LESSON 5
Habitat Assessment

NUTSHELL
Students work in small groups and use wildlife habitat requirements to assess potential animal habitat based on map interpretation, plant and forest inventory information, on-site forest composition and structure, and wildlife habitat needs.

BIG IDEAS
There is biodiversity within a forest. Different forests have different levels of biodiversity. (Subconcept 7)

Forests impact air and water quality, prevent soil erosion, and provide habitat for wildlife. (Subconcept 25)

OBJECTIVES
Upon completion of this lesson, students will be able to:
- Identify specific components of the forest that provide wildlife habitat.
- Assess the value of an area of the forest as habitat for a wildlife species.

SUBJECT AREAS
Science (biology, natural resources, wildlife, forestry)
Social Studies (geography)
Math

LESSON/ACTIVITY TIME
Total Lesson Time: 640 minutes (includes 345 minutes of student work time)

Time Breakdown:
Introduction – 10 minutes
Activity 1 – 60 minutes (includes 30 minutes of student work time)
Activity 2 – 180 minutes (includes 150 minutes of student work time)
Activity 3 – 120 minutes
Activity 4 – 60 minutes
Activity 5 – 180 minutes (includes 165 minutes of student work time)
Conclusion – 30 minutes

TEACHING SITE
Classroom and forested site

VOCABULARY
Limiting factor: something that controls (limits) growth or species population size or distribution. The availability of food, water, shelter and space as well as competition for resources, predation and disease are examples of limiting factors.
Interspersion: the spacial relationship between the different habitats a species needs.
Mast: is the reproductive bodies of plants that serve as wildlife food sources. Mast is often divided into categories of "hard mast" and "soft mast". "Hard mast" describes hard-shelled seeds, such as acorns and hickory nuts. "Soft mast" describes seeds that are covered with fleshy fruit, such as apples and berries.

MATERIALS LIST

The materials listed below are based on an example habit assessment protocol. During this lesson students develop their own habitat assessment protocols, which will include necessary materials. Actual material needs will be determined by the students and will vary by class.

For The Teacher
- Copy of Teacher Page 🦋1, *Example Habitat Assessment Protocol*

For Each Student
- Wildlife habitat information resources (see resource list)
- Clipboard

For Each Group of 4
- 100' Tape
- Diameter tape or tree scale stick
- 2 compasses (optional)

TEACHER PREPARATION

Make arrangements for a trip to the school forest (or other forested area)

SAFETY PRECAUTIONS

Visit the teaching site ahead of time to locate any hazards such as holes, hanging branches, protruding tree roots, poison ivy, etc. Encourage students to walk at all times. Consider these:
- Are you in sight or earshot of students?
- Are boundaries for students marked?
- Have you set expectations for being out of the classroom?
- Do you have a whistle, first aid kit, insect repellent, water, and sunscreen?
- Is everyone dressed appropriately?

BACKGROUND INFORMATION

All wildlife need appropriate habitat. Habitat must provide the basic needs of wildlife: food, water, shelter, space, air. All habitat components must exist in sufficient quantity, quality, and arrangement to support a species. The specific habitat needs vary by species.

Forest habitat components can be identified and compared to species needs to determine if the forest can provide habitat for that species. There are a number of scales and components to identifying appropriate habitat. These include:
- Species distribution/range – whether the species occurs in the geographic area of the forest
- Composition – the variety of plant species in an area
- Structure – the horizontal and vertical distribution of layers in a forest, including height, diameter, and species present.
- Interspersion of habitats – wildlife species often have different requirements during different seasons of the year. Interspersion is the relationship between the different habitats a species needs.
- Minimum area – the minimum area of contiguous habitat that is required before an area will be occupied by a species. Many wildlife species have minimum area preferences, that is, regardless of the quality of habitat, size may be a limiting factor.
- Availability of food – often the availability of food is a key determinant of habitat suitability. Carnivorous species, especially, are most often limited by food availability rather than other habitat components.

- Nursery – in general, the nursery area incorporates multiple habitat aspects of food, water, shelter, and space. Most species have specific needs related to where young will be raised. The quality of the nursery area greatly affects the species population and ultimately its future existence.

PROCEDURE
INTRODUCTION – WHAT IS HABITAT?
1. Discuss with students what they need to survive. Stressing needs, not wants, use the ideas to create a list of basic human needs. This should include food, water, shelter, space, and air.
2. Ask the students what wildlife needs to survive and create a list. Compare the lists. Explain to students that an animal's habitat must provide these basic needs. In this lesson, they will be assessing the wildlife habitat value of the area of the school forest or another identified area.

