**TITLE: Increasing the Contributions of Transmission Line Easements to Pollinator Success**

## INTRODUCTION AND BACKGROUND

In light of the recent Presidential Memorandum of June 2014 mandating a federal effort to promote the health of pollinators, research into practical strategies to create pollinator-friendly habitat in the United States is of renewed importance. Critical for food production, the economic value of pollination has been estimated to be between 100 and 200 billion dollars per year worldwide [1, 2]. Bees (Hymenoptera: Apoidea) are the most important animal pollinators of both agricultural crops and other vegetation worldwide [3]. Despite the tendency to focus on honeybees (*Apis mellifera*), pollination is a service provided regionally by hundreds of bee species. Research has demonstrated that a greater diversity of bees improves pollination services leading to bigger and more consistent crop yields [5, 6]. Unfortunately, mounting evidence suggests declines in the abundance and diversity of wild bees, thereby leading to declines in the pollination services they provide (ref). Increasing habitat that provides forage and nesting sites could boost struggling populations, particularly in urban, suburban and agricultural landscapes. Initiatives have sprung up to promote pollinator-friendly plants in gardens and meadow restoration on private lands, but the effectiveness of this approach is difficult to measure. The millions of acres beneath US transmission lines must be kept free of tall-growing vegetation and hence have the potential to provide suitable habitat for many native species. The significance of this ROW habitat is due not only to the amount of land, but perhaps more importantly, due to the continued management of vegetation within. Most protected areas in the U.S. have very a limited budgets for active management, leaving wildlife species dependent on early to mid-successional habitat in danger of being wiped out when these areas transition to forest. Thus transmission line easements have the potential to provide both substantial habitat space for these species, but also consistency, which cannot be easily found elsewhere.

A growing body of research has shown that Integrated Vegetation Management in rights-of-way can provide quality habitat for a variety of pollinators and other wildlife and is preferable to manual extraction or mowing where practical (refs). This technique minimizes disturbance to existing wildlife, creates a greater diversity of flowering plant species and provides living and dead woody stems are used nesting space for wild bee pollinators (ref). Although the benefits of IVM to wildlife are becoming clear and many companies are moving toward widespread use of IVM, significant questions remain. First, can we go further by targeting areas for more intensive, guided management to promote pollinators? If so, what are the relative costs and benefits of this approach? Second, if the goal of management for pollinators is to provide not just a home for these species, but to ensure pollination services to surrounding agriculture and/or native flowering plant species, can we demonstrate that these animals will forage some distance from the easement? In other words, can we measure the potential benefit these managed habitats provide?

This study is designed to help answer the questions outlined above and by so doing will provide both valuable scientific information informing the conservation of pollinators, but will also allow PSEG to be at the forefront of this very popular conservation

movement, thus further promoting its public image. Through its participation in this important work, PSEG becomes the company working toward providing habitat for the region's pollinators, providing valuable ecosystem services to farmers, gardeners and anyone who is invested in protecting native flowering plants.

**Objective 1. To demonstrate the potential landscape importance of the creation and maintenance of pollinator habitat under transmission-line easements.**

**Objective 2. To evaluate the relative cost and benefits of different types of vegetation management in relation to Objective 1.**

**Objective 3. To take advantage of public interest in conserving pollinators by promoting the value of these easements to conservation, thereby improving PSEG's customer and market perception.**

## METHODS

**Objective 1. To demonstrate the potential landscape importance of the creation and maintenance of pollinator habitat under transmission-line easements.** In order to demonstrate that providing habitat for pollinators will lead to an increase in the provision of ecosystem services, we need to directly measure both the success of the management in creating valuable habitat as well as the likelihood that resident pollinators will travel to forage in surrounding areas. Although prior studies have demonstrated that easements managed with low-impact methods do house more diverse and abundant pollinator communities, it has been difficult to scientifically demonstrate the effect on the surrounding landscape due to the lack of consistency and access in land surrounding the rights of way; Often this land is controlled by private landowners, who may be reluctant to modify their mowing regime or allow researchers on site to conduct surveys. A way around this is to use the easements themselves to test foraging distance, as management and access can be controlled. To do this requires the establishment of adjacent sections of easement, one section being the 'treatment' section wherein vegetation would be managed using low-impact techniques and the adjacent section which would be the monitoring section, wherein vegetation would be kept consistent through annual mowing (see Figure 1). This design would allow not only a quantitatively direct measure of the growth of the pollinator community through time as the vegetation matures (in the treatment area), but also by placing monitoring stations in the adjacent section at varying distances, we can directly measure the "spillover effect" of pollinators foraging away from their preferred habitat. These monitoring stations would consist of bee bowls (AKA pan traps) that would measure species diversity as well as temporary potted plant stations to measure visitation. A minimum of three sets of sites per treatment type is required to statistically analyze the data. The number of treatment types is therefore limited by the number of spans available for manipulation.

