of the Irkutsk region the species belongs to the category of vulnerable species. It is listed in the

Red Data Book. In the southern regions it grows on the territory of the Baikal National Park, but no special measures are taken to protect the species [1].

The study of the variability of morphological features of species of the genus *Anemone* is of great importance in assessing the state of natural populations of species, in addition, it allows us to identify key indicator morphological features and ecological and biological optima characteristic of each species. Furthermore, in our time the preservation of biological diversity is important. Humanity is actively influencing the environment, which leads to the extermination of many species.

Studies of *Anemone jensisensis* were conducted in June 2021 in the Irkutsk district, Bolshaya Rechka village. Morphological characteristics of 26 individuals were measured in the population (Table 1). The following characteristics were measured: the height of the generative shoot; leaf length; leaf width; perianth width; perianth length; stamen height. To analyze the variability of morphological features, we used the coefficient of variation (CV) parameter, showing the degree of variability of the trait to the average indicator of the sample. It is necessary to estimate the average diversity of a particular trait in the population as well as the amplitude of variability. We used the scale of S. A. Mamaev [4] in which the following levels of variability were identified: very low < 7 %; low – 8-12 %; average 13-20 %; increased – 21-30 %; high 31-40 %; very high – more than 40%.

Table 1.

Morphological features of *Anemone jensisensis* in the Irkutsk district

N specimens	Height of the generative shoot	Leaf length	Leaf width	Perianth width	Perianth length	Stamen height
1	18	6,6	1,1	0,8	1,2	0,7
2	14,5	4	0,7	0,5	0,8	0,4
3	11	3,5	0,6	0,5	1	0,5
4	13,5	5	0,8	0,5	0,9	0,4
5	11	3	0,6	0,4	0,7	0,5
6	13,3	4,5	0,5	0,5	0,7	0,5
7	14	3,2	0,9	0,4	1	0,3
8	12	6	0,5	0,7	1,3	0,6
9	11,9	4	1	0,6	1	0,4
10	16,5	6,5	0,5	0,7	1,2	0,7
11	12,5	4,3	0,7	0,5	0,7	0,5
12	14	5	0,7	0,5	3	0,7
13	10	4	0,7	0,5	0,7	0,4
14	14	5,3	0,6	0,6	1	0,5
15	14	5	0,5	0,5	0,8	0,3
16	18	6,6	1,1	0,4	1,2	0,7
17	11,7	3,8	0,5	0,2	0,4	0,3

18	13,3	5	2	0,3	1	0,5
19	17,2	3,8	0,7	0,4	1	0,6
20	16	5	2,7	0,3	2,8	0,5
21	12	2,6	0,5	0,4	1	1
22	17,5	6,2	1	0,8	2	1,1
23	18,3	6,9	1,8	0,9	2,3	1,3
24	18,9	7,5	2,9	1,2	2,8	1,9
25	17,8	6,2	3,1	1,2	3,2	0,9
26	17,3	5,8	3,3	0,4	3,7	0,7
Average, cm	14,5	4,97	1,15	0,56	1,44	0,65
Standard deviation	2,68	1,32	0,89	0,25	0,92	0,35
CV, %	18,6	26	81	33	64	58

In connection with the conducted research, it can be noted that the most variable morphological feature in the population of the Yenisei anemone is the width of the leaf, a high percentage of the diversity of features occurs in the length of the perianth and the height of the stamen. The average level of variability or the height of the generative shoot is determined, which indicates the stability of this trait.

The results of the high intra-population variability of the morphometric parameters of the study can be associated with the completion of the flowering stage, during which the signs of the generative sphere change, or is a consequence of anthropogenic impact on the population (since it is located on the territory of the village).

Anemone jenseensis (Yenisei anemone) is an endemic with a limited range that grows in coniferous and mixed forests of Eastern Siberia. The study of the variability of morphological features is of great importance when assessing the state of the population of a species. In addition, it allows us to identify key indicator morphological features and ecological and biological optima for each species.

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ANTS OF THE FOREST PARK ZONE OF AKADEMGORODOK IRKUTSK

Keywords: *diversity, habitat, impact, urban, invasive, hawthorn, shrubs, motley grass, myrmecological, foraging.*

Insects are one of the most ancient and numerous groups of animals. The importance of insects in nature and agriculture is great and diverse. Despite this, they are still very poorly studied. Ants are one of the most evolutionarily advanced insect families in terms of ethology, ecology, and physiology. They are very complexly organized insects that have a huge impact on the ecology of their habitat, that is why it is important to know their influence in various places for the conversion of ants for the benefit of the environment.

My hypothesis is this: a city, even a forest park, is a harsh environment for habitation - polluted air, asphalt all around the streets, people and cars. There should not be a large variety of species in the urban environment.

To confirm the hypothesis, a faunal study of ants was conducted on the territory of the Akademgorodok Forest Park in Irkutsk. Such studies are aimed at detecting the species composition of insects. They are of interest to science and practice; they allow us to identify the most widespread species, dangerous, as well as rare species that need protection. They help to identify invasive (introduced) species that can cause irreparable damage to local animals and plants. There are ants among them.

Akademgorodok Forest Park is located in the southwestern part of the city, on the left bank of the Angara River. Woody vegetation is represented by artificial plantings of mixed composition. Pine, birch and poplar predominate. Spruce, larch, and maple are less common. There are willows, hawthorn, bird cherry, and apple trees among the shrubs. There is motley grass. The road and path network makes up about 60% of the area of the forest park.

In order to identify the composition of ants inhabiting the forest park, standard studies were performed using the myrmecological method. The collection of ants was carried out by the route method with a strip of 2 m [2, 3]. Ants are small insects and it is very difficult to pin them. More often, they are carefully pasted on special triangles made of cardboard or placed in 70 or 96% alcohol [4]. The ants we collected were fixed in alcohol; we tried to catch both workers and foragers. Then the captured insects are identified individually by various signs. The main

feature by which we recognize the genus is determined by the habitat of ants (both geographically and locally), color, and size. The specific type should be determined with the help of a magnifying glass (or binoculars) – you need to examine the hairs on the abdomen or the base (scape) of the antenna, look at the shape of the head, and sometimes you need to consider the legs. The subspecies should be determined with the help of a binocular or a not very magnifying microscope. Here you will need to consider the platypus - the part of the head where the mandibles originate, its shape or other signs (whether its edge forms a trapezoid, an obtuse angle, etc.), frontal rollers-bumps from which the ant's antennae grow, etc.

During the inspection of the forest park on June 2, 2021, we detected three species of ants. A faunal list has been compiled. The species names of insects consist of two Latin words, the first of which means genus, and the second word in combination with the first indicates species. Species are grouped into a genus, genera - into a family, families - into orders. Usually, for the list, we also indicate the name of the entomologist who described this species and the year when it happened.

Camponotus saxatilis Ruzsky, 1895-the Russian name of this ant is the golden-haired tree ant, or Sakhalin ant. It was found in the forest part of the forest park. The worker ants are black, with golden hair. They live in the steppes and meadows of some regions of Russia, Mongolia and Kazakhstan. They make nests in the soil and wood. A distinctive feature of these camponotus is the yellow-golden hairs on the body, especially noticeable on the abdomen. Golden-haired woodworms are very beautiful ants. The combination of black color with golden hair gives them elegance. Golden woodworms, like many ants of the genus *Camponotus*, are quite large. In families, you can meet small and large worker ants, soldiers. The size of working individuals is 6-8 mm, soldiers - up to 13 mm. The queen is much larger and can reach 17 mm. Large soldiers are engaged in protecting the nest and help to carve up the prey. Collective foraging was observed in this species: scout ants go out to search for food as a whole group and mark the discovered feeding roads with pheromone traces, which are later followed by other ants in search of food.

Formica rufa Nylander, 1846 - a common thin-headed ant, or a thin-headed ant. It is wide-spread in Europe, Transcaucasia, Southern Siberia, Mongolia, and the Far East. It is a medium-sized ant. It is typical for forest clearings, glades and forest-steppes. It is an active predator, the entomophagus, builds small anthills from small plant remains, sometimes forming supercolonies of hundreds of nests. Working ants are 0.5-0.75 cm long. They are relatively large ants with a dark black belly and a top of the head and a body and a head of a copper-orange color. They are very aggressive and territorial and dominate the forest park.

Lasius niger is a black garden ant. This species is found on vast territories from Portugal and England across Europe to the central part of Siberia and to Mongolia. It lives both in the wild and in cities. The queens reach a length of up to 1 cm. Working individuals are small, 0.3-0.4 cm long. They are small black-

dark brown ants, very fast and nimble, timid. They breed aphids on plants, which causes serious harm. Workers protect aphids from enemies.

Only the completely underground anthill *Lasius niger* (L.) is prone to trampling. The rest partially or completely live above the ground – in trees or mounds.

The article by I. A. Antonov [1] states that 63 species of ants have been reliably recorded for Baikal Siberia. Irkutsk is surrounded by subtaiga and forest-steppe landscapes. They are characterized by 42 species of ants. As a result of collecting, processing and determining ants, only three species were identified for the Akademgorodok Forest Park in Irkutsk, which confirms our hypothesis.

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UDC 594.3

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ON THE SYSTEMATIC STATUS OF BITINII - THE FIRST INTERMEDIATE HOSTS OF THE FLUKE OPISTHORCHIS FELINEUS IN THE IRKUTSK FOCUS OF OPISTHORCHIASIS

Keywords: *bitinii, gastropods, opisthorchiasis, shell height, shell width, whorl height, mouth length, mouth width*

Relevance: Until now, there is no consensus on the species status of the gastropods bitinii – the first intermediate hosts of the cat fluke in the Irkutsk focus of opisthorchiasis.

Goal: Study of morphological features of gastropod shells from reservoirs of the Taishet district.

Tasks:

1) To conduct a comparative analysis of the bitinia shell from two reservoirs: Lake Zarechnoye and Lake Baikal.

2) To determine the species status of molluscs.

Materials and methods of research: the mollusks were collected from two reservoirs of the Taishet district: the Zarechnoye and the Baikal in June 2019. In the lake Zarechnoye there were 186 samples collected at the depths of 10-20 cm, in the lake Baikal - 91 samples at the depths of 10-50 cm.

