Conflict between red wood ants and their myrmecophile community

23.01.2016

Thomas Parmentier

INTRODUCTION

- myrmecophiles (‘myrmex ‘= ant, ‘philos’ = loving)
- myrmecophiles s.l.
  - also honeydew producers:

    aphids, scale insects, some caterpillars
  - plants
  - bacteria, fungi …

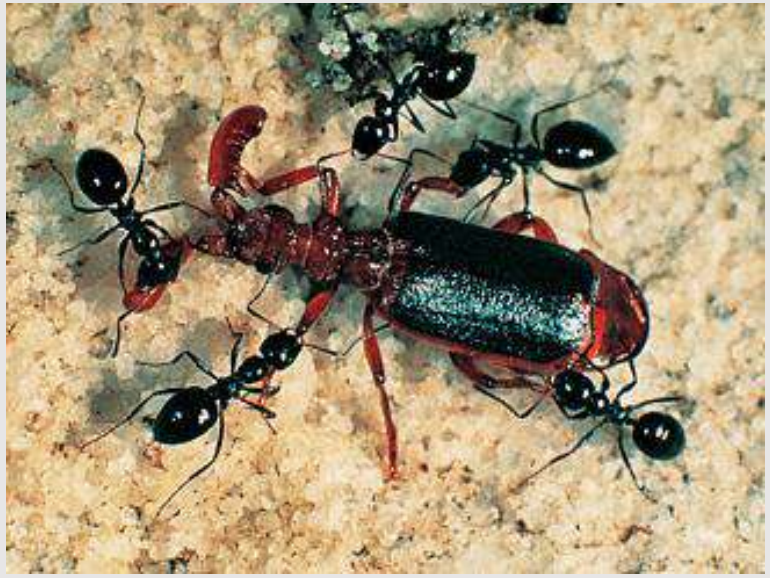
- focus on arthropods in ant nests → true myrmecophiles / ant guests /inquilines
- → PhD project: Conflict between ants and ant associated arthropods
- enormous diversity estimates up to <u>10.000 species</u>!
- almost all insect groups have representatives + spiders, mites

SPECIALIZED MYRMECOPHILES → treated as colony members !

Maculinea (*Phengaris*) *alcon*

Ecitomorpha (Staphylinidae)

Lomechusa (Staphylinidae)



*Paussinae (*Carabidae)

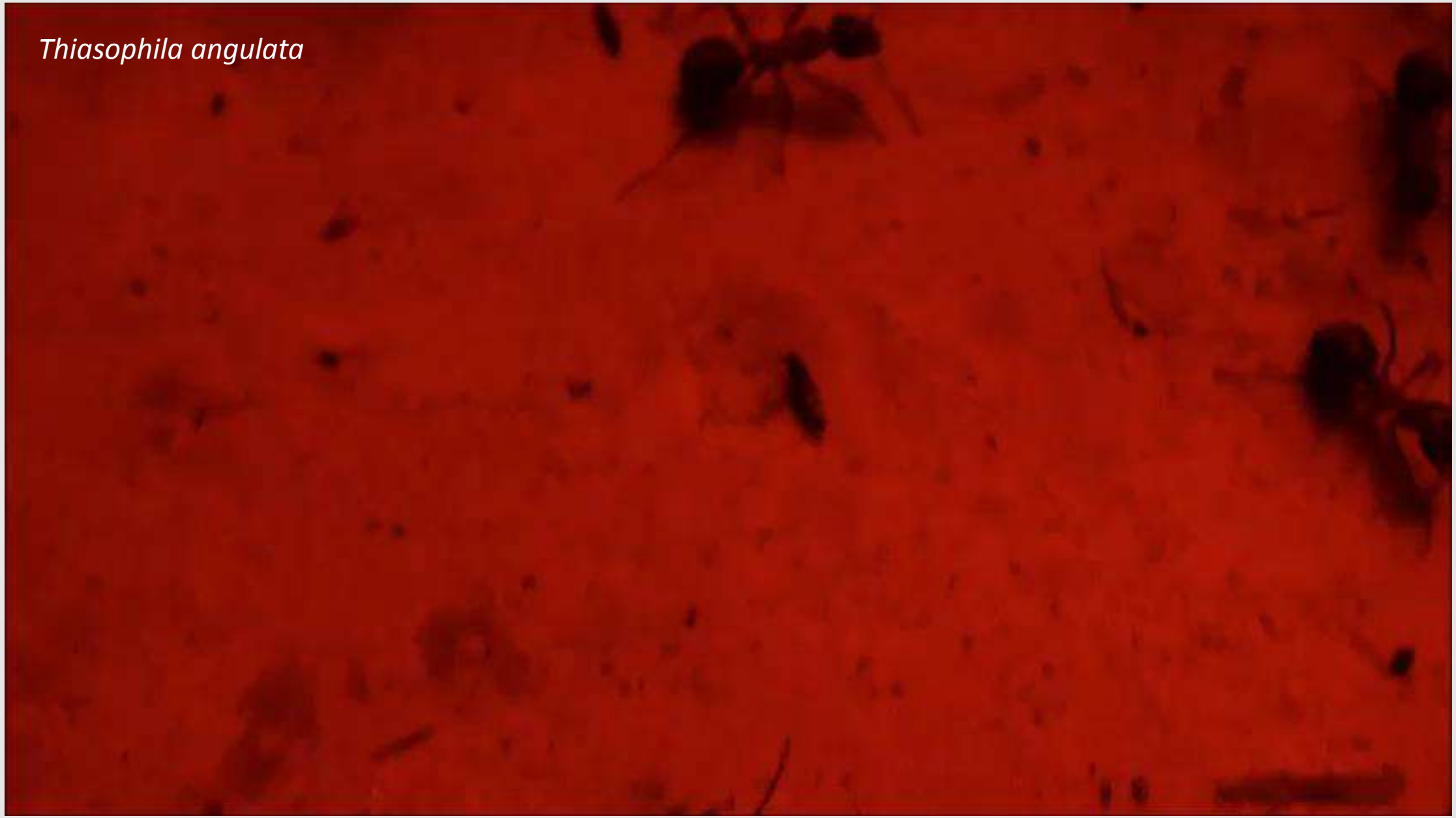
Claviger (Pselaphinae)

