Contrat doctoral – ED Galilée

Titre du sujet : Spatial organization and inter-colony interactions in tropical termites

- Unité de recherche : Laboratoire d'Ethologie Expérimentale et Comparée (LEEC)
- Discipline : Ethologie
- Direction de thèse : David Sillam-Dussès
- Contact : sillamdusses@univ-paris13.fr, +33 (0) 1 49 40 39 54, 07 60 84 78 88
- Domaine de recherche : éthologie, écologie comportementale
- Mots clés : comportement, termite, nutrition, compétition, modélisation

---

State of the Art

Termites are social insects which are the most diverse and abundant in the Congo Basin. Their role as the main decomposers of dead vegetal matter on Earth is fundamental (Eggleton 2000). Known to eat wood as well as soil, termite feeding niches span the decomposition gradient, with niche availability increasing among soil feeders. To study this, feeding niche partitioning among soil feeders can be assessed through stable nitrogen isotope ($\delta^{15}N$) analysis of soil samples and termite gut contents (Bourguignon et al. 2009). Existing research on termite spatial organization primarily focuses on single-colony nest structure and tunnel mapping (Darlington et al. 1982). This research provides key insights into foraging territories and inter-colony interactions at the surface but fail to capture the vertical complexity of termite spatial coexistence in the soil.

Aims

This project aims to reach three goals:

1. Delineate three 1-hectare sites and conduct onsite surveys of above-ground nesters and 5 × 5 m excavation plots to assess the subterranean termite communities
2. Integrate fine-scale excavation, agonism biotests, morphological and molecular analyses, and virtual 3D modeling for high-resolution termite colony mapping at the surface of the soil and in the soil.
3. Reveal patterns of competition, space exploitation strategies, and niche partitioning.

Methodology

The fieldwork will be performed in Gabon. The PhD student will identify and georeference all visible nests in 1-hectare sites, perform agonism behavioral tests (nest occupants vs. termites from soil between nests), and generate a 2D spatial distribution model of colony foraging boundaries. In addition, the student will excavate entire 5×5 m plots in 10×10×10 cm soil cubes, georeference cubes and systematically sort termites, conduct agonism behavioral tests, preserve termites and soil samples for lab analyses, and build 3D models. Species identity will be solved via termite morphology, enteric valve (species-specific gut microstructures) dissections, and DNA analysis (Bourguignon et al. 2013). At last, $\delta^{15}N$ analysis will assess niche partitioning.

Feasibility & Preliminary Results

This methodology was successfully tested in Cameroon in 2023. The PhD project, in the line of the research topics at the LEEC, will be supervised by Pr. David Sillam-Dussès, ethologist and termite specialist, who already visited Gabon in 2025 and reported ideal work conditions (field station access, contact and agreement with scientists from Gabon, and research permit acquisition). Further international collaboration with Dr. Cynel Moundounga (Gabon) has been agreed upon fieldwork management, with Pr. Martin Mihaljevič (Czech Republic) for $\delta^{15}N$ analysis, and with Dr. Thomas Bourguignon (Japan) for molecular analyses. Funding for data analysis is already held by Pr. Sillam-Dussès.

Significance & Expected Outcomes

This study provides a framework for the first attempt to assess termite colony spatial organization both above- and below-ground, improving understandings of resource partitioning, exploitation strategies, and inter-colony interactions. Findings may have implications for nutrient cycling, forest decomposition dynamics, and conservation efforts in tropical ecosystems, and are planned for publication in leading ecological journals.