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birdnetTools: An R package for working with BirdNET output

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Summary

`birdnetTools` is an R package for post-processing outputs from BirdNET, an open-source neural network developed by the Cornell Lab of Ornithology and Chemnitz University of Technology for detecting and identifying bird species from audio recordings (Kahl et al., 2021). The `birdnetTools` package streamlines workflows for cleaning and combining multiple BirdNET selection tables, filtering detections by species, confidence, or date/time, visualizing temporal and spatial patterns, and validating results using an interactive Shiny app. It also supports species-specific and universal confidence thresholds, enabling reproducible threshold-setting workflows.

Statement of need

Automated acoustic monitoring is increasingly used in ecology and conservation (Pérez-Granados, 2023), with BirdNET being one of the most widely adopted tools for bird sound identification (e.g., Funosas et al. (2024), McGinn et al. (2023), and Bota et al. (2023)). Although BirdNET was developed in Python, most of its primary users are ecologists who conduct analyses primarily in R. This language difference can limit accessibility for some research teams. While the `birdnetR` package (Günther & BirdNET Team, 2025) enables R users to run BirdNET classifications, there is no dedicated framework in R for post-processing these outputs (Figure 1).

The `birdnetTools` R package fills this gap by providing functions to clean and wrangle BirdNET detections, apply species-specific or universal confidence thresholds, visualize results, and validate predictions through an interactive R Shiny app. Its design is based on workflows commonly used in published studies (e.g., Tseng et al. (2024)) and incorporates methods for threshold setting and validation developed in recent research (i.e., Tseng et al. (2025); Wood & Kahl (2024)). By consolidating these tools, birdnetTools streamlines analysis and lowers barriers for ecologists and conservation practitioners adopting BirdNET in large-scale monitoring projects.

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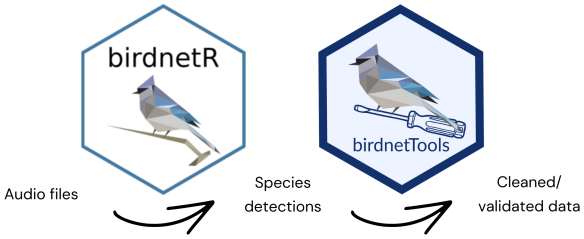

Figure 1: Integration of BirdNET R packages. birdnetR produces species detections from audio recordings, while birdnetTools provides tools for post-processing, data cleaning, and validation.

Key functionalities

Functions in `birdnetTools` fall into three categories: data import, data exploration, and detection validation (Figure 2).

1. Data import: `birdnet_combine()` integrates BirdNET outputs into R, supporting formats from the BirdNET GUI, Raven Pro, and the `birdnetR` package.
2. Data exploration: `birdnet_filter()` enables filtering by species, threshold, or date/time; `birdnet_add_time()` extracts temporal metadata; and `birdnet_heatmap()` visualizes activity patterns.
3. Detection validation: an R ShinyApp was developed, implementing threshold-setting approaches, including the precision-based method of Tseng et al. (2025) and the probability-based method of Wood & Kahl (2024).

