

Designing Environmental Education Activities at Kumis Glade Protected Natural Area

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Abstract: This publication is dedicated to developing the comprehensive environmental education program for the territory of the Kumis Glade Nature Park, using existing experience on conducting educational activities within protected natural areas. Studying and developing protected areas are important issues, since these territories are designed to preserve the biological diversity and cultural heritage of the regions, giving them a substantial recreational resource and tourist potential. The result of our study is a comprehensive environmental education program for school and university students, based on field studies by the program attendees along previously developed and designed educational nature trails. The developed original program is characterized in detail in this paper. The development of environmental education projects for youth could solve the problems of environmental education, environmental ethics and environmental culture of the regional population, along with organizing active and cognitive leisure and environmental protection in the area.

Keywords: protected natural area, environmental education for youth, extracurricular educational activities, field trip, educational nature trail, assessment of water quality.

Introduction

Currently, there exists a relevant issue of enhancing the environmental awareness of the population in order to improve the environmental situation at the city and regional scale, as well as at the national level. In 2012, by the Decree of the President of the Russian Federation, 'The Fundamentals of National Policy in the Field of Environmental Development of Russia for the Period up to 2030' was approved, in which the formation of environmental culture of the population was among the main tasks of environmental development [1]. The most significant component of the proposed strategy to form environmental culture in Russian society is environmental education of the population of all ages and educational levels, which implies the dissemination of environmental knowledge, and information about environmental safety, healthy lifestyles, the state of the environment, as well as about the use of natural resources [2].

The basic principle of environmental education involves 'education about the environment, through the environment and for the environment', which could be implemented by combining formal training

and informal extracurricular educational and recreational activities [3]. At institutions in charge of the management and/or protection of natural environment, it is necessary to create a system of environmental education, which should include not only the mass media and environmental courses taught at educational institutions, but also to ensure the acquaintance of every person with natural ecosystems and their biological entities [4]. One of the ways to resolve this issue could be the creation and development of educational ecological trails within natural areas, especially in those, having formal protected status due to high biodiversity and unique geomorphological features [5]. In this regard, it is especially important to develop the comprehensive environmental education program within the territory of a nature park of the Saratov region for younger age group of our population, in which the combination of conducting field studies, listening to lectures, and undergoing through recreational activities on the routes designed directly in the natural environment, would contribute to the formation of the environmental awareness in regional population, as well as to the implementation of innovative projects at the Federal level [6].

The most significant protected natural area in the vicinity of the city of Saratov, which is of great recreational importance for the local population and which supports high regional biodiversity, is the Kumis Glade Nature Park [7]. Previously, we published the results of our project on the development of four educational nature trails within its territory [8–10].

The main goal of our research project was to develop a comprehensive program of actions, events and procedures, aimed at environmental protection on the basis of the Kumis Glade Nature Park, and to involve active categories of the residents, primarily city youth, in environmental protection and research activities, encompassing environmental monitoring based on modern technologies, along with the development of ecological culture and environmental awareness of the of the regional population.

With this goal in mind, we aimed at pursuing and completing the following tasks:

- To analyze the importance of environmental education activities with various categories of the

residents in the region (school students, university students, adults) in order to create and maintain their ecological culture;

- To develop a series of environmental research projects for school students, spending their summer vacations at the recreation camps on the territory of the Kumis Glade Nature Park, along with university students at their educational field practice in ecological disciplines, in order to form and strengthen their competent attitude towards the environment;

- To acquaint the project participants with natural peculiarities of the Kumis Glade Nature Park, anthropogenic impact on its ecosystems, and its natural features, landmarks and highlights;

- To familiarize young scientists with up-to-date methods of field environmental research and protection of natural areas;

- To consider educational nature trails as a component of environmental education activities;

- To develop a list of socially beneficial volunteering activities to improve the ecosystems of the Kumis Glade Nature Park for the general population visiting the natural area for recreational purposes;

- To present the results of research projects that should contribute to the preservation of forest ecosystems and rational nature management within this protected natural area.

Materials and Methods

Our research project involves experimental studies in natural environment, based on teamwork – *i.e.*, the collaborative effort of a group to achieve a common goal by completing a task in the most effective way. Target audience is represented by the project participants among university students (from the biological and environmental science field of studies), along with middle school and high school students.

Project implementation timeline covers summer vacations of college and school students. Our original educational program, described below, is designed for three-month duration and is essentially a start-up activity. However, with the successful implementation of environmental

educational events, it is possible to develop and implement long-term projects designed to contribute to environmental education of the youth in the region on the ongoing basis. Project implementation plan presumes three stages of the environmental education activities with school and university students.

