Permanent acoustic recording is appropriate to assess bat diversity, activity and migration patterns

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Introduction

Recently the installing of wind power is spreading out into forested low mountain areas in Germany with lesser wind speeds compared to coastal regions. For bats forests provide both roosting and foraging sites of high quality. Most woodlands in central Germany are not only of high importance for local but also for migrating populations. In contrast, some guidelines for building up wind power in Germany (e.g. Bavaria, North Rhine-Westfalia) still consider bat activity acquisition unnecessary without clear evidence.

We predict that there is no landscape without bat activity. But it is considerable that there are differences in bat diversity, activity and migration patterns depend on climate, landscape composition and elevation.

Methods

In the course of several windfarm projects we investigated bat diversity and activity at 27 locations distributed over central and south-western Germany during 2012 - 2014.
We used stationary ultrasonic bat detectors (batcorders, EcoObs, Germany) for automatic long time monitoring from the end of March until the beginning of November. The real-time recordings of bat calls were determined manually at genus or species level and grouped in three bat-call-types, the *Pipistrellus*-group (bats of genus *Pipistrellus*), the *Myotis*-group (bats of genus *Myotis*, *Plecotus* and *Barbastella*) and the *Nyctalus* group (bats of genus *Nyctalus*, *Eptesicus* and *Vespertilio*). As a migratory species within the *Pipistrellus*-group, *Pipistrellus nathusii* is listed separately. By comparing the activity of the groups regarding time and locations we analyzed the phenology of bats in forested and open landscapes under different climate conditions.

Results

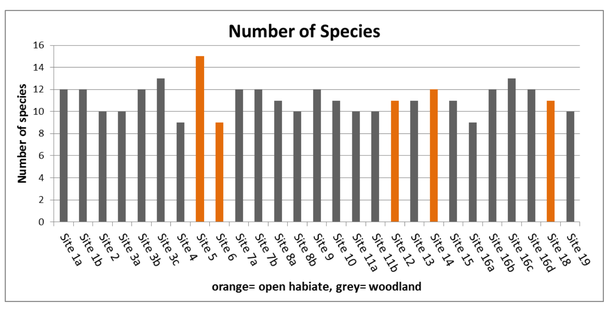

Fig. 1: Number of species (top) and average bat activity per night (down) while investigation.

At least we detected nine bat species in every landscape. The number of species ranged between nine and 15 and there is no difference in total between open landscape and woodlands (Fig. 1 top).

In comparison between the monitored locations bat activity varied in total and also within the bat-call-types (Fig. 1 down).

We found

- Ø 201 sessions per location (min: 148, max: 231),
- Ø 11 species per location (min: 9, max: 15),
- Ø 161,8 recordings per night (min: 15,8, max: 402,3).

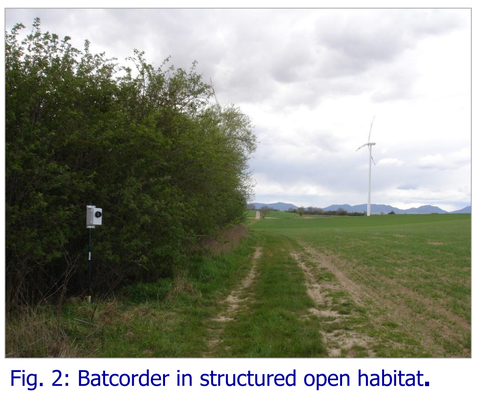

Fig. 2: Batcorder in structured open habitat.

Fig. 3: Batcorder in a gap in woodland.

There is no significant difference in bat activity between structured open landscape and gaps in forested areas (Fig. 4). Even forest dwelling bats were detected along tree lines and linear hedgerows in open landscapes in particular in late summer during post-lactation and migration period.

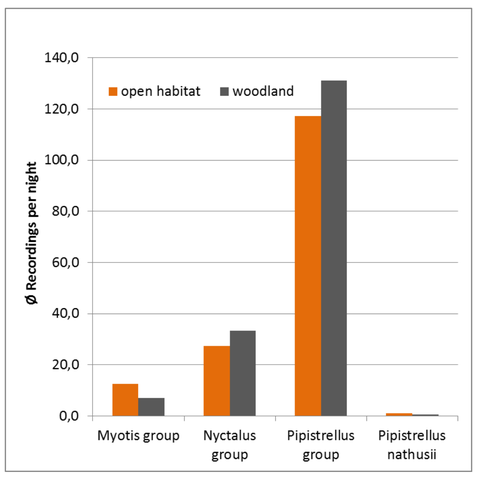

Fig. 4: Average bat activity (all bats at all study sites) per night in open habitat and woodland.

