Slave-making ants as an alternative model of collective decision-making

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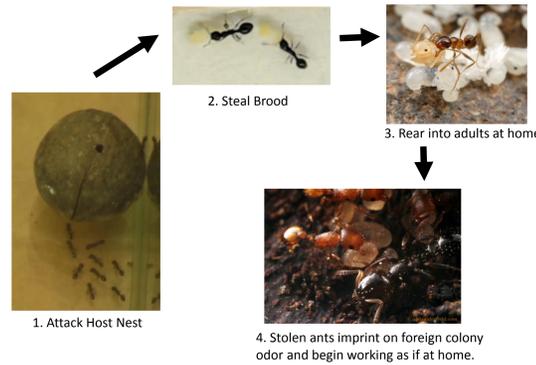
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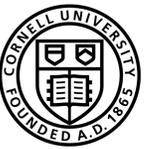
STUDY SYSTEM

HOST
Temnothorax Longispinosus
5 – 300 workers

SLAVE-MAKER
Temnothorax Americanus
2 – 4 workers

Both species nest in hollow acorns or sticks

1. Attack Host Nest
2. Steal Brood
3. Rear into adults at home
4. Stolen ants imprint on foreign colony odor and begin working as if at home.

Slave-making ants are social parasites that steal brood from nearby heterospecific nests and rear the young to serve as their worker-force. Slave-makers perform coordinated raids on these nests in order to steal brood.

OBJECTIVES

Collective decision: Where to launch an attack?

Determine how *T. americanus* colonies reach decisions over where to attack.

How does the ecology of a problem influence mechanisms of decision-making? Like other consensus decisions in social insects, slave-making colonies select a single option. But, slave-raiding is distinct from other problems in collective decision-making due to risks at multiple stages.

I focus on the following aspects of raiding:
1. Availability of and variation in target nests
2. Costs of gathering information
3. Payoffs for being selective

Finally, I ask whether the mechanisms of decision-making reflect these limitations and costs.

Costs of Acquiring Information

Scouts are at risk of being discovered by the host colony. Being discovered results in the following costs:

- Hosts mount a stronger defense (Kleeburg et al. 2014)
- Scouts may be immobilized by hosts and be unable to recruit
- Even if able to recruit, immobilization reduces stolen brood by 10% (t = 2.8886, *p* = 0.04)

METHODS

Raiding Arena

Observation Nest & Painted Slave-Makers

I stage raids in lab arenas by placing a slave-making colony and a host colony on opposite ends. I control the contents of host colonies depending on the experiment, and record individual behavior in the arena and inside the slave-maker nest.

Detection Ability

Scouts rarely enter nests when discovered, but instead will recruit to a nest after having only inserting their heads. Can scouts accurately assess the brood content of a potential target nest before recruiting to nest-mates? If so, scouts will not raid a broodless nest.

Experiment:

20 Brood & 20 Workers
1 : 1 Ratio

vs.

0 Brood & 20 Workers
1 : 1 Ratio

|	TREATMENT	
	Brood	Broodless
Raided	6	1
Unraided	12	6

P = 0.625
Fisher's Exact Test

Scouts will recruit to and raid broodless nests, suggesting they have imperfect information about the contents of target nests. However, scouts will reject unoccupied nests. Experiments are underway to test whether scouts can assess worker presence and number.
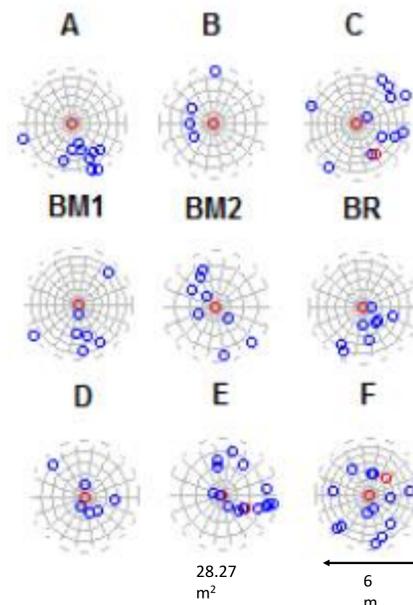
ECOLOGY

Field Demographics

Colonies have a mean 8 nests to choose from. Most nests are small to moderate in size, but a small fraction are large.

A B C
BM1 BM2 BR
D E F

T. am
T. long

Frequency of Nests

Brood per Nest

28.27 m²

6 m
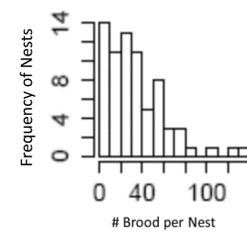
Mean 8 ± 1.5 nests per plot
Mean 26.1 ± 2.6 workers per nest
Mean 35.7 ± 3.3 worker brood per nest

RECRUITMENT

Multi-Step Process

1. Scout discovers nest
2. Scout recruits colony-mates
3. Scout takes trips between nests => attack latency

Slave-maker nest

2.5 trips (range: 1 – 9 trips)
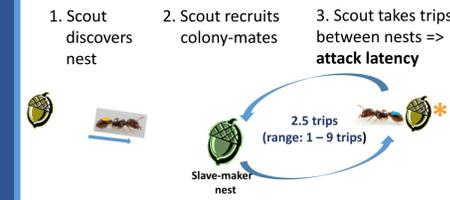
Does the duration of the **attack latency** or the number of trips relate to any feature of the nest being advertised?

Attack latency and trip number do not relate to either distance or nest size. It remains unclear whether this delay plays an important role in the decision-making process.

Within-Nest Recruitment

After a scout has discovered a nest, she will recruit a raiding party by head-butting colony-mates while rapidly moving throughout the nest interior. Are scouts communicating information about the discovered nest?
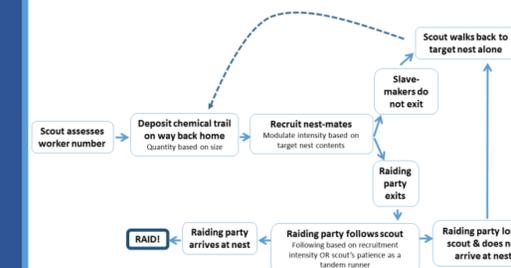
Tandem Running

The scout will lead the raiding party to the target through a combination of tandem running and chemical signals. Ants following the scout are unable to find the target unles the scout waits for her followers. The role of scout 'patience' not yet been investigated.

Raiding

Raiding occurs when a raiding party successfully follows a scout to a nest. 58 ± 7 % of the colony leaves in the raiding party, while the remainder serve as scouts. Raiding is a consensus decision, however it may become an allocation decision in larger colonies.

Hypothetical Model of Decision-Making

Scout walks back to target nest alone

Scout assesses worker number

Deposit chemical trail on way back home
Quantity based on size

Recruit nest-mates
Modulate intensity based on target nest contents

Slave-makers do not exit

Raiding party exits

RAID!

Raiding party arrives at nest

Raiding party follows scout
Following based on recruitment intensity OR scout's patience as a tandem runner

Raiding party loses scout & does not arrive at nest

Attack latency imposes a waiting period for smaller, less profitable nests so that better colonies may be found before committing a raiding party. But, it also ensures colonies raid if nothing else is found. Repeated trips may also make it harder to raid more distant nests.