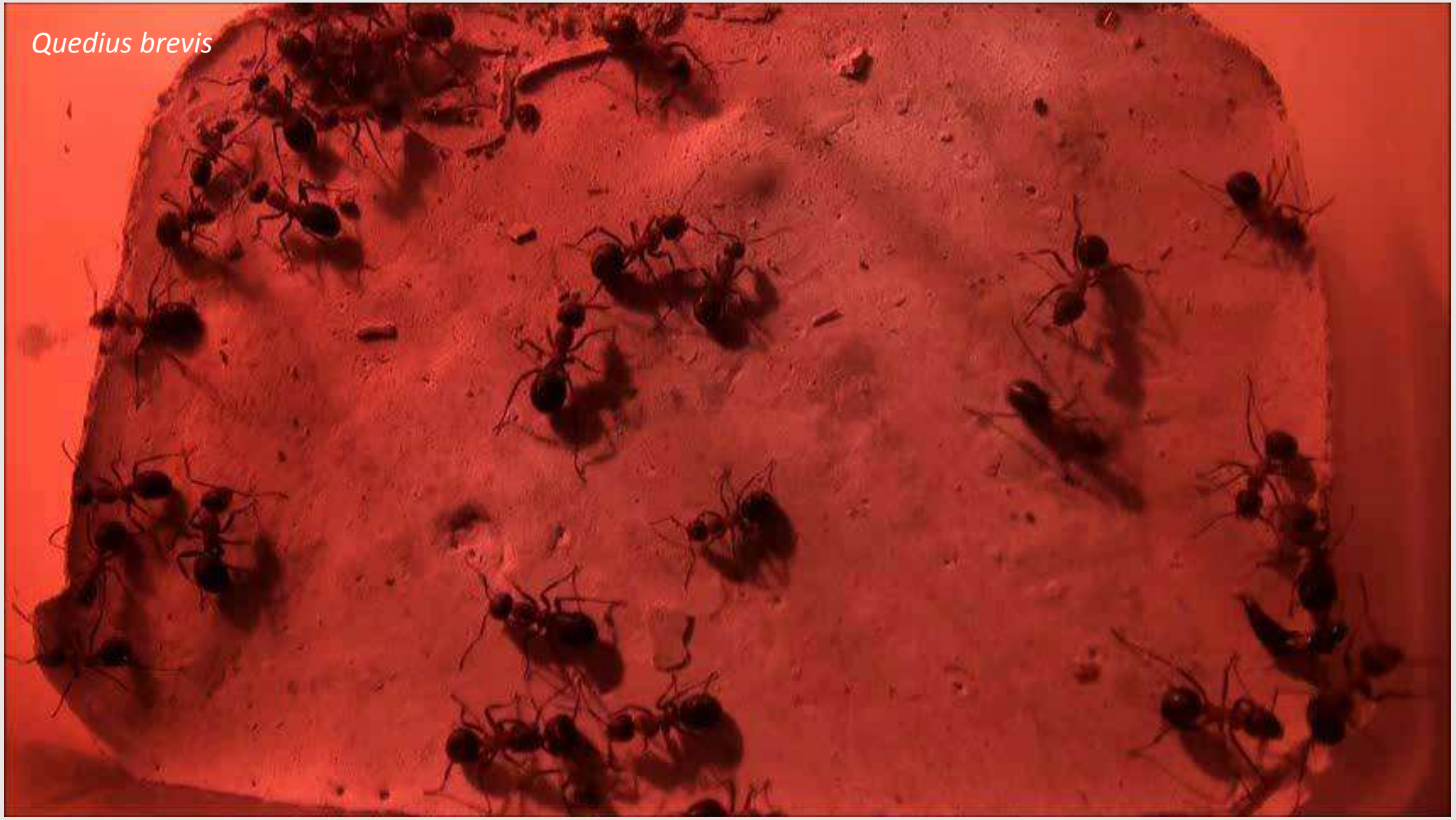
RED WOOD ANT MYRMECOPHILES

RED WOOD ANT MYRMECOPHILES

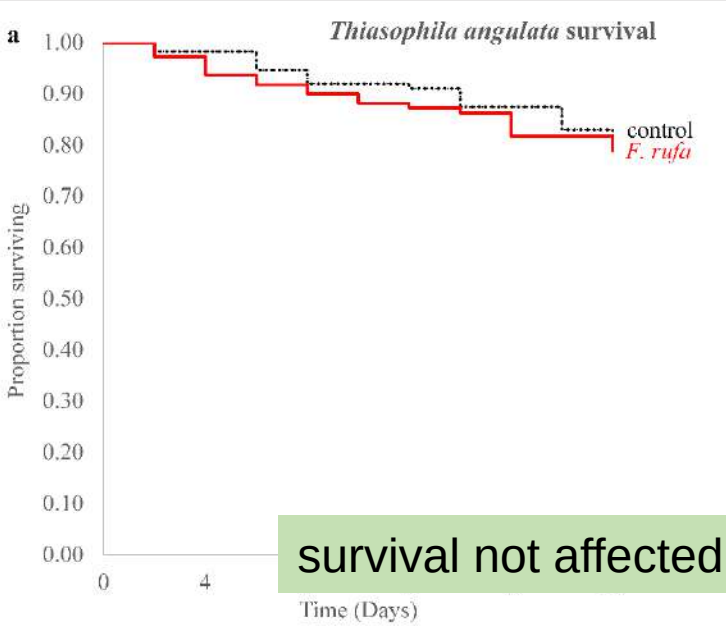
- diverse
- unspecialized species

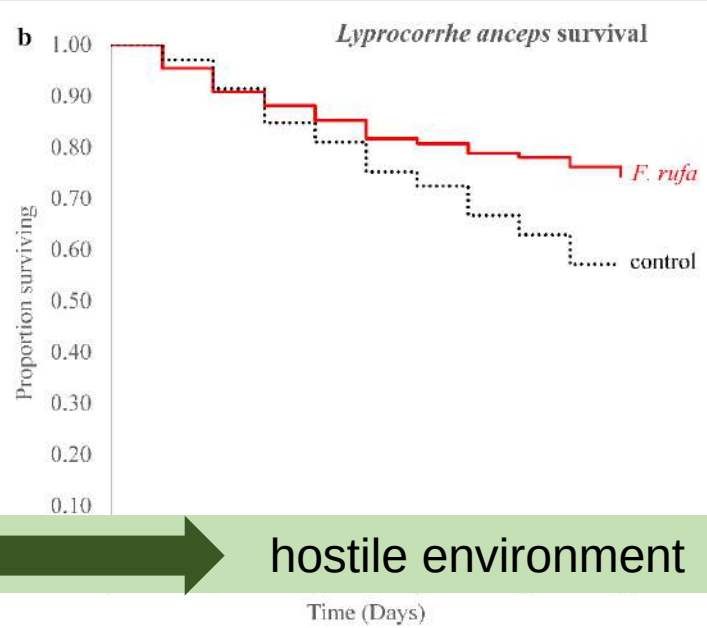

Thyreosthenius biovatus


Thiasophila angulata

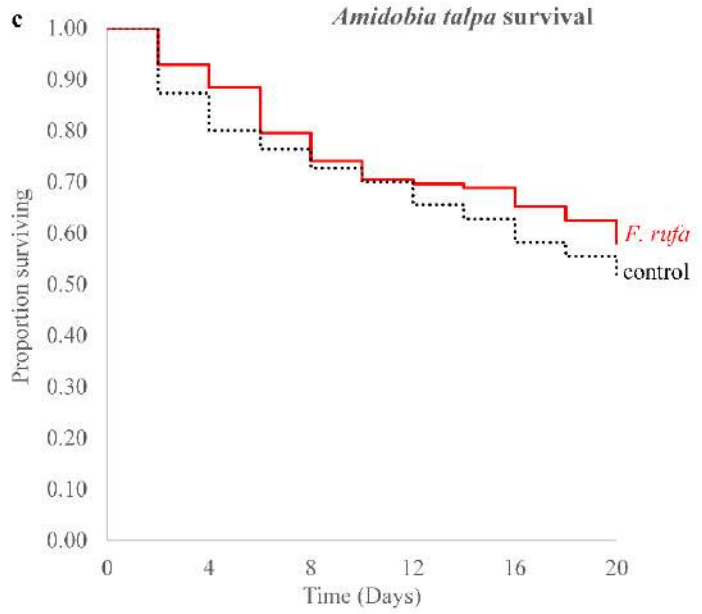

Quedius brevis

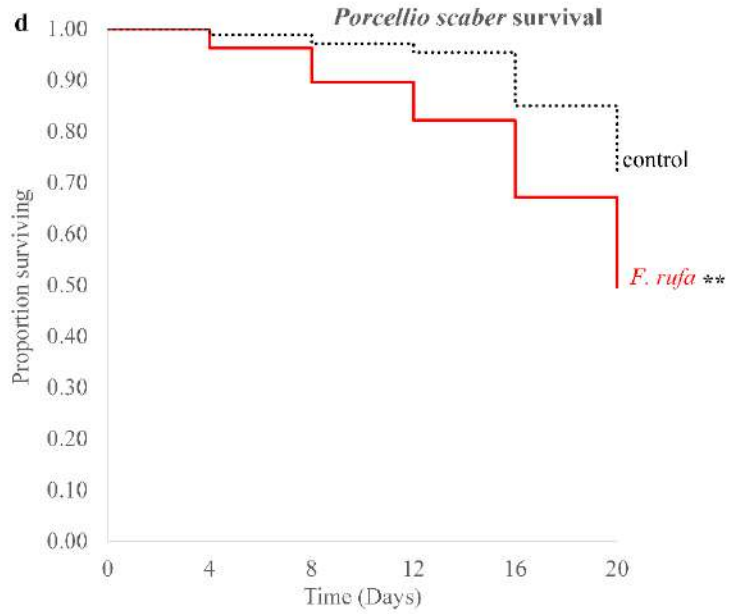
A) SURVIVAL ANALYSES





survival not affected ⟷ hostile environment





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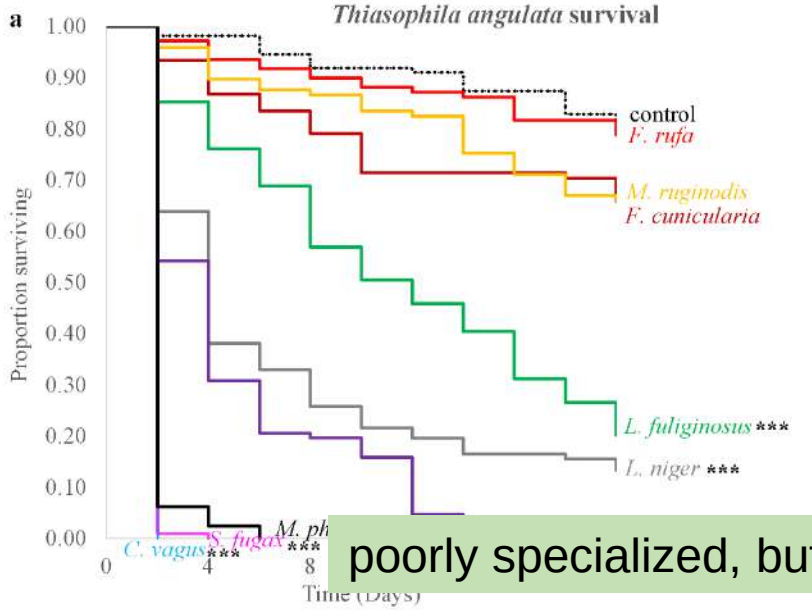
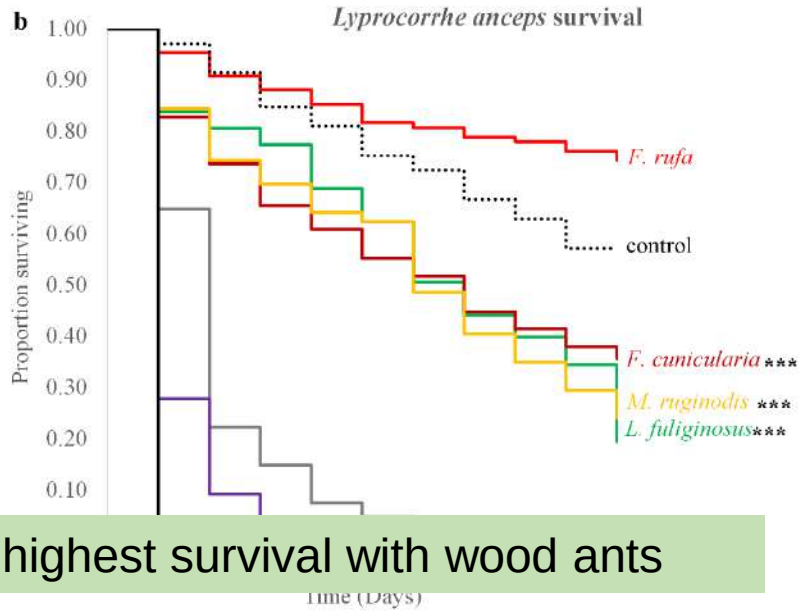
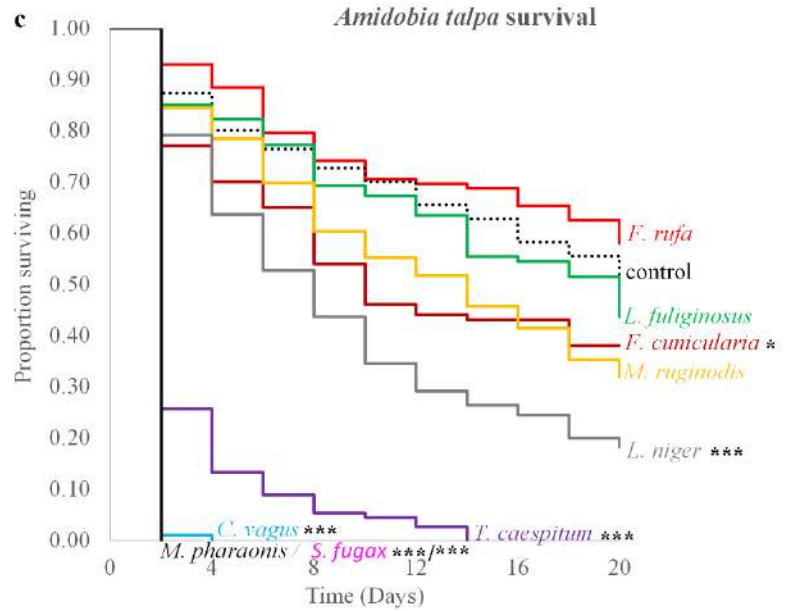
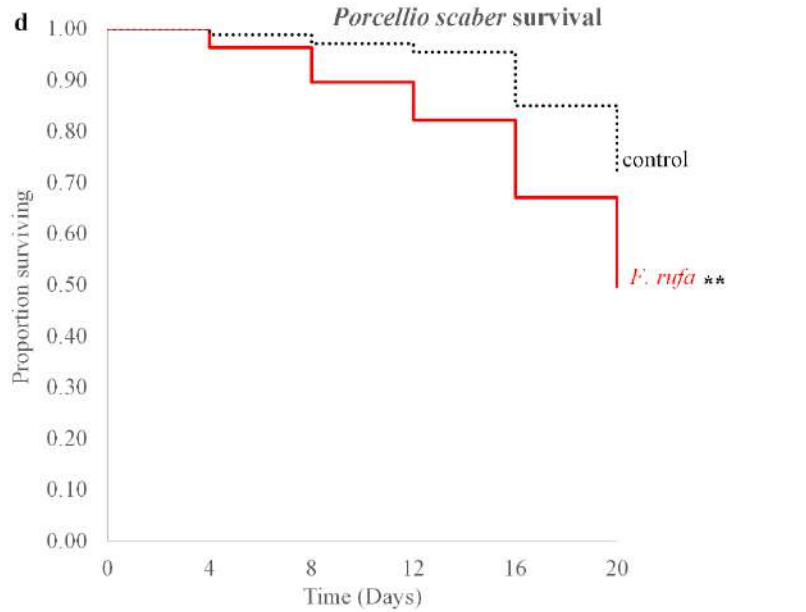




poorly specialized, but highest survival with wood ants





B) FOOD WEB

- direct preference tests
- stable isotopes

B) FOOD WEB

Different food sources offered:

↗ ant associated food (eggs, larvae, pupae, dead ants, trophallaxis)

↘ other (living) myrmecophiles: prey-predator interactions

Analysis:

