Ant Colony Simulation

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Introduction

Project description & Objective

Ant Colony

An ant colony is a **self-organised** (not a hierarchical) system that adapt to the environment.

The ants are really important for the ecosystem because they:

- Aerate the soil
- Dispersal of seed in the environment
- Provide food for many organisms

We cannot live without them!

Black Ant

The project focuses on the evolution of the *Black Ant Colony:*

- Monogynous
- 2000 - 7000 ants
- 23 - 35 °C
- Active from May to October

OBJECTIVE

Analyse an Ant Colony paying attention to the effects of the variation of the temperature and of the food present in the environment

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Assumption

Environment and Constraints

Environment assumption

Temperature

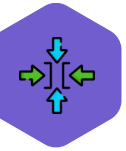
The temperature inside the nest and outside is the same and does not change during the time

Food

There is no distinction between water and food

Time

It does not exist the season cycle as well as the day-night cycle



Constraints

Ants

The mass of the ant and the pheromones are abstracted away by using the rates

Queen

The queen will lay a constant number of eggs each time

Activity

The simulation considers only the part of the year when the ant colony is active

3

The model

Description and Dynamics

Model description: main agents

QUEEN

The purpose is to lay eggs; the growth of the colony depends on it

FORAGER

Worker ant that harvest food for the colony

Worker ant who take care of feeding nest's ants and clean up the nest

NURSE

Immature ants that are the next generation of ants

LARVA

Model description: secondary agents

H

Home (Nest)