ACTIVITY 1 – HABITAT COMPONENTS
1. Work with the students to brainstorm a list of wildlife species that might be found at the school forest. Write all of the species on the board. At this point, do not remove any species that wouldn't likely be found at the forest.

2. Have each student select a wildlife species of interest from the list. Encourage them to select diverse species so that different taxonomic groups and species with diverse habitat needs are represented. Assign students to research its range to confirm that it could be found at the school forest. If, based on their research, students discover that their selected animal does not occur in the area of the school forest, have them select a different animal.

3. Once the students have a species that could occur in the school forest area, have them generate a generalized set of habitat requirements. The information generated will be used to develop a survey protocol to determine habitat suitability for a variety of species. Students can utilize the internet, field guides, and the USGS Habitat Suitability Index publications ("Habitat Use Information" section). Have students look for specific habitat requirements for their species.

4. Divide students into groups of four. Based on their species' requirements, have the student groups develop a generalized list of habitat components (e.g., a species requires trees >10" diameter: generalized, this would be tree size; a species requires 100% canopy closure: generalized, this would be canopy closure).

5. Have students share their lists of habitat components to create a master list of generalized habitat components. If not included, guide the students to include the following components:
   - canopy structure (layers)
   - canopy closure
   - size of trees
   - species of trees
   - shrub layer density
   - composition of shrubs
   - ground/herbaceous layer density
   - species of herbaceous plants (optional)
   - existence of snags
   - size of snags
   - degree of soil cover
   - existence of woody debris on forest floor

ACTIVITY 2 – DEVELOPING A HABITAT ASSESSMENT PROTOCOL

1. Working with the list created, assign student groups habitat components for which to develop a survey protocol or identify if the data has already been collected in a previous activity. The groups need to identify what information will be collected, how it will be collected (e.g., plot size, sampling method), and what tools will be needed (tools that they have used in previous lessons). Assign each group multiple components. Have at least two groups develop a protocol/identify data already collected for each habitat component.

   Alternative: Utilize the example protocol on Teacher Page ❦1, *Example Habitat Assessment Protocol*. Assign student groups each of the habitat components to be surveyed. They will be responsible for gathering the necessary tools and teaching the rest of the class how to conduct that component of the survey.

2. Have groups present their protocols or data sources to the class. Discuss any differences between groups with the same components.

3. Identify and review what information still needs to be collected during the next visit to the school forest. Have student groups develop data sheets to collect the field data. See Teacher Page ❦2A-C, *Example Habitat Assessment Datasheet* for an example.

ACTIVITY 3 – CONDUCTING THE HABITAT ASSESSMENT

1. Have groups train other groups on protocols. Each group will be responsible for sharing their protocol with the other groups and ensuring that each group member has the skills and information necessary to conduct the assessment. This can be done in the classroom or in the field.

2. Based on data that still needs to be collected, groups conduct the assessment at the determined location of the school forest using the tools and data sheets developed by the students or the examples provided.

ACTIVITY 4 – DATA SHARING AND ANALYZING

1. Have each group present their data to the class. Have them record their data on the board or in a spreadsheet.

2. Following presentation of all the data, have groups compare and contrast the results from each group. Is all the data reasonable? Why is there variability? (*No two areas are exactly alike.*) What should be done with the data for it to be useful? (*Averaging and converting to a per acre basis.*)

3. Following the discussion, have each group analyze the data set. Groups can either analyze all of the data or data from a specific habitat component could be assigned to groups. Groups should calculate averages for each habitat component and convert the data to a per acre basis where appropriate.

4. Review the data with the class to ensure everyone has the correct information.

ACTIVITY 5 – DETERMINING SUITABILITY

1. Individuals or groups will select a wildlife species that could be found at the school forest and is one of the species for which Habitat Suitability Indices (http://www.nwrc.usgs.gov/wdb/pub/hsi/hsiindex.htm) have been developed. These can be the same species students researched earlier in the lesson. Students can choose from the following species:

Barred Owl	Gray Squirrel
Black Bear	Hairy Woodpecker
Black-Capped Chickadee	Marten
Bobcat	Moose
Brown Thrasher	Pileated Woodpecker
Downy Woodpecker	Pine Warbler
Eastern Cottontail	Ruffed Grouse
Eastern Wild Turkey	Snowshoe Hare
Fisher	Veery
Fox Squirrel	Yellow Warbler

   In some cases, students will need to access GIS maps or aerial photos *(see the LEAF 9-12 Field Lesson Geographic Information System)* to determine interspersion or size of habitat. Otherwise all the information needed to determine habitat suitability should be available from the data that has been collected.

