A Comparison of Alder and Douglass Fir Leaf Litter Decomposition

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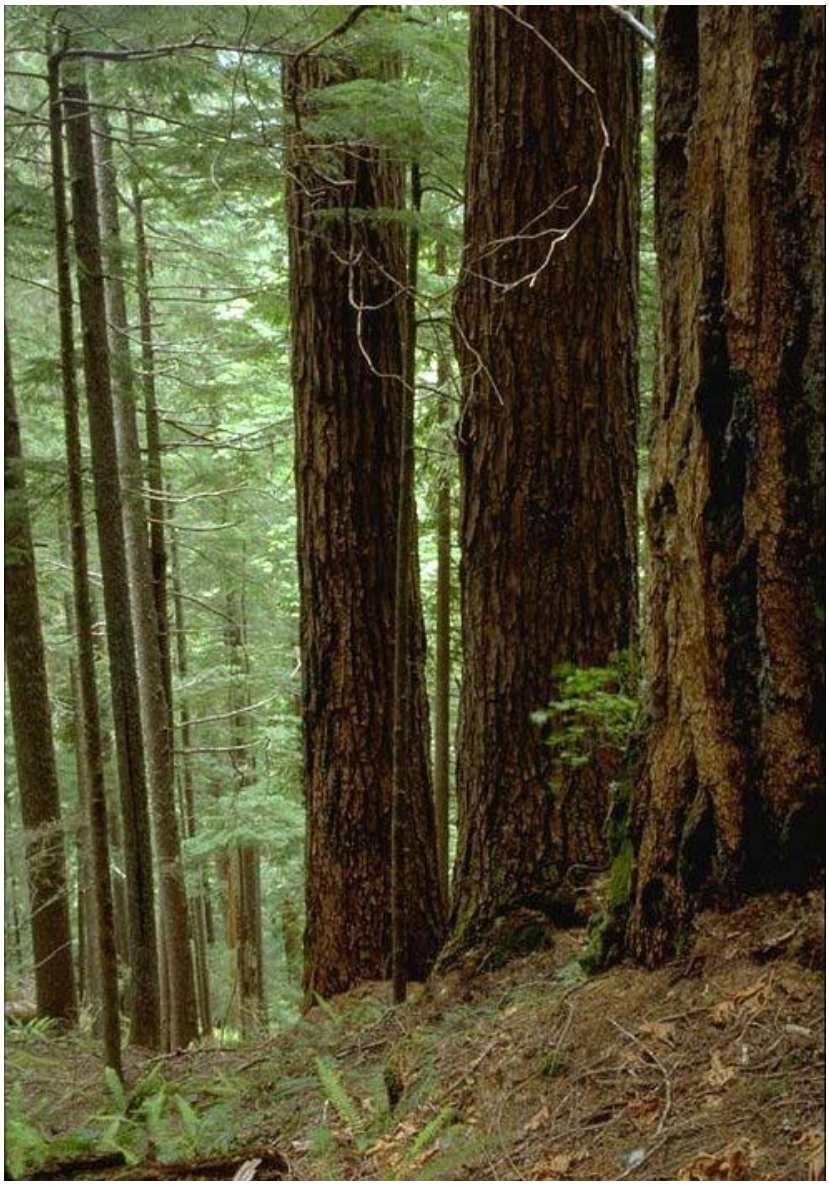


A Comparison of Alder and Douglass Fir Leaf Litter Decomposition

Abstract: The purpose of this study was to compare the decomposition rate of alder above the duff and below the duff in an Old Growth Temperature Rainforest at the HJ Andrews Site. There are several hypotheses examined in this study: 1) the amount of decomposition from the alder will be greater then the amount of decomposition from the live Douglass fir 2) the above ground litter will show more decomposition over the four month period compared to the below ground decomposition 3) The decomposition of the Douglass fir and alder litter will be greater in its natural habitat, old growth temperate rainforest compared to the amount of decomposition in the Tropical Rain Forest. The results showed the following: one, there was a higher decomposition rate of live Douglas Fir compared to alder in the study sites, two, the below ground litter decomposed at a faster rate then the above ground litter and three, litter decomposed faster in the Tropical Rain forest compared to the Old Growth Temperate Rain Forest.

