Honey Bees, Wild Bees, and Beekeepers in Chicago's Community Gardens

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Abstract

Chicago, IL (USA) hosts a robust culture of both community gardens and urban apiculturists (keepers of honey beehives). Western honey bees (*Apis mellifera*) are not native to North America, and their impact on wild bees is not fully understood. Through interviews with beekeepers and biodiversity surveys in 24 of Chicago's community gardens (9 with beehives), we explored questions about urban apiculturists' perceptions and knowledge of wild bees, as well as the impact of urban apiculture on wild bees in community gardens. In the context of urban community gardens, our research suggests that although honey bees are an introduced species, beekeepers can play a positive role in wild bee conservation.

Keywords

Apiculture · Community gardens · Bees · Introduced species · Biodiversity

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J. A. Diehl, H. Kaur (eds.), *New Forms of Urban Agriculture: An Urban Ecology Perspective*, https://doi.org/10.1007/978-981-16-3738-4_15

15.1 Introduction

Bee populations are declining worldwide, which is a threat to biodiversity and food security (Potts et al. 2010). The primary causes of these declines are thought to be pesticides such as neonicotinoids (Goulson 2013), parasites such as the disease-transmitting mite *Varroa destructor* (Le Conte et al. 2010) and the microsporidian *Nosema* spp. (Klee et al. 2007; Meeus et al. 2011), and a lack of floral resources (Carvell et al. 2006). These stressors combined have an impact greater than any individual stressor would have alone (Goulson et al. 2015).

Although wild bees are impacted by these stressors, much of the focus on declining bee populations has been on honey bees (*Apis* spp.; Geldmann and González-Varo 2018). The western honey bee (*A. mellifera*) is native to Europe, Africa, and the Middle East (Han et al. 2012), but has been introduced around the world as a commodity. According to the most recent agriculture census, more than 2.8 million honey bee colonies on more than 60,000 farms were reported in the USA in 2017. The honey collected by these farms was valued at more than $320 million USD in total (USDA, National Agricultural Statistics Service 2019a).

Because of bees' small size and modest land requirements, apiculture (beekeeping) is better suited to cities than most other types of animal husbandry. In fact, amateur beekeeping has become a trend in major cities across the world such as Berlin (Germany, Lorenz and Stark 2015), Perth (Australia, Carmody 2017), London (England, Owen 2009), and Philadelphia (PA, USA, Sreenivasan 2016). Even where urban residents do not have backyards, they can keep bees in places such as rooftops and community gardens.

It is not well understood what impact beekeeping has on wild bee species, most of which are native. Some, but not all, studies have demonstrated competitive interactions between managed honey bees and wild bees over pollen and nectar resources (Paini 2004). Even in areas where there are a lot of flowers, wild bee fitness could be reduced if the wild bees have to spend more time foraging (Pyke et al. 1977) or if they are forced to forage on flowers with lower quality pollen (Huang 2012). Managed honey bees could also spread pathogens to wild bees. Although the varroa mite only infests honey bees (Le Conte et al. 2010), shared pathogens could be transmitted through contaminated pollen (Singh et al. 2010) or when bees make contact in shared spaces (Fürst et al. 2014). These interactions have the potential to have negative impacts on wild bee abundance or geographic ranges, but very few studies have demonstrated or even measured population-level impacts (Mallinger et al. 2017).

On the other hand, wild bees could benefit from resources provisioned by beekeepers or gardeners for the honey bees. This is especially likely in urban areas, where humans play a major role in shaping the environment. Out of a desire to provide for honey bees, beekeepers and gardeners may be motivated to plant more flowers, tolerate flowering weeds, or reduce use of pesticides and other potentially harmful chemicals (Maderson and Wynne-Jones 2016). Weeds such as dandelions (*Taraxacum officinale*) and white clover (*Trifolium repens*) are especially important to bees early in the spring before many other species bloom (Hicks et al. 2016). The beehive itself may also unintentionally create a "no-walk zone" around it, which could provide nesting habitat for ground-nesting bees.