2. The groups will use the Habitat Suitability Indices to determine if the area they inventoried is suitable for their species. Go over an example of utilizing the Habitat Suitability Index Model. Tips on utilizing the Habitat Suitability Index Model:

   - The first section of each document (the "Habitat Use Information") provides good background information on habitat needs of the species. For lower or average performing students, this may be the only information to be used to determine habitat suitability.

   - The "Habitat Suitability Index (HIS) Model" section provides more in-depth specific habitat requirements. However, the information gets very technical in places. The most useful information is contained in the charts (example below). Each chart represents one component of a species' habitat. The left side of the chart can be read as a percent (1.0 = 100%) with a 1.0 score representing the ideal habitat. In instances where more than one habitat component is utilized to determine suitability, overall habitat suitability is determined by complex weighted formulas utilizing the scores of all the components. Instead of calculating the suitability based on the formulas, students can estimate suitability by averaging the scores.

   - To read the charts, find the number at the bottom of the chart that represents the data collected by the class. Follow a vertical line up from that number until it intersects the line in the chart. From the intersection point, read directly across to the left to get the habitat suitability index. Note that areas are generally provided in hectares (ha). One hectare equals 2.54 acres; therefore, 0.4 hectares equals 1 acre.

- For example "a" below, if the basal area of oak trees (hard mast) in the plots was 50 square feet per acre, the habitat suitability index would be approximately .75 (or 75% of ideal). For example "b," if the data indicated that the school forest had 2 species of mast producing trees (e.g., red oak and shagbark hickory) per acre (0.4 ha), the suitability index would be 0.9 (90% ideal)

- Advanced students may be able to utilize the formulas provided to calculate the actual habitat index, but they are not required to get the necessary information to determine the quality of the habitat surveyed.
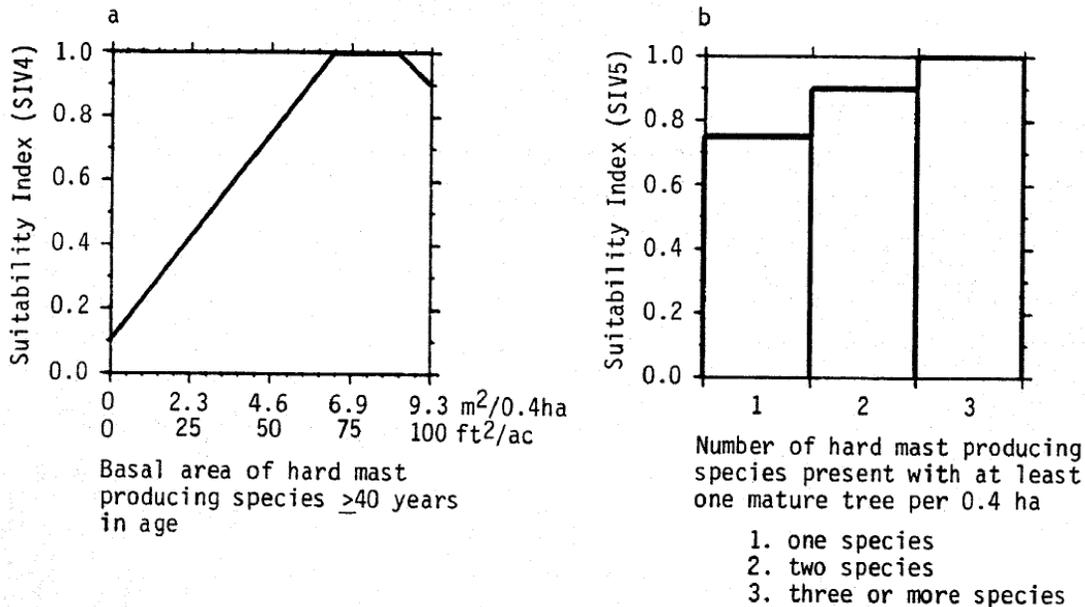

Figure 4. Relationships between habitat variables used to evaluate the availability of hard mast and suitability indices for the availability of fall food for black bears in the Upper Great Lakes Region.

