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# ПРОЕКТИРОВАНИЕ ЭКОЛОГО-ПОЗНАВАТЕЛЬНОГО МАРШРУТА НА ТЕРРИТОРИИ ГОСУДАРСТВЕННОГО ПРИРОДНОГО ЗАКАЗНИКА «АЮ-ДАГ»

# DESIGNING AN ECOLOGICAL AND EDUCATIONAL ROUTE ON THE TERRITORY OF THE AYU-DAG STATE NATURE RESERVE

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**Аннотация:** В статье рассматривается проект создания эколого-познавательного маршрута на территории государственного природного заказника регионального значения «Аю-Даг» (Республика Крым). На основе таксационного описания насаждений 32 квартала Запрудненского участкового лесничества проанализировано санитарное состояние древостоев, оценены исторически выявленные очаги вредителей и обоснована актуальность проведения санитарно-оздоровительных мероприятий. Разработан пешеходный маршрут «Артековская тропа» протяжённостью 1,8 км, включающий ключевые природные и историко-культурные объекты. Оценены экологические риски, связанные с рекреационной нагрузкой, и предложен комплекс мер по их минимизации. На основе экономического расчёта доказана финансовая

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целесообразность проекта: объём первоначальных инвестиций составляет 355 тыс. руб., прогнозируемый годовой доход – около 2,5 млн руб., срок окупаемости – 1,5 года. Реализация проекта способствует устойчивому развитию экологического туризма, сохранению биоразнообразия и повышению экологической культуры посетителей ООПТ.

**Abstract:** The article discusses a project to create an ecological and educational route on the territory of the state nature reserve of regional significance "Ayu-Dag" (Republic of Crimea). Based on the tax description of the plantings in the 32 quarters of the Zaprudnensky district forestry, the sanitary condition of the stands was analyzed, historically identified pest foci were assessed, and the relevance of sanitary and health measures was substantiated. The Artek Trail walking route has been developed with a length of 1.8 km, including key natural, historical and cultural sites. The environmental risks associated with recreational activity are assessed and a set of measures to minimize them is proposed. Based on economic calculations, the financial feasibility of the project has been proven: the initial investment is 355 thousand rubles, the projected annual income is about 2.5 million rubles, and the payback period is 1.5 years. The implementation of the project contributes to the sustainable development of ecological tourism, the conservation of biodiversity and the improvement of the ecological culture of visitors to protected areas.

**Ключевые слова:** эколого-познавательный маршрут, государственный природный заказник «Аю-Даг», рекреационная нагрузка, санитарно-оздоровительные мероприятия, устойчивый туризм, таксационное описание, лесное дело.

**Keywords:** ecological and educational route, the state nature reserve "Ayu-Dag", recreational load, sanitary and recreational activities, sustainable tourism, tax description, forestry.

## Introduction

In the context of increasing anthropogenic pressure on natural complexes

and climate change, the urgency of creating regulated ecological and educational routes in specially protected natural areas is significantly increasing. Such routes serve not only a recreational, but also an educational function, contributing to the formation of an environmentally sustainable worldview among visitors and minimizing the negative impact on ecosystems. The Ayu-Dag State Nature Reserve, located on the Southern coast of Crimea, is a unique geobotanical and archaeological site with rich biodiversity (577 plant species, 44 of them are listed in the Red Book) and significant recreational potential. The purpose of this work is to develop a scientifically based project of an ecological and educational route that takes into account the natural and climatic features, the sanitary condition of forest plantations, environmental risks and economic feasibility.

**Materials and methods of research**

The object of the study was the Zaprudnenskoe district forestry of the Alushta Forestry of the Republic of Crimea, within whose borders (block 32) the Ayu-Dag nature reserve is located. The work uses materials from the forestry regulations of the Alushta Forestry District, tax descriptions of plantings, data from the state forest pathology monitoring, as well as regulatory legal acts of the Russian Federation and the Republic of Crimea regulating the use of forests for recreational purposes and the conduct of sanitary and health measures (SOM).

The survey of stands was carried out in accordance with OST 56-69-83 and OST 56-84-85. The assessment of the recreational load and the design of the route were carried out on the basis of OST 56-100-95. The methodology included a field survey of the proposed route, cartographic analysis, assessment of environmental risks (trampling, erosion, fire hazard, fauna disturbance) and economic modeling of project costs and revenues.

**The results of the study and their discussion**

Sanitary condition of plantings

The tax description of the 6 allotments of the 32 blocks showed the predominance of oak forests of overgrown origin (rock oak, hornbeam and

hornbeam, field maple, ash). Bonus class V–VA, fullness 0.4–0.8, age group V–VI. The recreational characteristics of the plantings are assessed as average, the aesthetic assessment is class II. According to the data of the 2016-2017 forest pathology survey, a focus of green oak leafhoppers was recorded on an area of 110.0 hectares. By 2024, the outbreak was declared extinct under the influence of natural factors, and no harmful organisms were detected. Sanitary and health measures are not required in the quarter, but regular monitoring using pheromone traps and selective sanitary logging is recommended in case of deterioration of the phytosanitary situation.

Route design

A year–round walking route "Artek trail" has been developed with a length of 1.8 km (the width of the canvas is 2-3 m, the width of the footpath is 30 m). The route is laid along the existing trails of the northern and southwestern slopes of the Ayu-Dag mountain, taking into account minimal interference with the relief and vegetation cover. The route includes five key points:

- Entrance information complex (map, visiting rules, flora and fauna);
- Cultural heritage site "Monastery on Ayu-Dag Mountain";
- Areas where rare and relict plant species grow (small-fruited strawberry, high juniper, Pontic needle, etc.);
- A 15th-century Christian chapel;
- A viewing platform at the top (571 m above sea level) with the possibility of ornithological observations.

Environmental risk assessment and minimization measures

Predicted risks include increased anthropogenic load, slope erosion, fire risk, littering, and wildlife disturbance. To neutralize them, it is proposed: laying trails through already formed areas using natural materials (stone, wood), limiting the number of groups during peak seasons, installing information stands and MSW containers, creating a video surveillance system and regular environmental monitoring of soil and tree stands.

Economic feasibility

The total cost of the project is 355 thousand rubles (design, construction, information equipment, digital content development, volunteer support). Sources of financing: republican tourism development programs, the municipal budget, private investments and grants. The monetization model provides free basic access (50% of visitors), paid guided tours and themed routes (30%), additional services and workshops (20%). The projected annual income is estimated at 2.5 million rubles, with a payback period of 1.5 years.

**Conclusion**

The developed project of an ecological and educational route on the territory of the Ayu-Dag nature reserve is scientifically justified, environmentally safe and economically viable. The tax analysis confirmed the satisfactory sanitary condition of the plantings in 32 blocks, which makes it possible to safely integrate the recreational infrastructure without large-scale forestry interventions. The proposed route "Artek trail" provides a balance between educational function, conservation of biodiversity and a comfortable visit. The successful implementation of the project requires strict control over the recreational load, the introduction of a regular monitoring system, the involvement of local communities and active promotion through digital platforms. Further research may be aimed at assessing the dynamics of the soil and vegetation cover under the influence of a regulated tourist flow and adapting the route for low-mobility groups of the population.

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