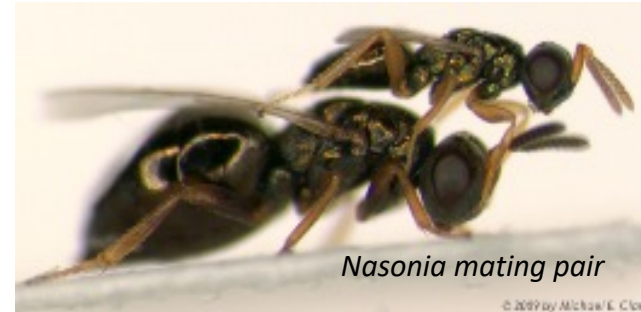


# Molecular Evolution and Sociobiology

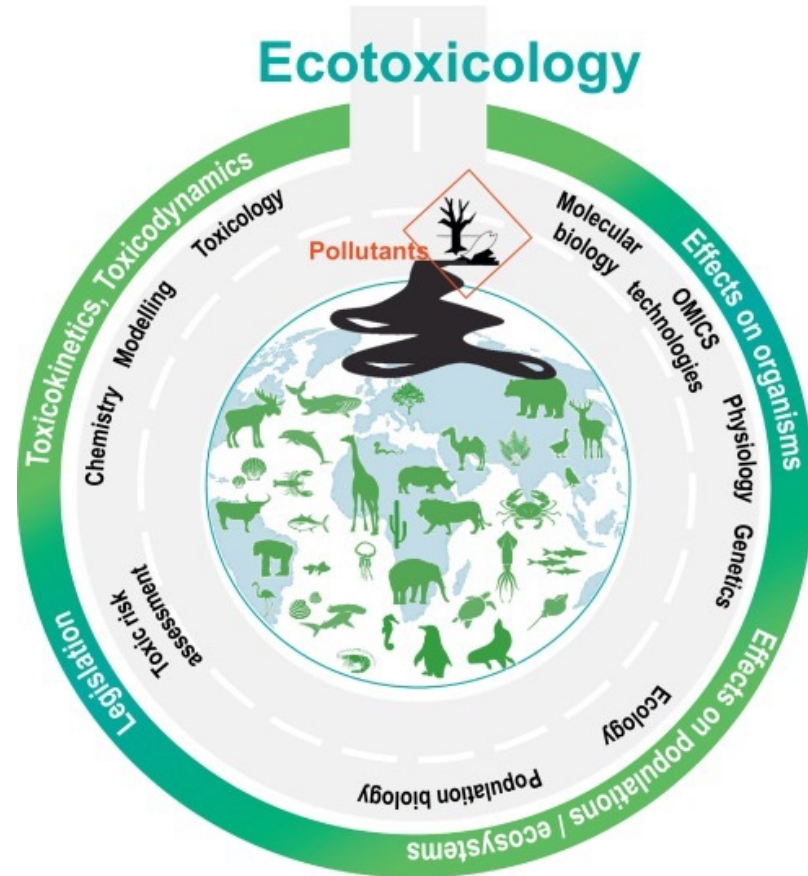


Prof. Jürgen Gadau

- **Research lines:**

- Sociogenetics, Populationgenetics and Sociogenomics of ants
- Functional and Comparative Genomics of hymenopteran parasitoids and ants
- Chemical Communication in insects and its genetic/genomic basis
- Genetic/epigenetic architecture, evolution, origin and maintenance of unusual breeding and caste determination systems in ants
- Behavioral Ecology of ants and parasitoids (individualized niche, host preference, social interactions)
- Effect of pesticides and GMOs on non-target organisms and in particular ants

# Lethal, sublethal and microbial effects of glyphosate-based herbicides (GBH) on the myrmecine ant *Cardioconcylla obscurior*



## Background:

- Commercial use of the herbicide glyphosate was recently extended for another 10 years
- Insects show strong sublethal and microbial effects
- Ants are currently not included in any risk assessment guideline
- Ants have a high ecological value
- Lack of data for long-term exposure

## Methodology:

- exposure of different GBH concentration on queen right colonies of *C. obscurior*
- tracking of mortality, pupation rate, behavioural changes, reproductive changes
- Insect dissection
- DNA metabarcoding
- Cultivation of digestive microbiome
- Statistical evaluation