For wild bees, cities can be important refuges that allow diverse bee communities to persist in spite of changes in surrounding natural and rural areas (Hall et al. 2017). While agricultural intensification (e.g., transitions to monocultures or innovations in systemic pesticides) makes rural areas increasingly inhospitable to bees (Hall et al. 2017), such changes are less common in urban agriculture. Urban agricultural spaces such as community gardens potentially offer important foraging and nesting resources for wild bees although their capacity to support bees may be limited by their size and the surrounding hardscape.

In this study, we focused on bees, beekeepers, and ecological resources in urban community gardens in Chicago, IL (USA). We echo the assertion that conservation issues require interdisciplinary, collaborative approaches (e.g., Suryanarayanan et al. 2018), especially in human-dominated spaces such as cities. Our study, a collaboration between ecologists and anthropologists, was carried out with this in mind. We wanted to know about the diversity of bees that Chicago's community gardens support, to understand the relationship between honey bee and wild bee abundance, and what factors predict these abundances. Finally, we wanted to know if urban beekeeping offered any potential benefits to wild bees. In 24 community gardens, 9 of which contained honey beehives, we recorded presence and identity of wild bees and honey bees and characterized floral resources and other aspects of the environment. In interviews with nine beekeepers who tend hives in community gardens, we asked about their perceptions of nature, wild bees, and honey bees. The results and discussion of both the social and ecological aspects of this study are combined to reflect the interconnectedness of the agents involved—wild bees, honey bees, beekeepers, and gardeners.

15.2 Methods

15.2.1 Study Sites

Chicago, IL (USA) is situated on the coast of Lake Michigan, on Potawatomi land in the Great Lakes Region (Greenberg 2002). With more than 2.7 million residents, Chicago is the third most populous city in the USA (US Census Bureau 2018). Chicago has hot summers and cold winters, offering a growing season that is short but potentially productive. On average, there are 175 days between the last spring frost and the first fall frost (Angel 2003), and different parts of the city fall in USDA hardiness zones 5b and 6a (USDA, Agricultural Research Service 2012). Chicago is home to many beehives, some of which are hosted in community gardens throughout the city. According to an interview subject, many hobbyist beekeepers do not formally report their hives, but in Cook county (the densely urban county where Chicago is located) 48 farms reported 1337 honey bee colonies in 2017 (USDA, National Agricultural Statistics Service 2019b).

Community gardens were found using the Chicago Urban Agriculture Mapping Project search engine (https://cuamp.org/) and Google Maps (https://www.google.com/maps). We contacted prospective study sites by sending an email to the garden managers, asking about the size of their garden, accessibility (i.e., whether the garden was fenced and locked), and whether they had beehives. If a garden's manager did not respond to our email, the garden was removed from the list of potential sites. Of the gardens for which managers responded, several garden managers were not able to grant us access or the gardens were very far from other gardens in the study. These gardens were excluded from the list of potential sites. We ultimately chose 24 gardens from a diversity of Chicago neighborhoods that each had at least 10 vegetable beds for food production, attempting to include as many gardens with honey beehives as possible. The final sample included 9 gardens with beehives and 15 without.

15.2.2 Bee Surveys

Bee surveys were conducted in July and August on days without rain, between 9 a.m. and 5 p.m., when most bee species are active. At each community garden, we selected ten random 1 m^2 sampling sites within vegetable beds and five 1 m^2 "pollinator garden" sampling sites. Pollinator gardens were defined as the areas in the community garden with the highest abundance of flowers and were not randomly selected. For 2 min, we observed each sampling site and recorded the identity and abundance of bees within the sample area. Bees were not collected, and thus many individuals could not be identified to the species level. We identified bees in the field to the genus level or lower when possible. If we encountered a bee and were unable to identify its genus but could rule out honey bees, we recorded it as "unidentified." Unidentified bees were included in our estimate of wild bee abundance. After observations were completed, we walked the garden for 5 min recording the identity (but not the abundance) of new bee taxa that we had not observed in our other samples. We conducted these surveys twice for a total of 30 sampled areas per garden; each sampled area was 1 m^2. Surveys at each site were separated by at least 30 days.