The first stage is *preparatory*: it is carried out during first two summer months. Over 7–8 weeks, the activities are carried out to set up specialized routes on educational nature trails within the protected natural area, which would serve as the main venues for practical training the project attendees. Within the specified period, it is necessary to construct the pathways for designed trails, to install small architectural forms and information stands. Parallel with this work, the activities are underway to prepare lecture materials and materials for classes in a discussion form. The topics of field workshops and individual research projects, and a form for reporting on the results of those projects are being developed, and the methodology for the project implementation is being chosen.

During the *main* (second) stage of the program implementation, young researchers will be invited to carry out their field research activities, related to the nature of the Kumis Glade Nature Park, over 10–12 days. A short course will be organized for the project participants, with the primary purpose of introducing the basics of environmental science to school students and fostering environmental culture among the youth.

Participants in the educational course will be asked to split into two teams with 8–10 students in each one. In such project implementation setup, it would be easier for students to perceive information; each student will be given time and the opportunity to express an opinion on topical issues of ecology and biology during the discussions; and teamwork-based practical training would facilitate the task of each participant and allow obtaining accurate research results, which will be verified by the participants themselves.

The third (*concluding*) stage will involve presentations of the project results by the participants, along with some summer field school feedback activities, further discussed in more detail.

Results

Kumis Glade Nature Park

Kumis Glade is a nature park (44 sq km) within the Greater Saratov city limits, established in 2008 and protecting unique forested areas amidst the steppe ecoregion (Figure). The soils under the Kumis Glade ridge retain significant reserves of groundwater emerging at the surface by numerous springs, discharging their water down the bottom of forest hollows, forming the streams and ponds [11].

The nature park contains predominantly deciduous forests, typical for European Russia, comprising of English oak (*Quercus robur* L.), Norway maple (*Acer platanoides* L.), small-leaved linden (*Tilia cordata* Mill.), silver birch (*Betula pendula* Roth.), and aspen (*Populus tremula* L.); with the understory of warty euonymus (*Euonymus verrucosus* Scop.) [11].

The fauna of the Kumis Glade is rich and diverse, including, for instance, about 175 species of birds. The most breeding species are Chaffinch (*Fringilla coelebs* L.), Collared Flycatcher (*Ficedula albicollis* Temminck), Great Tit (*Parus major* L.) and Blue Tit (*Cyanistes caeruleus* L.), followed by less abundant Song Thrush (*Turdus philomelos* Brehm), Eurasian Blackbird (*Turdus merula* L.), Thrush Nightingale (*Luscinia luscinia* L.), Yellowhammer (*Emberiza citrinella* L.), Tree Pipit (*Anthus trivialis* L.), and Blackcap (*Sylvia atricapilla* L.) (A. L. Podolsky, *unpublished data*). A large number of diverse plant and animal communities, water resources, interesting for the study and implementation of educational programs, can be spotted within the territory of the nature park [11, 12].

Due to growing anthropogenic impact, the Kumis Glade Nature Park is subject to environmental hazards, resulting in increasing number of lost undisturbed forest patches. This unique natural area should be provided a proper protection from construction operations (except those with a social or recreational value), littering, clear-cutting, and any kind of external interference. Protecting the ecosystems of the nature park would preserve the stability of the most important component of the natural environment in the region [13].

All of the above imply substantial educational and recreational potential of the area: the

