Urban Pollinators:

Bee diversity in Iowa City, Iowa

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http://blog.nwf.org/2013/05/in-the-buzz-about-bees-dont-forget-the-natives/

Urban bees

Managed bees

- Honey bees (Apis)/bumble bees/solitary bees
- Agriculture

Wild native bees

- Bumble bees, mining bees, squash bees and leaf cutting bees (The Xerces Society for Invertebrate Conservation, 2014)
- Urban gardens/yards
  - E.g. Bumble bees- tomato and pepper; bottle gentian
  - E.g. Solitary blue orchard bee (*Osmia lignaria*)-cold weather, willow, apples, cherries
  - E.g. Squash bee (*Peponapis pruinosa*) –pumpkins, squash and other cucurbits

Specialist vs generalists

- Bumble bees depend on succession of plants flowering from early spring when the queen emerges to late summer – early fall when the colony dies
- squash bees (cucurbit plants)

Ground-nesting Bees in Iowa


- Live underground in burrows and tunnels
- **Bumble bees**: pre-existing cavities made by rodents or small mammals
- Digger bees: ***Andrenidae***, ***Halictidae*** and ***Colletidae*** bees (e.g. yellow-faced bees), genera ***Lassioglossum*** and ***Agapostemon***
  - thin and sparse vegetation + loose soil
  - Native solitary bees: females dig cylindrical tunnels in shady areas for offspring
  - docile and less likely to sting than social bees




Hole-nesting bees in Iowa

- Take advantage of already existing holes

- Most members of the family *Megachilidae*, e.g. mason and leafcutter bees, are hole nesters who use certain materials to modify their nest chambers

- Mason bees (***Osmia***): use mud to construct partition walls between adjacent cells and a thicker plug to seal the nest entrance from parasites

- leafcutter bees: cut rounded leaf pieces for the same purpose, to line the inner walls of the nest burrow

Carpenter bees in Iowa

- Create burrows, or holes, of their own making

- Have powerful jaws called mandibles with which they can excavate tunnels in wood

Prefer soft wood and dislike paint or other finishing materials.

- genus ***Ceratina***

Cuckoo bees in Iowa

- Some members in *Apidae, Halictidae,* and *Megachilidae* family take advantage of their relatives

- become “cuckoos,” like cuckoos among birds

- do not gather pollen, parasitize the nests of bees in the family of *Andrenidae*

- Genus ***Nomada***: hairless and somewhat wasp-like in appearance

Photo: Nomad Bee (by Dan Edwards) www.uksafari.com

Effecting Bees in Urban Environments

Suburban regions of North Carolina had higher bee abundance and diversity than forested regions. Flower abundance, diversity, and open areas are positively associated with bee diversity and abundance.

Bee abundance was not driven by any specific ecological or life history traits. Generalists were more abundant. Urban bees were more likely to need multiple pollen sources. Almost half 47% of the flowering plants belonged to a single species (*Oxydendrum arboretum*).

