12-3-2013

Geo 585 Field Methods: Edge Effects [in the Gordon Natural Area]

Matthew Long
West Chester University of Pennsylvania

James Gregory
West Chester University of Pennsylvania

Timothy Snow
West Chester University of Pennsylvania

Geo 585 Field Methods

12/3/2013

Edge Effects

Matthew Long, James Gregory, Timothy Snow

Abstract

The Gordon Natural Area (GNA) is located on the South Campus portion of West Chester University (WVU). It is a preservation area with the principals and ideals to keep the natural environment intact so that the GNA can sustain the vitality and stability that it currently provides for the many species of plant and animal life that inhabit it. Recently the Pennsylvania Electric Company (PECO) came through and greatly expanded the clearings that are around the utility lines that run through the GNA. This was counter to the original relationship that PECO had with WCU as they did not disrupt a large portion of the overstory or understory.

The purpose of this project is to establish a baseline inventory of the woody plant life in the GNA and answer the questions of; ***what is the composition and structure of woody plants in and near the areas recently cleared for the utility pole maintenance? To what extent are these areas inhabited by invasive species? Given the current woody composition and structure of these areas, how might the forest change over time as a result of this fragmentation?*** There has been no baseline established as to the composition and structure of the GNA, so it is hard to say what invasive plant life will be able to inhabit the area because of the loss of canopy cover from the overstory and young growth of the understory. Using the principals of field method techniques, we will be able to establish a baseline of what the current woody plant life and structure a study area of the fragmented forest.

Introduction

The Gordon Natural Area located on south campus at West Chester University. As stated on the GNA's website, one of the principals of the GNA is to have an area preserved so as to have very minimal human activity. Forest fragmentation as discussed in Fahrig is "a large expanse of habitat is transformed into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original" (Fahrig 2013). Forest fragmentation has a quantitative conceptualization in the idea it has four effects, Fahrig discusses: (*a*) reduction in habitat amount, (*b*) increase in number of habitat patches, (*c*) decrease in sizes of habitat patches, and (*d*) increase in isolation of patches (Fahrig 2013). Fahrig continues to discuss that these four are the four form the main basis but forest fragmentation varies widely and some include only one effect, whereas other include two or three effect but not all four.

Studies and reviews describe the existence of both primary and secondary responses to the forest edge creation (Magrach 2013), known as "edge effects". Primary responses are direct consequences of edge creation (e.g. damage to trees and microclimatic, physical, or biogeochemical changes) (Magrach 2013). Secondary responses include alterations on the growth mortality or

reproduction of forest-dwelling organisms (Magrach 2013). The fragmentation of once continuous habitats is one of the key threats to global biodiversity (Reino, Beja, Arujo, Dray, Segurado 2013). Fahrig also supports this (Fahrig 2013):

> "Habitat loss has large, consistently negative effects on biodiversity, so researchers who conceptualize and measure fragmentation as equivalent to habitat loss typically conclude that fragmentation has large negative effects. The negative effects of habitat loss apply not only to direct measures of biodiversity such as species richness, population abundance and distribution and genetic diversity, but also to indirect measures of biodiversity."

With the literature reviewed the study will take into consideration the fragmentation of the GNA and what edge effects may be present. With the establishment of the baseline from the study area in the GNA, the continued cataloging of the fragmentation effects in the GNA can be quantified if an increase of invasive species becomes evident. With the study period being during the late fall season the vegetation growth was minimal to determine what invasive species have or will inhabit the GNA. With the baseline that is created in the study area, a composition of the overstory and understory can be kept to determine the future growth of different woody species because of soil and sunlight tolerance and the transfer of seeds and pollen. Harper discusses the direct effects of edge creation, "Direct effects of edge creation include (1) physical disturbance of vegetation and soil, (2) abiotic environmental gradient changes in attributes such as light, wind, and moisture, and (3) increased access for organisms, material (pollen, seeds, pollutants) and energy: (Harper et al. 2005)

All three of the direct effects that Harper has brought attention to, could be possible affects to the fragmented area in the GNA because of the clearing of woody species around the power lines that run the GNA. We will discuss in detail the methods used to determine the baseline for this study, so as future studies can show empirical evidence whether or not the fragmented study area is going to be affected.

