Biodiversity in Hartford Community Gardens

A Conservation Training Partnership project undertaken by David Cappaert and Lucia Volin, 9th grade student at Kingswood-Oxford School

Key objectives of the project were to develop a mentor relationship with the student and to address a conservation topic of interest to the community. Both Lucia and I are enthusiastic about insects, so we cooked up an ant project.

Regard this study as somewhere between a science fair project and a serious academic work. I think our findings lead to some useful questions about urban biodiversity.

Rationale:
Urban environments are simple, with few plant species and little structural complexity. So we would expect relatively few arthropod species. An urban garden in contrast should be much richer in species, because:

- In a typical plot, there will be at least a dozen, often 20 crop species.
- There are always untended borders and fallow areas that host weeds in various stages of succession.
- Vegetative debris – harvested plants, mulch, and compost create food and cover for arthropods.
- Presence of logs, boards, and bricks provide habitat (nest sites) for ants in particular.
- There will be an abundance of pollinators, given that many edible and ornamental crops are available in gardens.
- Irrigation will create additional niches for moisture-loving plants and animals.

Further, if we compare a small garden to a large garden, the latter will have a larger number of plant species, more complex structures, and so more arthropod species.

There are many ways to look at arthropod diversity. I this study, we will focus on ants, because it is a group where we can realistically identify all species. Additionally, the particular ants we encounter may tell us something about habitat quality. And: ants are really cool.

Hypotheses:

1) If we sample large gardens, we will find more ant species than we find in small gardens.
2) If we compare any garden site to a nearby "urban background" control site, we will find more ant species in the garden site.
3) The same prediction applies to all arthropod species, including ants.

Sites: We selected 3 large gardens (>5000 m^2), and 3 small gardens (<600 m^2). For each garden we chose a "control," an area within 400 m that was of comparable size. The controls for the large gardens were old field habitats. Controls for the small gardens were managed turfgrass.

Ant sampling: We sampled all 6 gardens Aug 6, Aug 24, and Sep 20, using 6 pitfall traps (40 dram vials) per site. We identified the ants for all sites on each of those dates.

All arthropods: Additionally, on Aug 24 we trapped 6 urban control sites, matched to each of the garden sites. For all 12 sites, we counted and identified all ants, and all other arthropods (by morphospecies).

Results in 3 tables:

1. Ant species list: which ant species present at each site? The garden site numbers are for all 3 sample dates. The control sites are for the single collection on 24 Aug.

Species	**WATKINS**	**HQRS**	BROAD STREET	SARGEANT	HUNTINGTON	**EARLE STREET**	WATK ctrl	HQRS ctrl	BROAD ctrl	SARG ctrl	HUNT ctrl	EARLE ctrl
Tapinoma sessile	X	**X**		X								
Brachymyrmex	X	X										
Camponotus chromaiodes												
Camponotus nearcticus				x								
Camponotus Pennsylvanicus	X		x	X								
Formica incerta						X						
Formica neogagates												
Formica subsericea	X			X		X						
Lasius claviger	X			X								
Lasius neoniger	X	X	X	X	X	X	X	x	x	x		
Nylanderia parvula				X		X						
Prenolepis imparis	X	X	X	X	X	X		x	x		x	x
Apheanogaster fulva	X											
Crematogaster cerasi				X								
Myrmica rubra	X			X	X	X	X			x		
Myrmica americana								X				x
Solenopsis molesta	X	X	X	X		X	X	x		x	x	x
Tetramorium immigrans	X	X	X	X	X	X	X	x	x		x	
Ponera pennsylvanica					X				x			
Species Count	11	6	5	12	5	8	4	5	4	3	3	3

No significant difference between large (bold type) and small gardens.
No significant difference between garden and control sites (looking at just Aug 24, see next table).

2. Pitfall trap results for Aug 24, total items collected, species richness for all arthropods and for ants.

Site	Var	Total items	MorphoSpecies	ant species
Broad	GARDEN SITES	40	16	4
Earle		44	13	4
Huntington		53	14	4
Knox		41	22	4
Sarg		51	25	6
Watkins		47	27	7
Broad Ctrl	CONTROL SITES	57	13	4
Erle Ctrl		51	16	3
Hunt Ctrl		32	11	3
Knox-ctrl		43	17	4
Sarg Ctrl		33	13	3
Watkins CTRL		92	34	5

Test	p=
# species	0.42
ant species	0.12
items	1

No significant difference for any comparison, either Mann Whitney or Wilcoxon Signed Rank tests.

3. Pitfall trap results for Aug 24, items collected in traps, sorted by arthropod group

Species Group	Broad	**Earle**	Hunt	**Knox**	Sarg	**Watkins**	Broad Ctrl	Erle Ctrl	Hunt Ctrl	Knox-ctrl	Sarg Ctrl	Watkins CTRL
Ant	18	21	40	21	15	17	44	9	23	11	23	38
Coleoptera	2	4	4	4	13	8	3	1	5	11	5	6
Diptera	3	1		3	7	3	1	3	1	2		4
Hemip/homop	12	6	3	4	5		4	2				20
Isop/Milli/Centi		10	3		1	10	3	13	1	15		5
Orthoptera			1		1	1		11		1		
Snail						2	1	5	1	1		6
Spider/Opiliones	4	2	2	7	8	6	1	3	1	2	5	6
Wasp	1			2	1			4				7
Grand Total	40	44	53	41	51	47	57	51	32	43	33	92

Summary:

The hypotheses are not supported. We would have to accept the null: monotonous urban background sites are just as diverse as garden sites.

However: variance is (unsurprisingly) large. This study does not have the statistical power to really evaluate the hypotheses.

One sampling date – Aug 24 – picked up less than half the ant species seen over 3 sample dates. I.e., intensive sampling is necessary to detect all species – there are certainly some that we missed.

Four ant species were nearly ubiquitous. *T. immigrans* and *M. rubra* are notorious invasive European species. *Lasius neoniger* and *S. molesta* are natives.

Three species were picked up at only one site of 12: *C. cerasi*, *F. incerta*, and *C. nearticus*. These are not unusual species in open sites in CT.

Takeaways:

Urban gardens do not appear to be hotspots of diversity (to the extent we've measured it) in the urban landscape. This is most striking if we compare specific garden sites to their controls. The Broad Street garden is a city lot jammed with a diverse set of crops, an equal area of weeds in shaded and sunny areas, and a surround of trees. The paired control is a lawn. Both sites have an essentially equal number of ant and arthropod species. If we consider a better measure of diversity incorporating evenness, we still see no clear difference.

If I revisit the rationale at the beginning of this report – all of the factors that should make gardens more diverse – I am puzzled. One possibility: we only looked at animals susceptible to pitfall traps. It may be that from the viewpoint of a ground beetle or spider, a lawn provides a prey abundance equal to that of a garden.

We have a pretty good baseline for ant species in Hartford (including collections made outside of this study in Keney Park). There is a host of interesting questions that might be asked about their ecology, e.g. competitive and parasitic interactions.