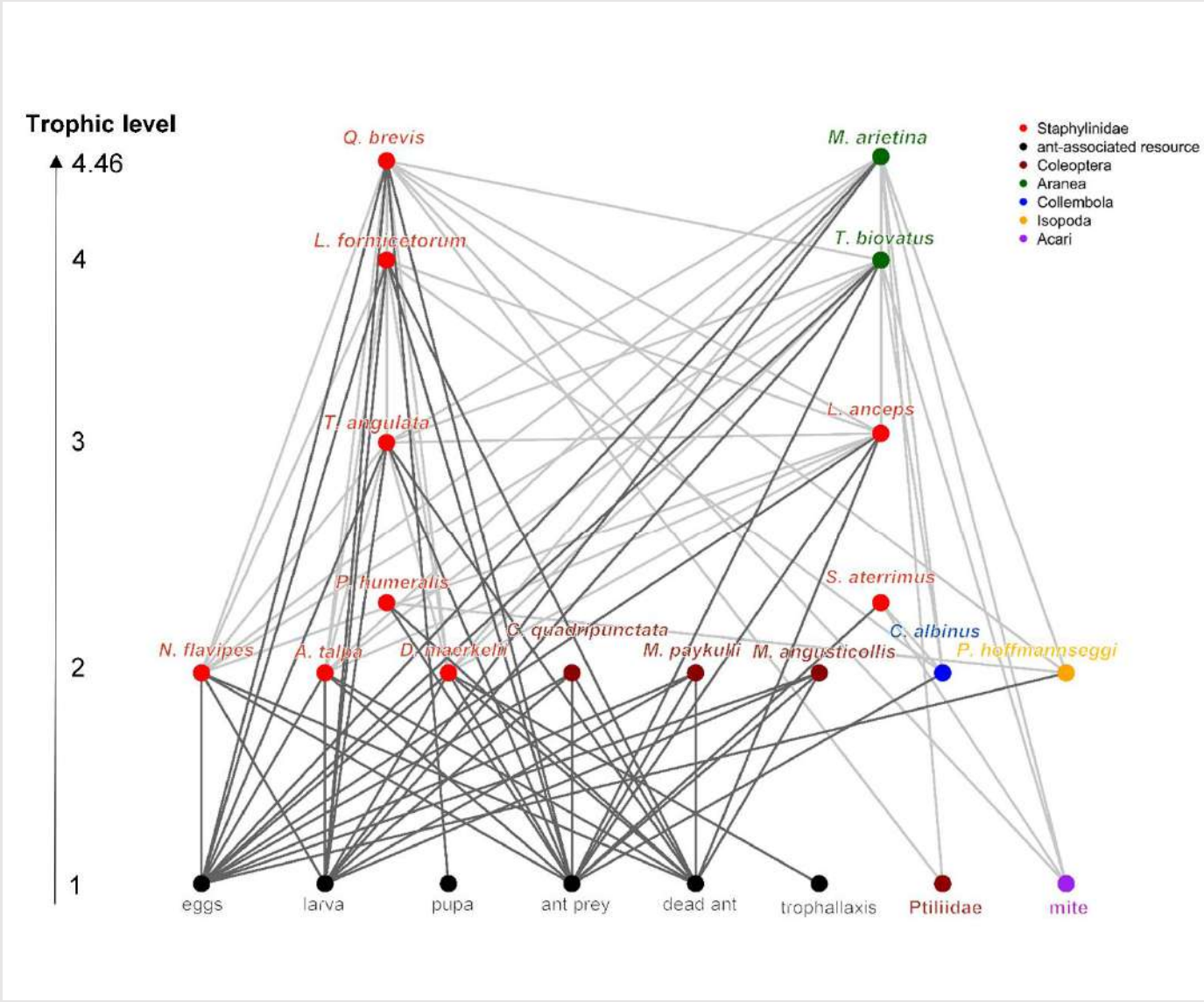
- video-recording under dark conditions during 1 hour
- acceptance after 1 day
- gut analysis after 1 day

B) FOOD WEB: DIRECT PREFERENCE TESTS

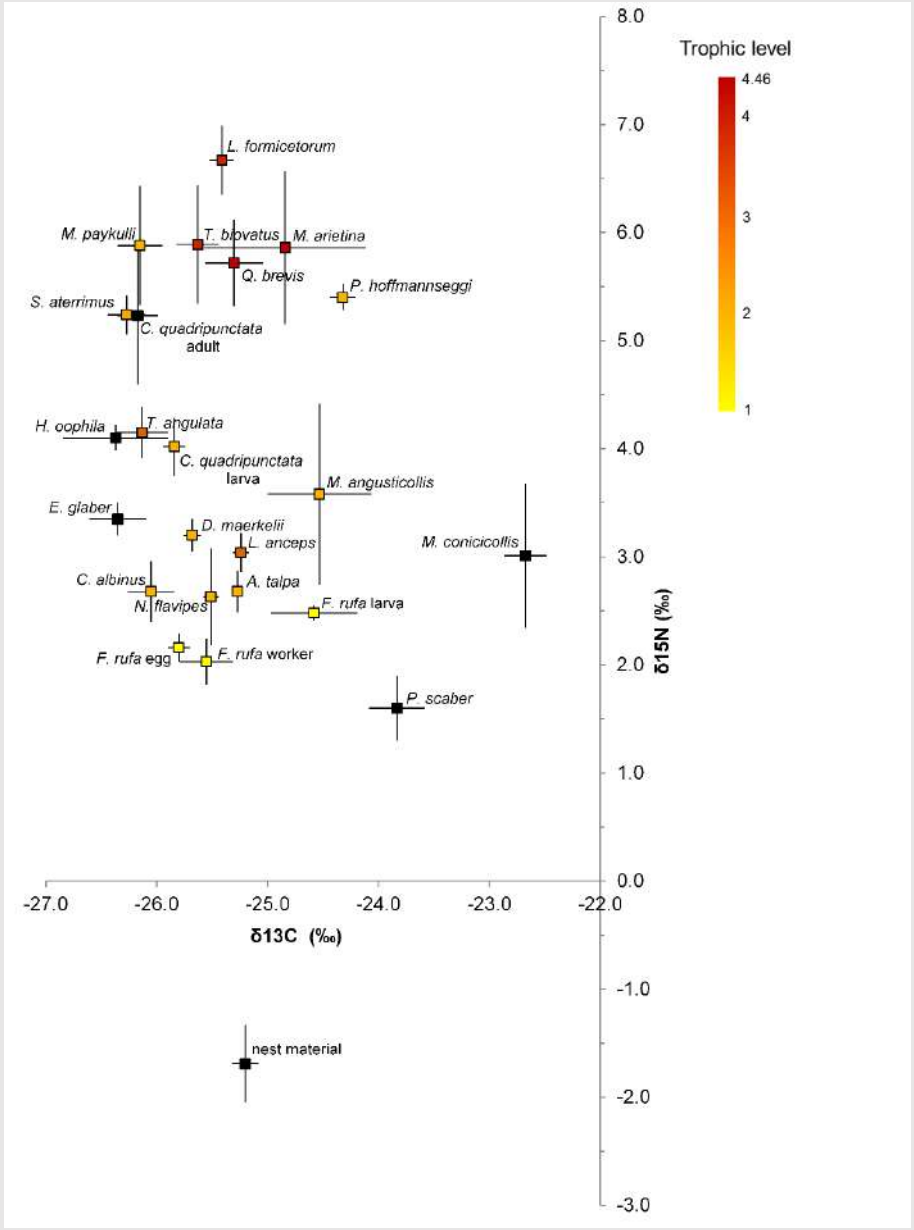
Table

		ANT ASSOCIATED FOOD						MYRMECOPHILIC PREY							
		ant eggs	ant larva	ant pupa	ant prey	dead ant	trophallaxis	*Cyphoderus*	*Platyarthrus*	*Amidobia*	*Monotoma*	*Ptenidium*	*Aleocharine larva*	*Thyreosthenius*	mite
ROVE BEETLES	*Thiasophila*	9/9	8/8	0/5	4/9	4/5	0/15	0/7	0/6	0/5	0/6	0/4	1/6	0/5	0/6
	Notothecta	10/11	5/5	0/5	5/5	5/8	0/6	0/5	0/5	0/5	0/3	0/3	0/5	0/5	0/5
	Leptacinus	4/5	3/5	0/5	4/5	1/5	0/5	1/5	0/5	0/5	0/5	0/5	3/4	0/5	0/6
	Lyprocorrhe	17/30	0/5	0/5	3/7	3/6	0/7	0/6	0/6	0/5	0/5	0/5	1/3	0/5	0/5
	Amidobia	3/21	4/5	0/5	3/8	4/5	0/9	0/5	0/5	0/5	0/5	0/5	0/5	0/8	0/13
	Dinarda	3/5	2/5	0/4	4/7	4/5	6/6	0/5	0/5	0/5	0/5	0/5	0/6	0/5	0/4
	Zyras				4/4	5/6		0/5	1/5	0/5	0/4			0/5	0/6
	Quedius	4/5	5/5	1/5	6/6	0/5	0/5	0/7	2/7	0/6	1/7	4/5	4/5	5/7	4/5
	Stenus	0/13	0/5	0/5	1/7	0/7	0/5	5/6	0/5	0/5	0/5	0/5	0/8	0/5	2/6
SPIDERS	*Thyreosthenius*	8/17	2/4	0/6	1/9	0/5	0/5	6/7	0/5	0/8	0/5	0/8	6/7	3/5	3/5
	Mastigusa	1/2	1/3	0/5	0/8	0/5	0/5	4/5	2/4	0/6	0/4	1/3	3/4	2/6	4/6
OTHER BEETLES	*Clytra*	11/20	3/7	0/5	1/5	1/5	0/5								
	Myrmetes	4/5	3/5	0/4	3/8	6/8	0/9								
	Monotoma	15/25	1/6	0/5	4/4	1/6	0/8								
COLLEMBOLA	*Cyphoderus*			0/5	3/10		0/5								
ISOPODA	*Platyarthrus*	8/13		0/5	0/5	0/5	0/12								

