

Preliminary Survey of the Plant Species on Carleton's Green Roof (Fall 2005)

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With help from Mark McKone, Phil Camil, Miranda Fix, Jennifer See, Jason Lord & Richard Strong

Introduction

In the spring of 2005, a team of Carleton College students built the first student-designed green roof in Minnesota at Carleton College. Consisting of 666 sq. ft., it was planted with 75 species of plants native to Minnesota prairies, and has given the building an aesthetic and environmental function. However, besides adding to beauty of our campus, one of the primary reasons to build the green roof was so that we could conduct research.

Our research interests are three-fold: We are curious about 1) the additional insulation value (R-value) that a green roof provides to an existing roof, 2) how a green roof affects water-runoff quality, and 3) how the unique environment of a green roof affects the colonization and survival of prairie plants native to Minnesota. This article addresses question number three and presents the findings of our first plant survey, which was conducted during the fall of 2005. The primary leader of this survey was Sonja Mae Langton-Yanowitz, a senior biology major, who became involved with the project because of her interest in plant identification.

During our design process, we thought that the unique conditions of our green roof, which the prairie plants would have to adapt to, would be a shallow soil depth, and a dry and hot environment. Prairie plants typically have deep root systems. However, the soil depth of our green roof ranges from 6" to 2". We predicted that the green roof conditions would be dry because the plants would not have an underlying water table to draw water from in times of low precipitation. Also, because of the exposed position on top of a roof, we predicted that the green roof environment would be hot as compared to a typical prairie system. With these conditions in mind, we were curious to see which plants would grow during the first season. The following survey explains what we found.

Planting the Roof

During the spring of 2005, root stock was hand planted in sections on the roof and a seed mixture was spread all over the roof. During fall, 2005, we noticed that species not present in the root stock or seed mixture were also growing on the roof; these plants will be referred to as colonists from this point forward.

Survey Method

The Daubenmeyer vegetation plot survey method was used to estimate the percent cover of each plant species on the roof. The roof was subdivided into 10 plots (Figure 1), and within each plot, each species was estimated as covering: 0, 0-1, 2-5, 6-25, 26-50, 51-75, 76-90, or 91-100 percent of the plot. For example, a person could look at a plot and estimate that dandelions are covering 6-25% of the plot, 6-25% of the plot is barren (no plants are growing), and clover is covering 51-75% of the plot. The data that we collected is presented in the tables following Figure 1.

I was not able to identify all plants growing on the roof because not all plants were in flower, and it can be difficult to identify a plant without the flower. For this same reason, some plants were only identified to family. It is likely that the identifiable species composition will evolve as the years pass because some prairie species require a period of dormancy (sometimes ranging up to a few years) before they are able to send up a flower stalk and can be identified.

Results

Overall, 75 species were planted on the roof; of these species 9 were found growing on the roof. Twenty-eight colonist species, which were not planted on the roof, were also found growing on the roof.

Suggestions for the Future

I would recommend surveying the roof during the summer, because more plants will be in bloom and identification will be easier. If anything, this survey underestimates the species richness on the roof, but at least it is a good preliminary survey. During this project, it was suggested by Myles Bakke (Carleton Arboretum manager) that since many prairie species thrive under periodic burns, it may be worthwhile to simulate the effects of a burn. He suggested mowing the roof

