Microgynous queens in ants: social parasites or dispersal morphs?

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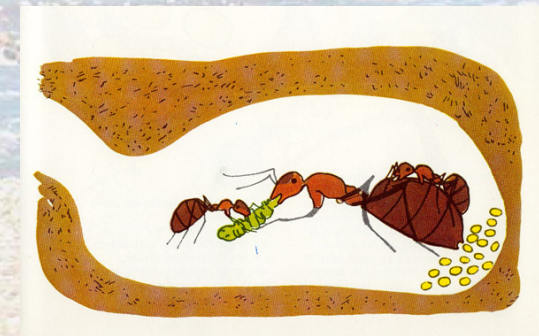
Social “macroparasites”

Exploit worker force of colonies of other social insects to rear their own young

<u>New colonies foundation</u>:

Solitary founding: nuptial flight, dealation, but high failure rate



→Alternative strategies

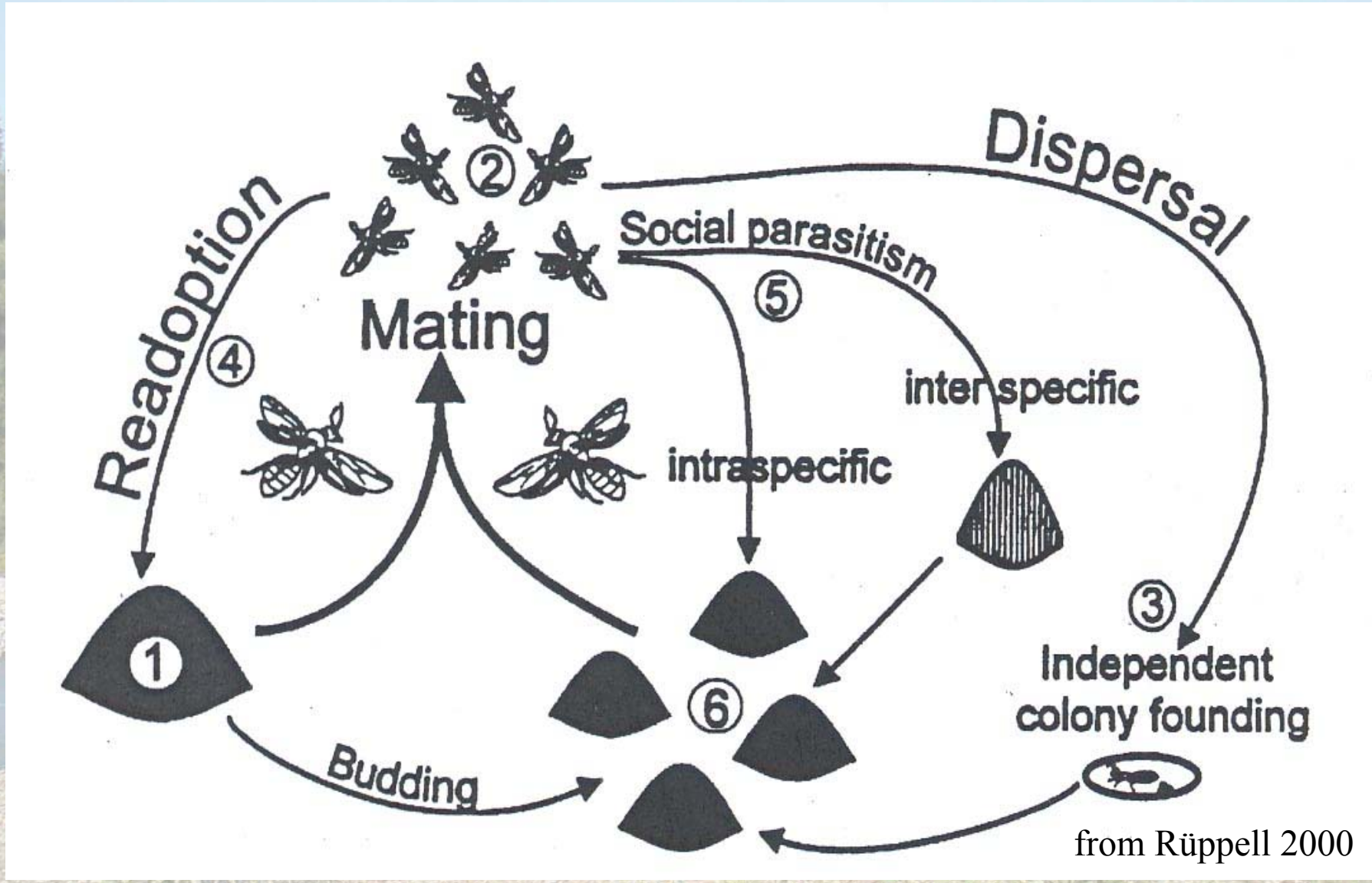
Alternative strategies

- Gynes return into their natal nest, readopted
→ polygyny → budding

- Gynes invade and take over the nest of another species
→ social parasites (slavery, inquilinism)

→ **Miniaturisation of gynes = microgynes**

Microgynes may evolve with intraspecific parasitism to sibling species (sympatric speciation)



from Rüppell 2000

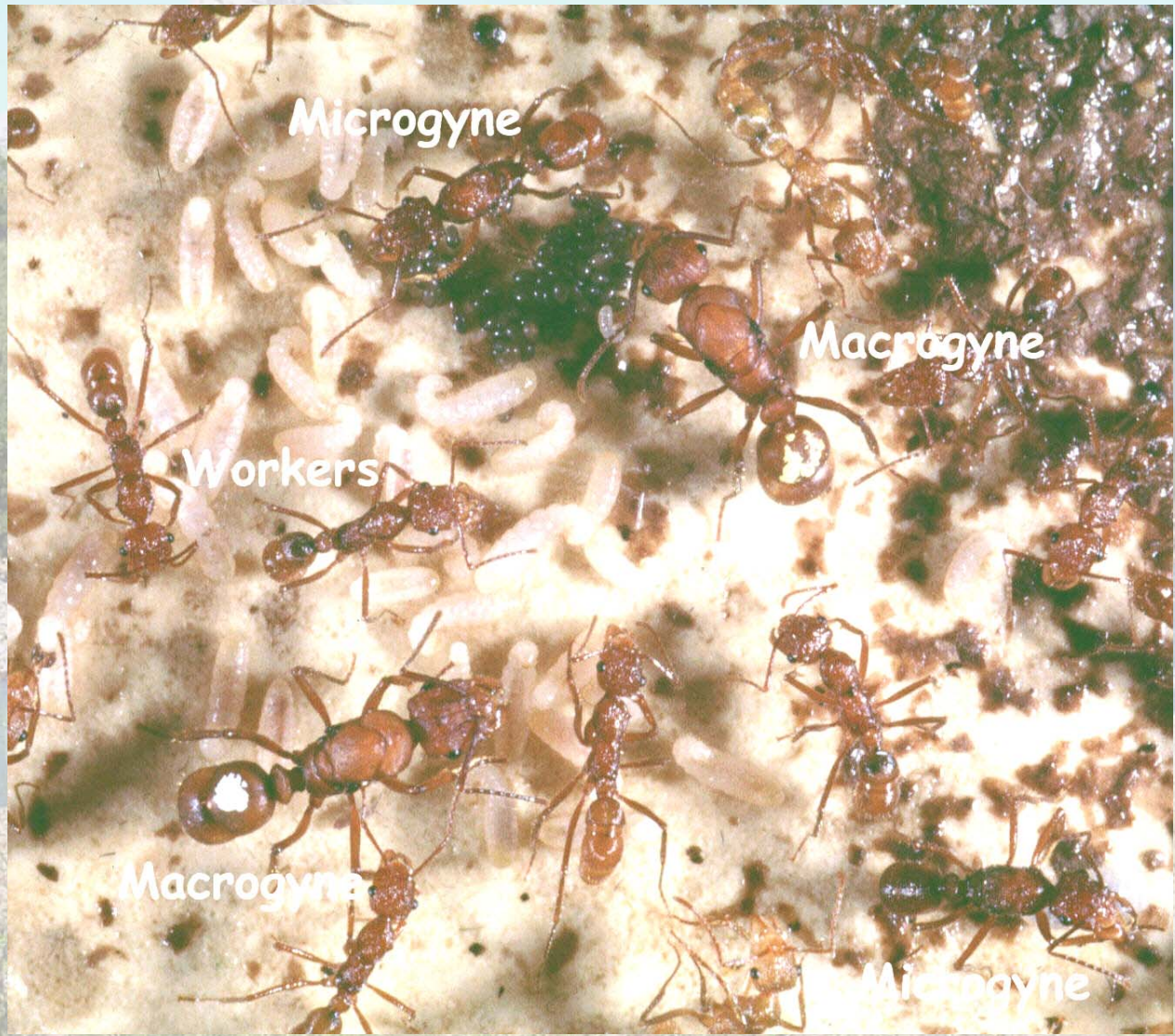
Microgynes

Many species, mainly in Myrmicinae

2 cases:
- Dispersal tactic, no genetic differentiation
Ex: *Myrmica ruginodis*, *Ectatomma ruidum*, *Temnothorax rugatulus*

