GEOBOTANY OF GLOBALLY RARE SANDSTONE PAVEMENT PINE BARRENS, CLINTON COUNTY, NY

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INTRODUCTION

Geobotany is the study of plant distributions, which often are determined by the interaction of plants with the underlying geology of an area. Historic and contemporary geologic and climatological influences have shaped the sandstone pavement pine barrens botanical community, which is considered rare in New York and the world (Edinger et al., 2014). The pavement barrens of Clinton County, New York were created over 12,000 years ago when glacial Lake Iroquois drained into glacial Lake Coveville (Franzi and Adams 1993). Plants have been able to survive in this harsh, nutrient poor ecosystem due to specialized characteristics and interactions with other organisms. The Altona Flat Rock sandstone pavement pine barren is fire-dependent, and the last stand-replacing fire burned over 1,200 ha in 1957 (Gooley, 1980). Fire acts as an ecological mechanism to restart succession in this type of community. An outstanding quality of this pine barren is its location at the northern extreme of pitch pine and southern extreme of jack pine, and both species depend on fire as a mechanism for reproduction. Another unique community found in the pavement barrens is the perched bog. These acidic peatlands are separated from the water table due to the sandstone bedrock and host unique plant species such as the carnivorous pitcher plant (Edinger et al., 2014). On this field trip we will visit the Altona Flat Rock pine barrens owned by the W.H. Miner Agricultural Research Institute and the Gadway Pine Barrens owned by the Nature Conservancy.

<u>Geological Setting (from Franzi and Adams 1999)</u>

The northeastern New York sandstone pavements (Figure 1) are entirely underlain by nearly flat-lying Potsdam Sandstone (Cambrian) (Fisher, 1968; Lewis, 1971). The lithology of the Potsdam ranges from cross-laminated, orange-pink to pale red, very coarse to medium-grained arkose with quartzitic green shale and conglomeratic interbeds to pinkish gray to very pale orange, well sorted, fine to medium-grained quartz sandstone (Fisher, 1968). The pavement surfaces generally slope north and east from an elevation of more than 300 meters a.s.l. (above sea level) to below 200 meters a.s.l. where they pass beneath surficial deposits in the Champlain Lowland (Denny, 1974). The sloping surfaces are broken into a series of stair-like bedrock treads separated by risers that range from a few decimeters to tens of meters in height. The tread surfaces have little local relief except near stream channels and risers. The eroded edges of truncated trough cross-beds, ripple marks, and solution pits are common minor surface features. Shoreline deposits from the highstand of glacial Lake Vermont (Fort Ann Stage) and morainal deposits (Woodworth, 1905a; Denny, 1970, 1974) lap onto the northern and eastern margins of the pavements.