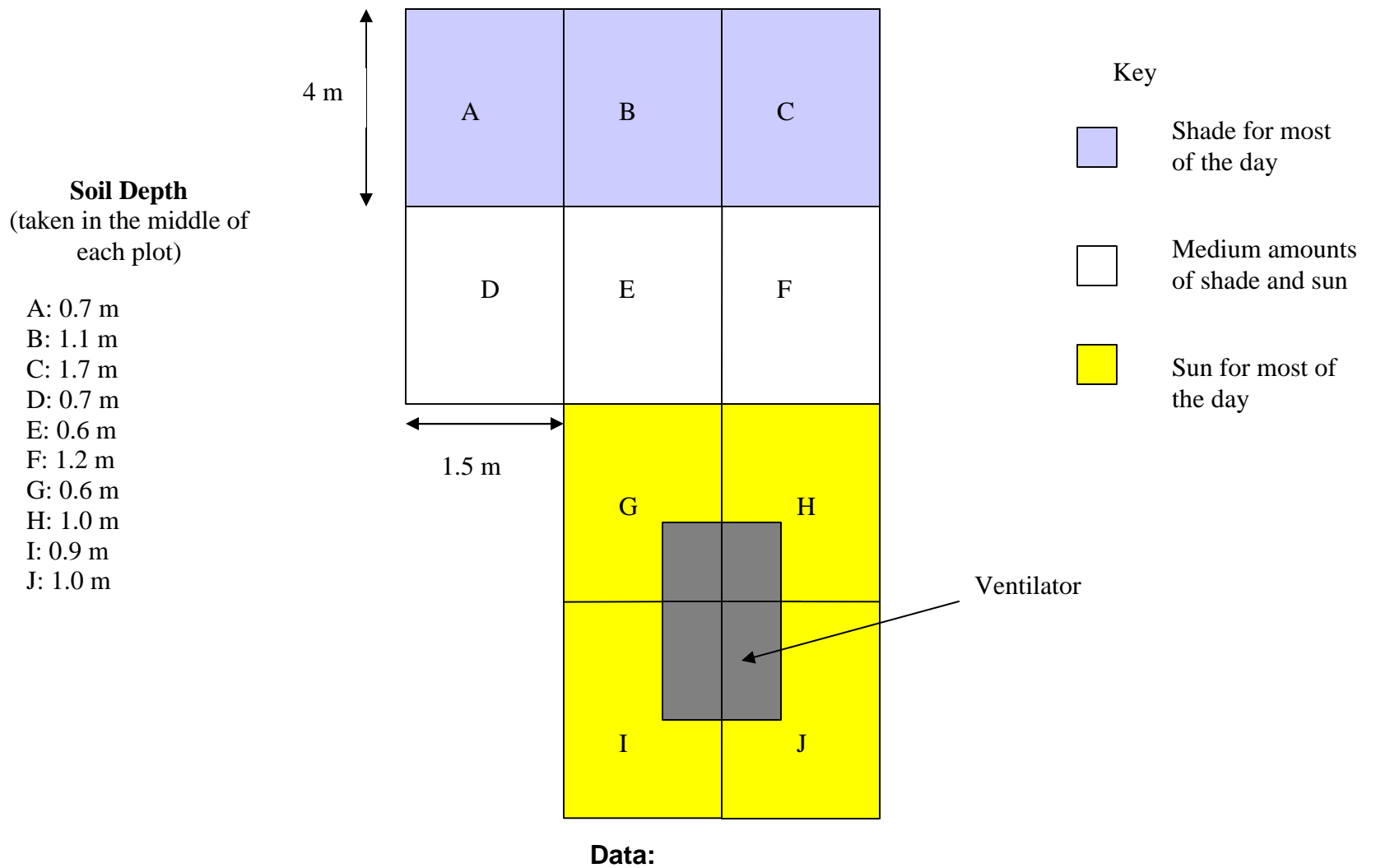
in the spring, burning the mulch, and then spreading the burnt mulch over the roof. This would give a competitive advantage to the prairie species by eliminating their competitors and would reintroduce nutrients back into the soil.

Also, Mark McKone (Biology Professor) suggested the possibility of growing vines on top of the roof. He said that vines are often a hardy species that can grow in little soil and are not very bothered by dry or wet conditions. Also, he said that the leaves of the vines would probably be good at absorbing heat, just like the other roof-top plants.




The green roof as viewed from Plot I (see Figure 1 below). The red flags pictured help mark the plot boundaries.

Figure 1. Diagram of the plots used to survey plant species on Carleton's green roof.