The nest act as food storage

DA

Death Ant

Includes all the dead ants like Queen, Nurse and Forager

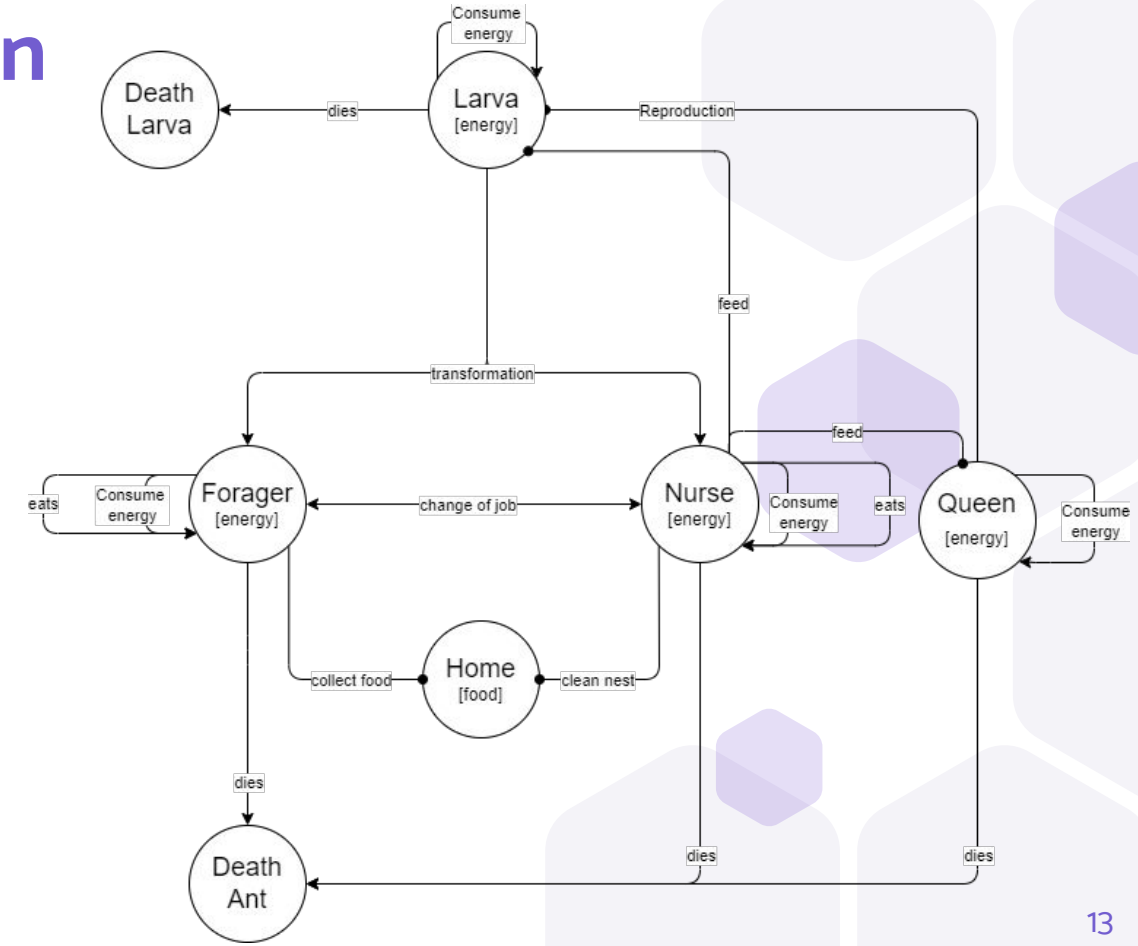
DL

Death Larva

Includes only the larvae that die

Model description
Abstract graph

All the rules and agents that interact in the colony, can be summarised with this abstract graph



Model dynamics: main rules

Reproduction

$$Q \mid H \text{ -}[\,\lambda\,]\rightarrow Q[+1] \mid H \mid L$$

Consume energy

$$A \text{ -}[\,\lambda\,]\rightarrow A[+1]$$

where $A \in \{ Q, N, F, L \}$

Collect food

$$F \mid H \text{ -}[\,\lambda\,]\rightarrow F[+1] \mid H[+3]$$

Feed

$$N \mid Q \text{ -}[\,\lambda\,]\rightarrow N[+1] \mid Q[-1]$$

$$N \mid L \text{ -}[\,\lambda\,]\rightarrow N[+1] \mid L[-1]$$

Die

$$A \text{ -}[\,\lambda\,]\rightarrow DA$$

$$L \text{ -}[\,\lambda\,]\rightarrow DL$$

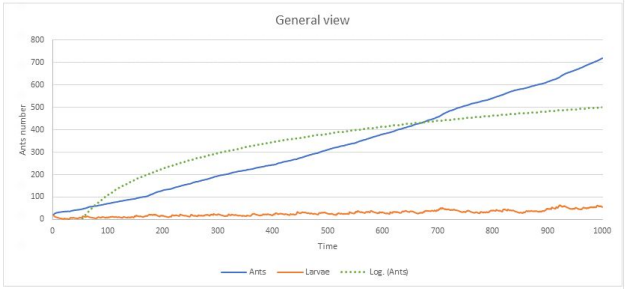
Change work

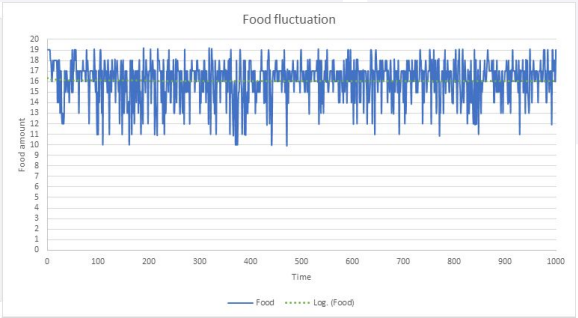
$$N \text{ -}[\,\lambda\,]\rightarrow F$$

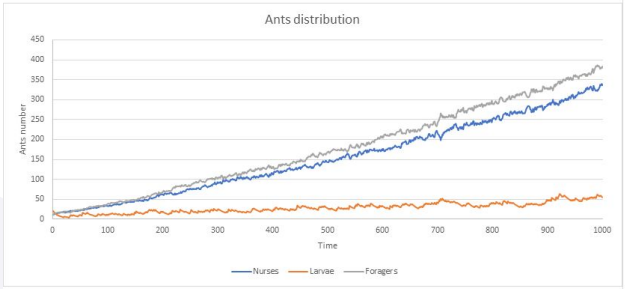
$$F \text{ -}[\,\lambda\,]\rightarrow N$$

