

# Age Growth Rate of Trees Along Forest-Meadow Ecotones

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## **Introduction**

Forest and meadow ecotones, or the boundary between two different plant communities, are areas that are located all over Montana and could play a role in better understanding our forests. In observing these areas, you can distinctly see the forest and meadow boundary line. Sometimes, there are several trees that run along the edge of the meadow and are noticeably smaller than the ones located in the tree stand. This phenomenon raises a few questions; are these smaller trees located in the meadow younger trees and the forest is extending out? Or are they older trees under some sort of stress-induced factor that is limiting their growth and the stand is retreating? This research will be focusing on these questions and will hopefully give a better understanding on how these ecotones can help us understand the future of our forests and the effects the change in climate could have on them.

Forest-meadow ecotones are located all around Montana and can tell us so much about the habitat. These boundaries can tell us about the changes in slope, the variety of soils and various factors that could all determine what effects the growth rate of the surrounding trees. Dendrochronology, or the study of tree rings, gives us a way to study how responsive different trees are to various abiotic factors. We can see when trees have larger rings, they are experiencing positive growth responses and when they have smaller rings, they are experiencing negative responses. Understanding these responses and how to identify them helps us in knowing what to expect for our forests in future changes in climate.

Previous studies have been done on different types of ecotones. These studies have shown that trees located within forest to meadow ecotones are often more responsive to climate drivers such as dry or wet summers. These trees can help in looking at past climates and show us how they responded. This gives us an idea of what could happen to forests in the future changes in climate. We can see how trees have responded in the past and use that to predict how they will respond in the future. Future climates are expected to have increased temperatures that could have positive or negative effects on trees and forest-wide processes but increased extreme heat will be negative (Whitlock et al., 2017). Being able to study their past responses helps us in determining what will happen in the forthcoming changes and what how various species will react to these changes differently.

Forest to meadow boundaries are crucial for bird habitat. Many birds, for example the Indigo Bunting bird, can be found in these ecotones where they go for breeding. Ecotones

contain a variety of bird species and help with biodiversity. They offer many resources including food, shelter, nesting, protection from predators, and many more. However, the future of forests can affect more than just the species of birds found in these boundaries. Forests are vital for all bird habitat and understanding the changes in forests can help in preserving these habitats and saving various species.

## Methods

The location of this study site is 2.8 miles southeast of Canyon Creek, Montana (Fig. 1). It is a private, ungrazed pasture owned by Robert Dagnall. This area was selected due to its limited livestock grazing, which can affect the colonization of tree species and other meadow or grassland types. The trees in this study were located on the same slope (northeast facing) because of factors such as aspect and slope direction could affect the growth rate of trees and could have played a role in the data collected.



**Figure 1.** The location of study site, the Dagnall Ranch. Located about 15 miles northwest of Helena, MT and south of Canyon Creek, MT. Owned by Robert Dagnall.

Once the location of the tree stand was found, three transects were identified within the stand. Transect #1 was located in the stand, transect #2 was located on along the tree line and transect #3 was located in the trees dispersing throughout the meadow area (Fig. 2). This

insured the trees used in this study were trees found along the gradient from forest to meadow. Each transect was about 100 meters long. Five *Pseudotsuga menziesii* (Douglas fir) trees were selected in each transect about 20 meters apart from one another. Once the trees were found, exact GPS locations were marked, and the diameter breast height and height of tree were recorded. A core sample from each tree was taken using an increment borer and stored for analysis. The cores were mounted, sanded and observed under a microscope where the age of the tree and growth rates were determined by counting and measuring the annual rings.

