UFZ HELMHOLTZ Zentrum für Umweltforschung

Passive acoustic monitoring (PAM) and automated species detection – ready-to-use technologies for landscape ecology?

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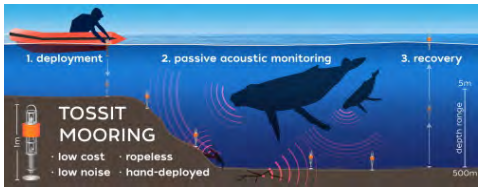
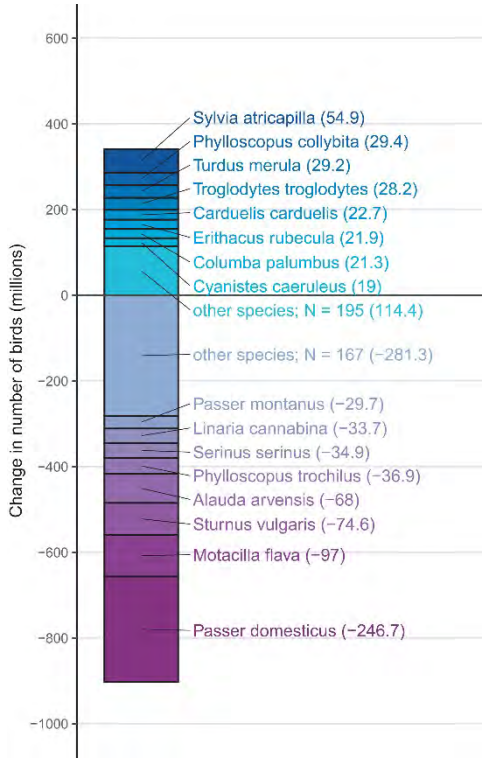
Introduction - Technological innovations for biodiversity monitoring

- Novel biodiversity monitoring techniques are emerging rapidly
- **Ecology is becoming a “data rich” discipline**
- We can ask different questions
- We can design studies differently
- Overcome expert bottle neck with **upscaling**
- Standard observation in **eLTER**
- **Advantages and limitations** still to be evaluated
- Can the **methodological switch** be done without collateral damage?



Introduction - Birds as sensitive and widely-studied ecological indicators

- **Birds** are among the most widely-monitored taxa
- EU: abundance **decline** and changes in community composition
- **Ecological indicators** (Farmland Bird Index)
- **Agricultural land use** as main driver



Burns et al. (2021)

Introduction - Scope of our study

Passive acoustic monitoring (PAM)

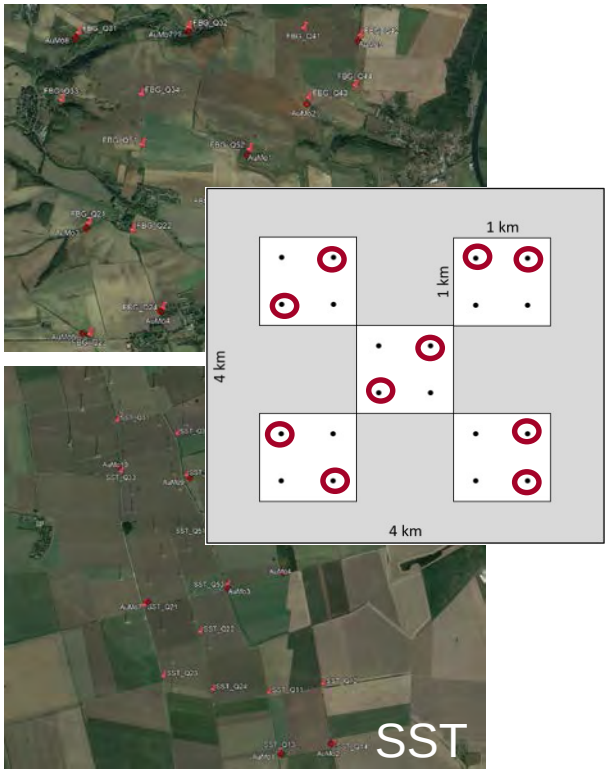
- Recording soundscapes to monitor sonant animals, glaciers, anthropogenic noise,…
- Deriving acoustic indices
- Evaluation by listening experts