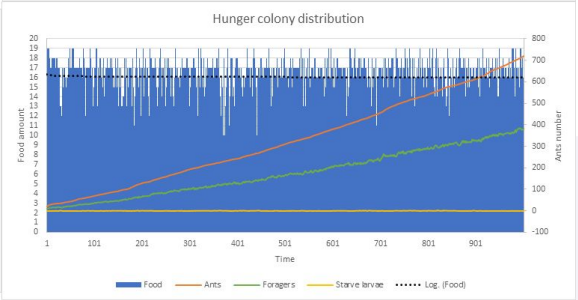
4 Simulations

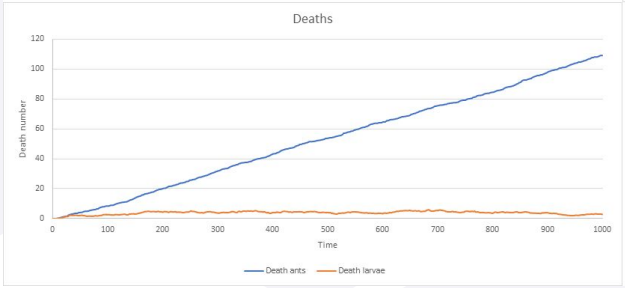
Results



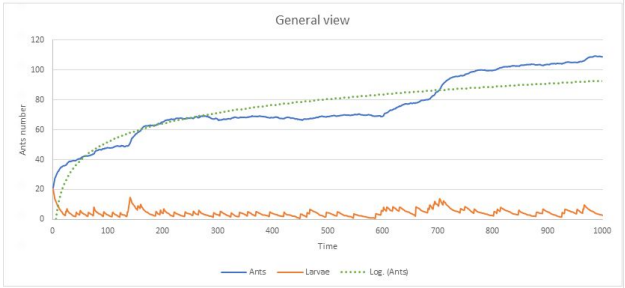


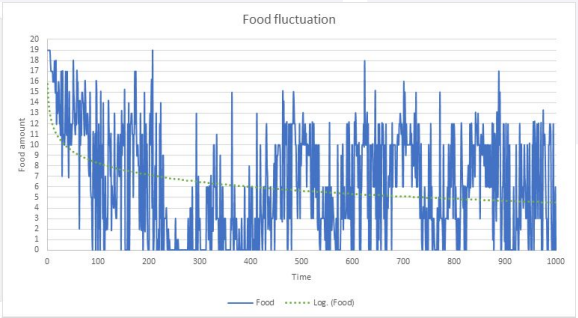


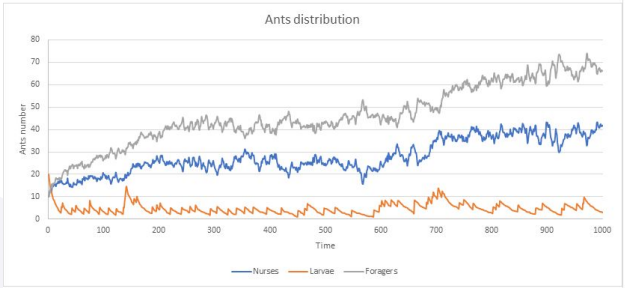


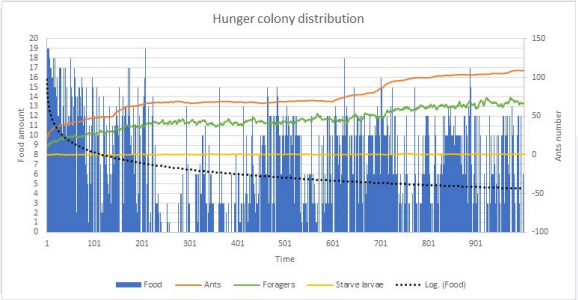


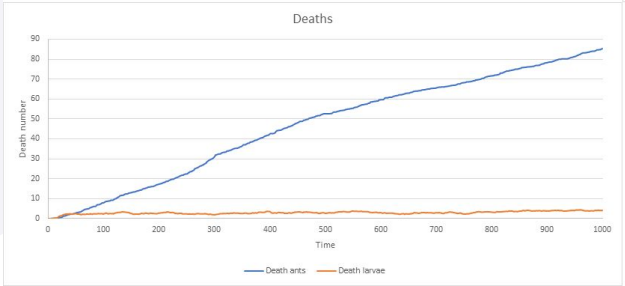
New Colony - Temperature 29 °C and Food availability 1