B) FOOD WEB: DIRECT PREFERENCE TESTS

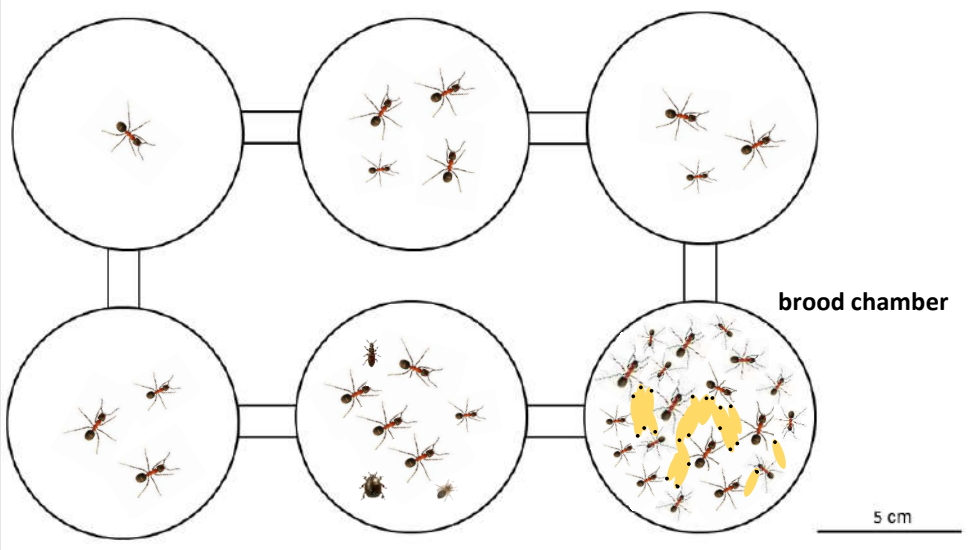


B) FOOD WEB: STABLE ISOTOPE ANALYSIS

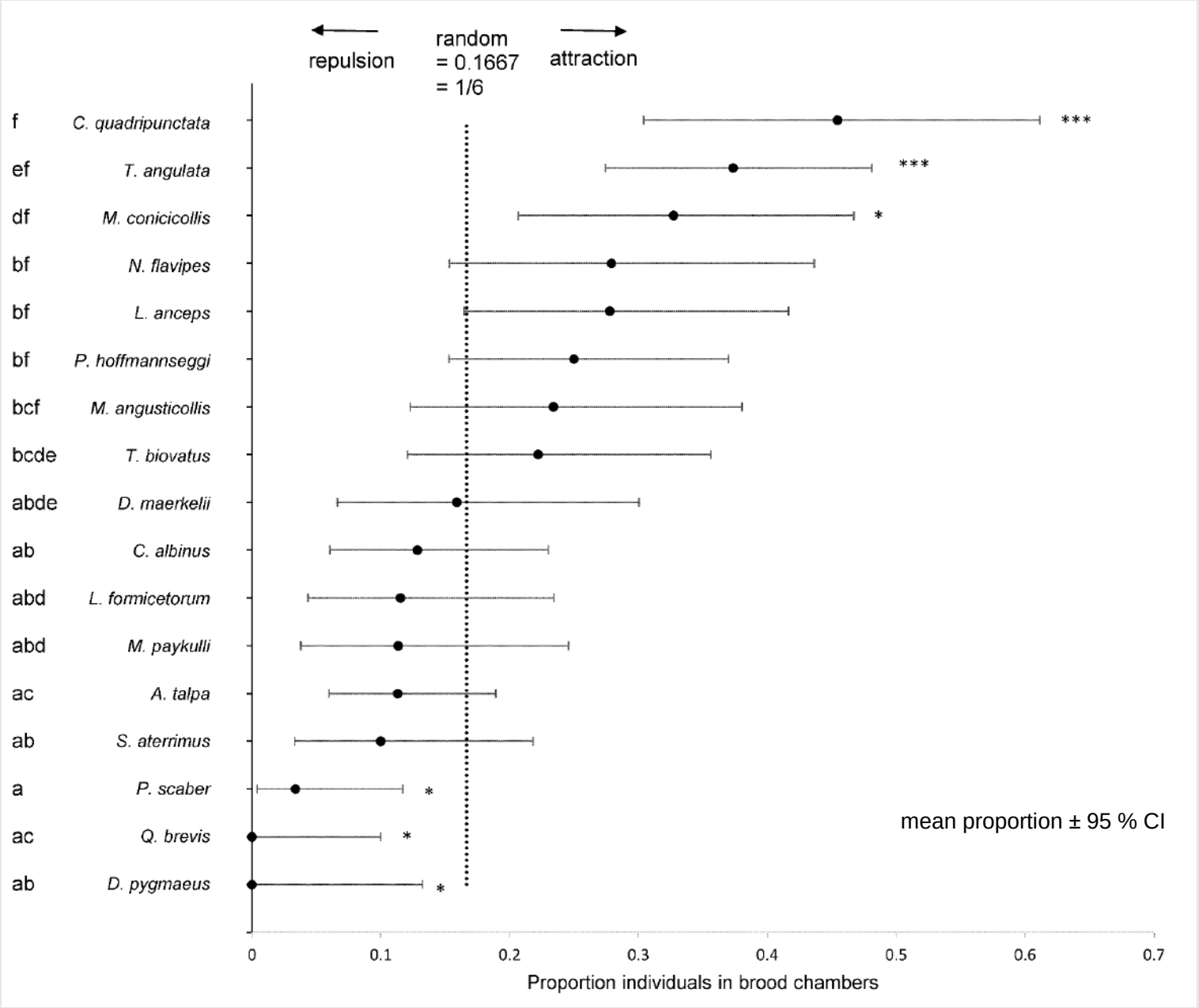


C) NEST LOCATION PREFERENCE (well-integrated vs poorly integrated)

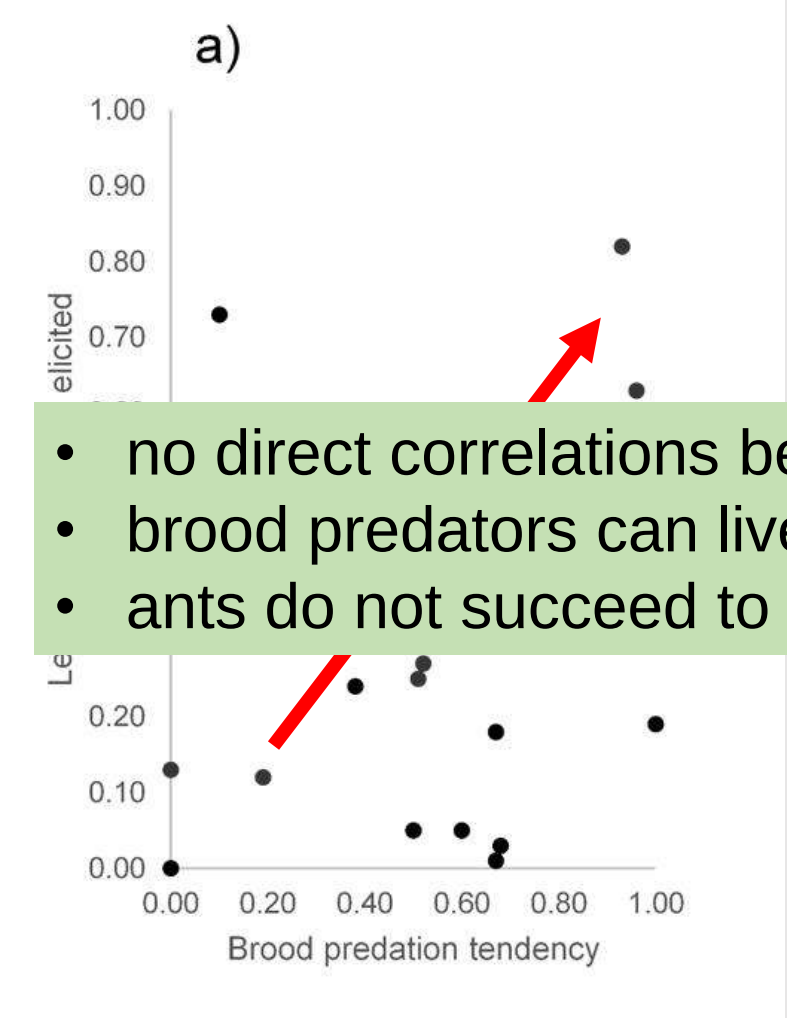
48 hours later



- 360 workers
- 100 larvae / 50 pupae
- → brood + most workers : brood chamber



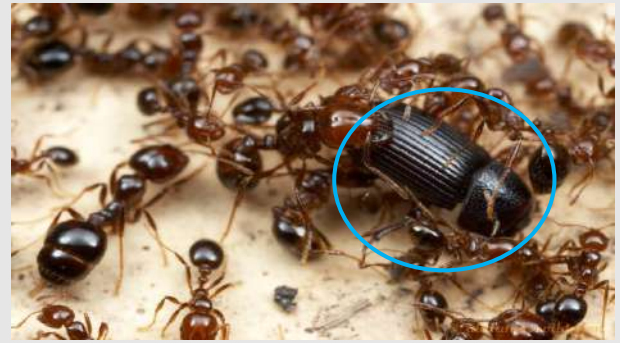
C) LEVEL OF INTEGRATION VS. AGGRESSION VS. BROOD PREDATION



- no direct correlations between life history parameters
- brood predators can live within the brood chambers
- ants do not succeed to deter some brood parasites from the brood chambers

more aggressive
towards more severe parasites

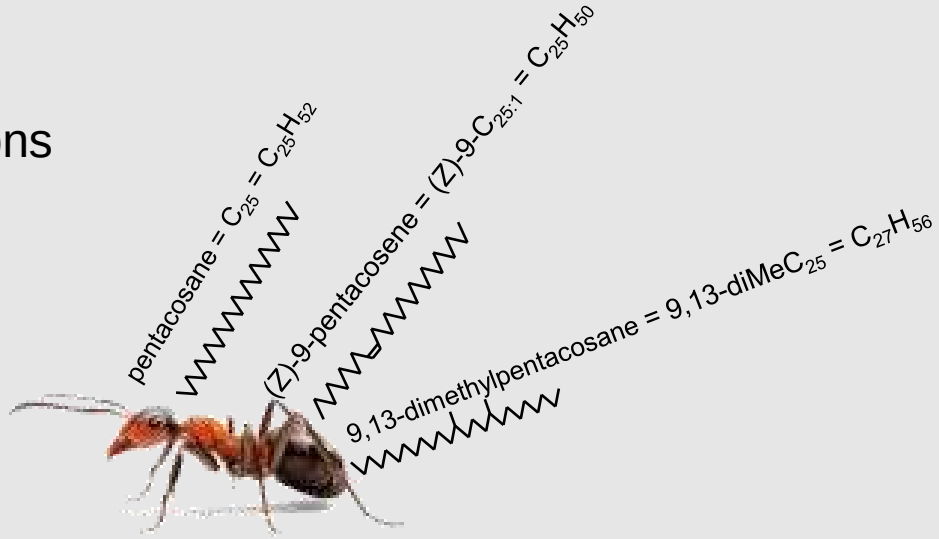
D) CHEMICAL ADAPTATION



cuticular compounds: colony specific recognition cue in social insects: **BREAKING THE CHEMICAL CODE**

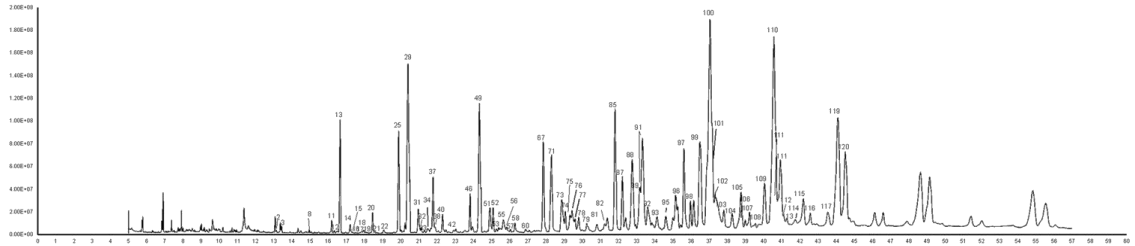
- Chemical camouflage: compound passively acquired
- Chemical mimicry: compound are biosynthesized a priori