15.2.3 Garden Assessments

Vegetation surveys were conducted during the month of July 2017 because the majority of gardeners have their plantings established by then. At each garden, we randomly selected ten vegetable beds using dice as a random number generator and conducted a weed survey. Weeds included any plant not intentionally cultivated. At each vegetable bed, we estimated the percentage of a 1 m^2 quadrat covered by weeds and recorded the height of the tallest weed. We combined these measures into one measure of weed volume using a calculation based on the volume of a cone (weed area times 1/3 the height of the tallest weed). We calculated the mean "weed density" (in L/m^2) of the ten quadrats in each garden by dividing the weed volume by the area sampled.

We estimated floral resources in the gardens in two ways, resulting in the variables "floral richness" and "floral density." In July, during the weed survey described above, we counted the number of all plant species flowering in the common areas for the variable "floral richness." Common areas included all areas outside of the vegetable beds. During the bee surveys in July and August, we also counted the number of flowers in each 1 m^2 observation sampling site, and estimated mean "floral density" for each garden. Finally, we estimated woody vegetation density in each garden by counting all woody vegetation taller than 1 m in each garden and divided this count by the area of the garden.

Finally, we assessed the size of the gardens and the percentage of impervious surface within 1 km of the center of the gardens, which represents the foraging range of many bee taxa (Greenleaf et al. 2007). Garden size was calculated by tracing the boundary of the garden and creating polygons in Google Earth Pro. Percent impervious surface was calculated in ArcGIS 10.5 (ESRI 2017) using a classified satellite image of Cook County land cover (O'Neil-Dunne 2010). We reclassified building, road, and other paved surface categories in the Cook County land cover file as a single category, impervious surface. Then we used the ArcGIS Focal Statistics tool to calculate the percentage of impervious surface within 1 km of each garden's centroid.

15.2.4 Beekeeper Interviews

We conducted semi-structured interviews with nine beekeepers in the city of Chicago as one component of a larger, ongoing ethnography of Chicago's community gardeners carried out by researchers at The University of Illinois at Chicago and The Field Museum. Beekeepers were identified in the course of participant observation by anthropologists in the gardens and using "snowball sampling," when informants encountered in the gardens introduced researchers to other beekeepers in their networks. Four of the nine beekeepers were involved with the gardens where we were conducting our fieldwork. The other five beekeepers were recommended as interview subjects by beekeepers with whom we had spoken previously. We intentionally sought interviewees with a range of experience in beekeeping, from established beekeepers to those who had been beekeeping for less than 2 years.

The interviews were open-ended and conversational, but with a few guiding questions. We asked questions about how the beekeepers learned about beekeeping, their motivations for beekeeping, and how beekeeping had influenced their perceptions of nature in the city. Some questions (such as "What do you think about honey bees versus native bees?") were intentionally open-ended, and the beekeepers interpreted the question broadly. Interviews were recorded, transcribed, and then read thoroughly for any responses that provided insight to our questions. Conducting the interviews was approved by the Institutional Review Board (IRB) of The Field Museum.