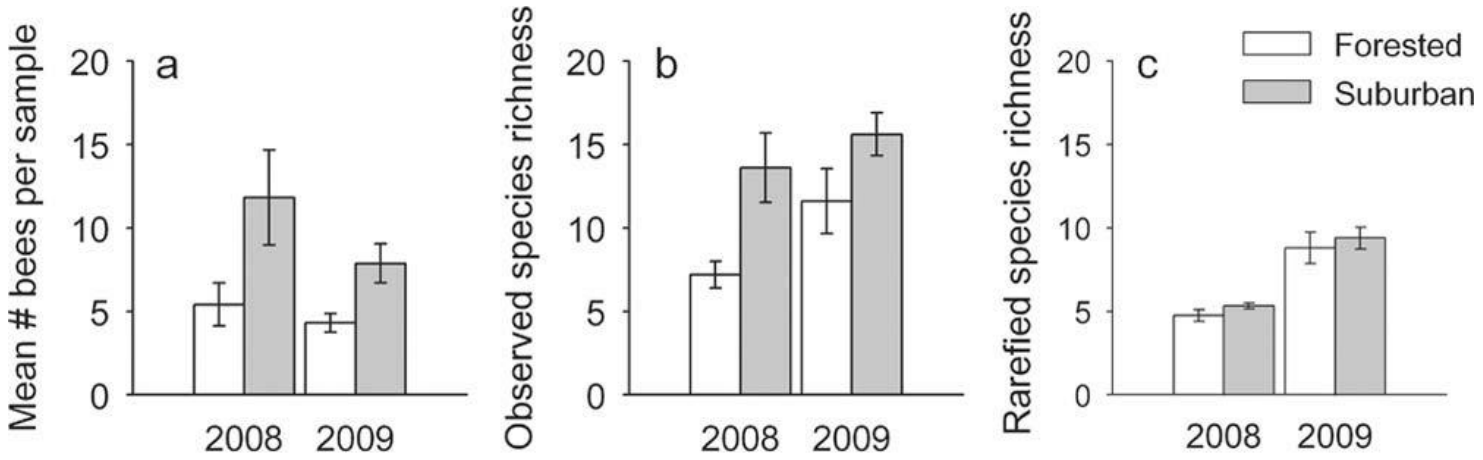


Fig. 1 Carper et al 2014

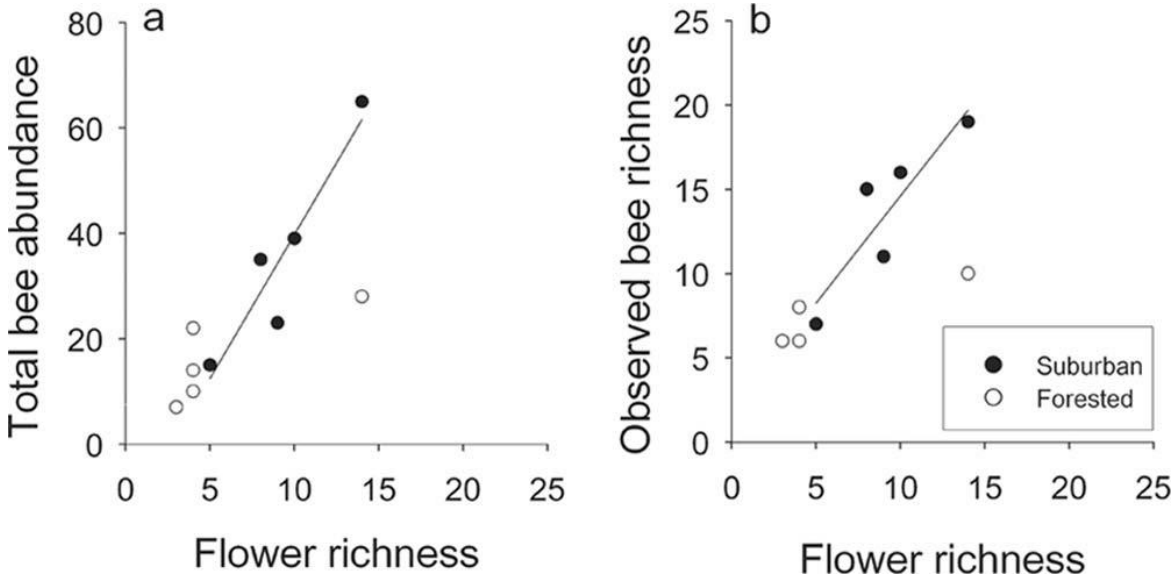


Fig.4 Carper et al 2014

Effecting Bees in Urban Environments

Urban parks in California focused on the genus *Bombus*. McFrederick and LeBuhn state the availability of resources is positively related, but the presence of a strong competitor is negatively related to species richness. Despite concentrated resources in urban areas, diversity between urban and wilder areas was similar, which suggest other influencing factors.