Introduction:

This study will examine the decomposition rate of alder litter to live Douglass fir litter in the HJ Andrews old growth temperate rainforest. The decomposition rate of litter affects the rate at which nutrients, such as Carbon and Phosphorous, are recycled from the litter and made available to the forest floor. (Chapman 2006). The availability of these nutrients provide a major energy source for the ecosystems food webs (Wallace, 1999) and can be an indicator of forest sustainability.

Physical breakdown of the leaf litter also occurs during the freeze thaw cycles. The alder and Douglass fir were put in leaf litter bags and put in the forest on February 1st 2008. They were both removed from their leaf litter bags and weighed on June 29th (double check the date). During this time period there was one freeze thaw cycle. The freeze thaw cycle increased the surface area for the invertebrates to decompose the litter, (reference) accelerating the rate of biological decomposition by insects and microbial bacteria. Decomposition of the leaf litter is essential to many ecosystems (reference). Good predictors of the rate of decomposition include leaf toughness (Barlocher & Oertli 1978, Quinn et. al 2000) and type of leaf litter, especially leaves with various degrees of nitrogen (Kaushik &Hynes 1971, Barlocher & Kendrick 1974).

There are several hypotheses examined in this study: 1) the amount of decomposition from the alder will be greater then the amount of decomposition from the live Douglass fir 2) the above ground litter will show more decomposition over the four month period compared to the below ground decomposition 3) The decomposition of the Douglass fir and alder litter will be greater in its natural habitat, old growth temperate rainforest compared to the amount of decomposition in the Tropical Rain Forest.

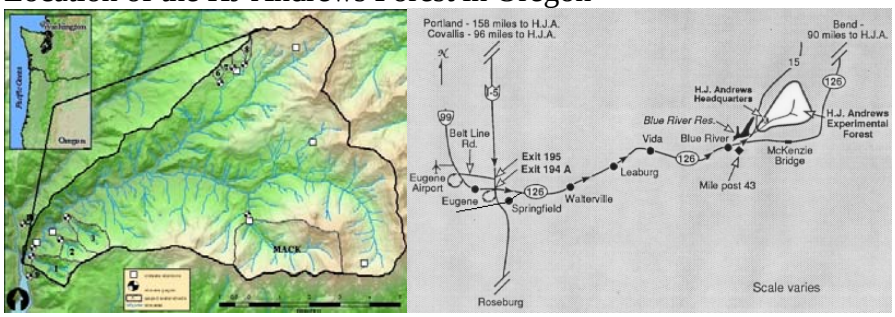
Each hypothesis has a corresponding rationale behind it. First the rate of decomposition of alder is compared to Douglass fir. Douglass Fir has a very waxy surface to it and the alder does not, therefore it is predicted that the Douglass Fir will take longer to decompose. Second the above ground litter is next to the duff of the forest floor where there are a lot of insects that biologically breakdown

the leaf litter, the duff provides nutrients for insects as well as air spaces for them to crawl around in. Third the old growth forest has insects and climates that have evolved around the trees and nutrient recycling. The only other consideration with the third hypothesis is that the assumption is made that a faster decomposition is beneficial for the soil, whereas if the soil decomposes too quickly and are not taken up by nitrogen fixers then the nutrients can be lost to runoff.

The picture to the left shows old growth Douglass firs found in the HJ Andrews forest, typical of the Douglass fir producing the leaf litter used in the experiment.