15.2.5 Analysis

To determine which variables best explained wild bee and honey bee abundances, we ran single-variable generalized linear models for these two dependent variables with each of six explanatory variables. Explanatory variables included five environmental variables (Table 15.1) as well as the abundance of the opposing group (i.e., wild bees or honey bees). To make model coefficients easier to compare, we standardized each explanatory variable by subtracting the mean of the variable from each observation, and then dividing by the standard deviation. For comparison, we also ran a null model for each response variable. We then selected the best models for each response variable using Akaike's Information Criterion (Anderson 2008) with a correction for small datasets (AICc). The models best fit a negative binomial error structure. For these analyses we relied on R packages AICcmodavg (Mazerolle 2017) and MASS (Venables and Ripley 2002). We did not use bee generic richness as a dependent variable because we determined that two of our data points were overly influential and could lead to misleading results (i.e., the gardens had a narrow range of generic richness except for two gardens). To determine the relationship between honey bee and wild bee abundance in Chicago's community gardens, we plotted wild bee abundance versus honey bee abundance and compared linear and quadratic regressions (both with negative binomial error structures) to a null model. We again used AICc to select the best of these models.

We ran a series of tests to examine differences between gardens with and without beehives. First, to test whether the presence of beehives impacted whether a particular wild bee genus was observed in a garden, we compared proportions of gardens with beehives and gardens without beehives in which each genus was encountered using the prop.test function in R, which compares proportions using the chi-squared test (R Core Team 2018). Second, to test whether the presence of beehives affected abundance of wild bees or honey bees, we compared abundances of each group in gardens with beehives to the abundances in gardens without beehives using boxplots and the Wilcoxon test. Finally, we also used boxplots and the Wilcoxon test to compare two garden attributes related to gardener behavior that might be influenced by beehive presence, weed density, and floral richness, in gardens with and without beehives. Throughout the results and discussion below, we use the beekeeper interviews to provide insight into our questions, but especially into our question regarding whether beekeeping offers benefits to wild bees.

Table 15.1 Candidate variables used in the generalized linear models to predict wild bee abundance and honey bee abundance

Variable	Minimum	Median	Maximum
Floral density (flowers/m^2)	8.54	33.45	79.00
Weed density (L/m^2)	0.81	6.23	41.08
Woody vegetation density (plants/m^2)	0.00	0.02	0.07
Garden area (m^2)	254	871	8939
Impervious surface within 1 km (%)	42.19	58.22	71.14

15.3 Combined Results and Discussion

15.3.1 How Abundant and Diverse Are Bee Communities in Chicago's Community Gardens?

In total, we encountered 2275 bees and 13 identified bee genera (including *Apis*) across all 24 gardens (Fig. 15.1). We were unable to identify 91 of the 2275 bees we encountered (0.04%). Honey bees were present at all 24 gardens, regardless of whether the gardens kept beehives. Many wild bee groups were nearly as widespread, such as bumble bees (*Bombus* spp.; 23 gardens), long-horned bees (*Melissodes* spp.; 23 gardens), sweat bees (*Lasioglossum* spp.; 22 gardens), and leafcutter bees (*Megachile* spp.; 22 gardens). The median generic richness across all gardens was 8 genera (range of 4–10 genera). The median honey bee abundance was 12.5 (range of 1–57 genera) and the median wild bee abundance was 70 (range of 29–151 genera); abundance is reported as the sum of the bees observed across $30 \times 1\ m^2$ sampled areas per garden.

Tonietto et al. (2011) collected bees in Chicago parks and green roofs, as well as prairies in the region. While the relative abundances of bees differ, the bee communities we observed in Chicago's community gardens were at least as diverse as those observed by Tonietto et al. in parks and green roofs at the level of genus. In some of the community gardens, we detected three genera that were not collected in parks or green roofs but were collected in prairies (*Augochlora*, *Coelioxys*, and *Colletes*). There were eight genera that they only collected in prairies that we did not encounter, and two that they collected in the city that we did not identify (*Halictus* and *Sphecodes*), although we encountered 91 bees that we were unable to identify due to the limitations of field identification. It is also possible that we misclassified

