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Forest Ecology: Point Pleasant Park Field Project

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On September 28, 2003, Hurricane Juan made landfall near Halifax, Nova Scotia, devastating the city's coastal urban forest. This recent ecological disturbance presented a unique opportunity to evaluate the effects of disturbance and document the physical and biological changes in the community over time. Six permanent plots were established throughout the park in 2004. In successive years, students visit the plots to measure tree diameter, estimate the percent cover of ground vegetation and make qualitative observations of the physical surroundings. The data is then used to reconstruct the pre-disturbance forest and assess regeneration in different areas of the park.

Keywords: Forest Ecology, Succession, Disturbance

Introduction

Background

Severe windstorms have been shown to significantly alter forest dynamics by removing vegetation and disturbing the soil (Foster and Boose 1992, Roberts 2004). The two most important stand-replacing disturbances in Atlantic Canada are hurricanes and insect damage. Historically, these types of catastrophic disturbances have been infrequent with the majority of the natural disturbances in the region only creating small gaps in the forest (Mosseler et al. 2003). However, the frequency and intensity of hurricanes has been increasing in the North Atlantic since the 1970s and is predicted to increase with global warming (IPCC 2007).

Point Pleasant Park is a 185 acre urban forest located on a promontory jutting into the Atlantic Ocean at the eastern end of the Halifax peninsula, in Nova Scotia, Canada (HRM 2008). The park is bounded by the ocean on all sides except its northern boundary which is residential (Jotcham et al. 1992). Historically, the park was primarily a military bastion and much of the Park was cleared for settlement and lines of fire. As the military presence dwindled, the park was increasingly used for recreation and in 1866 was leased to the Commission for a Public Park which undertook extensive reforestation of mainly native and some ornamental species (HRM 2008). Until 2003, the park was dominated by long-lived tree species such as red spruce (*Picea rubens*) and white pine (*Pinus strobus*) interspersed with red maple (*Acer rubrum*), balsam fir (*Abies balsamea*) and white birch (*Betula papyrifera*) (Jotcham et al. 1992; Neily et al. 2004), typical of mixed wood Acadian forests (Mosseler et al. 2003). The forest stand structure was primarily even aged with very little understory which combined with its small size and isolation rendered it highly vulnerable to catastrophic windfall damage (Jotcham et al. 1992). In 2003, Hurricane Juan, a category two hurricane on the Saffir-Simpson wind scale, made landfall on the eastern shore of Nova Scotia removing over 70% of the tree canopy in Point Pleasant Park (Burley et al. 2008).

Forest regeneration after disturbance is called succession, which is defined as the gradual change in the community of an area following a disturbance (Molles and Cahill 2008). Succession usually follows a set sequence which heavily depends on the soil quality and seed banks within the disturbed area or areas surrounding the disturbance (Burley et al. 2008 and references therein). Vegetation plays an important role in regulating hydrological, energy and nutrient regimes in a forest (Molles and Cahill 2008). The ecosystem level impacts of the extensive blowdown and removal of the majority of downed trees and woody debris (as a method to reduce fire risk) in Point Pleasant Park on the regulating functions of the forest are likely to have been severe. The topography, geology and soil composition of the park is variable (Jotcham et al. 1992, Neily et al. 2004), as was the impact of the Hurricane and associated clean up leaving a mosaic of landscape patches with very different physical and biological characteristics (Burley et al. 2008).

Exercise Details

This exercise is directed at students taking an introductory ecology course. The objectives of the field survey are to introduce students to field data collection methods, teach them about local plant species and their identification, examine the effects of disturbance on a forest community and identify the physical and biological processes that affect the different forest plots. For their report, students will attempt to reconstruct the forest as it existed before the hurricane and discuss the mechanisms of succession that are important for regeneration. This exercise is very simple to set up. With the exception of locating appropriate study sites, buying the 30

