The bees are back in town

Pollinators in an urban ecosystem

The growing urbanisation of the landscape poses a major threat to insect pollinators. The reduction in number of these insects, especially bee species, could have a severe impact on agricultural production as many of the crops that we rely on could not produce seeds without pollination. Working with the Volusia Sandhill Pollinator Project, Professors Cindy Bennington and Peter May investigate pollinator visitation to a small restoration site at Stetson University in Florida, to compare pollinators in an urban ecosystem to those in a larger conservation area.

Pollinators are any animals (usually insects) that transfer pollen from one flower to another, and without them around 75% of flowering plants would be unable to reproduce – including many species that we rely on for food and other products. The growth of towns and cities ('urbanisation') means the reduction in natural environments where these pollinator species thrive.

While declines in European honeybee populations have drawn global attention because of their importance to crop pollination, declines in native species worldwide are causing concern for both agriculture and native plant reproduction.

Stetson University researchers Professor Cindy Bennington and Professor Peter May investigate the pollinators visiting a small restoration area in an urban ecosystem to compare how the numbers and species of insects present compare to those found in a larger conservation area. The question is, does this small area provide enough habitat and food to support a diverse and abundant insect pollinator community?

THE VOLUSIA SANDHILL ECOSYSTEM

In 2011 a small field located near the Gillespie Museum on the Stetson University campus in Florida was selected to be restored to the natural sandhill ecosystem that would have dominated the area prior to urbanisation (European settlement). These sandhills are so called because of the deep, sandy soil of the area, but the dominant features of the landscape were the large, widely spaced pine trees. The sandhill restoration involved planting more than 80 native tree species, mostly longleaf pine, and the development of an understory of plants and grasses. This small fragment of restored ecosystem is still immature. The trees are young and don't provide the same high, thick canopy as you would find in a more mature ecosystem, which affects the smaller plants growing below. Yet already you can see the difference from the neglected lawn that was there previously, especially as pollinators return to visit the many flowering plants.

This area, known as the Volusia Sandhill Ecosystem, is now a teaching area to educate visitors about the natural landscape of the area and the native plants and insects. Anyone is welcome to visit the Gillespie Museum and take part in the Volusia Sandhill Pollinator Project – where volunteers can record pollinator activity and contribute to the ongoing data collection.

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Acmaeodera sp. (Family Buprestidae; the metallic wood-boring beetles).

Agapostemon splendens (Family Halictidae - the halictid or sweat bees).

Strymon melinus (Family Lycaenidae - the hairstreaks) - Red-banded Hairstreak.

Chauliognathus sp. (Family Cantharidae - the soldier beetles) - Leatherwing Beetle.

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Professors Bennington and May are interested in how well this small area of restored sandhill ecosystem might support pollinators, in comparison to a larger natural area. The Volusia Sandhill is surrounded by an urban ecosystem of residential, business and university campus areas. The ability of this and any small, isolated fragment of semi-natural habitat to support insect life depends upon its ability to provide suitable habitat for a diversity of species of plants and insects.

The contrast to this fragment is the Heart Island Conservation Area (DeLeon Springs, Florida), north of the Volusia Sandhill and Stetson University campus, which is more than 5700 hectares of semi-natural habitat. This covers a variety of ecosystems including sandhills, and the plant understory of the sandhills is made up of many native flowering plants that attract many native pollinators. This means that the pollinators visiting the Volusia Sandhill can be compared to the pollinators visiting the sandhills of Heart Island Conservation Area to determine if the same number and species of pollinators are present in the urban ecosystem as in the larger natural area.

PLANT-POLLINATOR INTERACTIONS

The pollinators we are most familiar with are bees, though other insects including wasps, butterflies, beetles, and flies are also common pollinators. Insects visit the flowers to access the nectar and pollen as a food source, and in the process carry pollen between plants. Some plants, referred to as 'specialists', are only pollinated by one group of insects (for example, they may only attract flies, or have the pollen situated such that only bees can collect it), and others may be 'generalists', meaning that any insect that visits the flower can collect or deposit pollen. To compare pollinators, two plants were selected that were present in both the Volusia Sandhill Ecosystem and the Heart Island Conservation Area – one generalist and one specialist.

The two areas differ in the plant species present, due to a variety of factors including the maturity of the ecosystem and the soil quality, but *Bidens alba (B. alba;* a generalist) and *Chamaecrista*

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fasciculata (*C. fasciculata;* a specialist) were present in both ecosystems and are common in dry areas of Florida. *C. fasciculata* is 'buzz-pollinated', which means that the vibrations from the buzzing of a bee are required to release the pollen from the flower. It is expected that specialist plant species would suffer from the reduced number of available pollinators in an urban ecosystem more than a generalist plant species, and so it is of interest to compare the pollination visitation to both specialists and generalists in urban and conservation areas.