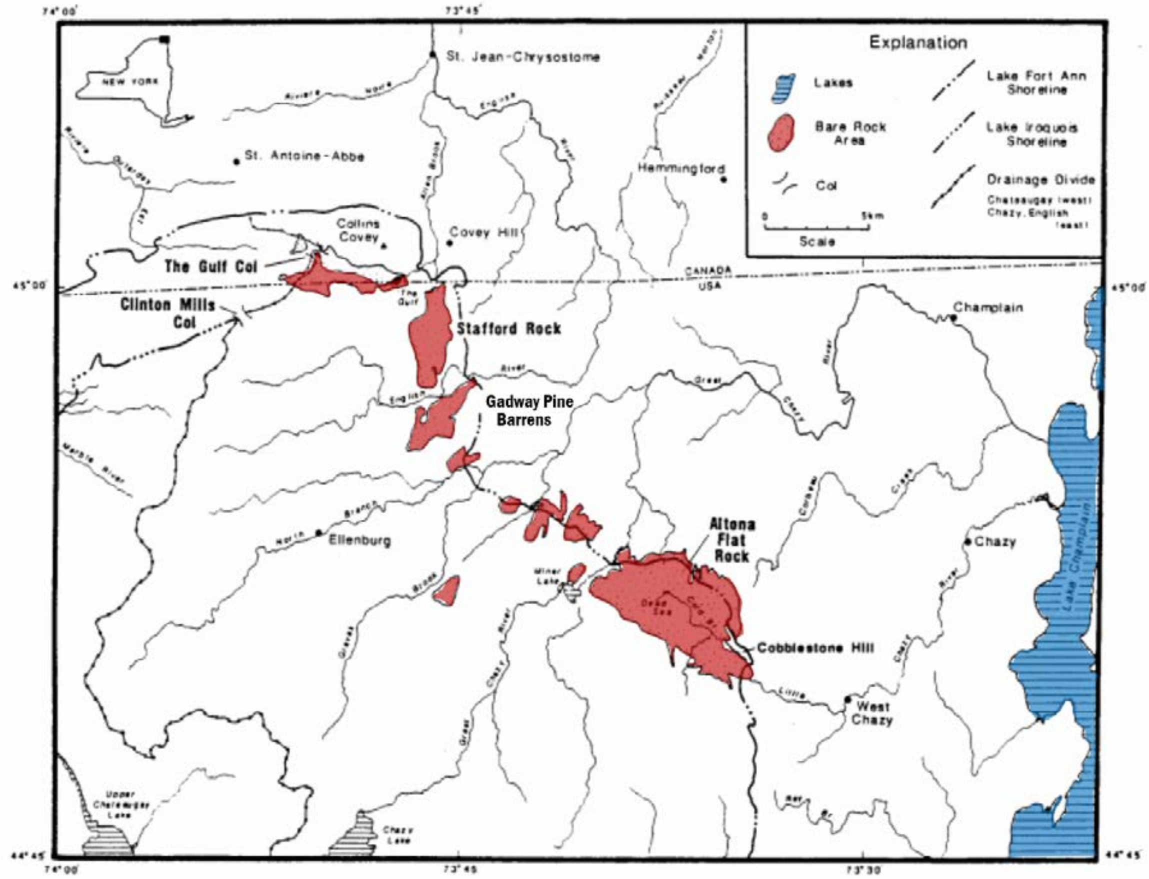

Figure 1. Pavement pine barrens in the upper Champlain Valley in northern New York and Canada formed by the drainage of glacial Lake Iroquois into glacial Lake Coveville including the Altona Flat Rock and Gadway Pine Barrens (from Adams and Franzi 1994).

The sandstone pavements were created more than 12,000 years before present by the erosional effects of ice-marginal streams related to drainage of glacial Lake Iroquois and younger post-Iroquois lakes (Woodworth, 1905a, 1905b; Coleman, 1937; Denny, 1974; Clark and Karrow, 1984; Pair et al., 1988; Pair and Rodrigues, 1993). Lake Iroquois occupied the Ontario Lowland and drained eastward across an outlet threshold near Rome in the western Mohawk Lowland (Coleman, 1937). Lake Iroquois expanded northeastward into the St. Lawrence Lowland during deglaciation between the Adirondack Uplands to the south and the waning Laurentide Ice Sheet margin to the north. The former water level probably stood at a present elevation between 329 and 332 meters a.s.l. near Covey Hill, Quebec (Denny, 1974; Clark and Karrow, 1984; Pair et al., 1988; Pair and Rodrigues, 1993).

Northward recession of the ice front into Chateaugay region diverted glacial meltwater westward along the ice margin and created the well-developed Chateaugay Channels (MacClintock and Stewart, 1965). Drainage through the channels emptied sequentially into the northeastwardly expanding Lake Iroquois as ice recession continued. Westward drainage ended when the ice front in the Champlain Lowland receded from the vicinity of the Ellenburg Moraine. Subsequently, eastward drainage of Lake Iroquois began as lower outlets were exhumed along the drainage divide between the Champlain and St. Lawrence drainage systems southwest of Covey Hill. The initial drainage may have occurred through a channel approximately 1 km north of Clinton Mills that was controlled by a threshold between 329 and 332 meters a.s.l. (Clark and Karrow, 1984). The falling levels of proglacial lakes in the St. Lawrence and Ontario lowlands temporarily stabilized at the glacial Lake Frontenac level (Clark and Karrow, 1984; Pair et al., 1988; Pair and Rodrigues, 1993) as the ice margin receded northward and the col at The Gulf (308-311 meters a.s.l.) was uncovered. Outflow from these lakes was directed southeastward along the ice margin where it crossed the English, North Branch and Great Chazy watersheds before eventually emptying into Lake Fort Ann which occupied the Champlain Lowland at an elevation between 225 and 228 meters a.s.l. (Denny, 1974). The outflow streams stripped large areas of their surficial cover and cut deep bedrock channels and plunge pools (e.g. The Gulf (MacClintock and Terasme, 1960) and the Dead Sea (Woodworth, 1905a; Denny, 1974)) into the Potsdam Sandstone. The most intense scour (e.g. Stafford Rock, Blackman Rock, and Altona Flat Rock) generally occurred on major watershed divides. The scour of the areas southeast of the St. Lawrence-Champlain divide continued as ice recession caused the drainage of Lake Frontenac around the northern flank of Covey Hill. Denny (1974) suggested that the ice margin may have oscillated in the area around Covey Hill causing the lakes in the eastern St. Lawrence Lowland to refill and empty several times. The lake-drainage episodes ended when the ice front receded from the northern flank of Covey Hill for the last time and the proglacial lake in the St. Lawrence merged with Lake Fort Ann in the Champlain Lowland Lowland (Pair, et. al., 1988; Pair and Rodrigues, 1993). The nature and timing of the outflow floods and their role in the creation of the sandstone pavements has been an issue of considerable debate (e.g. MacClintock and Terasme, 1960; MacClintock and Stewart, 1965; Denny, 1974; Muller and Prest, 1985; Coles, 1990) but it is likely that the erosion occurred in stages, as suggested by Denny (1974) and Coles (1990), rather than as a single massive flood event.

