Indicators of the Mixed-conifer Forest

Oregon State Standards

Science
7.1, 7.2, 7.2L.2, 7.2E.1
7.3
8.1, 8.2, 8.3, 8.3S.1, 8.3S.2
H.1, H.2, H.3, H.2L.2, H.2E.4

Vocabulary

- Conifer
- Hardwood
- Canopy
- Densiometer

Summary: Students learn about the mixed-conifer forests of the Pacific Northwest and conservation issues related to these habitats. Through direct observation and data collection, students have the opportunity to practice field research techniques and gain insight into bird-habitat relationships.

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Preparation Time: 15-30 minutes

Lesson Time: 60 minutes
This lesson can be adapted to be longer by having students collect more data. This will improve both the quality of the data, and opportunities to use the data for analysis or class research projects.

Grade Level: 7th-12th

Goals
- To introduce learners to the conservation issues associated with mixed conifer habitat
- To provide a structured exercise in natural resource data collection
- To encourage students make ecological connections between birds and their specific forest habitat type

Learner Objectives
Students will… .
- record observed bird species with use of binoculars and bird field guides
- work in groups to set up a research plot, and collect data related to bird habitat features and canopy density

Materials
- Student worksheets: Characterizing Forest Habitat Data Sheets
- Clipboards and pencils
- Binoculars
- Birds of Oregon Field guides
- Measuring tapes for each group (or pre-measured strings of 7.07m in length)
- Compass for each group (recommended)
- Densiometer

  Deensiometer substitute: Toilet paper roles can be used instead of a densiometer to aid the eye in estimating the percent canopy cover. Use tape and put two strings across one end of the role to make the opening divided into 4 sections. Using the strings as guidelines, look up through the toilet paper roll and estimate the percent canopy cover.

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Indicators of the Mixed-conifer Forest

Background Information

Southern Oregon is home to some of the most diverse conifers forests in the world. Overall the forest is heterogenous; few single species stands are found in these forests. This region contains around 30 different species of **conifer** trees. Conifers have either needle or scale leaves and are usually evergreen and cone-bearing. Douglas fir is the dominant conifer. Others species of conifer include Sugar Pine, Ponderosa Pine, Jeffrey Pine, Red Fir, White Fir, Port Orford Cedar, and Incense Cedar. The mixed-conifer forest is mostly composed of conifers but it is called "mixed" because it also contains some hardwoods. **Hardwoods**, also known as broadleaf trees are defined by having wide, flat leaves that are lost each year before winter. In the mixed conifer forest Tanoak is the most common hardwood and others include Golden Chinquapin, Pacific Madrone, Big Leaf Maple, and Canyon Live Oak.

The forest composition is characterized by the age and structure of various tree species. A tree offers different resources for wildlife at each stage of its growth. Even dead wood provides excellent habitat for a variety of organisms such as woodpeckers, insect larvae, black bears, amphibians, reptiles, fungi, small mammals, bats, moles, mosses, lichen, liverworts, bryophytes, mollusks, slugs, mites, microbes, bacteria, and fish. Dead wood on the ground provides nutrients for the soil.

The tops, or *crowns,* of mature trees collectively make up the **canopy** of a forest. The density of the forest canopy depends on the history and growth pattern of the forest. A simple tool that foresters commonly use to estimate the density of a forest canopy is a **densiometer,** a convex mirror with grid markings to aid the observer in measuring the canopy density overhead.

