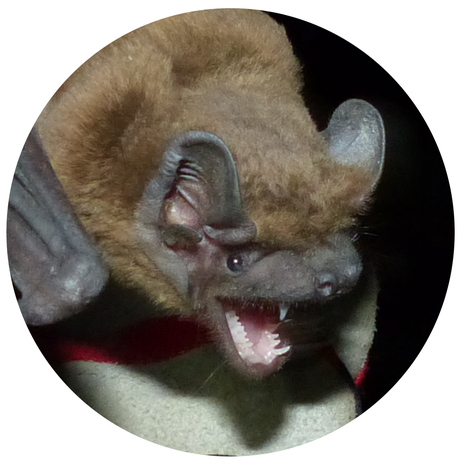


# Social networking... for bats?!

Manuel Roeleke, Ulrike E. Schlägel, Cara Gallagher, Jan Pufelski, Torsten Blohm, Ran Nathan, Sivan Toledo, Florian Jeltsch, & Christian C. Voigt

Squeak

## Overview @background

Some insectivorous bats are known to eavesdrop on feeding buzzes of conspecifics to find prey patches -> Local enhancement

Several recent studies indicated that open-space foragers may also use social information **while sampling the landscape**. As they can hear conspecifics over much larger distances than they can detect prey, bats may greatly increase their search radius when forming mobile sensory networks.

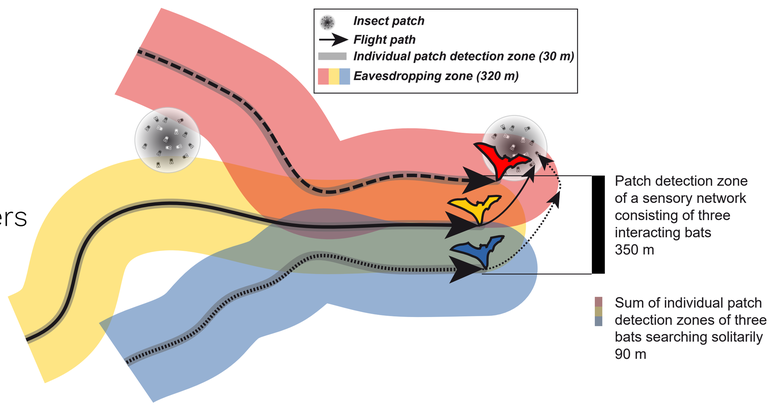
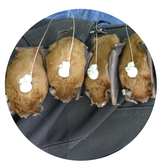



Figure 1 - Concept of a mobile sensory network, illustrated for insect-feeding bats.



## Tracking bats @empirical_analysis

81 tagged bats

359 foraging flights

5 sessions in 2018-2020

Individual fine-scale movements were analyzed in relation to tagged conspecifics to identify mechanisms by which bats form and maintain mobile sensory networks.

We first ran an integrated step selection analysis (iSSA) to detect instances where focal bats responded to the presence of a tagged conspecific.

Two linear mixed models were then run to identify conditions under which bats adjusted their flight trajectories to those of other tagged bats.

Results were compared to a null model using pseudo-dyads.

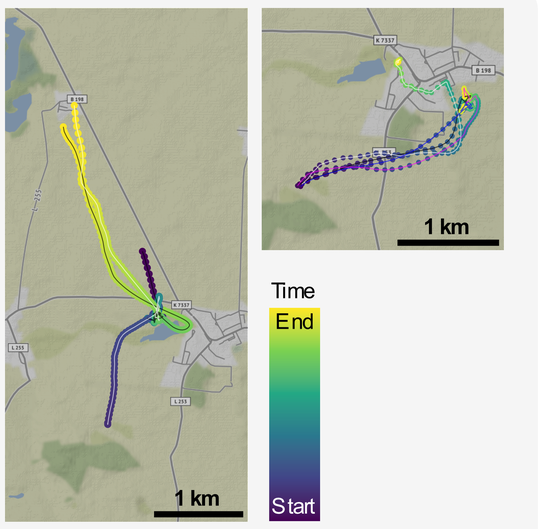
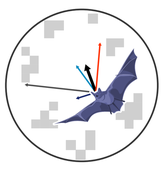


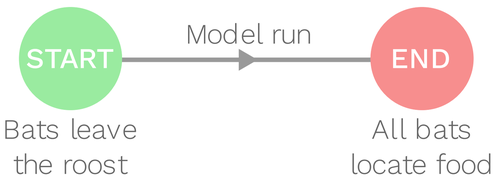

Figure 2 - Excerpts from exemplary flights of tagged bats that aligned with each other while searching for prey. Dots represent the spatial positions recorded by the ATLAS tracking system, with color coding for time of the day to facilitate recognition of simultaneously recorded positions.



## Simulating networks @modelling_analysis

To assess the potential benefits of sensory network foraging, we developed an agent-based theoretical model using general interaction-based movements and parameterized it with findings from the tracking data.

We simulated a colony of bats foraging in a landscape containing prey with varying levels of patchiness (Fig. 4a).