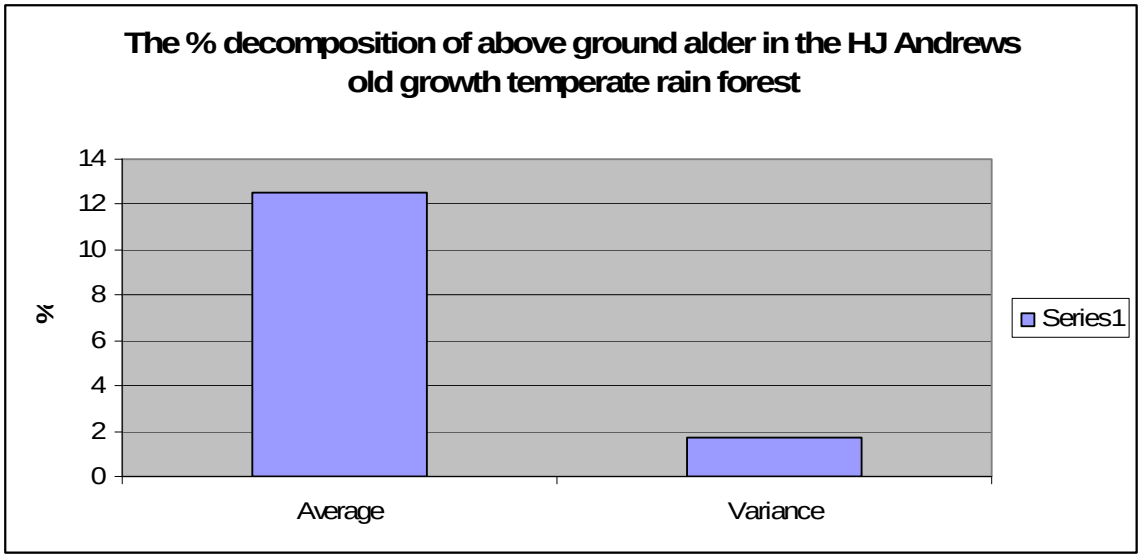
Methods: The litter decomposition method used in this study was designed by Jay Sexton, Senior Research Assistant. A brief summary of the methods are provided. Detailed methods for this study are provided on the ecoplexity.org website. First decomposition bags were made. Mesh and broad cloth were used to make these bags. Three sides of the bag were sewn together with one open side. The open side was used to add and remove the alder leaves. Alder leaves were collected from the Old Growth (OG) section of the forest floor at the HJ Andrews forest, stored in the litter decomposition bag (LDB) and placed above and below ground on February 1, 1008. Before the bags were placed under ground, the open side of the bag was stapled. Each bag had an aluminum number for identification purposes. Five bags were stringed together into harvest lines in the OG section of the HJ Andrews forest. Before the leaves were put underground they were dried for two weeks. The drying out process provided fairly uniform moisture content. (double check the order and the way they bags were transported to the site) Branches were put in areas animals may have been walking. In areas where the slope may have been an issue, a string was tied to a tree to prevent the bags from sliding down the hill.

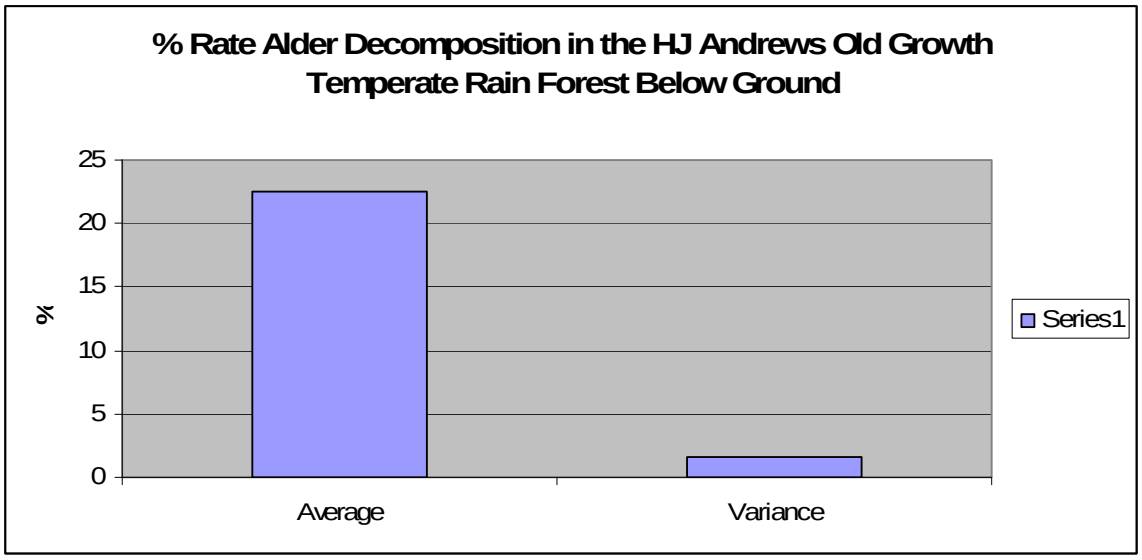
Location of the HJ Andrews Forest in Oregon