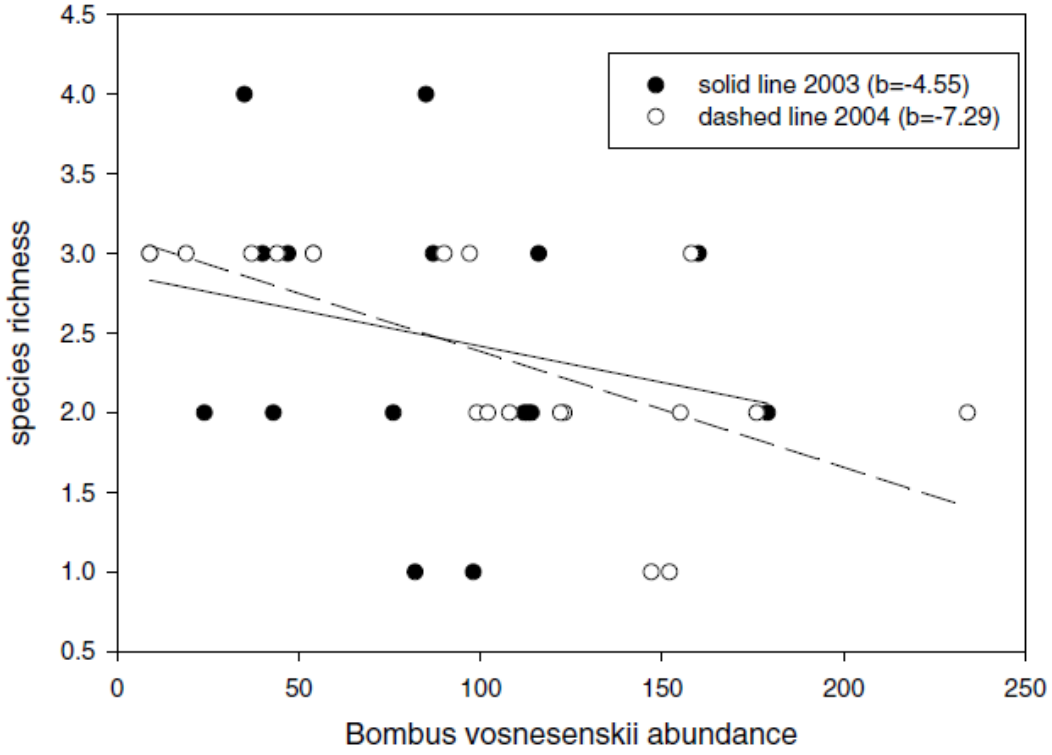


Fig. 5 McFrederick and LeBuhn 2006

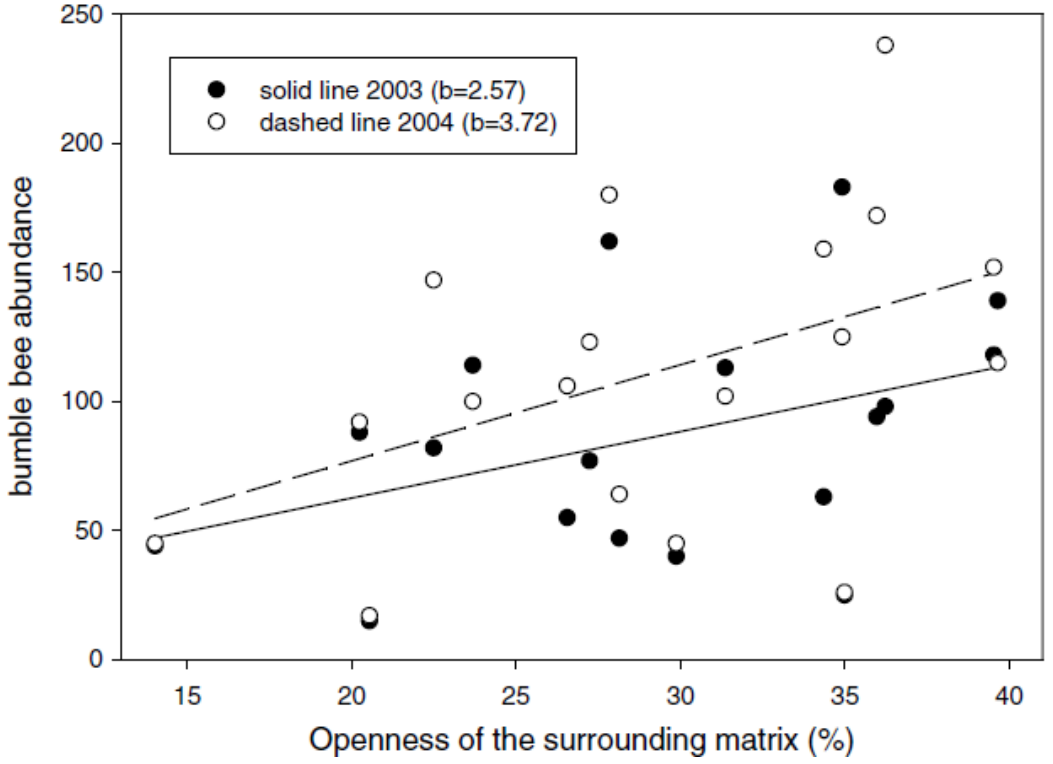


Fig. 3 McFrederick and LeBuhn 2006

Effecting Bees in Urban Environments

Studying non high-rise areas in Chicago provided a varied mixture of factors. Like most articles, the amount of open ground, floral abundance and diversity play a role. However, increased human population density had a positive effect on bee abundance due to people planting a variety of flowering plants. In addition, the amount of solar radiation had a negative effect on bee richness.

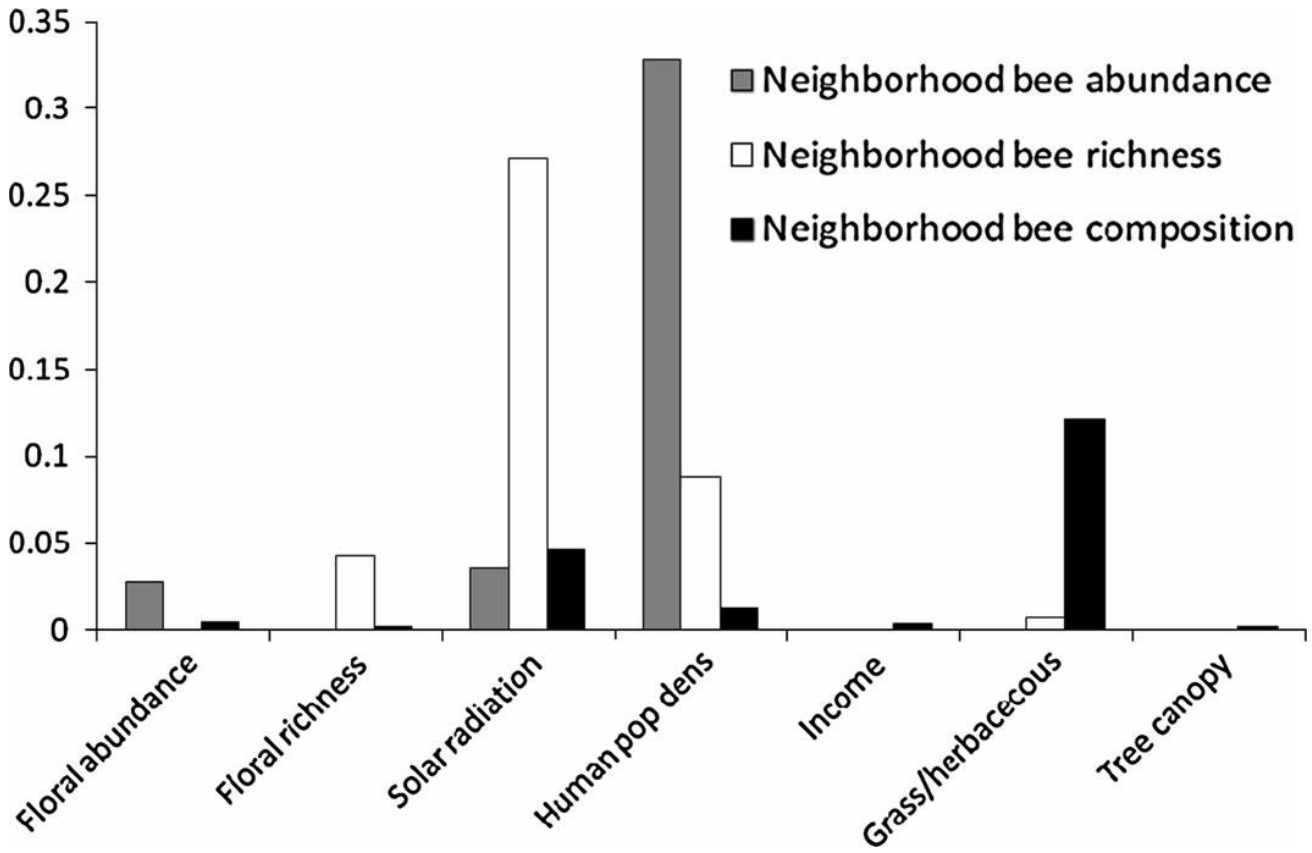


Fig. 3 Lowenstein et al 2014

Problem Statement

Provide Iowa City with information about how bee diversity compares across our study sites and how bee diversity is related to floral diversity.