Ecological Setting

The sandstone pavement pine barrens ecosystem, hereafter "barrens", exists as a discontinuous matrix of unique landforms stretching some 30 km starting at the Gulf unique area and extending as far south as Altona Flat Rock near West Chazy, NY (Figure 1). The barrens are typified by a shallow (5-15 cm), nutrient-poor soil with low water holding capacity, which sharply contrasts with the surrounding landscape of deeper, nutrient-rich soils. As such, plants found here are uniquely adapted to handle these physical and edaphic conditions (Adams and Franzi 1999). Additionally, these harsh living conditions result in low plant diversity relative to the surrounding area, because only plants with adaptations suitable for harsh and frequent disturbance can persist long-term. From north to south the ecological characteristics of the barrens gradually shifts; most notably in structure but less so in species composition. For example, tree height at the Gadway Pine Barrens (near the northern limit) rarely exceeds 7 m, whereas trees at Altona Flat Rock frequently exceed 10 m.

Most of the overstory in the barrens is dominated by a single tree species; jack pine (*Pinus banksiana*), which exists at the southern limit of its present natural range in the Champlain Valley (Burns and Honkala, 1990; Harlow, et al., 1991). This fire-dependent tree competes superiorly in the low nutrient soil and defines the gestalt of the barrens. Jack pine is a relatively short-lived (<150 years), shade-intolerant, boreal species that maintains communities on the sandstone pavements because of its adaptations to the conditions here. At younger ages, jack pines can form dense thickets; however, most the barrens have older trees that are well spaced creating a 'park like' visual impression. Near the southern extent of the barrens, pitch pine

(*Pinus rigida*) is present and in some stands is either co-dominant with jack pine or forms pure stands (DellaRocco and Straub 2015). In fact, the jack and pitch pine that co-exist here represents one of the few examples of this relationship in the world. Other overstory trees that exist here include gray birch (*Betula populifolia*), paper birch (*Betula papyrifera*), red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*) red maple (*Acer rubrum*), serviceberries (*Amelanchier* spp.) and quaking aspen (*Populus tremuloides*), however, these species are mostly relegated to the cracks and fissures in the bedrock where deeper soil has accumulated and they are usually short lived (DellaRocco and Straub 2015).

The diversity of understory shrubs is greater than the overstory in the barrens. The understory shrubs are predominantly late lowbush blueberry (*Vaccinium angustifolium*), black huckleberry (*Gaylussacia baccata*), black chokeberry (*Pyrus melanocarpa*), sweetfern (*Comptonia peregrina*), and sheep laurel (*Kalmia angustifolia*). These shrubs belong to the Ericaceae family and are often referred to as 'heaths'. Unlike the well-spaced overstory trees, structurally, these woody shrubs can cover up to 100% of the ground cover making it difficult to travel in some locations (Figure 2). Collectively these shrubs occupy a vertical structure from about 0.25 to 1.50 meters.

Figure 2. Example of the ericaceous shrub species that comprise nearly 100% of the shrub layer at the Altona Flat Rock. Pitch pine dominates the overstory in this photo.

The ground cover of the barrens can be split into two distinct categories; areas that have soil and those where it is absent. In the areas that have soil, species of lichens are common including *Cladonia uncialis*, *C. rangiferina*, and *C. mitis.* Intermixed with the lichen are a diverse group of bryophytes including haircap moss (*Polytrichum commune),* Schreber's big red stem moss *(Pleurozium schreberi),* two species of broom mosses *(Dicranum polysetum, D. scoparium),* and *Sphagnum* spp.. The lichens and bryophytes are good indicators of shallow or absent soil as these organisms are usually the first to colonize bedrock. Additionally they seem to coexist without a clear dominant species and more information is need to asses if dominance hierarchies exist among this group of organisms at this location. Lichens and bryophytes also serve as suitable substrate for higher vascular plants (see During and Tooren, 1990). There is also a large amount of downed trees that are in various states of decay (Sargis and Adams 2004, DellaRocco and Straub 2015). These logs persist in the understory for many years because of the combination of short growing conditions, low moisture, and strict fire suppression policies (see disturbance regime below). Some portions of the ground cover are absent of soil and here you can directly see the sandstone underlying bedrock. Often these areas are the result of footpaths or game trails but in other spots these barren spots are simply the results of the absence of plant colonization; areas that have yet to accumulate organic matter.

The combined effects of warm summer temperatures, low seasonal water availability with rapid runoff, flammable foliage and buildup of combustible downed wood, create a high-stress environment that is sensitive to natural disturbances, such as wildfires and ice storms. The barrens have a well-documented history of natural and human initiated fires (i.e., Gooley, 1980) which play a large role in the ecology of this site. Importantly the plant communities that dominate the barrens are adapted to survive and/or reproduce following a fire and are often referred to as fire-dependent. Specifically, jack and pitch pine both produce serotinous cones that require fire to melt resin on their cones which complete their ontogeny (Burns and Honkala, 1990). Jack pines as mature trees have thin bark and this trait leads to widespread mortality during a fire. However, the cones from the parent trees, which can also be stored on the branches, open and can successfully germinate after a fire. This sequence created the classic 'even-aged' jack pine stands throughout the barrens. Essentially, one can trace the age of the stand back to the last stand replacing fire. Historically, the fire regime consisted of frequent but low intensity fires that 'restarted' ecological succession; however the last stand replacing fire was probably 1965 at the Altona Flat Rock (Franzi and Adams 1999). Without the return of fire (or a suitable management alternative) the nature and integrity of this rare community type is in jeopardy (Adams and Franzi, 1994; Adams and Franzi 1998; and DellaRocco and Straub 2015).

