CNANT

## a complex network analisys on ants interaction patterns

Among *eusocial* animals, ants are the most fascinating ones. Ants colony organization resamble in many aspects complex human societies. Decentralized communication, self-organization, activity syncronization and emergent behaviours are common features of **complex systems** that can also be found in ants colonies. Therefore, tools from network theory, could help to investigate and shed light on the stuctural and behavioural patterns of ants. With this CNA we'll try to link properties found in interactions patterns to well known biological behaviors of ants.

day 1   day 21   day 41

Queen

Body size

interactions
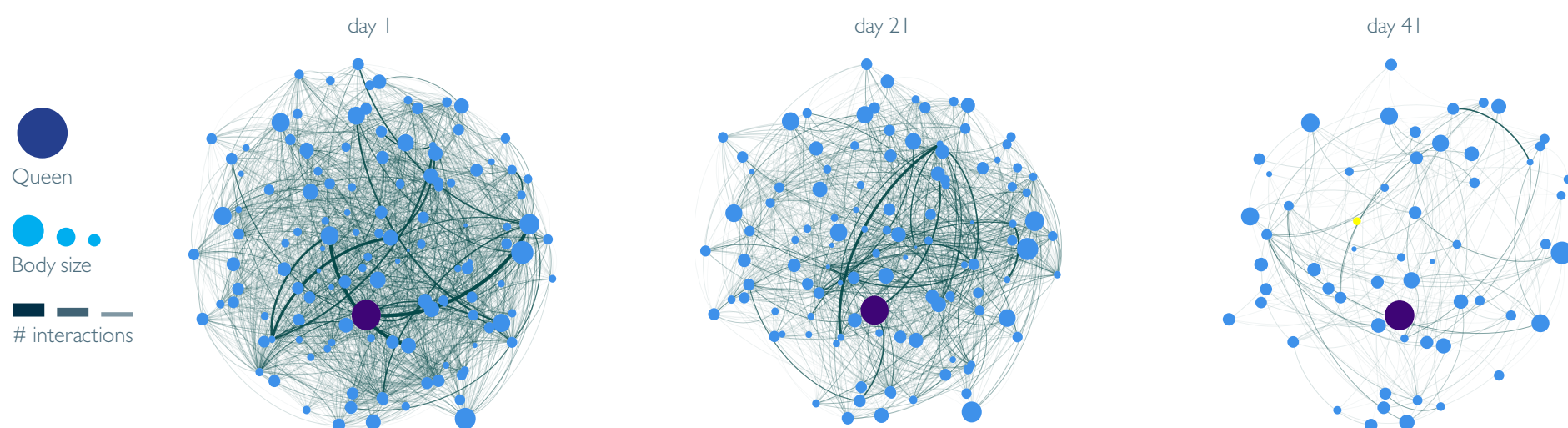
T

Network Data

Mersch et *al.* released experimental data of 6 colonies of *Camponotus fellah*. Each colony is a **temporal** network of 41 snapshots, each for one day of observation. Networks nodes represents ants, edges weights represents the **interaction frequency** among the individuals. To reduce snapshot's initial density we ran a global threshold filter to retain edges with at least 10 interactions (T). After, we cumulated all the interactions in the 41 days period to obtain an **aggregated** network (A). After this process all the temporal information is collapsed and a static CNA can be performed.

Small is the New Strong

Robustness is a general property that could be assesed in different ways. To get a general understanding we computed the network **assortatitivity** obtaining a coefficient of -0.086, suggesting a pretty neutral structure. Furthermore we assessed the robustness trough **connectedness** measures. We removed an increasing fraction of nodes under different attack scenario: random removal, removal by centrality, removal by age. The largest component size decreased almost proportionally, suggesting a robust behaviour in every simulated scenario.

It's a Ants Ants Ants World

To assess the tendency to a **small world** structure, we analyzed the **distances** and **clustering** properties of the network. We sticked to a well established methodology: checking the avg. path length and avg. clustering coefficient against a null model. We runned more than 1000 random - degree preserving - models to compute the small world *omega coefficient*. The obtained value of -0.36 suggests a slight tendency to a small world organization.
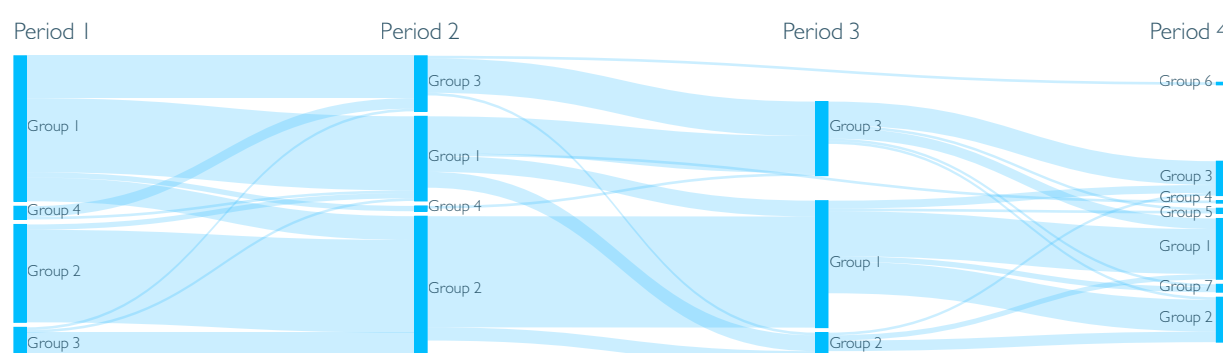