http://www.cancertruth.net/2013-july-newsletter/

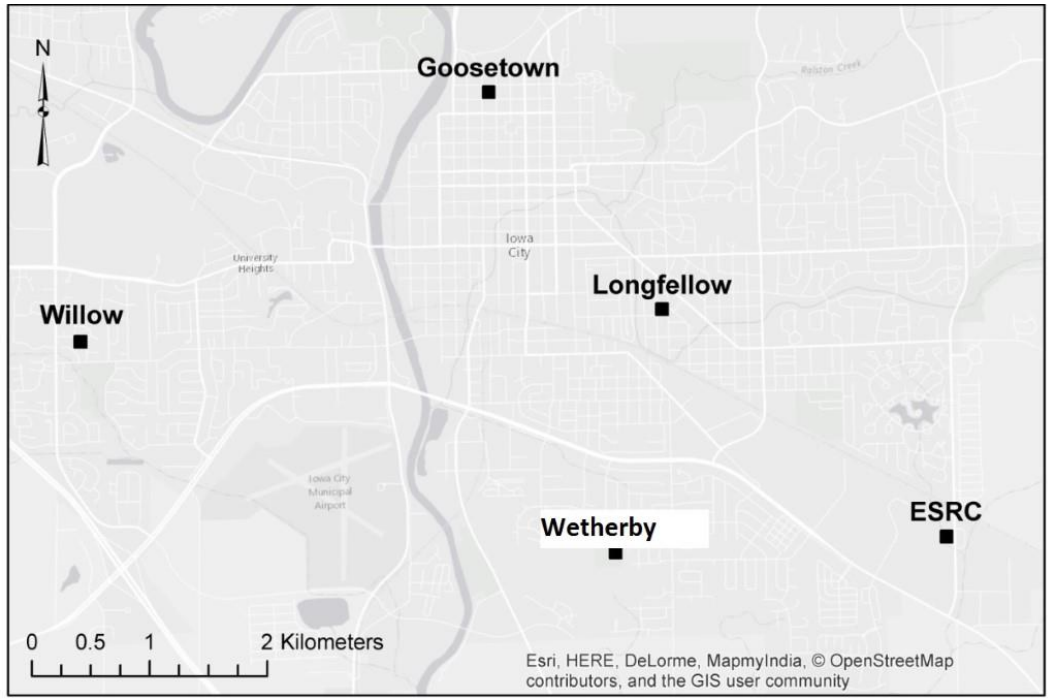
Locations

5 sites with area size of each site being 1 hectare (100 m X 100 m)

3 chosen haphazardly in residential areas

2 public sites-East Side Recycling Center and Wetherby Park

Public sites were chosen for having special characteristics that may yield higher bee diversity



Pan-trapping

12 bowls were set out at each site

Placed bowls out in the morning or early afternoon and let sit for at least six hours

4 sets of 3 colors-blue, yellow and white about 9-10 meters apart in a repeating pattern that was chosen randomly

Bowls filled with soapy water mix that reduces surface tension, lessening chance of escape

Sweep netting

Done in groups of two or three

Two would sweep net while one would assist with bee handling and compile floral resources of the site

Plot was divided in half and individuals swept for 30 timed-minutes. Individuals switched halves and swept once more.

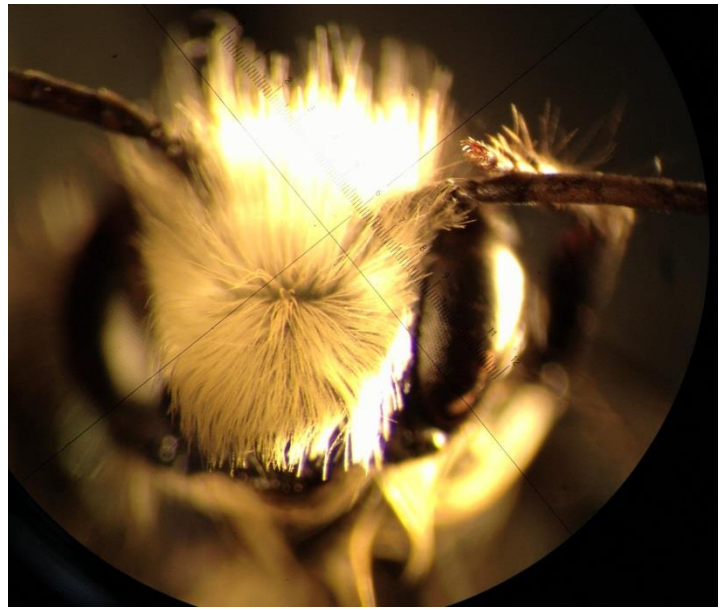
Bees were collected and put to rest in serenity chambers containing Potassium Cyanide