Bats move through the environment using four movement behaviors (Fig. 4b): attraction, alignment, and avoidance (which are influenced by interactions with conspecifics), and random walk.

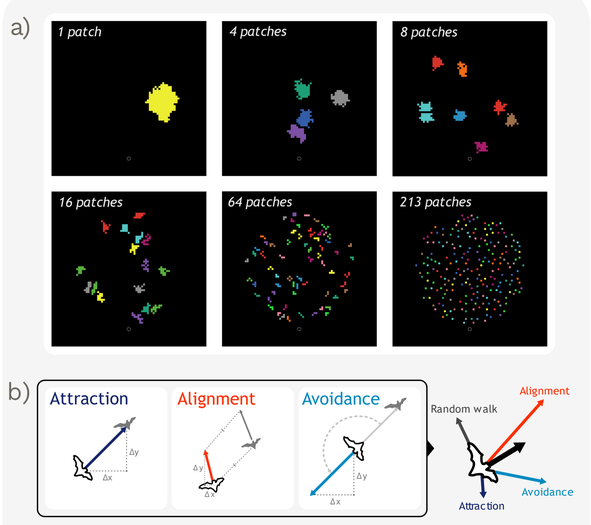



Figure 4 - a) Example model landscapes generated with dif ering numbers of patches. b) The three interaction-based behaviors and random walk vector which drive bat movement direction.

## Conclusions @Roeleke et al, PNAS 2022

This study is the first to present high-resolution movement data of several simultaneously tracked insectivorous bats and provides the first strong evidence that open-space foraging bats socially sample the landscape for food using sensory networks.

Simulations substantiated that the observed movement mechanisms lead to the formation of sensory networks, and additionally revealed under which conditions foraging as a sensory network is beneficial.

Our combination of empirical and modelling analyses helped to elucidate how groups of animals can locate prey ef ciently despite their dependence on unpredictable and ephemeral food patches.



**Common noctule bat**
@Nyctalus_noctula

## Key questions

1. Do common noctules form sensory networks during prey search by adjusting flight behavior to neighbors?

2. What are the potential benefits of sensory networking, e.g. in foraging efficiency?

## Trends for tracking data

Our integrated step selection analysis indicated that focal bats responded to tagged conspecifics in ~40% of cases.

The models revealed that bats adjusted their flight vectors and distances relative to conspecifics, depending on intraspecific distance and the hunting behavior of their nearest neighbors (Fig. 3)

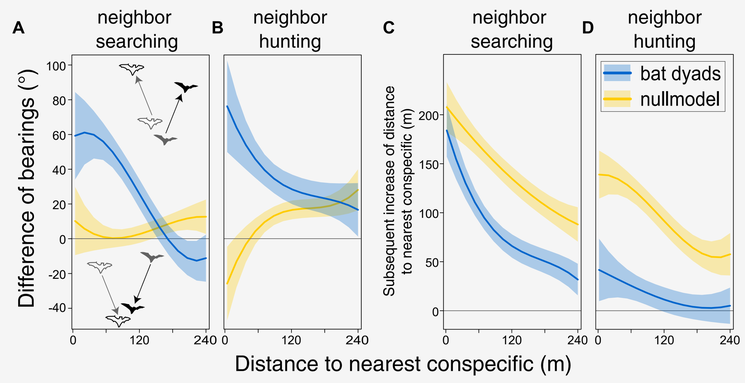



Figure 3 - Dif erence in bearings of (**a** and **b**) and change of distance between (**c** and **d**) the focal bat and its nearest conspecific during a 32 s flight interval.

## Trends for simulations

Networking increased prey search ef ciency in landscapes with patchy prey distribution. However, the benefit of networking diminshed with decreasing group size.

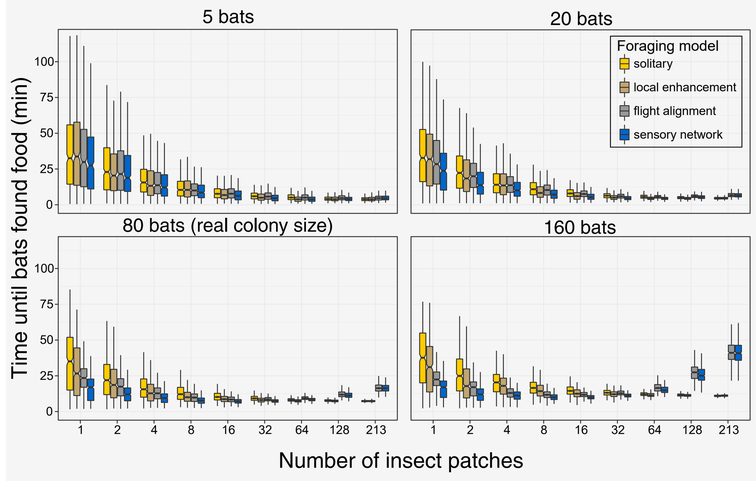



Figure 5 - Time it took simulated bats to find unoccupied food cells, depending on group size, resource patchiness, and the use of social movement strategies.

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