A

Queen   Body size   # interactions
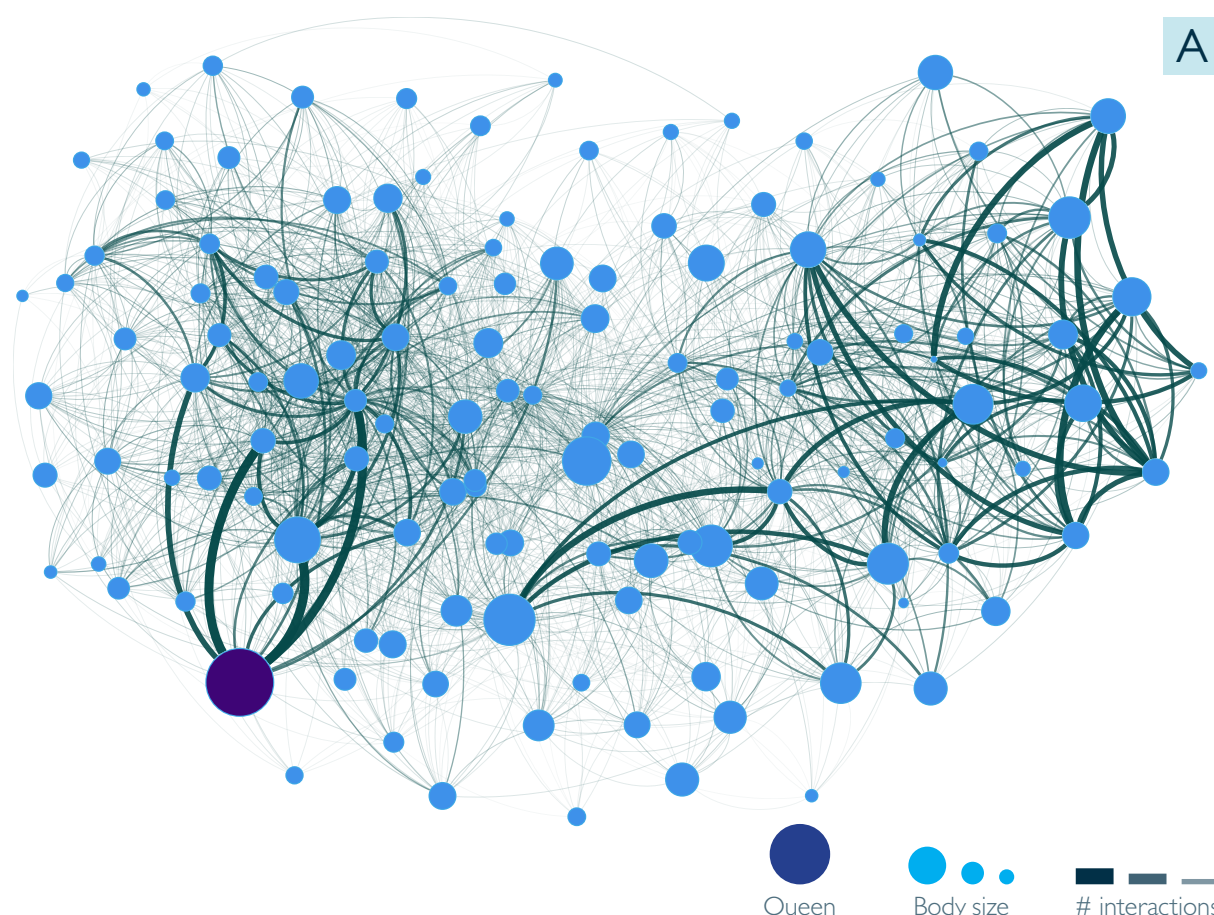
Wisdom of the older

Ants are well known for their division of labour and castes based society. Running Louvain **community detection** algorithm on temporal network we analyzed the ants flow between communities over time. In the Sankey diagram (S) we can observe an actual intermixing flow among the communities.

This is a common dynamic in ant's life since *temporal polyethism* play a key role in the colony organization: as ants grow older their caste change accordingly, starting as nurses inside the nest and then becoming foragers outside the nest.

S

Period 1   Period 2   Period 3   Period 4