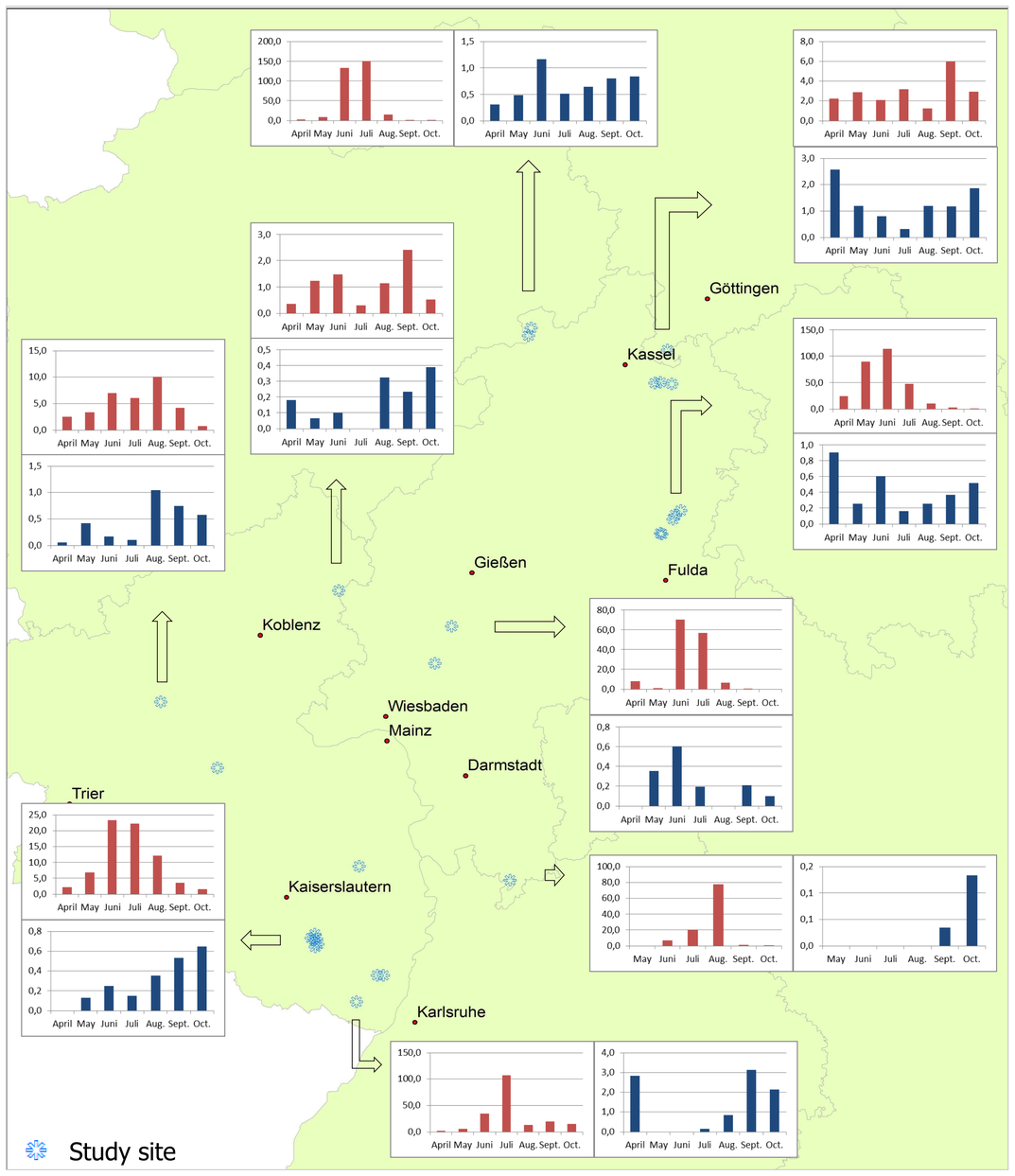

Fig. 5: Seasonal variation in bat activity at different study sites. red= Nyctalus group, blue= *Pipistrellus nathusii.* Ordinate shows average recordings per night in the corresponding months.