The following tables present the approximate percent cover of each species in the plots. I have included pictures of the plants that we found growing on the roof. Species that were planted but were not found growing on the roof are listed but I have not included pictures.

Root Stock
(Planted in sections on the roof)

Plants: Scientific name (Common name)	# of plants planted	Plots									
		A	B	C	D	E	F	G	H	I	J
<i>Agoseris cuspidate</i> (Prairie Dandelion)	12	0	0	0	0	0	0	0	0	0	0
<i>Anemone caroliniana</i> (Carolina Anemone)	12	0	0	0	0	0	0	0	0	0	0
<i>Anemone cylindrica</i> (Thimbleweed)*****	6	0	0	0	0	0	0	0	0	0	0
<i>Aster oblongifolius</i> (Aromatic Aster)	12	0	0	0	0	0	0	0	0	0	0
<i>Callirhoe triangulata</i> (Clustered Poppy Mallow)	12	0	0	0	0	0	0	0	0	0	0
<i>Echinacea angustifolia</i> (Narrow-leaved Coneflower)*****	12	0	0	0	0	0	0	0	0	0	0
<i>Liatris aspera</i> (Button Blazing Star)*****	80	0	0	0	0	0	0	0	0	0	0
<i>Liatris punctata</i> (Dotted Blazing Star)	12	0	0	0	0	0	0	0	0	0	0
<i>Muhlenbergia racemosa</i> (Upland Wild Timothy)	12	0	0	0	0	0	0	0	0	0	0
 <i>Opuntia humifusa</i> (Eastern Prickly Pear (Unrooted pads))	12	0	0	0	2-5	2-5	6-25	0	0	0	0


Shrubs: Scientific name (Common name)	# of seeds planted	Plots									
		A	B	C	D	E	F	G	H	I	J
<i>Amorpha canescens</i> (Lead Plant)	320	0	0	0	0	0	0	0	0	0	0
<i>Amorpha nana</i> (Fragrant False Indigo)	300	0	0	0	0	0	0	0	0	0	0
<i>Rosa arkansana</i> (Prairie Wild Rose)	250	0	0	0	0	0	0	0	0	0	0



Grasses, Sedges & Rushes: Scientific name (Common name)	# of seeds planted	Plots									
		A	B	C	D	E	F	G	H	I	J
<i>Andropogon scoparius</i> (Little Bluestem PLS)	6,000	0	0	0	0	0	0	0	0	0	0
 <i>Bouteloua curtipendula</i> (Side-oats Grama PLS)	6,000	0	0	0	0	0-1	0	2-5	0	0-1	0


Cover Crop: Scientific name (Common name)	# of seeds planted	Plots									
		A	B	C	D	E	F	G	H	I	J
 <i>Avena sativa</i> (Oats)	12,800	0-1	0	0	6-25	0	0	2-5	2-5	0-1	2-5



Colonist Plants



(These were not planted but were found growing on the roof)



Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <i>Acalypha virginica</i> (Virginia Threeseed Mercury)	0	0-1	0	0	0	0	0-1	0	0	0

Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <p><i>Achillea</i> (Yarrow)</p>	0-1	0	0	0	0	0	0	0	0	0
 <p><i>Amaranthus retroflexus</i> Foto: Jan Wesenberg</p>	0-1	0	0	0	0-1	0	0-1	0-1	0	0-1

<i>Amaranthus</i> (Pigweed)										
Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <i>Ambrosia artemisiifolia</i> (Common Ragweed)	0	2-5	6-25	2-5	0-1	6-25	0	2-5	6-25	2-5



		0	0	0-1	0	0	0	0-1	0	0	0-1
<i>Ambrosia trifida</i> (Giant Ragweed)											
Scientific name (Common name)	Plots										
	A	B	C	D	E	F	G	H	I	J	
		0-1	0-1	0	0	0	0	0-1	2-5	0-1	0
<i>Chamaecrista</i> : a type of legume (fixes nitrogen)											