Automated species ID

- Neural network identifying species from audio files

- Test the **combination** of low-cost recorders and freely available ID software in **a real-world setting**
- **Validate** the BirdNET IDs
- **Compare** them to a well-established monitoring approach

Methods - Study Sites and Data Collection



modified from Frenzel et al. (2015)

Point Counts	PAM
40 sites	20 sites
2 visits à 5 min	2 months of daily AudioMoth recording
Sunrise	Sunrise, Sunset, Night
Audible and visible species identified by ornithologist	Audible species identified by BirdNET Analyzer

TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

LTER-D
German Long-Term Ecosystem Research Network

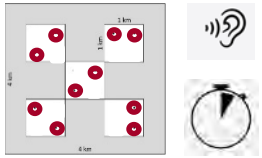
Methods - Data Analysis

1) Validation

- Random sample: at least 10 BirdNet detections per species (≥ 10 detections x 105 species = 752 sound files of 3 s each)
- Expert observer listened to sound files and determined the species
- BirdNet accuracy determined as agreement with observer (%)

2) Comparison

2a) Exact comparison

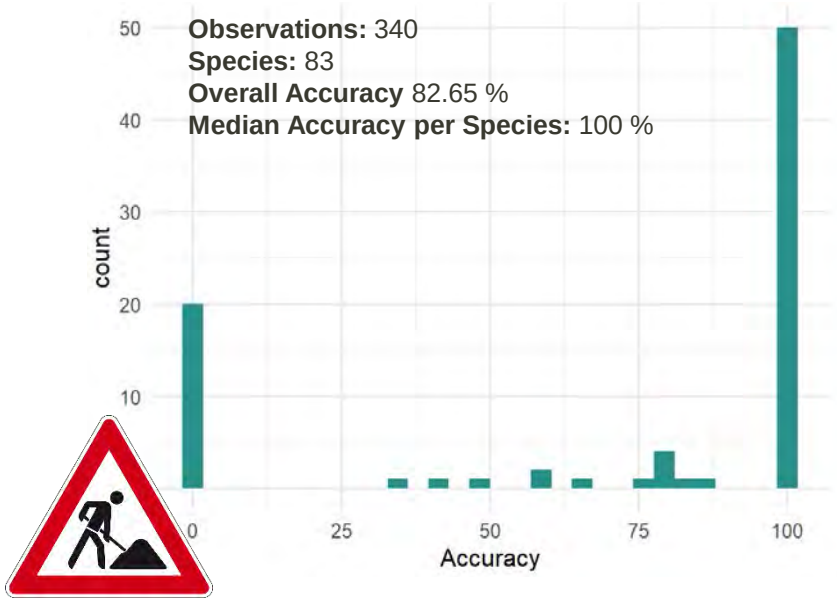


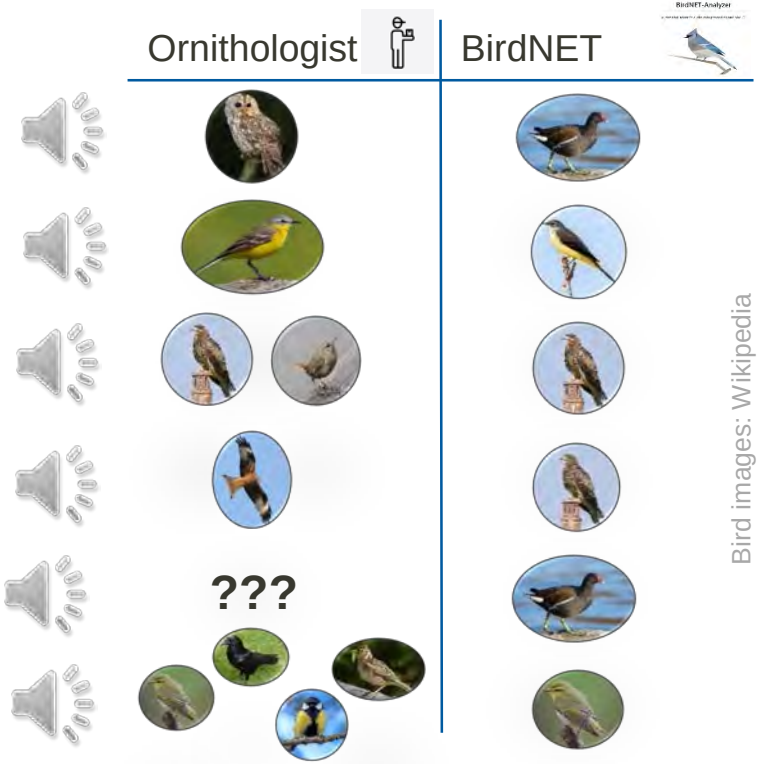
- Species richness
- Diversity
- Evenness