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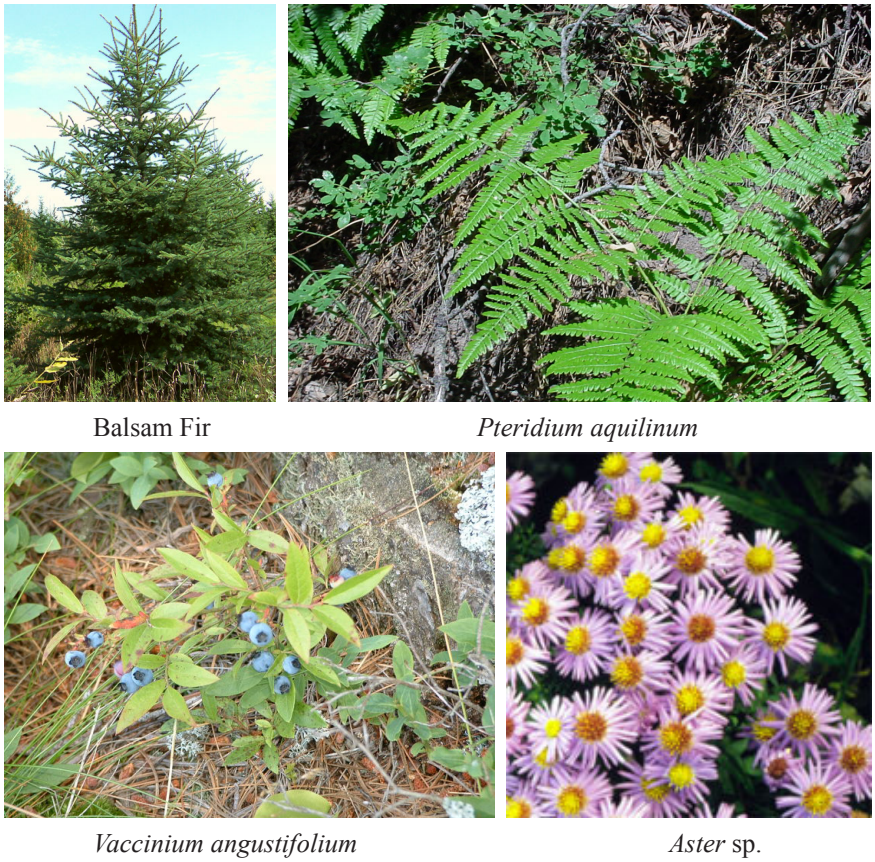
m measuring tapes and building the four wooden quadrats all of the set up is done in the field. In addition, putting together an identification guide of the plants the students will likely encounter will help the students to identify them on their own in the field. Examples of vegetation in the sample plot is shown in Figure 1.

Upon arrival at the site, 4 students are chosen to lay out the measuring tapes that delineate the 20 x 20 m plot where the data will be collected. The students are then divided into five groups. The first group (two students) is responsible for collecting a detailed site description that includes general physical (slope, elevation, exposure, etc.) and biological (wildlife activity, leaf litter extent, percentage of softwoods vs. hardwoods, proximity of seed sources, etc.) features of the study area. The second group (2-3 students) is responsible for identifying and measuring the diameter of all the living and dead (standing and stumps) trees that have a diameter at breast height (DBH ~ 1.3 m above the ground) ≥ 2.5 cm found within the plot. Finally, the last three groups (3 + students per group) are responsible for estimating the three - dimensional percent cover of each species of the ground vegetation found within 10 - 1 m^2 quadrats. The quadrats are located haphazardly within the 400 m^2 plot by throwing a brightly colored item blindly into the plot. Our role as the instructor is to help with the identification of vegetation and tree species and discuss some of the life and natural history characteristics (annual, perennial, early colonizer, medicinal herb, etc.) of the species and guide the students conducting the site description to ensure they get the most relevant and detailed information. The field data collection takes ~ 1 – 1.5 hours (including set up and take down).