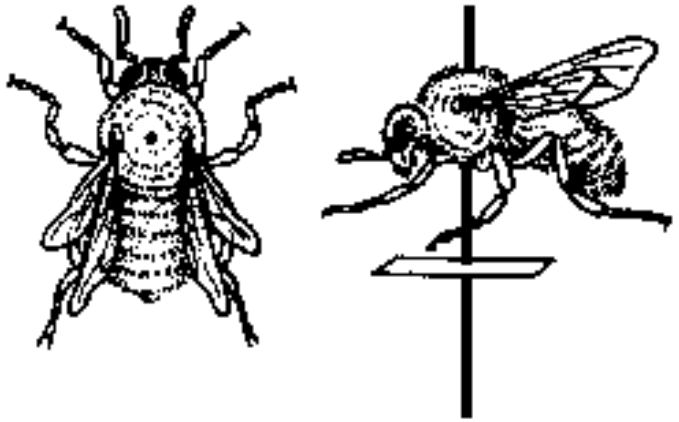
Pinning and identifying

Bees were pinned through the thorax

Separated by genus and sex

Sex determined by counting number of antennal segments





https://www.uky.edu/Ag/Entomology/ythfacts/4h/unit2/bee.gif

Bee Results

- We captured 104 bees from all our sites (78 identified so far)

Site ID	Number of individuals	Number of genera	Number of males	Number of females	Number of genera with only one gender collected
Brown	26	5	10	16	4
Dearborn	16	6	8	8	4
ESRC	19	7	3	16	7
Wetherby	7	3	1	6	2
Willow	10	6	4	6	4

We cannot conclude an area is supporting a breeding population of bees unless members of both sexes are collected.

Bee Genera

- 10 Lasioglossum-all females
- 3 Nomada-all males
- 6 Colletes- 2 females, 4 males
- 4 Halictus- all females
- 12 Ceratina- 5 females, 1 male
- 9 Apis- all females
- 33 Andrena- 18 females, 15 males
- 1 Agapostemon- female
- 4 Osmia- 1 female, 3 males
- 2 Bombus- 2 females
- Total: 52 Females, 26 males

Lasioglossum


Nomada


Agapostemon

Capture Method Results

Site ID	Number of individuals	Number of genera	Number genera caught by both methods	Number of genera only by pan	Number of genera only by sweep
Brown	26	5	1	2	2
Dearborn	16	6	1	1	4
ESRC	19	7	1	6	0
Wetherby	7	3	0	1	2
Willow	10	6	1	0	5

While numbers are still low, the amount collected exclusively by one technique or the other is much higher than expected.

Gender Disparity Results

Site ID	Number of individuals	Number of males	Number of females	Proportion of males by pan	Proportion of females by pan	Proportion of males by sweep	Proportion of females by sweep
Brown	26	10	16	0.8	0.563	0.2	0.438
Dearborn	16	8	8	1	0.25	0	0.75
ESRC	19	3	16	1	0.9375	0	0.0625
Wetherby	7	1	6	0	0.667	1	0.333
Willow	10	4	6	0	0.167	1	0.833
total	78	26	52	0.731	0.596	0.269	0.404

The trends in this data are largely what would be expected based on early-season bee behavior.

Floral Results

- Willow Site: 9 different genera of flowers, 3 visited by bees (based on sweep net capture)
- Brown Site: 19 different genera, 5 visited by bees
- Dearborn Site: 28 different genera, 3 visited by bees
- Wetherby Site: 3 genera of flowers, all visited
- ESRC Site: 3 different genera, 1 visited by bee

- Willow Site: approximately 2457 flowers available
- Brown Site: approximately 1149 flowers available
- Dearborn Site: approximately 101 flowers available
- Wetherby Site: approximately 537 flowers available
- ESRC Site: approximately 130 flowers available



