Description of the research topic

General information

Institute: Institute of Nature Conservation of the Polish Academy of Sciences.

Research topic: Spatio-temporal dynamics of mammal communities in mountain ecosystems: integrating camera traps, artificial intelligence and citizen science in Tatra National Park.

Scientific discipline: biological sciences.

Name of potential supervisor: dr hab. Nuria Selva Fernández.

Background information

Project number: 2023/05/Y/NZ8/00104
Project title: "Building a scalable wildlife monitoring system through the integration of camera trapping, artificial intelligence and Essential Biodiversity Variables" (WildINTEL)
Project leaders: Dr Carlos Bautista Leon and Prof. Nuria Selva (Institute of Nature Conservation, Polish Academy of Sciences)
Scientific institution: Institute of Nature Conservation, Polish Academy of Sciences
Institution address: al. Adama Mickiewicza 33, 31-120 Kraków, Poland

Project information: The project received funding under the second call of the European Biodiversity Partnership Biodiversa+, "Improved transnational monitoring of biodiversity and ecosystem change for science and society" (BiodivMon). The call was organized by the National Science Centre (NCN, Poland) under the multilateral UNISONO programme.

Information on doctoral student funding: The doctoral scholarship is financed through a scientific scholarship within project no. 2023/05/Y/NZ8/00104 entitled 'Building a scalable wildlife monitoring system through the integration of camera trapping, artificial intelligence and Essential Biodiversity Variables' (WildINTEL) until the end of the project implementation period (January 2028). After the completion of the project, funding of the doctoral scholarship for the remainder of the doctoral training period will be provided by the Institute of Nature Conservation of the Polish Academy of Sciences.

The main question to be addressed in the project

Mountain ecosystems are sensitive to multiple global change components such as climate change, tourism pressure and land-use practices. Accordingly, they require biodiversity monitoring systems capable of detecting ecological responses to anthropogenic disturbances

but also natural ones that are associated with global environmental change; bark beetle outbreaks, windthrow events, forest dieback and avalanche dynamics.

This PhD will investigate the spatio-temporal dynamics of mammal communities in the Tatra Mountains integrating camera-trapping, with artificial intelligence and citizen-science.

The project will address three main research questions:

1. How do tourism intensity and recreational infrastructure affect mammal occupancy, activity patterns and community composition across mountain ecosystems?
2. How do forest structure, natural disturbances and management practices influence mammal communities in mountain regions?
3. How can camera-trap monitoring systems be optimized to efficiently monitor communities and selected focal species across forest and alpine habitats?

This PhD will help to better understand the factors shaping mammal communities in mountain ecosystems currently and under future global change. Additionally, will contribute to the development of scalable monitoring systems for mountain wildlife. The results will support biodiversity conservation and adaptive management in Tatra National Park and other mountain regions that are also increasingly threat by environmental and anthropogenic pressures.

Information on the methods/description of work

The PhD project will investigate the distribution, relative abundance, detectability and community composition of terrestrial mammals in mountain ecosystems using camera-trap data. The candidate will build upon the existing camera-trap-based monitoring systems in Tatra National Park within the WildINTEL project, which integrates classified records of wildlife by artificial intelligence and citizen-science into workflows for biodiversity monitoring.

Analyses will focus on spatio-temporal patterns in species occurrence and abundance, their environmental drivers, and the development of predictive models to support wildlife monitoring and conservation. Depending on the research questions and data characteristics, analytical approaches may include occupancy models, Royle–Nichols models, N-mixture models, multi-species occupancy models, random encounter models, and community-level analyses of species turnover and beta diversity.

Predictive modelling will be used to estimate species distributions and community patterns in unsampled areas. Environmental predictors will include topography, habitat characteristics, vegetation productivity, snow cover, forest structure, natural disturbances and management practices, using the highest spatial and temporal resolution data available.

Fine-scale habitat characteristics will be quantified through a combination of field surveys, camera-trap image interpretation, remote-sensing products and expert assessments. The project will be conducted in close collaboration with Tatra National Park, ensuring access to high-quality ecological data and facilitating the transfer of results to conservation practice.

Research outputs will be disseminated through peer-reviewed scientific publications, conference presentations, technical reports, policy briefs and outreach activities.

Additional information

The ideal candidate should demonstrate strong quantitative and analytical skills, particularly in the analysis of ecological and biodiversity data. Previous experience with implementing camera-trap projects for wildlife monitoring, species distribution modelling, occupancy modelling or related approaches are required.

Candidates should be skilled in R and/or python and have experience with GIS software and spatial data analysis. Experience with platforms designed to organize, process, and analyze massive multimedia datasets generated by camera traps is required. Familiarity with statistical modelling and biodiversity monitoring concepts is highly desirable. Good oral and written communication skills in English are required, as the project will involve international collaboration and publication in peer-reviewed journals.

The project includes fieldwork in mountain environments; therefore, candidates should be willing and physically able to conduct field activities under variable weather and terrain conditions.

Knowledge of the WildINTEL project, camera-trap monitoring workflows, artificial intelligence applications in biodiversity monitoring, and citizen-science approaches will be considered strong assets. Good command of Polish, both spoken and written, will be advantageous for collaboration with local stakeholders and protected-area managers.

Place/name of potential collaborators

Tomasz Zwijacz-Kozica, Carlos Bautista, Seth T Wong, Simone Santoro.

References

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