Forest structure can be quickly altered by land management activities. The conifer forests of the Northwest have primarily been influenced by timber production and harvest. Specific practices that alter forest structure include the suppression of fires, disease control, salvage logging, short harvest rotations, clear-cutting, slash and burning, herbicide application, and forest thinning. As a result of practices such as these, the forests have fewer large-diameter trees, fewer snags, fewer and less-well-connected late-successional stands, and greater likelihood of large scale fires because fire suppression policies have resulted in an increase in available fuel in the forest. These changes have influenced the structure of the forest and thus the habitat resources for wildlife. In the conifer forests of Oregon and Washington, 32 bird species have been in significant decline over the last few decades (Altman and Alexander, 2012)

Components of Forest Structure:

1) Seedling
2) Sapling
3) Pole tree
4) Young tree
5) Mature tree
6) Injured tree: wounded (signs of disease, discoloration, destruction)
7) Dead tree: snag or fallen tree

Spherical Densiometer

Used to estimating the % of overhead canopy cover

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Indicators of the Mixed-conifer Forest

Background Information continued

Mixed conifer forests are very important for bird populations. The temperate rainforests of the Pacific Northwest support the largest abundance of birds of any North American conifer forest. Food resources and shelter are rich and varied, providing birds with habitat. Many bird species depend on certain forest characteristics and their populations respond quickly if these characteristics are no longer present in the environment. For example, some species depend on ecological processes like fire to create early successional habitat. Other species may require large habitat patches. A focal species is an organism associated with important habitat attributes. A group of focal bird species can be chosen to represent the key habitat attributes in a given habitat type (e.g., mixed conifer forest) and this group of species can be monitored to ensure the key habitat attributes are present in that habitat; if the habitat is able to support all the focal species then it will be expected to contain sufficient diversity (structural, compositional) to support a wide range of wildlife. In short, the focal species are used as ecological indicators

Furthermore, focal species can be monitored to help us understand the impacts of land management actions and ultimately to improve land management. Because birds are vocal and numerous, many species can be surveyed using a single standardized methodology. Thus, using focal bird species to guide land management decisions is an inexpensive and reliable way to understand ecosystem patterns.

Prepare:

Optional: Conduct a lesson prior to the field trip on how to identify birds using field guides. See the KBO lesson: Using Bird Field Guides

- Read over background information
- Become familiar with how to use a densiometer (see "Investigate")
- Make copies and look over the student data sheets
- Choose an outdoor location to conduct the activity. Look for an area that has a mixed-conifer forest and is also easy for students to walk around. Use a map, or look online to find the elevation of the location.

Teacher tip: It will be helpful to gather information about the location so that you may inform students of other factors that have shaped this habitat. This can also be assigned as a study for students to take on either before or after they visit the forest. Example inquiries include: what is the land-use history of the area? What other habitat types are adjacent? Who currently owns and manages the land?

Focal Species Spotlight:

Vaux's Swift

is the smallest swift in North America, roosts (sleeps) communally in forest trees. By roosting in large groups of hundreds of birds, they are able to gain heat from their neighbors and save energy while sleeping on cold nights. During the day, they forage for insects in forest openings. Vaux's swifts also rely on coniferous and mixed forests for nesting. They prefer forests that have dead snags so that they can nest in tree cavities.

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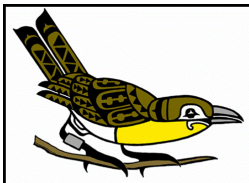

Indicators of the Mixed-conifer Forest

25 Bird Indicator Species of Oregon and Washington's Mixed-conifer Forest*		
Forest Condition	**Habitat Attribute**	**Focal Species**
Old-growth/Mature	Large snags	Pileated Woodpecker
Old-growth/Mature	Large snags	Brown Creeper
Old-growth/Mature	Deciduous canopy trees	Pacific-slope Flycatcher
Old-growth/Mature	Mid-story tree layers	Varied Thrush
Mature/Young	Closed canopy	Hermit/Townsend's Warbler
Mature/Young	Open mid-story	Hammond's Flycatcher
Mature/Young	Deciduous understory	Wilson's Warbler
Mature/Young	Forest floor complexity	Winter Wren
Young/Pole	Deciduous canopy trees	Black-throated Gray Warbler
Sapling/Seedling	Residual canopy trees	Olive-sided Flycatcher
Sapling/Seedling	Snags	Northern Flicker
Sapling/Seedling	Deciduous vegetation	Orange-crowned Warbler
Unique	Nectar-producing plants	Rufous Hummingbird
Unique	Mineral springs/seeps	Band-tailed Pigeon
Unique	Montane wet meadows	Lincoln's Sparrow
Unique	Alpine grasslands	American Pipit
Unique	Waterfalls	Black Swift
Unique	Large hollow snags	Vaux's Swift
Unique	Landscape mosaic forest	Blue (Sooty) Grouse
Klamath Mts. Mixed forest	Pine-oak canopy/subcanopy trees	Purple Finch
Klamath Mts. Mixed forest	Dense shrub understory	Nashville Warbler
Klamath Mts. Mixed forest	Shrub-herbaceous interspersion	Hermit Thrust
Klamath Mts. Mixed forest	Forest canopy edges	Western Tanager
Klamath Mts. Mixed forest	Montane brushfields	Fox Sparrow
Klamath Mts. Mixed forest	Post-fire	Lazuli Bunting