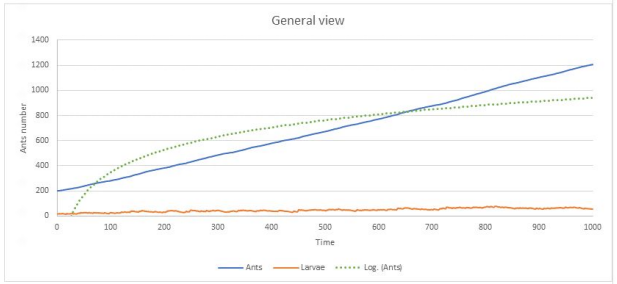


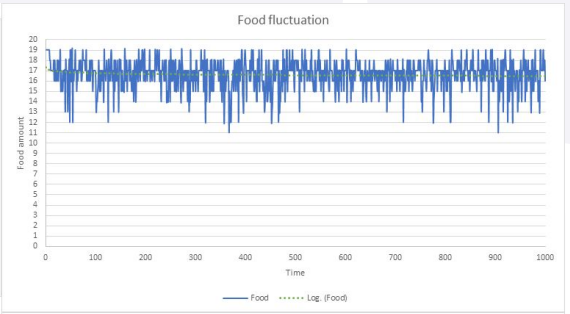


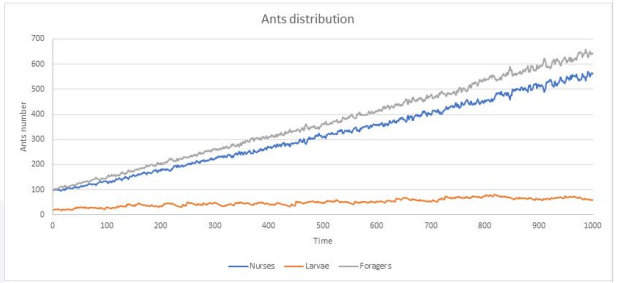


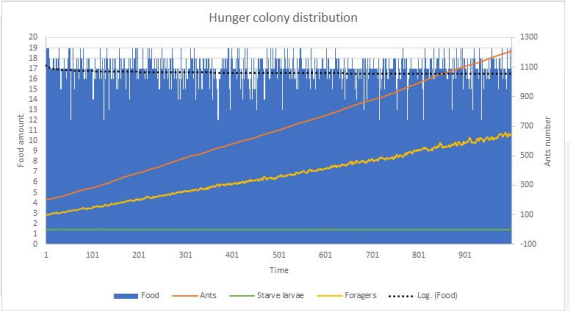


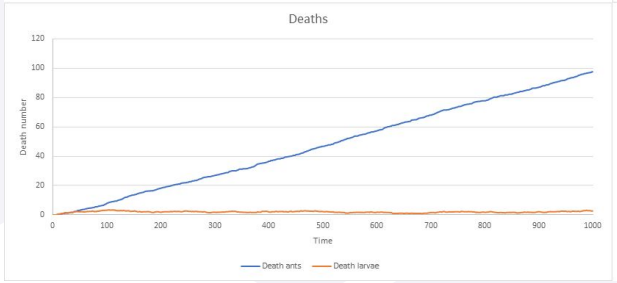
New Colony - Temperature 29 °C and Food availability 0.5



