Microclimates on Blackhawk Island

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Program Purpose: Participants will explore the concepts of aspect and microclimate using the tools of forestry and meteorology to answer the Essential Question, "How are the habitats on the north and south sides of Blackhawk Island different?

Maximum number of Participants: 42 [dependent on barge capacity]

Length of Program: 3 hours
Ideal Age: Elementary - Adult

Learning Standards: NGSS Cross Cutting Concept Standard 9. *Interpret cause and effect relationships*. (HSSCI9)

Wisconsin Science Standard. *Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems*. (SCI.CC2)

Wisconsin Environmental Literacy and Sustainability Standards:

- *Students develop and connect with their sense of place and well-being through observation, exploration, and questioning.* (ELS.C1)
- *Students evaluate relationships and structures of natural and cultural systems and analyze their interdependence.* (ELS.EX2)

Objectives:

After participating in this lesson, participants will be able to:

- Understand basic paddle skills involved in navigating a barge across the Wisconsin River
- Define the terms "aspect" and "microclimate" and describe the importance of each in determining what lives in a habitat
- Use measurement tools such as a Kestrel weather meter, densiometer, infrared thermometer, and thermal camera to describe a habitat's characteristics
- Use scientific vocabulary and data to answer the Essential Question, "How are the habitats on the north and south sides of Blackhawk Island different?"

Teacher Preparation:

Before the class arrives:

- Confirm river flow rate is below 14,000 cfs (if higher, island hike is cancelled)
- Unlock the barge, boathouse, and rescue boat and gather water safety equipment
- Gather all program equipment. **Ensure that thermal cameras are charged using the charge cords and kestrels/infrared thermometers have working batteries.**

Materials in the Kit

- 10 densiometers
- 7 clipboards
- 7 Data Collection packets
- Golf pencils
- 6 Kestrel pocket meters
- 6 infrared thermometers
- 6 thermal cameras + charging supplies
- 7 tree identification guides
- Extra AAA batteries

Safety Information:

- This program involves collecting measurements in natural areas, which may involve entering tick habitat. Long pants and insect repellant are recommended.
- Before this lesson, scout the areas where data collection will take place for poison ivy, stinging/wood nettle, or thorned plants. Modify the data collection location to avoid these plants.

Program Activities:

1. Introduction: Ask participants to line up on the path by the barge boathouse. Point to the barge and the island and say that in order to hike on Blackhawk Island, we must paddle to barge from the dock on the mainland to the island dock. Every person on the barge must wear a Personal Flotation Device (PFD). Model how to put on and tighten a PFD and the "check" (have a partner try to lift up the shoulders of the PFD you're wearing; it should stay secure). Pass out appropriately sized PFD's and assist participants in tightening and testing the PFD's. Then take a paddle and explain that 14 lucky participants (7 per side of the barge) will be providing the power to get to the island dock. Model how to rest the paddle blade on your close-toed shoe (NOT the blade on the ground). Ask for volunteers to paddle (or select, depending on the size/ability of participants). Pass out the paddles to participants and **keep one for yourself**. Paddlers should line up FIRST, but NOT walk down the ramp until you tell them to.

2. Loading the barge: You are the first person on the barge. Model for participants the parts of the barge they should step on (front, stair, and bottom grate), and parts they shouldn't (benches, middle, or outside gunwales). Ask the paddlers to walk down two at a time and split the paddlers to the outside of the barge benches (closest to the sides of the barge). Load all 14 paddlers. Then ask the non-paddlers to walk down two at a time and split the non-paddlers to the inside of the barge benches (closest to the center board where the boats are bolted together). Ask all participants to angle their knees to point towards the front of the barge (where you are standing). Differentiate the sides of the barge by giving each side a name (EX: port side = peanut butter, starboard side = jelly). Check for understanding by asking each side to raise their paddles where they hear their name.

3. River Crossing: Model how to hold the parts of the paddle (inside hand on the top or "grip," outside hand just above the blade, or "throat".) Demonstrate how to paddle forward (reach forward with the blade, put it in the water, and pull back). Model how to paddle backwards (reach behind you with the blade, put it in the water, and pull forward). Demonstrate "break" (put the paddle on your knees). Untie the barge, push off, and begin giving paddling instructions. You have a paddle to help steer the barge more effectively toward the dock. Have the participants begin paddling toward the Blackhawk Island dock. You may have to assist with paddling or steering.