The data for each site is collated individually and students from each lab period are given data from two different plots (one they collected and another that was collected by a different lab group) to compare in their field report. The report is divided into two exercises. In the first exercise, the students are asked to summarize their data separately for both sites using a verbal site description and tables and figures. In the second exercise, the students are expected to explore and interpret their data and observations by reconstructing and comparing the pre-disturbance state of each plot, comparing the current state of the vegetation between plots and extrapolating their findings into the future in the context of forest succession, as well as discuss the role of disturbance in shaping communities and influencing biodiversity.



Balsam Fir | *Pteridium aquilinum*

Vaccinium angustifolium | *Aster* sp.

Figure 1. Representative vegetation from study plots (Credits: http://www.lrfd.ca/christmas (top left), http://www.wnmu.edu/academic/nspages/gilaflora/pteridium_aquilinum.html, Russ Kleinman & Adela Lente, Pinos Altos Range, Little Cherry Creek Ranch Road, June 27, 2007(top right); http://rslandscapedesign2.blogspot.com/2010/09/vaccinium.html (bottom left).

Student Handout

Forest Ecology: Point Pleasant Park Field Project

Background

Five years ago on September 28-29, 2003, Hurricane Juan made landfall near Halifax removing over 70% of the tree canopy in the Park resulting in a dramatically altered landscape. The devastation was so severe that the park was closed to visitors for eight months for clean-up efforts (removal of blow-downs and weakly rooted trees), until the following June when it was deemed safe for public use.

Objectives

This recent ecological disturbance in a well-established and formerly protected forested area presents a unique opportunity to study and evaluate the effects of disturbance as well as to document physical and biological changes in the community over time in terms of qualitative description and quantitative measurement.

The students will collect information at six 20 x 20 m study plots. At these sites they will attempt to determine the current forest composition and "reconstruct" the pre-Juan situation using tree stumps and other artifacts.

In the Field

Your "lab" this week will be held in Point Pleasant Park, on the tip of the Halifax city peninsula. We will **meet at the study site** in Point Pleasant Park on **your regular lab day and time**. For details on the trip (maps, etc.), AND information on any changes OR **last-minute announcements,** check the class website. Each lab will be divided into teams on site.

- Team 1 (2 students): Responsible for collecting a detailed site description that includes general physical (slope, elevation, exposure, etc.) and biological (wildlife activity, leaf litter extent, percentage of softwoods vs. hardwoods, proximity of seed sources, etc.) features of the study area.

- Team 2 (2-3 students): Responsible for identifying and measuring the diameter of all the living and dead (standing and stumps) trees that have a diameter at breast height (DBH ~ 1.3 m above the ground) ≥ 2.5 cm found within the plot.

- Teams 3-5 (3+ students): Responsible for estimating the three - dimensional percent cover of each species of the ground vegetation found within 10 - 1 m^2 quadrats. The quadrats are located haphazardly within the 400 m^2 plot by throwing a brightly colored item blindly into the plot.

Report

You will be provided with copies of the data collected during the field trips. Based on the collected information and on your subsequent data analyses, you will be required to submit a 2-part field project report.

Exercise I: Site descriptions and data summary: Point Pleasant Park Field Project: Project report - Instructions and guidelines.

1. Write a detailed description for your site and the other site for which you have been given field data. Provide a physical and biological "picture", **incorporating summaries of all site characteristics and measurements taken**. Each written description should be about one page, double-spaced. In addition, include a map (hand-drawn sketch or picture) showing the location and orientation of BOTH sites within the park. You CANNOT use the map on the class website, you must make your own. Your plots must be drawn to scale on the map and the figure must include a scale bar.
2. Calculations of Total Basal Area: (Do for both sites). Calculate Total Basal Area values for (1) dead trees (stumps and standing) and for (2) living trees on the site. (You will need to calculate basal area for individual trees, then sum the measurements.) Give your Total Basal Area answers per m^2 (where the plot is 400 m^2). Summarize your findings in a table - DO NOT include calculations.
3. For the ground flora and shrubs, construct a "species accumulation curve" for each site. Accumulated species richness represents the number of new species added to the species pool as you increase the number of samples. Using a scatterplot, show the accumulated number of species in relation to the number of quadrats (cumulative area) sampled. Draw

a curve of best fit. See Part II Question 3 for more details on accumulations curves. Summarize your findings in a table - DO NOT include calculations.