Scattered sporadically throughout the barrens are perched bogs. The bogs are acidic peatlands that are separated from the groundwater table below due to an impermeable layer such as bedrock (Figures 3 and 4) and most have relatively shallow peat depths of 0.5 to 1.5 m. These nutrient-poor bogs are considered a rare community type in the state of New York and are dominated by sphagnum moss (Edinger et al., 2014). Other plant species found here include shrubs such as leatherleaf (*Chamaedaphne calyculata*) and blueberry species (*Vaccinium* spp.) and herbs including spoon-leaved sundew (*Drosera intermedia*) and northern pitcher plant (*Sarracenia purpurea*) (Edinger et al., 2014). These plants have developed special adaptations to survive in waterlogged and nutrient poor habitats.

Woody species belonging to the heath family (Ericaceae) are prevalent in perched bog communities. These shrubs, including leatherleaf and blueberry, have common characteristics such as tough, waxy leaves that last for 1-4 years (Figure 4) and epicormic branching, the ability to sprout from dormant buds (Eastman 1995). Researchers have determined that these leaf adaptations help the plants conserve nutrients, water, and reduce frost damage (Aerts, 1995; Eckstein et al., 1999; and Wright et al., 2004). Epicormic branching of leatherleaf has been associated with bog mat development; as old branches are covered in sphagnum moss, new branches radiate out and increase the mat surface (Swan and Gill, 1970).

While carnivory in plants is a rare phenomenon worldwide, we find numerous insectivorous species in northern bogs including sundew and the northern pitcher plant (Figure 5). Both sundew and the northern pitcher plant devote much of their biomass to structures that trap insects including sticky pads and pitchers, respectively. The plants use enzymes to digest the insects to derive nitrogen as opposed to only taking up nutrients from the soil and atmosphere. Therefore, these plants have relatively small and shallow root systems. While both low availability of nutrients and waterlogging stress have been postulated as advantages of carnivory in bog systems, this adaptation is likely due to both stressors (Adamec, 2011).