•cuticular hydrocarbons

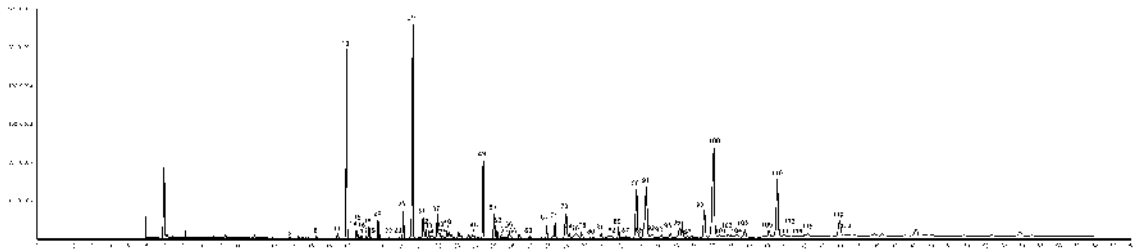


- Chemical odourless

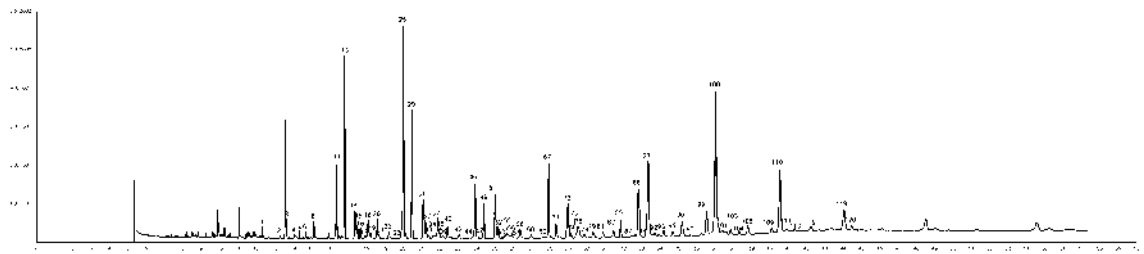
Formica pratensis



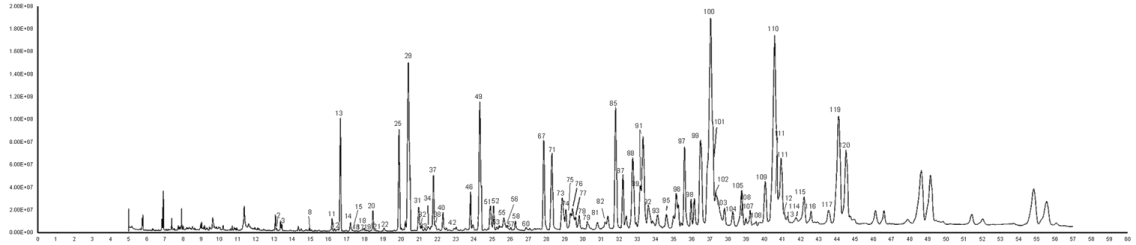
Dendrophilus pygmaeus



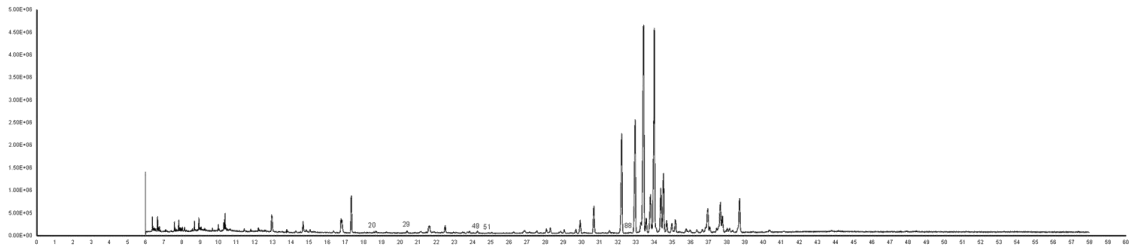
Myrmetes paykulli



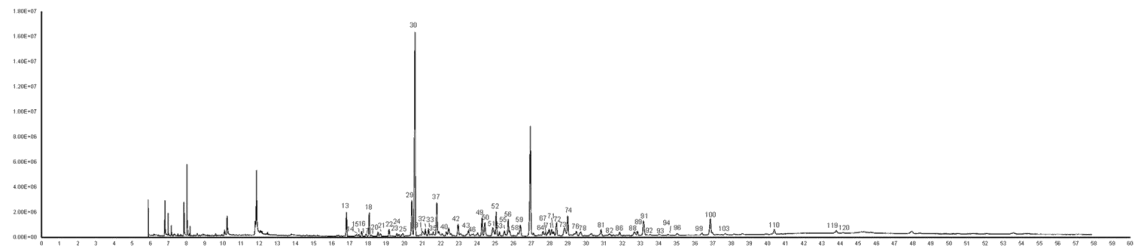
Formica pratensis

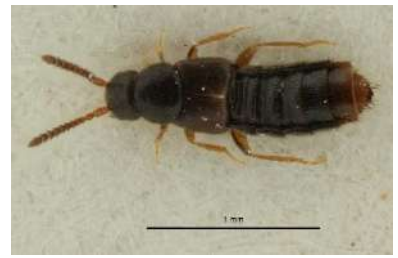


Thyreosthenius biovatus

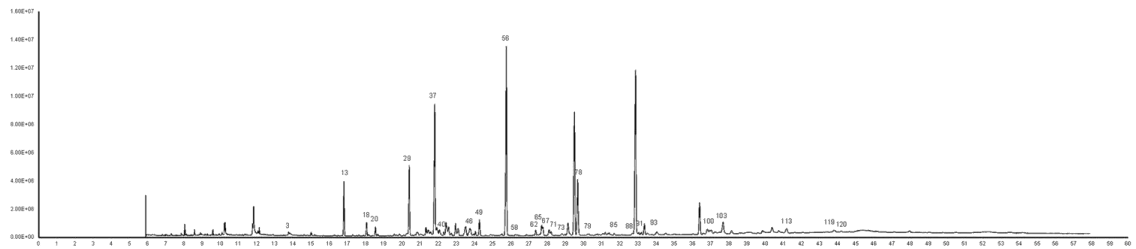


Amidobia talpa

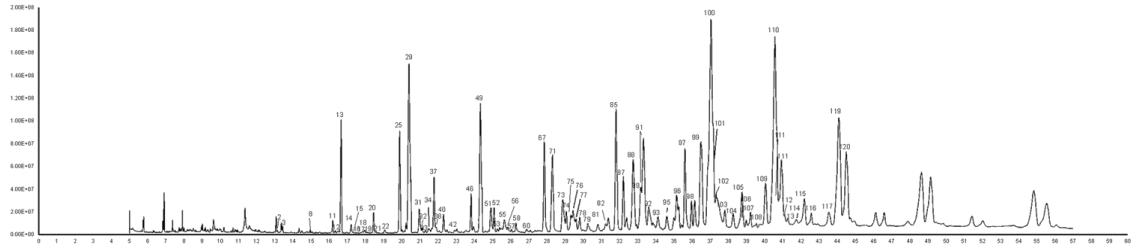




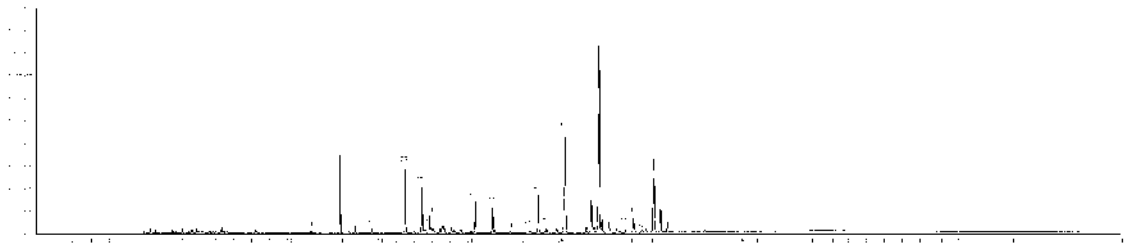
Lyprocorrhe anceps



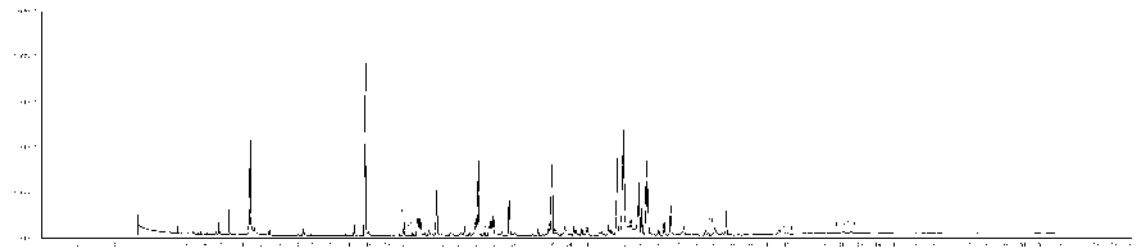
Formica pratensis