***Treatment types***. Three treatment types have been identified for study **1)** Integrated Vegetation Management (company standard best practices), **2)** Cut-stubble, followed by IVM and **3)** Integrated Vegetation Management Plus supplementation in the form of pollinator seed mixes.

***Site selection.*** Nine sites have been selected for this study (3 replicates of each management type) – see map.

**Objective 2. To evaluate the relative cost and benefits of different types of vegetation management in relation to Objective 1.** Detailed cost information will be documented over the duration of the study to allow for quantitative comparisons of the resources necessary for each treatment protocol. Benefits to wildlife can then be quantified in relation to cost of management, resulting in a meaningful metric that can be used by PSEG and other companies in their decision making process.

**Objective 3. To take advantage of public interest in conserving pollinators by promoting the value of these easements to conservation, thereby improving PSEG's customer and market perception.** Where possible, this project will involve community gardening groups, pollinator protection organizations and community volunteers to help with vegetation management (especially plug or nest box installation). Results of the study will be discussed and presented and local events and scientific meetings.

**TIMELINE**

**Prior work (unfunded**): Preliminary surveys of pollinators were conducted beginning in June 2016.

Initial mowing of study areas occurred in late Fall (2016).

Raking & seeding in the IVM plus sites was completed in October 2017 and have been mowed annually to promote the success of the native seeds.

Thus far, bee surveys have been conducted May, July & October 2018, July 2019, May & July 2020.

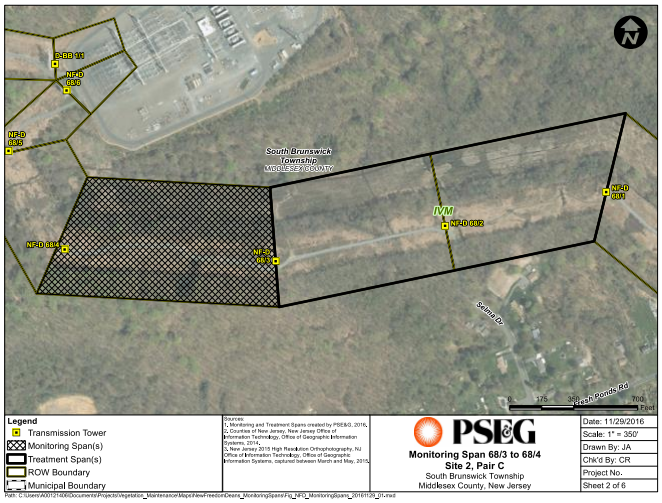
**Initiation of Funding by PSEG:**

Surveys will be conducted in May, July & October 2021 & 2022. This work will be completed by Dr. Russell and her team of undergraduate students.

Specimen Processing & Identification is ongoing. This step requires the hiring of student workers who will be trained on techniques and specimen identification.

Projected final analysis & report by the December 2022 (manuscript submission by July 2023). This work will be completed by Dr. Russell & co-authored by advanced undergraduates.

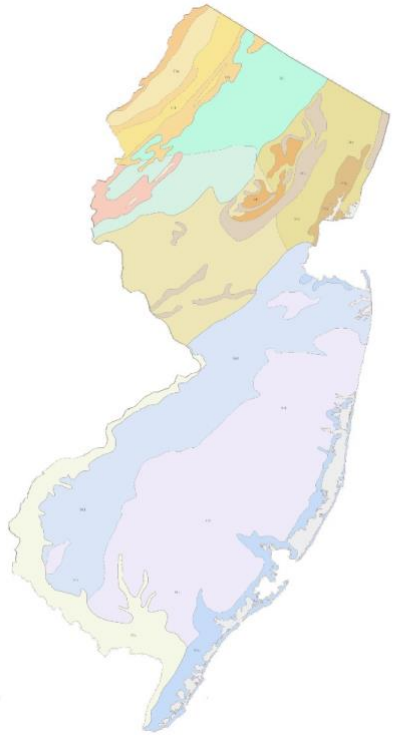
**Figure 1. Study Design.** Each site represents a section of easement, the length of which is between two and four spans. Half of the site area is the treatment zone, with treatments characterized by vegetation management categories (e.g., “mow” “IVM” or “IVM plus”). The other half is the monitoring zone with the “x” marking the location of transects where pollinator populations will be sampled at intervals to determine the potential spatial reach of pollination services of each treatment type over multiple years.


**Example: Site 4**

**Figure 2. New Jersey EcoRegions (a) & Selected study sites (b).** EcoRegion maps show that ecological regions are identifiable through the analysis of biotic and abiotic feature patterns that show differences in ecosystem quality and integrity (Wiken 1986; Omernik 1987, 1995). These features include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another.

a.



b.