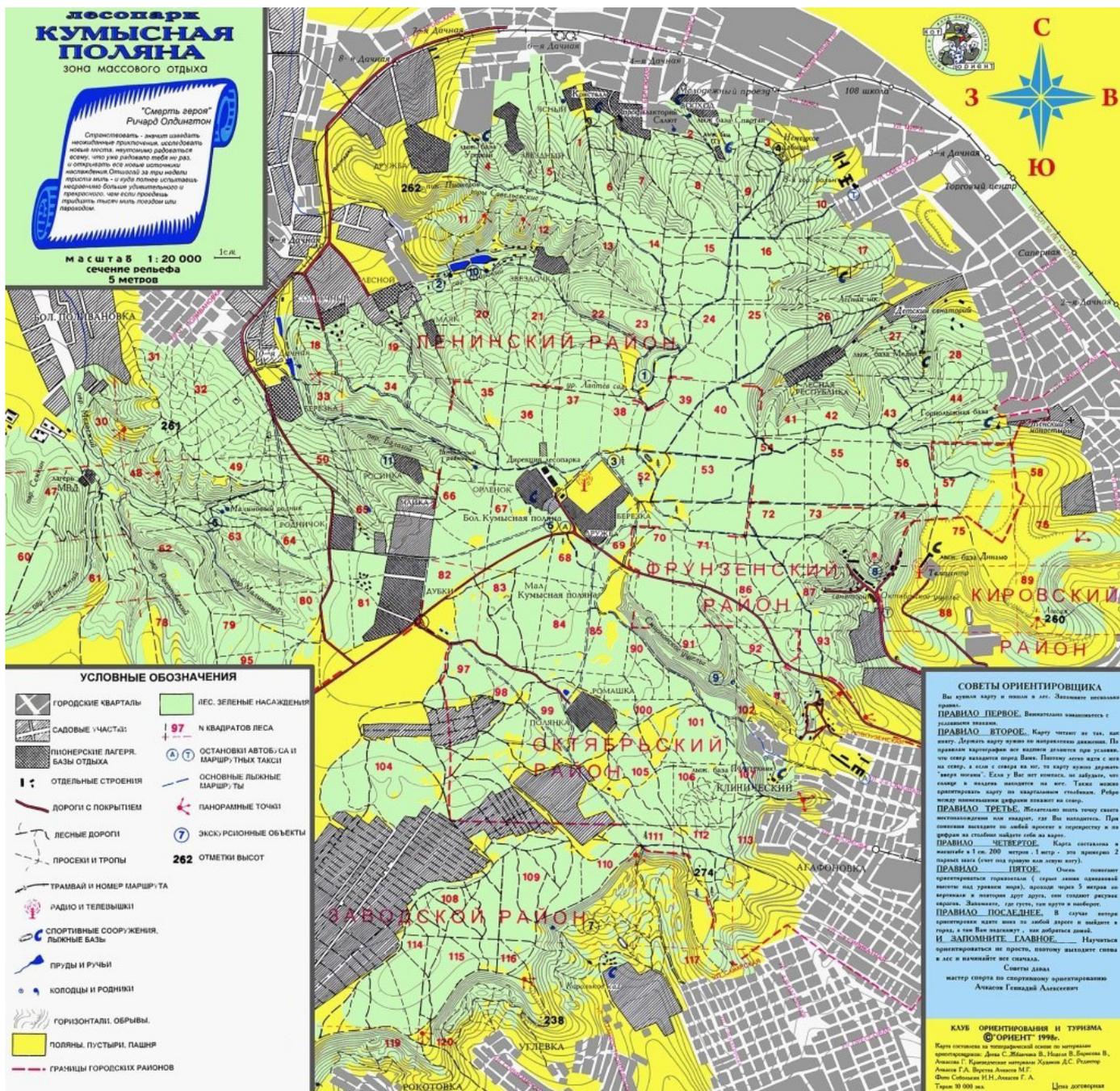


Figure. The map of the Kumis Glade natural area as of 1998

important issues of studying the area biodiversity, possible water and soil contamination, and evaluating anthropogenic impact on the nature park ecosystems could constitute the topics of individual research projects for school and university students. The projects could be implemented on four previously designed educational nature trails within the Kumis Glade Nature Park [13, 14].

Environmental education program for school and university students

On Day 1 of the field educational course, an organizational meeting for both groups of students is held, during which participants are offered to familiarize themselves with the full program of educational and recreational activities, as well as to participate in team building. Since the team members would need

to regularly interact for sufficiently long time, such event would allow young people to get to know their teammates in a relaxed atmosphere. Besides, an entertainment event will set the course participants in a positive mood and promote their zest for future work. This meeting is organized on the territory of the Kumis Glade Nature Park.

In the recreational areas of the nature park, there is the opportunity to rent a bicycle, or take a walk in the woods, or rent a shelter/gazebo, where students could enjoy the surrounding nature. The central areas of the nature park are suitable for educational recreation. By participating in the proposed activities, young people will be able to acquaint themselves in person with the nature of the Kumis Glade.

On *Day 2* of the environmental education program, an introductory lecture is held in the field within the Kumis Glade for course participants. University and school students are invited to the talk about the flora and fauna of the nature park, its soils, geological features, elevations and water resources of the area. Students are guided on the natural grounds (an introductory field trip), and information materials for self-study are provided to them. The main objective of this event is to familiarize young people with the natural environment.

Day 3 of the program also includes listening to a lecture, but this time students are offered a more complex – but no less relevant – topic: *Preserving Natural Resources of the Kumis Glade Nature Park*. The event takes place at a nature park. At the end of the training session, young people are invited to complete their homework: prepare for a debate of the biodiversity conservation issues within the Kumis Glade natural protected area.

