

Brief information about the project

Title of project	AP26103653 'Recreational capacity modeling using UAV, GIS and AI tools to prevent overtourism in Ile-Alatau National Park'
Relevance	The relevance of the project is determined by the growing problem of overtourism in Kazakhstan's national parks, particularly in Ile-Alatau National Park, where intensive visitation leads to the degradation of natural ecosystems and a decline in the quality of the tourist experience. Traditional methods for assessing recreational carrying capacity fail to account for dynamic changes in tourist flows and uncertainty factors, which limits management effectiveness. The proposed integration of unmanned aerial vehicles (UAVs), geographic information systems (GIS), and artificial intelligence (AI) offers an innovative approach to real-time monitoring and modeling of recreational load. This will enable the development of scientifically grounded solutions for regulating tourist flows, preventing route overload, and preserving natural resources, thereby promoting the sustainable development of tourism in Kazakhstan.
Purpose	The aim is to develop and validate modern methods of monitoring and modeling of recreational capacity of natural areas (on the example of Ile-Alatau National Park) using unmanned aerial vehicles (UAV), geographic information systems (GIS) and fuzzy linear programming.
Objectives	1. To conduct a systematic analysis of the scientific literature and existing examples of combating overtourism in different tourist destinations, focusing on cases that use modern technologies such as GIS, UAVs and fuzzy linear programming to monitor and manage tourist flows. 2. Develop and test a methodology for the use of unmanned aerial vehicles for aerial photography and monitoring of tourist flows on key routes of the national park, including drone setup, determination of launch points and flight routes, as well as methods of video filming and processing. 3. Develop and train an AI model capable of analyzing videos taken from drones for automatic recognition and counting of people on tourist routes. Using computer vision techniques, train the system to recognize people in different conditions (lighting, landscape, seasonality) and to take into account the movements of groups of tourists. 4. Develop and adapt a fuzzy linear programming model to determine the maximum allowable number of tourists on each route. The model will take into account uncertainties such as seasonal changes in tourist flows, weather conditions and the state of infrastructure. 5. Assess the impact of tourist flows on the park ecosystem. Utilize UAV and GIS data to identify areas

	most susceptible to negative impacts. 6. Based on the analysis of UAV data and the results of the recreational capacity model, develop proposals for optimizing tourist routes, introducing visit quotas, introducing reservation systems or directing tourists to alternative routes
Expected and Achieved Results	1. Expected Result (ER): A comprehensive literature review with examples of successful strategies to combat overtourism that will serve as a theoretical foundation for further phases of the study. 2. ER: Methodology for monitoring tourists using UAVs, which includes collecting data on the density and movement of recreationists. 3. ER: Accurate data on the number of hikers on each trail, which will allow for automatic recreation counts based on analysis of drone footage. 4. ER: A model for estimating recreational capacity that allows flexible management of tourism flows depending on external conditions. 5. ER: Map of vulnerable areas subject to environmental pressures, with recommendations for limiting tourist flow to these areas. 6. ER: A set of management recommendations including proposals for infrastructure (gazebos, viewing platforms and rest areas) that will improve management of tourist flows and prevent overloading of key sections of trails in the national park. 7. ER: Intellectual property protection documents will be obtained. A monograph in the field of project research will be published. The results will also be published: - at least 3 (three) articles and (or) reviews in peer-reviewed scientific publications on the scientific direction of the project, indexed in Science Citation Index Expanded and included in the 1st (first), 2nd (second) and (or) 3rd (third) quartile by impact factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database not less than 60 (sixty); - at least two (2) articles or reviews in a peer-reviewed foreign or domestic publication recommended by the Ministry of Science; One of the articles with the category - multidisciplinary or interdisciplinary practice. For domestic journals from Ministry of Science list 1 that are not categorized as multidisciplinary, journals from Ministry of Science lists 1 and 2 that are indexed in two or more categories are counted. Based on the results of the project implementation (in the relevant area of science): - training of at least 1 (one) Doctor of Philosophy (PhD) or doctor in the profile (training jointly with higher education institutions licensed for postgraduate education in doctoral studies is permitted).

Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	1. Assipova Zh.M. – Project Leader, PhD, Associate Professor. h-index: 5. Scopus Author ID: 56124528100 https://www.scopus.com/authid/detail.uri?authorId=56124528100; Web of Science ResearcherID: B-4536-2013 https://publons.com/researcher/2672362/zhanna-assipova/ 2. Musagaliyeva A.N., PhD. Hirsch Index (WoS): 2; Scopus: 2. ResearcherID: AAG-9050-2019; ORCID: 0000-0001-8041-9247; Scopus Author ID: 7211293422 3. Kakimzhanov E.Kh., PhD, Associate Professor. h-index: 4. Scopus Author ID: 56946816100 https://www.scopus.com/authid/detail.uri?authorId=56946816100 4. Bazarbekova M.M., PhD. h-index: 4. Scopus Author ID: 57201650093 https://www.scopus.com/authid/detail.uri?authorId=57201650093 5. Turumbayeva M.O., PhD, Acting Associate Professor. h-index: 6. Scopus Author ID: 57197808769 https://www.scopus.com/authid/detail.uri?authorId=57197808769 6. Pazylkhayr B.M., PhD Candidate. Scopus ID: 59312549400 https://www.scopus.com/authid/detail.uri?authorId=59312549400; ORCID: 0000-0002-2296-9512 7. Zhuman K., PhD Student. ORCID: https://orcid.org/0009-0002-1407-2075
List of publications with links to them	1. Aktymbayeva A., Nuruly Y., Artemyev A., Kaliyeva A., Sapiyeva A., & Assipova Zh. (2023). Balancing Nature and Visitors for Sustainable Development: Assessing the Tourism Carrying Capacities of Katon-Karagay National Park, Kazakhstan. <i>Sustainability</i>, 15, 15989. https://doi.org/10.3390/su152215989 (Web of Science: Q2-Q3 (SCIE, SSCI), Impact Factor 2022=3.9; Scopus: 87-58, CiteScore 2022=5.8, SJR 2022=0.664) 2. Aktymbayeva A., Assipova Zh., Moldagaliyeva A., Nuruly Y., Koshim, A. (2020). Impact of small and medium-sized tourism firms on employment in Kazakhstan. <i>GeoJournal of Tourism and Geosites</i>, 32(4), 1238-1243. https://doi.org/10.30892/gtg.32407-563 (Scopus: CiteScore 2022=3.2; 94-55 percentiles). 3. Aliyeva Z., Sakypbek M., Aktymbayeva A., Assipova Zh., Saidullayev S. (2020). Assessment of recreation carrying capacity of Ile-Alatau national park in Kazakhstan. <i>GeoJournal of Tourism and Geosites</i>, 29(2), 460-471. https://doi.org/10.30892/gtg.29207-482 (Scopus: CiteScore 2022=3.2; 94-55 percentiles). 4. Bazarbekova M., Assipova Zh., Molgazhdarov A., Yessenov M. (2018). Review of transportation modes in Kazakhstan region, Central Asia. <i>Cogent Engineering</i>, 5(1), 1450799. https://doi.org/10.1080/23311916.2018.1450799 (Web of

	Science: ESCI, Impact Factor 2022=1.9; Scopus: CiteScore 2022=3.2; 64-47 percentiles). 5.Kulakhmetova G., Aktymbayeva A., Assipova Zh., Baoleer B., Koshkimbayeva, U. (2022). Current Problems In The Tourism And Hotel Industry Taking The World's Tourist Cities As An Example. GeoJournal of Tourism and Geosites, 43(3), 841-849. https://doi.org/10.30892/gtg.43301-895 (Scopus: CiteScore 2022=3.2; 94-55 percentiles). 6.Sapiyeva A. Z., Nuruly Y., Assipova Zh. M. (2020). Evaluation of the multiplicative effect of ecotourism development in Kazakhstan (on the example of the «Buyratau» National Park). Central Asian Economic Review, (6), 116-126. https://caer.narxoz.kz/jour/article/view/282?locale=en_US
Patents	-