Once landed and tied off on the Blackhawk Island dock, have the participants stay seated while you model what to do (wear PFD until on the landing, take off and clip the top clip over the railing). Wear your PFD back onto the barge and unload the middle of the barge first. Then have the paddlers lay their paddles down on the grate on the opposite side of the bench (where the non-paddlers were just sitting) and unload. You are the last person to leave the barge. Check that all PFD's are clipped to the railing before giving further instructions.

4. Background: Tell participants this program is called "Microclimates on Blackhawk Island." Check for understanding by asking participants what they think of when they hear the word "microclimate." It may be helpful to define "micro" and "climate" separately. **Micro** = very small; **Climate** = the average weather in a place over a long period of time. Ask how climate differs from weather.

Weather = the day-to-day state of the atmosphere which varies from minutes to hours to days.

Use multiple participant responses to develop a group definition for microclimate:

Microclimate is the **climate of a very small area that differs from the surrounding climate**.

Ask participants to brainstorm why the microclimate in one area might differ from another area? Some answers include:

1. Elevation (EX: the top of a hill vs. the bottom of a valley)
2. Land use (EX: a paved parking lot vs a natural area)
3. Large bodies of water (EX: areas along coasts are cooler than areas a few miles inland)
4. **Aspect**

The last term is what we'll be studying today to answer the Essential Question. At our latitude (43°N) the sun is never directly overhead, so the sun's rays are always hitting the earth at an angle. Ask participants what **latitude** means (how far north or south a place is from the equator*). If the sun is directly overhead at the equator, what does this mean for how the sun's rays hit the earth where we are?* As a hint, ask participants what the climate is like in Florida vs. in Wisconsin. Based on this information, do the sun's rays hit the south or the north more? (South). On a hill, the side facing south will receive more direct sunlight than the side facing north. Ask participants *which side of the island they are on now?* (South side).

So what is aspect, and how does it relate to the Essential Question? Use multiple participant responses to develop a group definition for the word:

Aspect is the term used to describe **which direction a hill faces with respect to the sun**.

***Essential Question*: How are the habitats on the north and south sides of Blackhawk Island different?**

Tell the participants you will revisit the Essential Question at your first stop. Hike to the Dell House Beach or other designated spot.

5. Field investigation equipment & procedure (Site #1):

Today, each group of participants will be part of a team to study the microclimate in two habitats to answer the Essential Question (6 teams, 4 youth per team). Ask youth to self-select into 6 teams, or ask teachers to form teams.

Pass out the Data Collection packets and clipboards to the individual in each team with the best hand writing. This person will be the **Data Recorder.** Ask a participant to read the Essential Question. Ask the participants, "*If you know the south side of the island receives more sunlight than the north, what could we measure to determine how the habitats are different on the north side of the island compared to the south?*" Brainstorm some ideas (bolded characteristics are data the participants will collect and record):

1. **Temperature**
2. **Wind speed**
3. **Humidity**
4. Soil moisture
4. **Plant species present**
5. **Animal species present**
6. **Canopy cover**

Then, as a team, groups should answer questions #1 and #2 on their Data Collection Sheet. Give groups about 5 minutes to do so.

When finished, explain that each team member has a role and a set of tools to use.

1 - **Data recorder**: keeper of the data sheet/clipboard/writing utensil + infrared thermometer
2 – **Wildlife biologist:** observes and reports animal signs (burrows, nests, tracks, chew marks, scat, calls/songs, live animal sightings, etc) + thermal camera
3 - **Climate scientist**: keeper of the Kestrel (measures and reports air temperature, wind speed and humidity)
4 – **Forester**: measures and reports % canopy cover (densiometer) + tree identification with field guide (for younger youth, consider counting different species based on leaves/bark instead of identifying species, or use the Younger Microclimates Data Collection Journal pages)

The procedure for each stop where data is collected is outlined below. Each team member will collect data three times at each stop point. Participants should always be within the boundaries you set for data collection but should spread out to try to take data from three distinct areas within the habitat.

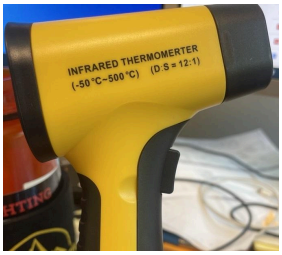
*If participants have not already been matched with a role, take a few minutes to divide students into teams of 4-6. For teams of 5-6, double up on the roles for Data recorder.

