A Shift Away from Turfgrass Dominated Landscapes Will Improve Bee Health

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Neatly manicured grass lawns first arose in seventeenth-century Europe (Upton, 2014). These lawns originated as a sign of wealth because, before the invention of the lawnmower, numerous people needed to be employed to cut the grass and remove the weeds. As European settlers came to the New World, they brought the idea of the lawn, and the seeds to grow it with them. In America, just as it had been in Europe, a decorative lawn was a sign of wealth. Over the centuries, the invention of the lawnmower, and the middle-class migration to the suburbs promoted the proliferation of grass lawns. In the 1950s, Abraham Levitt and his sons created Levittown, which was the first neighborhood in which the homes had lawns when the owners first purchased them. Today, this ubiquitous element dominates the American landscape. Lawns cover more than 163,000 square kilometers of US land (Lerman, Contosta, Milam & Bang, 2018). Unfortunately, the desire for the perfect lawn has robbed bees of some natural food sources and subjected them to harmful pesticides. A shift from highly manicured landscapes dominated by turfgrass, to a more natural landscape, will improve bee numbers and overall bee health.

Lawn Management

In the face of increasing urbanization, there is a critical need for a change in turfgrass management practices to maintain biodiversity. A study published in 2017 in *Crop Science* points out that from 1982 to 1997, urban land cover in the United States increased by 50%. Turfgrass now covers over 1.9% of the total land area in the country (Thompson & Kao-Kniffin, 2017). Today, there is three times more land area covered by turfgrass than by any irrigated crop. In some areas, turfgrass covers 60% of a community's land.

Traditional methods of lawn management adversely affect suburban ecosystems. Susannah Lerman and her colleagues studied private landscapes of homes in Springfield, Massachusetts. The team collected bees from May through September in two consecutive years. Researchers counted both bee abundance and species richness. The number of lawn flowers in the turfgrass in each location was counted. They identified 111 species of bees in their 5,331 bee collection samples (Lerman & Milam, 2016). Over 78% of the species came from fewer than half of the lawns in the study. The number of lawn flowers directly correlated with the number of bees found. Unmaintained areas containing clover and dandelion had the most bees. Most of the bees in their study were polylactic, gathering food from multiple unrelated plants. Additionally, 96.5% of the bees they found were soil nesters. The study concluded that non-chemically treated lawns could serve as bee habitats if weeds are allowed to grow within the grass.

Two years later, Lerman again examined the suburban landscape. In this study, they proposed that allowing weed species to grow in the grass could help mitigate the effects of urban development on pollinators (Lerman, Contosta, Milam, & Bang 2018). They studied single-family, owner-occupied yards that were not irrigated or chemically treated. The lawns in the sample also did not have vegetable gardens or pollinator gardens. All lawns were mowed with the same type of lawnmower. Each was assigned a mowing frequency of once a week, once every two weeks, or once every three weeks. Lawn flowers and planted cultivated flowers were counted separately before each bee sampling. They sampled bees every two weeks. They found the highest number of bees existed in the two-week mowing cycle yards. The team concluded that a "lazy lawn mower" approach with less frequent mowing, could help bee populations. They also found that allowing flowering weeds to grow in the grass supports higher bee numbers, but they also acknowledge it is difficult to garner support for this approach. The widely accepted

view of an aesthetically pleasing landscape that includes large expanses of weed-free, meticulously mowed lawns, has developed over centuries. It will take time and the work of dedicated people to change this view.

Composition, Configuration, and Practices

A large-scale study, with contributing authors from across the globe who are scientists from various universities and environmental agencies, was published in *Ecology Letters*. They performed an analysis of wild bees at 605 field sites, encompassing different biomes. They studied multiple variables, including organic vs. conventional farming, landscape composition, and landscape configuration. Analysis of data on social and solitary bees was performed. Findings show organic vs. conventional practices and landscape composition both correlated strongly with total bee abundance (Kennedy et al., 2013). Landscape composition affected solitary bee richness less than social bee richness. Organic practices had a strong positive association with bee richness in both groups in tropical and Mediterranean biomes. Landscape configuration had little effect on either bee abundance or richness. It shows that social and solitary bees respond differently to surrounding landscapes. The team showed that increasing the amount of high-quality habitat available to bees in a given area will increase the total number of bees and the number of taxa identified. The study highlights the need for local-scale plant diversity to increase bee numbers.