Shell measurement scheme and main qualitative features:

In addition to the basic measurements of shells (shell height, shell width, whorl height, mouth length, mouth width), there are also such characteristics as the shape of a shell, the shape of revolutions, the uniformity of the convexity of revolutions, the indices of a shell, the presence of a navel and its shape.

Methods of analysis:

The main statistical analysis that were used:

1) The average sizes, standard deviations from the average were calculated, the minimum and maximum values were determined;

2) The significance of the difference (Student's coefficient) ($p < 0.05$) between Excel and Statistica 6.0 for Windows was determined.

Table 1.
Comparison of morphological parameters of Lake Baikal

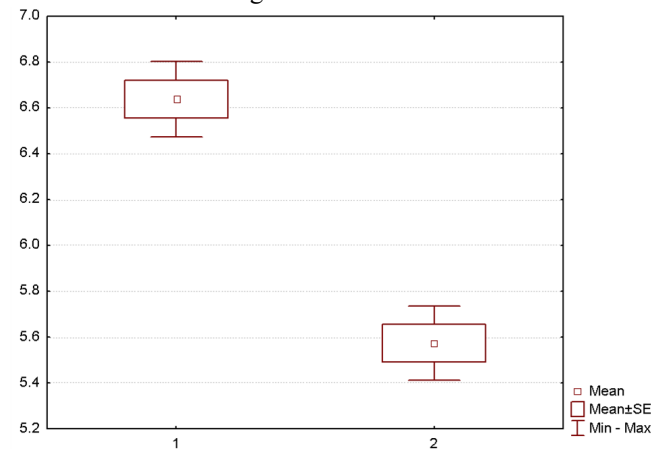
Feature	Average value ± Standard deviation (min-max) in mm
Shell height	5,57 ± 0,79 (3,5 – 7,35)
Shell width	4,64 ± 0,59 (3,05 – 5,9)
Mouth length	2,58 ± 0,53 (1,3 – 3,9)
Mouth width	3,22 ± 0,4 (2,1 – 4)
Whorl height	2, 6 ± 0,32 (1,8 – 3,2)
Number of revolution	3,79 ± 0,25 (3,5 – 4)

Lake Zarechnoye

Feature	Average value ± Standard deviation (min-max) in mm
Shell height	6,6 ± 1,14 (3,1 – 10)
Shell width	5,3 ± 0,84 (2,75 – 7,6)
Mouth length	3,28 ± 0,6 (1,5 – 5,5)
Mouth width	3,54 ± 0,53 (1,9 – 4,9)
Whorl height	2, 86 ± 0,42 (1,6 – 4)
Number of revolutions	3,92 ± 0,19 (3,5 – 4)

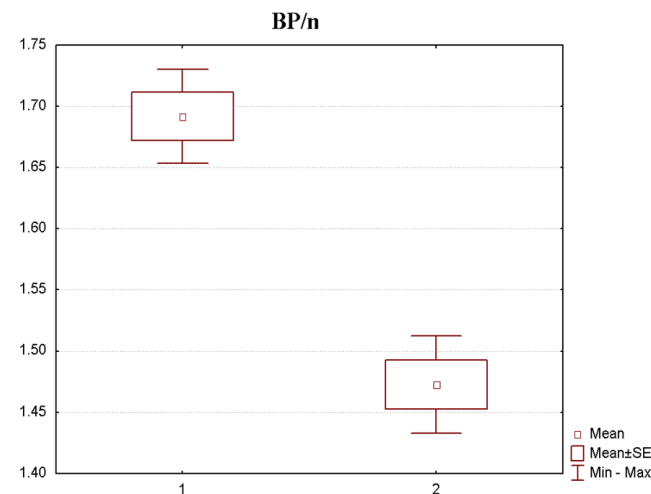
Comparison by shell characteristics

Height of the clam shell



Comparison by shell indexes

Height of the clam shell/n



Conclusions:

1) Gastropods living in lake Zarechnoye are statistically significantly larger than in lake Baikal.

2) According to the totality of signs, it was established that these mollusks belong to the species Bithynia (or Opisthorchophorus) troschelii (Paasch, 1842).

Applications:
Lake Baikal



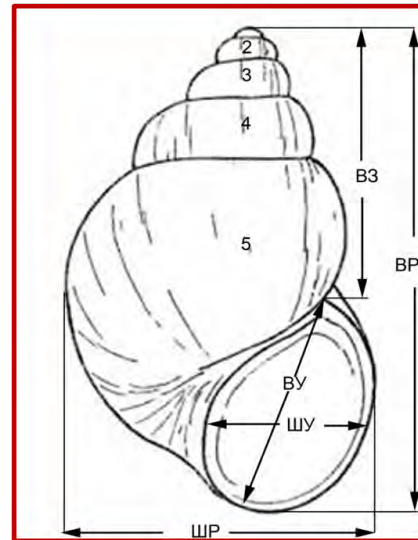
Lake Zarechnoye



Bithynia (Opisthorchophorus) troschelii



Shell measurement scheme



Section 4. Ecology

UDC 502.3

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ANALYSIS OF PRACTICAL IMPLEMENTATION OF A COMPREHENSIVE SYSTEM OF SOLID MUNICIPAL WASTE MANAGEMENT: THE CASE STUDY OF IRKUTSK

Keywords: *garbage, solid municipal waste, ecology, disposal, separate collection, recycling.*

The paper considers the issues of the impact of garbage on the environment and the measures for the introduction of a system of separate garbage collection in Irkutsk.

The economic growth and development of our country over the past decade has led to a natural increase in production and consumption. This growth is the main driving force for increasing the amount of waste because no production is completely waste-free.

Garbage is solid waste of plant, animal and mineral origin that accumulates in the household and communal services, trade and industry.

Household garbage or solid municipal waste (MSW) include paper, glass, organic residues, plastics, fabrics, metal objects, old furniture, household appliances, and so on. The removal of solid household waste, which accompanies humanity throughout its development, is a complex and time-consuming task. However, in recent decades, the problem of solid waste removal, especially in large cities, has become particularly acute and requires immediate measures to solve it. The accumulation of solid waste in a modern city reaches 250-300 kg per person per year, and the annual increase in waste per capita is 4-6%, which is 3 times higher than the rate of population growth [2]. These are huge volumes.

Every resident of Russia on average produces almost fifty kilograms of garbage every month. Everyone can calculate the volume of the garbage heap of their city by themselves. It is obvious that garbage is a big problem of modern human society. Kilometer-long and numerous landfills are filled with household waste. Wildlife also suffers: tons of garbage can be seen both in the forests and in the oceans. At the same time, the accumulated waste poses a direct threat not only to the environment, but also to human lives. How can we fight this "plague"?

Humanity has come up with several ways to solve this problem.

The first way is to take all the waste far away to landfills and bury it there. It's cheap and cheerful, but very harmful, because often toxic substances get into the sewage. Landfills gradually fill up, and someday they will be completely filled, and it is very difficult to find a new place for storing garbage.

The second way is to burn it. This method of waste management is extremely harmful to the environment. When burning garbage, various dangerous substances are released, which settle on the soil and end up in the water. And if they get into the lungs, they can cause diseases. The third way of dealing with waste is recycling. This method of waste management involves the reuse of various raw materials.

It is obvious that recycling is the safest way to deal with waste, but not everyone uses it and not always. It is quite difficult to establish such a system in order to make money from waste alone. Therefore, the government or the "third sector" is engaged in the organization of garbage processing.

Many countries are gradually moving from the burial and incineration of waste to their recycling. This trend is also observed in Russia, but the pace of this "transition" is quite slow here. In the European part of the Russian Federation, the fashion for separate garbage collection is slowly taking root, but not everyone knows about waste sorting "beyond the Urals".

In 2013, the President of Russia announced the necessity of creating a system for regulating the collection and disposal of garbage, of forming market and administrative tools that would ensure effective waste management. And the new reform of garbage collection and processing, which started in 2016 in Russia, will be completed in 2024 by achieving the main indicators defined by the passport of the national project "Ecology".

According to statistics, the Irkutsk Region is on the ninth place in the Russian Federation in terms of the amount of solid household waste (MSW) generated and on the third place in the SFD (after the Kemerovo Region and the Krasnoyarsk Territory). In terms of the volume of recycling and disposal of garbage, our region takes one of the last places. This figure is 60% in the country, but we have only 27.7% so far. The Ministry of Natural Resources and Ecology of the Irkutsk Region claims that up to 1.2 million cubic meters of municipal waste are generated annually in the Irkutsk Region. However, due to the lack of weight control in most waste disposal sites, it is still impossible to name exact data [1].

The Greenpeace organization together with the famous Google company launched Recyclemap (0+), which indicates the points of reception of recyclables. Users can add to the map and improve it themselves. According to this map, there are more than 50 separate garbage collection points in Irkutsk. Each of them accepts certain types of waste, including paper, glass, plastic, metal, clothing, batteries, light bulbs, household appliances and hazardous waste. Note that there are no places in the city where you can hand over a Tetra Pak package, but most of the waste can be sent for recycling without any problems.

It turns out that in Irkutsk we can sort the garbage ourselves and take it to the appropriate recycling collection points.

Now many residents of Irkutsk are ready to collect garbage separately. It remains only to convince all segments of the population and the authorities who will be able to create this infrastructure. It is necessary to constantly hold environmental actions for residents. And the authorities should be addressed with appropriate initiatives.

Currently, various measures have already been taken in the Irkutsk region to eliminate the amount of garbage [3]:

– In some areas of Irkutsk, plastic containers for separate garbage collection have appeared, for example, containers for collecting plastic and glass have been installed on Alexander III Square. For the present, 20 containers for collecting plastic have been manufactured.

– About 70 buried containers are installed on the territory of the city, which can be adapted for separate collection. The advantage of this type of containers is that there are no smells of rotting, no one can get in there, the garbage is not scattered by the wind or dogs, it has an aesthetic appearance, there is no need for fences, they can be placed next to playgrounds and houses.

– A factory on wheels has appeared in Irkutsk that can turn construction debris into asphalt. This crushing and screening complex is the second in the country. Rock, stones and even construction debris are converted after processing into a mixture suitable for the production of asphalt, which contributes to cheaper road construction, reducing construction time and increasing efficiency [5].