*(Altman and Alexander 2012)

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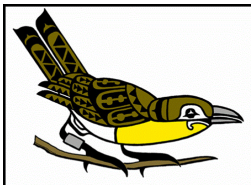

Indicators of the Mixed-conifer Forest

Discuss:

Have students come think of a definition for a "healthy" forest. After discussing their answers, explain that a "healthy" forest supports numerous forms of wildlife, provides ecosystem services (e.g., air purification, water purification, water retention, carbon sequestration), and is resilient and likely to persist.

Ask students to think of ways to determine the ecological "health" of a forest. There are many possible answers including measuring and comparing the types of plants, analyzing nutrients as part of a forest system, looking at the wildlife living within the forest, measuring the size/age of trees etc. If these sorts of things are measured over time and through changing circumstances, one can better understand the functioning of a forest.

Ask students to describe the forests local to their region. One of the predominant ecosystems of the Pacific Northwest is the Mixed-conifer forests. Discuss mixed conifer forests and their conservation issues (described in the background information). Explain how assessing the bird species in a forest is a good way to monitor a forest, especially over time.

Investigate

1. Tell students that they are now going to gather data to understand the forest type and what bird species they may find. Specifically this study will help to more accurately characterize the forest habitat.

2. Students will use a densiometer (for toilet paper roll modification: see Materials section) to estimate the density of forest canopy. Demonstrate the proper protocol for using the densiometer:

- hold the densiometer in front of your abdomen, at the closest distance without being able to see your own reflection in the mirror.
- There are a total of 24, 1/8" x 1/8" squares in the grid. Each square assists in observing the area of canopy opening or canopy cover.
- Count the number of canopy opening squares. If there are squares that are only partially filled, these can be added to make a complete square.
- The uncovered area is determined by multiplying the number of squares by 4.17. Subtract this number from 100% to determine overstory density in %.

e.g. 100% - (10 unfilled squares x 4.17) = 58.3% overstory density

3. Students will work in groups of five to gather information for the student data sheets "Characterizing Forest Habitat" and "Bird Species Count.".

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Indicators of the Mixed-conifer Forest

Investigate continued

4. Demonstrate the data collection protocol for the students and check for understanding so that students will be gathering data consistently across groups.
a) Each group goes to a designated plot center that has been marked.
b) Students should fill in their name, date, locations and elevation on the top of the sheet.
c) Within a group, four students each choose a different cardinal direction and walk away from the center for 7.07m (in order to make a 10m X 10m plot) and stand at the corner of the plot. Students should use a compass, and measuring tape or pre-measured string. *Note: if a student must leave their corner to gather data.*

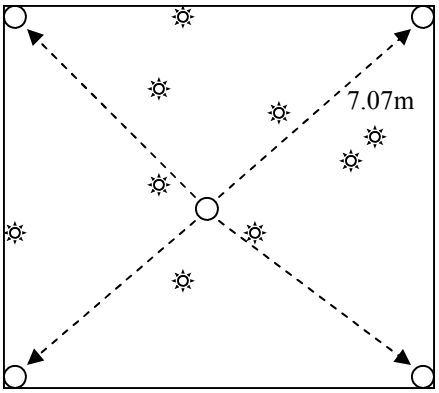
5. Students should individually fill in the first journal data sheet "Field Journal Notes." Allow about 5-10 minutes.

