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Pollinators in the Out-of-Play Areas of Virginia Golf Courses

Authored by Shannon Bradley, Student Graduate Assistant, Department of Entomology, Virginia Tech; and Alejandro Del-Pozo, Assistant Professor and Extension Specialist, Department of Entomology, Virginia Tech

Introduction

Pollinator preservation efforts have increased in recent years through the establishment of pollinator-friendly habitats (Fig. 1). Virginia golf courses offer potential pollinator friendly spaces in the out-of-play areas. These out-of-play areas are the spaces beyond the maintained turf of a course, which can provide the food and shelter to pollinators that turfgrass could lack. There is limited information about the plant and insect makeup of these potential pollinator habitats in a golf course. Remote sensing, including the use of drones and light reflectance, offers the potential to both identify and monitor the presence and health of these potential pollinator habitats.

Figure 1. Monarch butterfly (*Danaus plexippus*, Lepidoptera) photographed in a native out-of-play area in Williamsburg, VA. Photo by Shannon Bradley.

Pollinators

Pollinators are animals that support an ecosystem through their pollination services. Bees, beetles, butterflies, and flies are some of the insects considered as pollinators (Fig. 2). There are native bees, such as the squash bee, well-adapted to local conditions benefiting not only commercial agriculture fields, but also the landscape across locations. In fact, pollinators could contribute ~$110 million to Virginia's agricultural income annually, according to an estimation made by the Virginia Department of Agriculture and Consumer Services.

Figure 2. From left to right Eastern carpenter bee (*Xylocopa virginica*, Hymenoptera), snowberry clearwing / hummingbird moth (*Hemaris diffinis*, Lepidoptera), and Eastern tiger swallowtail (*Papilio glaucus*, lepidoptera). Images were taken in out-of-play areas in Glen Allen, Williamsburg and Blacksburg, VA, respectively. Photos by Shannon Bradley.

Native Pollinator Habitats in Out-of-play Areas

Pollinator habitats can feature a variety of plants native to Virginia. These include plants that could flower throughout the spring, summer, and fall months, to ensure that there would be a constant source of pollen for the pollinators. These habitats are often undisturbed, with no irrigation, no pesticides, or without significant human intervention. These habitats act as a refuge for native species of arthropods and other animals in turfgrass systems, increasing its system biodiversity (Fig. 3 and 4).

Figure 3. A potential pollinator habitat at a golf course showing the variety in plant type and height in Henrico County, VA. Photo by Shannon Bradley.

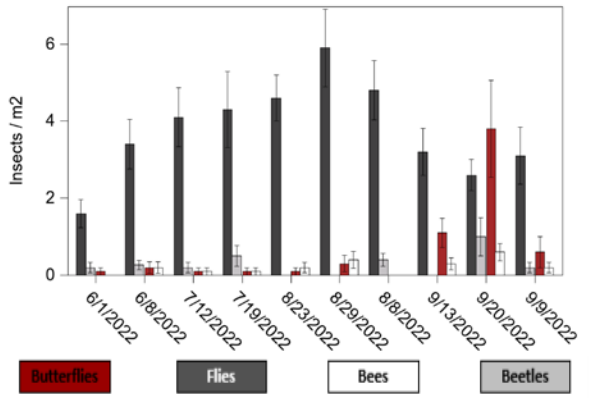

Figure 4. Counts of insects performed at an out-of-play pollinator habitat in a golf course in Williamsburg, VA, in 2022. Flies accounted for the largest group of insects that were seen interacting with flowering plants.

Monitoring Pollinator Habitats with Light Reflectance

Out-of-play areas which can act as pollinator habitats or refuges, are not to be disturbed by excessive human intervention or maintenance. As popularity for these pollinator spaces grows, so does the need for a method of monitoring to assess habitat identification, limiting the disturbance of the area. Visual counts of pollinators, ground cover and plant categorization have been performed as part of an effort to document the relationship between these areas and pollinators (Fig. 5). Light reflectance as part of a remote sensing approach, offers a method that minimally disturbs native plants and wildlife during data collection.

Figure 5. PVC frame placed at each out-of-play pollinator habitat to mark the sampling area for assessing the presence of insect pollinators and plant type. Photo by Shannon Bradley.

Remote Sensing

Remote sensing is the use of technology to collect information from a space that would otherwise be difficult to physically access for observation. This would include spaces that are too large to monitor or are unsafe for an individual to enter. Remote sensing includes the use of technology such as drones, sensors, cameras, and GPS; and is currently being used in nurseries and turfgrass to collect plant inventory, plant stress, and other data.

Light Reflectance

The drones used for remote sensing can collect multispectral light reflectance data. This reflectance can include a range of visible and non-visible wavelengths such as ultraviolet (UV) and infrared (IR). Light reflectance is the measurement of the amount of light that is reflected off an object (Fig.6). The light reflectance data can be used to determine proxies associated with the health of a plant. It is expected that the healthier a plant, the higher the light reflectance is. There are some mathematical indices that can also use light reflectance data to calculate different characteristics of a plant, such as the level of green or other colors. These indices can highlight more specific light wavelengths. For instance, Normalized Difference Vegetation Index

(NDVI) is commonly used to detect the level of green in the turfgrass industry.

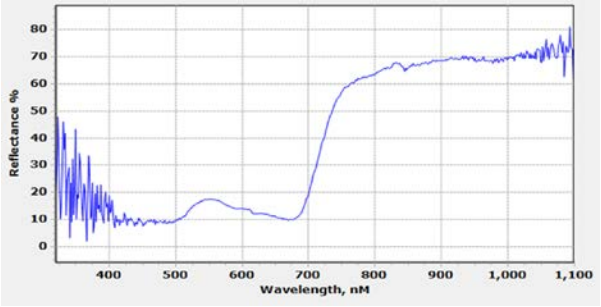

Figure 6. Light reflectance profile collected from several plants at an out-of-play area. Ultraviolet is measured from 100-400 nm, and is attractive to many pollinators. Plants with a higher percentage of UV reflectance may be likely to attract pollinators.

The Relationship Between Light Reflectance and Pollinators

The light reflectance of plants could be used as a proxy to characterize the ‘quality’ of out-of-play areas on golf courses, as pollinator-friendly habitats. This reflectance is applied to several indices and then related to the number of pollinator insects that were visually scouted. An index could be used to establish the range of light reflectance present at a scouted area where high numbers of insects interacting with flowers have visited. Light reflectance indices highly correlated with the presence of pollinators could be selected to identify and locate these ‘high quality’ pollinator-friendly habitats in out-of-play areas across a golf course. Having a remote sensing approach to delimit these pollinator habitats will reduce labor and aid on improving an integrated pest and pollinator management program under golf course settings.

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