Ant Biodiversity in Urban Ecosystems

Introduction

Are Urban Green Spaces Important for Biodiversity?

Urban areas dominate a large portion of our world today. These developed areas can have negative effects on biodiversity. In Connecticut, 19% of the total land area had been developed by 2010. From 1985 – 2010, 149mi^2 of land in Connecticut was developed,[1] which translates to 10 acres developed per day over that 25 year period. While urban landscapes continue to expand worldwide, in many urban areas there are often pockets of "green space," which may play an important role for biodiversity.

Using Ants as Biodiversity Indicators

When you look outside on the ground, one of the first things you probably see are ants, maybe "black" and "red" ones, right? However, there are 12,000 known species of ants in the world. According to Aaron Ellison's data, there are about 84-100 ant species in Connecticut. Ants are important to ecosystems as predators that control the number of other insects, and as decomposers. These roles protect ecosystem functions and help balance biodiversity in "green spaces." [2]

Fig. 1 (a) Hartford urban land coverage, (b) Two Hartford ant species, *Camponotus chromaiodes* (large, black) and *Solenopsis molesta* (tiny, yellow).

Objectives & Hypotheses

Our objective was to assess how much ant biodiversity (species richness) is supported in urban gardens. At 42.4%, Hartford has a high level of developed, or impervious, land surface (Fig. 1a).

We hypothesized that: 1) large community gardens would have greater ant species richness than small community gardens, and 2) community gardens, whether large or small, will have greater ant species richness than nearby old field or turfgrass "control" sites.

Fig. 2 Examples of a: (a) large Knox community garden and (b) a small community garden in Hartford, Connecticut. Google map view (c) shows the urban setting of Huntington, a small garden (bright blue rectangle).

In the Field

In Hartford, we set up our project in the Knox Community gardens. Knox is a non-profit organization that combats food insecurity by providing Hartford residents with plots on which to grow food.[3]

We studied ant species richness in 3 large community gardens of >5000m^2 (Fig. 2a), and 3 small community gardens <600m^2 (Fig. 2b). Each garden was paired with a "control" area that was located within 400m of each garden site (Fig. 3c). Controls for the large gardens were old field habitats, while for the small gardens they were turfgrass areas. Our surveys were conducted in August and September of 2018.

Within each plot we placed 6 pitfall traps and left them overnight to trap insects (Fig. 3a). We used Track Kit GPS to map our pitfall locations. The next day, we collected the insect samples to be brought to the lab. We also hand sampled haphazardly.

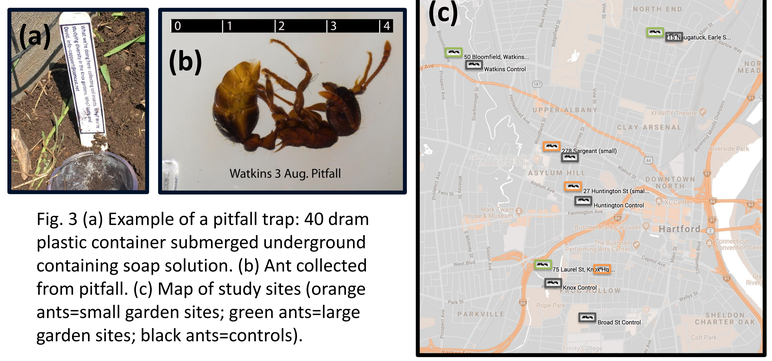


Fig. 3 (a) Example of a pitfall trap: 40 dram plastic container submerged underground containing soap solution. (b) Ant collected from pitfall. (c) Map of study sites (orange ants=small garden sites; green ants=large garden sites; black ants=controls).

In the Lab

In the lab, we used a dissecting microscope to separate ants from other insects (Fig. 3b, & Fig. 4a). We placed each in vials organized by trap/garden. To identify the ant species present we mounted an exemplar from each vial, and examined under a microscope while referencing a field guide (Fig. 4b). Ant ID is challenging as it requires interpretation of small details. For example: to decide whether the clypeus ("upper lip") of the ant in Fig. 4c is slightly concave or clearly notched.