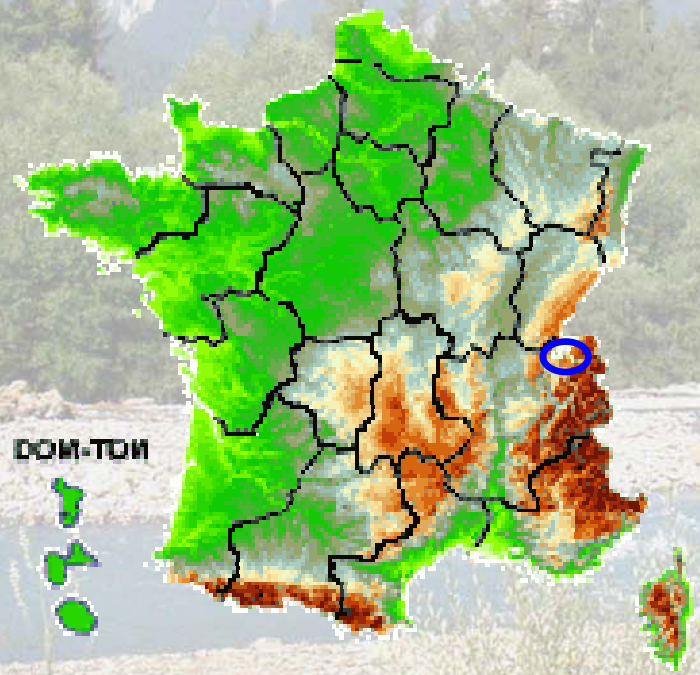
- Social parasite, genetic differentiation
Ex: *Myrmica hirsuta / M. sabuleti*
Myrmica microrubra / rubra ?
Formicoxenini (*Chalepoxenus*)
Ectatomma tuberculatum,

Ectatomma tuberculatum, first case of social parasite in poneromorph subfamilies



Hora et al, in press

Discover of microgynes in *Manica rubida*




Leman lake
Giffre Valley (Haute-Savoie, Fr, 700m asl)
Geneva
Mont-Blanc
Image © 2005 EarthSat
Image © 2005 DigitalGlobe
Google