The debate on the topic *Let us Protect the Nature Park* is held on *Day 4* of the field environmental educational program at the same location. During the debate, university and school students are able to express their opinions on the most pressing issues of the current ecosystem state of the Kumis Glade Nature Park, to get acquainted with the proposals of opponents and specialists. The goal of the debate is to consider novel points of view, foster an ecological culture and form an environmental approach in education. This day completes the theoretical module of the field environmental education course. At the end of the class, the

participants are sent to a field workshop, having previously discussed the rules of conduct on the grounds, along with the goals and objectives of their field research.

Days 5 and 6 are allocated to practical workshop in natural environs. To complete the assignment, the course participants are divided into two teams that walk the route along two educational nature trails (each group walks just one route, determined in an arbitrary way). Educational nature trails can be completed by participants in one or two days (at the discretion of the team members). The working title of the field workshop is *Analysis of the Water Resources of the Kumis Glade*. Because of large number of water sources in the territory of the nature park and their convenient locations, it is important to use the water resource for field research.

The goal of the practical workshop of both teams is to take samples from springs and other water bodies along the route for subsequent analysis of water in laboratory conditions. School and university students have to determine the qualitative and quantitative content of in the samples and assess the quality of water resources. Despite the fact that such studies are regularly conducted on the territory of the nature park, young people are encouraged to carry out their own practical study in order to add missing data on unexplored resources, and to compare the results of previous formal studies with those collected by students themselves. Such comparison would reveal inaccurate data, or validate previously conducted studies, whichever is the case.

The tasks of the practical workshop include:

- Walking the nature trail from the start to the finish point and familiarization with information stands along the route;
- Performing activities on the quality assessment of water resources;
- Presentation of research results.

The object of the students' research includes the water resources found along the route of a nature trail. The study subject involves water quality the objects under study. The use of educational nature trails during a field workshop is an original approach for

TABLE 1.
Assessment of Odor Intensity

Odor intensity	The nature of odor manifestation	Odor intensity score, points
None	The odor is not sensed	0
Very weak	The odor is not sensed by a consumer, but is detected during laboratory research	1
Weak	The smell is noticed by a consumer if his/her attention is prompted	2
Moderate	The odor is easily noticed, leading to disapproval of water by a consumer	3
Distinct	The smell attracts attention and makes consumer refrain from drinking	4
Very strong	The odor is so strong that it makes water unusable	5

conducting environmental education classes in the territory of a nature park. In this regard, we could talk about the novelty of the developed environmental education project.

At the time of completing the educational nature trails No. 1 and 2, young people deliver the collected water samples to the laboratory. The students will have to conduct laboratory tests at the next stage of completing their research projects.

Water quality is among the most important indicators of environmental quality that affects human health. With the help of physical, chemical and biological studies, it is possible to assess the water quality and indicate the trends of its change. Such studies could provide useful insights into the adverse impacts on water bodies and onto how to restore water health. Program participants are invited to conduct a number of simple experiments, described below.

Experiment 1. Organoleptic methods for determining the odor of the water sample

Organoleptic methods determine the nature and intensity of smell. Testing is conducted as follows:

1. The nature of the odor of water samples is determined by the perceived smell (earthy, chlorine, petroleum products, etc.);
2. Determination of odor at 20 °C. In a flask with a ground stopper and capacity of 250–350 ml, we pour 100 ml of the water sample at a temperature of 20 °C. The flask is closed with a stopper, the contents of the flask are stirred several times with rotary movements, after which the flask is opened, and the nature and intensity of the odor are determined;

3. Determination of odor at 60 °C. Again, 100 ml of water sample are poured into the flask. The neck of the flask is closed with a watch glass and heated in a water bath to 50–60 °C. By moving the glass to the side, we can quickly determine the nature and intensity of the odor;

4. The intensity of the odor of water sample is determined at 20 and 60 °C and is evaluated on a five-point scale, according to the requirements specified in the Table 1.

Experiment 2. Determining water sample pH

Testing is conducted as follows:

1. The test water is poured into two test tubes and a strip of red litmus paper is immersed in one of them, while a strip of blue litmus paper in the other. After 5–10 minutes, the paper strips are removed from the test tubes and compared with equivalent strips moistened with distilled water. The results are interpreted as follows: red strip turning blue means an alkaline reaction, blue strip turning red stands for acidic reaction, color does not change signifies a neutral reaction;
2. Reaction with liquid litmus: 5 ml of water and 1 drop of litmus are poured into a test tube, if the color is red, then the medium is acidic; if blue, it is alkaline; if purple, the reaction is neutral.

