Comparative analysis of vegetation and pollinator Diversity at the Long Island Solar Facility

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Abstract

The Long Island Solar Farm, an aggregation of photovoltaic panels located at Brookhaven National Laboratory (BNL) which generate renewable energy, is a clean and ecologically sound power generating facility for the residents of Long Island. Solar facilities may create an improved habitat for wildlife and plants, in which many pollinators coexist in a mutualistic relationship with the vegetation. Specifically, bees have a major role in their contributions to the intricacy of the ecosystem including but not limited to pollination, wild plant growth, wildlife habitat, and biodiversity. The remarkable insects pollinate more than 80% of all flowering vegetation including 70 of the top 100 human food crops. The natural mechanism of pollinators ensuring reproductive success of ecologically important flowering plants and agricultural crops is directly related with the sustainability of human well-being. Recent studies reflect that bee populations are declining which is the basis for their selection as the focal taxa of this research. The goal of the project is to collect and compare the variations in vegetation and pollinators both inside and outside of Solar Fields 1, 2, 4, and 6. This research is unique because it is the first study at BNL to collect the scientific knowledge base, add to the limited existing data, and compare the results. The methodology for surveying the solar facility consists of collecting vegetation data on random rows of the solar farm using 50 m transects. Data is observed and recorded for both vegetation and pollinators at 10 m intervals. To assimilate the influence of large scale solar facilities on wildlife and the ecosystems of habitation is essential. The increasingly diverse makeup of vegetation supports increased pollinator activity in addition to providing and preserving a habitat for bees. This research supports that there is a difference in vegetation and pollinators from inside the solar facility in comparison to outside.

Introduction

Pollinators play a significant role in global biodiversity through supplying essential ecosystem services to crops and wild plants. Pollination is a fundamental task in both human managed and natural terrestrial ecosystems. The necessary service is largely determined by the degree of interdependence between species, the pollinated and the pollinator. The outcome of complex interactions among plants and animals, and the reduction of either will influence the survival of both. The natural mechanism of pollinators is directly related to the sustainability of human well-being. “Without interaction between animals and flowering plants, the seeds and fruits that make up nearly 80 percent of the human diet would not exist”[1]. Interest in the conservation of pollinators has increased on a global scale because countries understand the impact that pollinator declines will have on the economy and environment. The current conservation status of bees threatens the sustainability of human food and crop production, global agricultural market, biodiversity, wild life habitat, wildlife plant growth, and the harmony of the ecosystem which is why they are the focal taxa of this research. Many pollinators coexist in a mutualistic relationship with the vegetation of their habitat[2] . The Long Island Solar Farm is a 32 MW AC aggregation of photovoltaic panels which generate renewable energy, is an innovative, clean, and ecologically sound power generating facility located at Brookhaven National Laboratory (BNL). Managed correctly, the solar farm may create an improved habitat for wildlife and plants. The solar farm supports biodiversity and ecosystem function for improved habitat diversity and increased pollinator services. The goal of the project is to collect and compare the statistically significant variations, if any, in vegetation and pollinators both inside and outside of Solar Fields 1, 2, 4, and 6 to better understand pollinator/plant relationships.

Methods & Materials

The methodology for surveying the vegetation and pollinator diversity in the solar farm consists of collecting data inside and outside of solar farm arrays 1, 2, 4, and 6. Within the solar farm random rows were selected and data were recorded based on visible and careful observations along 50 m line transects. A meter tape is used to establish transect length and data were recorded for both vegetation and pollinators at 10 m intervals using a 1m^2 quadrat (with four sub-quadrats of 50 cm^2 to collect data as accurately as possible) at each interval. The vegetation types found within each sub-quadrat were recorded in percentages. Outside of the solar farm this method was repeated and the global positioning system (GPS) coordinates were recorded at the beginning and end of each 50 m transect. The GPS coordinates were entered using a Geographic Information System (GIS) tool to capture, analyze, manage geographic data, and develop a site map (figure 1). Once the observations of the solar farm were complete the data will be normalized and evaluated. Data will be analyzed statistically, using Microsoft Excel software, to determine if there is a significant difference in vegetation and pollinators diversity between two habitats – inside and outside of solar farms.