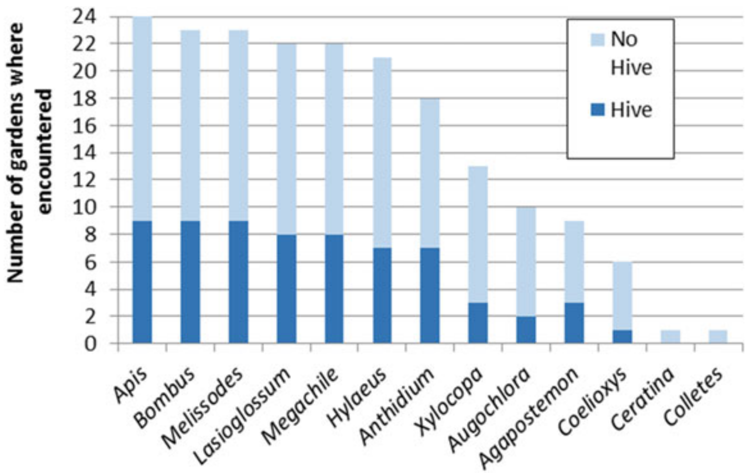

Fig. 15.1 Bee genera encountered across all 24 gardens, ranked by the number of gardens in which they were encountered and coded by whether the gardens did or did not keep honey beehives

some *Halictus* bees as *Lasioglossum*, since these genera can be difficult to distinguish without a specimen in hand.

15.3.2 What Is the Relationship Between Honey Bee Abundance and Wild Bee Abundance, and What Factors Predict Wild and Honey Bee Abundances?

Because cities are largely artificial, the question of urban biodiversity conservation is often considered moot. One of the beekeepers we interviewed expressed, "I feel fine keeping bees in Chicago, because it's such an altered environment. There are so many [pollinator] resources and I don't feel like I'm displacing native bees. But I get really mad when people are like, 'Oh yeah I just got a house next to a massive nature preserve, and I want to like, put a bunch of beehives there.' Like, just let the native bees have it."

However, urban ecology research increasingly demonstrates that cities provide important habitat for wild bees. Many cities support an abundance and species richness of wild bees that are absent from surrounding rural areas (Hall et al. 2017). If honey bees depressed wild bee populations, then urban apiculture would be threatening valuable habitat for wild bees. Because a diversity of wild bees is important for crop pollination (Rogers et al. 2014; Mallinger and Gratton 2015; Lowenstein et al. 2015), this would also have negative implications for fruit production in urban agriculture.

We cannot answer this question definitively or globally, but in Chicago's community gardens there was no strong evidence that honey bees depressed wild bee communities or populations. The presence of beehives did not have a significant effect on whether a wild bee genus was encountered at a garden for any of the genera encountered (Fig. 15.1). Beehive presence did not affect abundance of either honey bees or wild bees; the differences were not significant according to the Wilcoxon test

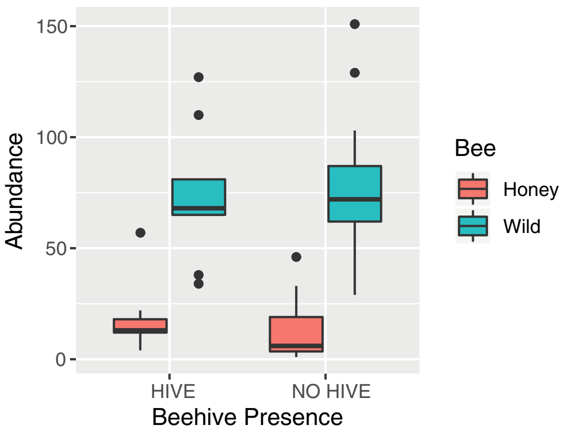

Fig. 15.2 Comparisons of wild bee and honey bee abundances in community gardens with and without beehives. Beehive presence did not affect abundances of either wild bees or honey bees. Abundance is reported as the sum of the bees observed across 30 sampled areas per garden; each sampled area was 1 m^2

