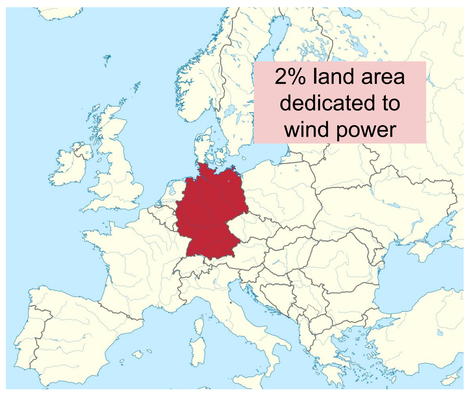
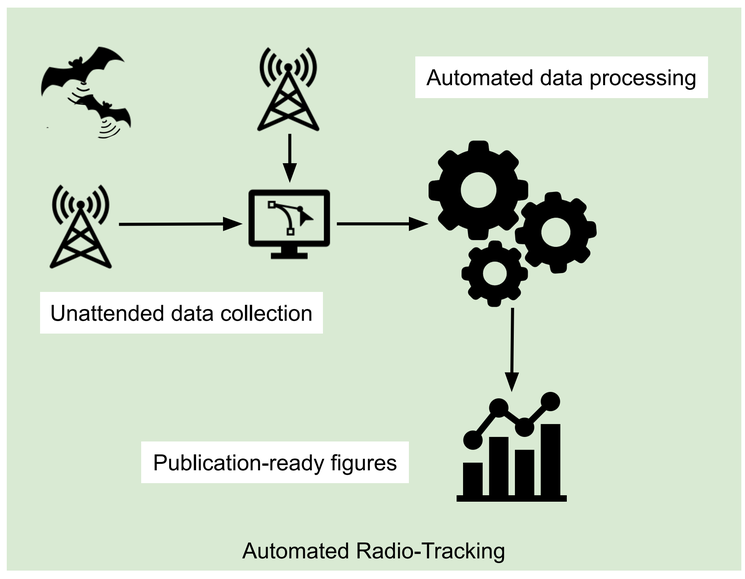
Balancing Renewable Energy Expansion and Species Protection through Automated Radio-Tracking

Jannis Gottwald (gottwald@trackit.systems), Jonas Höchst (hoechst@trackit.systems)
trackIT Systems GmbH, Marburg, Germany
https://trackit.systems

Expansion of renewable energies and bat conservation in conflict: Radio-Tracking is the only method to identify roosts and essential foraging areas of bats



species protection vs. climate protection



Automated Radio-Tracking

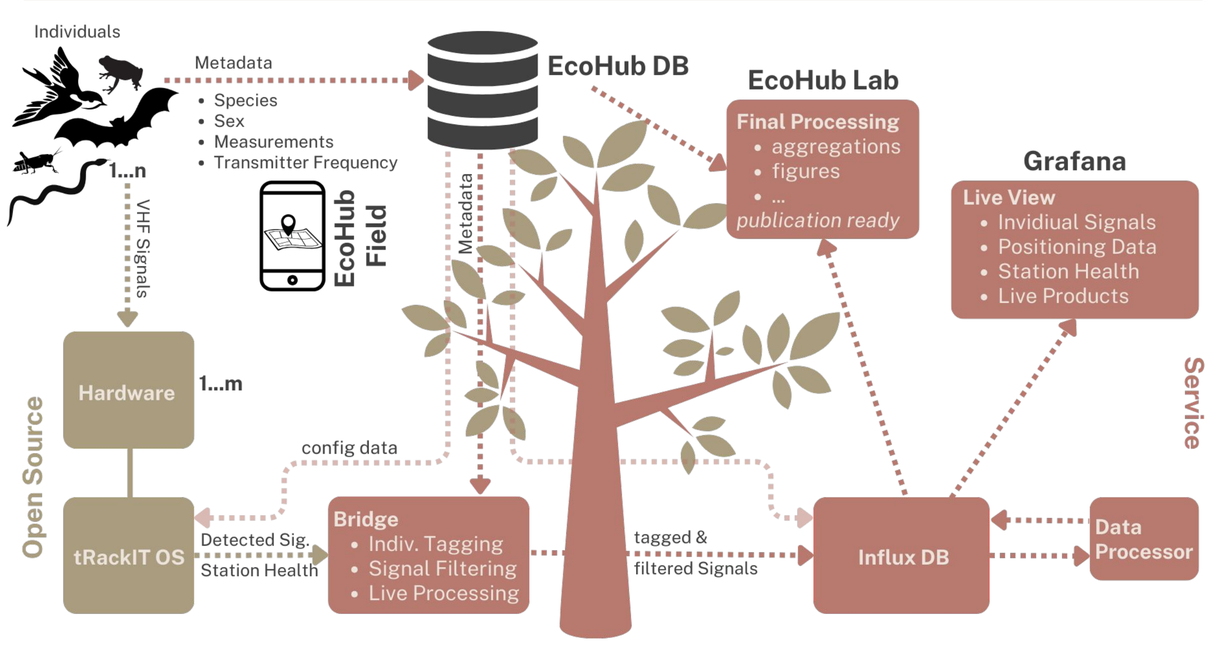
Manual Radio-Tracking	vs.	Automated Radio-Tracking
- Labour-intensive, time-consuming - Only scalable with more field workers - Limited data output, in terms of observations - Time delay between recording and evaluation		- Minimal exertion and time commitment - Continuous recording of up to 40 individuals - Thousands of observations per individual - Live transmission and output computation, e.g. localizations, body temperature, activity index, …

