Reynolda Campus: Possible Pollination Sites

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Introduction

Pollination is an important process that allows plant life to both thrive and proliferate. As with most ecological processes, research has suggested that climate change poses a significant threat to pollination health, especially in areas experiencing homogenization and fragmentation of landscapes. (Vasiliev, Greenwood, 2021) Though effort has been made to ensure that development, planning, and construction of the Wake Forest University campus minimizes the negative effects of homogenization and fragmentation, there still remains a compelling case to determine where the campus could improve in providing pollination services in face of both a changing climate and further development of university property. Using data from Survey123, this report aims to determine where pollinator habitats currently exist using specifically-manicured flower beds throughout campus. Additionally, this report aims to tackle which land on campus could be ideal for pollination service growth, using image classification tools as well as digital elevation models.

Methodology

First, a survey was created using Survey123 in order to collect data on pre-existing flower beds on campus. All data using this survey was collected by myself, in the months of March and April. The survey asked the user to draw a polygon of the flower bed, determine which species of flower was in the flower bed using iNaturalist to aid in identification, make a rough estimation of how many flowers are in the flower bed, and an option to take a picture of the flower bed. It is important to note that in some instances, the flowers in the bed were unable to be identified or there may have not been a dominant flower species. In ArcGIS Pro, 4-band satellite imagery from the North Carolina Orthoimagery program from 2022 was used to display a satellite image of Wake Forest University's Reynolda Campus. (NC DIT, 2022) Additionally, a polygon layer was created to analyze "obstacles" or impediments that would make an area unfeasible for a flower bed, such as a road on-campus that was built a couple of months after the satellite imagery was produced or areas that have proven difficult for plant life due to persistent disease or poor soil conditions. (WFU Campus Tree Advisory Committee, 2025) Prior to classification, the imagery was merged and was run through the segmentation tool in order to

make classification run a little smoother. For classification, classes were used: greenspace and developed areas, such as buildings, parking lots, and roads. Binary choices for classes were used for ease of processing and analysis. The classification method used was a support vector machine.

After the image classification was run, manual reclassification was done within the study bounds to correct certain errors or oversights that the classification program had done. From here, both classes were extracted into respective raster layers which were then converted into polygon layers. Using ModelBuilder, these resulting layers were processed using the Distance Accumulation Tool to find individual distances from areas of development and the aforementioned obstacles. These raster layers were then converted from floating point to integers, and the extract by attribute tool was used to isolate areas of each distance accumulation raster where pixel values were greater than or equal to 15. Concurrently, a digital elevation model was used to determine areas of stormwater and runoff flow in order to take into account areas where water may gather and flood as a result of storms. (USGS Gap Analysis Project, 2011) The extract by attribute tool was also used to isolate higher areas of elevation, by extracting values greater than 270 meters, or around 885 feet. This layer was also converted to a polygon layer post-attribute extraction.

After these three past layers were extracted, they were once again converted into polygon layers in order to determine which sites were able to be reasonably used for new flower beds. The distance from obstacle layer and the distance from developed area layers were inputted into the pairwise intersect tool to essentially combine the purpose of the two layers, and the resulting intersect layer was run through the pairwise intersect tool once more with the extracted digital elevation data to determine which sites on the Reynolda Campus were far enough away from obstacles, developed areas, and out of the way of floodwater collection. This resulting layer was run through the piecewise intersect layer for the final time alongside a survey bounds layer, to ensure that only the sites within campus and the survey boundary were displayed. The map layout was compiled using these layers. Further features were added to the map for context, specifically in local geography.

Results & Discussion

The final map suggests that the possible sites for future flowerbeds include Poteat Field, Davis Field, Hearn Plaza, the area behind Martin Residence Hall, quad areas in between South Campus Residence Halls, and the quad area between ZSR Library and Salem Hall. Additionally, flowers could be planted intermittently throughout wooded areas on campus. This being said,

there are some glaring issues with these possible sites, especially in regards to use. Hearn Plaza, commonly known as the Quad, is a significant site to Wake Forest and faces significant use and therefore should not be considered as a possible site. Though less “culturally” significant, Poteat Field also faces significant use and may not be entirely suitable. This being said though, the outer areas of the field especially towards the parking lot and Carroll Weathers Dr. could be a site for consideration as these areas face less immediate foot traffic and are not used for recreational purposes. The area around Martin Residence Hall could be another prime area for future pollination sites and flower beds, especially given the building’s age and status should renovations occur to the building in the upcoming years.