Manica rubida / Formica selysi


Manica rubida
1 cm


Manica rubida
Myrmecology.org


5 cm


Subterranean nests

Nuptial flight and semi-claustral foundation

1998

1 *Manica rubida* nest with small microgynes and normal macrogynes

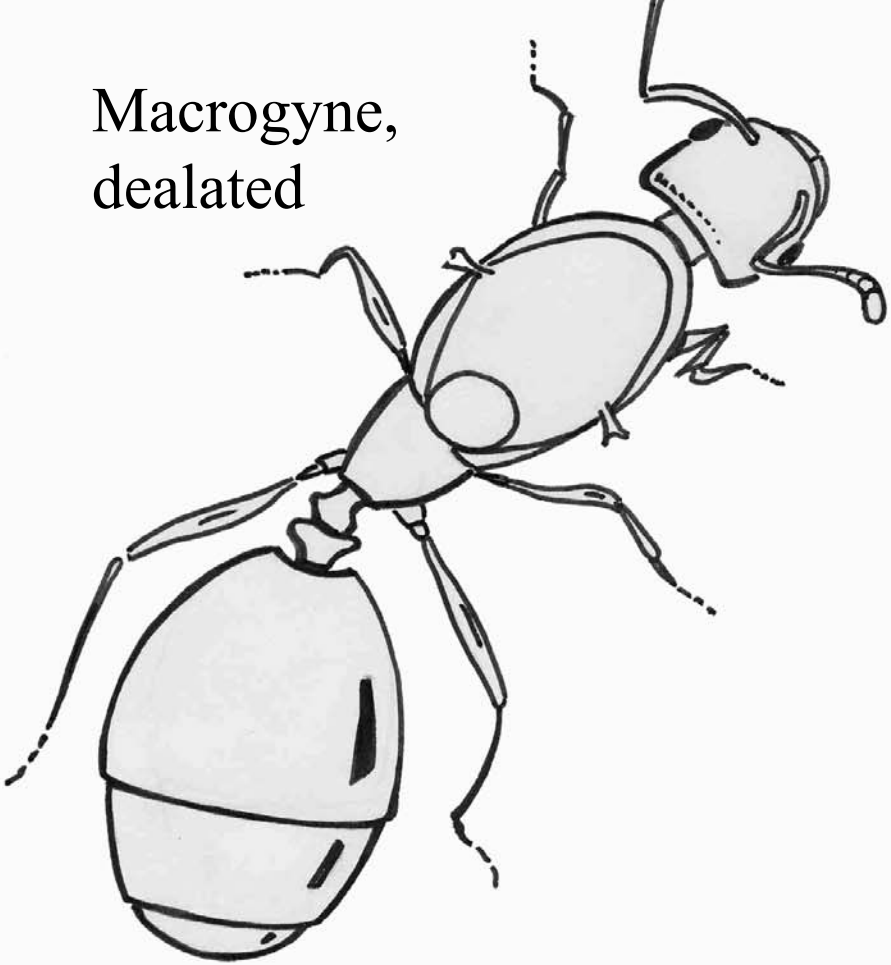
Microgyne

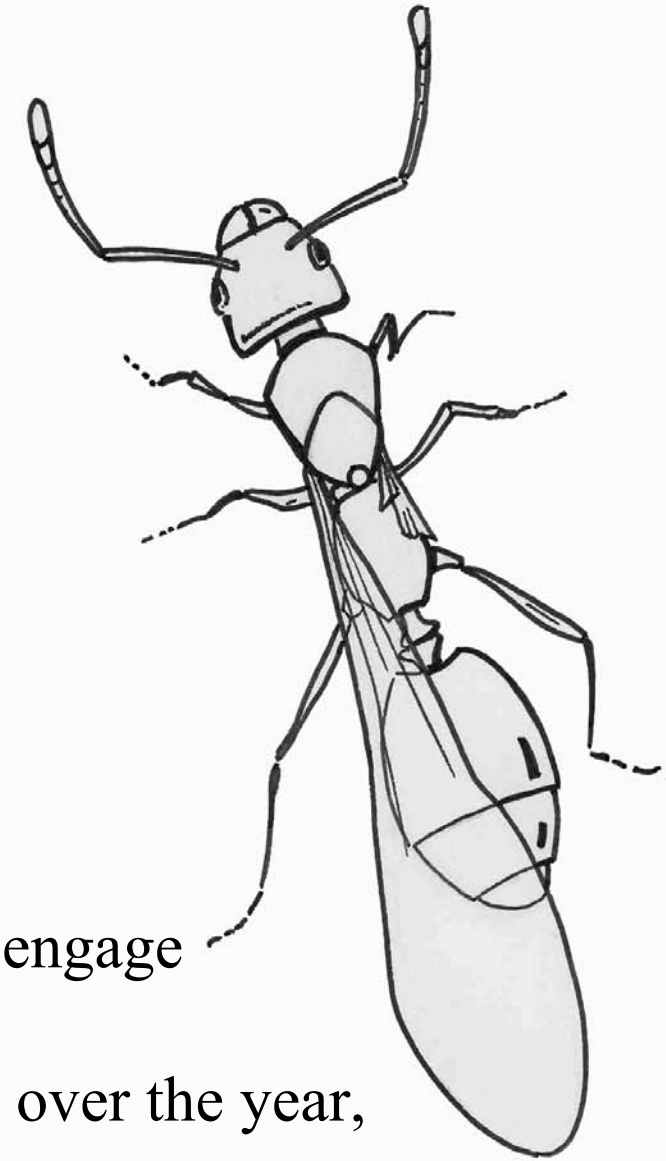
Macrogyne

Microgynes and workers

Photos N. Châline

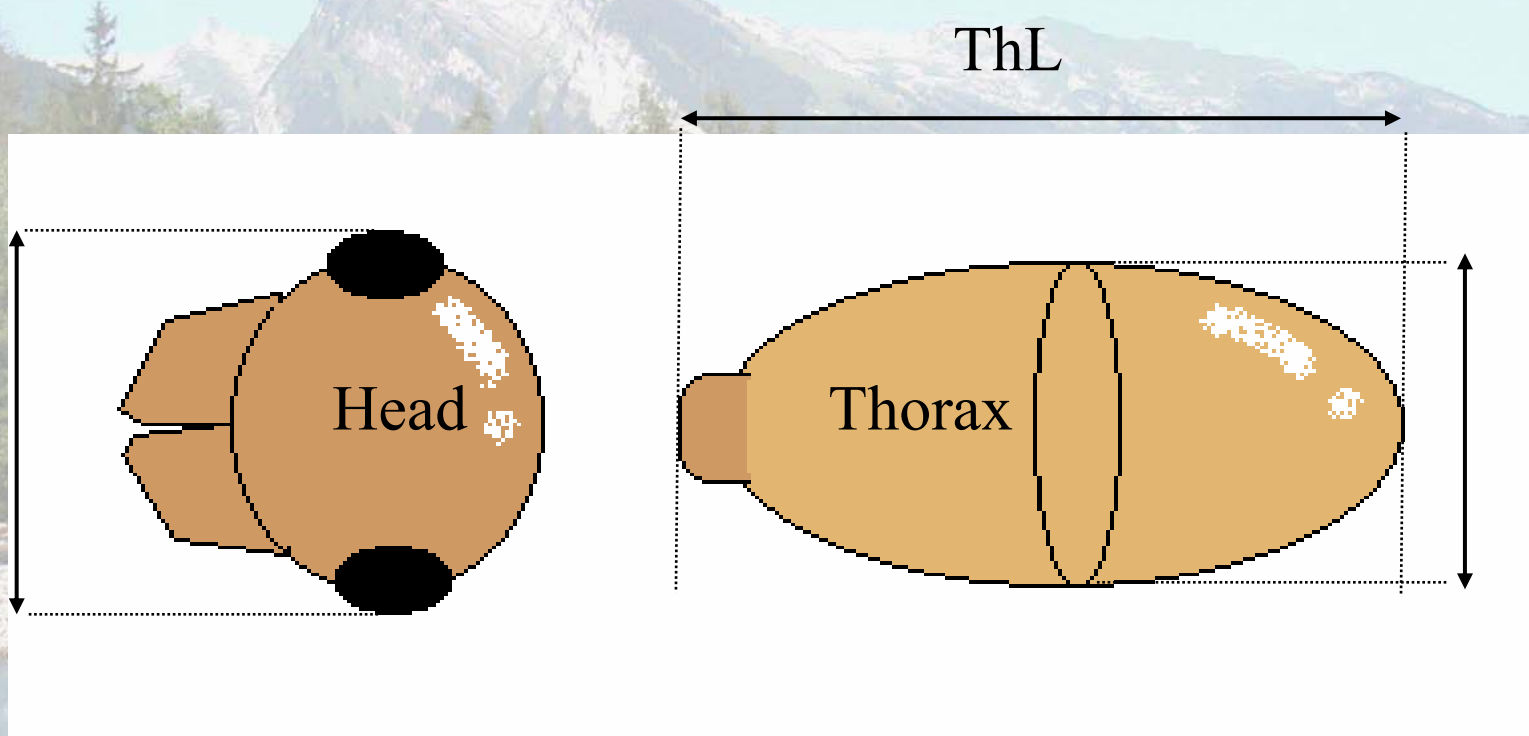
Macrogyne,
dealated



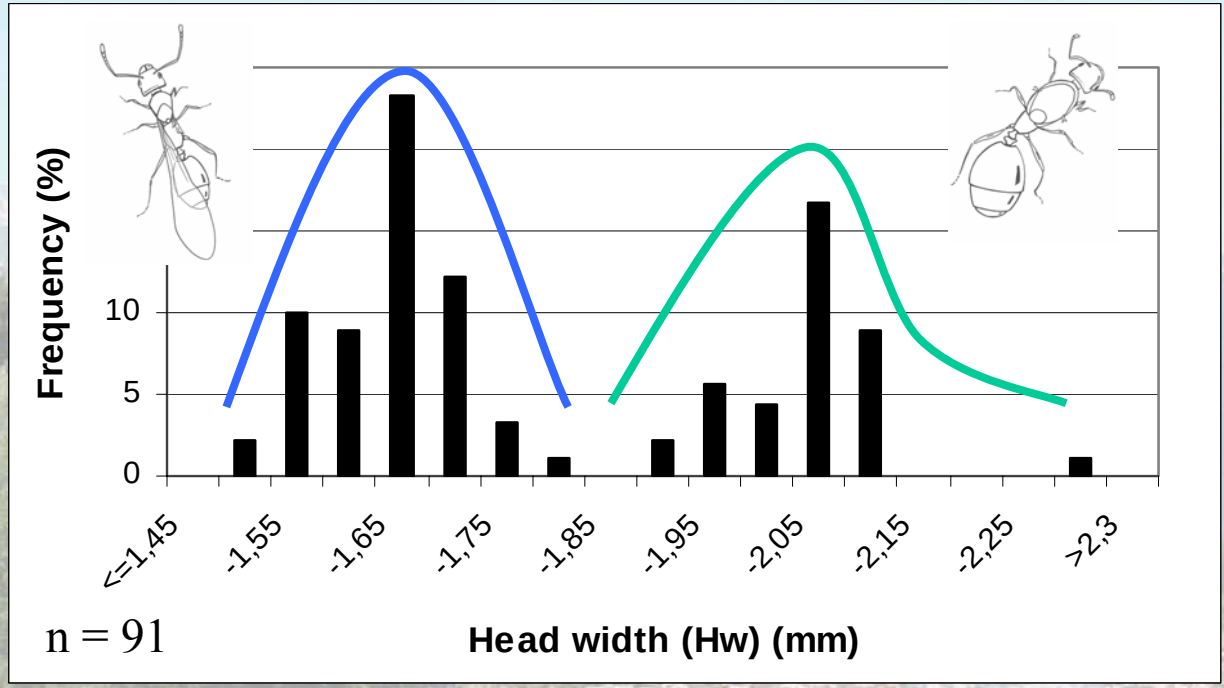


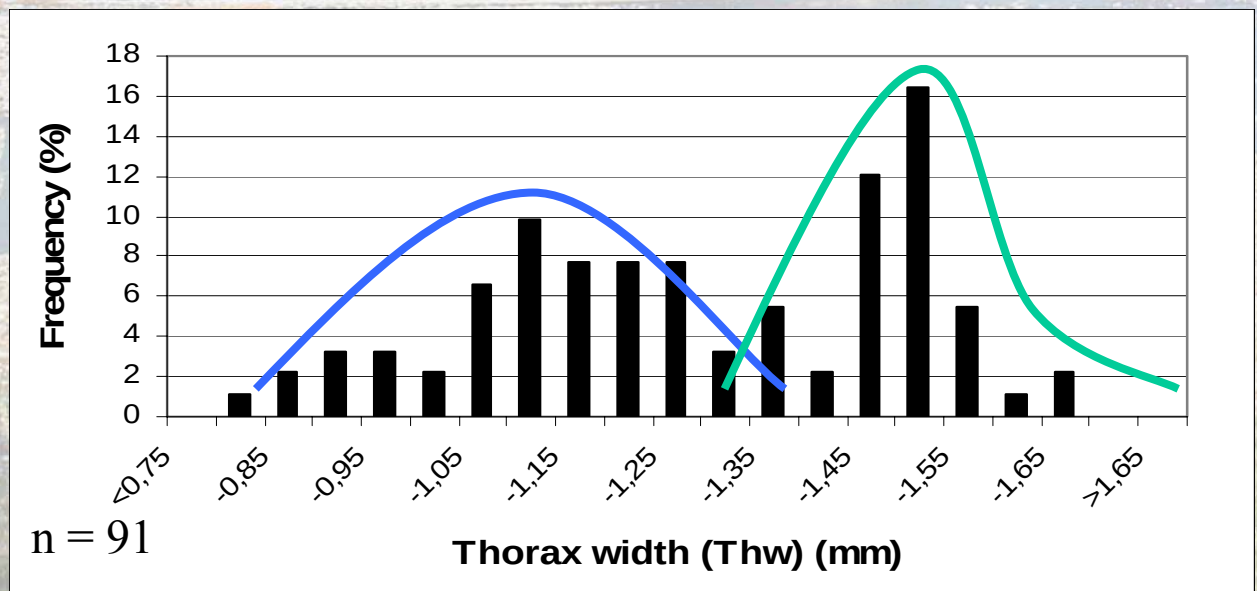
Microgyne: do not engage
in nuptial flight
and stay in the nest over the year,
keep their wings