– In 2011, on the island of Olkhon they began to press polyethylene and plastic bottles with the help of a device for compressing plastic garbage “Baby”, donated by the Baikal National Park.

– For faster cleaning of the unique island of Olkhon, local craftsmen have invented a homemade device for compressing garbage from old agricultural equipment for processing wool.

– The construction of a large landfill site for solid household waste has begun near the island of Olkhon. The landfill site is being built 15 kilometers from the bay. It will occupy an area of 6 hectares. The works are designed for two years. 17.5 million rubles are allocated from the regional budget for them. The expected result of the implementation of this item of the program is a reduction in the volume of unauthorized landfills by 80%.

– In the Irkutsk region, unmanned aerial vehicles are used to find illegal landfills of solid household waste. It allows recording the exact location of landfills using a photo and video camera, which will help to quickly take measures to eliminate them.

Currently, waste paper is accepted by the Angarsk company “Sibrontek “ and “VtormaBaikal “. According to these enterprises, mostly old, retired women hand over the paper. Young people and the middle generation practically do not apply.

Therefore, it is necessary to organize environmental actions with the involvement of large groups of people in them, to stimulate the population by increasing the cost per kilogram of paper, to arrange information banners, posters on the territory of the region with information about the location of paper collection centers. After all, each ton of collected waste paper saves about three cubic meters of forest from cutting down [3].

Various environmental projects and actions for the selective collection of plastic, glass, wastepaper, batteries, mercury-containing waste are constantly carried out in Irkutsk. Some of them are implemented with the support of the city authorities, while others take place thanks to the initiative of public figures and volunteers. All these projects are united by one thing – the active participation of people. Irkutsk residents do not remain indifferent to the problem of ecology and, if possible, support such actions [4].

Thus, we can conclude that the cleanliness of the environment is the task of every person without exception. Only through joint efforts can we achieve good results and make our city and country cleaner and more beautiful. Separate garbage collection, as an obligatory part of the complex of measures to protect the environment, is the personal responsibility of each citizen of the country!

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STUDY OF PHYTOTOXICITY OF SOIL UNDER HEAVY METAL CONTAMINATION

Keywords: *heavy metals, plants.*

Object of research: phytotoxicity of soil when contaminated with heavy metals

Subject of research: natural processes characterizing the accumulation of heavy metals by plants.

Hypothesis: the presence of heavy metals in the soil inhibits the growth and development of plants, while the reaction of plants depends on the specific metal.

Purpose of the work: to determine the phytotoxicity of soils when contaminated with heavy metals by the degree of germination and development of plants.

Tasks:

1. To study the influence of the content of heavy metals on the agroecological indicators of plants.

2. To find out the peculiarities in the development of plants when grown in various soils contaminated with heavy metals.

3. To establish the possibility of using plants as phytomeliorants.

Basic methods of work: physical, chemical, agro-ecological.

Novelty: at present, the influence of different concentrations of heavy metals on the development of plants has not been sufficiently studied. The methodology for determining the ability of plants to accumulate heavy metals was tested.

Practical significance: the collected data characterize the ability of the studied plants to accumulate and bind heavy metals.

Theoretical significance: the data obtained from the research results expand the modern understanding of the processes of accumulation of heavy metals by plants.

Environmental friendliness: vegetation and soil cover are indicators of the general ecological state of the territory. Changes in various parameters of soil and vegetation affect the state of the ecosystem.

Conclusion

1. It has been established that the salts of heavy metals copper (Cu), molybdenum (Mo), iron (Fe), nickel (Ni) affect the agroecological indicators of plants, slowing down their growth and development, the most inhibitory effect is exerted by salts of molybdenum (Mo) in 8 times.

2. When growing plants in various soils contaminated with heavy metals, the germination capacity, the length of the aboveground and underground parts of plants were 1.5 times higher in the soil purchased in the store. 3. Oats and watercress can be used as phyto ameliorants, as they are resistant to heavy metal contamination of the soil.

Thus, the hypothesis put forward at the beginning of the study is correct. The presence of heavy metals in the soil contributes to the inhibition of plant growth and development, while the reaction of plants depends on the specific metal.

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PROBLEMS OF DEFORESTATION AND FOREST DEGRADATION IN IRKUTSK REGION

Keywords: *deforestation, fires, forest, ecology, forest cover, illegal logging, ecological education, sustainable forest management.*

The level of afforestation in different regions of Russia depends on physiographic, climatic and soil conditions, as well as anthropogenic factors. At the beginning of 2022, the area of land covered by forests was over 794 million hectares. Thus, Russia is in first place in the world for the availability of forests - about 20% of the world's timber reserves. The Irkutsk region is considered to be the leader among Russian regions in terms of forest cover - 82.3%.

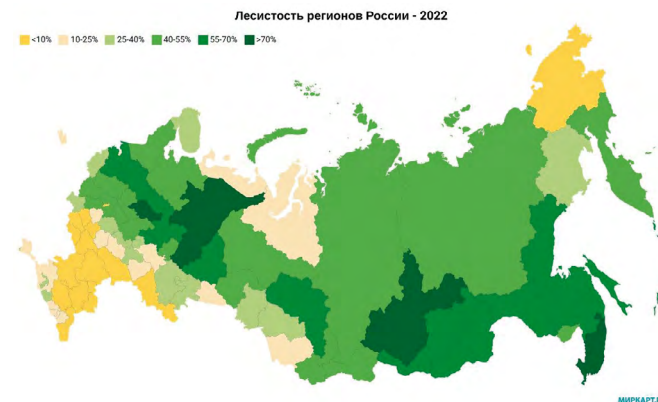


Fig. 1 Forest cover of Russian regions

Over the last 20 years, the area of forest lands in the Angara region has decreased by approximately one third. Issues of deforestation are relevant not only because of the changes in the forest region's ecosystem and biodiversity, but also because of the changes in the balance of the forest complex that has been formed over thousands of years. Another important reason is the interest of wood-processing companies in timber of a limited number of species. This imbalance in favor of a few species leads to changes in its composition of large forests. [1]

The law passed in December [2], which reduces the area of spawning forest belts along the banks of rivers, poses a great danger. As a result, more than 50 million hectares of forested land may fall under logging. Finally, the disappearance of forests threatens to worsen air quality in populated areas where businesses and boiler houses operate. According to official data from last year, air quality deteriorated sharply in several industrial centers of the Angara Region.

According to the analysis of satellite images the forest areas have been catastrophically reduced in the Irkutsk region over the last seventeen years. There are two main reasons for the forest decline - fires and felling. Forest fires have been raging in Irkutsk Region since July. According to the Human Rights Council under the RF President, last year the region lost 666 thousand hectares of forest due to logging, fires, pests and diseases. On average, the forests of the Irkutsk region are shrinking at a rate of 502 thousand hectares per year. By comparison, the area of Irkutsk is 28 thousand hectares. Human rights activists consider the scale of logging in the Irkutsk region to be "catastrophically depleting" [1].

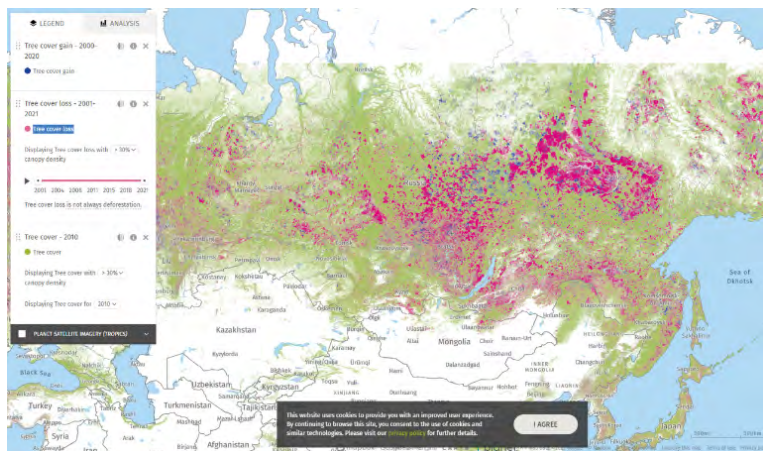


Fig. 2 Map of forest losses in the Irkutsk Region

The volume of illegal logging in Russia on forest lands in 2020 was 1.1 million m³. This is 0.5% of the legal logging, which amounted to 217 million m³ last year [4].

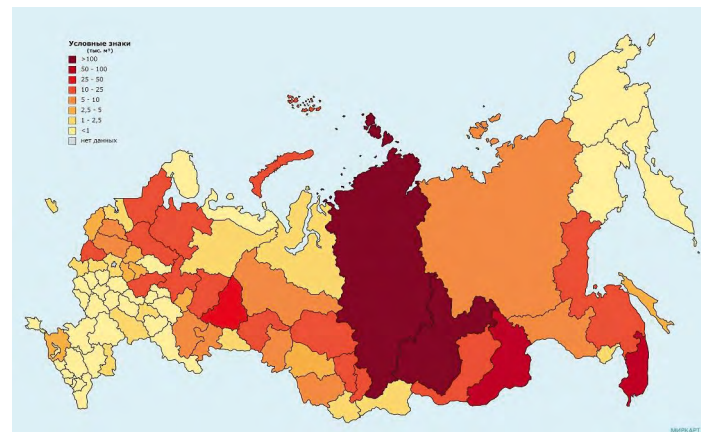


Fig. 3 Statistics of illegal logging in Russia

One way to combat deforestation is to use modern technology: satellite and radio communications, and quadcopters to monitor and protect forest lands better. This will also help in responding quickly to fire-hazardous situations in the forest. As for the processing of waste from woodworking factories, it is necessary to organize timber factories that would combine sawmills, woodworking capacities, and chemical companies engaged in the processing of residues. They should be located on one site and must include full processing of all timber arriving for production [5].

We also propose to use the technology of sustainable forest management [6]. Continuous and non-depleting forest use in exploitable forests is defined as the ability to use forest resources with constant high efficiency over a predetermined period of time or indefinitely. The proposed approach to estimating the allowable cut for exploitable forests is based on a simulation model of the dynamics of the entire age structure of forest stands, from the initial age classes to older ones. The allowable volume of timber withdrawal is calculated, which allows using it for operational forests with different initial age structure and intensity of forest use.