Experiment 3. Methods for identifying nitrate content

The volume of water samples for determining the content of nitrates should not be less than 200 ml. A sample is taken on the day of the testing, or else it should be preserved by adding 2–4 ml of chloroform or 1 ml of concentrated sulfuric acid per 1 liter of the test water.

Testing is conducted as follows:

1. Test water in the amount of 1 ml is poured into a porcelain cup, then 2 ml of concentrated sulfuric acid are added, followed by cooling and subsequent addition of a crystal of diphenylamine. If there are salts of nitric acid in the water, then a light blue color appears, quickly turning into a deep blue;

2. The nitrate content is identified from the Table 2.

Days 7 and 8. The final stage of the environmental education program begins with a visit to the training laboratory. During two days, teams conduct laboratory experiments and compile their texts with research results.

Over the next two days (*Days 9 and 10*), the teams prepare the project reports. In them, students need to provide a brief account of going through the program and to announce the results of their practical work. Students can give their assessment of the project and recommendations for future programs.

On the following days (*Days 11 and 12*), students will be asked to close up the environmental education program. On the territory of the nature park, young people will be able to receive the memorabilia and certificates of completing the environmental educational program, and to spend the final day of their study in the nature. At the end of the program, young people will be asked to walk educational nature trails again, but this time students will follow new routes with the main objectives of recreation and educational tourism.

Discussion

The anticipated results of the environmental education program can be summarized as follows:

- Development of students' sustainable interest in nature;
- Formation of ecological culture among young people;
- The emergence of novel ideas and environmental projects worthy of development and implementation.

The intended outcome of the program includes individual research projects by the participants with the

TABLE 2.
Determining Nitrate Content

Solution color	Concentration, mg/L
Light blue	1–2
Deep blue	2–10
Dark blue	10–20
Ultramarine	20–40

presented results. In the course of the project implementation, the participants should form a holistic understanding of the nature park ecosystems, taking into account the ways of solving existing environmental problems. When conducting classes, various methods can be used: phytocoenological (studying the structure, development and distribution of vegetation; diagnosing the species composition; clarifying the physiological state of the plants; etc.), zoocoenological (studying the fauna of insects, species composition of birds; studying amphibians, reptiles and other animals), phenological (study of weather and climatic features), orographic (study of the terrain, eye survey, drawing up landscape ecology maps), soil science (study of soil as a habitat for plants and animals), hydrological (study of water bodies, organoleptic and chemical water properties, hydrobiological composition), and environmental (determination of the nature and degree of pollution, development of measures to improve the environmental situation, calculation of anthropogenic impact, etc.).

There is a vital necessity to create an environmental research station on the basis of the nature park, with the help of which city residents will be able to independently conduct environmental monitoring, based on simple methods. Along with the educational activities among the population, the scientific studies, related to the assessment of the environmental quality in the city, could be carried out on the basis of the nature park. Parks are conditionally clean zones of the city; the monitoring results, obtained within their territories, could be used as control data for research projects aimed at determining the environmental quality in Saratov.

In the course of the completing the program, the participants should form an integrated perception of the surrounding world, aimed at the fact that sustainable development depends solely on the skills and abilities of a person to solve global problems at

the local level. Hence, taking part in solving the environmental issues of the region is one of the ways to help humanity as a whole, and to foster a sense of compassion for all living creatures, and to help young people realize what essentially is love for their homeland [15].

The project results are intended for submission to the Division of the Federal Service for Supervision of Natural Resources in the Saratov Oblast, and to the Ministry of Natural Resources and Environment of the Saratov Oblast.

Conclusion

The development of environmental education projects solves the following problems:

- Fostering the environmental awareness and ecological culture of the youth;
- Organization of their active and cognitive leisure;

■ Environmental protection.

Within the framework of a comprehensive educational program conducted in the field, theoretical classes are held in combination with the workshops, field trips around the territory of the nature park under the guidance of scientists, lectures and master classes by the leading experts, aimed at solving specific environmental problems in the social and natural environment of the Saratov region.

Our research project resulted in a comprehensive environmental education program, based on the technology of educational field research activities of university and school students, thus fostering an environmental culture and awareness of the regional population, organizing active and educational leisure, as well as protecting the environment. The latter is especially important because Kumis Glade Nature Park acts as an air filter, providing the city of Saratov with clean air.

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