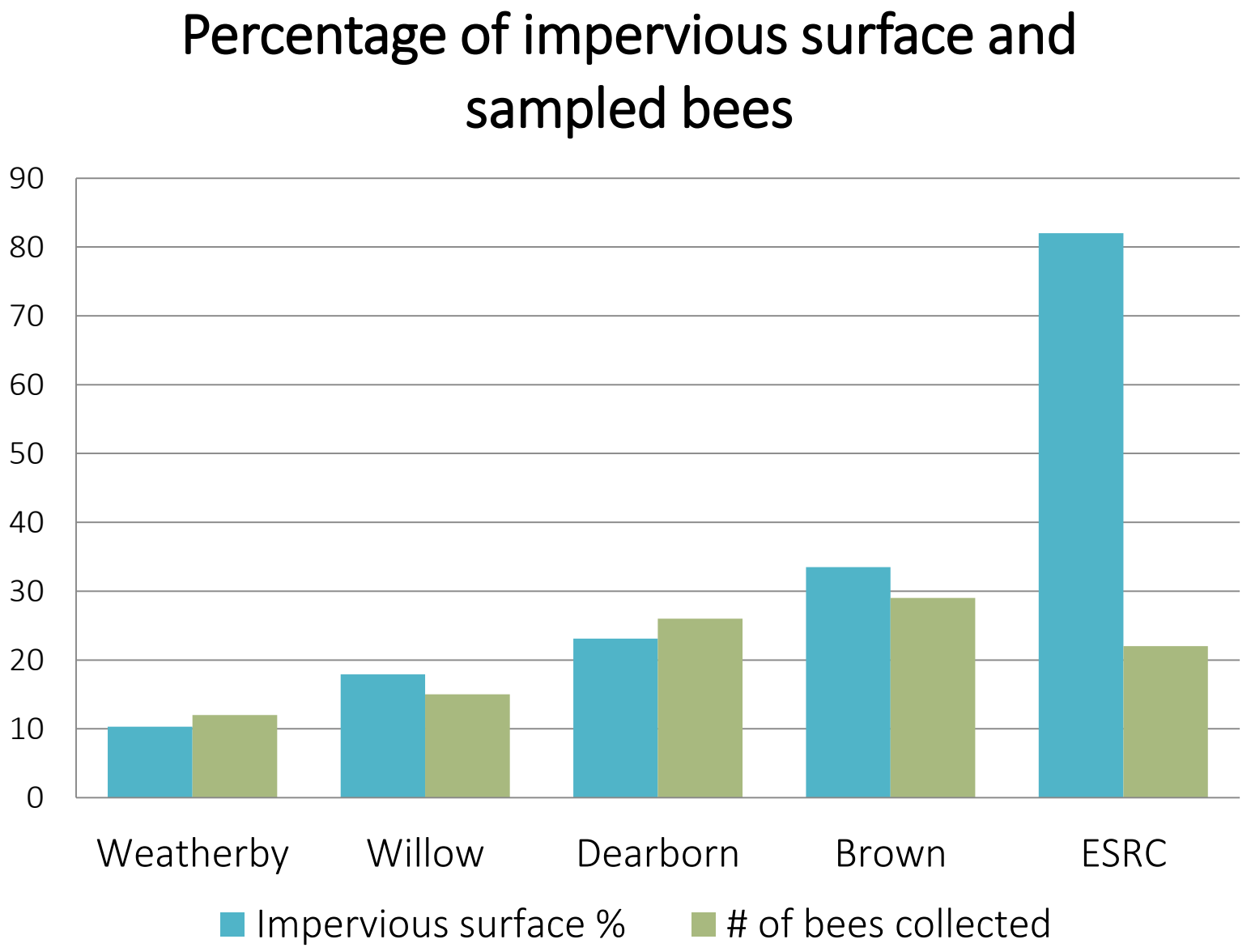


Impervious surface

Weatherby	Willow street	Dearborn	Brown	ESRC
10.3%	17.9%	23.1%	33.5%	82.0%

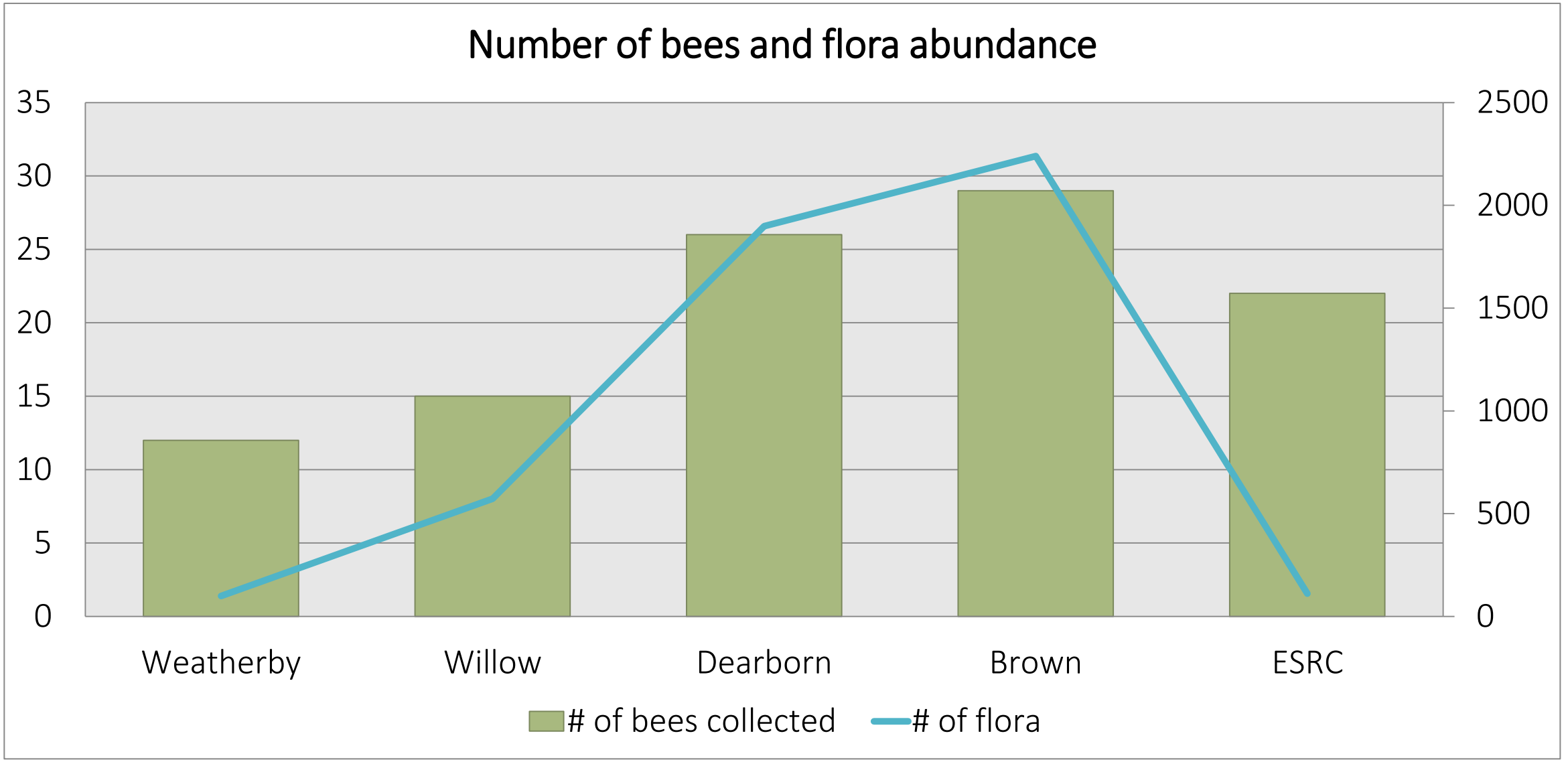
NLCD impervious surface 2011 http://www.mrlc.gov/nlcd11