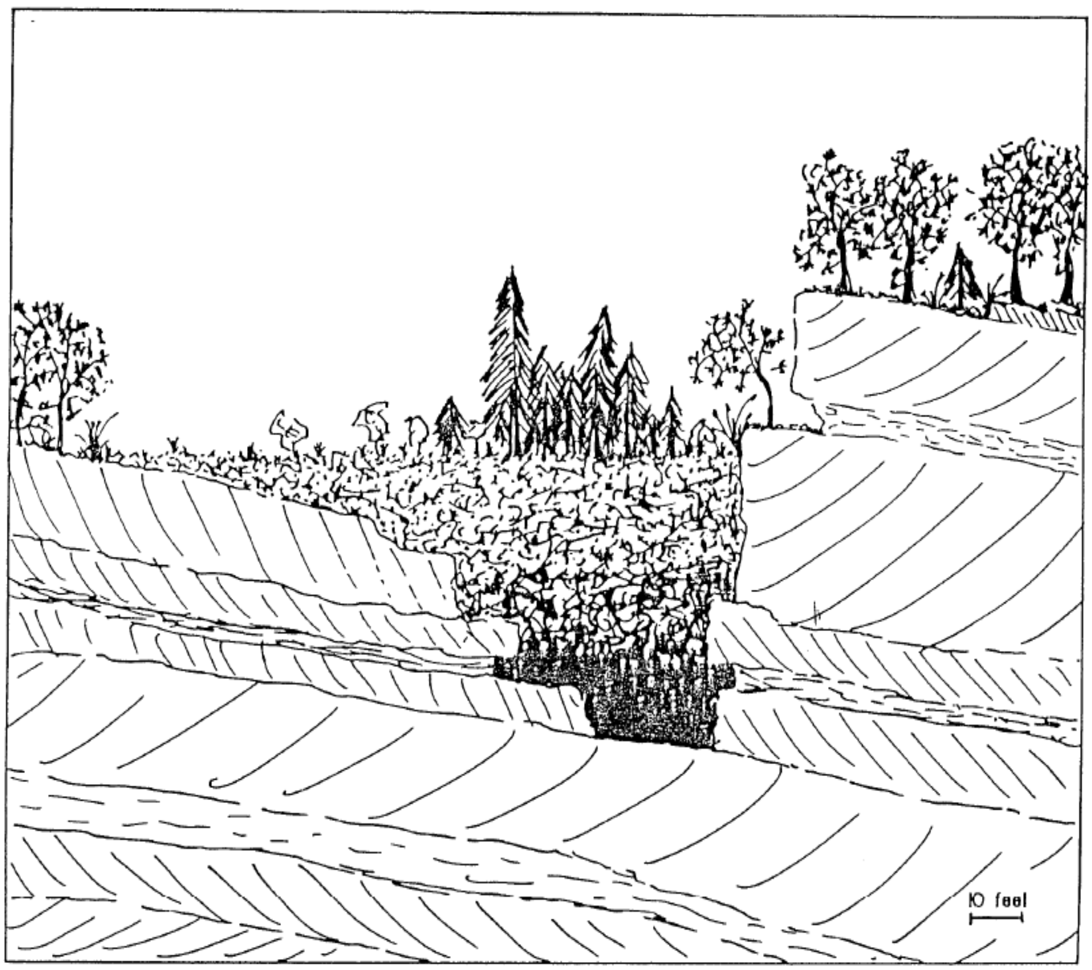

Figure 3. A "ledge" or "perched" bog in cross section. These wetlands are perched above the water table due to water pooling in the space between two ledges of bedrock. Here peat has developed on the bottom and a wetland community is supported on top (from Coles, 1990).

Figure 4. A perched bog at the Altona Flat Rock. This bog is dominated by sphagnum moss and the low-lying shrub, leatherleaf. The edge of the sandstone pine barren is shown in the background.

Figure 4. The waxy, evergreen leaves of the ericaceous shrub, leatherleaf (*Chamaedaphne calyculata*), a dominant plant in perched bogs.

Figure 5. The northern pitcher plant (*Sarracenia purpurea*) is able to trap and derive nutrients from insects and other species that drop into its pitcher. The recurved hairs on the top of the pitcher hinder escape.

Recent Investigations in the Sandstone Pavement Pine Barrens

Year: 2014

Title: Plants as Hydrologic Indicators: A comparative study

Location: Altona Flat Rock

Investigators : Veronica Schmitt (B.S Ecology; 2014) & Jacob Straub (faculty advisor)

Summary: Certain plants tend to grow in areas that have high moisture content in the soil and where the water table is close to the surface. However, these plants vary from region to region. Importantly, scientists have found that these plants can serve as indicators of groundwater hydrology and/or underlying geology. No efforts have been made to determine if plants in the sandstone pavement barrens of Clinton County, NY can serve as indicators of wetland hydrology or geology, although these studies have been conducted elsewhere (Goslee et al. 1997, Lewis 2001). The purpose of this study was collect baseline data on species composition as well as chemical and physical data from a random subset of wetlands from the Altona Flat Rock area.

Eight wetlands were sampled in the spring of 2014 soon after snow melt. Data was collected on acidity, temperature, conductivity, water depth and oxidation reduction potential (Table 1). In addition all plants were identified and compared with Goslee et al. (1997). Goslee et al. (1997) assessed woody and herbaceous plants based on their reliability to predict groundwater, seasonal surface water or permanent surface water. We compiled a list of nine species that serve as hydrology indicators in this area that matched the records from Goslee et al. (1997) (Table 2). However, the degree to which these nine species remain effective and reliable indicators of wetland water source in the barrens remains an important question to be examined. Indeed there are major differences in the physical and chemical attributes most namely the groundwater from the barrens is particularly low in ions (Romanowicz per. communication).

Table 1. Chemical data including pH, specific conductivity (Sp. Cond.; μS / cm), water depth (cm) temperature (°C) and oxidation reduction potential (ORP; millivolts) collected from 5 wetlands at Altona Flat Rock, spring 2014.

Wet-land	pH			Sp. Cond. (μS / cm)			Depth (cm)			Temp. (°C)			ORP (mV)		
	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max	min
1	7.3	7.8	6.6	79.4	105.5	61.0	9.1	15.5	5.0	11.7	14.0	9.3	93	124	79
2	8.0	8.2	7.7	129.2	138.3	121.0	7.8	16.0	0.0	8.9	11.5	6.4	65	86	20
3	5.3	5.8	4.9	24.2	37.3	19.0	19.2	25.0	4.0	9.5	9.7	9.3	241	254	232
4	4.7	4.7	4.6	44.4	51.0	39.0	0.4	2.0	0.0	7.5	8.1	6.6	233	247	218
5	5.2	5.7	5.1	21.0	24.0	19.8	2.0	4.0	0.0	7.1	8.1	6.5	247	257	240

Table 2. Plants that occurred in both the Altona Flat Rock and from Goslee et al. (1999) from central Pennsylvania and used as indicators of wetland water source.

Genus	Species	Common name	Associated hydrology
Glyceria	*striata*	Manna grass	Seasonal and permanent surface water
Juncus	*tenuis*	Path rush	Seasonal surface water
Kalmia	*angustifolia*	Sheep laurel	Groundwater
Mentha	*arvensis*	Mint	Seasonal and permanent surface water
Phalaris	*arundinacea*	Canary grass	Seasonal and permanent surface water
Potamogeton	*pectinatus*	Sago pondweed	Permanent surface water
Thelypteris	*noveboracensis*	New York fern	Groundwater
Thelypteris	*palustris*	Marsh fern	Groundwater
Typha	*latifolia*	Cattail	Permanent surface water

