

Names: _____

Monitoring Forest Health

Today at Thorncrag Bird Sanctuary, we will examine the interdependent, complex forest system that people, plants and animals depend on.

Today, you will:

- Observe the natural surroundings and conduct a forest health checkup in a small area of Thorncrag Bird Sanctuary.
- Analyze and evaluate collected data regarding the ecological services provided by trees and forests.
- Use the information gathered about the ecological service of trees to describe the services and benefits of the local forested area.

In order to accomplish these objectives, you will need to:

<i>Description</i>	<i>Done</i>
1. Explore the Thorncrag Nature Preserve on the assigned trail to find your observation area.....	<input type="checkbox"/>
2. Determine a 11-16m ² plot of the preserve to analyze – the area must have an assortment of tree size and other growth.....	<input type="checkbox"/>
3. Use the string to mark your observation area.....	<input type="checkbox"/>
4. Conduct Forest Health Indicator: Size and Diversity – 11 to 16m²	<input type="checkbox"/>
5. Conduct Forest Health Indicator: Lichen Abundance – 2 trees	<input type="checkbox"/>
6. Conduct Forest Health Indicator: Snags and Debris	<input type="checkbox"/>
7. Conduct Forest Health Indicator: Regeneration	<input type="checkbox"/>
8. Conduct Tree Height Survey: Clinometers	<input type="checkbox"/>
9. Complete Forest Health Summary: Data summary	<input type="checkbox"/>
10. Complete Photography Requirements	<input type="checkbox"/>
11. Online activity: Evaluating Tree Benefits	<input type="checkbox"/>

Forest Health Indicator: *Size Diversity*

A healthy forest includes a variety of different plants and animals. One way to assess this diversity is to determine whether there is a mix of plant sizes and ages.

When there are different sizes and ages of plants, this creates “layers” of growth in the forest, each with it’s own special habitat.

In order to determine size diversity, we need to chart the DBH of the trees in your region. This will help us to see the various habitat layers in the area.

DBH – *Diameter at Breast Height* – is 1.3 meters or 4.5 feet

Method:

1. Mark off an area that is 11-16m² with the stakes provided. Make sure there is a variety of tree sizes in your designated area.
2. Once your area is set, inspect all of the growth (both large and small!).
3. Count the number of seedlings. Record in the table below.
4. Calculate the **DBH** for each tree. Record in the table below.
5. Calculating **DBH**:
 - a. Measure Circumference
 - b. Divide Circumference by π (3.14159)
6. **Photograph** size diversity among the plants of your forest plot.

SIZE DIVERSITY		
Tree Size	DBH	Number found in sample plot
Seedlings	< 4 inches	
Saplings	4-9 inches	
Small	10-14 inches	
Medium	15-19 inches	
Large	20-29 inches	
Giant	> 30 inches	

Forest Health Indicator: Layer Diversity

A healthy forest is comprised of various “layers” of organic growth that reflects relative health, age and biodiversity of the region.

7. Assess the presence or absence of different forest layers according to the *tree layer* descriptions in the chart below.
8. Using these descriptions, record your findings.
9. **Photograph** layer diversity among the plants of your forest plot.

FOREST LAYER DIVERSITY		
Tree Layer	Description	Present in sample plot? (Y/N)
Overstory	<i>Trees whose canopies are exposed to the sun.</i>	
Understory	<i>Trees growing in the shade of other trees.</i>	
Tall Shrub	<i>Shrubs greater than 6 feet tall</i>	
Short Shrub	<i>Shrubs less than 6 feet tall</i>	
Forb	<i>Plants such as ferns, wildflowers, and/or grasses</i>	
Leaf Litter	<i>Dead and decaying leaves and other matter on the forest floor</i>	



Forest Health Rating:

To determine the overall health rating of the forest, determine the rating of each category. Circle one point rating in the right column.

SIZE DIVERSITY RATING		
Rating	Description	Points
Good	<i>Three or more size classes present</i>	3
Fair	<i>Two or more size classes present</i>	2
Poor	<i>One size class present</i>	1

LAYER DIVERSITY RATING		
Rating	Description	Points
Good	<i>Three or more size classes present</i>	3
Fair	<i>Two or more size classes present</i>	2
Poor	<i>One size class present</i>	1

Overall Rating:

Determine the overall rating by adding up the points shown for **size** and **layer** diversity then divide the total by two to get the average score. Round to the nearest tenth.

$$\left(\frac{\quad}{\text{size diversity}} + \frac{\quad}{\text{layer diversity}} \right) \div 2 = \frac{\quad}{\text{average Overall Rating}}$$

What is the overall rating of your survey area?

Do you think this is comparable to other areas in the park?