Size of gynes

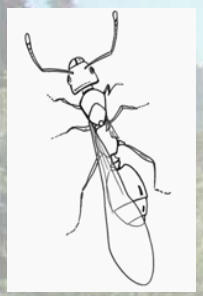


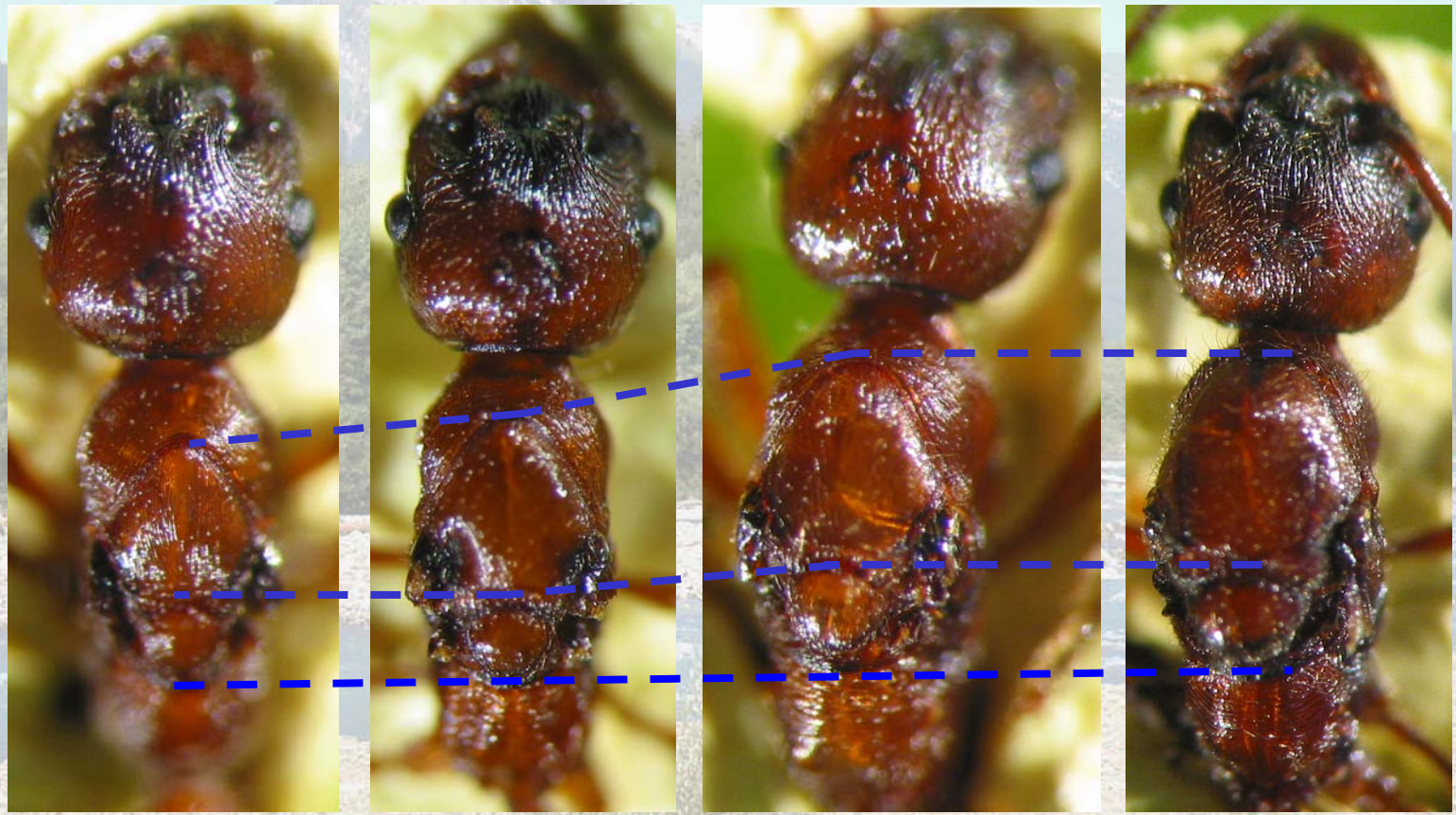
Size of gynes





Sculpture of thorax



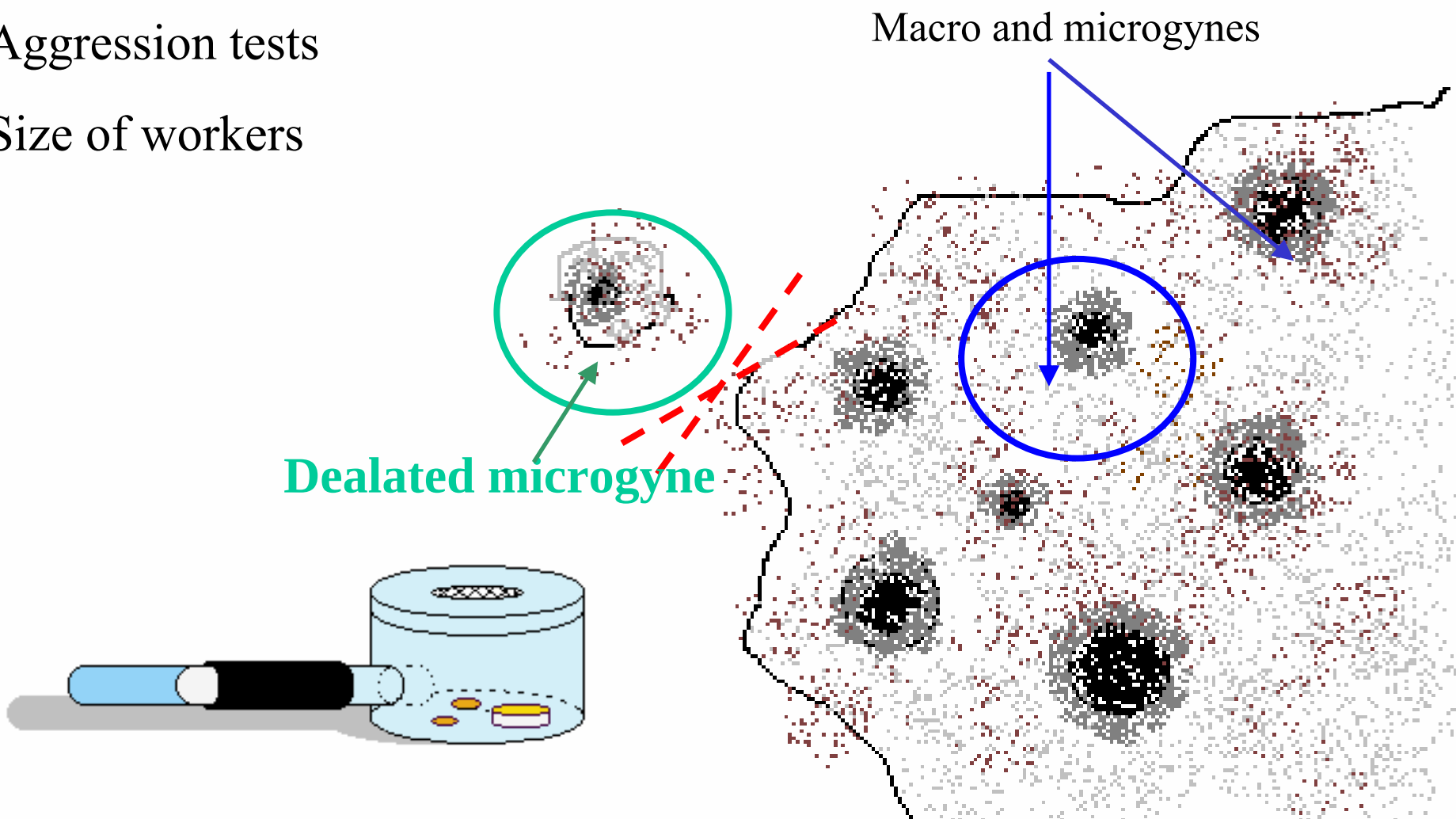


Males: no size difference

One big colony, with a small neighbouring one

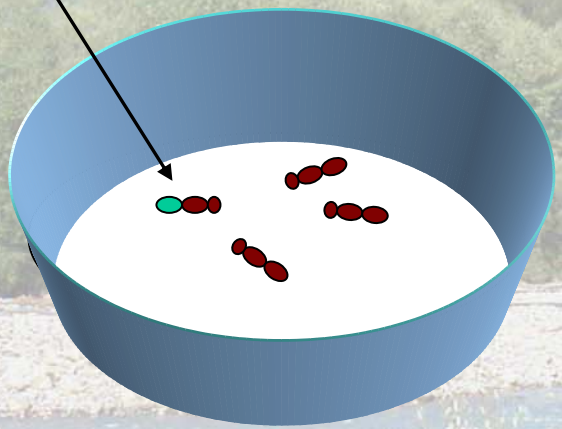
Fighting at the limits

- Microgyne laying
- Aggression tests
- Size of workers



Aggression tests (5 mn)

Intruder A/B and B/A



Encounters types:

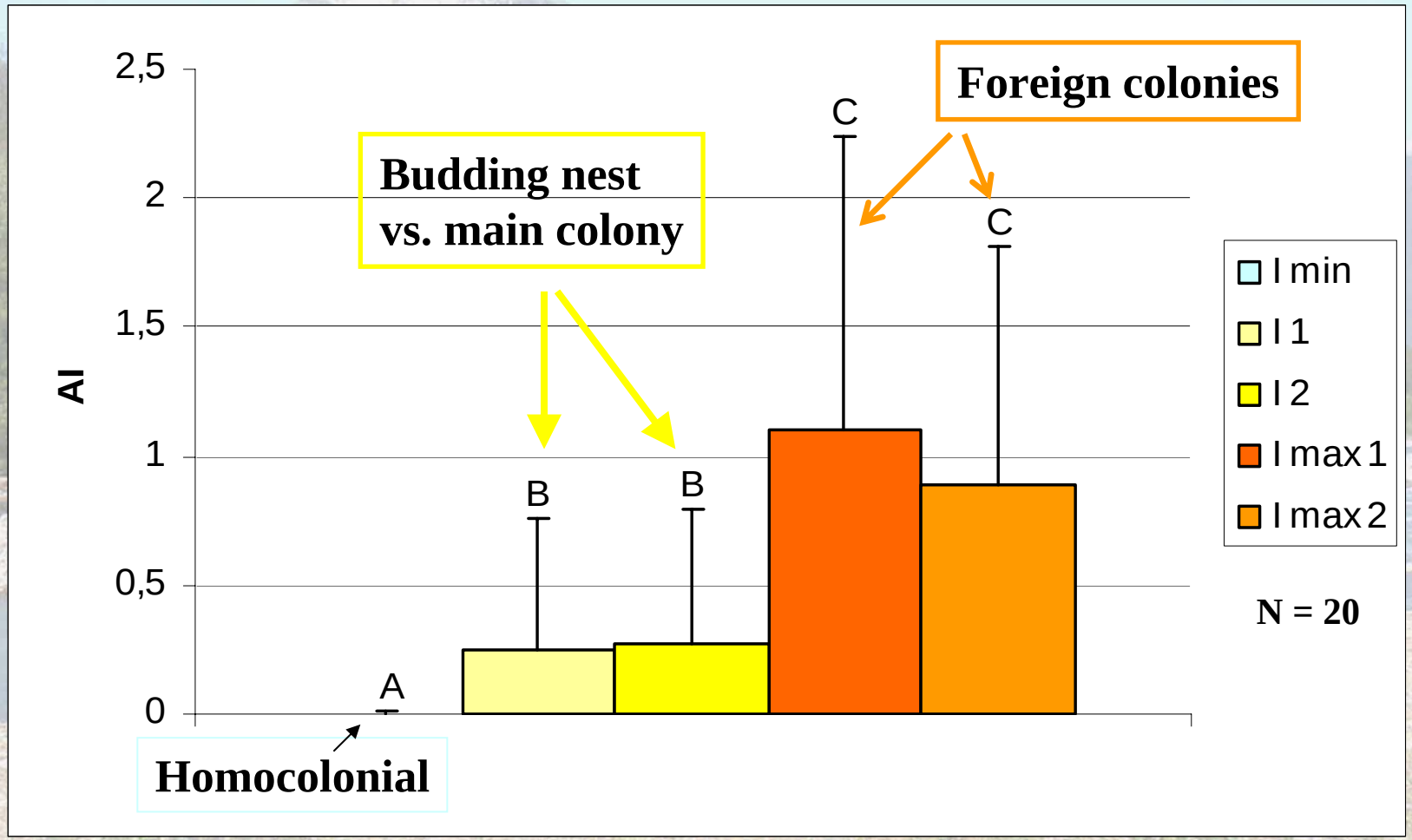
- Intracolonial
- Main and subcolony
- 2 foreign colonies

Aggression index (***Hefetz et al 1996)***

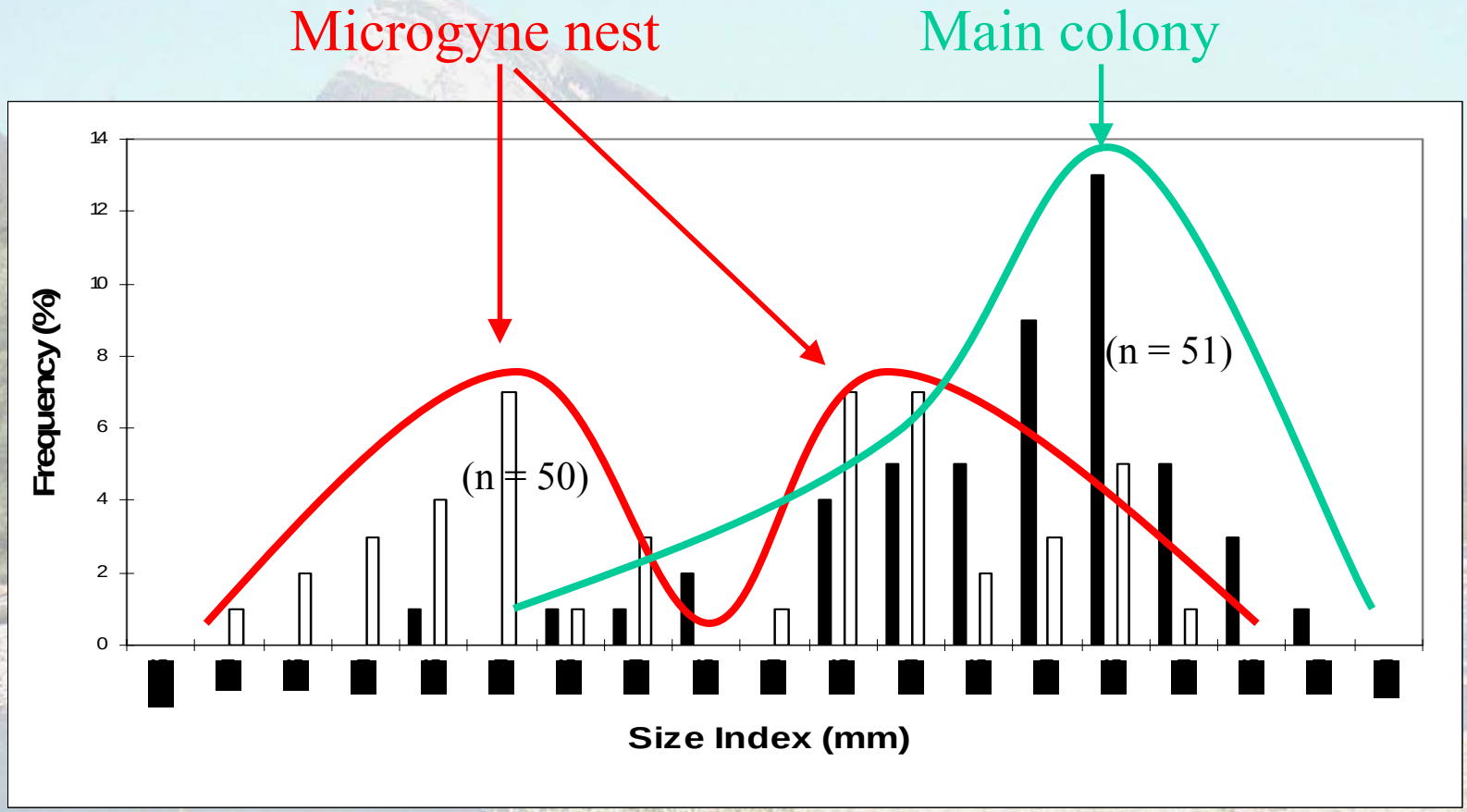
$$AI = \sum_{i=1}^{k} (f_i * AC_i) / n$$