6. Using the "Charactizing Forest Habitat" data sheet, each group count number of conifer and broadleaf trees in their plot in order to characterize the *habitat class.*

The student in the middle will take a reading using the densiometer, and then passes it to the other group members standing at the corners of the plot to use. Students record all canopy measurements on their data sheet. Students should take an average of these readings to characterize the *canopy class.*

7. Ask students to walk around their plot and look for both bird habitat features and birds. Record information on the "Habitat Assessment" and "Bird Count" student data sheets. Remind students that additional resource sheets are located at the end of the student data sheets to assist with bird identification. Allow 15-20 minutes.

Data Plot Layout



KEY

Student observation position

Student path from center to corner of plot

Plot boundary

Example trees

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Indicators of the Mixed-conifer Forest

Conclusion

Gather class together and ask groups to share and reflect on their data collection experience and results. Example questions:
- Are there any observable patterns between habitat class and bird species? Or canopy class and bird species?
- Did you notice any interesting bird behaviors while recording the species you saw?
- Do you think any of those behaviors depended on specific characteristics of the mixed-conifer forest (i.e. nest building with specific materials, caching pine seeds, feeding on bark insects, etc)?

Classroom Extensions

Use your data!
1) Have the class share their data from the "Characterizing Forest Habitat" worksheet and compare their findings. After students graph their data: habitat class v bird species, canopy class v bird species, conduct a class discussion about the results. Possible questions to discuss:
- Did habitat class or class seem to have more of an effect on bird species seen by different groups?
- What could we do to get better quality data?
- How do you think time of year and/or location may affect the data?
2) Follow up this classroom visit with the KBO lesson Exploring eBird: Students contribute bird species counts data to a national citizen science project that gathers information for bird conservation and research. Students analyze line graphs of bird species seen in different regions throughout the year.

Further Resources

Kauffman, Michael Edward. Conifer Country: A natural history and hiking guide to 35 conifers of the Klamath Mountain region Backcountry Press 2012

Literature Cited

Altman, B. and J.D. Alexander. Habitat Conservation for Landbirds in the Coniferous Forest of Western Oregon and Washington Version 2.0 Oregon-Washington Partners in Flight (www.orwapif.org) and American Bird Conservancy and Klamath Bird Observatory. (2012)

Chase, Mary K. and G. R. Geupel. "The Use of Avian Focal Species for Conservation Planning in California." USDA Forest Service Gen. Tech. Rep. PSW-GTR-191 (2005) Web. 25 Jan. 2013: http://www.fs.fed.us/psw/publications/documents/psw_gtr191/psw_gtr191_0130-0142_chase.pdf

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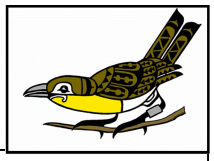

Field Journal Notes

Record observations of your surroundings. This is a preliminary step in the scientific process.

Location:

Weather:
Temperature:
Percent clouds:
Wind severity: **Wind direction:**

Habitat description:

Observations:

Thoughts and/or Feelings:

Sketches:

List questions generated from your observations:

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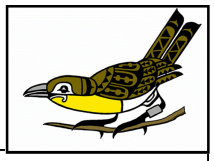

Characterizing Forest Habitat

Use the guidelines below to measure your plot and determine:
1) Habitat Class: classification of the forest based on tree composition
2) Canopy Class: classification of the canopy based on density of vegetation

Location:_____ **elevation:** _____

1) Habitat Class

# of conifer trees: _____ # of broad-leaf trees: _____ Total trees: _____

Percent conifers in plot: _____% *(= # of conifers / total number of trees)*

Percent broad-leaves in plot: _____% *(= # of broad-leaves / total number of trees)*

Which percentage is higher? (circle one) conifer broad-leaf

Using the above percentages, subtract the smaller one from the larger one: _____%
If the difference is > 25%, then the **Habitat Class** is the one you circled above.
If the difference is < 25%, then the **Habitat Class** a conifer-broad leaf mix.