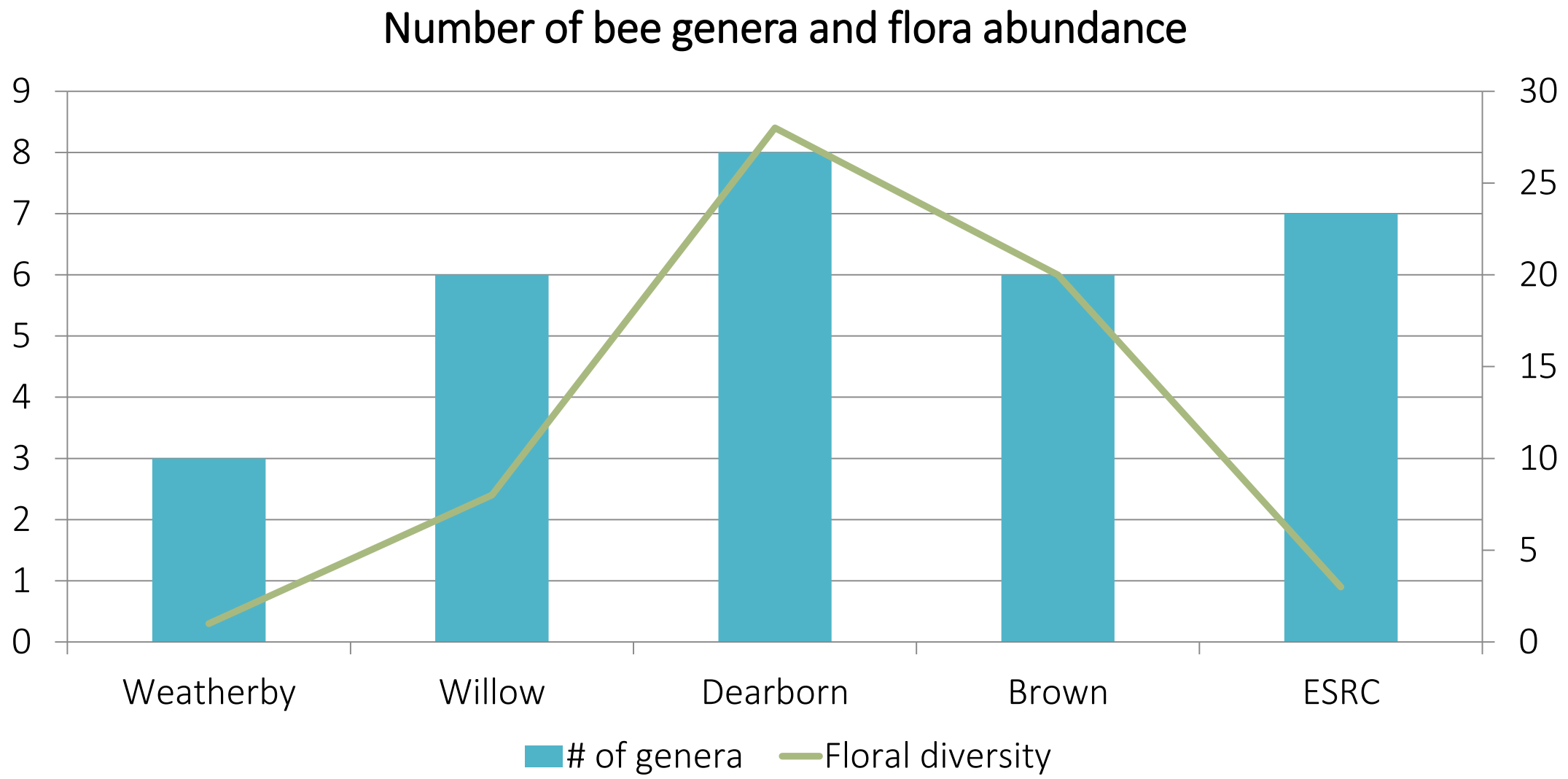
Site	Impervious surface %	# of bees collected
Brown	33.5	29
Willow	17.9	15
Dearborn	23.1	26
Weatherby	10.3	12
ESRC	82.0	22

