

Differences in decomposition of nitrogen-fixer and non-nitrogen fixer leaf litter in the HJ Andrews Experimental Forest, June 23-July 3, 2008.

Ecoplexity
Sally Kirkpatrick

Abstract: Taking the small samples of leaf litter from the HJ Andrews Experimental Forest old growth site a comparison was made between nitrogen-fixers and non-nitrogen fixers. Using mass loss as the measurement for decomposition, nitrogen-fixers were shown to have decomposed faster, or lost a greater percentage of mass, in the four month period of the study, except for Douglas fir. This species is not only a native of the Andrews, but was also the only species placed in this area that was also a resident growing in this same plot. Although Alder is native to the temperate rainforest of the Andrews, in a simultaneous study no Alder was found to be growing in this old growth plot. Due to 'homegrown' advantage, Douglas fir may have the necessary microbes and shredders present to help decompose at a higher rate than even the chemical advantage nitrogen-fixers such as the native Alder and the non-native Mesquite.

Hypothesis:

Nitrogen Fixer leaf litter loses mass faster than non-nitrogen fixer leaf litter in the HJ Andrews old growth test plot.

Introduction:

Leaf litter quality, especially nitrogen content, has been shown to have a large effect on the breakdown rate of leaf litter. (Richardson, 2004) The differences in mass lost over a four-month period between the nitrogen-fixer leaf litter, alder and mesquite, and non-nitrogen-fixer leaf litter, Cecropea, Douglas fir and grass presented a possible connection. Alder and Douglas fir are native to the HJ Andrews temperate rainforest, while the other three species are not. The study included different LTER sites; however the data from these locations was not available for comparison.

Methods:

Ten samples of six separate leaf litter were collected. After drying, each type of litter was placed in separate bags using weight to keep the amounts similar. Five bags of each litter type were placed within the duff layer and five bags were placed on the surface of the duff.

For four months, from February 1, 2008 until June 24, 2008 the leaf litter lay in the elements of the temperate rainforest at HJ Andrews. Upon retrieval on the 24th, the litter was extracted from the polyester bags and dried. The litter was then weighed.

The before and after litter weights were entered into a data base, noting the type of litter as well as above ground (surface) and below ground (within duff) placements. Using this information, the percentage of mass lost by each sample was calculated.

(For more details go to Ecoplexity.org Leaf Litter Protocol)

Discussion:

Nitrogen fixers show significantly higher rates of decomposition. The equilibrium of an alder grove in a temperate rainforest is reached at 6years. This is due to the nitrogen and chemical make-up of the alder. (Zavitkovski, 1971) Using this information, an ANOVA 2-factor statistical analysis was conducted on data of the leaf litter samples from HJA old growth plot. There were two nitrogen fixers in the six types of leaf litter samples, alder and mesquite. Cecropea, while some species are nitrogen-fixers, the one in this study were not nitrogen fixers. The grasses, Douglas fir and paper were also non-nitrogen fixer litter.

Although the nitrogen-fixer leaf litter lost great mass over the four months of this study than non-nitrogen fixers, the Douglas fir(DF) litter, a non-nitrogen fixer species, lost the greatest amount of mass. Other studies have shown the 'home field advantage' of native litter in over 25 sites worldwide.(Gholz, 2000) Little information is known about coniferous tree litter decomposition.(Richardson, 2004) Because data from the four other sites in this four month study was not available, only data from the HJA was used in this study.

A $<.05$ P-value was used as a benchmark to state significance difference between the averages of weight loss in the leaf litter types. While the p-value was significantly small, $<.01$, the difference between Alder and Doug fir was lowest. The above and below samples had similar differences between these two native species.

Alder and Cecropea P-values

ANOVA						
<i>Source of Varië</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Sample	1154.968	1	1154.968	348.3911	2.77E-12	4.493998
Columns	286.4632	1	286.4632	86.41036	7.51E-08	4.493998
Interaction	31.00601	1	31.00601	9.352825	0.007508	4.493998
Within	53.04239	16	3.315149			
Total	1525.48	19				

The nitrogen-fixers, alder and mesquite, lost greater mass in the four month period than all other leaf litter types accept Douglas fir.

Alder and Douglas fir Average %Mass Loss

Anova: Two-Factor With Replication

SUMMARY	A	B	Total
<i>Doug Fir</i>			
Count	5	5	10
Sum	160.6954347	170.726	331.4215
Average	32.13908694	34.14521	33.14215
Variance	0.715398529	0.121485	1.489872

<i>Alder</i>			
Count	5	5	10
Sum	62.48543094	112.7825	175.2679
Average	12.49708619	22.5565	17.52679
Variance	1.690799339	1.556213	29.55194

<i>Total</i>			
Count	10	10	
Sum	223.1808656	283.5085	
Average	22.31808656	28.35085	
Variance	108.2383639	38.05071	

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Sample	1219.196711	1	1219.197	1194.151	1.84E-16	4.493998
Columns	181.9713914	1	181.9714	178.2331	4.33E-10	4.493998
Interaction	81.06934073	1	81.06934	79.40392	1.33E-07	4.493998
Within	16.33558476	16	1.020974			
Total	1498.573028	19				

Conclusion:

Nitrogen fixing does not show as the only factor as Douglas fir is not a nitrogen-fixer species, but did lose more mass in the 4 month study period. Other factors, then, must be considered. The Alder is a native species, so home field advantage would be similar between it and the Doug fir. However, the study area was in an old growth plot at HJA where Douglas fir was present but no Alder. (Plant Diversity 2008 data set, Ecoplexity.org) This area was constantly decomposing DF, utilizing microbes and shredders adapted to the DF needles.

The Doug fir needles are waxy and have greater surface area. Possibly microbes, chemical breakdown and moisture affect the needles more efficiently within the temperate rainforest. A comparison of the other ecosystem sites needs to be done to rule out this hypothesis.

Literature Cited:

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