

Literature Review 3: Topic Summary

Summary

Leafcutter ants (tribe Attini) grow fungus gardens inside of their nests (Weber, 1972). The relationship is mutually beneficial: the fungus acts as a primary food source for the ants while the ants forage for plant clippings to sustain the garden (Weber, 1972; Currie & Stuart, 2001; Muratore & Traniello, 2020). The gardens are also susceptible to infection from pathogens, and as such, require protection from the ants (Currie & Stuart, 2001). In 2001, Currie & Stuart conducted ad libitum sampling of ants with contaminated gardens and found that weeding (physically removing contaminants using mandibles) and grooming (“licking” of the garden and nestmates to collect spores of the contaminant in the mouth and later dispose of them as non-viable pellets) behaviours were exhibited when removing pathogens.

These fungus cultivating behaviours are divided up amongst different workers in the colony according to their caste system – or in other words, according to morphological traits such as body size (Abramowski et al., 2010). In 2010, Abramowski et al. observed an *Acromyrmex octospinosus* colony exposed to *Escovopsis* fungi where during each observation period, the number of ants present on the fungus were counted according to their body size (Abramowski et al., 2010). The results found that small workers mostly participated in grooming, while larger workers mostly participated in weeding (Abramowski et al., 2010). Similarly, when Caliheiros et al. did an ethogram study of leafcutter ant labour division in 2019, they found that larger workers participated in more foraging and weeding behaviours than small workers. The results of these two studies suggests that labour division according to body sizes determines which fungus-cultivating behaviour a worker ant will exhibit (Abramowski et al., 2010; Caliheiros et al., 2019). Interestingly, although small workers groom the garden at higher rates, Richard & Errard found in their observational study that large foraging workers spend more time grooming themselves and fellow nestmates (2009). It’s hypothesized that this may be due to foragers having increased risk of pathogen exposure (Richard & Errard, 2009). Additionally, Muratore & Traniello’s review suggests that genetic influences impact the morphology, and therefore, the labour division and behaviour of ants (2020). For example, large foraging workers can learn how to assess plant quality, which requires a larger brain for information processing (2020).

Labour division may also play an important role in the communication of pathogen presence (Gerstner et al., 2010). In 2010, Gerstner et al. conducted an observational study to test whether large workers influenced the movement of small workers towards infected garden sites. To do this, the researchers created a dual-chamber where one chamber had an infected garden and large workers present, and the other chamber had only small workers present (Gerstner et al., 2010). The results found that although small workers can move on their own accord, the number of small workers moving towards infected sites increased in the presence of large workers (Gerstner et al., 2010). It’s hypothesized that the large workers are able to communicate this through the use of pheromones antennae sensors, however further research is required (Gerstner et al., 2010).

Leafcutter ants have an additional mutualistic relationship with pathogen-inhibiting bacteria from the genus *Pseudonocardia* (Currie et al., 2006). The bacteria grows within a cavity behind the head where the ants sustain the bacteria through gland secretions (Currie et al., 2006). In 2006, Little et al. looked at the microbial makeup of disposed post-grooming pellets through means of dissection. The results showed that colonies exposed to *Ecovopsis* had significantly more pellets and that the pellets contained *Pseudonocardia*, indicating that the bacteria play a role on pathogen removal (Little et al., 2006).

These close relationships between bacteria, fungi, and ants suggest that they co-evolved (Currie et al., 2006). In 2017, Brantstetter et al. conducted a phylogenetic analysis of 78 Attini ants and found that they primarily originated in South America approximately 57-61 million years ago, suggesting millions of years of co-evolution. It appears that specific species of Attine ants are specialized to specific groups of fungi and *Pseudonocardia* bacteria (Currie et al., 2006). It's also suggested that Attina ants may have evolved fungus-cultivating behaviours due to decrease in prey and increase in fungi, however, this theory requires further research (Brantstetter et al., 2017).

References

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