4. In a histogram, present a distribution of tree diameters. Do this for both sites. Show stumps (dead trees) and living trees separately but IN THE SAME FIGURE. For this you will need to consider the range in diameter measurements and lump diameter classes (e.g. 0-10 cm, 10-20 cm) in increments that make sense and give the most informative "picture" of each forest plot.
5. Present one summary table of the average cover (across the 10 quadrats) of each ground flora and shrub species found in each of the two sites you are working with. You also want to include the total species richness and average species richness per m^2 ($\pm$ SD) for each site.
6. For the ground flora and shrubs, construct a "species accumulation curve" for each site. Accumulated species richness represents the number of new species added to the species pool as you increase the number of samples. Using a scatterplot, show the accumulated number of species in relation to the number of quadrats (cumulative area) sampled. Draw a curve of best fit. See Part II Question 3 for more details on accumulations curves.

Exercise II: Exploration / interpretation of the data and observations.

The following discussion questions are based on your "reconstruction" of the sites as they existed prior to the 2003 hurricane AND on the current status of these same sites. Make sure these time distinctions are clear in your report.

1. Consider the number of individual stumps counted and the associated basal area values (cross-sectional area of wood) for each of your study sites. Reconstruct the pre-disturbance forest in terms of average tree diameter, stem density, basal area per plot and any other pertinent measurements.
   a. Describe the forest stands as you think they existed prior to Hurricane Juan.
   b. How do the two sites differ? What characteristics associated with each particular site might explain these results.
2. Compare the ground vegetation and shrub inventory of the two sites on the basis of what species were present (or absent), richness (biodiversity) and average cover values.
   a. Were there characteristics associated with each particular site that might explain the findings there, as well as account for differences between the two sites? Discuss.
   b. In what ways might the ground cover data be different if there had not been a hurricane (or other significant disturbance)?
3. Consider the species accumulation curves: The curves should rise steeply at first because we expect to find new species in each of the first few quadrats, but as we sample more and more quadrats we should find that most of the species have already "shown up". As the curve continues over more and more quadrats, the slope should (nearly) level off.
   a. Describe the shape of your species accumulation curves in relation to what might be expected (as described above) and suggest reasons for any marked differences between the observed and expected shapes.
   b. Can you reasonably predict an upper limit to species richness (number of species) on the two sites based on your findings?
   c. Again, based on the shape of the curves, do you think 10 quadrats were adequate to assess the ground flora of the 20 m x 20 m sites?
4. Speculate on the potential for forest regeneration on the two study sites. (Use any supporting information collected during our field trips and at least 1 reference).
   a. Do you think that 15 years from now, there will be a forest similar to the pre-disturbance forest, except younger? What about 50 years from now? Explain and support your position. What role might the surviving trees play?
   b. Comment on physical or biological differences in the sites that might affect the composition of each regenerating forest.
5. Discuss the role of natural disturbance in shaping communities and influencing species richness, with particular reference to the pre- and post-hurricane situations in Point Pleasant Park (about 250 words, and use at least 2 references).

Materials

This lab is aimed at accommodating up to 25 students. Required materials include:

- Four - 30 m retractable measuring tapes which are used to delineate the 20 x 20 m forest plot.
- Four - 1 x 1 m collapsible wooden frames this makes them easier to carry but essentially they can be constructed out of any material. Only three frames are needed for the three groups but a fourth is always handy in case one is broken or lost.
- Two - 1 m long measuring tapes for the group measuring tree diameters
- Data sheets for each group
- Species identification guides for each group .The content will depend on what the students will see at the time of year that they collect the data.
- Digital camera (optional) to capture photos of the plots year after year as well as shots of the students working (and having fun!).

Sample Field Data Sheet

An example of a data sheet is shown at the bottom of the page.

Ground Flora

Students will fill out the percent cover for each species found in their quadrat. If they find a species not on the list it is identified and added to the bottom. Average percent cover per species and species richness and accumulation are calculated at home.