Results

The details of the plant vegetation diversity among all solar farms both inside and outside are summarized in figures 2-9. Based on statistical analysis grass is the dominant species inside and outside of solar farms 1,2,4, and 6 ranging from 48.5±5.2%/m^2 in SF1 to 15.0±2.2%/m^2 in SF6 (inside) and from 49.5±5.9%/m^2 in SF4 to 34.9± 8.6%/m^2 in SF2 (outside). Collectively, inside of the solar farm followed by grass in dominance are crown vetch, fox grape, and mugwort . The least dominant plant found inside the solar farm are the dandelion species (0-0.1%/m^2). Outside the solar farm followed by grass in dominance is mugwort. The least dominant species are Bull thistle, St. John's-wort , and dandelion species (0-0.1% /m^2).

Acknowledgements

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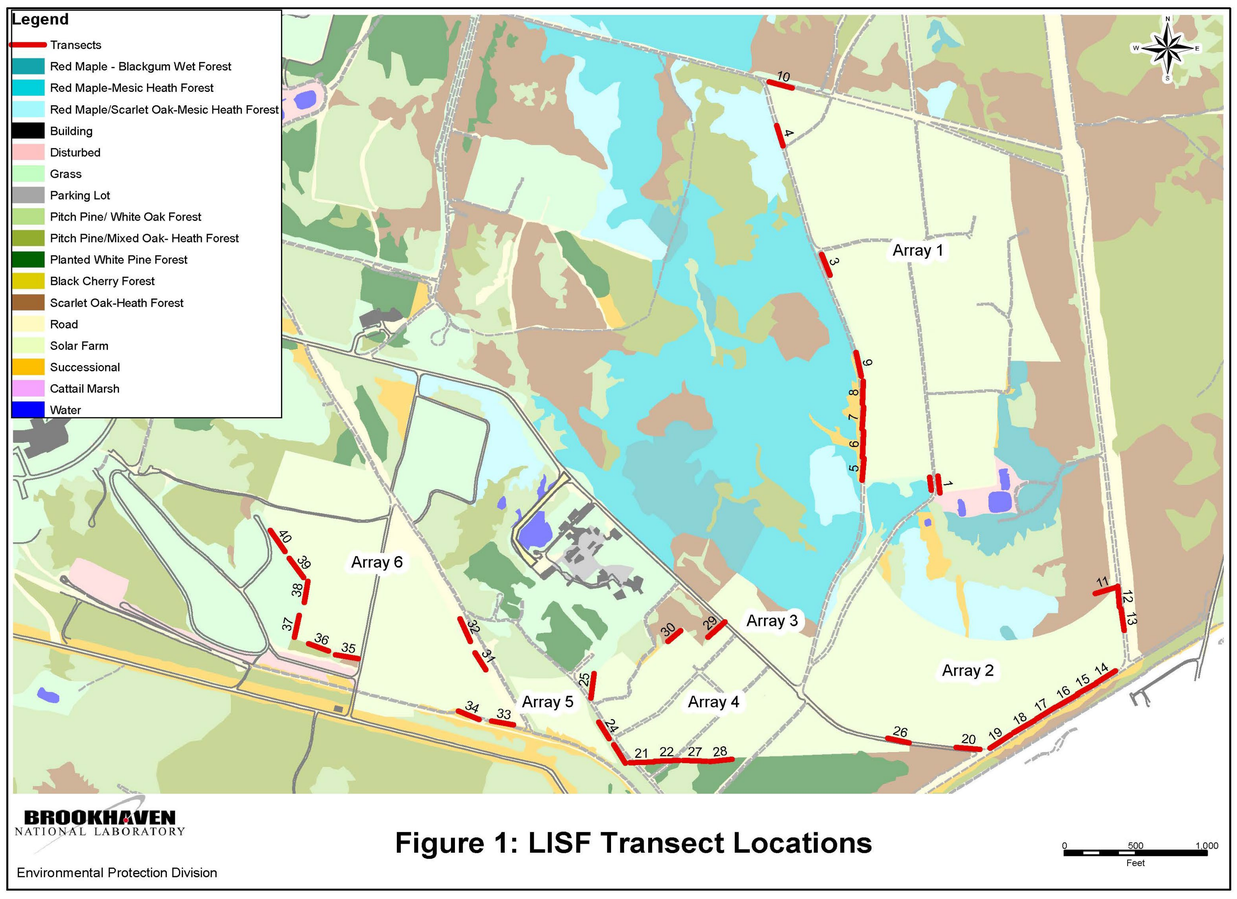
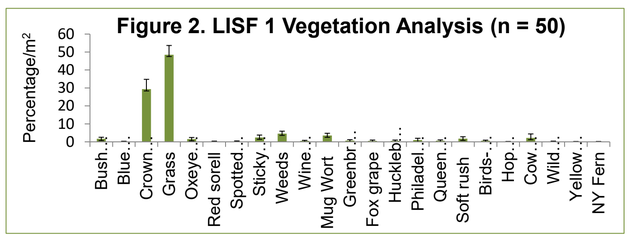
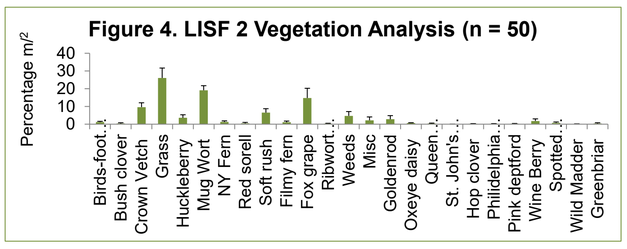
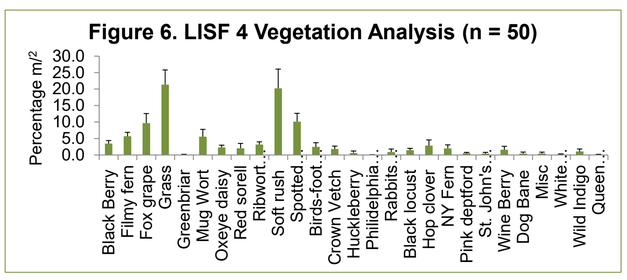