According to scientists at the V.B. Sochava Institute of Geography, Siberian Branch of the Russian Academy of Sciences, there is no ecological catastrophe now. The threat of forest degradation is insignificant, because after fires and cuttings the forest is actively restored. Fire prevention in the fire-hazardous season, introduction of fines for being in the forests - this practice has been applied in the Republic of Buryatia for about 5 years. The problem of loss of biodiversity is also insignificant. The environment in small-leaved forests is friendlier to animals than in dark coniferous forests, but the threat of loss of native species is still presented.

At present, there are many actions in favor of the ecology of the Irkutsk region, but the problem of human mismanagement, especially in the fire-

dangerous season, is still there. It can be fought with eco-education and a system of restrictions. It follows that the problem of deforestation and degradation of forests in the region is insignificant, but still requires attention.

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PROBLEMS OF BAIKALSK PULP AND PAPER MILL PRODUCTION WASTE MANAGEMENT

Keywords: *Baikalsk Pulp and Paper Mill, waste, reclamation, environmental risks, protection of Lake Baikal, freezing of colloidal sediments.*

The problem of BPPM waste management in the Irkutsk Region has a long history. Specialists note a number of problems related to insufficiency of places for waste disposal, lack of modern recycling technologies, low awareness of the population about the rules of waste sorting and disposal. As a result, the level of environmental risks increases.

The problem with the wastes of BPPM (chlorine-free white cardboard paper) arose because the pulp production used an inefficient method of purification, which led to the release of large amounts of sludge-lignin [2].

Sludge-lignin is an organic compound produced during the treatment of wastewater from pulp production. It contains chloride compounds. It is a typical waste of pulp production and contains such hazardous substances for health as sulfur oxides, formaldehyde, pesticides, xylool, benzene and many others. When released into the environment, sludge lignin can cause soil, water, and air pollution and even become a source of genetic mutations [5].

According to Alexander Suturin, senior researcher of the Irkutsk Limnological Institute of the Siberian Branch of the Russian Academy of Sciences, candidate of geological-mineralogical sciences [3], the permissible concentration of waste in Baikal: 1 mg of lignin / liter of water. The scientist believes that if the existing waste accumulators break through, the concentration of lignin (suspended substances) will sharply exceed the permissible concentration. This will cause the following effects:

- organics, sulfates, chlorides, hydrogen sulfide, methylmercaptan will end up in the lake;
- the water will freeze, oxygen will bind, all fish and wildlife will die;
- the whole part of South Baikal will become uninhabitable for living organisms.

The BPPM site generated about 650 thousand tons of sludge-lignin annually, of which only 15-20% was recycled. Most of the waste was stored at landfills, often without appropriate permits for waste management. In addition, many landfills are located near populated areas, increasing public health risks.

The content of substances in the BPPM sludge reservoirs depends on the technological processes used at the mill and may vary depending on the way paper and pulp are produced. Its treatment and utilization requires accurate determination of the composition and properties of the sludge in order to reduce its possible negative impact on the environment.

One of the main ways to eliminate waste is the possibility of recultivation of storages, conversion of hazard class 4 waste into harmless soil. In the future, the soil can be used to backfill landfills, landfills, quarries, as well as to restore forests and areas affected by fires. Waste remediation can also include vegetation growth within the boundaries of sludge ponds and bioremediation. All reclamation programs are expensive and require significant effort and time to implement.

A technology that is currently being studied by scientists is the technology of freezing colloidal sediments of sludge-lignin. The essence of the technology is that colloidal particles of sludge-lignin are subject to freezing at a temperature below 0 degrees Celsius, after which they are separated from the liquid phase as a result of ice formation. The resulting ice is separated from the liquid phase and after defrosting, a virtually pure product is obtained. In the course of the tests it

was determined that the technology of freezing makes it possible to achieve a high degree of purification of sludge-lignin (up to 95 %). In addition, this technology has low energy consumption and does not require the use of chemical reagents.

Purified lignin sludge can be used for various “peaceful” purposes:

- 1) Biofuel production
- 2) Fertilizer production
- 3) Chemicals production
- 4) Bioabsorbent production

The issue of BPPM waste management is discussed at the level of the Irkutsk Region, but the existing programs to solve the problem cannot completely solve this problem. It is necessary to provide additional funding for this area. Also the issue of BPPM waste handling is discussed at the federal level, but so far no specific solutions have been found.

Experts emphasize that the solution of the problem of BPPM’s waste recycling requires an integrated approach. It is necessary to provide modern technologies of processing and to set up a control mechanism on the part of authorities. However, it is important to remember that solving the problem of BPPM’s waste recycling takes time, financial and organizational resources. For an effective solution of the problem it is necessary to support both on the level of Irkutsk region and on the federal level, to find those forces, who will be able to solve the task of environmental risks minimization in a complex way.

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Section 5. Journalistic Essays on Ecology

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FOCUS ON GLOBAL WARMING

Keywords: *global warming, atmosphere, rising temperatures, greenhouse effect, carbon dioxide.*

Global warming has to do with the increasing temperatures of the atmosphere and oceans over a period of time.

In the past 100 years, the global average temperature has experienced four alternating fluctuations from cold to warm. Generally speaking, the temperature is a long-term upward trend. Since the 1980s, the global earthly temperature has risen significantly.

Why is the climate of the Earth warming? The global atmosphere and the earth’s surface is like a huge “greenhouse”, which keeps the earth’s surface at a certain temperature, creating an environment suitable for humans and other organisms. In this system, the atmosphere does not only prohibit the solar radiation from reaching the ground, but also prevents the loss of ground radiation. This process is called the greenhouse effect, and the gases that cause the greenhouse effect are called greenhouse effects. As greenhouse gases, they allow the free passage of solar short-wave radiation, while at the same time attracting long-wave radiation from the earth’s surface. These gases include carbon dioxide, methane, chlorofluorocarbons, ozone, nitrogen oxides and water vapor, among which carbon dioxide is the most important agent. In the past hundred years, the global climate temperature has been gradually increasing, and at the same time, the concentration of greenhouse gases in the atmosphere has been also rising. Many scientists believe that the aggravation of the greenhouse effect caused by the massive emission of greenhouse gases is the root cause of global warming. The large amount of greenhouse gas emissions is directly related to the increasingly developed modern industry. Therefore, it has become the consensus of all countries in the world to advocate energy conservation and environmental protection along with developing new eco-friendly industries.

Not only the industrial enterprises will emit a large amount of greenhouse gases, but with the improvement of people’s living standards, each of us will also cause a certain amount of greenhouse gas emissions in our daily lives through electricity, water, and paper consumption. In other words, each of us is responsible for global warming, that is why we must live, work, and study scientifically and let our every word and deed be green.

The result of global warming is catastrophic: glaciers melt, sea level rises causing loss of coastal tidal flat wetlands, mangroves and coral reefs, coastal erosion, seawater intrusion into coastal groundwater layers, and salinization of coastal land. As a result, the natural ecological environment of coasts, estuaries, and bays is unbalanced, which has caused extreme disasters to the ecological environment of the coastal zone. Moreover, it will also increase the water area as well as the degree and severity of the impact of the storm, and shorten the life of the reservoir dams. Rising temperatures may also cause melting of ice in the Antarctic Peninsula and the Arctic Ocean, and polar bears and walrus might gradually become extinct. Eventually, the earth on which humans depend for survival will become an uninhabitable planet.

However, to solve this problem, we must rely on ourselves. Although there is no accurate plan to curb global warming, I believe that as long as mankind establishes a scientific concept of environmental protection and protects the environment for all, it will delay the natural catastrophe, and in the near future, mankind will succeed in finding a scientific method to decrease the earth's temperature.

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PROBLEMS OF WASTE MANAGEMENT AT OAO USOLIEKHIMPROM AND AO SAYANSKKHIMPLAST

Keywords: *Usoliekhimprom, Sayanskkhimplast, mercury pollution, ecotechnopark, recycling, remediation.*

Usolie chemical plant (Usoliekhimprom) is a chemical plant located in the town of Usolie-Sibirskoye and was built in 1936. The plant has been built on the banks of the Angara River on 610 hectares and is known as a chemical giant. The chemical plant produced various chemical products such as hydrogen peroxide, synthetic rubber, nitrogen and others. However, after the plant closure in 2017 (due to bankruptcy), serious problems arose with the management of accumulated waste, and some 16,000 people were left jobless.

The main environmental problem was the 255 tons of chemical hazardous substances left on the plant's premises after its closure. The main part of the remaining chemicals was mercury. Local residents started stealing and opening the tanks with hazardous substances, which could lead to the environmental disaster.

To solve the problem, the original plan was to recycle the waste from the plant. Mercury was sent to Novosibirsk for recycling, tanks with silicon tetrachloride were sent to Tomsk, and tanks with epichlorohydrin were sent to Krasnoyarsk. However, cases of theft continued. In 2018, an emergency was declared at the plant site. The entire hazardous substance processing operation was financed to the tune of 1.7 billion rubles.

The situation reached its culmination in 2020, when a dam break occurred in the town of Usolye-Sibirskoye. Water that had risen from the sewage treatment plant and the hazardous chemicals left on the site of the chemical plant were carried by the current into the Angara River (1.5 km from the plant). Coastal residents involved in fisheries received mercury poisoning due to the consumption of fish. That incident showed the government that waste treatment could not be delayed any longer.

Work has been started on remediation of hazardous substances at Usoliekhimprom. The mercury electrolysis shop was dismantled, an impervious curtain was built to stop the spread of contaminated soil. Finally, the mercury-contaminated soil was removed and disposed of according to all the rules.

On the area of the former Usoliekhimprom plant, the first stone of the Vostok Eco-Technopark was ceremonially laid by order of Rosatom Greenway. Its creation is planned in parallel with the reclamation and recycling of chemicals accumulated at the industrial site of Usoliekhimprom.

The Vostok Ecotechnopark project received a positive conclusion from the state ecological expertise. The main activities of the eco-techno-park will be production of marketable products, provision of services to third party organizations and recycling of main wastes of Usoliekhimprom. In the future, land reclamation, demolition of structures, and the emergence of production aimed at the reclamation and recycling of industrial waste from the entire Irkutsk Region are planned on the territory of the plant.

