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Spatial Ecology of Lowbush Blueberry Pollination in Brunswick, Maine

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Ecological dynamics can vary greatly across the landscape of an ecosystem. A spatial perspective is promising to be critical in our stewardship of ecosystems involving pollinators, a stewardship which is highly needed due to the worldwide decrease in the abundance and diversity of pollinators on which our food supply and global ecology depend.[1] For example, because forests offer ground nesting sites and unique floral resources,[3,5,6] researchers have found that there are more small bees,[2,3] more species of bees,[4,5,6] and more total bees[2,4,5] closer to forest edges and in sites with greater amounts of forest area.[7,8] While there is strong evidence that pollinator populations are influenced by proximity to forest edge, the spatial patterns of levels of pollination (in terms of pollen transfer, fruit development, etc.) in relation to forest edge are less studied and less agreed upon.[6,9] The location of managed honey bee hives is another spatial factor potentially impacting the spatial distribution of pollination in need of study. While honeybees are known to reduce the efficacy of wild pollinators by competing with them,[10] fruit development has also been found to decline with increasing distance from honey bee hives.[11] Even fewer studies[12] have examined the combined influence that the location of managed honeybee hives and the location of forests may have on pollination patterns across space.

This summer, we investigated the impact of forest adjacency on crop pollinator population composition while focusing on the understudied dimension of actual pollination success and the added influence of honeybees. We specifically studied the spatial ecology of pollination of wild lowbush blueberry ecosystems (called "blueberry barrens") in Brunswick, Maine. Blueberry is a helpful crop on which to focus because it is a unique part of Maine's economy and because its complete reliance on pollinators for fertilization make its fruit development a good indicator of pollination. Preexisting studies of lowbush blueberry spatial ecology are similar to the broader literature on pollination spatial ecology in their focus on pollinator populations in blueberry fields[2,4] rather than on fruit development after pollination and the impact of honeybees[13] in those fields. They also tend to focus on commercial blueberry fields rather than wild blueberry barrens. Filling these knowledge gaps will inform future approaches to blueberry agriculture[14] and ecology in the face of increasing deforestation[8] and honeybee introduction.[10]

We researched these questions of lowbush blueberry spatial ecology in two blueberry barrens. Both had substantial forest edge to the north, and one had managed honeybee hives located on its south edge. In order to answer the subject of spatial variation of pollinator population composition in relation to both forest and honeybee hives, we observed blueberry pollinators as we walked across each blueberry barren in North-South paths (called "transects"). When we came across an insect appearing to draw nectar from a flower, to our best ability we captured the insect with a net in order to photograph it for later identification, recorded the type of plant the insect was pollinating, and then we marked the location of the insect along the transect with a GPS. The reason we chose to record insects pollinating any type of flower rather than just blueberry flowers was because the insects that pollinate blueberry flowers also rely on other types of flowers for resources, so observing those flowers will give us greater understanding of the different ecological relationships that impact blueberry pollination.[12] In the end, this left us with 300 pollinator observations.

To answer the question of spatial variation of blueberry development in relation to forest and honeybee hives, we selected around 30 spots spreads across each blueberry barren in which we carefully followed blueberry development. At each spot at the beginning of the summer, we counted the number of unopened flower buds of blueberry stems in that spot and then covered those buds with a mesh bag in order to be able to control the time at which the flowers would be able to be accessed by pollinators. We then removed the bags from the blueberry stems (all except one stem which we left as a control) once we were ready to begin walking the transects to observe the pollinators. During this time, we also photographed 1 square meter of the blueberry barren ground cover at 30-meter intervals along each transect so that we could later determine whether the openness of flowers varied spatially at a given time. Once all the blueberry flowers had died (mid-June 2021), we covered all the stems with bags again so that birds could not eat the blueberries as they developed. Once most berries had developed (end of July 2021), we brought the blueberries on each stem to the lab and we counted the number of turning and green berries and the number and weight of ripe berries. We also have plans to count the number of viable seeds present in a subset of the ripe berries because this will give us insight into the success of pollination. Currently, we are working on analyzing all the data we have collected to determine if the compositions of the pollinator populations and the blueberry fruit development are significantly impacted by proximity to forest edge and/or honeybee hives.

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