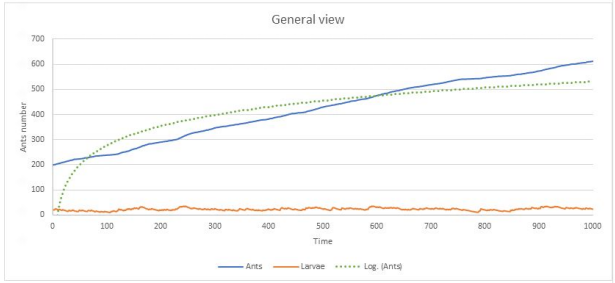


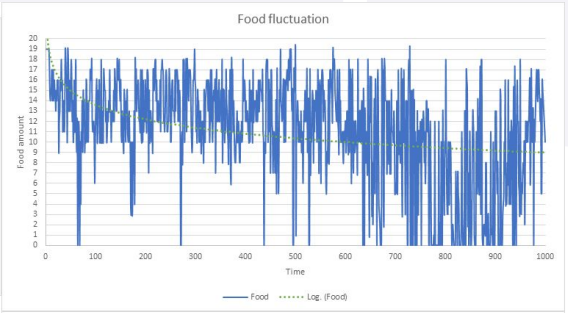


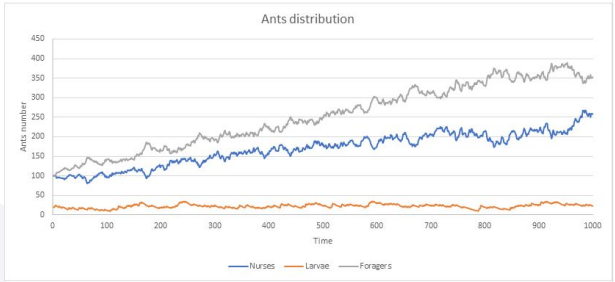


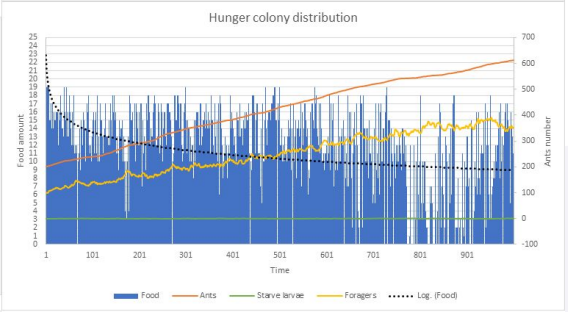


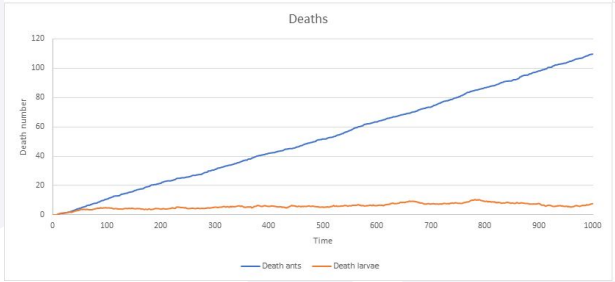
Old Colony - Temperature 29 ℃ and Food availability 1





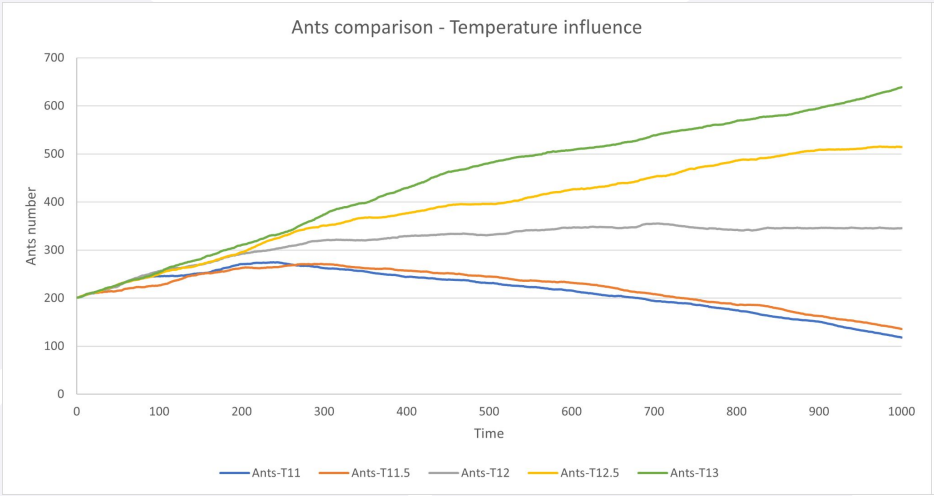




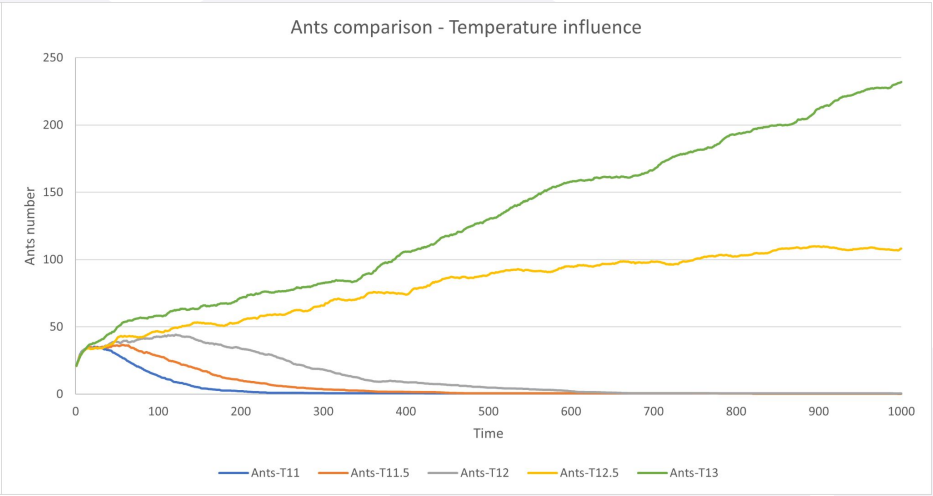


Old Colony - Temperature 29 °C and Food availability 0.5

Old colony



New colony



Old Colony vs **New Colony** - Temperature 11 °C - 13 °C and Food availability 1

5 Conclusion

Analysis & Achieved results

Achieved results

By changing Temperature and Food, there is an impact on the colony

Temperature & Food

Can boost the colony speed if moderate

Or, can sign the colony dead

New vs Old colony

Old colony are advantaged respect to newest one

THANKS!

Any questions?

You can find me at:

matteo02.romagnoli@studenti.unicam.it