AC: threat = 1
biting = 2
stinging = 3

Aggression tests



Size of workers

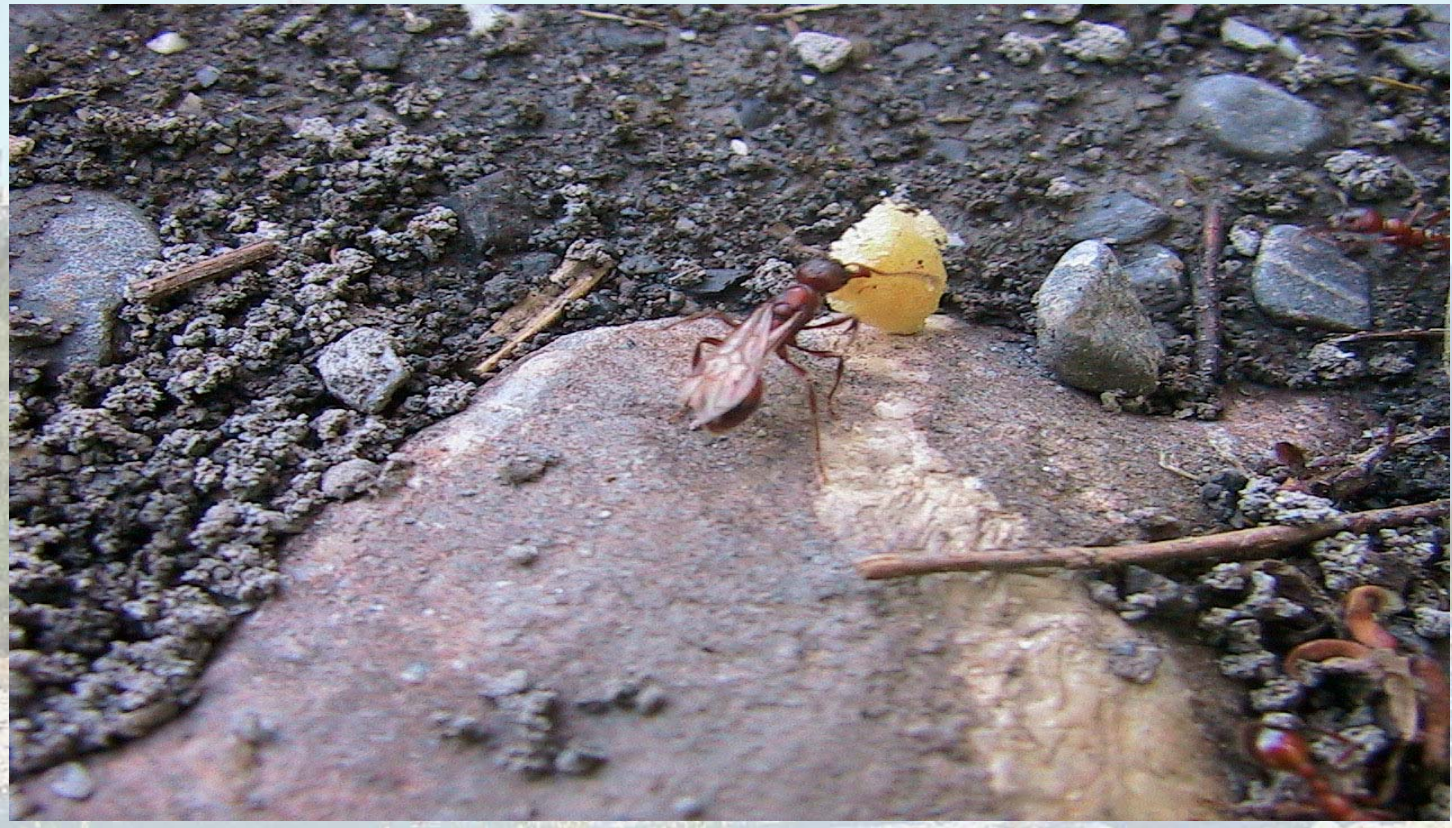


Size Index = (Hw + sq(ThL * Thw))/2

Rüppell et al 1998

-> budding in progress?

Behaviour of microgynes

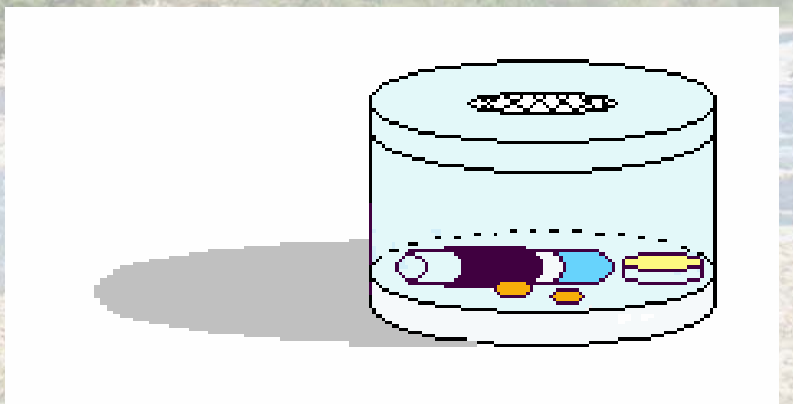


Field observations in June 2004:
53 micro foraging in 1 nest (1 hour)

Microgynes behaviour in the lab

Brood retrieving in a small nest: 20 individuals + 20 brood (n= 13)

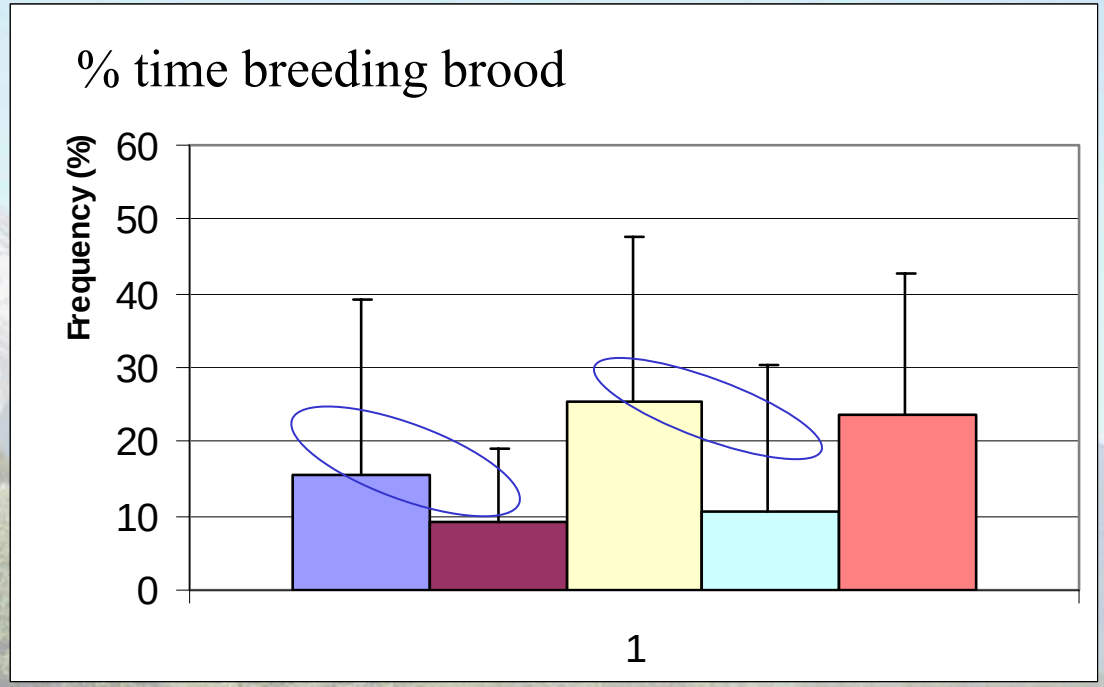
No difference between groups:
- workers: 318 s (± 126)
- microgynes: 332s (± 210)

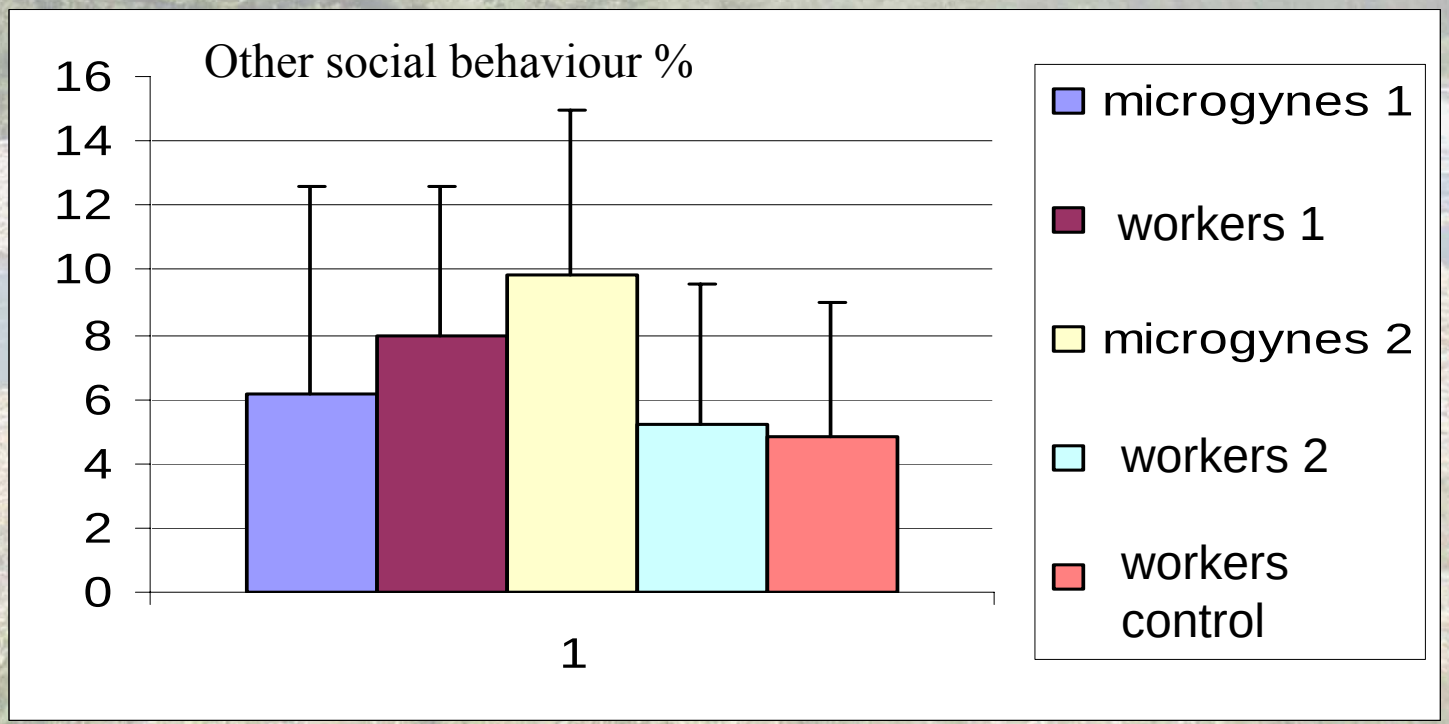


Microgynes behaviour
by scan sampling
- 10 micro + 10 workers
- 20 workers
+ 40 brood