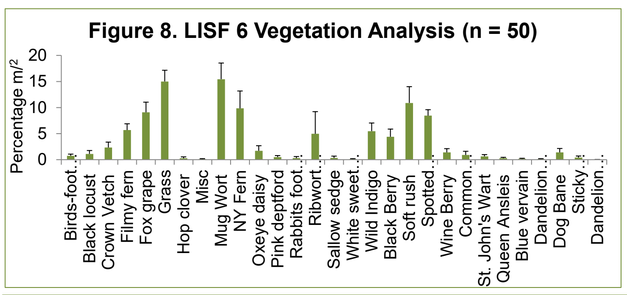
Figure 1: LISF Transect Locations

Solar Farm Inside

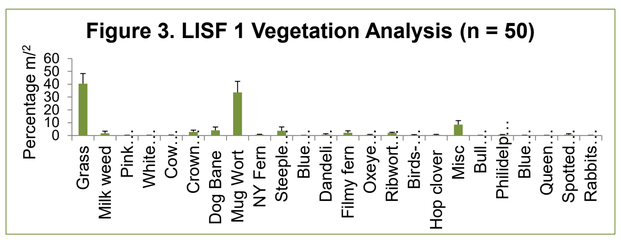


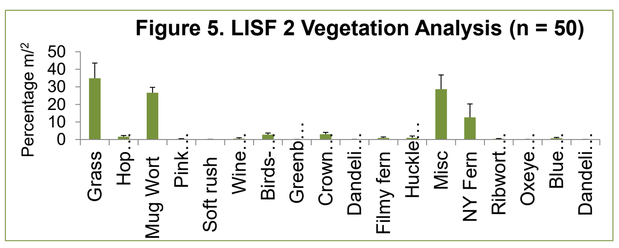


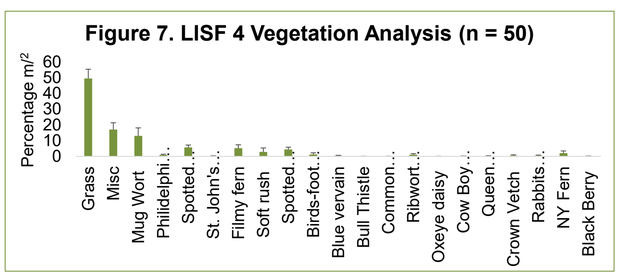


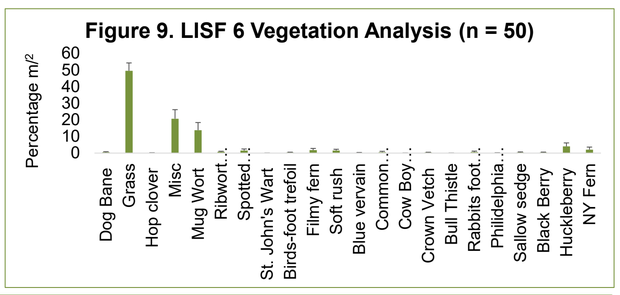


Solar Farm Outside



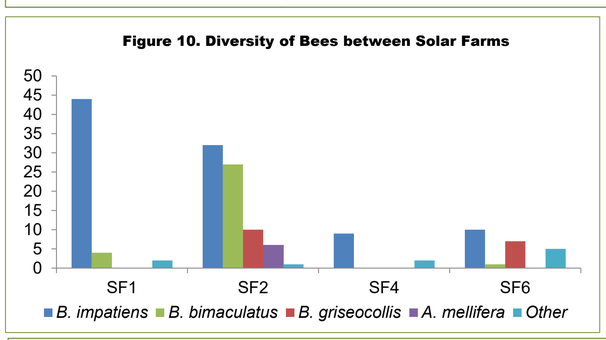


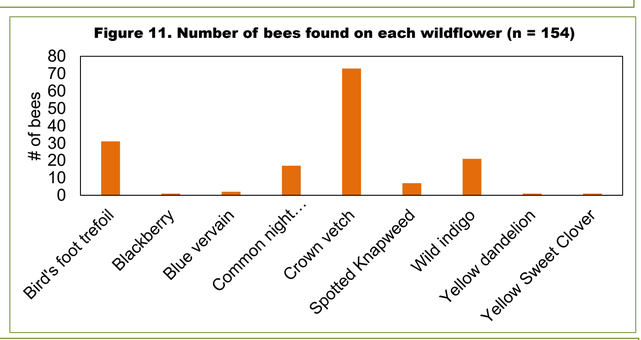




Discussion & Conclusion

This baseline study carried out at Brookhaven National Laboratory deals with management of natural vegetation and pollinators. Biodiversity depletion and the destruction of ecosystems and the services they provide are key concerns modern society must address. Solar farms have the potential to increase pollinator activity through providing wildlife habitats, reassuring the presence of species which have great conservation value and reinforce the ecological system with environmental and economic benefits. To assimilate the influence of large scale solar facilities on wildlife and the ecosystems of habitation is essential. The increasingly diverse makeup of vegetation supports increased pollinator activity in addition to providing and preserving a habitat for bees. This research supports that there is a difference in the diversity of vegetation and the frequency of bees visiting flowers, based on results from inside the solar facility in comparison to outside. In conclusion based on statistical analysis crown vetch was the most frequently visited flower by bumble bees, followed by birds-foot trefoil.





References

1. McGinnis, Michael Vincent . *Science and Sensibility: Negotiating an Ecology of Place*. Oakland: Univ of California Press, 2016
2. Walston, L J, et al. “Examining the Potential for Agricultural Benefits from Pollinator Habitat at Solar Facilities in the United States.” *Environmental Science & Technology.*, U.S. National Library of Medicine, 3 July 2018.

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