Over the preceding two years, the trackIT System has been operational at over **600 planned wind power** sites in Germany and has been endorsed as a **novel standard** by the federal state of Rhineland-Palatinate. Outcomes emphasise the notable enhancement in data granularity facilitated by automated telemetry, translating the database from a few manual telemetry points and survey dates into **hundreds of thousands of data points per individual** throughout the transmitter's lifespan.

System architecture: open source meets cloud service

trackIT OS: Open-source Software for Reliable VHF Wildlife Tracking

- Operating System: Specifically created for trackIT stations using VHF signals from tags on animals; built with low-cost, off-the-shelf hardware.
- Core Functions: Includes VHF signal processing, system monitoring, configuration management, and user access.
- Capabilities: Records, stores, analyzes, and transmits detected VHF signals, calculates bearings of emitted signals, and classifies animal activities.
- Open Source: All components are available under the GNU GPL 3.0 open source license on GitHub.



EcoHub: Wildlife Data Management Cloud Service

- EcoHub DB: Metadata storage for individual measurements, roosts, mist nettings, transmitters, …
- Bridge: Filtering, assignment of received signals to applied transmitters and individuals and further processing
- Influx DB: Time series data storage
- Grafana: Interactive live data visualization
- EcoHub Lab: post-season data processing for publication-ready figures

Independently hosted cloud service per customer.

trackIT Systems in Numbers

3000+ observations per hour per transmitter and station

600 wind power sites in 2023 and 2024

650 observed individuals (bats, birds, snakes, hedgehogs, …)

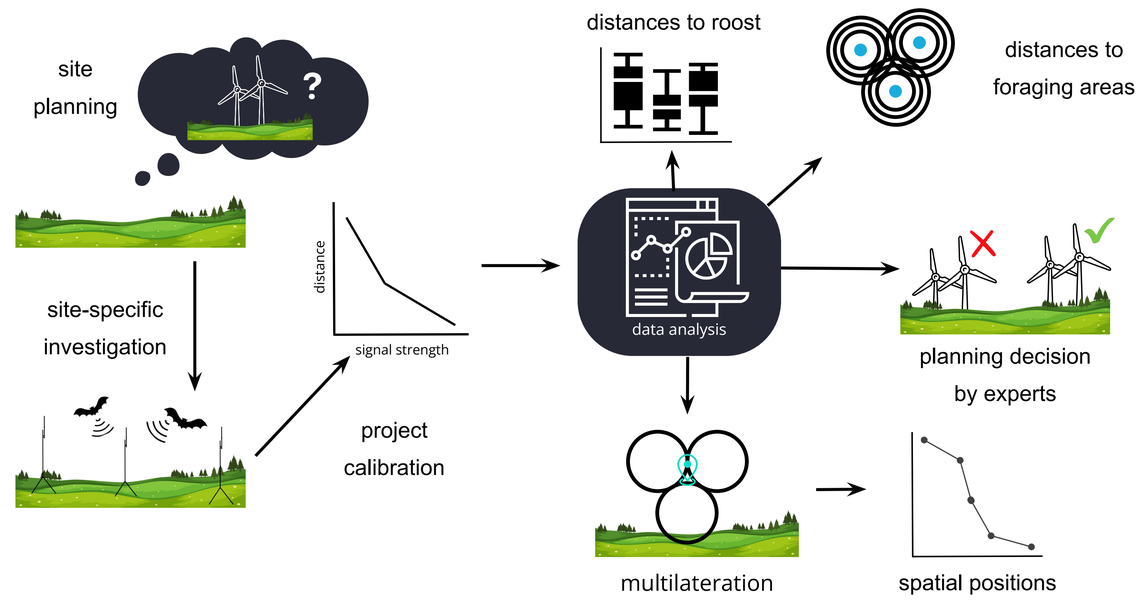
3 projects in road construction

Contact @ EBRS

Jannis Gottwald
CEO trackIT Systems GmbH
gottwald@trackit.systems
+49 1578 3538221