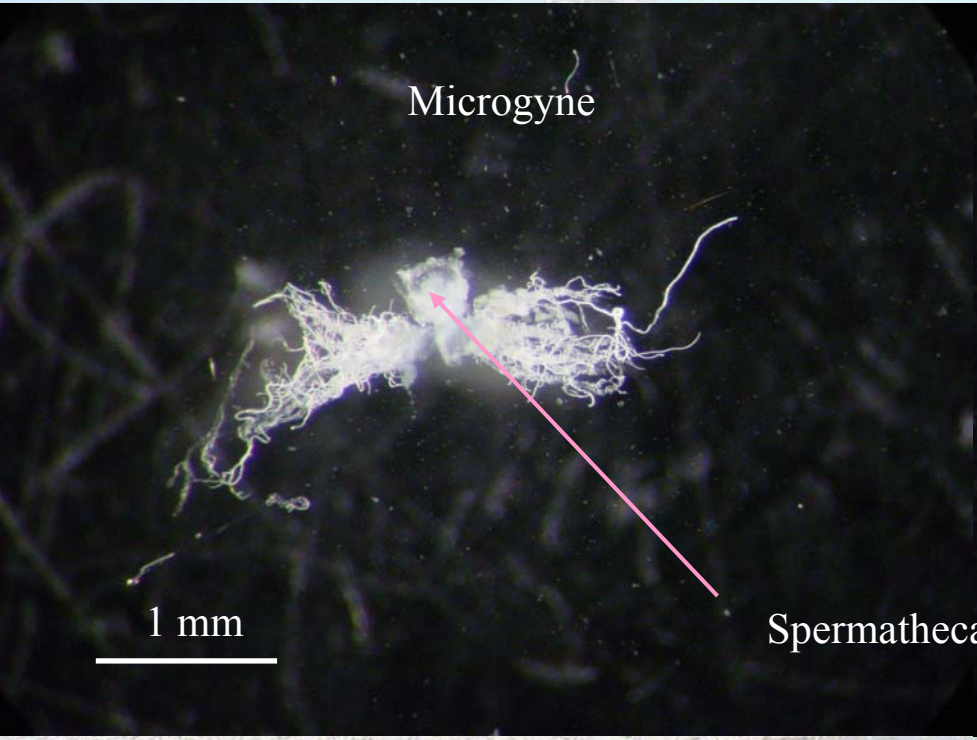
100 * 3 scan

Worker behaviour



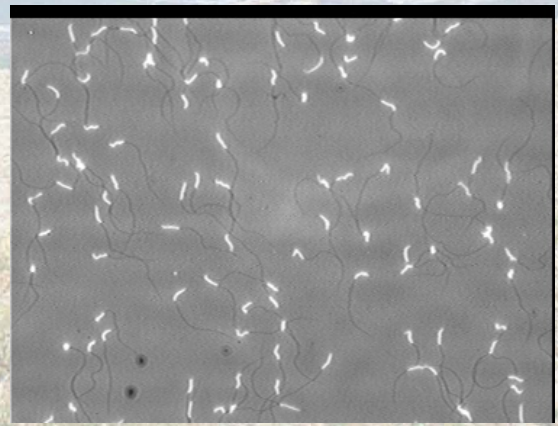


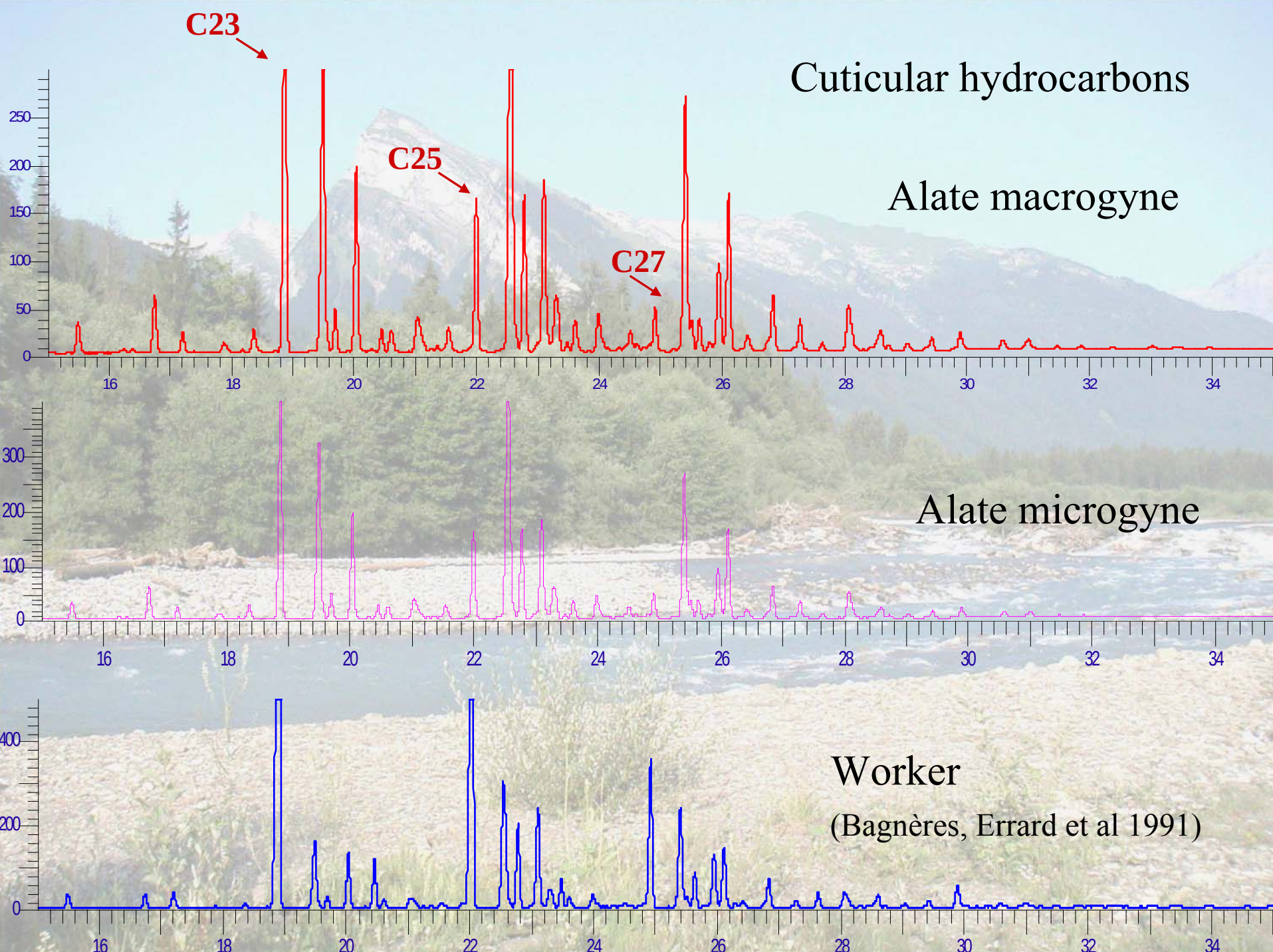
Ovaries and spermatheca



1/38 (2.8%) alate microgynes fecundated,
1 dealated produces workers
Intranidal copulation?