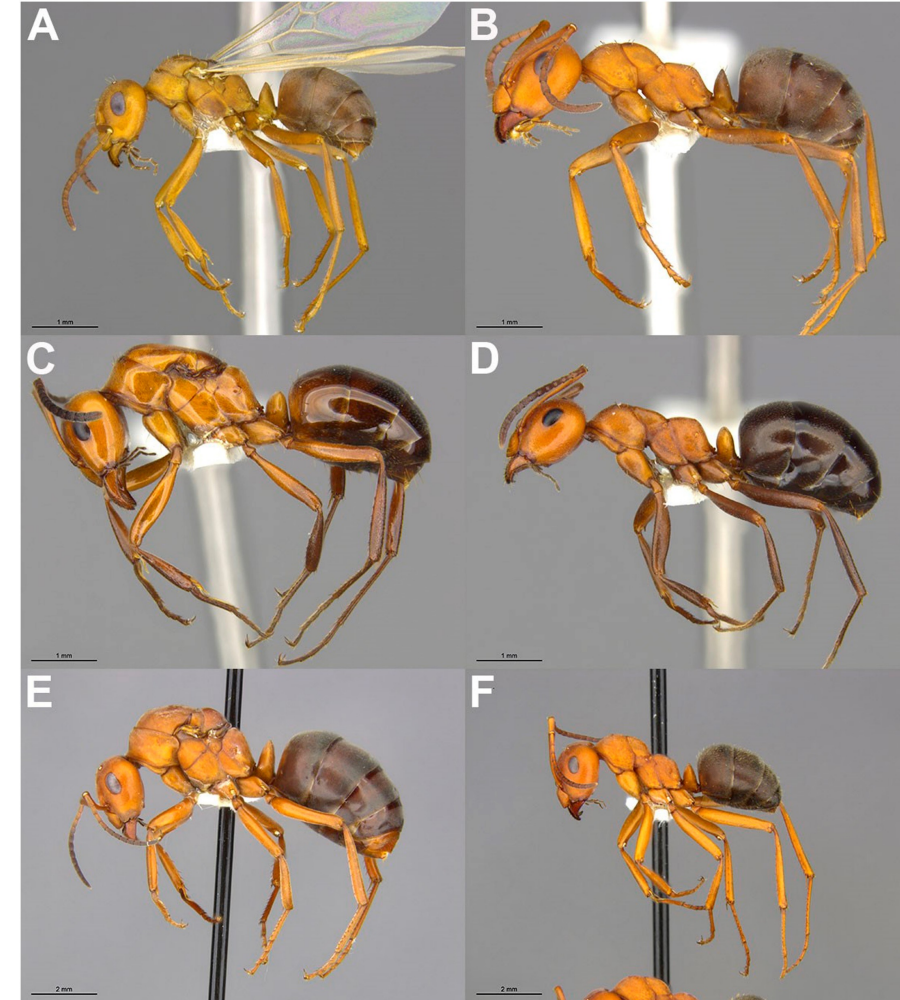
# Hybridization, population genetics and social structure of the wood ant *Formica polyctena* and *Formica rufa*

## Methodology:

- DNA Extraction
- Polymerase chain reaction (PCR)
- DNA purification
- DNA Barcoding
- Primer developing/optimizing
- Microsatellite analyses
- Phylogeny

## Background:

- Wood ants (genus *Formica*) are widely distributed in the northern hemisphere
- Major cleaning force in forest areas
- Possible hybridization of *F. rufa* and *F. polyctena*
- Preliminary work showed a diverse social structure





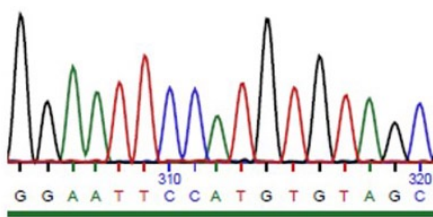
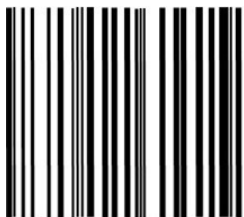
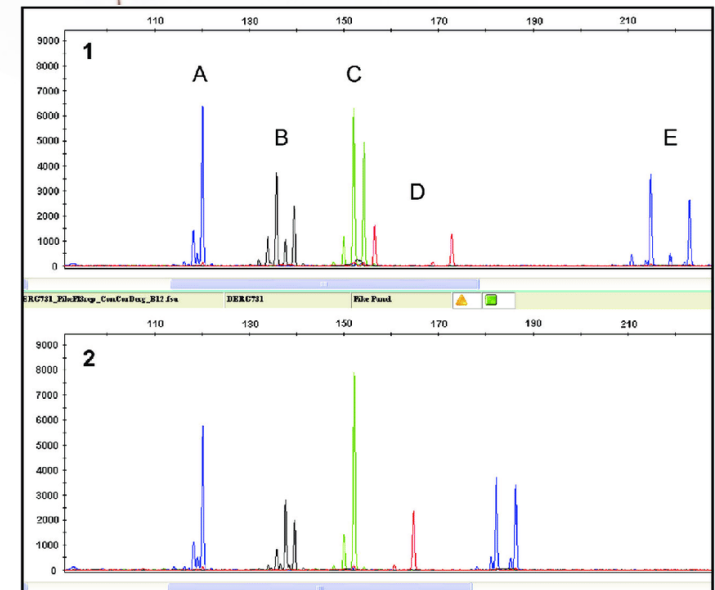
# Species identification, population genetics and social structure of the seed harvester ant genus *Messor* sp.