Methods

In coordination with a staff member of West Chester University Dr. Hertel, we established 15 10x10 m^2 plots in a grid format, as shown in Figure 1. With direction from Dr. Hertel, the plots central point is where the forest fragmentation occurred with PECO clearing the trees and vegetation around the power lines that run through the GNA. In each 10x10 m^2 plot we recorded the latitude and longitude of each tree that we inventoried as part of our baseline.

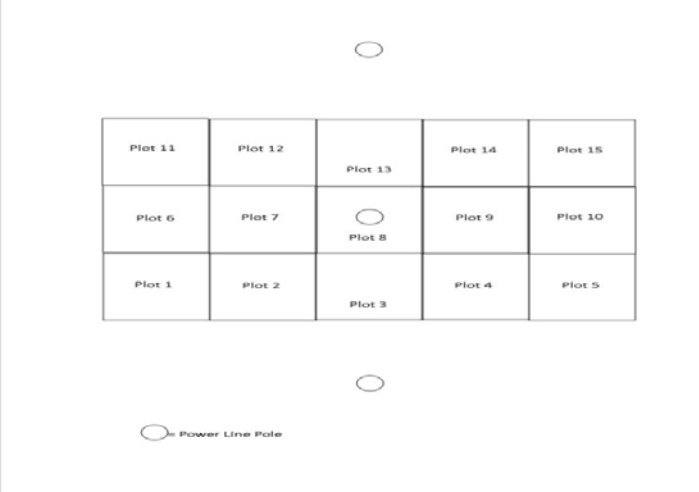

Figure 1

The attribution for each species of any woody plant life was whether the species was alive or dead and what the DBH of the cataloged species was. This will allow for the creation of a baseline of the current species that inhabit the area. Materials used for the field work included a GPS receiver, DBH measuring tape and note recorder. We sampled all species that were in the study area not excluding any particular species. Because of the clearing of the plots immediately adjacent to the power lines, we also accounted for the stumps of trees that were cut down and limbs of those that were left standing. This was accounted for to determine the overall human impact to the baseline that was created.

The late fall season made it rather difficult to determine the vegetation cover of the ground floor of the study area, therefore making it difficult to determine if there was the presence of any invasive species at this time. Also, there were wooden pallets placed along the center of the study area that did not allow for any vegetation growth.

Results

The results of our baseline study area was a wide variety of species, this is summarized in Figure 2. Along with the species, DBH for each tree inventoried showed a vast range in size with the smallest wooded species at 1.1 cm (spice bush) in diameter and 83.1 cm (tulip poplar) in diameter for the largest. There was only one recorded tree to be dead, and 6 trees were cut down to stumps. Given the fall season, no new vegetation was growing in the newly fragmented areas, when the spring season returns and the new fragmented areas are exposed to the change in temperature, sunlight and precipitation; a change in the woody species may start to occur. This may cause the growth of non-native invasive species to inhabit the GNA and affect the other species of trees unless a management program is adopted for the area.