3. Have students write a report on the suitability of the school forest as habitat for their selected species. Components of the report could include:
   - General overview of the species range and habitat requirements
   - Protocol for the data collected
   - Summary of the data collected
   - Discussion of the suitability of the forest as habitat for their selected species
   - Recommendations of how to make the forest better habitat for their species

CONCLUSION – IDENTIFY PROJECT IDEAS
Brainstorm with the class potential student project ideas based on their habitat assessments. Is there a need to improve habitat? How could this be done? Who else should be involved? What resources are needed?

SUMMATIVE ASSESSMENT
The data analyzation and habitat suitability determination will serve as the summative assessment. Data analyzation will require transferring concepts (scale, sampling) from previous activities. The suitability determination utilizes all the information collected in this lesson (and much what was collected in previous lessons) to evaluate the suitability of the area of the school forest surveyed as habitat for a specific wildlife species.

EXTENSION

1. Have a local wildlife manager visit the classroom. If the visit is prior to protocol development, have the manager discuss how they conduct habitat assessments and utilize the data. If it's after the students have drafted their protocols, they can present their protocol for feedback. If the manager visits after the students conduct their assessment, have students share their protocol and information and ask for the manager's feedback.
2. Have students present their assessments to the class. Begin the discussion of how to manage land for all of these different species. Are they all compatible? How does a manager decide for which species to manage? Are some species more important?
3. Utilize "trail" cameras to document wildlife on the school forest.
4. Have students research additional species (especially amphibians, reptiles, and insects) and develop habitat guidelines for those species.

RECOMMENDED RESOURCES

NRCS Fish and Wildlife Habitat Management Leaflets
http://www.whmi.nrcs.usda.gov/technical/leaflet.htm

USGS Habitat Suitability Index publications
http://www.nwrc.usgs.gov/wdb/pub/hsi/hsiindex.htm

Wisconsin DNR "Wildlife and Your Land" Publications
http://www.dnr.state.wi.us/org/land/wildlife/publ/wildland.htm

Peterson or National Audubon Mammal and Bird Field Guides

MODEL ACADEMIC STANDARDS

Agriculture Education C.12.2
Leadership
Standard is: Practice skills relating to communication, problem-solving, and decision-making through individual, group, and team processes.
Students work in groups to develop and conduct a wildlife habitat assessment of the forest. They collaborate to develop a protocol. Individuals play different roles in the group to collect and analyze information collected.

Agriculture Education E.12.2
Ecology/Environment
Standard is: Analyze benefits, costs, and consequences of land use

- Explain, design, and demonstrate projects that can improve wildlife habitat

Students develop and implement a protocol to conduct a wildlife habitat assessment of their school forest. Students utilize the data to assess the suitability of the habitat for a particular wildlife species. Based on the assessment, students brainstorm ways to improve the habitat of the school forest.

Agriculture Education E.9-12.1
Ecology/Environment
Standard is: Engage in applied learning opportunities emphasizing ecological and environmental principles.
Students conduct a wildlife habitat assessment of their school forest and utilize the information to determine habitat suitability for a particular wildlife species based on their forest plant species composition and structure.

English Language Arts A.12.4
Reading and Literature
Standard is: Read to acquire information
- Analyze and synthesize the concepts and details encountered in informational texts such as reports, technical manuals, historical papers, and government documents

Students analyze species specific habitat information found in the U.S. Fish and Wildlife Service "Habitat Suitability Index Models" to determine the habitat suitability of their school forest for a particular species.

English Language Arts B.12.1
Writing
Standard is: Create or produce writing to communicate with different audiences for a variety of purposes
- Prepare and publish technical writing such as memos, applications, letters, reports and resumes for various audiences, attending to details of layout and format as appropriate to purpose

Students write a report that explains their wildlife habitat assessment protocol and results, provides background on their wildlife species, describes the suitability of the school forest as habitat for their species, and makes recommendations for management to improve habitat for their species.

Environmental Education A.12.2
Questioning and Analysis
Standard is: Suggest possible investigations and describe results that might emerge from the investigations

Students develop a protocol to conduct a wildlife habitat assessment of their school forest. Students utilize the data to assess the suitability of the habitat for a particular wildlife species.

Mathematics B.12.5
Number Operations and Relationships
Standard is: Create and critically evaluate numerical arguments presented in a variety of classroom and real-world situations (e.g., political, economic, scientific, social)

Students utilize the wildlife habitat assessment data to determine the habitat suitability of their forest plot. Students discuss differences in interpretation of the information.

Mathematics D.12.3
Measurement
Standard is: Determine measurements indirectly, using
- estimation

Students estimate the density of canopy, shrub, and ground-level vegetation.