	2-5	5-25	6-25	0-1	2-5	26-50	2-5	2-5	6-25	26-50
<i>Chenopodium album</i> (Lambs Quarters)	Plots									
Scientific name (Common name)	A	B	C	D	E	F	G	H	I	J
	0	0-1	26-50	0	0	6-25	0	0	0	0-1
<i>Commelina communis</i> (Asiatic Dayflower)										

		0	0	0	0-1	0-1	0	2-5	0	0	0
<i>Dandelion</i> (Dandelion)											
		2-5	6-25	0-1	2-5	6-25	26-50	6-25	6-25	6-25	6-25
<i>Digitaria</i> (Crabgrass)											
Scientific name (Common name)	Plots										
	A	B	C	D	E	F	G	H	I	J	



		0-1	0	0	0	0	0	2-5	0	2-5	0
<i>Echinochloa</i> (Barnyard Grass)											
		2-5	0	26-50	2-5	0	0	0	0	0	0
<i>Eragrostis</i> (Lovegrass)											



Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J



		0	0	0	0	0	0	0-1	0	0	0-1
		0-1	0	0	0	0	0	0	0	0	0


Lactuca (Wild Lettuce)

Lepidium (Pepperweed)

Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <p><i>Panicum</i>: unknown weedy species #1 (round seeds)</p>	0	0-1	0	0	2-5	6-25	0	6-25	0	0
 <p>Looks like <i>Panicum</i> unknown weedy species #1 but has thin seeds</p>	6-25	6-25	0	6-25	2-5	0	6-25	26-50	6-25	6-25

Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <p><i>Plantago major</i> (Common Plantain)</p>	0	0	0	0-1	0	0	0	0-1	0	0-1
 <p><i>Polygonum aviculare</i> (Prostrate Knotweed)</p>	0	0-1	0	1-5	0	0	0-1	0	0	0

Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <p><i>Portulaca oleracea</i> (Little Hogweed)</p>	6-25	0-1	0	0	6-25	6-25	0	0-1	0	
 <p><i>Setaria</i> (Foxtail): several types</p>	2-5	26-50	51-75	2-5	6-25	26-50	6-25	51-75	26-50	6-25

Scientific name (Common name)	Plots									
	A	B	C	D	E	F	G	H	I	J
 <i>Trifolium repens</i> (White Clover)	0	0	0	0	0	0	0	0	0-1	0
Barren (no plants: only mud, section of roof removed, or ventilator is in the way)	6-25	0	0	6-25	6-25	0	0	0	0	26-50

*****These species were planted both as root stock and in the seed mixture. Species percent cover per plot is only recorded under the seed mixture section.

? a question mark next to a percentage estimate (e.g. 0-1?) means that we were unsure if the plant is identified correctly, but it is our best guess.

Conclusions

The interesting result of our survey is that colonist species were more prevalent than the plants that we actually seeded. One biology professor suggested that we may observe a cycle of succession on the green roof as time passes. The concept of succession can be applied to many natural systems. As applied to our system, it means that the species composition present on a “new” green roof, known as primary species, may evolve as secondary species that have a longer dormant period start to take over later on. Hopefully future surveys will help clarify if and how species composition changes over time on our green roof.

As a side observation, we noticed that instead of the green roof having dry conditions as we predicted, the soil was often noticeably wet. The additional moisture could be due to the organic matter (43% of our soil) retaining too much moisture, or our drainage system may not be as effective as we had expected. Regardless, it will be interesting to note how the prairie plants, which have long roots in order to resist drought, adapt to these wet conditions.

For more information about our Carleton College building and design process, see the Greenroofs.com July 2005 Student Guest Article "[The Carleton College Green Roof Project](#)" by David Holman, Jason Lord, Jake Gold, and Andrew Kaplan of Carleton College.

Sonja Mae Langton-Yanowitz is a senior Biology major at Carleton College. Her interest in plant identification began when she worked as a Naturalist for the Superior National Forest Service during the summer of 2004. She will be attending Dental School at the University of Minnesota in the fall of 2006.