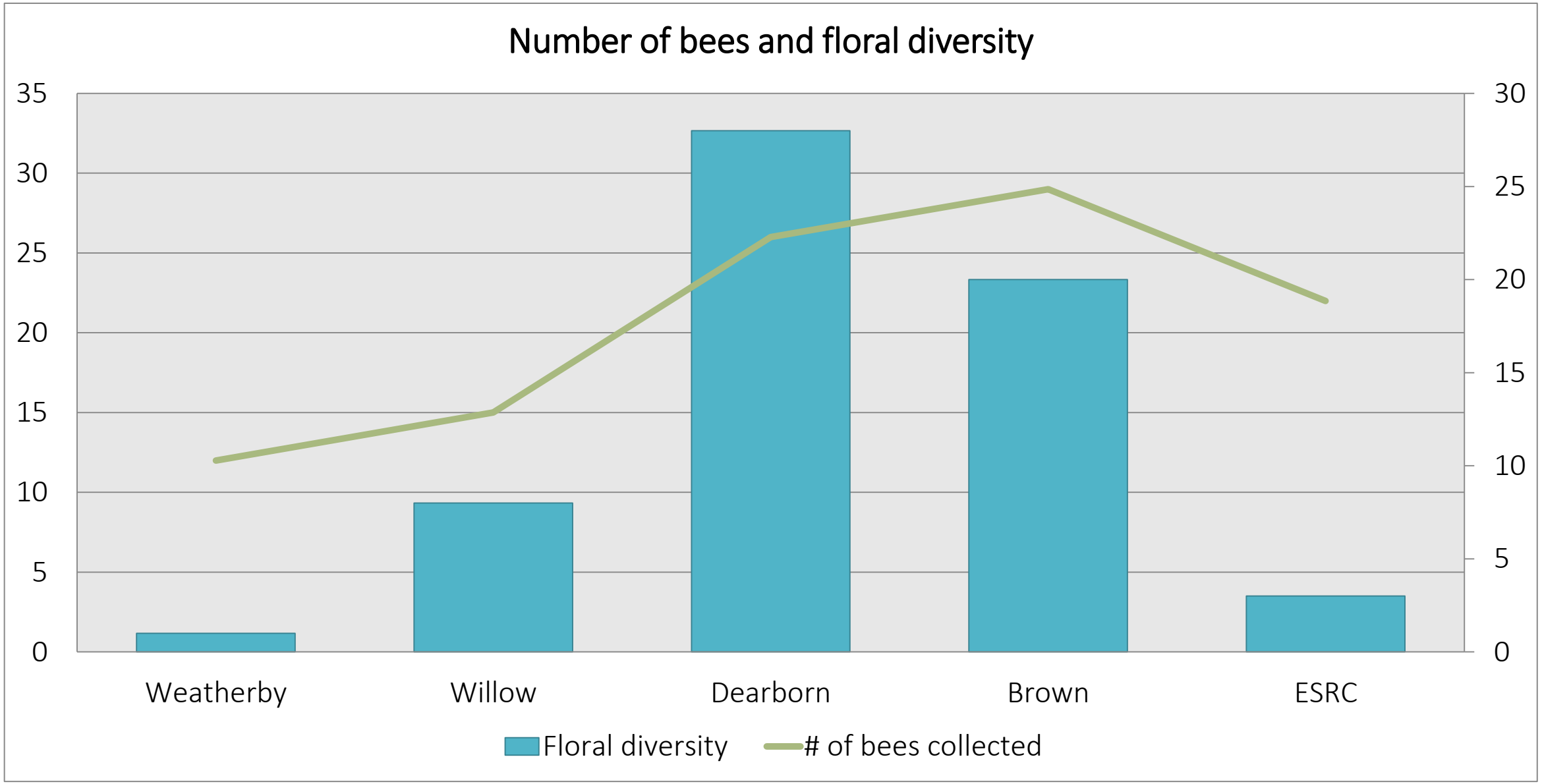


Pearson correlation coefficient

	Impervious surface %	# of bees collected	# of genera	# of floral	Floral diversity
Impervious surface %	1.00	0.36	0.46	-0.22	-0.22
# of bees collected	0.36	1.00	0.71	0.83	0.77
# of genera	0.46	0.71	1.00	0.47	0.65
# of floral	**-0.22**	0.83	0.47	1.00	0.93
Floral diversity	**-0.22**	0.77	0.65	**0.93**	1.00


Number of bees and flora abundance
35
30
25
20
15
10
5
0
2500
2000
1500
1000
500
0
Weatherby
Willow
Dearborn
Brown
ESRC
# of bees collected
# of flora


Number of bee genera and flora abundance
9
8
7
6
5
4
3
2
1
0
30
25
20
15
10
5
0
Weatherby
Willow
Dearborn
Brown
ESRC
# of genera
Floral diversity


Number of bees and floral diversity
35
30
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20
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5
0
30
25
20
15
10
5
0
Weatherby
Willow
Dearborn
Brown
ESRC
Floral diversity
# of bees collected

What can we do for urban bees?

- **Necessity: Food**
  - Nectar
  - Pollen
- **More native flowering plants**
- **Diversifying flowering plants**
  - Diversity of plant species
    - *A healthy bee diet*
    - *Attract a great diversity of bees*
  - Blooming at different time
  - Different flower colors, fragrances, and shapes
  - Consider leaving flowering weeds such as creeping charlie, violets and dandelions to serve as alternate nectar sources for pollinators

https://beespotter.org/topics/beegarden/#choosing

http://www.extension.iastate.edu/news/2005/mar/pollinators0305.htm

Development of bee-friendly habitats

- **Necessity: shelter**
- **Exposed & undisturbed soil**
  - Dry, sandy soil with vegetation on a hill slop
  - Ground-nesting bees (60%-70% e.g. Genus *Andrena,* Bumble bees*)* (Joel, 2015)
- **Bee house**
  - Tunnels for cavity-nesting bees (30-40%) (Joel, 2015)

Development of bee-friendly habitats

Necessity: shelter

- Improve habitat quality

- Reduce pesticide and herbicide usage
- Apply chemicals that are the least disruptive to pollinators
- Apply insecticides when pollinators are least active
  - *very early morning, late evening or after dark*
- Do not apply insecticides to plants that are blooming or when it is windy