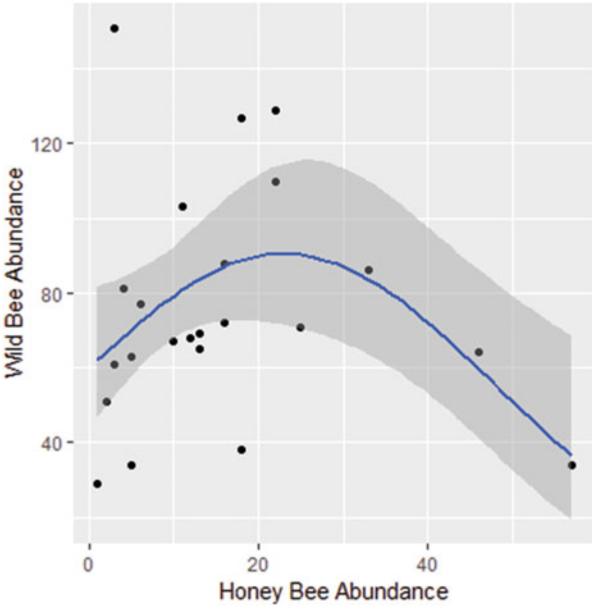

Fig. 15.3 Fitted quadratic regression for wild bee abundance plotted against honey bee abundance (pseudo-$R^2 = 0.21$). Each data point represents one garden. The line represents a quadratic generalized linear model (negative binomial error structure), while the shaded area represents the 95% confidence interval. Abundance is reported as the sum of the bees observed across 30 sampled areas per garden; each sampled area was 1 m^2

(Fig. 15.2; $p = 0.23$ and 0.81, respectively). It is also possible that, due to honey bees' dispersal abilities and the prevalence of hives outside community gardens, honey bee abundance was elevated throughout the city and wild bee communities were depressed everywhere as a result; such background honey bee abundances would make the effect of beehives on wild bees difficult to detect.

There was also no consistently negative relationship between wild bee abundance and honey bee abundance. In most of the gardens, where there were more resources, there were more bees of all kinds. There were only two gardens where honey bee abundance was very high and wild bee abundance was low (and one garden where the opposite was true). The data fit a quadratic curve (Fig. 15.3; pseudo-$R^2 = 0.21$) better than a simple linear regression (both models with negative binomial distributions). This suggests the possibility that resource competition could become a problem at very high honey bee abundances although the small number of data points in the upper range provide only weak evidence of that possibility. We present this figure in accordance with the precautionary principle.

Wild bee abundance was positively related to weed density. None of the other single-variable models explaining wild bee abundance out-performed the null model (Table 15.2). Meanwhile, honey bee abundance was best explained by (and positively correlated with) density of woody vegetation (Table 15.3). This could suggest some degree of resource partitioning, where honey bees are attracted to the concentrations of flowers available on trees, vines, and shrubs such as hibiscus (*Hibiscus* spp.) and roses (*Rosa* spp.) while wild bees forage more often on the more scattered weedy species. Such resource partitioning could be a problem for wild bees if the nectar and pollen in weeds were of lower nutritional quality or if

Table 15.2 AICc table for single-variable generalized linear models (negative binomial distribution) predicting wild bee abundance

Variable	K	AICc	ΔAICc	AICc weight	LL	Coefficient	Pseudo-R^2
Weed density	3	233.04	0.00	0.29	−112.92	0.14 ± 0.08	0.13
Null	2	233.86	0.83	0.19	−114.65	4.33 ± 0.08	0.00
Floral density	3	234.25	1.21	0.16	−113.52	0.12 ± 0.08	0.09
Impervious surface	3	234.53	1.49	0.14	−113.66	0.11 ± 0.08	0.08
Garden area	3	235.57	2.54	0.08	−114.19	−0.08 ± 0.08	0.04
Woody vegetation	3	235.62	2.59	0.08	−114.21	0.08 ± 0.08	0.03
Honey bee abundance	3	236.36	3.32	0.06	−114.58	−0.03 ± 0.08	0.01