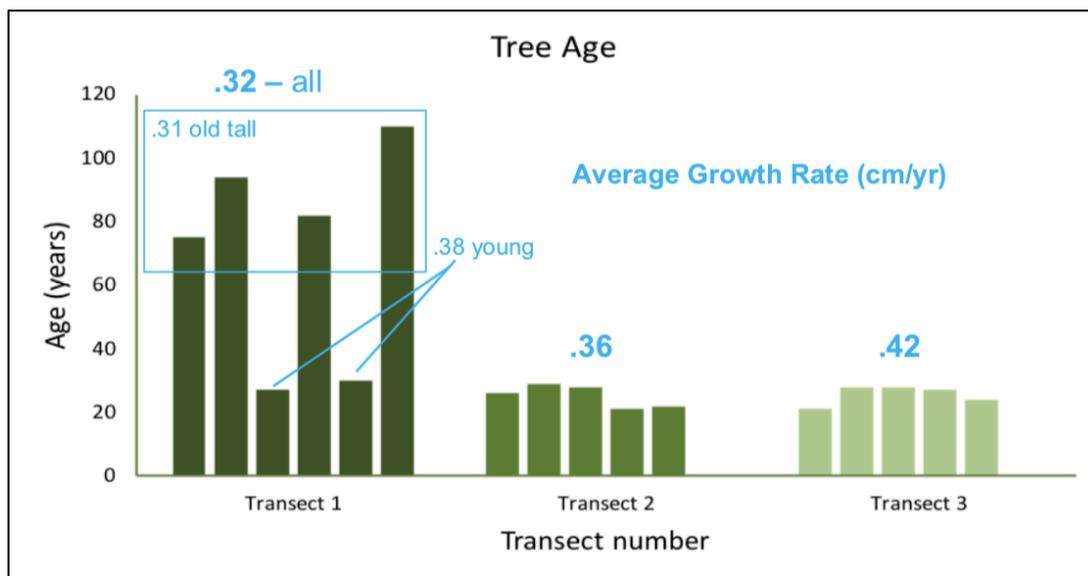


**Figure 2.** Location of the three transects along the forest and meadow gradient. Each transect was about 100 meters long and had five samples in each transect, giving a total sample size of 15 Douglas fir trees.

After collecting tree data, a bird survey was conducted to help understand the various bird species living among the area, and how they differ throughout the forest and meadow gradient. The survey took place along the gradient of each transect. This was done using Merlin Bird ID and eBird Montana. Birds were identified both visually and audibly.

## Results

Transect #1 had an average tree height of 60-80 feet tall and the ages ranged from 27 to 110 years old. The average growth rate of these trees were about .32 centimeters per year. Transect #2 had an average tree height of 15-30 feet tall and aged around 21-28 years old. The average growth rate was around .36 centimeters per year. Transect #3 had an average height of 10-20 feet tall and aged around 21-28 years old as well. The average growth rate for these trees were roughly .42 centimeters per year (Fig. 3). The results show there is a gradient among the trees within these transects, with older trees towards the middle and younger trees extending out.



**Figure 3.** Graph showing the age of each tree by transect number. Average growth rate is shown in blue.

The bird survey identified seven different species around the area (Fig. 4). This included Chipping Sparrow, Evening Grosbeak, Song Sparrow, American Crow, Vesper Sparrow, Warbling Vireo and Common Nighthawk. These species were found throughout the three transects with a majority of species found in transect #2 and #3. Most of the Sparrows (Chipping and Song) were found around transect #2, with species such as the Evening Grosbeak and Warbling Vireo found in both transect #2 and #3. The Common Nighthawks and American Crows were found in transect #3.

Chipping Sparrow	7
Evening Grosbeak	6
Song Sparrow	4
American Crow	3
Vesper Sparrow	2
Warbling Vireo	2
Common Nighthawk	2

**Figure 4.** Table of the various bird species found in the study area and their abundance.

## Discussion

After analyzing the data, it was found that the smaller trees found along the ecotone and into the meadow are younger trees (not older trees under growth stress, making them smaller), and the trees found within the stand were older with slower growth rates. This indicates that the forest is in fact extending out, not retreating. This data can help better understand how our forests are responding to the various changes in climate and can give us an idea of what could happen in future changes. We can compare how our trees are responding now to past changes and predict how they will respond in the future.

Because forest to meadow boundaries are so crucial for bird habitat, understanding the responses in these ecotones and the current diversity of bird species in them now will help us prepare for future changes in bird habitat and aid in preserving these areas to help maintain bird diversity and resources among Montana. The results from our data show that forest to meadow ecotones are abundant in bird diversity and an important resource for their survival. Understanding how we can help and predict the future of our forests helps us know the future of our bird species.

## Literature Cited

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