**If participants have not already been introduced to the tools (Kestrel pocket meter, densiometer, and thermal camera), demonstrate how to use each of the tools while a participant reads the instructions for that tool below.

***SAFETY INFORMATION: Students **MUST NOT** look into the laser pointers of the thermal camera or infrared thermometer!! These tools should **NEVER** be pointed in a person's face, nor should they be looked into by the operator. Doing so can cause damage to vision! If the instructor witnesses misuse of the tool, the operator will lose the privilege of using the tool.

Procedure:

Each group member is responsible for reporting to the **Data Recorder** their findings. The **Data Recorder** is also responsible for working with the **Wildlife Biologist** to find the areas of maximum and minimum temperature, and recording on the data sheet.

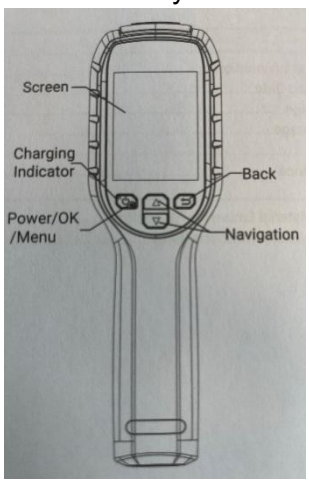


#1: Data recorder: write all data provided by group members onto the data sheet.

The Infrared thermometer measures surface temperatures.

1. Turn the thermometer on by pressing the trigger
2. Turn OFF the laser pointer function by pressing the button with a light inside a triangle
3. Change units by pressing the deg C/deg F button
4. Turn on the screen light by pressing the light bulb button
5. **Write down the maximum and minimum surface temperatures on the Data Sheet**

#2 - Wildlife biologist: within the area specified by your instructor, search for signs of animal activity (burrows, nests, tracks, chew marks, scat, calls/songs, live animal sightings, etc.) It is okay to not know for certain what made these signs, but you should make an educated guess based on what you see.



Using the thermal camera, locate areas of the greatest temperature difference within the area specified by your instructor and describe on the data sheet.

1. Turn the thermal camera on by pressing the red power button. Note the vertical color and temperature scale on the right side of the screen (blue shows colder, red shows hotter).
2. The Max and Min temperatures are on the top left in white.
3. The red & blue cross hairs show the hottest and coldest points in the view.
4. On the data sheet, draw or describe the area in the habitat with the greatest temperature difference.
5. **Report all evidence of animal activity observed to the Data Recorder.**

 # 3 - Climate scientist: To determine the temperature, wind speed and humidity:

1. Turn the Kestrel pocket meter device on by pressing white circle button with a line through it.
2. Use the down arrow to scroll through wind speed, temperature and humidity. NOTE THE UNITS on the screen (mi/hr and deg F).
3. Hold the Kestrel towards the wind with the screen facing you. (If a plastic cover is over the impeller, open the plastic cover to allow air to pass through the impeller). You will see the impeller spin if the wind is blowing. **Report the wind speed number and units to the Data Recorder.**
4. Use the down (*or right*) arrow button to scroll to the temperature. **Report the temperature number and units to the Data Recorder.**
5. Use the down (*or right*) arrow to scroll past wind chill to humidity. **Report the % humidity to the Data Recorder.**
6. Repeat this procedure two more times for 3 locations total, each time **reporting results to the Data Recorder.**

#4- Forester

1. How much canopy of trees overhead can be measured with a densiometer as a percentage.
    - ❖ If there are no trees overhead, that would be rated as 0% canopy cover.
    - ❖ If half of your view overhead is trees and half is sky, that would rate as 50% canopy cover.
    - ❖ If you can only see trees overhead and no sky, that would rate as 100% cover.