Forest Health Indicator: *Lichen Abundance*

Lichens often grow on trees and shrubs, absorbing nutrients from the atmosphere. Because lichens are very sensitive to air pollution – particularly to sulfur dioxide, fluoride, and ammonia – their presence or absence is an indicator of forest health. The acidity of a tree’s bark can also affect lichen abundance. Some of the lichens lay flat on the tree surface, so get really close to the tree to see them.



A lichen is actually two different organisms – either a fungus and alga, or a fungus and a cyanobacterium – living in a symbiotic relationship. The fungus provides protection and moisture, while the alga or cyanobacterium provides food through photosynthesis.

Method:

1. In your survey area, identify two trees with a DBH greater than 20 inches.
2. Use a compass to determine North, South, East and West.
3. At each of the 4 directions at **DBH** (4.5 feet from the ground), place the 100 circle grid transparency against the tree.
4. Count each circle where lichen is present and record the data in the chart below.
5. For each tree, find the average lichen coverage by totaling the lichens found within the circles, and then dividing the total by 4 (for each direction).
6. **Photograph** a group member using the 100 circle grid transparency. Also photograph three different forms of lichens, if possible (Crustose, Foliose, and Fruticose.) Note: You may have to find these as you travel through the forest.

LICHEN ABUNDANCE						
	North	East	West	South	Total	Tree Average
Tree #1						%
Tree #2						%

6. Add the two tree averages and divide this total by two. This will give us the average lichen abundance in your survey plot.

Average Lichen Coverage for survey plot: _____ %

LICHEN ABUNDANCE RATING		
Rating	Description	Points
Good	> 5% coverage	3
Fair	3% - 5% coverage	2
Poor	< 3% coverage	1

Forest Health Indicator: *Regeneration*

Forest regeneration is a good measure of the health of the forest habitat. When a forest can produce enough young trees to replace the canopy trees when they are cut, blow down, or die, such production is an indication that the forest is vibrant and sustainable. Regeneration is measured by the number of tree seedlings present. For regeneration, you may have to measure out a separate plot as this forest tends to have groupings in a wide variety of locations.

Method:

1. Survey your plot and count the total number of seedlings present, both coniferous (cone bearing, needles, pine) or deciduous (leafy, maple, oak).
2. **Note:** tree seedlings are below waist height.
3. Record your data below.

Coniferous Seedlings Present: _____

Deciduous Seedlings present: _____

Total Seedlings: _____

A forest is considered healthy if at least 60% of the trees in your plot are seedlings:

4. Look back at the *Size Diversity* chart and total the number of trees in your plot:

Total Count of Trees: _____

5. What is the percentage of seedlings in your plot?

(Total Seedlings ÷ Total Count of trees) x 100 = _____ %

6. Give your plot a rating (circle one in the chart below):

REGENERATION RATING		
Rating	Description	Points
Good	> 60% seedlings	3
Fair	25% - 60% coverage	2
Poor	< 25% coverage	1

7. **Photograph** an example of both a deciduous and coniferous seedling.

8. Forest Health Indicator: Snags and Debris

In natural forest ecosystems, the examination of non-living organisms provides an indicator of forest health. What you will examine are the following:

Snags – *standing dead trees*

- look for trees with dry texture, and missing leaves and/or bark
- their presence indicates a forest of diverse ages

Woody Debris – *dead logs and large branches on the ground*

- these are larger in diameter, do not count smaller than arm-length twigs.
- their presence provides habitats for small insects and animals
- they contribute to stabilizing and rebuilding soil nutrients

Method:

1. Count the number of snags and the number of live trees in your survey area.
2. Calculate the percentage of standing trees that are snags.



SNAGS	
Number of snags	
Number of live trees	
Total number of standing trees (snags + living)	
Percentage of snags (snags ÷ total trees)	%

3. Count the number of logs and downed branches (longer than your arm)
4. Calculate the abundance of coarse woody debris.



WOODY DEBRIS	
Number of logs/branches	
Total number of standing trees (from above chart)	
Abundance of debris (number of logs ÷ total trees)	%

5. **Photograph** examples of snags and woody debris.

Forest Measurement Guide: Tree Height

Measuring the height of trees is somewhat difficult in a dense forest, but you can estimate a tree's height by using a **clinometer**. In order to use the instruments we have created, find a tree on fairly level ground, and stand far enough away that the top of the tree is visible.

Method:

1. Before measuring with the clinometer, establish the following distances:
 - a. **Eye Height** – *the distance from observer's eye to the ground*
 - b. **Step Length** – *the distance covered by one step of observer.*
2. Measure the distance from your eye to the ground; record this in the space.
3. Measure your step length and record in the space.
4. Find a level (flat) section of ground where the top of the tree is visible.
5. Measure the tree and complete the table for three separate distances in the range of 20 – 60 steps.
6. Locate the tangent value in the chart on the following page.
7. **Photograph** the tree, both close up and far away.