Thanks to the use of a federal-level solution to environmental problems - the involvement of a federal environmental operator represented by Rosatom State Corporation - the situation at Usoliekhimprom has greatly improved, and most of the waste has been sent for disposal. In 2022, the emergency regime was lifted.

The unfavorable environmental situation at Usoliekhimprom, which was nicknamed "Siberian Chernobyl" in the media, arose for a number of reasons. The main one was due to disruption of technological processes, as the management of mercury wastes was not an important task, which led to dispersion of hazardous substances and their accumulation in the environment. Usoliekhimprom dates back to Soviet times, when environmental legislation was not as strict as it is today. Economics came first.

The situation with the accumulation of environmentally hazardous waste is very different at another chemical giant, Sayanskkhimplast. It is a chemical industry enterprise, one of the backbone enterprises in Russia. The

technological process of JSC “Sayanskhimplast” at the initial stage was similar to Usoliekhimprom. In 1979 the mercury electrolysis shop was started up, which meant the accumulation of mercury waste. The decision was revolutionary when in 2006 the Sayan chemists converted the mercury electrolysis to the membrane method. The conversion completely eliminated mercury from the process, reducing emissions to the environment. The conversion turned the company into a full-fledged technical upgrade. The number of mercury cell electrolyzers was reduced from 96 to 9.

The re-equipping of the chemical industry did not end there. The country’s only hydrogen-fired boiler plant, commissioned in 2004, helps to reduce greenhouse gas emissions. It generates steam by burning hydrogen, which is released during electrolysis. From 2021 the plant has started a project to convert the membrane electrolysis to the latest generation of zero-gap technology. Asahi Kasei Corporation’s unique Japanese zero-gap technology for chlorine and caustic production is a state-of-the-art technology that maximises product output and reduces specific energy consumption by up to 30% compared to the classic membrane technology.

Thus, in the example of the two major chemical companies, we can see the difference in approaches to the organization of production in terms of concern for the environment. The continuation of JSC Sayanskkhimplast has contributed to an increased focus on ecology and the search for new technologies. As a consequence, the company remains competitive and economically sustainable as its products meet all modern requirements.

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PROTECT THE EARTH AND CHERISH WATER

Keywords: *water, recycling, irrigation, pollution, fresh water.*

Protecting our homeland is a strength for each of us. The earth has lost its ecological balance and many places have been destroyed. The earth before, the sky was blue, the grass was green, and the sea was clear. Animals live happily here. How happy and fulfilling this is! But we destroyed it, polluted everywhere, and caused many animals to lose their homes and become extinct.

Water is an indispensable thing in our lives. Nowadays many countries are seriously short of water, such as Brazil, Russia, Canada, China, the United States, Indonesia, India, Colombia, Congo, and others. According to statistics, a person needs to drink about 51,000 liters of water in his lifetime. What a huge amount! The freshwater resources on the earth only account for about 2% of the total water volume on the earth, and the total amount of freshwater that can be used by humans only accounts for three hundred thousandths of the total water volume on the earth, accounting for 0.34% of the total fresh water storage. At present, more than half of the world’s land area, in more than 100 countries and regions, is short of water, and 2 billion people have difficulty drinking water. Humans are consuming water resources with fresh water demand that doubles every 15 years. So far, human freshwater consumption has accounted for 54% of the world’s available freshwater. According to a survey by the World Health Organization, 70% of people in the world cannot drink safe and sanitary drinking water. Now, 15 million children under the age of 5 die every year, and most of the deaths are related to drinking water. According to United Nations statistics, every day 250,000 people in the world get sick due to bad drinking water or die due to lack of water. The number of deaths is terrifying! Water pollution not only threatens human beings, but also brings huge losses to fisheries: it severely kills fish and shrimp, and also interferes with fish reproduction. As a result, the yield and quality of fishery are greatly reduced. Sewage also pollutes farmland and crops, reducing agricultural production. Water pollution also causes the decline of other environments, affecting people’s travel, entertainment and recuperation.

Water is not only the source of life. It is extremely important to mankind. Therefore, we should prevent and protect water resources, and make good use of water. The government has also launched some measures to protect water sources. For example, through the construction of large, medium and small water conservancy projects, south-to-north water transfer and regional regulation, water conservancy engineering measures such as air conditioning control during reservoir storage seasons, and cross-regional and temporal-spatial science of water

resources Deployment and efficient utilization; northern coastal cities vigorously develop seawater utilization and actively use seawater to replace freshwater resources; promote water-saving farming techniques, such as drip irrigation, sprinkler irrigation, and plant drought-tolerant crops to reduce irrigation; industrial wastewater treatment, recycling use the “second water resources”; vigorously promote water-saving measures and publicity efforts, formulate reasonable water prices to improve residents’ awareness of water-saving, and establish a water-saving society.

We also need to protect resources. We can wash vegetables with rice water and then clean with water, which not only saves water, but also effectively removes residual pesticides on vegetables. Wash mopping with washing water, mopping the floor, flushing the toilet could also help. After flushing the toilet, try not to open a large water pipe to flush, but make full use of the used “dirty water”. In summer, sprinkling water on the indoor and outdoor floors to cool down, try not to use clean water, but use the laundry water after washing instead. When cleaning bicycles and household cars, instead of flushing with water, use a damp cloth. If it is too dirty, it is also advisable to rinse with the remaining water after laundry.

We must save the water and protect our homes!

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GLOBAL WARMING SURVEY REPORT

Keywords: *global warming, atmosphere, rising temperatures, greenhouse gases, concentration of carbon dioxide.*

After investigation, we found that the main reason for the increase in greenhouse gases is human activities. Take carbon dioxide as an example. At the beginning of the 19th century before the industrialization of human society, the concentration of carbon dioxide in the atmosphere was 270 ppm, but in 1988 it rose up to 350 ppm. There are two main reasons for the increase in the concentration of carbon dioxide in the atmosphere. Firstly, the rapid growth of population and extensive industrialization, the drastic rise in the consumption of fossil fuels by human society, the combustion of large amounts of carbon dioxide in the atmosphere, and the increase in the concentration of carbon dioxide in the atmosphere. Secondly, the destruction of forests. It decreases the amount of carbon dioxide absorbed and utilized by plants, which reduces the rate at which carbon dioxide is consumed, and also enhances the concentration of carbon dioxide in the atmosphere. Greenhouse gases other than carbon dioxide, such as methane, chlorofluorocarbons (Freon), and nitrogen oxides, have also augmented to varying degrees.

Although there are many uncertainties, it is obvious that the impact of global warming on climatic zones, precipitation, and sea level, as well as the resulting

impact on human settlements and ecosystems, is extremely complex and must be addressed with due attention. It is irresponsible to think that this impact is irrelevant in the long run.

The main causes of global warming are the destruction of the atmosphere, serious pollution, and the possible impact of global warming from the greenhouse effect. Global warming will bring complex potential impacts to the earth and humans, both positive and negative. For example, with global temperature rising, the subpolar regions may be more suitable for human habitation: under appropriate conditions, higher carbon dioxide concentrations can promote photosynthesis, so that plants have a higher rate of carbon sequestration, leading to increased plant growth. That is, the increasing effect of carbon dioxide is a positive effect of global warming. But compared with the positive impact, the negative impact of global warming on human activities will be greater and far-reaching. In August this year, CCTV reported that the summit of Mount Everest had dropped by 1.3 meters due to climate warming.

According to expert analysis, in addition to natural climate factors, the retreat of glaciers and the rise of snow lines are also mainly related to population expansion, overloading and overgrazing, excessive reclamation, deforestation, and indiscriminate extraction of groundwater.

Global warming will also endanger our own lives, but because global warming is not easy to detect, it is difficult for human beings to realize that they will face a moment of crisis. One thing is certain: in the long run, this problem is gradually becoming severe. Therefore, we should have a deep understanding of this problem for the sake of future generations, but not just deal with official business and formulate measures to curb global warming.

For the healthy life of all mankind, we call on society to take action and jointly resist the greenhouse effect!

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THINK GREEN – LIVE BETTER

Keywords: *environment, abnormal climate, environmental pollution, protecting the environment, nature.*

Humans are part of the natural environment, and nature ensures the existence of mankind. The relations between humans and nature are like those between fish and water who cannot be separated even for a while. But what about environmental protection on a global scale now? Due to the rapid population growth and anthropogenic pressure, a series of problems such as abnormal climate, land desertification, and species extinction have arisen. At the same time, human beings vigorously develop industrial production to survive, causing serious environmental

pollution, which in turn affects population quality and human health. Therefore, the environment is very important to mankind. Everyone must cherish the environment and protect it from the adverse consequences of human activity.

Then, what can we personally do to protect the environment?

First, we must raise public awareness of this issue, observe social ethics and have a positive morality. Environmental protection is a kind of social morality, by which we mean a code of conduct that the entire human race should have when different social systems coexist. Today, when the condition of the global environment is deteriorating, it is the responsibility of everyone on the earth to care for nature. Accordingly, respectful attitude should become the basis of a new human ethics. Some people destroy the environment for their own personal gain and do not possess this kind of public morality. At the same time, maintaining the environment is an integral part of socialist civilizational approach. Respectful attitude towards nature is not only one of the important goals that modern civilization must achieve, but also the content of the spirit of a civilized person. Without a certain material base and a certain amount of investment, protecting the environment is empty talk. However, if people are uncivilized, no investments, no matter how good the equipment is, will be able to protect the environment. If every conscious civilized person possesses understanding and virtues, loves trees, meadows and wild animals, and fights against the manifestations of reckless behavior that destroys nature, we can form a stable habit in future generations.

The concept "Protecting the environment starts with me" means always keeping the environment in mind. In current rapid economic development, environmental pollution and ecological destruction are happening almost all the time, in all walks of life, and all over the country. If each of us consistently cares about the environment, we can consciously protect nature and develop the habit of caring for the environment.