2b) Overall comparison

- Bray-Curtis similarity
- Jaccard index
- Simpson similarity

Results - Validation

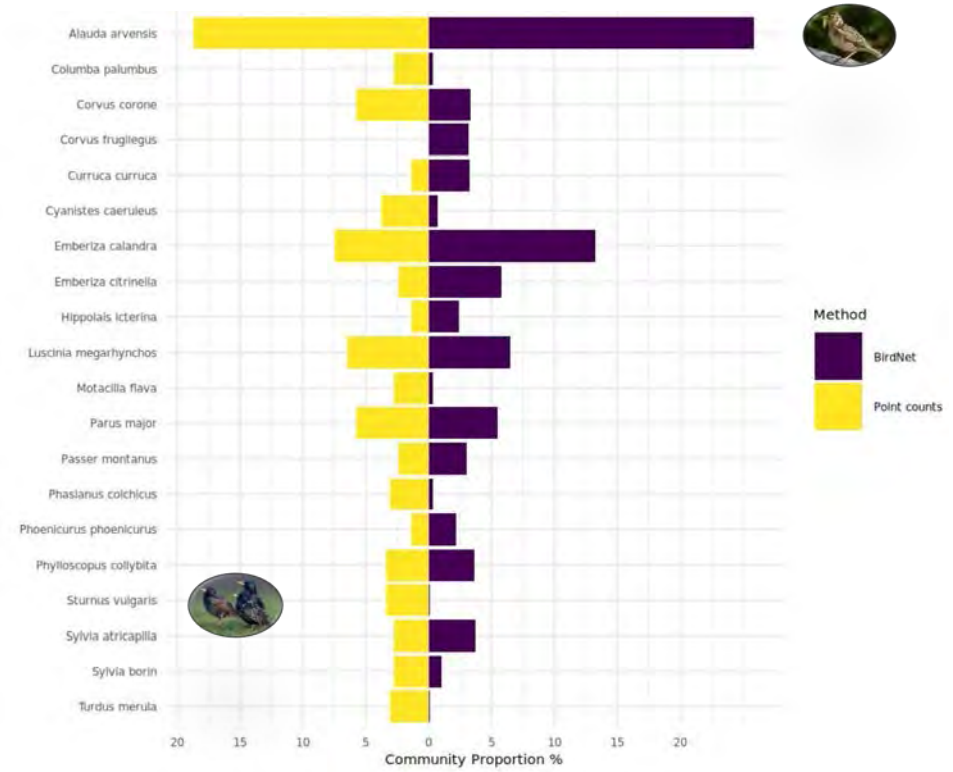




Bird images: Wikipedia

Paulus et al. (in prep.)

Results - Exact Comparison



Species Richness: 45
Shannon Diversity: 3.25
Evenness (0-1): 0.85

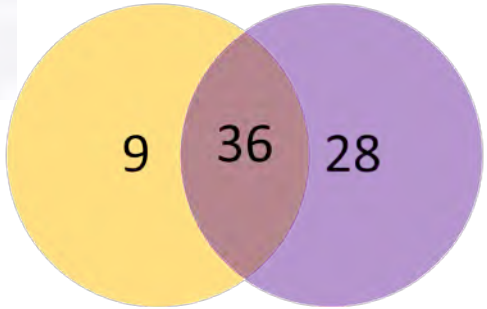
Species Richness: 64
Shannon Diversity: 2.92
Evenness (0-1): 0.7

BirdNET-Analyzer
Automated scientific audio data processing and bird ID.