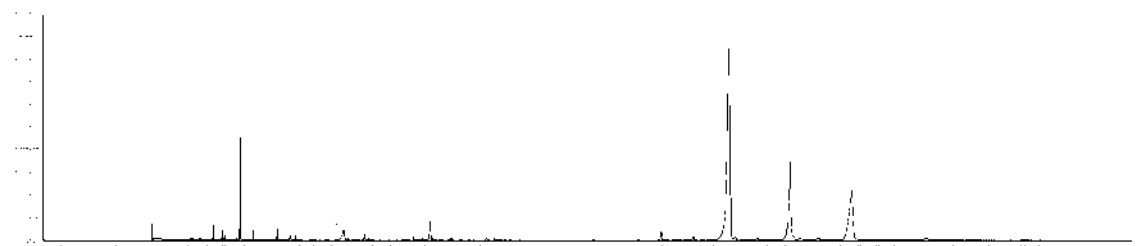
Dinarda maerkelii



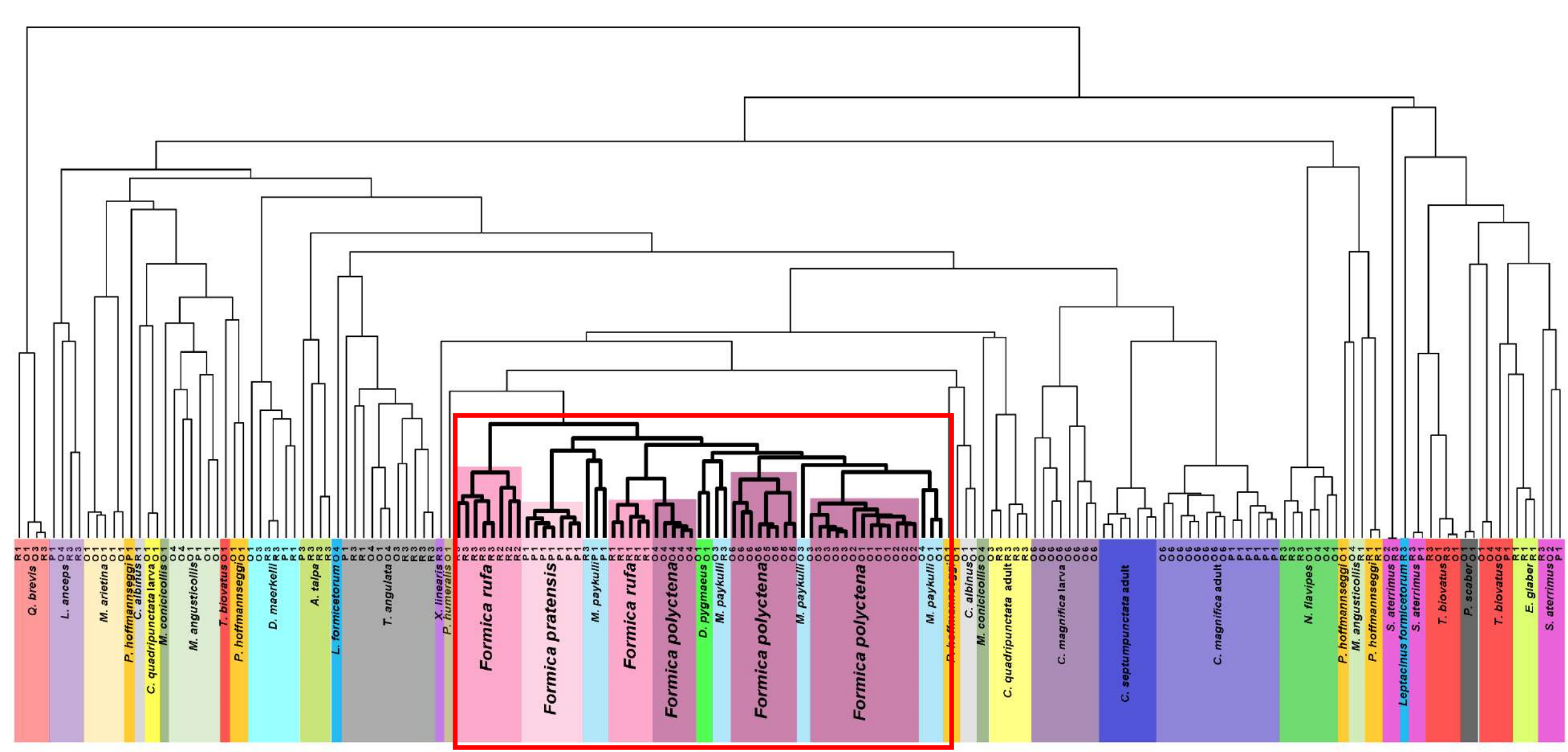
Emphylus glaber



Quedius brevis



D) CHEMICAL ADAPTATION: CUTICULAR HYDROCARBON SIMILARITY



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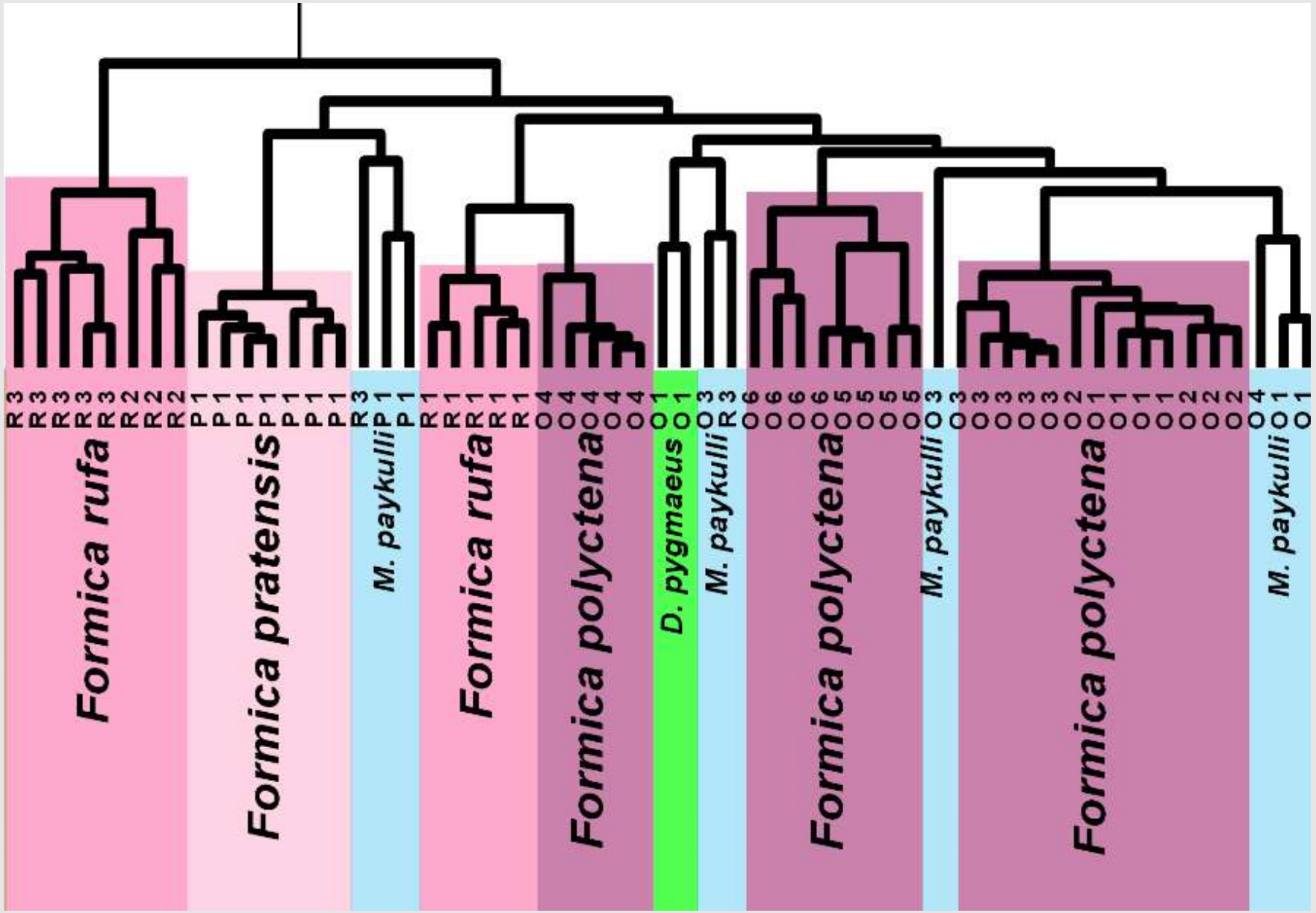
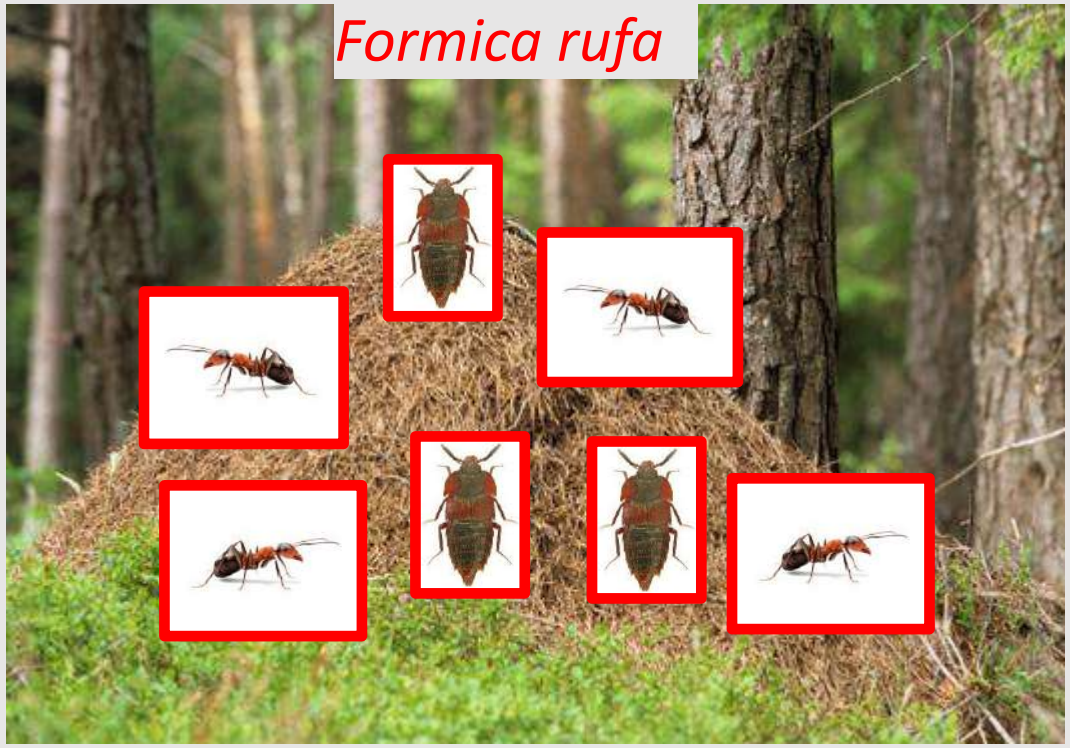
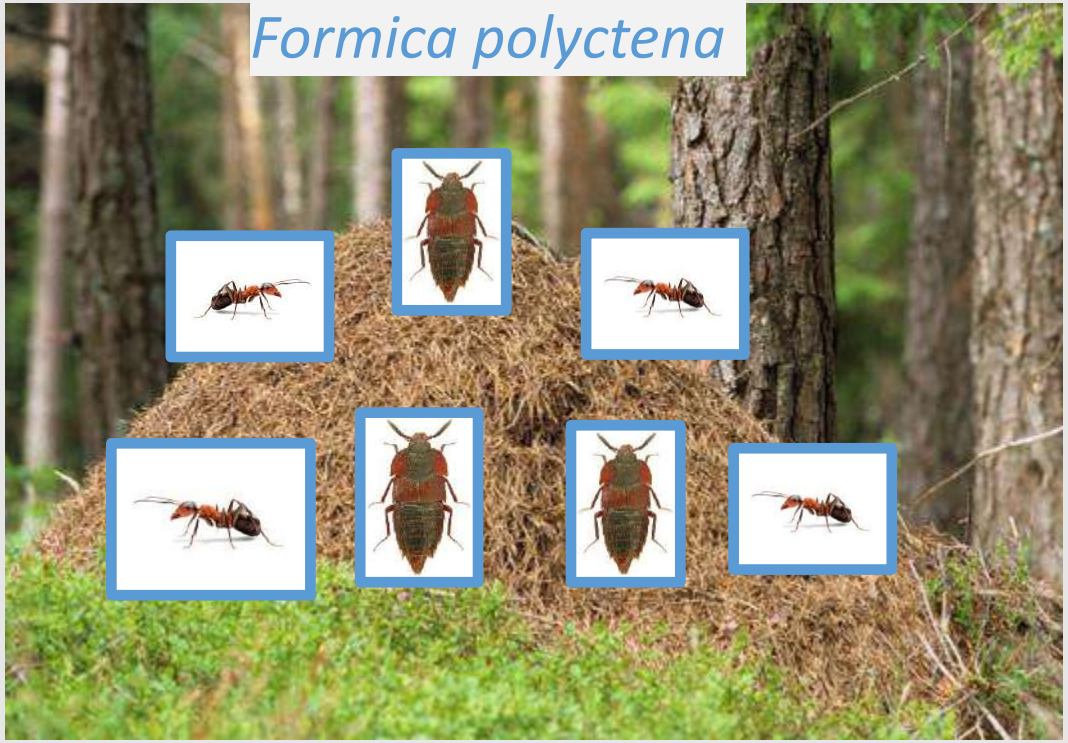
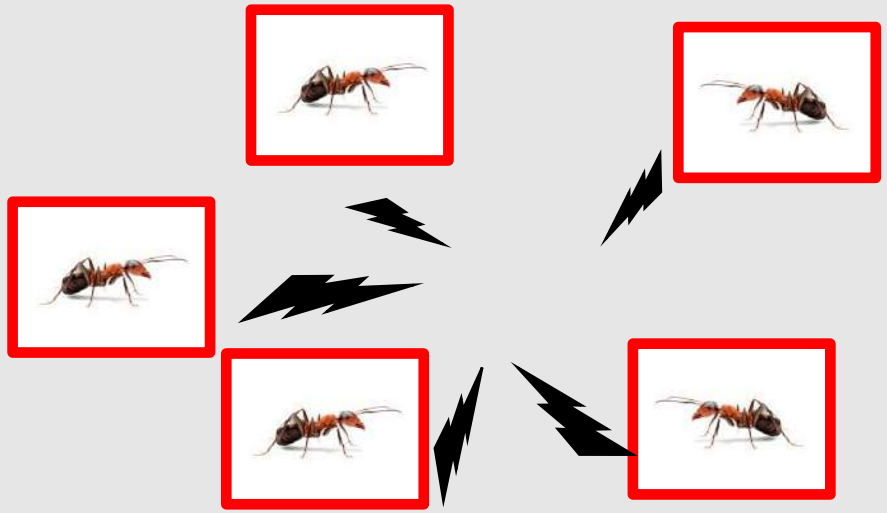


D) CHEMICAL ADAPTATION: BEHAVIOUR EXPERIMENTS



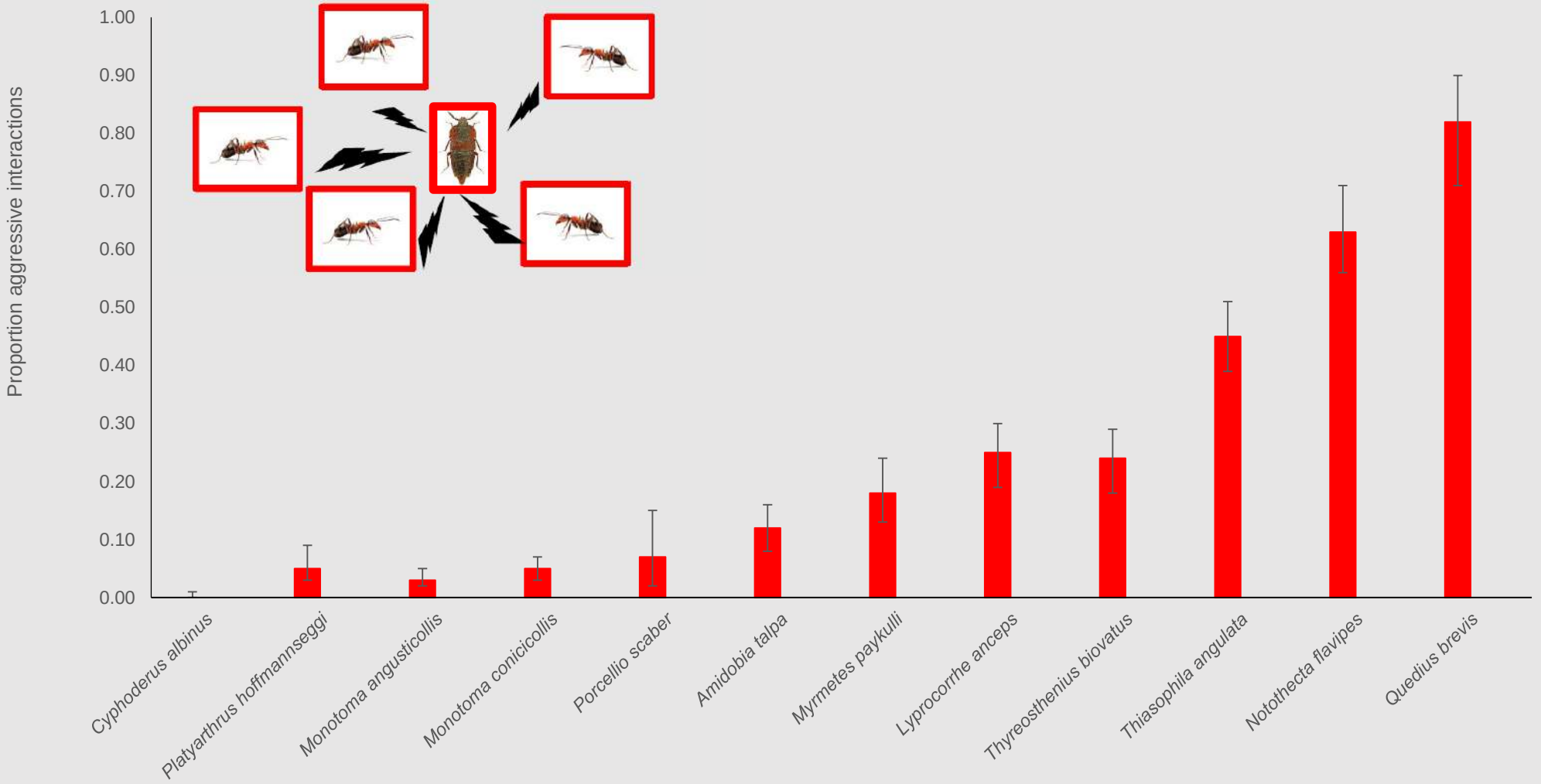




40 *Formica rufa* workers of same polydomous colony

first 20-30 interactions scored (ignoring, opening mandibles, biting, acid spraying, chasing)