A responsible environment is to do our best to protect the environment anytime, anywhere. Responsible attitude to the environment implies not only work aimed at protecting nature, but also adhering to a certain way of life. For example, in our daily life, we must reduce the use of disposable plastic bags, chopsticks and lunch boxes, replace paper towels with handkerchiefs, not throw away used batteries, and save every drop of water. Don't trample on the grass, pick flowers and trees for your own convenience or pleasure, don't throw away rubbish casually, don't hunt on wild animals, don't wear fur following fashion. If everyone pays attention to protecting the environment, starting with themselves, the environment will improve significantly. Several advanced capitalist countries of the world experienced environmental hazards in the 1950s and 1960s. After 20 or 30 years of hard work, the environment has improved significantly, and people have developed a habit of caring for the environment. As a representative of the Chinese nation with traditional virtues, I understand that the people of our socialist society can treat nature responsibly and do it better than the inhabitants of capitalist countries.

In order to consciously protect the environment, I must have a sense of responsibility and use natural resources carefully. I don't have to put up with environmental irresponsibility. Only when each of us can truly "protect the environment, starting with me," will we be able to curb current environmental degradation and substantially change our environment. This is true for a single person, and it is true for the whole country. Protecting the environment means protecting the Earth and therefore protecting ourselves.

To protect Earth, the cradle of humanity, let's start with ourselves!

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PROSPECTS FOR DEVELOPMENT OF RECYCLING SYSTEM OF PRODUCTION AND CONSUMPTION WASTE IN THE IRKUTSK REGION

Keywords: *waste recycling, waste sorting, cluster development, recycling center, cluster development.*

According to the Ministry of Natural Resources and Environment, about 5.4 billion tonnes of all types of waste are generated in our country each year and about 375 million tonnes require special conditions for industrial processing. As a rule, the concentration of useful substances contained in waste exceeds that of similar substances in natural resources. The trend towards treating waste not as something negative, but as a useful raw material, a resource, is therefore gaining ground. However a serious problem impedes the maximum use of this raw material - in Russia there is no centralized infrastructure of gathering and recycling of secondary resources. In this regard, a system of separate waste collection and recycling is being developed.

Separate waste collection (SWC) is a system where waste is segregated by type so that it can be recycled and made into something new, rather than simply thrown away. Recycling aims to reuse it by recovering useful resources, raw materials and energy.

Challenges solved by separate collection and recycling

- Reduced consumption of natural resources due to the use of recyclable materials;
- Reducing the amount of waste deposited in landfills and unauthorised dumps
- Improved environmental situation;
- Reduced recycling costs.

According to the regional operator RT-NEO Irkutsk, in 99% of cases recycling containers contain mixed waste. For example, a cardboard container may contain food residues, broken glass, etc. Due to the high percentage of contamination, the SWC is considered spoiled and unsuitable for recycling and will in any case be taken to landfill. Clean secondary resources are sent to a logistics centre where they are baled, packed and sent for recycling.

Due to the lack of environmental culture and the consequent accumulation of waste, it is predominantly landfill waste. Landfill waste takes a long time to decompose and produces toxins that poison the environment and humans. At the same time, unauthorised landfills arise.

Despite the fact that the number of container sites for separate collection is constantly increasing, practice shows that society is not yet ready for flawless implementation of sorting rules.

For the Irkutsk region, the following promising directions for the development of the separate waste collection and recycling system are highlighted.

1. Construction of a waste sorting plant (Figure 1)

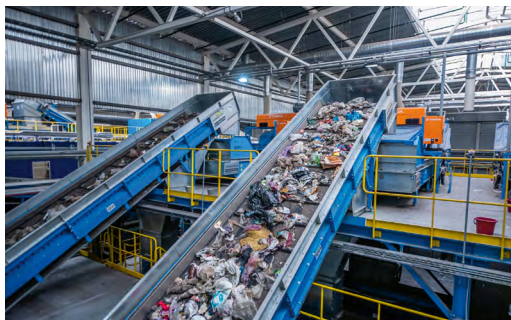


Fig.1 Recycling plant from inside

A comprehensive solid municipal waste management facility will appear in the region in 2025. The facility, to be built near the city of Angarsk, will have a capacity of 405,000 tonnes per year for municipal waste treatment and 142,000 tonnes per year for recycling.

2. The emergence of recycling centers



Fig. 2 Example of a recycling center

A recycling center is a place for the centralized reception, processing and temporary storage of secondary material resources (SMR) generated during waste sorting. A network of recycling centers will be established in the southern part of the region by 2030. The first recycling centers are planned to be built on the territory of BPPM (Baikalsk) and in Irkutsk in 2023. The launch of the recycling center will enable the centralized collection of sorted waste - from construction waste and tyres to some types of industrial waste. From here, recyclables will be sent for recycling to large recycling plants (in the regions neighbouring the Irkutsk region, primarily the Krasnoyarsk region).

Cluster development of MSW management infrastructure.

Cluster development implies creation of large waste management centers combining:

- processing (sorting) of solid municipal waste;
- recycling plant for organic waste;
- landfill with preliminary pressing of “tails” (pressing of the remaining waste after sorting into special briquettes).
- Six clusters are expected to appear in the region in the near future:
- Cluster “Central” - Angarsk urban district;
- Ust-Orda cluster - Ust-Ordinsky settlement;
- Slyudyanka cluster - Bystraya village;
- Mikhailovka cluster - Mikhailovka settlement, Cheremkhovsky District;
- Sayansk cluster - Zima District;
- Kazachinsk-Lensky cluster - Kazachinsk village. Kazachinskoye.

The implementation of the above projects will significantly change the key indicators in the area of waste management.

Table 1.
Table with current and planned indicators

Indicators	Current indicators	Planned indicators
Average transport shoulder (km)	71	75
Processing volumes (tonnes)	-	762 994
Volumes of organic waste recovered for biocomposting (tonnes)	-	261 784
Volumes of recoverable secondary raw materials (PET, waste paper, glass) (tonnes)	-	119 753
Waste disposal volumes at the landfill (tonnes)	762 994	381 457

Waste reform is moving towards its goal and already the entire volume of waste in the south of the Irkutsk region is under full digital control, and industry development at this rate will lead the region to 100% waste segregation and a reduction in landfill disposal of at least 50% by 2030.

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CHERISH WATER

Keywords: *water, pollution, nature, water recycling, ecology.*

When I saw the sea for the first time when I was a child, the vastness of the sea amazed me, and I thought: water is endless, inexhaustible, and inexhaustible.

Indeed, in people's impression, water is everywhere, serving people's production and life. It is the blood of industry, the lifeblood of agriculture, and the most indispensable little helper in life. In short, water is the precious wealth that we rely on for survival, and according to surveys, the earth we live in has another alias called "water polo". As the name suggests, 70.8% of our earth is full of water. But with so much water, sea water accounts for 97%, surface water on land accounts for 0.017%, and half of it is in inland seas and salt lakes. The fundamental source of freshwater is rain and dew. The water that falls on land every 49 years is only 105,000 cubic meters. Of this, 2/3 is transpired by plants or evaporated by the ground, and only 1/3, or 37,500 cubic meters of water can be used by humans.

Is so little water enough for us? The answer is negative.

Water is the source of life. People can not eat for 10 days, but not drink water for 3 days. Nowadays, 2 billion people in the world are suffering from severe water shortage! In other words, water is the source of the lives of 2 billion people. And every year around 50 million children die from dirty drinking water. What a shocking figure! Therefore, conserving water and protecting water resources is now the top priority.

That being the case, why do people always turn a blind eye to the tap water flowing from the tap, and they don't want to take a step forward to turn off the tap? Why when some people throw rubbish into rivers, seas and lakes, they can't think of the pollution to the water? Why do people not feel sorry when industrial sewage flows into rivers, seas and lakes, when the original clear water turns into sewage?

In fact, human beings are committing suicide slowly. They do not hesitate to pollute and waste water resources, which is so precious! If we don't cherish water resources now, water in the future will be as precious as oil.

Therefore, we must do a good job in water recycling. Using natural desalinators to desalinate seawater is environmentally friendly and saves money. People should invent more water-saving products such as the "electrolyzed water molecular washing machine". The "electrolyzed water molecular washing machine" uses the principle of electrolyzed water molecules to allow the oxygen atoms in the water molecules to absorb the stolen goods in the clothes, and the electrolyzed hydrogen atoms can be used as environmental protection. The fuel of a car does not damage clothing fibers, but also provides power to the car. It also contributes to the environmental protection cause. Why not do it?

Although there are many water-saving products, the most important thing is to rely on people themselves - not to waste or pollute water resources, so as to better protect water resources.

It's high time for humans to wake up! If we do not start using water carefully, the last drop of water on the earth in the future will be our own tears.

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CHERISH THE EARTH

Keywords: *the earth, Yellow River, environmental pollution, environmental protection, nature, ecology.*

The earth is our homeland and the mother of mankind. We rely on it and explore it. How beautiful this azure planet is! And we must realize that the Earth is unique.

Regrettably, many people turn a blind eye to this easy-to-understand truth, and continue to do whatever they want, ignoring the safety of the earth's homeland. Environmental scientist Qu Geping once said: "Only change can save the destiny of mankind, and only change can make our children and grandchildren survive for generations to come." The "change" in it refers to environmental protection. That is why now there are many people holding slogans and shouting empty slogans on the street, but they do nothing. Will the pollution get better in this way? Of course not!

Everyone knows that trees can absorb carbon dioxide, emit oxygen, and purify the air, which are necessary conditions for human existence. Excessive deforestation of trees in pursuit of benefits has severely damaged the vegetation of the earth, and the resulting desertification of oasis, floods, mudslides, and sandstorms have threatened the survival of our human beings. As for the disposable chopsticks we usually use, tens of acres of forest are consumed every day. In the eyes of those people, trees seem to have no value except for furniture and building materials.

With the ever-increasing global population, our living space continues to shrink. If this continues, we may even lose our land. In addition, our mother river, the Yellow River, has continuously increased its bed and sand content in recent years, making it one planet of the most polluted rivers in the country. We can't just watch the Yellow River dry up from our hands. Therefore, many environmental scholars have studied the pollution control plan of the Yellow River in an attempt to improve the water quality of the Yellow River. But without our joint participation, our cradle of life -the Yellow River - will go to exhaustion and death.

If we unscrupulously destroy the environment, nature will punish us. Those huge floods have claimed the lives of many people. Due to the greenhouse effect, the melting of glaciers in the Antarctic and Arctic has caused water levels to rise, and seawater has flooded coastal areas, causing heavy economic losses.