To make coefficients easier to compare, all variables have been standardized. For each variable we give the estimate of the coefficient ± the standard error. The coefficient for the null model is the intercept. For pseudo-R^2 we used the formula 1 − (residual deviance/null deviance)

Table 15.3 AICc table for single-variable generalized linear models (negative binomial distribution) predicting honey bee abundance

Variable	K	AICc	ΔAICc	AICc weight	LL	Coefficient	Pseudo-R^2
Woody vegetation	3	180.45	0.00	0.58	−86.62	0.38 ± 0.16	0.19
Null	2	183.18	2.73	0.15	−89.31	2.72 ± 0.18	0.00
Weed density	3	184.65	4.20	0.07	−88.73	0.21 ± 0.17	0.04
Floral density	3	184.89	4.45	0.06	−88.85	−0.23 ± 0.18	0.04
Garden area	3	185.04	4.59	0.06	−88.92	−0.15 ± 0.18	0.03
Wild bee abundance	3	185.69	5.24	0.04	−89.25	−0.06 ± 0.18	0.00
Impervious surface	3	185.81	5.36	0.04	−89.30	0.00 ± 0.18	0.00

To make coefficients easier to compare, all variables have been standardized. For each variable we give the estimate of the coefficient ± the standard error. The coefficient for the null model is the intercept. For pseudo-R^2 we used the formula 1 − (residual deviance/null deviance)

foraging on weeds took more time or energy. If the bees are partitioning their resources in this way, there would likely also be fewer opportunities to transmit pathogens.

15.3.3 Does Urban Beekeeping Provide Any Benefits to Wild Bees?

In the gardens where people kept honey bees, there was a significantly higher number of plant species flowering than in gardens without honey beehives (Fig. 15.4). Gardens with hives also had a slightly higher median weed density,

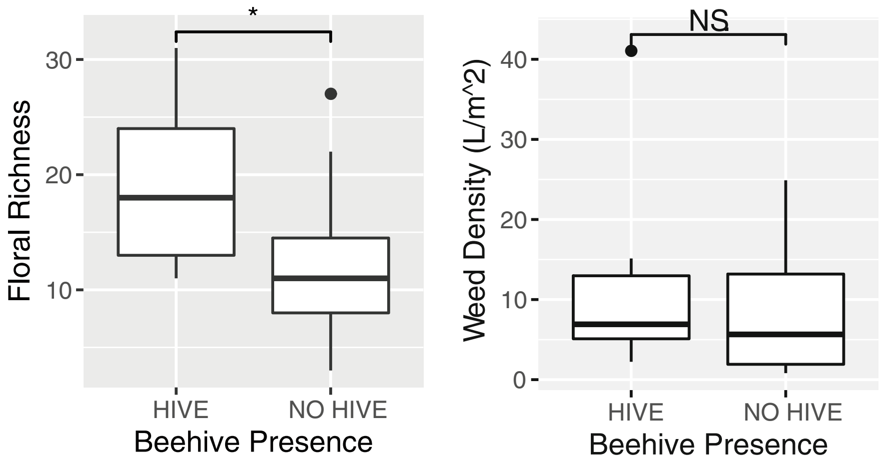

Fig. 15.4 Boxplots comparing floral richness (left) and weed density (right) in gardens with and without honey beehives. The asterisk (*) in the image to the left indicates significance at $p < 0.05$. NS stands for "not significant"

but the difference was not statistically significant. The influence of beekeeping on human behavior and perception is better illuminated by the interviews. When asked whether beekeeping influenced the way he saw urban space, one interviewee responded, "Oh, definitely. Way more attuned. Like, dandelions are—I want to start a campaign to save the dandelions. Just so people see them as not a weed, but it's a food source for somebody for something. It's a beneficial plant, it's got its purpose, it's going to bloom for a month and it's going to go away. No amount of spraying is going to make it go away. So, it definitely made me more attuned with blooming plants and nature and agriculture in general."