D) CHEMICAL ADAPTATION: BEHAVIOUR EXPERIMENTS



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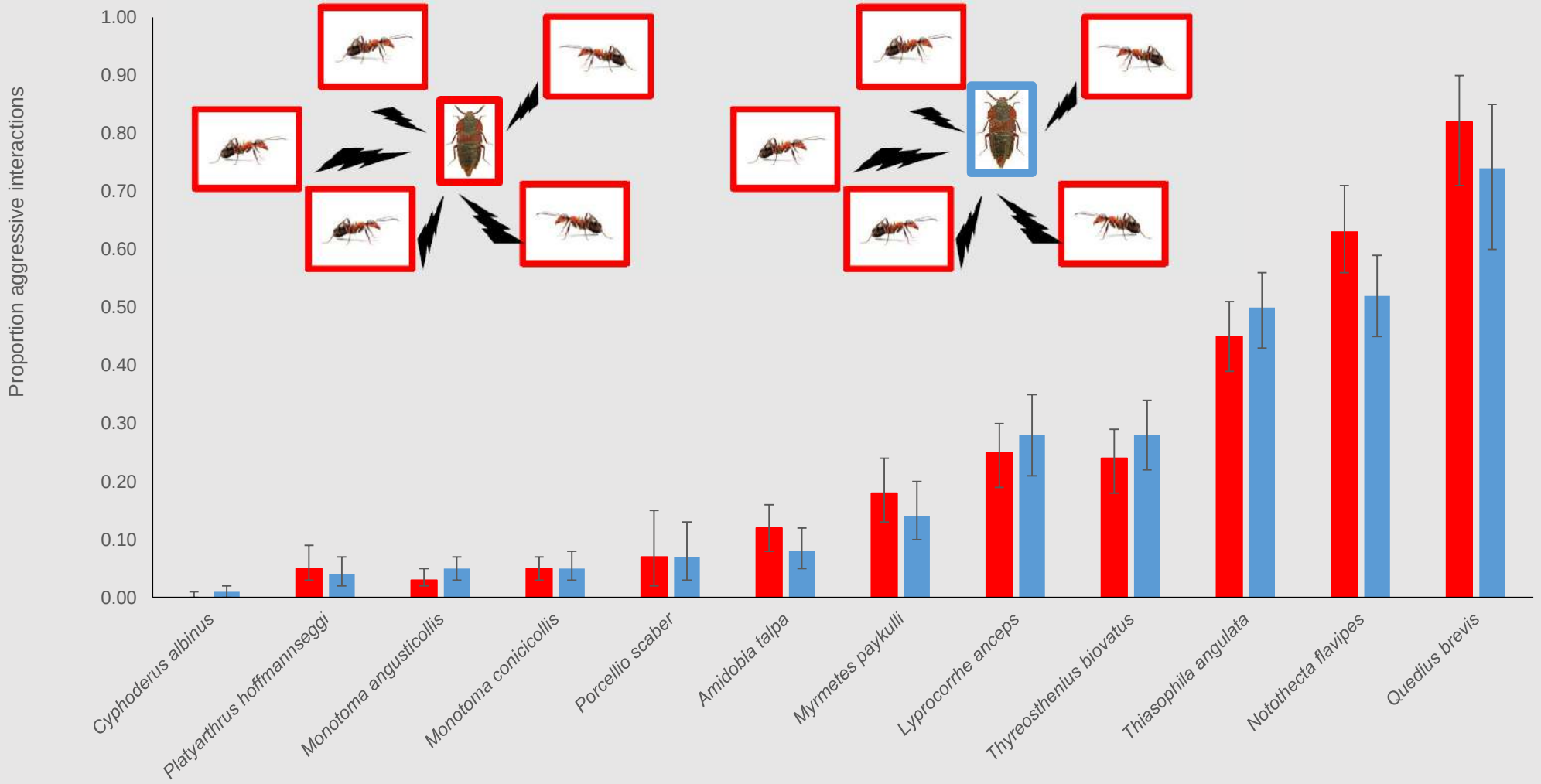
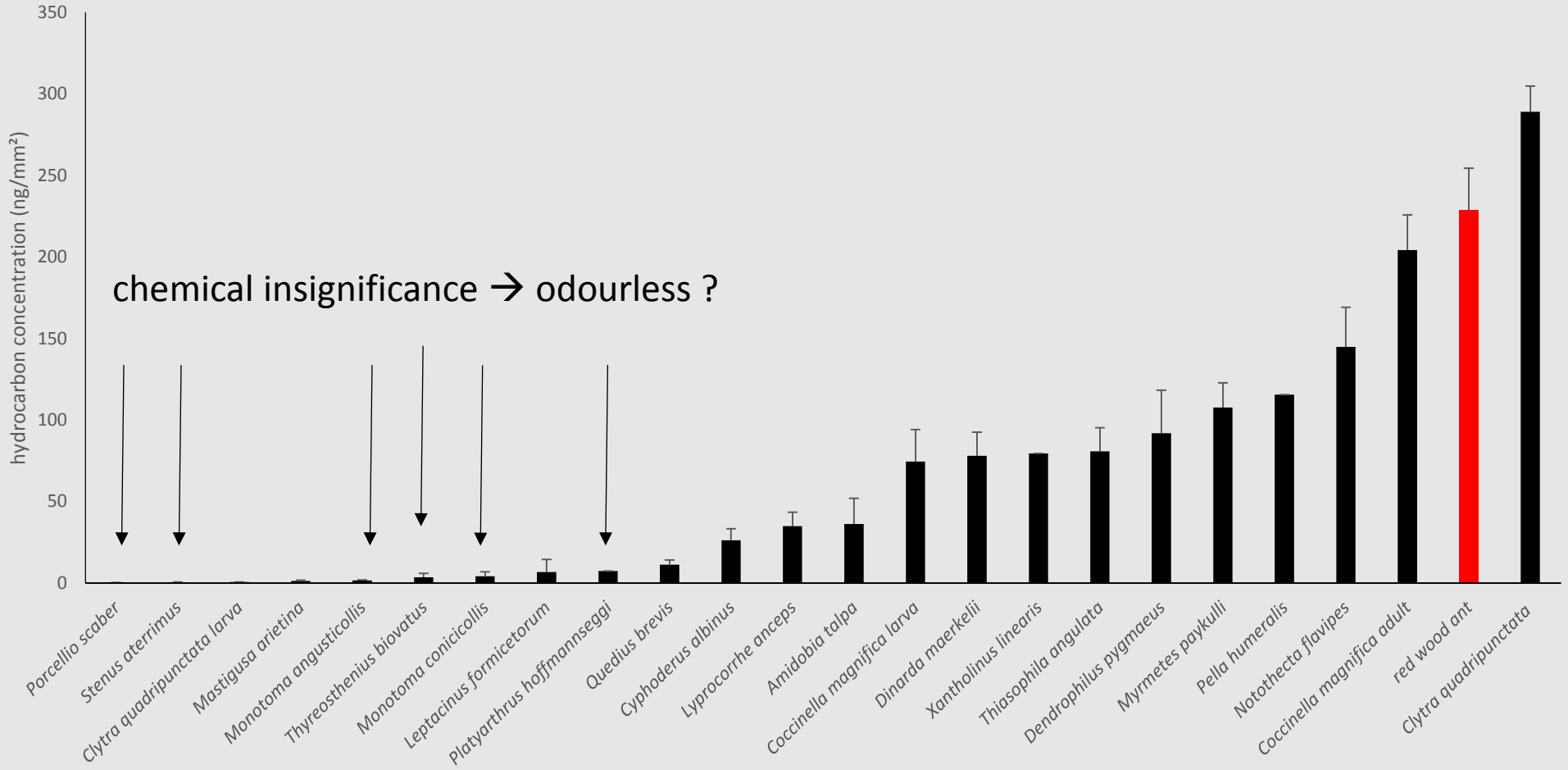
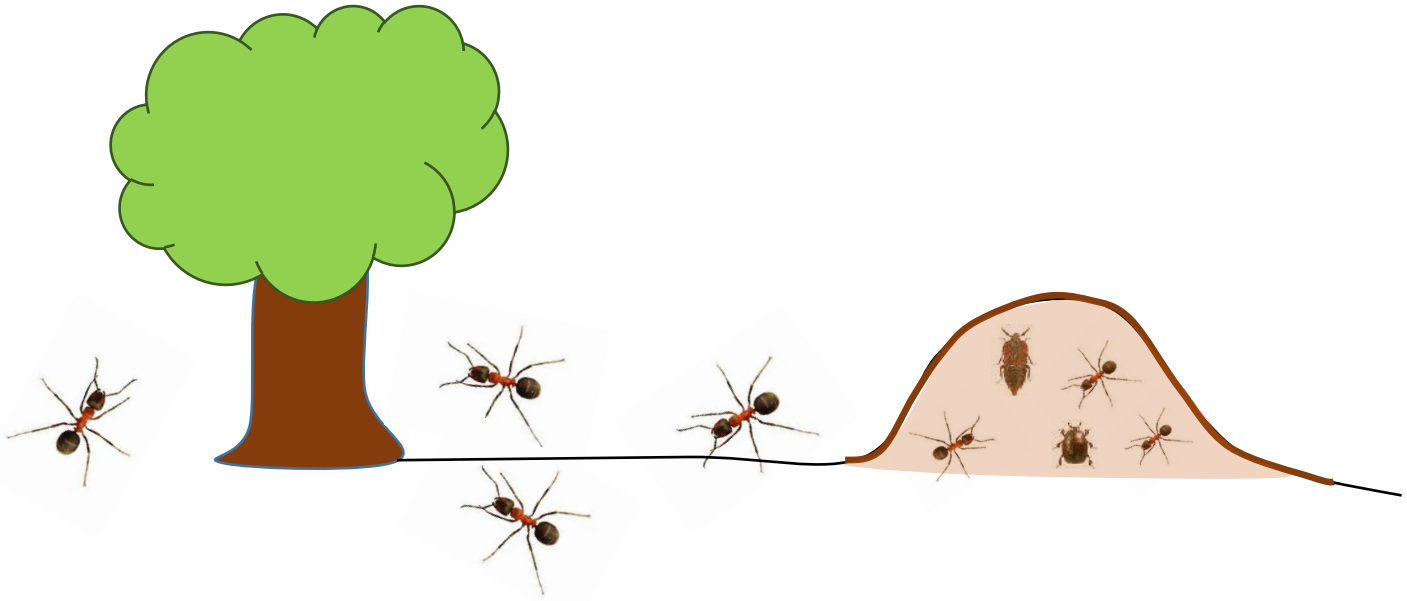