38%

50%

2. Hold the densiometer (toilet paper tube with cross hairs) up to the sky straight overhead. Estimate how much of your view of the sky is blocked by tree canopy by choosing a number between 0 and 100.
3. **Report the % canopy cover to the Data Recorder**.
4. Repeat this procedure two more times for 3 locations total, each time **reporting results to the Data Recorder.**
5. Using the tree identification guide, try to identify a few common trees. **Report the tree species to the Data Recorder.**

Give participants about 10 minutes to collect data and report to the Data Recorder. Provide time checks so participants know how much time remains. Before leaving the site, gather all the groups together and point out the major plant species in the area. For the south side of the island, this may include: *red pine, white pine, Pennsylvania sedge, huckleberry*, and others (see Appendix for botanical list). **Data recorders should write the plants identified on the data sheet.**

Ask participants to hold on to all their materials as you hike to the second stop (Upham caves).

6. Field investigation (Site #2): Before beginning data collection again, ask a participant to read the Essential Question. Without any data, ask participants *how does this place feel different from the previous location where they took measurements*?
Tell participants this is the north side of the island where they will collect microclimate data.

Reiterate the guidelines:
Each team member will collect data three times. Participants should always be within the boundaries you set for data collection but should spread out to try to take data from three distinct areas within the habitat.

Give participants about 10 minutes to collect data and report to the Data Recorder. Provide time checks so participants know how much time remains.

Gather all the groups together and point out the major plant species in the area. For the north side of the island, this may include: *eastern hemlock, yellow birch, basswood, maidenhair fern, bracken fern*, and others (see Appendix for botanical list). **Data recorders should write the plants identified on the data sheet.**

Before departing, tell participants they now have the data they need to answer the Essential Question. Ask participants to hold on to all their materials as you hike to the third stop (Snider Homestead, other designated spot, or hike back to the barge landing).

7. Summarizing the data (Site #3): Ask groups to share out the data they collected using some guiding questions:

    1. Which habitat had a higher average temperature? How did the humidity compare between the two habitats?
    2. Which habitat had the greatest difference between maximum and minimum temperatures?
    3. How was the canopy cover different between the two habitats? How was the wind speed different?
    4. What plants were identified in each habitat? Were some plants found in both?
    5. What animal signs were observed in each habitat? Were some animal signs found in both?
    6. How would you answer the Essential Question: "***How are the habitats on the north and south sides of Blackhawk Island different?"***

8. Why changes in microclimate matter:

Tell participants they have just compared the microclimates of two different habitats. Ask participants how they think this information is useful? If students struggle, suggest that scientists and foresters often track the populations of where plants and animals are found. If the microclimate of an area changes, how will that impact where plants and animals are found?

- Mushrooms, mosses and ferns grow best in moist, humid, shaded environments. If the microclimate becomes hotter and drier in an area, they may not survive as well and their populations may be reduced or even disappear.
- Amphibians like salamanders, newts, frogs,and toads need water, often ponds, to reproduce. If an area is warmer and drier, they may not reproduce as successfully. If an area becomes warmer and wetter, they may be more successful at reproducing.
- Warmer and wetter climates are better for fungus, some of which causes disease in amphibians. They may become more vulnerable to fungal infections.
- In winter, reptiles and amphibians hibernate in soil or in the bottom of waterways. If the microclimate is warmer in winter, they may have to burrow deeper into the ground or the river bottom to stay cold enough to hibernate successfully.
- If there is more rain and less snow in winter, animals like small mammals may be less successful because they shelter in deep snow cover for insulation.
- Animals with big, 'snowshoe' feet, like snowshoe hares, lynx, and wolves, survive better in winters with deep snow as they're better adapted to move through it than deer and other mammals with small feet. More rain and less snow may reduce populations of snowshoe hare, lynx and wolves.
- Warmer winters may not get cold enough to freeze insects, so insects may move into areas they've never been before. This may mean plants may now face insect predators they've never faced before.
- As insect populations move, some birds that eat insects may change their migration patterns.

9. Is the climate changing in Wisconsin & the world? The facts:

Globally, some parts of Earth are warming faster than others. But on average, global air temperatures near Earth's surface have gone up around 2 degrees Fahrenheit in the past 100 years[1].