Once we made the identification, we preserved reference specimens to aid in subsequent identifications. This was a difficult step as ants' limbs often refuse to cooperate when attempting to put them in a good viewing position (Fig. 4b&c).

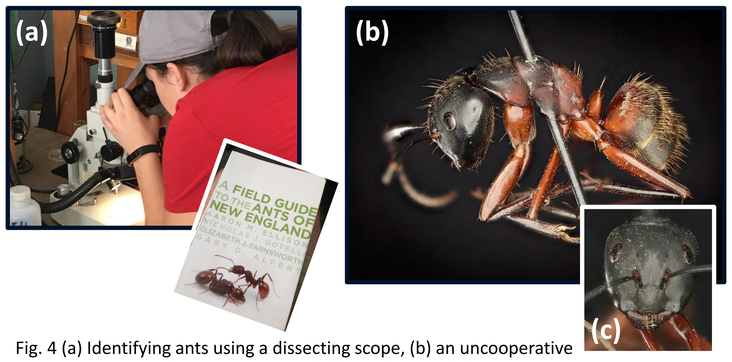


Fig. 4 (a) Identifying ants using a dissecting scope, (b) an uncooperative ant we tried to pin from the side, and (c) frontal view of the mounted ant.

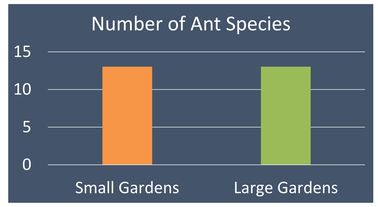
Results

Hartford Urban Ant Species Checklist

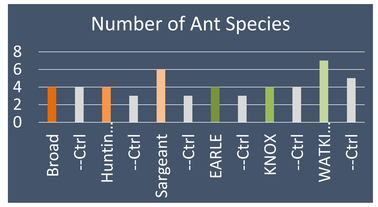
Species	Small Gardens	Small Garden Controls	Large Gardens	Large Garden Controls
Tapinoma sessile	X		X	
Brachymyrmex			X	
Camponotus chromaiodes				
Camponotus nearcticus	X			
Camponotus pennsylvanicus	X		X	
Formica incerta			X	
Formica subsericea	X		X	
Lasius claviger	X		X	
Lasius neoniger	X	X	X	X
Nylanderia parvula	X		X	
Prenolepis imparis	X	X	X	X
Apheanogaster fulva			X	
Crematogaster cerasi	X			
Myrmica rubra	X	X	X	X
Myrmica americana				X
Solenopsis molesta	X	X	X	X
Tetramorium immigrans	X	X	X	X
Ponera pennsylvanica	X	X		
Species Count	13	6	13	6

Note: "X" indicates the presence of the ant species in at least one of the sites per habitat type (i.e., small gardens [3 sites], large gardens [3 sites] and their respective controls [3 trufgrass sites & 3 old field sites]). Presence/absence data are from 3 survey dates for garden sites and from 1 survey date for controls.

Large Gardens More Diverse than Small Gardens? (based on 3 survey dates)



Gardens More Diverse than Controls? (based on 1 survey date)



Conclusions

- Surprisingly, there were no significant differences between the number of ant species in large and small gardens, nor between gardens and control sites. Thus, neither hypothesis was supported in our study.
- A Manhattan study on urban ants also found that similar habitats, regardless of size, had similar ant diversity (e.g., like our gardens).[4]
- However, the results from Manhattan differed from ours in that they found differences in ant species diversity between different habitat types -- unlike our gardens and control areas. Also the number of ant species found in the Manhattan study (i.e., 42 species) was more the 2x found in our study (i.e., 18 species).
- Urban green spaces are understudied when it comes to biodiversity, although some studies have shown them to be important. However, in our study, ant diversity was fairly low across all sites regardless of size or habitat type. Future studies should sample throughout the ant active season and sample more intensely, and possibly use more than two sampling methods.

References

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2. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2311.2006.00793.x
3. https://www.knoxhartford.org/programs/community-gardens/
4. https://phys.org/news/2014-11-high-ant-diversity-underfoot-urban.html

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