Another interviewee, who managed a university greenhouse, said that before he started working there the greenhouse used pesticides for years (which can harm bees), but he eliminated pesticide use when he became manager. He also said he enjoyed growing plants that bees like, "There's something that's just fun about that. So, I pay attention to which plants are visited by bees, and I grow more of those plants, and I try to give more of those plants away. So, I know I'm a little bit of a Johnny Appleseed whenever I say, 'Take this plant, you're going to be amazed how many bees come to it.'"

Most of the beekeepers we interviewed participated as a hobby, rather than as paid work. Some expressed a love of beekeeping or an attachment to the bees themselves, viewing the bees as pets or even colleagues. One participant started volunteering with the beehives at a community garden just to have something to do, and it inspired him to build native bee habitats at both the community garden and his home garden.

Many of Chicago's beekeepers engage the public in bee education, both formally and informally. In fact, one of the interviews we conducted took place during an outreach event at a public conservatory. During other interviews, beekeepers stopped to answer the questions of curious passersby. In this way, beekeepers educate the public and give city-dwellers an opportunity to engage with nature. Positive conservation outcomes depend on broad public support, and these kinds of opportunities for engagement can help to build that support (Miller and Hobbs 2002). Bee ecosystem services alone may not be a strong enough argument for their conservation simply because rare bee species do not contribute as much to crop pollination as abundant species (Kleijn et al. 2015). When bees are reduced to the monetary value of their pollination services, the numbers may not always be in favor of conservation. Perhaps our urban beekeepers can teach the public to feel the same attachment to bees that the beekeepers feel. The value of public concern and engagement has been demonstrated in the conservation of another charismatic pollinator, the Monarch butterfly (*Danaus plexippus*). In short, nature needs cities, and urban residents are important stakeholders in biodiversity conservation (Derby Lewis et al. 2019).

Some of the education the beekeepers provide also benefits wild bees in more direct ways. At the aforementioned event at the conservatory, beekeepers were demonstrating how they detect and reduce varroa mites on the honey bees. When a member of the public asked them what people who are not beekeepers can do to help honey bees, one beekeeper replied, “People who are not beekeepers, what can be done is the more. . .plants you plant the better nutrition the bees get, the better their immune system is, the more they can resist the mites. At the end of the day, it’s all about the immune system and nutrition. Just like us.” This response is not only astute, but it gives actionable advice that benefits all bees. Like us, bees require certain essential amino acids which they get from their food. A diverse diet of high-quality pollen helps bees meet those needs and improve their resistance to parasites and other stressors (Huang 2012; Di Pasquale et al. 2013) and increase their longevity (Schmidt et al. 1987).

15.4 Conclusion

One beekeeper we interviewed expressed that she had experienced hostility from people who are concerned with native species conservation. She gave an example of an email she had received: “She was like, my milkweed are covered in honey bees and what are you going to do about this?” Our research suggests that such antagonism between “wild bee people” and “honey bee people” might be unwarranted. We cannot speak authoritatively on all habitat types where honey bees and wild bees interact, but in Chicago’s community gardens there is evidence that these two groups coexist, possibly as a result of floral resource partitioning. At moderate honey bee abundances, wild bees and honey bees were positively correlated with each other. In general, we encountered more bees of all kinds where there were more floral resources, and we found evidence that beekeeping positively influences floral resource availability.

In spite of the potential for competitive interactions between wild bees and honey bees, both parties (beekeepers and conservationists) are stakeholders in bee health and floral resource availability. Combining our efforts, through public engagement and plantings in community gardens and elsewhere, is likely to achieve better conservation outcomes than if we treat other stakeholders as adversaries. Both parties can advocate for and provide resources for both managed honey bees and wild native bees in cities. Community gardens are important urban spaces for bees, both in providing habitat and inspiring advocates; beekeepers have influence in both of these areas.

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