Year: 2015

Title: Fifteen-year Community Type Change in a Sandstone Pavement Barren

Location: Altona Flatrock

Investigators: Thomas DellaRocco (B.S Ecology; 2015) & Jacob Straub (faculty advisor)

Summary: The Altona Flat Rock sandstone pavement barren is a rare fire-dependent ecological community geographically located at the narrow overlap of jack pine and pitch pine species ranges. We studied fifteen year post-ice storm plant community change at the Altona Flat Rock pine barren in Clinton County, New York. Prior research predicted plant community changes in the barren due to fire exclusion. Our study is the first to examine long-term changes in plant species composition of this pine barren community. In the overstory, pitch pine basal area and density remained similar (i.e., < 20% difference) between 1999 and 2014, while density and basal area of red maple increased 67% and 109%, respectively. In contrast, jack pine overstory mortality was 100% between 1999 and 2014. Very few jack pine saplings (12.5 stems/ha) and no pitch pine saplings were present in sample plots. However, a high density of red maple saplings (1,950 stems/ha) existed. Ground cover was dominated by huckleberry, Sphagnum spp., and Schreber's big red stem moss (Figure 6). With absence of fire and the subsequent decreases in jack and pitch pine, this post-ice storm pine barren is developing into a boreal heath barren dominated by huckleberry with an overstory comprised mostly of red maple. In the absence of fire, or a suitable management alternative, this rare ecological community type may become extirpated from the Northeast. Further research will provide a more complete understanding of the ecological requirements for successful regeneration of pines and associated species in fire-prone ecosystems such as Clinton County's sandstone pavement barrens.

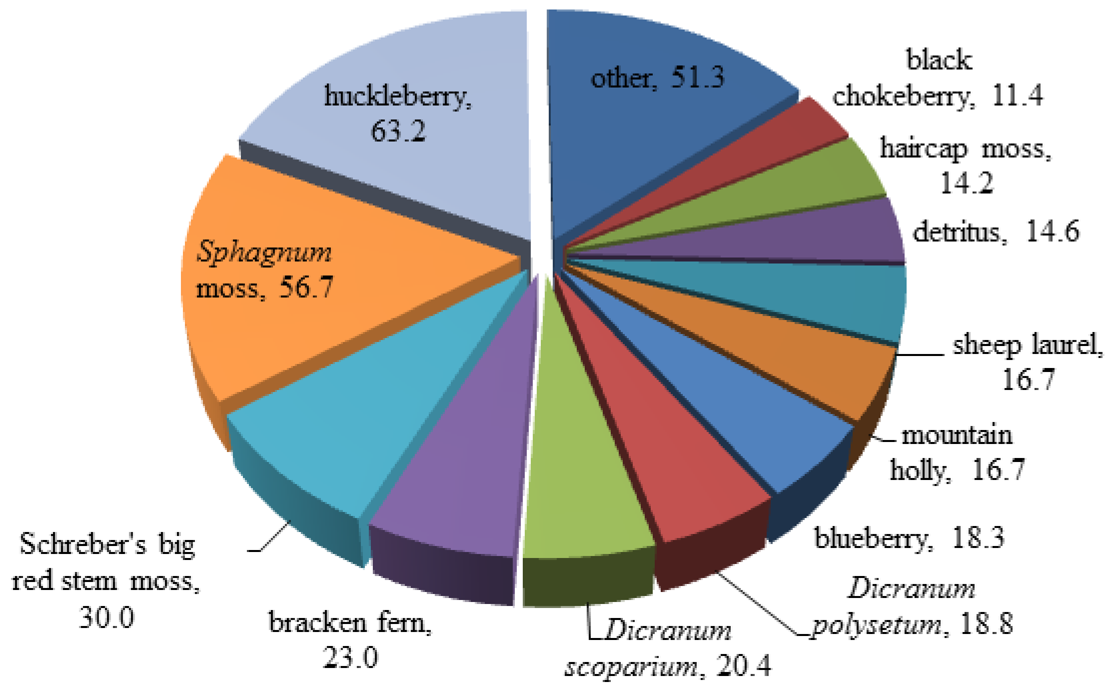

Figure 6. Absolute percent cover by species for ground cover sampled from 1 m^2 plots at Altona Flat Rock pine barren, autumn, 2014.

Year: 2014

Title: Assessment of post-burn jack pine regeneration

Location: Gadway Pine Barren

Investigators : Forest Ecology and Management students at SUNY Plattsburgh

Summary: Since 2011, students in the Forest Ecology and Management course at Plattsburgh State have been monitoring the success of jack pine seedlings, estimating density of live and dead trees, and assessing the characteristics of the ground cover in the burn and adjacent unburned. This fire event has provided a unique opportunity to study succession in this rare community type. In fall 2014 students estimated there were 7,708 jack pine seedlings in the burned area and no seedlings in the unburned area (Figure 7). A great example of the importance of fires to the life cycle of jack pines! In addition, there were large differences in the number of live and dead standing jack pine trees between the burned and unburned plots (Figure 8). Lastly, exposed bedrock was 30% of the ground cover in burned plots and only 2% in unburned, indicating the fire removed much of the lichen and bryophyte layers.

