iomE
Institut für Organismische und Molekulare Evolutionsbiologie

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Master thesis:

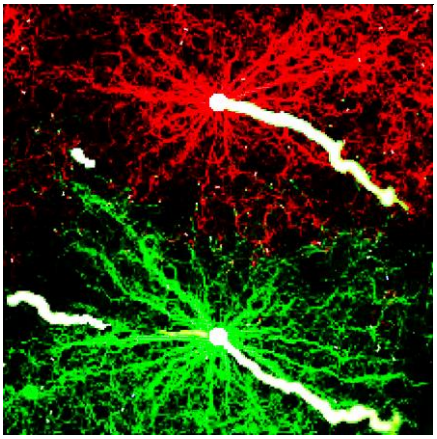
Agent-based model of foraging behaviour in ants

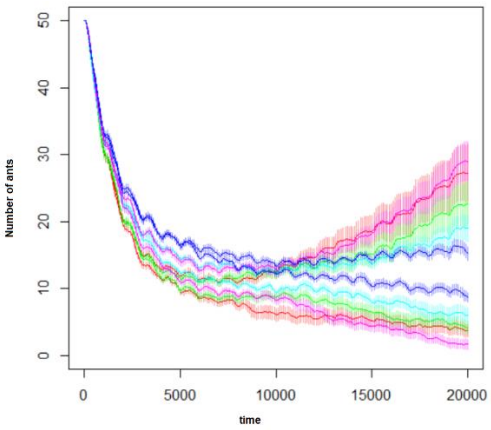
Social insects have evolved manifold ways to achieve efficient foraging. Ants are particularly famous for their system of trail pheromones, which ensures that individual ants who found a food source can direct their fellows to a good food source in the most efficient way (Czaczkes et al. 2014). This method has even inspired routing algorithms in the world wide web and are crucial for an efficient connection between server and client (Bonabeau et al. 2000).

Foraging *Tapinoma sessile* ants on a trail. Photo: Alex Wild.

But ants do not blindly follow trail pheromones. Competing ant colonies also populate their habitat – and they all leave chemical traces, so-called chemical footprints. Ants take these footprints into account when deciding where to go, and avoid some but approach others (Wüst & Menzel 2017, Menges & Arz unpublished data). This behaviour may be crucial to allow optimal foraging while reducing competition.

We offer a master thesis to study how footprint responses affect foraging success via agent-based modelling. Agent-based models allow to implement individual behaviour and then study how it scales up to the fitness of the whole colony. We want to determine the optimal strategy to react to footprints, including behavioural variation between workers, learning of unknown footprints and variation in the tendency to fight with competitors.





left: Simulation of two colonies with trail pheromones (white) and a network of colony-specific footprints (red and green).
right: population dynamics of simulated pairs of ant colonies with different footprint response strategies. Both graphs by Marti Wittke

We search for a highly motivated Master student to investigate how variation in footprint responses affects colony fitness *in silico.* No *a priori* programming skills are necessary, but affinity to write code is helpful. The thesis may be complemented by behavioural experiments with ants in the field or in the lab. Starting date is flexible, from January 2022 or later. If you are interested or have further questions, please do not hesitate to contact Dr. Florian Menzel (menzelf@uni-mainz.de; Biocentre I, Room 01-474).

References

Bonabeau, E., Dorigo, M., & Theraulaz, G. (2000). Inspiration for optimization from social insect behaviour. Nature, 406(6791), 39-42.

Czaczkes, T. J., Grüter, C., & Ratnieks, F. L. (2015). Trail pheromones: an integrative view of their role in social insect colony organization. Annual review of entomology, 60, 581-599.

Wüst, M., & Menzel, F. (2017). I smell where you walked–how chemical cues influence movement decisions in ants. Oikos, 126(1), 149-160.