An example table in on the next page.

Forest Inventory

Students identify the trees and fill in the DBH. Basal area is then calculated at home. You can have as many sheets as needed. See page 133 for an example form.

Sample Field Data Sheets

Site Characteristics

Plot ID:	**Date:**	**Group Member Names:**			
Site cover	**%**	**Topography**	**[x]**	**Slope**	**[x]**
1. Rock outcrop		Level		North	
2. Moss carpet		Undulating		South	
3. Needle carpet		Rolling		East	
4. Leaf carpet		Hilly		West	
5. Herbaceous grass growth					
6. Organic debris		**Drainage**		**Elevation (m)**	
7. Residual hardwoods		Well drained			
8. Residual softwoods		Mod-drainage			
		Poorly Drained			

Site History
Here they would insert a description of the history of the particular site (e.g. was it cut, planted, used as a battlement)

Notes on regeneration
Here they would include a description of the overall pattern of regeneration in the particular plot.

Wildlife or evidence of wildlife
Here they describe if they see evidence of wildlife (scat, footprints) and why they may be in the plot (food, shelter).

General notes
Here they would describe anything that doesn't fall under any other category (e.g. proximity of seed sources for regenerating trees, condition of the trees and other vegetation)

Group Member Names: Plot ID: Date:

Collect ground cover and shrubs in 10, 1 m² sections		Percent cover in quadrat										
	Species or group	1	2	3	4	5	6	7	8	9	10	Avg.
1	Apple tree											
2	*Aster* spp.											
3	Balsam Fir - *Abies balsamea*											
4	Blueberry - *Vaccinium angustifolium*											
5	Bracken fern - *Pteridium aquilinium*											
6	Bristly sarsaparilla - *Aralia hispida*											
7	Bunchberry - *Cornus canadensis*											
8	Club mosses - *Lycopodium* spp.											
9	Common cinquefoil - *Potentilla simplex*											
10	Daisy											
11	False Holly - *Nemopanthus mucronata*											
12	Ferns (unidentified spp)											
13	Fungi											
14	Goldenrod - *Solidago* spp.											
15	Goldthread - *Coptis groenlandica*											
16	Grasses/sedges											
17	Hemlock tree - *Tsuga canadensis*											
18	Lichens											
19	Mayflower - *Epigaea repens*											
20	Mosses											
21	Mountain ash - *Sorbus americana*											
22	Norther Bush Honeysuckle - *Diervilla lonicera*											
23	Northern Wild Raisin - *Viburnum nudum*											
24	Partridgeberry - *Vacinium vitis-idaea*											
25	Pin Cherry - *Prunus pensylvanica*											
26	Raspberries/blackberries - *Rubus* spp.											
27	Red maple - *Acer rubrum*											
28	Red oak - *Quercus rubra*											
29	Red pine - *Pinus resinosa*											
30	Red spruce - *Picea rubens*											
31	Shadbush - *Amelanchie*r spp.											
32	Sheep laurel - *Kalmia angustfolia*											
33	Starflower - *Trientalis borealis*											
34	Sugar maple - *Acer saccharum*											
35	Sweet-fern - *Componia peregrina*											
36	Two-eyed berry - *Michella repens*											
37	*Viola* spp.											
38	White birch - *Betula papyrifera*											
39	White pine - *Pinus strobus*											
40	Wild lily of the valley - *Maianthemum canadense*											
41	Wild sarsaparilla - *Aralia nudicaulis*											
42	Wintergreen - *Gaultheris procumbens*											
43	Witherod - *Virburnum cassinoides*											
44	Yellow clintonia - *Clintonia borealis*											
	Species richness											
	Accumulated species richness											

Sample Forest Inventory

Group Member Names:

Plots ID: Plot Size: Date:

Tree Species	DBH (cm)	Basal Area (m^2)	Tree Species	DBH (cm)	Basal Area (m^2)
Red Maple	2.5				
Stump	76.5				

Notes for the Instructor

Although, this is focused on succession after damage caused by a hurricane, this could easily be adapted to any type of damage or even post-harvesting regeneration. It could also be adapted to compare forest tracts in different stages of maturity. If data is collected over many years students could analyze trends over time during laboratory sessions in the winter months when field trips may not be possible due to weather.