Habitat Class: check one
- ☐ Conifer dominant (e.g. pines, firs, junipers)
- ☐ Broad leaf dominant (e.g. oak, madrone, maple)
- ☐ Conifer-broad leaf mix

2) Canopy Class

Canopy density: *use the densitometer at each of the four corners of your plot to estimate percent canopy cover*

_____ _____ _____ _____

Average Canopy measurement:

Canopy Class: check one
- ☐ Savannah (0-25% canopy cover)
- ☐ Open (25-50% canopy cover)
- ☐ Closed (50-75% canopy cover)
- ☐ High density (75-100% canopy cover)

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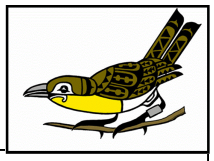

Forest Habitat Assessment

Provide information about the location and habitat components found at the this site.

Location: _____

Habitat components found at this site:

Food:_____

Water:_____

Shelter:_____

Space:_____

Using your observation skills, walk through the habitat and search for these specific habitat aspects. Place a tally mark next to each aspect each time you observe it. If there is anything interesting you come across, write a description of your findings.

Forest Habitat Aspect	Tally	Description of Interesting Observations
Snags (standing dead trees)		
Fallen logs		
Tall pine or oak trees		
Thick native shrub layer		
Forest edge habitat (where forest meets an open area)		
Small diameter trees		
Post-fire evidence		
Signs of mismanagement		

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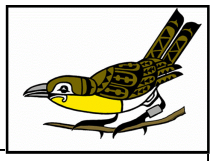

Forest Habitat Assessment

Using the information on the previous page answer the following questions.

1. Which habitat aspect did you find the most of? Why do you think this is the case?

2. How many snags did you come across during your observation? Why are they important to this type of habitat?

3. Did you find any forest edge habitat? If so, how open was the edge habitat?

4. Was there any post-fire evidence around? What evidence did you observe?

5. Given your assessment results, do you feel that this forest habitat is healthy or do you think it has been mismanaged? Why?

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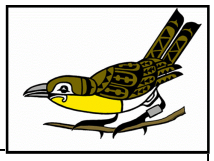

Bird Species Count

Observe birds around you and fill in the spaces below to guide your bird species count. Use your bird field guide or the following pages to help identify the birds.

Site:_____

Habitat Class:_____ **Canopy Class:** _____

Start Time:_____ **End Time:**_____

Temperature:_____ **Weather:**_____

Bird Species Name	Number of Birds
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	

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Name:_____
Date:_____

Bird ID Tips

Use the following information to help you record bird observations.