All dealated macrogynes fecundated




C23
C25
C27
Cuticular hydrocarbons
Alate macrogyne
Alate microgyne
Worker
(Bagnères, Errard et al 1991)
0
50
100
150
200
250
300
400
16
18
20
22
24
26
28
30
32
34

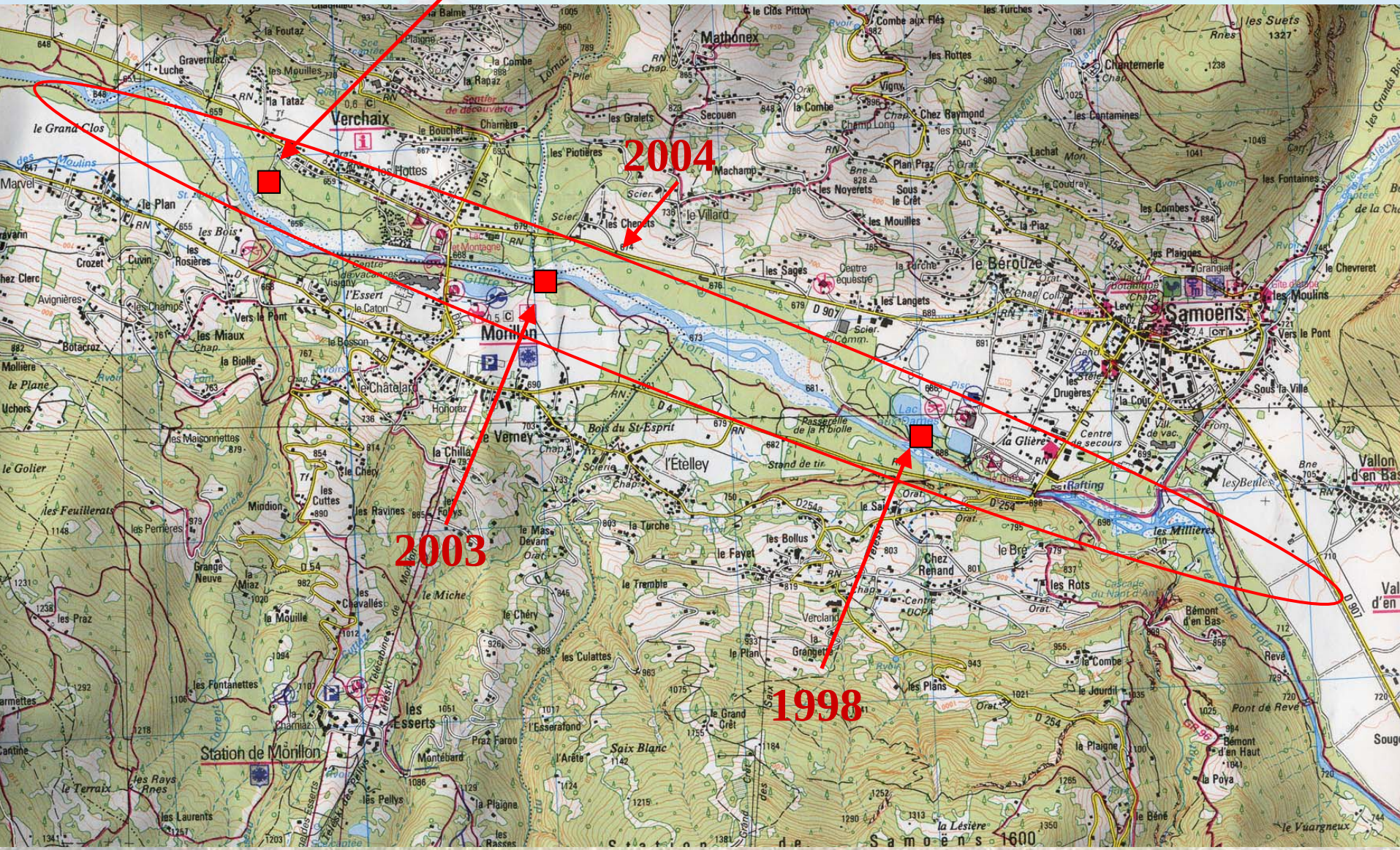
Phylogenetic analysis

Preliminary analysis: *M. rubida* microgynes differ from its "host" with 3 base pairs in COI (1449 bp) and COII (284 bp)

→ Some reproductive isolation between the 2 morphs

Giffre Valley

2005: one big colony with only microgynes!

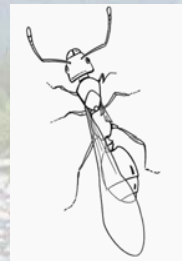


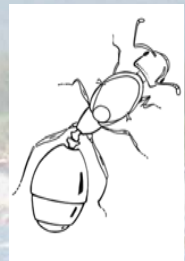
Conclusions

***M. rubida*: microevolution operating?**

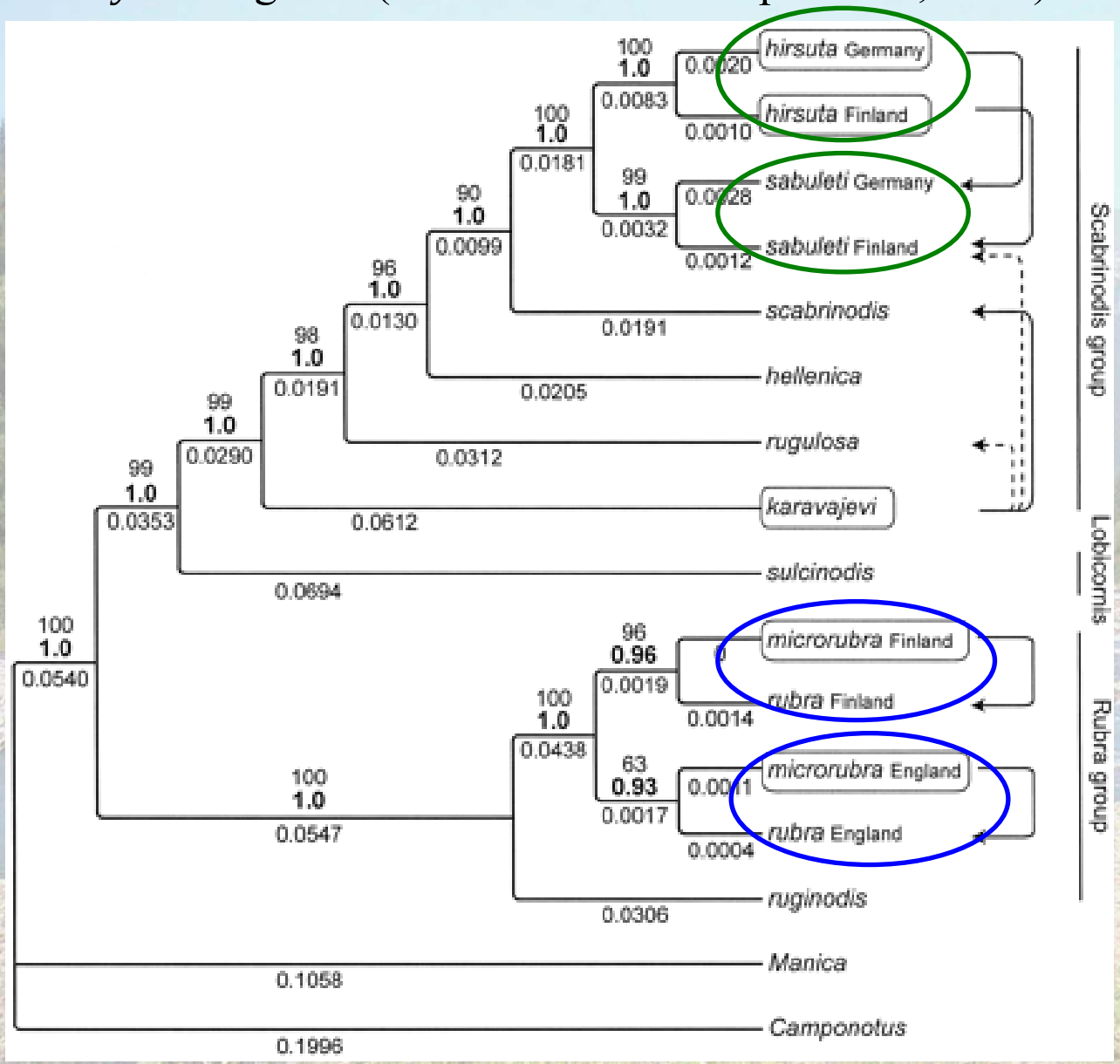
A new caste in the evolution of the species

Some genetic differentiation
microgynes are social parasites of *M. rubida*?
comparison with *Myrmica rubra*





Myrmica genus (Savolainen and Vespäläinen, 2003)



Manica rubida microgynes

Mutation on development genes?

Caste conflict: larvae try to escape queen inhibition and develop into gynes, but fail to develop into large macrogyne?

Dispersal strategy: efficient but rare, observed in 1 case only
Fecundated microgynes must emigrate to develop their own colony (cf *Myrmica ruginodis*)

Problem: not very efficient as colonies produce many microgynes which stay in the mother nest
as workers… (microgynes costly)

To be followed:

- progression of the “mutation”? Invasion by microgynes?

- phylogenetic analysis: genetic differentiation

- microsatellite analysis (effects on consanguinity if micro replace macro without nuptial flight)

- other places? (Bessans, Haute-Savoie: no microgynes)

Please have a look in the Alps mountains! 

Contact me immediately 

Thanks to P. D'Ettorre

Thanks
to N. Thurin and Jeremy
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