## Background:

- Wood ants (genus *Formica*) are widely distributed in the northern hemisphere
- Major cleaning force in forest areas

## Methodology:

- DNA Extraction
- Polymerase chain reaction (PCR)
- DNA purification
- DNA Barcoding
- Primer developing/optimizing
- Microsatellite analysis
- Phylogeny



# Lethal and sublethal effects of the GMO plant MON810 (Cry1Ab-Ac) on the European corn borer (*Ostrinia nubilalis*)

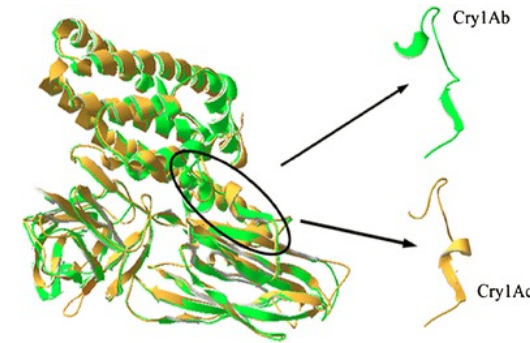


## Background:

- Insect pests are globally distributed and actively destroy the agricultural yield
- Chemical pesticides are used to fight pest insects
- Leads to strong ecological side effects
- **Genetically Modified Organisms (GMOs)** are used as an alternative to fight pest insects
- So called Cry-Proteins derived from *Bacillus thuringiensis* are target specific

## Methodology:

- Establishing a new exposure method for *O. nubilalis* experiments
- Plant sap extraction
- ELISA assays
- Exposure experiments assessing lethal and sublethal effects
- Mortality curves
- Statistical evaluation
- Tracking of sublethal effects



1. *Cardiocondyla* – Glyphosate/Imida/GMO. (Marius)
2. *Nasonia* – nuclear-mitochondrial incompatibility/speciation (finishing Dhevi`s dataset (1000 males) – ms etc. (Jürgen/Dhevi)
3. Sociogenetics of (*Messor* – Marroco, *Formica* – Hiddensee, ...) (Marius, Jürgen)
4. *Pogonomyrmex californicus*– ontogeny of DNA Methylation (Tania)
5. Functional Genomics (dsRNAi knockdowns) of elongases - cuticular hydrocarbons in *Nasonia vitripennis* (Wei)
6. *Myrmecocystus mendax* – e.g. peptidase in FP; Which individual becomes a honeypot – large pupae in ? environment, regulation of caste determination at the genetic/epigenetic level (transcriptomes/DNA methylation?). Jürgen/Lukas/Microbiology



# Social Evolution in *Pogonomyrmex californicus*: “Gene expression differences between developmental stages of the two social types”

♀  
Haplometrosis

Evolution/Maintenance of tolerance for  
cofounding/cohabitating queens

♀ ♀ ♀  
Pleometrosis

- Tolerant and aggressive queens are equally successful founding colonies
- Mutations -> *supergene*, genes for epigenetic modifications/chemical communication
- Expression differences for different social types in different social environments (phenotypic plasticity/social niche construction)
- Phenotypic plasticity modulated by gene expression

**Bachelor Project: Determine if gene expression patterns differs between stages and between the two social strategies in *P. californicus* queens.**

**Methods:** RNA extraction, RNA differential expression, Bioinformatics, statistical analysis, coding in R.

Coordination: PhD Tania Chavarria Pizarro ([tchavarria@uni-muenster.de](mailto:tchavarria@uni-muenster.de))

Project Manager: PhD Jürgen Gadau.