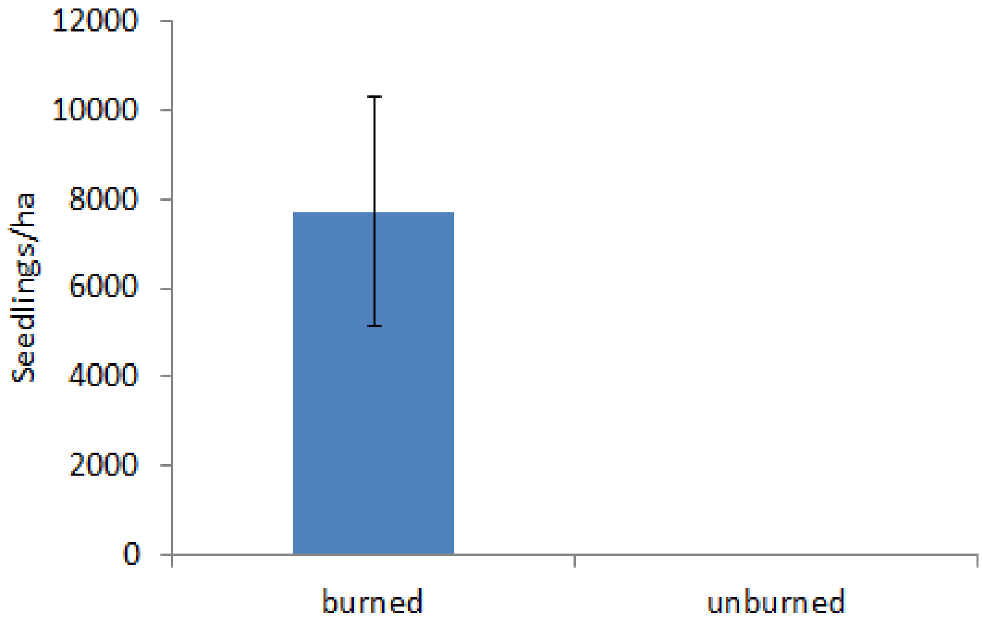

Figure 7. Density of jack pine seedlings at Gadway pine barrens in a burned and unburned area, autumn 2014. The burned area was from a fire in May 2010.

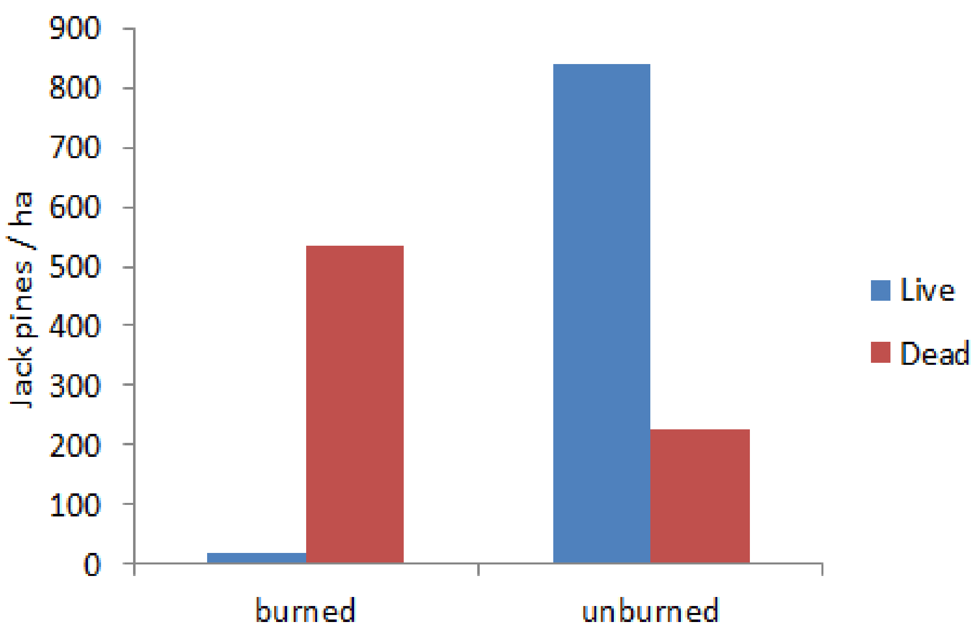

Figure 8. Density of live and dead jack pine trees at the Gadway pine barrens in burned and unburned areas, autumn 2014. The burned area was from a fire in May 2010.

FIELD GUIDE AND ROAD LOG

Meeting Point: Southeastern parking lot of Hudson Hall on the SUNY Plattsburgh campus. The lot is located at the corner of Beekman and Broad streets.

