Colony Entropy: Quantification of liquid food storage and mixing in ant colonies.

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Food is brought into the ant nest by forager ants which constitute only a small fraction of the entire colony. The collected liquid food is then disseminated in the colony through a cascade of trophallactic events (mouth-to-mouth feeding). This division of labor requires nutritional regulation on both individual and collective scales. While the food in the colony is aggregated within workers' crops it is also being mixed when food is exchanged in trophallaxis. ‘Well’ mixing of the food may be beneficial for the collective regulation of food intake. For example, in this ‘well’ mixed scenario, foragers could easily detect the colony nutritional state by interacting with any random worker. On the other hand, separation in nutrients (‘low’ mixing) may allow regulation on the individual level. In this latter case, each worker can regulate her own intake by accepting/avoiding food from various workers, each with different food mixture. It is therefore interesting to know how well food is mixed within and between the individuals in the colony. To study the processes of food accumulation and food mixing we track the food within colonies of *Camponotus sanctus*. We combine images of fluorescently labeled food with video tracking of ant trajectories. This measurement technique provides a quantitative data set of food flows on both individual and collective levels. To quantify processes of food accumulation and food blending we define the Shannon Entropy of the colony. Shannon Entropy, provides a single quantity that reflects the relative abundance of its constituents and provides a common scale by which to measure food distribution within ants’ colony. Under this mathematical framework, we discuss the impact of the fraction of foragers, the stochastic nature of food flow between individuals and the fact that ants have finite crop capacity on the processes of food accumulation and mixing.