- Wisconsin is experiencing more 80+°F degree days statewide in June, July, August, and September.[2]
- LaCrosse is getting warmer on average in both the winter and summer compared to historical data going back to 1945.[3]
- Summers in Door county are getting warmer on average compared to historical data going back to 1910.[3]

- Wisconsin has become about 10-20% wetter since 1950, but the increase is not evenly distributed across the state: southern and central Wisconsin have experienced the biggest change.[4]
- Wisconsin's average winter temperature (December, January, February) has already increased on average 4-7 °F from 1950-2024.[5]

The Wisconsin Initiative on Climate Change Impacts (WICCI) predicts that Wisconsin's climate will continue to change in several ways:

- An average annual mean temperature increase between 2-8 °F.[5]
- More 90 degree or higher days.
- Annual average precipitation will likely increase by 2050, especially during fall, winter and spring.
- In winter we are likely to see more precipitation as rain rather than snow.
- Animals and some plant species likely to migrate farther north, but some tree species are migrating farther west.[6]

10. Conclusion

By collecting microclimate data in different habitats, youth are helping to investigate and track changes in microclimate. Collecting data on a regular basis enables us to document changes over time and helps us determine what we can expect in the future. It helps us predict migration pattern changes for plants and animals. It helps us understand how growing seasons are changing and how the ranges for plants might be expanding or contracting in the future. It also gives us an opportunity to take action to slow or lessen changes we do not like and work towards preparing for climate changes in the future.

Thank the youth for investigating the microclimates of different habitats today. Ask for ideas on how they could independently track changes over time in Wisconsin's climate (when robins return in the spring, when frogs start calling, when maple sap starts running, when lakes freeze over or ice off, when plants leaf out or bloom, etc). Encourage the youth to talk to their parents, grandparents, neighbors, farmers, or others in their community about whether and how Wisconsin's climate is different now compared to how it was when they were growing up.

Before departing, collect all of the materials and tools from all the participants. Tell participants you are about to head back to the dock and return to the mainland. This time, different people can paddle (if desired). They can think about whether or not they want to paddle on the short hike back to the dock.

11. River Crossing: At the landing, ask all participants to find their PFD, put it on, and conduct the "check" for snugness (lifting up on the PFD shoulders) just like they did before coming over. Paddlers, whether same or different, will load by twos (splitting to opposite sides of the barge). Demonstrate once again where participants should and should not step. Paddlers can pick up a paddle from the inside of the barge after they are seated. Then load non-paddlers.

Review how to hold the paddle correctly and how to paddle forward and backward. Use the same names for sides of the boat (EX: port side = peanut butter, starboard side = jelly), or choose new names. Check for understanding by asking each side to raise their paddles where they hear their name.

Untie the barge, push off, and begin giving paddling instructions. You may have to assist with paddling or steering as now participants are moving against the current. Once landed and tied off on the mainland dock, have the participants stay seated while you model what to do (wear PFD until on the pavement, take off and clip the top clip. Then **hold onto it.** Demonstrate for paddlers how to rest the paddle blade on your close-toed shoe, not on the ground. Wear your PFD back onto the barge and unload the middle of the barge first. Then unload paddlers, carrying their paddles. When all are on the pavement, ask a few adults to help in collecting PFD's by gripping the

left shoulder for 4-5 of them. Meanwhile, collect the paddles and hang up in the boathouse. Then hang the PFD's in bunches on pegs from the left shoulder.

Coordinate with the group leader on whether to hand back Data Collection sheets at that time, or at a later point. Thank all of the participants for being great team members for paddling and data collection to answer the Essential Question.

References:

1. climate.nasa.gov
2. https://www.ncei.noaa.gov/products/land-based-station/nclimgrid-daily
3. https://mrcc.purdue.edu/newclimate/home
4. https://dnr.wisconsin.gov/climatechange/science
5. https://wicci.wisc.edu/wisconsin-climate-trends-and-projections/
6. Fei, S., Desprez, J. M., Potter, K. M., Jo, I., Knott, J. A., & Oswalt, C. M. (2017). Divergence of species responses to climate change. *Science Advances*, *3*(5), e1603055.

Appendix A: Additional Background Information

I. Forest Types

Blackhawk Island and the Wisconsin Dells area are at the bottom part of the Wisconsin tension zone. A tension zone is a geographic area that marks the change from one vegetation type to another. In Wisconsin, the tension zone marks the difference between mostly prairie habitats and mostly boreal habitats; plants and animals representing each habitat type can be found in this zone.

Ecological communities flourish or perish depending on their environmental conditions. The types of plants and animals that make up the community may change through a process called succession. On Blackhawk Island, the evidence of forest succession can be seen by studying the variation in trees and tree ages. The island was once home to towering red and white pines. Once those were all clear-cut, oaks were given the opportunity to germinate in the open sunlight, creating the towering oaks you see now.