Bird images: Wikipedia

Paulus et al. (in prep.)

Results - Exact Comparison

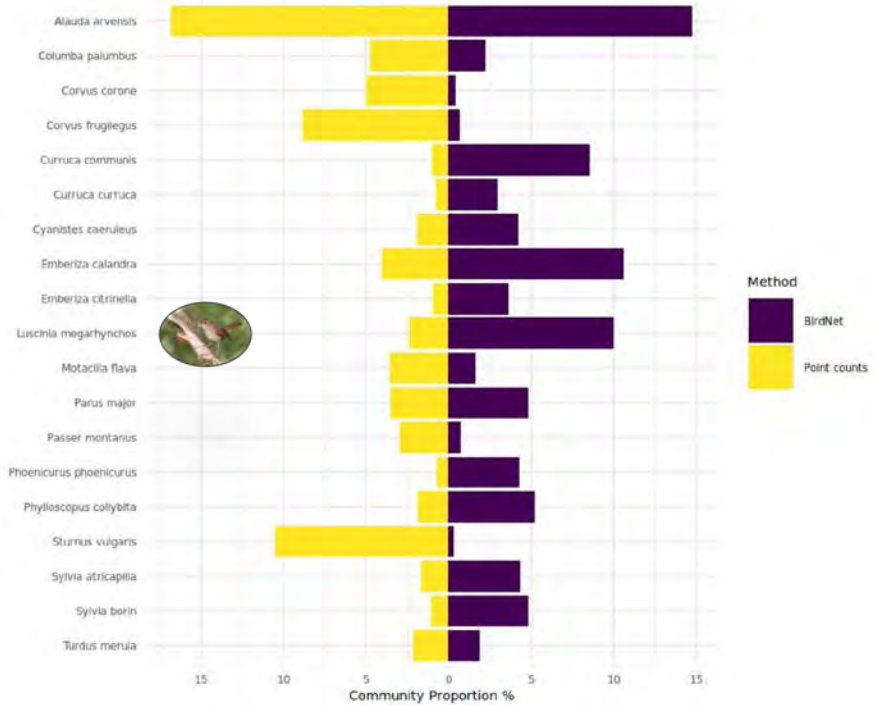


Bray-Curtis = 1 = no shared species
Jaccard = 1 = all species shared
Simpson = 1 = all species shared

Bray-Curtis dissimilarity (0-1): 0.31
Jaccard index (0-1): 0.49
Simpson similarity (0-1): 0.80

Paulus et al. (in prep.)

Results - Overall Comparison



Bird images: Wikipedia

Paulus et al. (in prep.)

Species Richness: 70
Shannon Diversity: 3.36
Evenness (0-1): 0.79

Species Richness: 103
Shannon Diversity: 3.13
Evenness (0-1): 0.67

Results – Overall Comparison

Bray-Curtis = 1 = no shared species
Jaccard = 1 = all species shared
Simpson = 1 = all species shared

Bray-Curtis dissimilarity (0-1):	0.004
Jaccard index (0-1):	0.52
Simpson similarity (0-1):	0.84

Paulus et al. (in prep.)

Synthesis & Take Home Messages

- Validation proved **high accuracy** of BirdNET Analyzer: 80 % agreement with human expert
- PAM + automated species ID detect **higher number** of species than point count survey
- Few species “missed” (especially rare species – less training records available?)
- **Possible bias** towards highly vocal species
- Postprocessing/**filtering** of BirdNet detections to make results comparable to point count surveys

Thank you!

Elisabeth Rahmsdorf for fieldwork support

Toni Harzendorf for help with EVE

Drawn bird icons © Elina Takola