Meeting Point Coordinates: 44.691°N, 73.467°W

Meeting Time: 8:30 AM

Distance in miles (km)		Route Description
Cumulative	Point to Point	
0.9 (1.4)	0.9 (1.4)	Assemble in the southeastern parking lot of Hudson Hall. Leave parking lot, turn left at the entrance, and continue northward on Beekman Ave. to Boynton Ave.
1.4 (2.6)	0.5 (0.8)	Junction of Beekman and Boynton streets. Turn right onto Boynton Ave. 0.5 miles until reaching the turn off for NY-22 N.
10.3 (16.6)	8.9 (14.3)	Turn left onto NY-22 N and follow north for 8.9 miles until reaching W Church St.
11.8 (19.0)	1.5 (2.4)	Turn left onto W Church St. and follow westward until reaching Barnaby Rd.
14.1 (22.7)	2.3 (3.7)	Turn right onto Barnaby Rd. and continue onto Blaine Rd.
14.4 (23.2)	0.2 (0.3)	Stay right to stay on Blaine Rd. for 0.2 miles. You will park at the end of this road.

STOP 1: Altona Flat Rock Pavement Barrens, Chazy, NY

Location Coordinates: (44.837 °N, 73.570 °W)

The Altona Flat Rock pine barren is located in the township of Altona, Clinton County, and is primarily owned by The W. H. Miner Agricultural Research Institute. Altona Flat Rock is the largest of the sandstone pavements in northeastern New York (Figure 1). The central portion of Altona Flat Rock is drained by Cold Brook, a headwater tributary of the Little Chazy River that originates near the Dead Sea.

The Altona Flat Rock was heavily influenced by a large ice storm in 1998 (Irland 1998). An assessment of overstory tree composition at this site in 1999 revealed it was dominated by an admixture of jack pine (*Pinus banksiana*), pitch pine (*P. rigida*), and red maple (*Acer rubrum*). An outstanding quality of this pine barren is its geographic location at the northern limit of pitch pine and southern limit of jack pine (Burns and Honkala 1990). Both species depend on fire for reproduction (Yorks and Adams 2003). This particular sandstone pavement pine barren is fire-dependent and considered a rare ecosystem by the New York Natural Heritage Program

(Edinger et al. 2014). The last stand-replacing fire to affect this pine barren occurred in 1957 and it burned over 1,200 ha. In this type of ecosystem fire acts as an ecological mechanism to set the successional state back to a less developed state (Noble and Slatyer 1980).

Distance in miles (km)		Route Description
Cumulative	Point to Point	
16.9 (27.2)	2.5 (4.0)	Return to the vehicles and backtrack northeast on Blaine Rd. to Barnaby Rd. and continue to Recore Rd.
19.2 (30.9)	2.3 (3.7)	Turn right on Recore Rd. and follow to NY-190.
28.6 (46.0)	9.4 (15.1)	Turn right onto NY-190 W until Alder Bend Rd.
31.6 (50.9)	3.0 (4.8)	Turn right onto Alder Bend Rd.
33.3 (53.6)	1.7 (2.7)	Turn left onto US-11 S and follow to Cannon Corners Rd.
35.8 (57.6)	2.5 (4.0)	Turn right onto Cannon Corners Rd. and follow to Gadway Rd.
36.6 (58.9)	0.8 (1.3)	Turn left onto Gadway Rd. and follow the road to the parking area.

STOP 2: Gadway Pine Barrens, Mooers Forks, NY

Location Coordinates: (44.950410°N, 73.753830°W)

The Gadway Sandstone Pavement Pine Barren is located in Clinton County, near the border with Quebec (Figure 1). The Gadway barren is an outstanding example of a sandstone pavement barren, a globally rare ecological community with fewer than 20 sites in the world and fewer than five sites in New York State. The Gadway barren is approximately 210 ha (520 ac) in size and is dominated by jack pine. With its serotinous cones, jack pine is one of the best examples of a fire-adapted species in New York.

The most recent example of a wildfire in the barrens occurred at Gadway on May 28, 2010. The day prior to the fire, there was lightning area which is believed to have caused this. With winds from a westerly direction, the main fire was a backfire spreading into the barren at a rate of less than 1 m/min. The forest ranger response was rapid and the fire burned only approximately 2 ha (5 ac).

In addition to the exploration of the plant communities at Gadway, we will also visit sites that expose fossils in the Potsdam Sandstone. According to Landing et al. (2007), "arthropod trackways (predominantly *Diplichnites* and *Protichnites*) as well as probable mollusk trackways *Climactichnites* and *Plagiogmus,* are well preserved on some bedding surfaces."

Distance in miles (km)		Route Description
Cumulative	Point to Point	
37.4 (60.2)	0.8 (1.3)	Return to the vehicles and backtrack northeast on Gadway Rd. to Cannon Corners Rd.
39.9 (64.2)	2.5 (4.0)	Turn right onto Cannon Corners Rd.
41.6 (66.9)	1.7 (2.7)	Turn left onto US-11 N.
44.6 (71.7)	3.0 (4.8)	Turn right onto Alder Bend Rd.
60.8 (97.8)	16.2 (26.1)	Turn left onto NY-190 E
63.3 (101.9)	2.5 (4.0)	Turn left onto Mason St. / Tom Miller Rd.
64.0 (103.0)	0.7 (1.1)	Turn right onto Prospect Ave.
64.3 (103.5)	0.3 (0.5)	Turn left onto Broad St. and left onto Beekman Ave., parking will be on left at Hudson Hall.

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