WELCOME VISITORS

The researchers counted insect visitors to *B. alba* and *C. fasciculata* flowers at both sites between May and August over three years (2016 – 2018) and found a surprising result: there were slightly more pollinator visitations to both plants at the Volusia Sandhill Ecosystem than at the Heart Island Conservation Area. Although there was no statistical difference in the number of insects visiting the plants in each area, the total numbers were higher for the Volusia Sandhill and this is not what was expected in the urban ecosystem.

Most of the visitors to both plants at both sites were native bees, but there was a much greater diversity of visitors to *B. alba* at the Heart Island Conservation Area. Over 70% of pollinator visitation to *B. alba* at the Volusia Sandhill were Hymenoptera (bees and wasps), but at the Heart Island site they made up only 41% of visitors. Lepidoptera (moths and butterflies) made up 31% of visitors at Heart Island, and Diptera (flies) and Coleoptera (beetles) together made up another 14%. This means there is a much greater diversity of insects present at Heart Island than at the Volusia Sandhill, where Lepidoptera, Diptera and Coleoptera all together only made up a little over 12% of the visitors to *B. alba*.

As expected, the most common pollinator to visit *C. fasciculata* was the bumblebee (*Bombus spp.*), and while there were slightly more visitors at the Volusia Sandhill, bumblebees were the large majority at both sites indicating no significant difference in the diversity of insect visitors to this plant.

Bombus sp. at *Chamaecrista fasciculata* (Family Apidae - bumblebees, honeybees).

Bembix americana (Family Crabronidae - the square-headed wasps) - American Sand Wasp.

Cosmosoma myrodora (Family Erebidae - a nameless moth family) - Scarlet-bodied Wasp Moth.

URBAN POLLINATORS

This research suggests that this small and immature fragment of restored habitat could be enough to support a community of bees in an urban ecosystem. Potentially this could also be assisted by the non-native plants in the gardens and green areas in the residential, business and university campus surroundings, and perhaps some cavity-nesting species can find suitable habitats on the sides of buildings. The study supports previous research which found that Hymenoptera are more resilient to urbanisation than other pollinator species. The species composition at each site varied a great deal, however, and so it seems that specific bee and wasp species are differently impacted by the changing ecosystem. The surface area available to ground-nesting species and other factors such as larval food supplies are likely to also play a role in determining which species thrive in an urban environment.

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Coelioxys slossoni (Family Megachilidae - the leafcutter bees) - Cuckoo Leafcutter Bee.

Leptotes cassius (Family Lycaenidae - the hairstreaks) - Cassius Blue and *Halictus* sp. (Family Halictidae).

Hedriodiscus trivittata (Family Stratiomyidae - the soldier flies).

The lack of the expected difference in visitation to *C. fasciculata* can most likely be explained as being due to the pollinator not being specific to the plant – *C. fasciculata* may rely on the bumblebee for pollination, but *Bombus* spp. can visit many plants including both specialists and generalists. The low numbers of beetle and butterfly visitors to the plants at the Volusia Sandhill Ecosystem suggests these are more sensitive to urbanisation, and this is again likely due to these insects having requirements (other than food in the form of nectar) that are not met in an urban ecosystem.

Professors Bennington and May (and volunteers with the Volusia Sandhill Pollinator Project) continue to record pollinator visitation to the Volusia Sandhill Ecosystem each summer, and hope to attract a greater diversity of pollinators by increasing the available larval food sources and adding further flowers to provide resources to insects year-round.

Behind the Research

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Peter May

Research Objectives

Professors Cindy Bennington and Peter May assess the ability of the Volusia Sandhill Ecoystem to support wild insect pollinators.

Detail

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Bio
Cindy and Peter are both Professors of Biology at Stetson University, a small liberal arts college in Florida. Studying the pollinators in the Volusia Sandhill, a campus restoration site, was a natural pairing given their contributions to the site's development and their respective expertise in plants and insects. Having been friends and colleagues for decades, they got married in the Volusia Sandhill in June 2017.

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Collaborators
Dr Karen Cole, Director of the Gillespie Museum

References

Bennington, C. and May, P. (2020). Pollinator Communities of Restored Sandhills: a Comparison of Insect Visitation Rates to Generalist and Specialist Flowering Plants in Sandhill Ecosystems of Central Florida. *Natural Areas Journal*, 40(2), 168-178. https://doi.org/10.3375/043.040.0208

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Personal Response

What could this mean in terms of protecting native pollinator species against habitat destruction and climate change?

"Our research is consistent with that of others who have found that small urban ecosytems can provide habitat for plants and invertebrates in an increasingly human-dominated landscape, though the pollinator communities in urban fragments may be a novel mix of species. The extent to which these new, urban communities can also withstand accelerating climate change requires continued investigation."

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