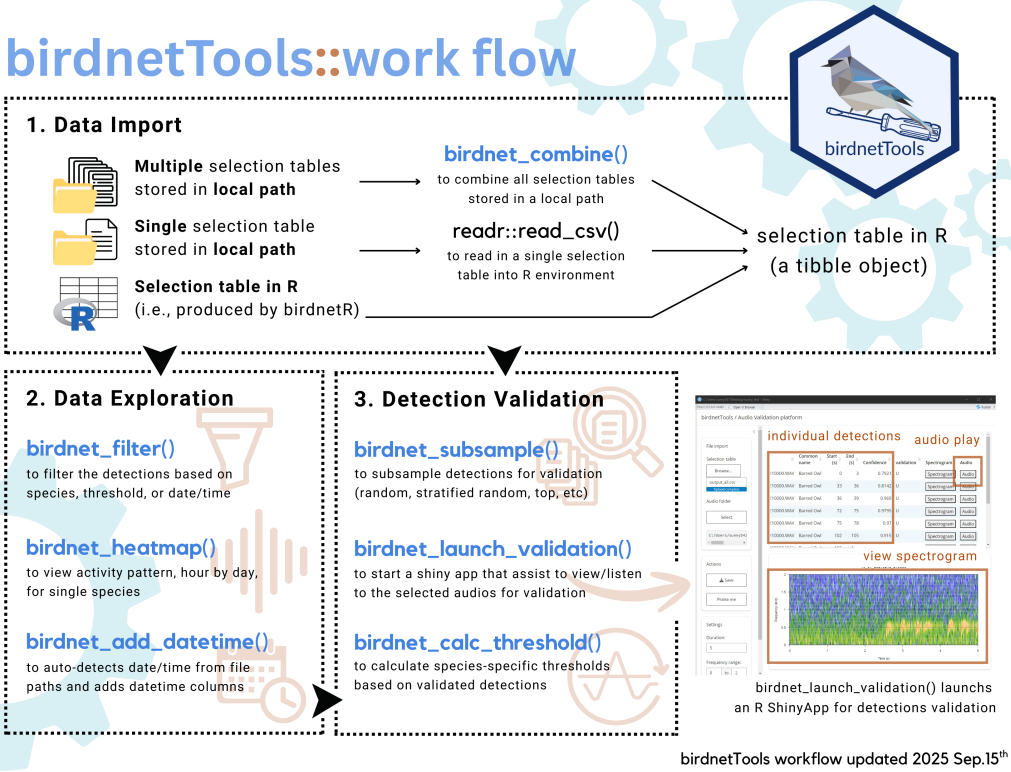

Figure 2: Workflow of the birdnetTools R package.

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References

Bota, G., Manzano-Rubio, R., Catalán, L., Gómez-Catasús, J., & Pérez-Granados, C. (2023). Hearing to the unseen: AudioMoth and BirdNET as a cheap and easy method for monitoring cryptic bird species. *Sensors*, *23*(16), 7176. https://doi.org/10.3390/s23167176

Funosas, D., Barbaro, L., Schillé, L., Elger, A., Castagneyrol, B., & Cauchoix, M. (2024). Assessing the potential of BirdNET to infer european bird species from acoustic data. *Ecological Informatics*, *164*(112146). https://doi.org/10.1016/j.ecolind.2024.112146

Günther, F., & BirdNET Team. (2025). birdnetR: Deep learning for automated (bird) sound identification. In *Github repository*. GitHub. https://birdnet-team.github.io/birdnetR/

Kahl, S., Wood, C. M., Eibl, M., & Klinck, H. (2021). BirdNET: A deep learning solution for avian diversity monitoring. *Ecological Informatics*, *61*. https://doi.org/10.1016/j.ecoinf.2021.101236

McGinn, K., Kahl, S., Peery, M. Z., Klinck, H., & Wood, C. M. (2023). Feature embeddings from the BirdNET algorithm provide within-species classification of acoustic events. *Ecological Informatics*, *74*(101995). https://doi.org/10.1016/j.ecoinf.2023.101995

Pérez-Granados, C. (2023). BirdNET: Applications, performance, pitfalls and future opportunities. *Ibis*, *165*(3), 1068–1075. https://doi.org/10.1111/ibi.13193

Tseng, S., Hodder, D. P., & Otter, K. (2024). Using autonomous recording units for vocal individuality: Insights from barred owl identification. *Avian Conservation and Ecology*, *19*. https://doi.org/10.5751/ACE-02680-190123

Tseng, S., Hodder, D. P., & Otter, K. A. (2025). Setting BirdNET confidence thresholds: Species-specific vs. Universal approaches. *Journal of Ornithology*, *166*. https://doi.org/10.1007/s10336-025-02260-w

Wood, C. M., & Kahl, S. (2024). Guidelines for appropriate use of BirdNET scores and other detector outputs. *Journal of Ornithology*, *165*. https://doi.org/10.1007/s10336-024-02144-5