Let us be kind to humans and nature! I wonder if you have read the article "100 Things You Can Do to Protect the Environment". In fact, there are many things we can do. For example, plant a pot of flowers and plant a tree on Arbor Day; protect wild animals to balance the ecology; cherish water resources and don't dump rubbish into rivers; be a guardian of environmental protection and use every green anniversary to promote environmental protection awareness. All these are the things within our power. Why are we not willing to practice them?

Now that the earth's ecological environment has worsened, the environmental protection alarm bell has sounded. Let us all join the ranks of protecting the environment and create a beautiful future in which man and nature live in harmony and continue to multiply!

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PROTECT OUR PLANET

Keywords: planet, population growth, nature, global environmental problems, environmental protection spirit.

The beauty of a country can be seen from many aspects. One of them is environmental sanitation. Only a good environment can make this country the most beautiful, and only a good environment can make the first impression left on others unique.

The environment and mankind coexist. Since the birth of mankind, all the food, clothing, production, and life depend on the planet we live on, its atmosphere, forests, oceans, rivers, soil, grasslands, wild animals and plants. Forming an intricate and closely related natural ecosystem, this is the basic environment on which mankind depends for survival. For a long time, in the process of civilization, mankind has been stuck on conquering and plundering nature. Protection and

return, while achieving glorious achievements in civilization, the plundering of nature by humans has scarred the planet we live on. The population growth and the increase in production activities have also impacted and brought pressure on the environment.

It is well known that human beings are based on the natural environment as the material basis for survival and continuity. However, with the development of modern industry, the natural environment has suffered more and more serious damage. Air pollution, water pollution, land pollution... and there is no pure land in the world. You might think that the important thing is to develop science and technology. It is not too late to go to environmental protection after science and technology is developed. Or you will regret it when the time comes. If we are now overly intoxicated with the victory against nature, thinking that we have achieved something remarkable, then we are not far from destruction.

Climate warming, a hole in the ozone layer, acid rain, toxic waste, extinction of wildlife, and air and water pollution are a series of global environmental problems we are currently facing. What should we do to face these problems? It is everyone's responsibility to protect the environment, but we are only students now, and it is impossible to make a significant contribution to the environment of all mankind. However, we can start from the environment around us and from the protection of the school environment, such as: complying with relevant regulations. Regulations on prohibiting littering of all kinds of waste, throw waste into designated places or containers, avoid using disposable beverage cups, lunch boxes, plastic bags, and replace them with cartons, which can greatly reduce garbage and reduce garbage disposal work pressure. We are able to take care of flowers and trees, keep the campus clean, and many other things like this.

By starting to conserve resources and reduce pollution, and by making adjustments to our lifestyles, we can contribute to protecting the planet.

History and reality tell us: a country that does not protect the environment and participate in protecting the environment is hard to thrive; a society without protecting the environment and participating in protecting the environment is hard to maintain long-term stability; a country that does not protect the environment and participate in protecting the environment is hard to be self-sufficient to sustain the nation; similarly, a campus that does not protect the environment and participate in protecting the environment is hard to sustainably grow.

Let us work together to save resources, protect the environment, and be the masters of protecting the earth.



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CHERISH MOTHER EARTH

Keywords: *pollution, environment, average temperature, climate, ecology.*

The earth is our home for survival. It is like a mother, providing us with the resources and conditions for survival. We are the masters of the earth, and we have to protect it as well as we treat ourselves.

Who doesn't want to make their homeland better and more beautiful? However, with the development of science and technology, there are more and more various kinds of domestic garbage, most of which can cause environmental pollution. For example, commonly used batteries will cause great environmental pollution if they are not properly disposed of after being used up. According to research, a spent button battery can make 600,000 liters of water undrinkable. If everyone discards a waste battery, then water might become a luxury item.

Therefore, in order to protect the environment, please separate your garbage so that it can be easily recycled.

My country implemented the "Plastic Limit Order" on June 1, 2008. This practice has enabled my country to save 37 million barrels of oil each year. Plastic bags. This kind of thing is commonplace for ordinary families, but did you know that plastic bags are a big factor that pollutes the environment? Plastic bags use petroleum as raw material, which not only consumes a lot of resources, but also takes 500 years to be naturally decomposed.

Therefore, in order to protect the environment, please reduce the use of plastic bags.

The recent Global Climate Change Conference held in Copenhagen has once again sounded the alarm. The meeting said that the global average temperature is gradually rising, and most of the icebergs have begun to melt. If this continues, the world will be flooded. The current global average temperature has risen by 1.1°C compared to the previous one. If the global average temperature rises by 4°C, the temperature in the North and South Pole will rise by 16°C. By then, the North and South Pole will also be able to see big trees. What will the world be like by then? Just think about it.

In fact, the major culprit of these disasters are humans. According to research, the electrical appliances or other things we use every day emit a large amount of carbon dioxide, which is a prime factor in increasing the temperature. If you reduce the use of electrical appliances, carbon dioxide emissions will also decrease. Car exhaust also contains a lot of carbon dioxide. Parents should be reminded at any time that they should take the subway or bus when going to work or traveling, and drive as few private cars as possible, which can reduce a lot of carbon dioxide emissions.

Therefore, in order to protect the environment, please reduce the use of electrical appliances and drive fewer private cars to work or travel.

As masters of society, we have a shared responsibility and duty to improve the global environment. When everyone in the world is environmentally friendly, a completely new and beautiful world can be created!

Yang Yuixuan
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RAISE AWARENESS OF ENVIRONMENTAL PROTECTION

Keywords: *environmental awareness, nature, pollution, ecology.*

What have we done to the environment? This is a question worthy of everyone's thinking. The process of mankind's progress towards civilization is one in which mankind takes care of the environment and the environment benefits people. Protecting the environment is not just about the government taking a few measures. News organizations have widely promoted it. What is more important is that every citizen must acquire a sense of protecting the environment and act upon it, wherein the whole people must be involved in the environmental protection. Only in this way can the environment repay us. As an environmentalist said: "We love the earth as we love ourselves, and the earth will give us everything she has.

Human beings live in the environment, and every human move will affect the environment. Currently, people's environmental awareness is extremely important. How to dispose of waste electrical appliances, how to solve "white pollution", and how to treat the surrounding plants and trees? Ultimately, these are questions of environmental protection awareness; this awareness has been strengthened, and some thorny issues are no longer a problem. Therefore, enhancing the awareness of environmental protection is the foundation of environmental protection.

In the face of the devastated natural environment, the measures we have taken finally focus on enhancing people's environmental awareness. The strength of environmental awareness reflects one's civic qualities and is a measure of the level of civilization in a country. After all, we cannot require that everyone be an environmental protection expert, but more people can have more environmental knowledge. The spreading of environmental protection knowledge must start from the little things. One has to only remedy the situation slowly, but it cannot be done overnight.

First of all, the media is an effective carrier for environmental protection propaganda. It covers a wide area and can cover all classes and age groups. It is good to use television, radio, newspapers, and the Internet to form an interaction of these four. For example, we can create more environmental protection websites, promote environmental protection knowledge, and set up environmental protection

forums. In addition, one can make some environmental protection documentaries, public service advertisements. Unnoticed by people, their environmental awareness will inevitably increase.

Second, we have to do a good job in education. The situation in China today is good, with a great deal of attention paid to education. The education that a child receives from an early age will play a decisive role in shaping his or her view of the world and life. Let children understand the importance of environmental protection and the seriousness of the situation from an early age, which will certainly play a good role in promoting environmental protection. We can incorporate environmental knowledge into teaching materials, and organize more environmental lectures on university campuses. In this way, starting from the young students, environmental protection will be sustained, and it will continue endlessly.

Third, the government should intensify propaganda efforts, combine awareness from top to bottom, install billboards, billboards and distribute leaflets so that environmental knowledge and environmental awareness penetrate the countryside and communities that include workers, farmers, intellectuals and other social strata. Everyone is aware of the importance of environmental protection. Of course, we must introduce various specific rules and regulations as well as legislation; vigorously punishing the “enemy of the people” who harms the environment. Laws and regulations must be more specific, with detailed and clear provisions for industrial pollution, agricultural pollution, and pollution of daily necessities, so that environmental protection is on the legal agenda.

At present, the economic development of our country is still difficult; the cultural qualities of people, including environmental awareness, are not high enough, so the road to environmental protection in our country is long and difficult. However, as our government has always stressed, in order to achieve coordinated development of the environment, resources and people, we must never sacrifice the environment for the sake of temporary economic development. This requires that our country’s economic development follow a high quality and highly efficient path, rather than expanding blindly. Education in our country is growing rapidly, and the overall quality of society is constantly improving. Therefore, although our environmental challenges are extremely serious, with strong government support and the general progress of society, we are full of confidence for the future!



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CHERISH THE EARTH AND PROTECT OUR HOMELAND

Keywords: *nature, greenhouse effect, environment, carbon dioxide.*

The development of industry has brought drastic economic progress into human life, so that people no longer chew over the bitterness of the past.

Perhaps, however, beautiful things should leave some melancholy to make people think about the fact that this is our land, our nature, which has been badly damaged and devastated.

It is not difficult to notice that thick smoke is billowing from the towering chimneys, obscuring the entire sky, and the loud sound of machines working and sewage pouring out is heard instead of the beautiful melody of nature. Flowers and plants have lost their freshness, the water in the river is no longer clear, the fragrance of flowers is diluted by smoke, birdsong is drowned out by noise, the healthy body has become sick, and the joyful mood has become irritable!

The increase in exhaust gas has led to widespread acid rain. Not to mention the decay of species, the greenhouse effect caused by the increase in carbon dioxide alone will inevitably increase the global average annual temperature by 2-3°C. Therefore, scientists make sad predictions: an increase in the Earth’s temperature will cause an increase in seawater and melting icebergs, which will lead to a rise in sea level, and this will endanger 1/3 of the Earth’s population living within 60 kilometers of the coastline. Many cities and ports will disappear, and an increase in chlorofluorocarbon gas will destroy the Earth’s protective umbrella, the ozone layer, which absorbs ultraviolet rays.

Moreover, the pollution and depletion of fresh water supplies, frequent wars and natural disasters, and rapid population growth are undoubtedly fatal for the earth. These are all failures of man’s own civilization. It is an unintentional slap in the face to humanity in building its own civilization. It is a huge grave that wise men have dug for themselves. We are designing our own funerals!