It is essential that everyone is prepared for the field trip. In our case it is a 1.5 to 2 km walk along maintained trails to the study sites. However, once at the plots the terrain is uneven with lots of woody debris and deadfalls, often with damp and slippery conditions underfoot. It is always necessary to emphasize the site conditions to the students so that they come with appropriate footwear (i.e. no sandals), clothing (i.e. rain gear, sweater, etc.), and supplies (i.e. water, sunscreen). The only time we cancel the field trip is if it is raining hard, or if the winds are potentially dangerous. Bringing extra supplies, a first aid kit and cell phone, are essential in case of an emergency, but are also important for minor injuries, such as scrapes, or preventing dehydration if a student needs water.

If you decide to bring a digital camera choose a location in a plot with a reference point that you can easily recognize year after year as the forest regenerates to be able to compare the growth over time using the images. This can be useful for the students as they write up assignments. They can also be used to make a poster to promote the class and its activities.

Literature Cited

Burley, S., Robinson, S.L., Lundholm, J.T. 2008. Post-hurricane vegetation recovery in an urban forest. *Land. Urban Plan.* 85, 111-122.

Foster, D.R., Boose, E.R., 1992. Patterns of forest damage from catastrophic wind in Central New England, USA. *Ecology* 80, 79–98.

Halifax Regional Municipality (HRM), 2008. Point Pleasant Park: A Symbol of Halifax. Retrieved November 26, 2009 from **http://www.pointpleasantpark.ca/en/home/education/aboutthepark.aspx**.

Intergovernmental Panel on Climate Change (IPCC), 2007. Climate change 2007: The physical science basis. *Contribution of working group I to the fourth assessment report of the Intergovernmental Panel on Climate Change*. University Press, Cambridge, UK.

Jotcham, J.R., Strong, K.W., Marvin, T.K., 1992. *An Ecological Survey of Point Pleasant Park.* Marbicon Inc., Maritime Testing Ltd., Halifax, Nova Scotia.

Molles, M.C., Cahill, J.F. 2008. *Ecology Concepts and Applications.* Canadian Edition. McGraw-Hill Ryerson. Toronto, Canada.

Mosseler, A., Lynds, J.A., Major, J.E., 2003. Old-growth forests of the Acadian forest region. *Environ. Rev*. 11 (Suppl. 1), S47–S77.

Neily, P., Keys, K., Quigley, E., 2004. *Forest Ecosystems of Point Pleasant Park.* Ecosystem Management Group. Nova Scotia Department of Natural Resources, Truro, Nova Scotia.

Roberts, M.R., 2004. Response of the herbaceous layer to natural disturbance in North American forests. *Can. J. Bot.* 82, 1273–1283.

About the Authors

Allison L. Schmidt is currently completing her PhD in Marine Community Ecology while working full time as the instructor for the second year Introductory Ecology course at Dalhousie University. Her interests focus on human impacts on the coastal ocean and her dissertation research examines the impacts of eutrophication on the functions and services of eelgrass communities in Eastern Canada. She has been teaching ecologically oriented courses in the field and laboratory setting at Dalhousie University since 2005. Her passion is the oceans but with her new position as the Ecology instructor, she has had to broaden her focus allowing her to re-discover the beauty of the terrestrial environment, igniting a new excitement for learning and sharing that enthusiasm with students.

Christine Beauchamp has been involved in teaching Introductory Ecology, Evolutionary Biology, and Field Ecology during her years as an Instructor at Dalhousie University. While her biology background is in terrestrial and applied ecology, her more recent interests have focused on science teaching and learning, student advising, and the student experience. For the most part, though, this “rubber boot “ biologist is in her element scrambling through the forests and heathlands of Nova Scotia with a gaggle of students in tow!

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