I. Biotic Communities of Blackhawk Island

As participants hike around Blackhawk Island, be sure to note the different forest types. Differences in forest types on the island can be observed when following the Overland or Narrows Trail to the north and northeast side of the Island, where the habitat changes from Dry-Mesic forest to Hemlock Moist Forest.

1. Hemlock Relict Forest: This forest type is associated with moist sandstone cliffs and ravines with eastern or northern exposure. Plant life typically includes eastern hemlocks, white pine, yellow birch and paper birch. Ferns and club mosses are the dominant ground layer, although often sparse due to the lack of light reaching the ground because of dense hemlock shade.

2. Southern Dry-Mesic Forest: This forest type is associated with loamy soils and is considered an upland forest community dominated by red oak, white oak, basswood, sugar maple and red maple. Characterized by a diverse understory including ferns and spring ephemerals.

3. Northern Dry- Mesic Forest: This forest type is associated with glacial topography with sandy or loamy soils. Dominated by white pine and red pine, with occasional mixing with red oak, red maple, sugar maple, paper birch, and aspens and a shrub understory. Historically considered the "great pineries", this forest type's biggest factor of change is logging disturbances.

4. Dry Cliff Communities: This community is found on the exposed Cambrian sandstone gorges flanking the Wisconsin River. It includes ferns, mosses, and lichens covering the moist rock faces. This diversity of smaller fauna helps to create small microclimates to support spring ephemeral and rare plant communities. Five endangered, threatened or species of special concern have been recorded on the island: maidenhair spleenwort, bird's-eye primrose, Sullivant's coolwort, cliff cudweed, and putty root orchid.

Appendix B: Blackhawk Island
Botanical List 8/15/94

Deer Exclosure 1 – Fenced off area (1/10 acre) on the White-tailed Trail just off the Overland Trail

Red Maple	Point-Leaved tick trefoil	Smooth Solomon's Seal
Maidenhair fern	Fern	White Lettuce
Hog peanut	Bedstraw	Bracken fern
Wild sarsaparilla	Wild Geranium	Red Oak
Jack-in-the-pulpit	Witch-hazel	Red Oak
Sapling staged ash	Spotted St. John's Wort	Raspberry
Large leaved aster	Canada Mayflower	Bristly greenbrier
Pennsylvania sedge	Partridegeberry	Rosy twisted stalk
Ironwood	Indian pipes	Basswood
Blue cohosh	Interrupted fern	Elm seedling
Yellowbud Hickory	Wood sorrel	Wild oat
Enchanter's nightshade	Panicum grass	Yellow Violet
Dogwood	Woodbine	
Honewort	White Pine	

Deer Exclosure 2 – Fenced off area (1/10 acre) on the Narrows Trail

Red Maple	Hickory	Orchid species
Sugar Maple	Blue cohosh	Clearweed
Baneberry	Enchanter's nightshade	Red oak
Maidenhair fern	Large coralroot	Buttercup
Hog Peanut	High bush honeysuckle	Black raspberry
Wild sarsaparilla	Fern species	Common elder
Jack-in-the-pulpit	Bedstraw species	Nodding pogonia
Ash Seedling	Wild geranium	Nettles
Grass	Witch-hazel	Violet
Pennsylvania Sedge	Round-lobed hepatica	

Boat Landing/ Allen Spring Gulch

Red Maple	Poverty grass	Jack pine
Silver Maple	Flowering spurge	Red pine
Sugar Maple	Black huckleberry	White pine
Lyre-leaved rock cress	Frostweed	Wild basil
Yellow birch	Hawkweed	Gray goldenrod
River birch	Round-headed bush clover	Spiderwort
Harebell	Panicum grass	

Dell House Area

Common ragweed	Indian tobacco	Common cinquefoil
Pussytoes	Wood sorrel	Heal-all
Calico aster	Panicum grass	Prickly ash
White snakeroot	Lopseed	Burnweed
Rattlesnake plantain	Plantain	Red-topped grass

Understory and Overstory of Black Hawk Island

Red maple	Pennsylvania sedge	Oak (variety)
Sugar maple	Ironwood	Basswood
Japanese barberry	Indian pipes	Hemlock
Yellow birch	Hophornbeam	