Title

An ant-dispersed plant community recovers following a small-scale disturbance in a Connecticut forest

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Abstract:

Many species of plants exhibit a dispersal syndrome called myrmecochory, in which nutrient-rich seed appendages recruit ants which in turn transport seeds. This food-for-dispersal mutualism is common in the understory spring ephemeral and seasonal-green plant community found in temperate deciduous forests of Eastern North America and Europe. In the Northeastern U.S. mixed deciduous forest ecoregion, common wildflower genera including *Trillium, Erythronium, Dicentra, Claytonia* and *Hepatica* are dispersed by the facultative mutualist ants *Aphaenogaster.* Current evidence suggests that this mutualistic ant-plant complex depends on intact, closed-canopy forest and that the loss of one mutualistic partner could cause the decline of the other. It is unclear if, following disturbance, this mutualistic community can recover and support typical abundances of either ants or plants. Forests in Connecticut (USA) are particularly impacted by urbanized development, but the myrmecochores that could be impacted by this land used changes are not well described systematically. To address this shortcoming, I sampled multiple locations where myrmecochores were common. At a particularly intact site, I performed a long-term, small-scale removal of all elaiosomes-bearing diaspores in a gridded plot in a forest understory dominated by myrmecochores. From April to May from 2009 to 2011, all seeds were removed by hand from three 50m^2 plots, each paired with control plots with no removal. Following predictions of the life history of plants and ants in this system, I returned in Summer 2017 to collect data on % coverage of ant-dispersed plants and the abundance of seed-dispersing ants relative to the entire ant community. I found that despite entirely removing three growing seasons worth of elaiosomes, ant communities were not impacted or had made a recovery within the 6-year duration of the experiment. The % coverage of ant-dispersed plants did not impact any of the members of this plant community, suggesting that these populations were not seed limited or had made a concomitant recovery. Consequently, I conclude that as long as surrounding habitat (e.g. closed canopy secondary forests) is maintained, myrmecochorous communities have a robust ability to tolerate disturbance to the mutualistic interaction.

Introduction

Seed dispersal mutualisms are important components of terrestrial food webs since they represent a source of energy flow from plants to animals. Conversely, seed dispersal mutualisms have significant impacts on primary productivity since they regulate plant populations and community structure. Most mutualisms exhibit some degree of specialization, in which there is a co-evolutionary history between animal disperser and the dispersed plant species. In the case of myrmecochorous, or ant-dispersed plants, some forest understory plants present a syndrome of traits associated with seed dispersal by generalist ants. These myrmecochores produce seeds (diaspores) with fleshy, nutrient rich appendages called elaiosomes which attract foraging ants. Ant foragers return the seeds to the parent colony, remove the elaiosomes to freed to brood, and then discard the remaining seed to ant colony middens. Elaiosomes contain nutrients that can be limiting for ant colony development, and the abundance of ant-dispersed plants in some habitats suggest this is an important food source for ant colonies.

Myrmecochory is common in understory plants following the spring ephemeral life history strategy. These relatively small flowering plants have short leafing and flowering times, often completing emergence, pollination, and seed production before the forest canopy closes. In these habitats, *Aphaenogaster* ants are numerically dominant, and evidence suggests these are the most effective dispersal mutualist for myrmecochores. *Aphaenogaster* ants rapidly discover and move diaspores, preventing seed predation by small mammals.

Given the specificity of this mutualism, there is concern that habitat modification, disturbance, or fragmentation could negatively impact myrmecochorous communities or their seed-dispersing ants like *Aphaenogaster*. Elaiosomes are a food source for *Aphaenogaster* colonies and can be particularly important when another insect prey is not available (Clark and King, 2012). It is predicted that disturbance which removes one of the mutualistic partners could negatively impact populations of the other. Consequently, there could be cascading effects as the result of the decline of this putative mutualist ant *Aphaenogaster*.

Methods:

In 2009-2010, I completed a range of surveys with volunteer students from Central Connecticut State University and University of Connecticut on myrmecochore abundance in secondary forests. The locations, although not exhaustive, represent sites that were accessible and had reports from amateurs about high myrmecochore abundance. The goal of these surveys was to provide preliminary data on the most common myrmecochore species found across a range of secondary forests typical to the state of Connecticut. These sites included:

Results:

The composition of the plant communities surveyed is reported in supplemental tables and figures S1-Sx. *Erythronium americanum*, *Trillium erectum*, *Dicentra cucularia*, and *Claytonia virginia* were found to be common. We chose to the habitat manipulation at a site where all members of the myrmecochore complex easily found in Connecticut were present.

2017 baits used to record the ground-foraging ant community and *Aphaenogaster* colony abundance yielded five species of ants, including *Aphaenogaster rudis* group, *Camponotus pennsylvanicus*, *Lasius neoniger*, *Myrmica punctiventris,* and *Tapinoma sessile*. This sample event following three-years of myrmecochore removal and a six-year waiting period. We observed no difference in the abundance of seed-dispersing *Aphaenogaster* colony abundance among removal, control, or supplementation treatments (Fig. 3, Kruskal-Wallis, χ2 = 1.15, df = 2, *P* = 0.56). *Aphanogaster* workers were present at every observed bait in the removal treatment, additionally indicating they were abundant in these plots. Additionally, there was no difference among treatments in the recruitment of non-*Aphaenogaster* ants to these baits (Fig. 3, Kruskal-Wallis, χ2 = 0.78, df = 2, *P* = 0.67).

Discussion:

References:

Clark, R. E., and J. R. King. 2012. The ant, Aphaenogaster picea, benefits from plant elaiosomes

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Figure captions:

Fig. 3. Violin plot for recruitment lines of workers found at baits in 2017 assay. Width of violin plots within each treatment indicates the relative number of counts of that number, while length indicates the range of observed outcomes (0-3 colonies per bait). Center points and error bars indicate mean and standard error of the mean.

Fig. 3.