Agriculture

The questions then arise, how large of an area is considered local to a bee, and what effect does a greater travel distance to food have on the bees? Scientists from the agroecology department of the University of Gottingen in Germany did a study to attempt to answer these questions. This article studies bee dances in correlation to foraging distance in simple versus

complex landscapes. Complex landscapes are those that contain largely diverse habitats and a large amount of semi-natural habitat. It notes that there was increased dance activity with higher quality of food and that dance activity decrease when the food was at longer distances from the hive (Steffan-Dewenter & Kuhn, 2003). The study was conducted in a typical landscape of highly managed agricultural land with patches of forest and semi-natural grasslands. All the queens in the study had the same mother mated at a single mating session. The researchers used glass hives were so they could observe the bees. They found that simple landscapes lead to greater foraging distances for pollen-collecting bees but not for nectar collecting bees. The most significant differences in foraging distance between landscape types were found in June when most of the flowering had stopped. The authors suggest that foraging differences in the two types of landscapes could result in landscape-dependent changes in gene flow in bees.

Foraging ranges were examined further. This time the decline of honeybee populations in Europe and North America and its threat to human food sources was the focus. This 2010 study in *Apidologie*, hypothesizes fragmentation of habitat, and the lessening diversity of nectar sources are among the reasons for the decline (Decourtye, Mader & Desneux, 2010). The authors show that a shift toward single crop farming has caused a less diverse bee habitat. They suggest the use of cover crops that provide flowers for bee foraging in the spring and fall could help ensure bees had adequate food in the non-crop season. Rotation crops can also boost soil nitrogen, eliminating the need for synthetic fertilizers that could be harmful to bees. This article further suggests that adding flowers to non-cropped land in the area of farms could help bee populations. Another suggestion by the authors is adding roadside plantings. They conclude that there is clear evidence of a threat to bees from current practices. They propose purposeful

planting in non-cropped areas will help to lessen bee losses. It also cites the use of pesticides as a culprit of population collapse.

Not all people agree that all chemical use in landscape maintenance is entirely bad. A *Range Management* article suggests herbicides could have a positive impact due to their ability to kill the invasive weeds, which do not serve as bee food (Crane, 2011). The emergence of exotic weeds and plants that have become invasive threaten bees in western rangelands. The plants are displacing native plants that bees use for food.

Climate Change

A changing climate is one reason some plant species are becoming invasive. German researchers from various universities and environmental research agencies monitored data from six sites in Germany that are part of the Terrestrial Environmental Observatories or TERENO. They use landscape and weather data, as well as statistical analysis, to study the effects that semi-natural habitat had on bees to determine if this habitat could lessen the impact that increasing temperatures due to climate change would have on bees (Papanikolaou, Kühn, Frenzel, & Schweiger 2016). The study looked at both short-term and long-term weather changes. They found that temperature directly impacted bee development, numbers, survival, and foraging range. They also found higher temperatures adversely affect bee diversity in highly agrarian areas. Agricultural areas where suitable supplemental habitats, such as hedgerows, were provided were less adversely affected. Positive impacts of including semi-natural landscapes were found in both short-term and long-term weather patterns. The researchers concluded that semi-natural habitat could mitigate the effects of rising temperatures on bees.

