

Passive acoustic monitoring of birds in beech forests affected to varying degrees by human activity

PhD Thesis

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The present study aims to characterise bird breeding communities in beech forests, affected to varying degrees by human activity, through acoustic data. For the implementation of this goal, the following three tasks were set: 1) Characterisation of bird breeding communities using acoustic indices; 2) Comparison of bird breeding communities in old-growth forests and mature managed forests using data from passive acoustic monitoring; 3) Comparison of bird breeding communities in mature managed forests and pre-mature managed forests using data from passive acoustic monitoring. Due to the availability of a sufficiently large sample, data on the presented in the region species of conservation significance, the Semi-collared Flycatcher (*Ficedula semitorquata*), were also analysed.

The study was conducted during the breeding season (March-June) in 2022 and 2023 at twelve locations in Belasitsa Nature Park. The relief is mountainous, with an altitude between 1100 m and 1450 m. Four autonomous sound recorders (Song Meter Micro © Wildlife Acoustics) were placed in three types of beech forests: 1) old-growth forests in the Kongura Reserve; 2) mature forests managed by irregular-shelterwood system (80-130 years of age); 3) pre-mature even-aged managed forests (subjected to clearcut some 60 years ago).

Collected acoustic data were analysed manually to identify all vocalising bird species, as well as to determine the vocal activity rate of the Semi-collared Flycatcher. Kaleidoscope Pro software (Wildlife Acoustics, Inc.) was used to calculate acoustic indices (Acoustic Complexity Index – ACI, Acoustic Diversity Index – ADI, Acoustic Evenness Index – AEI, Bioacoustic Index – BI).

The relationship between acoustic index values and bird species richness, determined by listening to a subsample of the collected sound recordings, was investigated. Acoustic index

values were compared among the three types of beech forests and between two breeding seasons. Additionally, the relationship between the vocal activity rate of the Semi-collared Flycatcher and key forest features (canopy cover, trees with cavities and standing dead wood) was analysed. The results of the present study are described in the following publications:

Panova, K. R., Zlatanov, T. M. & Nikolov, B. P. (2024) Avian Diversity Monitoring in Mountain Beech Forests using Acoustic Indices: a Case Study in the Belasitsa Nature Park, Bulgaria. *Acta Zoologica Bulgarica*, 76 (3): 323-331.

Panova, K. R., Marinov, M. P. & Nikolov, B. P. Vocal activity rate of the Semi-collared Flycatcher *Ficedula semitorquata* in breeding sites is associated with forest features: a case study from differently managed beech forests – accepted for print in *Ardeola: International Journal of Ornithology*.

In conclusion, the conducted study demonstrated that passive acoustic monitoring can be an effective tool for bird monitoring in remote and hard-to-reach places.