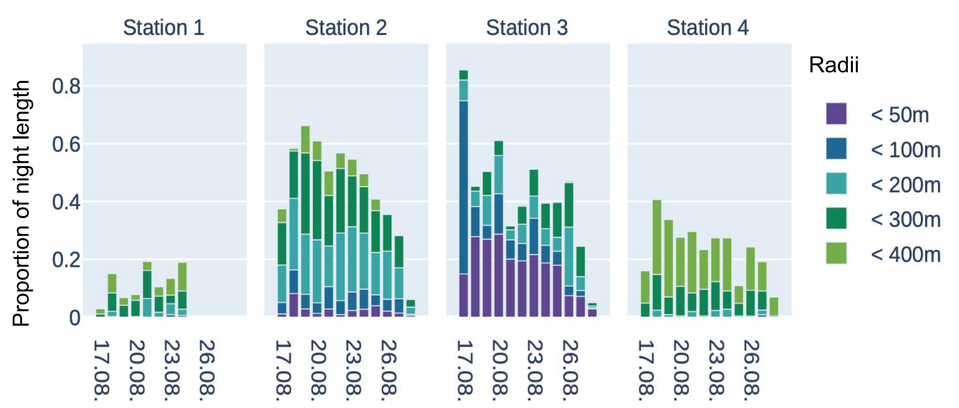
https://trackit.systems

Presence-absence telemetry in wind power planning



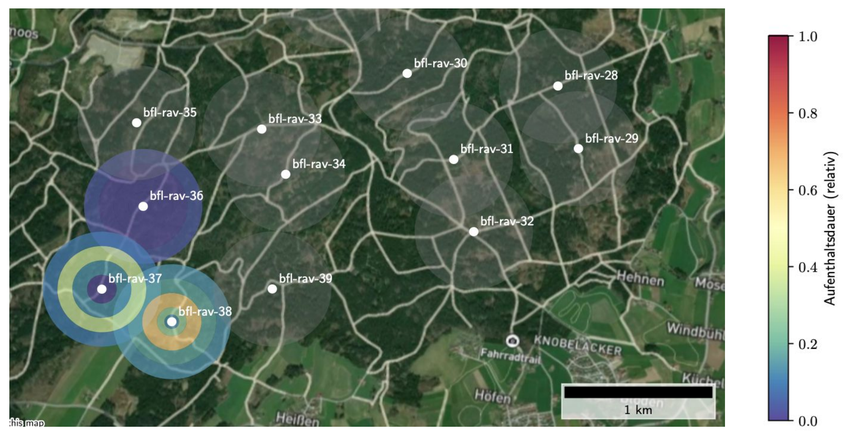
Location-based presence/absence telemetry enables the **permanent and precise recording** of the distances of **foraging areas and roosts** to the area of intervention. The high temporal resolution also enables the precise recording of very short events such as line crossings

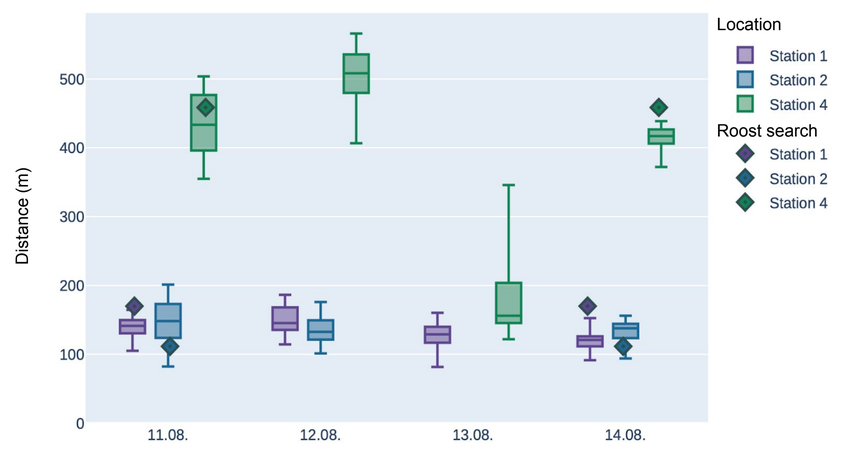
Presence-absence analysis: foraging and roosts



For each intervention site, a figure is created both per individual and aggregated by species that shows the **relative duration of presence in radii around the intervention site**. Assessors can thereby easily evaluate the suitability of the site.