Ordinances Limit Bee Friendly Landscaping

An article found in the *Michigan State University Extension Bulletin* mentions that, in addition to honeybees, there are 3,600 species of native bees that provide pollination services (Brown, Elsner, Landis, Shrewsbury & Herms, 2019). It points to the loss of habitat and flowers as a cause for an 80% decline in the bee population. It also attributes the decline in bees to pesticide use. It urges people to consider the amount of lawn they maintain and if this area could be transformed into bee habitat, primarily allowing clover, dandelions, and other beneficial, flowering weeds to coexist with turfgrass. It asks that individuals help to change ordinances the prohibit these "weeds" from existing in lawns. These ordinances are wide-spread, and changing them is no easy task. The change to maintain their desired esthetic, many homeowners' associations, HOAs, mandate that homeowners use herbicides and pesticides that are harmful to bees. They also require yards to completely weed-free, removing a primary source of food for the bees. For example, the covenants of Solano Wood Homeowners' Association in Ponte Vedra Beach, Florida, explicitly states "Landscape maintenance, without limitation, shall include, irrigation, fertilization, weeding, mowing, trimming, spraying for insects and disease, and periodic replacement of dead, damaged or diseased plants. The yard shall be kept free of weeds and bare spots." (p. 12) If owners fail to adhere to this policy, they face fines and possible liens on their property. This type of clause has become the norm. There are efforts by some states to limit some of this. However, HOAs are still including these clauses and dissuading their residents from exercising their rights to a more ecologically friendly yard. In Florida, there is a law allowing "Florida friendly" landscaping; however, it does not include a provision mandating that weeds are permitted to coexist with turfgrass.

What is a Weed

Several studies discussed in this paper have suggested that weeds are beneficial to bees and should be allowed in landscapes. However, the definition of a weed has not been made clear. The Cambridge Dictionary defines a weed as" any wild plant that grows in a garden or field where it is not wanted." (Weed, n.d.) Who gets to decide if the plant is wanted? The answer is not clear. Even within the same municipality, different agencies may have different definitions of a weed. For example, In Chicago, Mayor Richard Daley awarded one woman a prize for her native plant garden, as part of the city's sustainable backyards program (Rose & Rose). This woman was ticketed and fined for the same garden because it violated the Streets and Sanitation Department's weed ordinance. That department uses an ambiguous definition of a weed that leaves all plants over ten inches in height at risk of being deemed weeds. Not one consistent, concrete definition of a weed could be found in the research.

Solutions

Regional agricultural extension offices have begun to compile information for the public to help them make better landscape choices. The University of Maine Cooperative Extension is one of these. A multi-disciplinary team at this office have published information on creating bee-friendly landscapes. The article tells of the bees' need for plants that produce pollen and nectar from spring through autumn. It urges the selection of native plants and encourages the reduction in the size of the lawn to accommodate more diverse plantings (Stack, Drummond & Dibble, n.d.). As with other articles examined in this paper, it says that allowing weeds to remain within the lawn area is beneficial to bees.

A myriad of flowering plants must be provided in the landscape to help cultivate a thriving bee population. These plantings can come in many forms. Hedgerows and boarder plantings can be added to mono-cropped fields. Cities can promote the installation of rooftop

gardens and add flowering plants to public spaces. Homeowners can reduce the percentage of turfgrass they plant and add diverse flower beds. The definition of a weed can be codified to be a non-native plant that is invasive and harmful to the area in which it is planted. This change will allow for clover, dandelions, and other flowering plants to be intermingled with turfgrass and bed plantings, expanding the bee's food sources. In short, to save the bees, there must be a move away from homogeneity in all landscapes, agricultural, municipal, commercial, and residential.

Over a decade of research supports a move away from vast expanses of highly manicured, weed-free turfgrass. While none of the studies call for total abandonment of lawns, they all conclude that grass treated with herbicides, pesticides, and fertilizers, utterly devoid of weeds, is not conducive to a thriving bee population. As the human population grows, causing more and more land to become urbanized, the need for a shift from highly manicured landscapes dominated by turfgrass, to more natural landscape becomes a crucial factor in improving bee numbers and overall bee health.

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