Migration patterns differed between the monitored landscapes without a clear influence of habitat, climatic conditions or geography. At some sites bimodal activity peaks of Nyctalus group can be observed (Fig. 5). Peaks in June and July are also detected when no nurseries were found or known for the region. Migration of the Nyctalus group is by trend earlier than migration of *Pipistrellus nathusii.* Nathusius` pipistrelle shows more distinctive patterns of migration with lower detected activity (on ground) in total (Fig. 5).

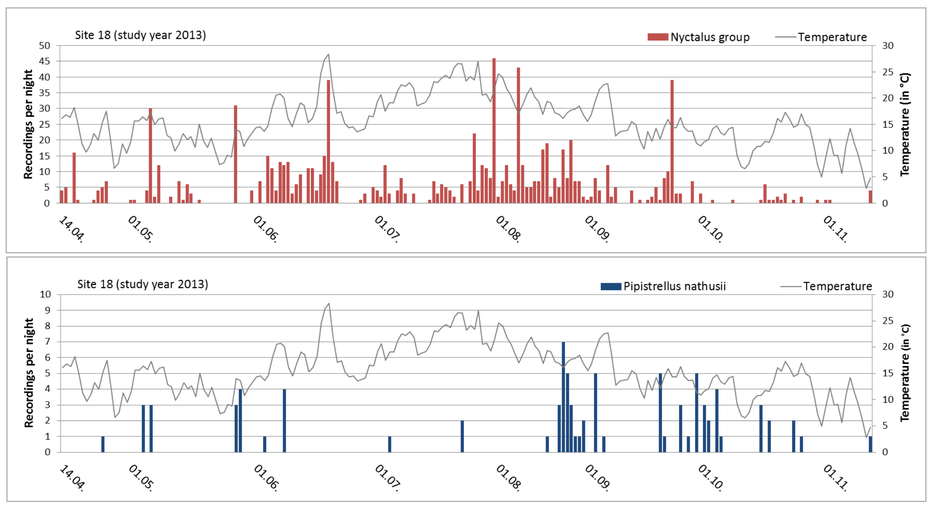

Fig. 6: Bat activity (recordings) per night during investigation. Each bar represents one night.

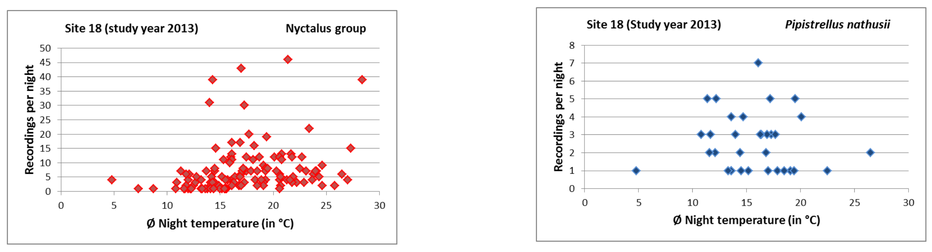

Fig. 7: Bat activity depending on temperature (representative example). Every point represents one night. Nights with no activity are excluded from diagram.

The top diagram (Fig. 6) shows a representative example of bat activity throughout the year. Bat activity runs in peaks. High bat activity in single nights or periods alternate with very low activity. Misjudgments are likely by using only detector transects in single nights. Fig. 7 shows representative distribution of activity depending on temperature. Nights below 10 degrees Celsius rarely show high bat activity of aerial hawking bats. Most monitored study sites show a similar picture as Fig. 6 and Fig. 7.

Conclusion

- ✓ Bat activity can be observed at all study sites. There is no landscape without bats!
- ✓ Bat investigations due to wind park projects must be obligatory.
- ✓ Even in open habitats activity was consistently high.
- ✓ The activity can not be explained exclusively by habitat, climate or elevation.
- ✓ The Nyctalus group often shows bimodal activity pattern with peaks during nursery period (June and July) and autumn migration (end of July, August and September).
- ✓ In central and southern Germany *Pipistrellus nathusii* shows more pronounced migration patterns. In some locations a substantial activity peak during spring migration was observed. Furthermore it was remarkable that autumn migration starts later and lasts longer compared to Nyctalus group.
- ✓ Bat activity runs in peaks throughout the time of investigation. Therefore permanent automatic acoustic recording from early spring to beginning of winter time gives an accurate image of activity. Using detector transects only is not enough!

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