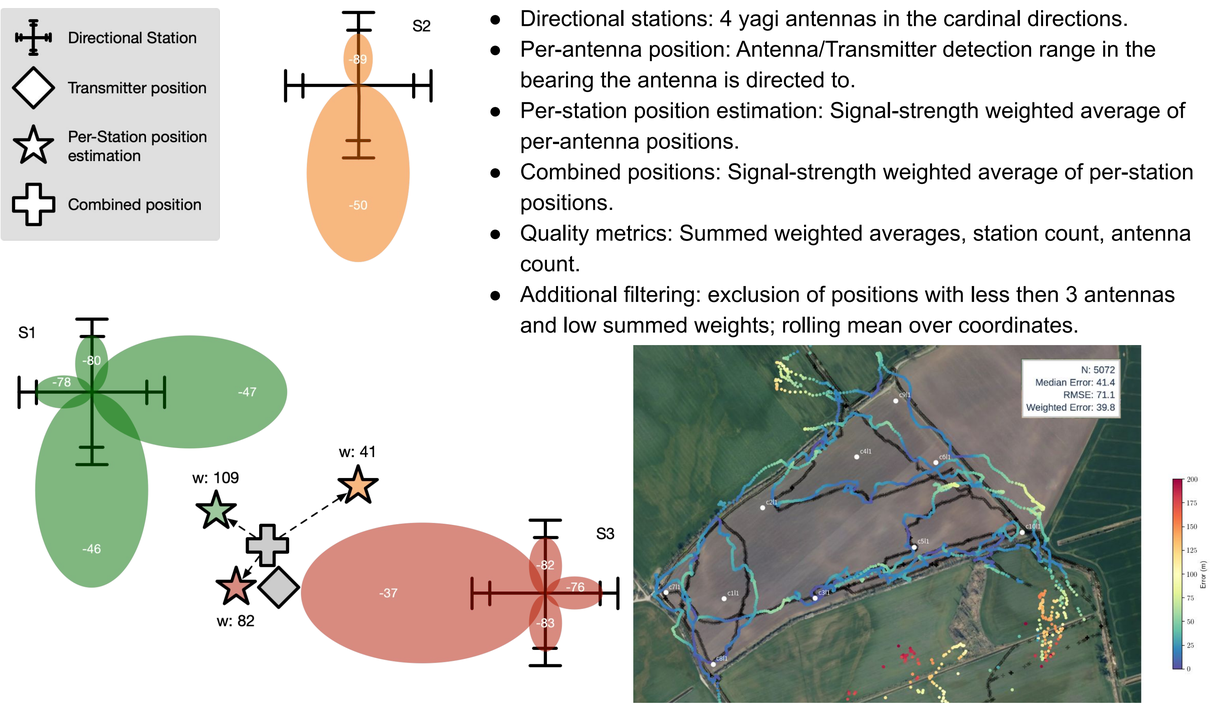
An aggregated spatial representation of the nocturnal presence times enables the localization of probable hunting areas. The distance circles show the **nights with the longest duration of presence**.





Manual **roost searches** that are usually carried out on two days (diamonds) can be supplemented by automatic roost-distance to intervention site detections (boxplots). In the diagram shown, the individual changed the roost on day three which was not detected by manual roost searches.

Position-finding with directional stations



- Directional stations: 4 yagi antennas in the cardinal directions.
- Per-antenna position: Antenna/Transmitter detection range in the bearing the antenna is directed to.
- Per-station position estimation: Signal-strength weighted average of per-antenna positions.
- Combined positions: Signal-strength weighted average of per-station positions.
- Quality metrics: Summed weighted averages, station count, antenna count.
- Additional filtering: exclusion of positions with less then 3 antennas and low summed weights; rolling mean over coordinates.

Positional telemetry allows a **spatially and temporally precise resolution**, for example when intervention sites are not yet known, or other issues, such as in the example shown, the use of space within maize fields is to be investigated.

References

Gottwald, J., Zeidler, R., Friess, N., Ludwig, M., Reudenbach, C., & Nauss, T. (2019). Introduction of an automatic and open-source radio-tracking system for small animals. *Methods in Ecology and Evolution*, 10(12), 2163-2172. DOI: 10.1111/2041-210X.13294

Höchst, J., Gottwald, J., Lampe, P., Zobel, J., Nauss, T., Steinmetz, R., & Freisleben, B. (2021). tRackIT OS: Open-source Software for Reliable VHF Wildlife Tracking. In *GI-Jahrestagung (pp. 425-442)*. DOI: 10.18420/informatik2021-035

Gottwald, J., Royauté, R., Becker, M., Geitz, T., **Höchst, J.**, Lampe, P., ... & Nauss, T. (2023). Classifying the activity states of small vertebrates using automated VHF telemetry. Methods in ecology and evolution, 14(1), 252-264. DOI: 10.1101/2022.03.22.485147