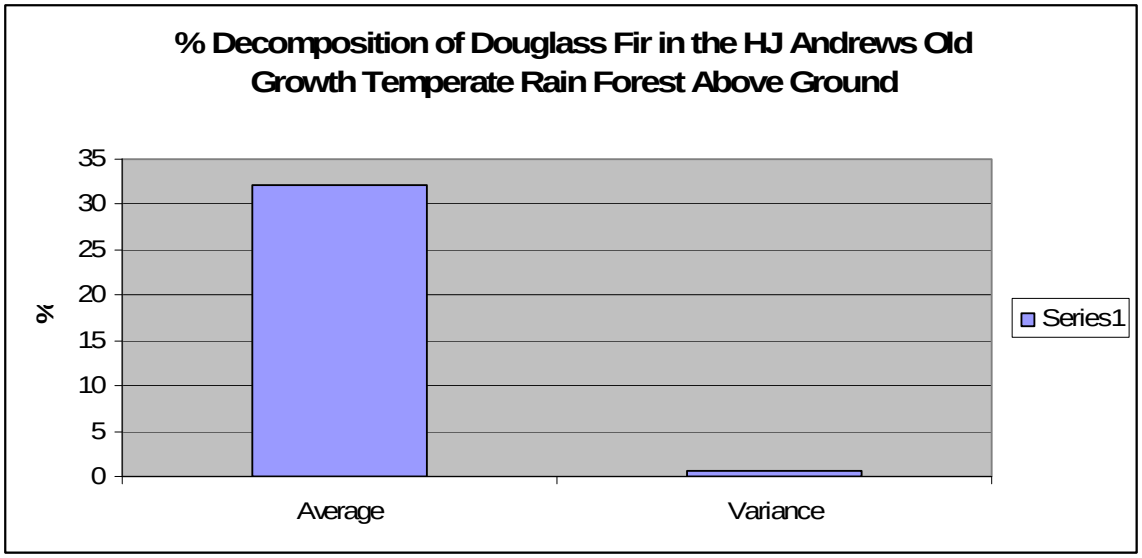
Results:

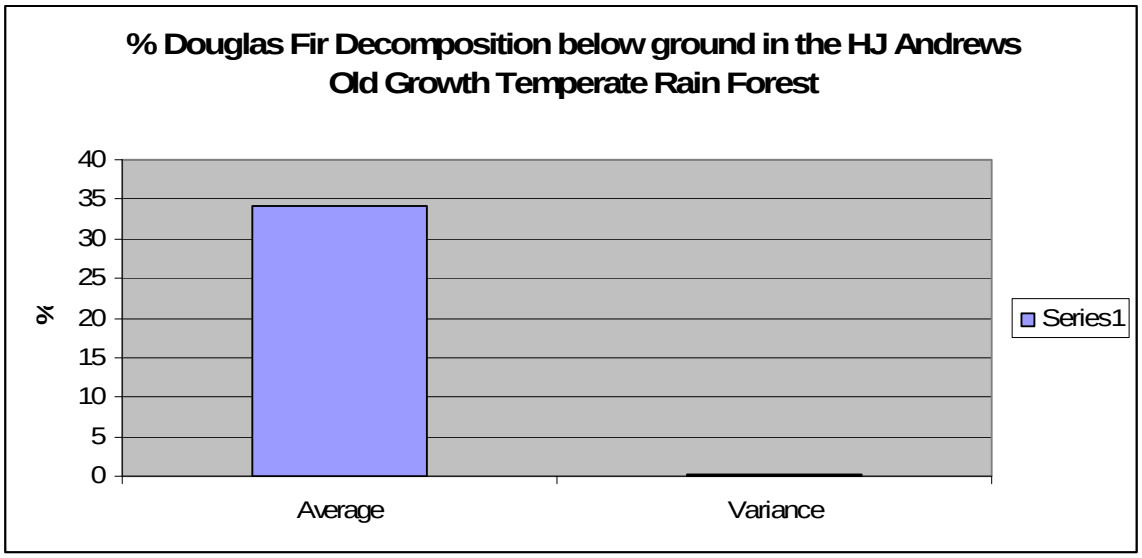
The results below show the percent litter decomposition during the four month period the leaf litter was in the HJ Andrews Old Growth Temperature Rainforest. The losses are represented as a percent loss and represent averages of the five samples used. The graphs are separated into %Alder decomposition above ground, %Alder decomposition below ground, % Douglass fir decomposition above ground and % Douglass fir decomposition below ground. The average variance for the five samples is shown as well.





The above graphs show a greater decomposition rate of alder and Alder Fir beneath the ground compared to above the ground in the HJ Andrews Old Growth Temperate Rain Forest.