During the processing method, a polygon layer had to be introduced to add a rough depiction of the Wake Forest Rd. extension through Davis Field due to the construction of it shortly after the satellite imagery for image classification was used. The analysis suggests that flower beds and pollination sites could be built roughly adjacent to the road, though extension onto Davis Field itself may not be feasible due to recreational use as well as elevation and potential runoff drainage issues. In a similar location to Davis Field and in a similar sense to Martin, upcoming renovations on the Scales Fine Arts Center could also include pollination sites as the area adjacent to it seems to be suitable for their construction. Greenspace adjacent to the South Campus Residence Halls could also be prospective sites, though quad areas between them generally would not be an ideal site due to community use.

Additionally, the analysis suggests that some wooded areas on campus could serve as possible sites. During the data collection and surveying process, “intermittent” was used to denote these areas as they were relatively large swaths of land with similar species to those in our current flower beds which likely spread into these areas due to seed dispersal, either by wind or animals. These areas did not seem specifically maintained, and they intermittently had bunches of flowers throughout them. It could be worth giving more specific attention to these areas or further facilitating dispersal of seeds into these areas, as long as it is not to an extent which threatens existing plant life in these areas.

Limitations & Further Research

One thing to note about this analysis is that it takes into account specifically manicured flower beds on campus, and does not necessarily have a complete view of pollination sites. Flowering trees and bushes serve as numerous and important pollination sites on campus, however, taking data collection on every flowing tree and every flowering bush on campus would not have been feasible for a one-person crew nor the given time frame of one semester.

This could be a possible jumping off point for future research in order to get a picture of how current campus pollination sites look, past the flower beds that this analysis looks at.

Seasonal trends may have had some impact on the analysis and data collection, as well. Seasonal constrictions with flower blooming and inconsistent weather in March during the data collection period may have resulted in a missed flower bed here and there. This being said, though, data was collected throughout the entire month and into early April and as such the analysis should contain most of the flower beds on campus. In a similar fashion, the satellite imagery used for the image classification was taken in early 2022 judging from the status of campus construction projects, when most of the plant life in the imagery had gone dormant for the winter. This may have had an impact on the image classification product due to conflicting or inconsistent pixel colors. Future research around this topic could be done at a more opportune time for data collection. The North Carolina Orthoimagery website suggests that satellite imagery for the area will be updated again in 2026, and should this imagery be taken in the spring or summertime, could be used to create a better image classification model.

During the planning process of this analysis, using the Sun Shadow Frequency tool in ArcGIS Pro was considered with the aim of incorporating sunlight and shade availability from building shadows into the analysis. However, this tool would require updated 3D Modeling data for buildings on campus, which does not yet exist. The USGS 3DEP LidarExplorer suggests that lidar point cloud data exists for the general area, though is from 2017 and would not include recent construction projects on campus that have occurred in the past eight years. This is an important factor in determining where flower beds could be put, and this analysis would stand to benefit from its inclusion in the future once the required data is available.

Though outside the scope of this analysis, a majority of the flower bed polygons have metadata attached to them regarding the amount of flowers and what species exist in each respective bed. This data could be used in the future to determine where we have certain flowers, such as perennials and annuals, in order to see what seasonal differences might exist in the seasonal availability of pollination sites. Additionally, quantitative spatial data such as acreage of total flower beds could be gathered from the flower bed data and supplemented with pre-existing but non-spatial numerical data regarding flowers on campus.

Conclusion

Maintaining pollination sites and pollination pathways on-campus is an important consideration given both the planned development of campus and future impacts from climate change. Using Survey123, image classification, distance accumulation models, and digital

elevation models, this report analyzed where future areas on-campus for the construction of pollination sites and flower beds could reasonably and feasibly exist. The main areas found were around Poteat Field, Martin Residence Hall, Davis Field, and the Scales Fine Arts Center. Further research around this topic could take into consideration the presence of other pollination sites like flowering trees or bushes, seasonal differences, and other analyses that focus on connecting spatial data that was collected in this report with pre-existing nonspatial data.

Sources

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