Prospects for the implementation of a separate waste collection system in specially protected areas by the example of the Tunkinsky National Park

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Abstract. The article discusses the problems of handling specially protected territories by the example of the Tunkinsky National Park. The analysis of approaches to effective waste management in individual national parks is carried out. The rationale for the need and calculations of the effectiveness of using the separate collection system for municipal solid waste using the example of the Tunkinsky National Park.

1. Introduction
There are 12 thousand specially protected territories (SPNA) in the Russian Federation, including 85 in the Republic Buryatia, of which 8 are of federal significance. One of the priority tasks of the development of the system of protected areas of federal significance is determined by environmental education, including the development of ecological tourism [1, 2]. As a result of the implementation of the federal project "Conservation of Biological Diversity and the Development of Ecological Tourism" of the national project "Ecology", it is planned to increase the number of visitors to protected areas from 3.57 million people in 2018 to 7.89 million people in 2024, to 16 million people by 2035 g [3]. It is planned to implement in the territory of at least half of the national parks the economic tourism model, including two in the territory of the Republic Buryatia. [4].

The negative impact of tourism on the environment due to high attendance rates that exceed the capacity of the territory was noted in the works of Gučík M. and Marciš M. [5], Newsome D. et al. [6], Ragazz I. et al. [7], Ringo J.E. et al. [8], Sasidharan et al. [9]. In particular, one of the most significant negative environmental impacts due to the increase in tourist flow is an increase in the volume of solid waste generated.

2. Problem Formulation
Tunkinsky National Park is one of the largest national parks in Russia, created to preserve the unique ecosystems of the East Sayan and the spurs of the Khamar-Daban on a total area of 1,183,622 hectares. The park is located in the southwestern part of the Republic of Buryatia on the territory of the Tunkinsky district. In the east and north, the park borders on the Irkutsk region, in the west and southwest - with the Republic Mongolia, in the south - with the Zakamensky district of the Republic Buryatia.
For the Tunkinsky National Park, whose borders coincide with the administrative boundaries of the Tunkinsky district of Republic Buryatia, the problem of solid municipal waste management (MSW) is relevant and is becoming more acute due to the increase in visits to protected areas and the increasing anthropogenic load.

The MSW management system in the Republic Buryatia is based on the burial of the capacity of the generated waste. But on the territory of the protected areas, the construction of facilities for the treatment, recycling, disposal, disposal of waste is prohibited, therefore, the resulting MSW must be removed outside the Tunkinsky district. Only temporary storage for up to 11 months and removal of waste from a temporary storage point (Galbay village) outside the district to the MSW landfill in the village of Nizhny Sayantuy, Tarbagatai district of the Republic Buryatia is allowed. The MSW transportation distance is about 500 km. A long transport shoulder makes garbage collection more expensive, which leads to unauthorized waste disposal by the population and enterprises. According to the Ministry of Natural Resources of the Republic Buryatia, in 2019 there were 10 places of unauthorized placement of MSW in the territory of the district with a total area of 7.15 hectares, on which 2080 m$^3$ of waste was accumulated.

The prohibition of the construction of facilities for the treatment, utilization, neutralization and burial of waste of the territory of Tunkinsky National Park, the projected increase in tourist flow and, correspondingly, an increase in the volume of waste, necessitate the introduction of a separate collection system for solid waste in the national park.

### 3. Problem Solution

The main sources of MSW formation on the territory of the Tunkinsky National Park are:

- residents of settlements located in the park;
- tourists.

According to Federal State Statistics Service of Russia, at the beginning of 2019, 20.2 thousand people lived in 14 rural settlements located in the national park (Table 1).

#### Table 1. Resident population of Tunkinsky district in the context of rural settlements

| Name of rural settlements of Tunkinsky district | Population, person |
|-----------------------------------------------|-------------------|
| Arshan                                        | 2426              |
| Galbai                                        | 736               |
| Dalahai                                       | 689               |
| Zhemchug                                      | 1559              |
| Zun-Morino                                    | 1080              |
| Kyrenskoye                                    | 5132              |
| Mondy                                         | 873               |
| Tolttoy                                       | 842               |
| Tory                                          | 1094              |
| Tunka                                         | 2230              |
| Turan                                         | 783               |
| Kharbyaty                                     | 717               |
| Khoito-Gol                                    | 573               |
| Khuzhiry                                      | 1445              |
| **Total**                                     | **20179**         |

The number of officially registered visitors to the national park in 2017 was 171.8 thousand (Fig.1)
According to the Directorate, in 2019, 59.784 thousand m³ of MSW were formed on the territory of the national park [11]. To determine the potential volumes of secondary raw materials and reduce the volume of solid waste collected, the results of the project “National Parks Without Garbage” for the separate collection of solid waste were used. This project implemented since 2019 in the Zabaybalsky National Park by the Lake Baikal Foundation for Environmental Applications and Research with the support of the Presidential Grants Fund. As part of this project, the morphology of MSW was studied on the territory of the Trans-Baikal National Park in two zones (Ust-Barguzin and Chivyrkuisky Bay). It was determined that “in the average composition of the park’s wastes, fractions potentially suitable for recycling account for 42% of all wastes (up to 11% of polymer wastes, 7% of metal, about 24% of glass) produced by tourists and the public” [12]. It is noted that “the predominant fraction is organic waste (food waste), which accounts for 29% of all waste” [12].

Based on the uniform tariffs for the services of the regional operator LLC EcoAlliance for the management of MSW for legal entities and individual entrepreneurs for 2019, which price to 408.6 rubles per m³, the potential savings by introducing a separate MSW collection system in the national park were determined to more than 10 million rubles per year, and taking into account the use of composting of organic waste - more than 17 million rubles per year. It should be borne in mind that at the initial stage of introducing a separate waste collection system and ensuring its functioning, additional funding is needed for the construction and equipping of container sites, information support, training of specialists, etc., which will be further compensated by reducing the cost of garbage removal and possible income from the sale of separately collected secondary material resources to utilizing companies.

4. Conclusion
Based on the data obtained, it can be concluded that by organizing separate collection of solid waste and composting food waste in the territory of the Tunkinsky National Park, it is possible to reduce the volume of solid waste collected at landfills by 71% and, accordingly, reduce the cost of their removal. The existing practice of introducing a separate waste collection system in protected areas indicates the prospects in both economic and environmental aspects, as well as in the Stolby State Nature Reserve
since 2015, the savings on the export of MSW exceeded 900 thousand rubles. [13]. According to our estimates, the potential savings in the implementation of the separate MSW collection system in the territory of the Tunkinsky National Park will amount to more than 10 million rubles per year, and taking into account the use of composting of organic waste, more than 17 million rubles per year.

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