Project brief

Thünen Institute of Forest Ecosystems 2024/19a

Quantification of biological diversity using (bio-)acoustic methods – Integration into forest monitoring

Helge Rölleke[1], Franz Kroiher[1], Zoë Hester[1], Sandra Mueller[3], Karl-Heinz Frommolt[2], Olaf Jahn[2], Benjamin Werner[2], Mario Lasseck[2], Jarno Asmus[2], Tanja Sanders[1]

- **Acoustic forest monitoring („AkWamo“) as a new way of describing biological diversity**
- **Feasibility study on six beech, five pine plots and one mixed forest experimental plot in Brandenburg, Hesse and Lower Saxony**
- **Determination of the potential for nationwide, standardised forest monitoring**

Background and objective

Utilizing the soundscape of the forest, to investigate changes in the occurrence of vocalizing animal species, represents an innovative method. Long-term recordings have only recently become scientifically usable, as they are memory-intensive and their analysis is computationally intensive. Digital analysis opens up new perspectives to better understand the condition of our forests and protect them more effectively. Using artificial intelligence, the diverse sounds of the forest are to be identified and developments and relations uncovered.

The AkWamo project presented here explores the potential of acoustic quantification of biological diversity for a nationwide forest monitoring through sound recording and field validation. As part of the feasibility study, workflows and analysis processes are developed and standardized. These are necessary in order to establish nationwide acoustic monitoring.

Approach

The project is a collaboration between the Museum für Naturkunde Berlin, the University of Freiburg and the Thünen Institute of Forest Ecosystems. The feasibility study is being carried out by scientists specialized in bioacoustics, ornithology, IT and forestry.

The acoustic characterization and assessment of biodiversity and variety of sounds is within the core competence of our project partners. The central tasks of the Thünen-Institute of Forest Ecosystems include establishing an IT infrastructure for (bio-)acoustic monitoring, developing workflows, conducting profitability calculations, and integrating acoustic parameters into the existing intensive forest monitoring (Level II).

Data acquisition, data preparation and data management

Commercial acoustic recording devices are used for recording in the audible range. These devices record environmental sounds every tenth minute. Other recording devices are used to capture bat calls in the frequency range that is not audible to humans. The continuous operation of the recording devices produces approximately one terabyte of data per month. Handling these massive amounts of data is a technical challenge.

Figure 1: Sound recording device for the audible range (Picture: B. Michler)

The establishment of the IT infrastructure for (bio-)acoustic forest monitoring is intended to ensure the accessibility of sound recordings and provide rapid analysis and visualization capabilities.

The IT infrastructure enables storing the original data on a data server, retaining metadata in a database and building a web-based structure for acoustic analysis. Web access to the data server enables uploading, playing and downloading audio data.

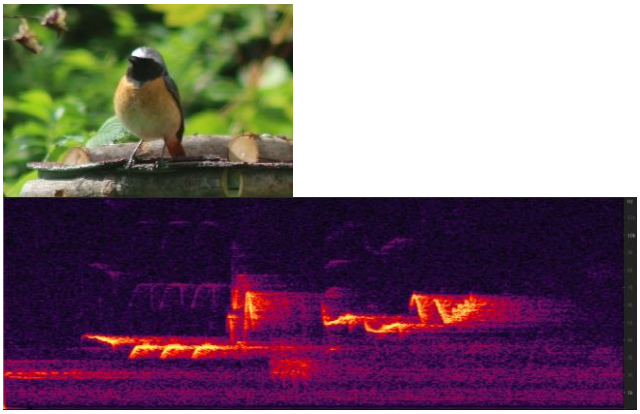

Figure 2: (a) Male of the common redstart (Phoenicurus phoenicurus), (Picture: T. Sanders), **(b)** Spectrogram of a song part of the same bird species from Britz, Brandenburg (Spectrogram: Museum für Naturkunde, Berlin).

A database with a web interface is being set up, capable of representing sound recordings in the form of spectrograms, acoustic indices as well as results of species identification based on acoustic pattern recognition. Pattern recognition algorithms will be integrated and the acoustic data will be processed into a suitable form for forest monitoring.

Integration into forest monitoring

The acoustic parameters and determined species compositions are intended to be cross-referenced with regularly collected data on forest condition from the Level II program and other large-scale inventories and compared with peer-reviewed literature.

Temporal relationships between the soundscape and (1) the large-scale structural diversity of habitats, (2) meteorological conditions, (3) local tree species composition and (4) the seasonal phenology of trees will be investigated.

The project investigates to what extent the patterns of (bio-) acoustic activity are related to the results of the Level II measurements and the National Forest Inventory and National Forest Soil Inventory.

Figure 3: Pine experimental plot from the Level II program (Picture: A. Schmitz)

Based on profitability calculations, the material, personnel and financial requirements for the continuation and expansion of (bio-)acoustic forest monitoring will be estimated.

The insights gained within the project will be published and will then be made available as a reference for further investigations. The feasibility study also lays the foundation for an audio archive that will ensure long-term access to acoustic data and enable comparative analyses.

Further information

Contact

[1] Thünen Institute of Forest Ecosystems

Franz.Kroiher@thuenen.de
www.thuenen.de/en/wo

Duration

02.2023 - 01.2026

Project-ID

2673

Website

AkWamo

DOI: 10.3220/PB1719228636000

Partner

[2] Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung

[3] Albert-Ludwigs-Universität Freiburg

Funding

FNR
Fachagentur Nachwachsende Rohstoffe e.V.