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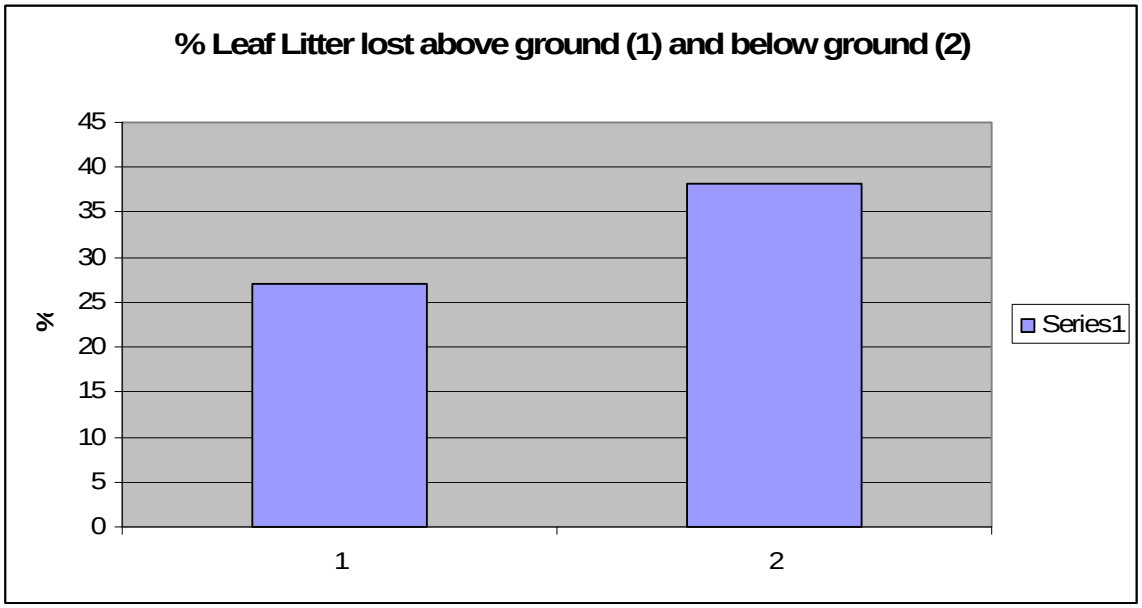
ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	1219.197	1	1219.197	1194.151	1.84E-16	4.493998
Columns	181.9714	1	181.9714	178.2331	4.33E-10	4.493998
Interaction	81.06934	1	81.06934	79.40392	1.33E-07	4.493998
Within	16.33558	16	1.020974			

The anova was computed comparing the above ground leaf litter with the below ground leaf litter and showed a significant P value, as seen in the above table.



The above graph shows the % of leaf litter lost above and below ground at the luquillo research site. The luquillo research forest is located in a tropical area. According to this data, it appears this site decomposes leaf litter from the NW Temperate rain forest at a faster rate. The data is inconclusive since there was only one trial run.

Discussion:

The diverse micro-organisms in the forest, including insects and bacteria, play a major role in the decomposition of the leaf litter. (reference)

The discussion will provide an analysis of the results compared to the original hypothesis. The first hypothesis predicted that alder litter would decompose faster then the douglass fir litter. According to the data collected this hypothesis was incorrect. Perhaps the smaller size of the douglass fir leaf litter provides an advantage for physically breaking down the douglass fir leaves. In addition, the invertebrates may prefer the douglass fir debri to the alder debri. The impact of decomposition rates can be studied to see the relevance of a mixed coniferous forest. If a logging company comes in to an area and cuts down all the douglass fir, for lumber for example, how will the depleted forest

survive? It is well known that alders are nitrogen fixers and need to be left for longevity but how will the nutrient releasing abilities of the alder compared to the Douglass fir affect the nutrient richness of the soil when the Douglass firs are cut, and used for commercial purposes such as lumber.

Second hypothesis showed a higher decomposition rate above ground then below ground. This was not expected as we had expected the freeze thaw cycle to effect the physical breakdown of the plant debri. Possible explanations for this could include favorable temperatures for enzymatic reactions that need to occur to break down the leaf matter. In addition, the Tropical Rain Forest did not have a freeze thaw cycle and showed the same results.

From the data shown the third hypothesis can is unsupported. At the luquillo research forest five above ground and below ground bags were put in the soil to decompose but only one was taken out. Therefore the validity of the data is in question. But the results are interesting and if correct, one factor to consider is the climate of the region, since the plant debri was the same. The tropical rain forest has different seasons, temperatures and rainfall patterns. A slower rate of nutrient release may prove beneficial to the old growth temperature rain forest system.

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