Eye Height: _____

Step Length: _____

Distance from tree (Step Length) x (# of steps)	θ <i>Angle measured</i>	$\tan \theta$	Height = Distance x $\tan \theta$	Total Height Height + Eye Level

What is the **DBH** of the tree you measured?

What is the average total height of the tree?

Which measurement is the furthest from the average?

Why would this measurement be more inaccurate than the others?

Tangent Chart

1. Find your measured angle in the left column of the chart ranging from 0° to 90° .
2. Your tangent value is paired in the right column.

Example: If the **Angle** = 26° then $\tan 26^\circ = .4877$

Angle	tan(a)
0.0	0.00
1.0	.0175
2.0	.0349
3.0	.0524
4.0	.0699
5.0	.0875
6.0	.1051
7.0	.1228
8.0	.1405
9.0	.1584
10.0	.1763
11.0	.1944
12.0	.2126
13.0	.2309
14.0	.2493
15.0	.2679
16.0	.2867
17.0	.3057
18.0	.3249
19.0	.3443
20.0	.3640
21.0	.3839
22.0	.4040
23.0	.4245
24.0	.4452

Angle	tan(a)
25.0	.4663
26.0	.4877
27.0	.5095
28.0	.5317
29.0	.5543
30.0	.5773
31.0	.6009
32.0	.6249
33.0	.6494
34.0	.6745
35.0	.7002
36.0	.7265
37.0	.7535
38.0	.7813
39.0	.8098
40.0	.8391
41.0	.8693
42.0	.9004
43.0	.9325
44.0	.9657
45.0	1.000

Angle	tan(a)
46.0	1.0355
47.0	1.0724
48.0	1.1106
49.0	1.1504
50.0	1.1918
51.0	1.2349
52.0	1.2799
53.0	1.3270
54.0	1.3764
55.0	1.4281
56.0	1.4826
57.0	1.5399
58.0	1.6003
59.0	1.6643
60.0	1.7321
61.0	1.8040
62.0	1.8907
63.0	1.9626
64.0	2.0503
65.0	2.1445
66.0	2.2460
67.0	2.3559
68.0	2.4751
69.0	2.6051
70.0	2.7475

Angle	tan(a)
71.0	2.9042
72.0	3.0777
73.0	3.2709
74.0	3.4874
75.0	3.7321
76.0	4.0108
77.0	4.3315
78.0	4.7046
79.0	5.1446
80.0	5.6713
81.0	6.3138
82.0	7.1154
83.0	8.1443
84.0	9.5144
85.0	11.430
86.0	14.301
87.0	19.081
88.0	28.636
89.0	57.290
90.0	infinite

Forest Health Summary: Data Summary

Use this page to tally the Forest Health Indicator investigations that you have conducted for your forest plot, while noting any key observations. Use the indicators to make an assessment of the forest's overall health.

FOREST HEALTH SUMMARY			
Forest Health Indicator	Overall Point Value (3, 2, 1)	Overall Rating (Good, Fair, Poor)	Key Observations
Size Diversity			
Lichen Abundance			
Snags and Debris			
Regeneration			
Wildlife (did you see any?)			
Averages/ Conclusions			

What is the Overall Health Assessment for your study plot? _____

Explain your reason:

Evaluating Tree Benefits:

1. Pick one tree to study, and use a resource of your choice to identify the species.

Example: Compare a photo to a field guide or online source

Tree Species: _____



2. Determine the tree's **DBH**, and then measure the tree's height.

You should use the information recorded in this packet.

DBH: _____ inches

Height: _____ feet

3. Visit the Tree Benefits website (<http://www.treebenefits.com>) to determine the ecological services that your selected tree provides by entering the species name and DBH (in inches).

4. Record you data findings below:

Overall Benefits

At current size: \$ _____ a year

If it continues to grow: \$ _____ a year

Stormwater

_____ gallons of stormwater intercepted a year

Property Value

\$ _____

Energy

Electricity conserved (for cooling): _____ kilowatt/hours

Oil/Natural gas conserved (for heating): _____ therms

Air Quality

Ozone (O₃), deposited: _____

Volatile Organic Chemicals (VOC), avoided: _____

Nitrogen Dioxide (NO₂), deposited: _____

Nitrogen Dioxide (NO₂), avoided: _____

Sulfur Dioxide (SO₂), deposited: _____

Sulfur Dioxide (SO₂), avoided: _____

Particulates less than 10 microns (PM₁₀), deposited: _____

Particulates less than 10 microns (PM₁₀), avoided: _____

Carbon Dioxide (CO₂)

Total pounds of atmospheric carbon reduced: _____

5. Describe any other ecosystem benefits provided by this tree (sketches and diagrams with brief descriptions are encouraged!).



**Materials in this packet all mimic and are adapted from:
Project Learning Tree - Exploring Environmental Issues: Focus on Forests
Monitoring Forest Health
American Forest Foundation**