As part of the natural world, humans are responsible for the planet, so we need to make protecting the environment and striving for world peace a hotspot of human support. Join together to protect our homes and nature. Then I will look to the future with confidence. The majestic factory buildings are covered in gorgeous colors, the chimneys emit light smoke, the vegetation is still beautiful, and the sounds of the birds are still clear!

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COMPREHENSIVE STUDY OF ECOLOGICAL STATE OF SOIL COVER ACCORDING TO PROFILE OF TERRITORY EXPERIENCING ANTHROPOGENIC LOAD

Keywords: *soil cover, biological activity, soil.*

V.I. Vernadsky considered the soil “the main substrate of life,” “the main element of the biosphere.” Soil cover as one of the key components of the biosphere undergoes transformation as a result of increasing human impact on the environment, which leads to changes in various soil indicators, depriving it of the ability to perform key environmental functions [1]. The biological activity of the soil, the qualitative and quantitative composition of the soil microbiota immediately respond to any anthropogenic effects. Therefore, land cover indicators can be considered as reliable and informative indicators reflecting the state of the environment.

Purpose: to conduct a comprehensive study of the ecological state of the soil cover according to the profile of the territory experiencing anthropogenic load.

Tasks:

1. Study physical and agrochemical indicators characterizing the ecological state of the soil;
2. Assess spatial change of soil biological activity within different areas of urban environment by methods of enzymatic activity study.

Soil samples from 7 points located in the area of Akademgorodok in Irkutsk were taken for research. These are the territories located in the housing estate (points 1 and 7), on the Angara River (point 3 and point 2 - Warm Lakes), in the forest (points 4, 5, 6). All points are located in areas to varying degrees subject to anthropogenic load [2]. The Orlov-Grindel spectrophotometric method was used to determine the humus content. According to the results of the studies, the largest humus content was recorded at point 1, located in the Akademgorodok housing estate, confined to spruce vegetation. The smallest content of humus is at point 3, which is located on the banks of the river. Angara is composed of river alluvium.

Soil biological activity (BAP) of the study areas was evaluated through cellulolytic, protease and urease activity. As a result of the experiment, it was shown that samples 2 (10-15 cm), 4 (5-10 cm), 7 (5-10 cm) had the highest percentage of destruction. The high activity of cellulase here is explained by the

richness of the soils of these territories with nitrogen (points 4 and 7), mobile forms of potassium (points 2 and 7) and phosphorus (points 2 and 7) - this was established during experiments

Soil protease activity was determined by photo paper. The method is based on microbiological splitting of gelatin available in the emulsion layer of photo paper. According to the results of the study, the darkest color was recorded in samples 7 (5-10 cm), 5 (10-15 cm), 2 (10-15 cm) and in the control sample, which is associated with the highest protease activity of the soil. A larger percentage of the decomposition of photo paper was recorded mainly (except for point 1) at a depth of 10-15 cm, which is explained by the large presence of organic matter in the upper horizon of soils.

To determine the urease activity of the soil, the express method of T.V. Aristovskaya, M.V. Chugunova was used [3]. It was found that the most intense color (blue) was recorded at point 7, which indicates a high biological activity of the soil at this point. For soil taken from this territory, the reaction of ammonia release proceeded much faster (2 hours) compared to other areas under study. Also, a high BAP is noted at point 1, but the color change rate of the indicator is much lower here.

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THE ANATOMICAL FEATURES OF GENUS PINUS FOR IDENTIFICATION DURING EXPORT ABROAD

Keywords: *genus Pinus, Pinus sibirica, Pinus sylvestris.*

Relevance: The forest resources of the Russian Federation account for a fifth of the total world timber reserves, a significant share of which is concentrated in the Siberian and Far Eastern federal districts, accounting for 40 and 24.9% of

the total Russian timber reserves, respectively. The Irkutsk Region exports round timber, about 600 thousand cubic meters per year, and sawn timber of various tree species. Often, under the guise of Scots pine ballasts, Siberian pine is exported. Necessary to control the process of exporting timber not only by assortment, but composition of wood species.

Hypothesis: possibilities to apply simple techniques for anatomical studies to representatives of the genus *Pinus* for species identification?

Goal: Find out the features of the anatomical structure of exported pine tree species (*Pinus sylvestris* L., *P. sibirica* Du Tour).

Tasks:

1. To study the features of export wood flows within the Irkutsk region.
2. Determine the anatomical features of wood structure *Pinus sylvestris* L., *Pinus sibirica* Du Tour.
3. To develop a manual for diagnostics of species-specific characteristics of exported wood for genus *Pinus*.

Research object: genus *Pinus* - *Pinus sylvestris* L., *P. sibirica* Du Tour

Subject of research: anatomical features of the studied species.

Determination of anatomical differences between *Pinus sylvestris* L. (Scots pine) and *Pinus sibirica* Du Tour (Siberian pine, cedar).

1. We made a radial cut of pine and cedar with a thickness of 1 mm in order to reveal the differences in their microstructure by the method of light microscopy.
2. Coloring of wood with an aqueous solution of methylene blue (exposure 1 minute).
3. Using a Levenhuk C-series digital video camera, the image was captured and recorded and saved on a computer.

Conclusions

For the first time, we have established that *Pinus sibirica* Du Tour and *Pinus sylvestris* L. are anatomically distinguishable. The Siberian pine tracheid has a zigzag shape, with a slight bend, in contrast to the Scots pine, in which the tracheids are usually straight. In Scots pine, when tracheids are superimposed on the heart-shaped ray, the connection between them is sharply overlapped. In Siberian pine, on the contrary, the ends of the tracheids are crenate and smoothly connected to each other. The research data can be used as methodological recommendations in the customs business.

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Section 6. Scientific Historiography

UDC 929

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VLADIMIR FIALKOV IS A MAN OF LEGEND

Keywords: *biography, carrier, science, geography.*

In the research project on the topic “Vladimir Fialkov is a man of legend” the biography of Vladimir Fialkov was studied starting from an early age. The published materials from the scientist’s life were analyzed and previously unknown facts were collected.

Vladimir Abramovich Fialkov is a researcher of Lake Baikal, Candidate of Geographical Sciences, general director of the Baikal Museum of the ISC SB RAS (Irkutsk scientific center, the Siberian Branch of the Russian Academy of Sciences). Vladimir Abramovich has been studying Lake Baikal for 50 years and he is the chairman of the Irkutsk branch of the All-Russian Society for the Protection of Nature. Moreover, he is a member of the Scientific Council on Lake Baikal problems under the Governor of the Irkutsk Region and the member of the public council of the West Baikal interdistrict prosecutor’s Office. Also, he is a member of the delegation of the Ministry of Natural Resources and Ecology of the Irkutsk Region.

The general aim is to study the biography of Vladimir Fialkov.

Anticipation: It is assumed that information about the biography of Vladimir Fialkov is known fragmentary. It is necessary to get a complete picture of the life of this person, about his family, about the events of that time that influenced its development. To confirm our anticipation published materials were previously studied from the biography of the scientist. The meeting was organized with Vladimir Abramovich, and he was interviewed by our students.

Vladimir Abramovich Fialkov was born in Omsk. In 1948 Fialkov’s family moved to Kharkov because Vladimir’s mother could not endure severe Siberian winters. In Kharkov, his life ran its course. It is not known how the life of Vladimir Abramovich would have developed if he had not signed up for extracurricular activities of «the Naval Affairs» in the sixth grade. The first hobby was the creation of sloop models. But everything changed in 1956. An athletics class was named «Easy Divers». A passion that will rock Vladimir’s world, a passion that will turn into a favorite job. In 1957, the first dive took place in the pool using

oxygen devices. Vladimir Abramovich notes when he visited that athletics class, he received good knowledge of physiology. The scientist says: «Water is a hostile force of nature and it is very important to know how the body will react in this environment. It’s important to keep calm».

After the eighth grade, Vladimir Abramovich worked at a boiler and mechanical plant as a milling fitter. There he made his first pulmonary device for diving. After finishing the 10th grade, he entered the Mining Institute at the Mining Engineering department. In 1961 Vladimir did not graduate from the Mining Institute. He chose the Leningrad Hydrometeorological Institute. He had never regretted it. In 1962, he decided with friends to go to the Caspian Sea for experimental dives. The importance of this trip is that he became acquainted with Mikhail Mikhailovich Kozhov. And in 1963, he invited Fialkov to his accommodation on Lake Baikal to work as a diver in the summer. At this time he lived in the village Bolshie Koty. There Mikhail Kozhov had a cottage. There was also a base at the university’s biological center. Thanks to Mikhail Kozhov, Vladimir Fialkov entered the Irkutsk State University in the department of hydrology of land.

For almost 50 years he has been studying the streams of the coastal zone of Lake Baikal. The famous scientist explored every piece of place on the coast of our lake. He achieved a personal record diving to a depth of 84 meters. He studied the impact of the pulp-and-paper mill on the ecology of the lake. He went about underwater drilling during the construction of the Trans-Siberian Railway. He was one of those who proposed the possibility of using the Pisces deep-sea vehicles to study Lake Baikal. In 1977, he took part in the first dive of this vehicle to the bottom of Lake Baikal. The first dive was to a depth of 200-400 meters. Vladimir Fialkov spent more than 4000 hours under water and wrote 140 papers including 8 monographs.

Scientists devote a lot of time to the Baikal Museum of the ISC SB RAS. In 1993, he became general director of the Baikal Museum of the ISB RAS. Under his leadership the museum’s activities expanded significantly and the section “Environmental Education” was created in the Baikal integrated program. The International collaboration was opened.

As a result of the conducted research, several previously unknown biographical facts of the scientist’s life were collected. Our anticipation has been borne out. In general, 2021 is the second anniversary for Cand. Sc. Geography and scientific general director of the Baikal Museum of the ISC SB RAS Vladimir Abramovich Fialkov. Firstly, it is 30 years since the dive of a person in the deep-sea vehicle «Pisces» to the maximum depth of Baikal. Secondly, it is the 80th anniversary of the famous Irkutsk scientist and founder of the famous Baikal Museum becoming the visiting card of the Irkutsk region.

It may be stated that Vladimir Abramovich Fialkov is a legend for our generation.



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