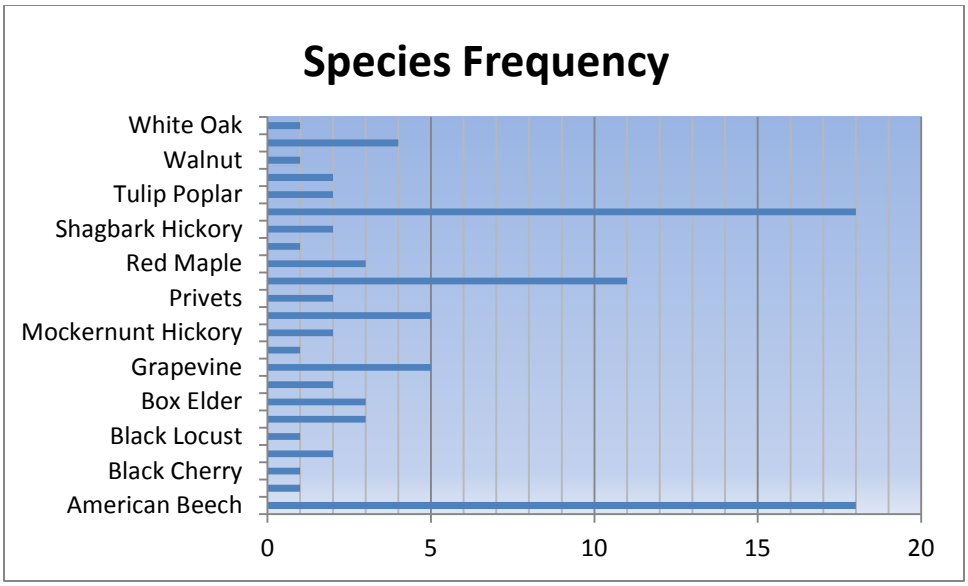

Figure 2

Discussion

A few trees were totally removed creating space in the canopy for possible invasive species to enter the study area, thus the fragmented area in the GNA will have a change in soil moister and the amount of sunlight that will be able to reach the trees throughout the edge effected area. The woody composition of the cleared areas by PECO has a variety of wooded species, allowing for biodiversity being abundant in the study area. Though, "Habitat loss has large, consistently negative effects on biodiversity, so researchers who conceptualize and measure fragmentation as equivalent to habitat loss typically conclude that fragmentation has large negative effects (Fahrig 2013).

Because of the recent removal of the trees and placement of the wooden pallets, in conjunction with the fall season, there was very little vegetation growth that had occurred in the study area. The continuation of this baseline study in the spring season, when ground vegetation returns, will allow for a categorical conceptualization of the current and possible invasive species that could inhabit the GNA in the future. Because of the clearing of plots 3, 8, and 13 where the power line runs directly through, a vast fragmentation has been introduced to not only the study area of the GNA. This will allow for more direct sunlight and increased precipitation to reach the forest floor, effectively changing the soil composition.

Further study questions for this study area could be to determine the long term effects of trees that will continue to be cut back because of the desired accessibility of PECO to its power lines that run through the GNA. Coordination with PECO to determine if this is a best practice given the effects that this this fragmentation will have on the GNA and the introduction of edge effects as well. A culmination

of efforts to determine the ramification of this new clearing method could produce a better clearing method for PECO power lines in the future.

Conclusion

The establishment of a baseline through this study was vital to track the changes on the GNA that will occur because of the forest fragmentation and to provide more empirical evidence for edge effect studies. We found that there was a great human impact that occurred in the GNA, contrary to the ideals and principals of the creation of the GNA. PECO historically would only clear a little area around the power lines that run through the GNA, but that was not the case this time with entire trees being removed and more cut back. Because of the vast clearings that now exist in the GNA, a management program should be considered to manage soil runoff and erosion to the now exposed areas. To re-establish the root system of the study area would bring stability to the soil in large rainfall events. Also, this would allow you to introduce non-invasive and native wooded species to the area to prevent a lack of biodiversity from any invasive species that could consume the study area.

As discussed in Harper, 'The influence of the adjacent nonforest environment on forest structure and species composition at created edges is now widely recognized' (Harper et al 2005). This is an empirical study that can be supported for further research in the GNA and would be a good reaffirmation to the principal of the GNA, to have an area that has little human activity other than the preservation and sustaining of its natural state.

References:

Fahrig, L. 2003. Effects of Habitat Fragmentation on Biodiversity. Annual Review of Ecology, Evolution, and Systematics. 34: 487-515

Reino, Luis, Pedro Beja, Miguel B. Araujo, Stephane Dray, and Pedro Segurado. 2013. Does Local Habitat Fragmentation Affect Large-scale Distributions? The Case of a Specialist Grassland Bird. *Biodiversity Research* 19: 423-432.

Magrach, Ainhoa, Luis Santamaria, and Asier R. Larrinaga. 2013. Forest edges show contrasting effects on austral mistletoe due to differences in pollination and seed dispersal. *Journal of Ecology* 101 : 713-721.

Harper, A. K. Ellen, S. E. Macdonald, P. J. Burton, J. Chen, K. D. Brosofske, S. C. Saunders, E. S. Euskirchen, D. Roberts, M. S. Jaiteh, and P. Esseen. 2005. Edge Influence on Forest Structure and Composition in Fragmented Landscapes. Conservation Biology. 19(3):768-782

Acknowledgment:

Dr. Gerard Hertel, West Chester University Adjunct Professor