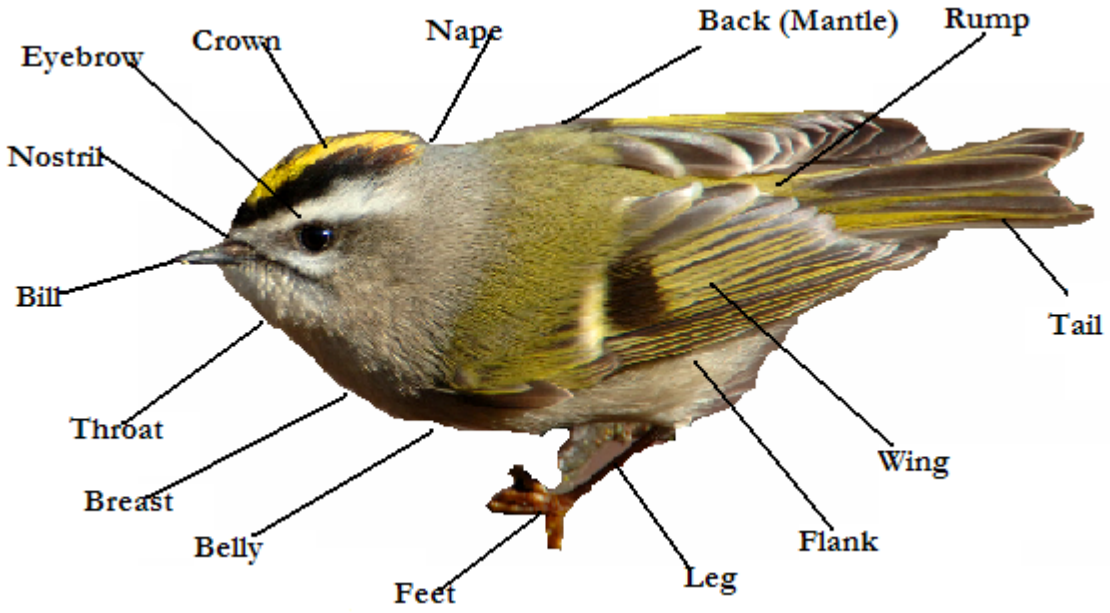
Bird Identification– What did the bird look like?

1. *Silhouette*: Body and tail shape, length of bill, etc.
2. *Field marks*: Feather coloration, wing bars or patches (see below Bird Body Parts).
3. *Posture:* Was the bird sitting upright or vertical or perching horizontally?
4. *Size:* Was the bird small like a finch or large like a hawk?

Bird Behavior– What was the bird doing?

1. *Foraging:* Another word for feeding. Describe what it is feeding on.
2. *Flocking:* More than three birds together in a group. Describe flock size.
3. *Preening:* Cleaning their feathers with their bill.
4. *Flying:* Describe whether the bird is soaring, hovering, flapping, or gliding.
5. *Singing:* Long, complex musical notes sung only by male birds.
6. *Calling:* Short, simple notes made by both males and female birds.

Bird Body Parts:



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Conifer Density

Indicators of the Mixed Conifer forest

Bird species vary with forest composition

High Volume Conifer

Brown Creeper

Hermit Warbler

Hammond's Flycatcher

Winter Wren

Golden-crowned Kinglet

Low Volume Conifer

Mountain Chickadee

Olive-sided Flycatcher

Dusky Flycatcher

Green-tailed Towhee

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Broadleaf vs Conifer

Indicators of the Mixed Conifer forest

Bird species vary with forest composition

Broadleaf-conifer mix

Oak woodland

Pacific-slope Flycatcher

Hutton's Vireo

Black-headed Grosbeak

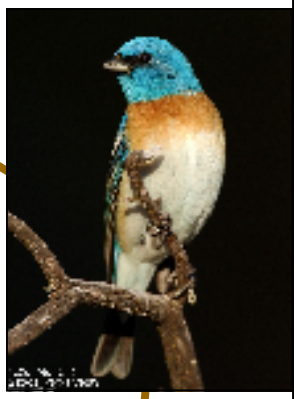
Spotted Towhee

Black-throated Gray Warbler

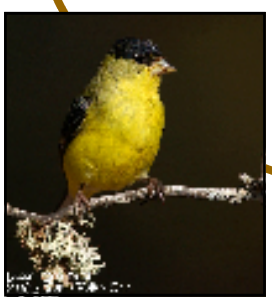
Western Scrub-Jay

California Towhee

Bewick's Wren

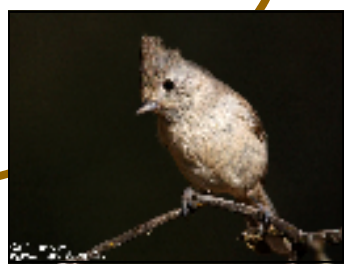


Lazuli Bunting



Lesser Goldfinch

White-breasted Nuthatch



Oak Titmouse

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