D) CHEMICAL ADAPTATION: CUTICULAR HYDROCARBON CONCENTRATION



E) ANT DEFENCE SPECIALIZATION



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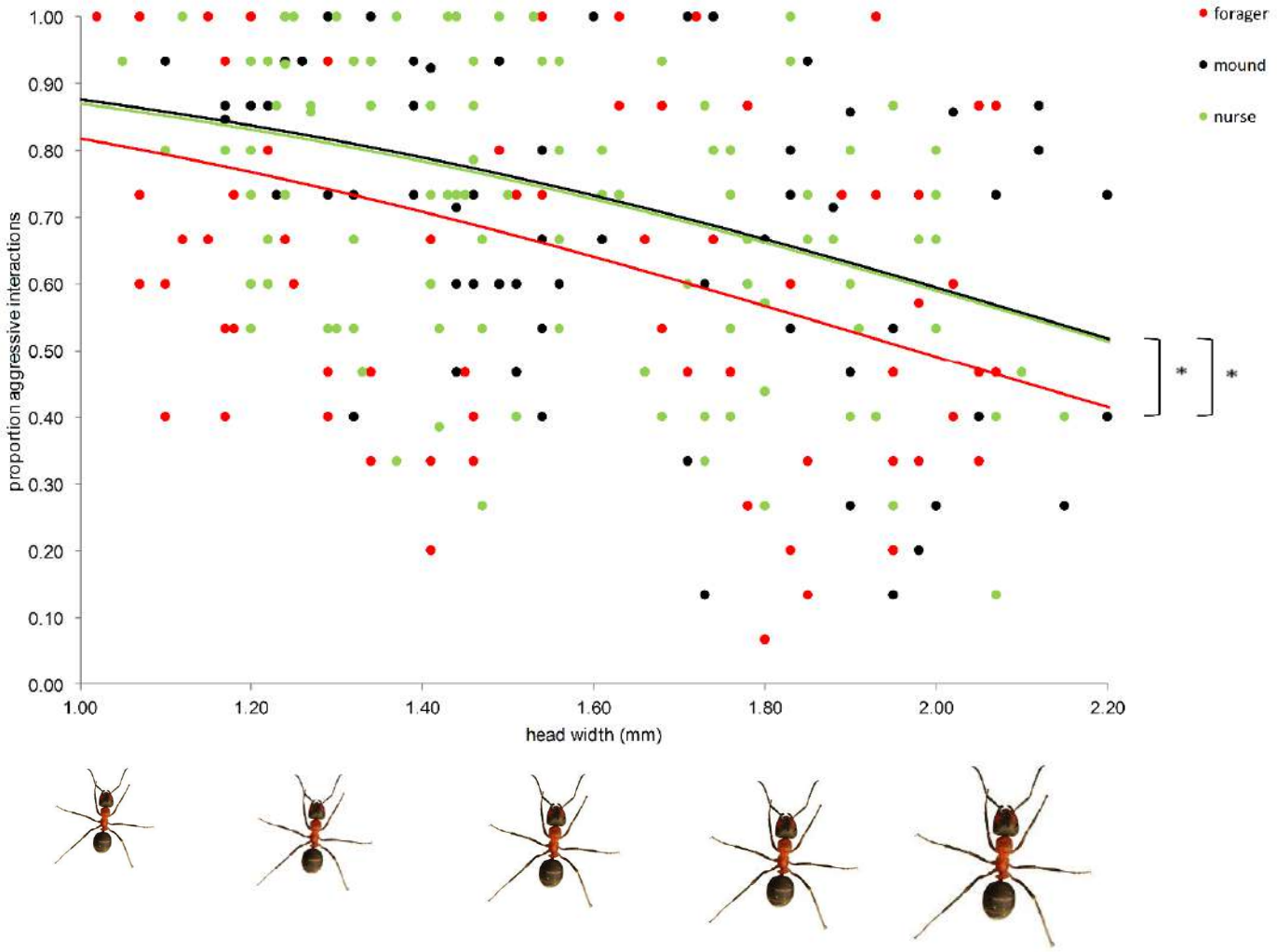
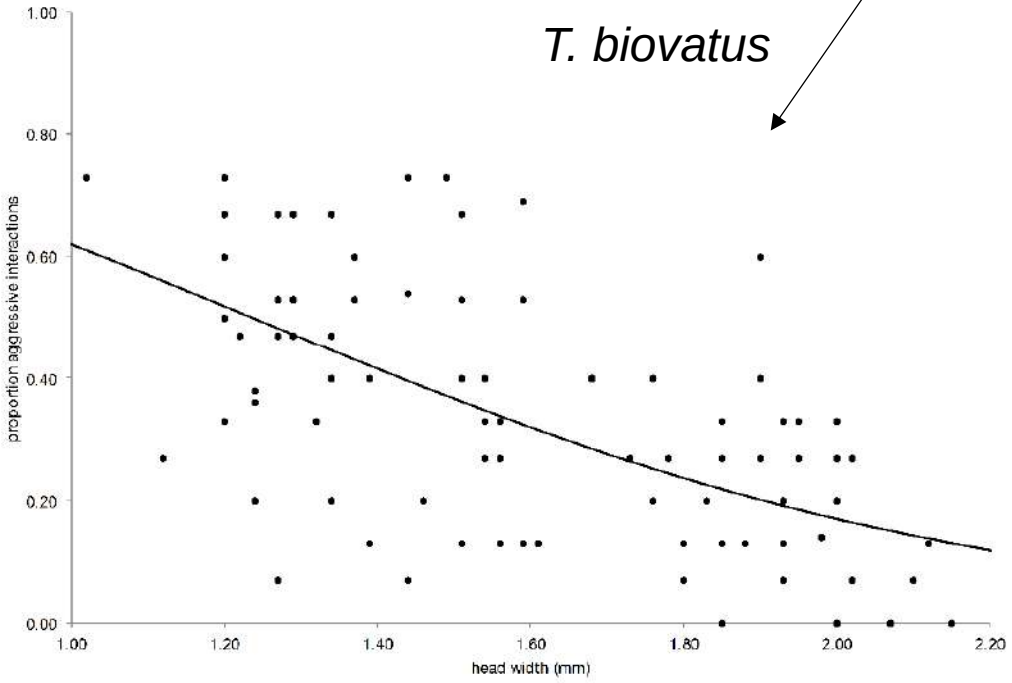
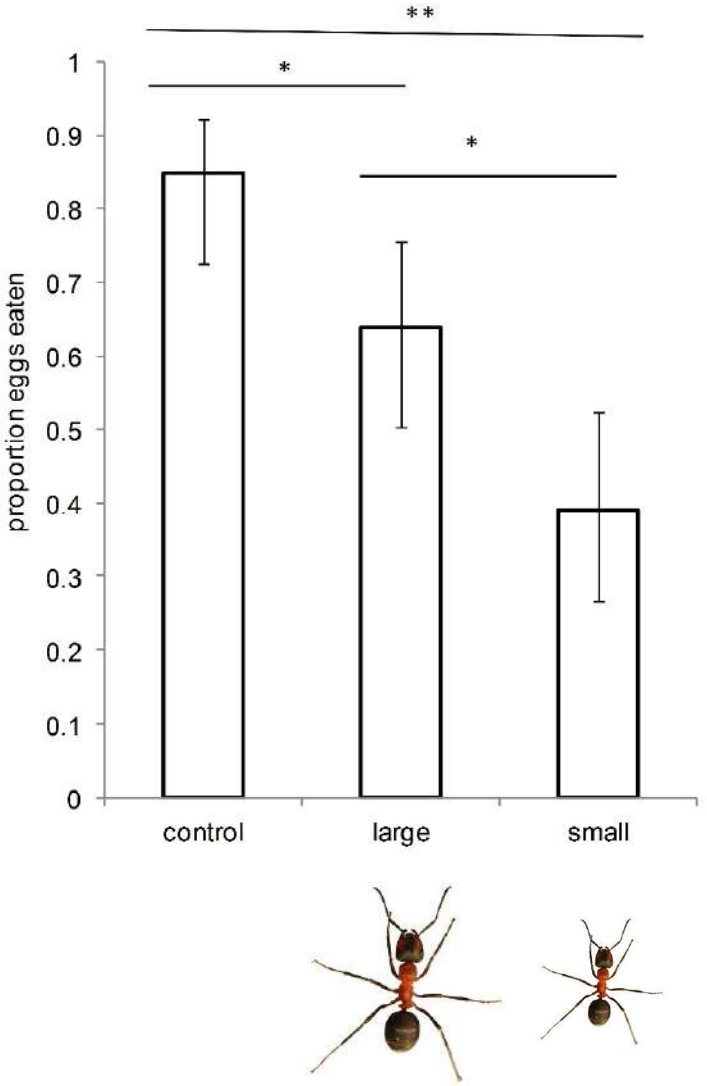


T. angulata

T. biovatus



E) ANT DEFENCE SPECIALIZATION: EGG PROTECTION



T. angulata

CONCLUSION

- **unspecialized** species succeed to live in wood ant nests
  - absence of chemical appeasment glands
  - absence of specialized behaviour
  - absence of chemical mimicry

- some live preferentially among the brood and ants do not adjust their aggression towards potential more harmful species.

  But:
  - complex food web: other food sources and intraguild predation among brood predators
  - size-dependent defence of workers
  - other mechanisms: nest moving?

- biased focus on specialized myrmecophiles !!!

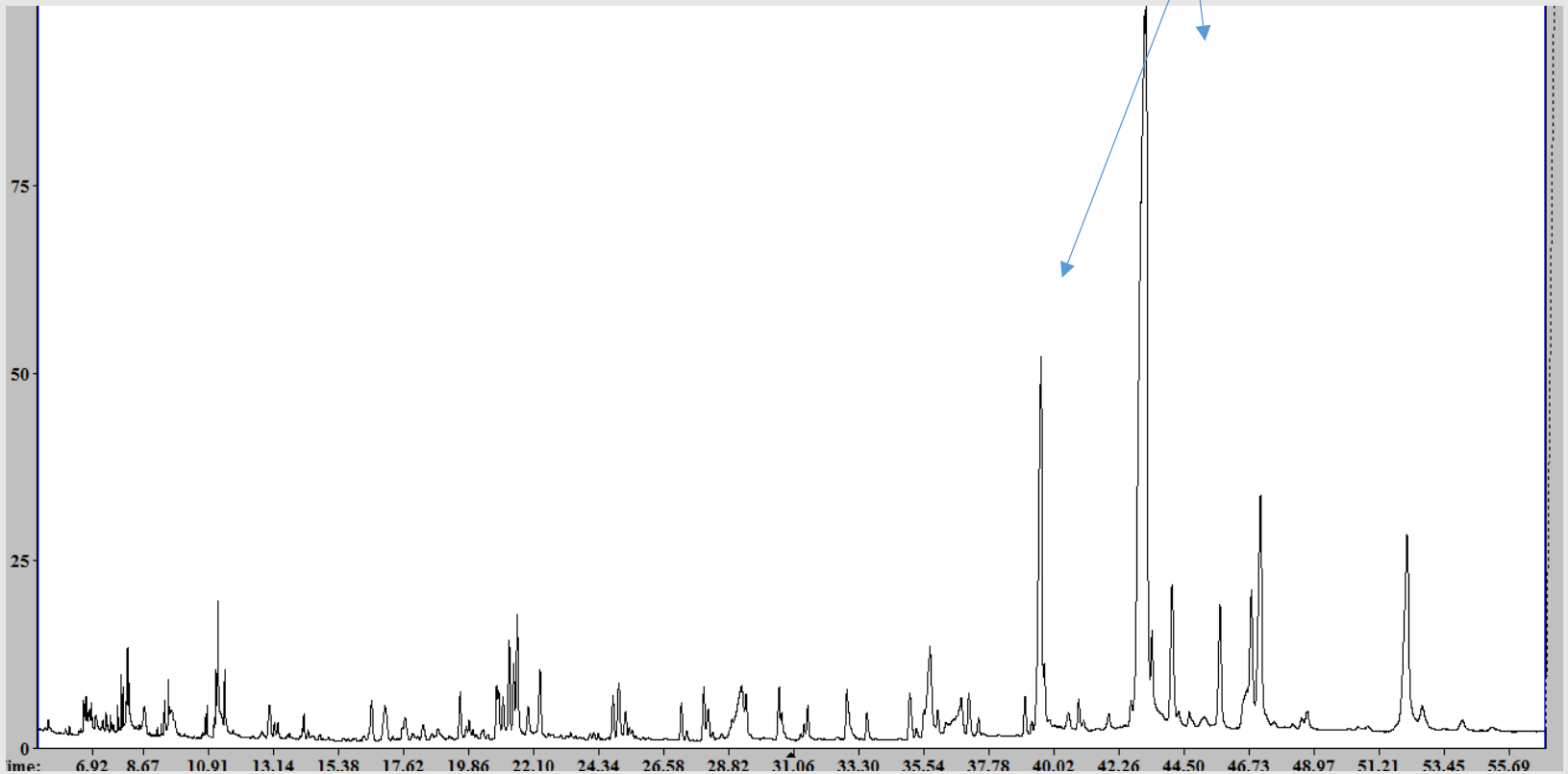
ROOT APHIDS

Lasius flavus

***Anoecia* sp. (most likely *Anoecia zirnitsi*)**

Hexane-methanol 5 min extraction

Triglycerides ?



LOMECHUSA

larva with *Formica fusca* in summer

adult with *Myrmica* in winter

colony-specific chemical mimicry of beetle larvae

ants preferentially carry beetle larvae into safety compared to their own larvae