Mathematics E.12.1
Statistics and Probability
Standard is: Work with data in the context of real-world situations by
- Formulating hypotheses that lead to collection and analysis of one- and two-variable data
- Designing data collection plan that considers random sampling, control groups, the role of assumptions, etc.
- Conducting an investigation based on that plan

Students develop and implement a wildlife habitat assessment collection protocol that includes data collection tools and methods. Students analyze the information collected to create a written report explaining the protocol, results, habitat suitability, and recommendations for management.

MULTIPLE INTELLIGENCES

Verbal-Linguistic

Logical-Mathematical

Visual-Spatial

Interpersonal

Intrapersonal

Naturalistic

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Example Habitat Assessment Protocol

1. Select the area to be assessed. Identify plot centers to be used by different groups using a random sample generator or just have each group select their plot area.

2. Have students establish a plot center and plot boundaries for a 1/50th acre plot (radius = 16.7 feet). All measurements will be conducted in this plot.

3. Students document the number of layers that exist in their plot. There are 5 potential layers (litter layer, forb/herbaceous layer, shrub layer, understory layer, and overstory layer)

4. Students determine the species and measure the DBH (diameter at breast height) of all the trees greater than 4" DBH in the plots. Indicate which species are mast producing trees. Mast producing trees are trees that produce fruits or nuts. Common mast trees are oaks, hickories, walnuts, cherries, mulberries, apples, maple, and mountain ash.

5. Students determine the DBH and approximate height of all standing dead trees (snags). Students record notes on the type (hard/solid or soft/rotten) of snags and the presence of cavities in the snag.

6. Students estimate the canopy closure of their plot – the percentage of light blocked by the canopy with leaves on. The canopy is the layer of forest made up by the tops of the trees (canopies). 100% canopy closure means no sunlight reaches the forest floor, 0% means there is no canopy. Students select categories of canopy closure (0-25%, 25-50%, 50-75%, 75-100%).

7. Students estimate the coverage of the shrubs in the plot in categories (0-25%, 25-50%, 50-75%, 75-100%). Like, canopy closure, this is the percentage of sunlight that the shrubs are blocking from the ground. The shrub layer is consists of bushes and small trees below the tree canopy. Record the number and species of mast producing shrubs. Potential mast producing shrubs include hawthorn, June berry (service berry), hazelnut, and viburnum.

8. Students indicate the percentage of the shrub layer that is deciduous and evergreen.

9. Students estimate the coverage of the forbs/herbaceous layer in the plot in categories (0-25%, 25-50%, 50-75%, 75-100%). Coverage is the percentage of ground covered by non-woody plants (herbs/forbs) such as grasses, sedges, and flowers. Record mast producing herbs such as raspberry, blackberry, wintergreen, and bunchberry.

10. Students estimate the percentage of ground covered by downed woody debris (branches, fallen trees) in their plot. Estimates will be made in categories (0-10%, 10-25%, 25-50%, and >50%)

11. Students estimate the percentage of soil covered by leaf litter (decaying leaves and other plant materials) in categories (0-25%, 25-50%, 50-75%, 75-100%).

EXAMPLE HABITAT ASSESSMENT DATASHEET

☙2A

Habitat Assessment Worksheet

Group Members: _____

Date: _____

Plot size: _____   Plot radius: _____

Forest layers

Make a sketch of and label the layers of the forest found in the area of your plot

❦2B EXAMPLE HABITAT ASSESSMENT DATASHEET

Trees

1. Trees >4" DBH in the plot

#	Species	DBH	Mast Producing (yes or no)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

2. Snags (any standing dead tree >6' tall) in the plot

#	DBH	Comments on type (hard or soft), presence of cavities	Approximate Height
1			
2			
3			
4			
5			
6			
7			

3. Canopy closure in the plot: 0-25%   25-50%   50-75%   75-100%

EXAMPLE HABITAT ASSESSMENT DATASHEET ☙2C

Shrubs

1. Shrub closure in the plot: 0-25%   25-50%   50-75%   75-100%

2. Percentage of deciduous and evergreen shrubs: _____% Deciduous   _____% Evergreen

3. Species of mast producing shrubs

#	Species	Number in Plot
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Ground layer

1. Forb/herbaceous cover in the plot: 0-25%   25-50%   50-75%   75-100%

2. Downed woody debris coverage in the plot: 0-10%   10-25%   25-50   >50%

3. Soil coverage with leaf litter: 0-25%   25-50%   50-75%   75-100%

4. Mast producing forbs in the plot:

#	Species
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	