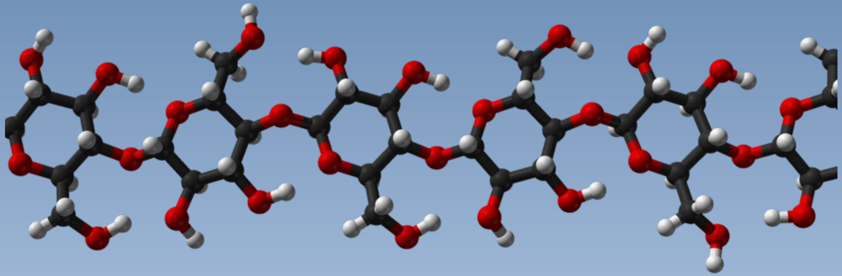
An Introduction to Cold Fire

Jeffrey Ravage, CSO, COCO, Inc.

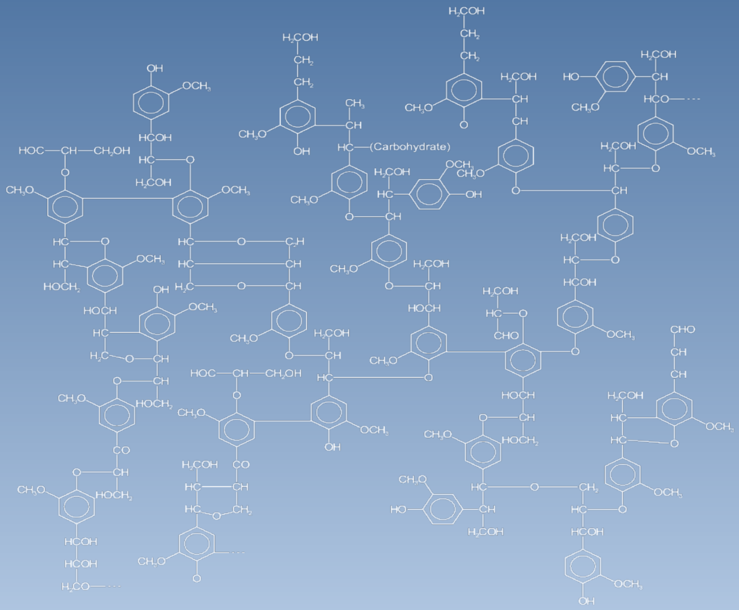

Wood is a carbohydrate

Cellulose



Cellulose
$C_6H_{10}O_5$

Lignin



Lignin

$C_9H_{10}O_2, C_{10}H_{12}O_3, C_{11}H_{14}O_4$

Hot Fire

Pyrolysis

A Second-Order Phase Transformation

- Thermal Decomposition of organic materials at elevated temperatures in the absence of oxygen

Endothermic

Involves change of chemical composition and physical phase

Irreversible

Cellulose ($C_6H_{10}O_5$) -> Methane, Guaiacol, Phenols, Cresols, pyrocatechols, Methylated compounds

Combustion

A First-Order Phase Transformation

- Thermal Transformation of organic materials at elevated temperatures in the presence of oxygen

↓

Exothermic

Involves change of chemical composition and physical phase

↓

Irreversible

Cellulose ($C_6H_{10}O_5$) -> CO_2, CO, CH_4, H_2O + Heat & Ash

Cold Fire

A Second-order Phase Transformation

- Enzymatic Transformation of organic materials at ambient temperatures in the presence of oxygen

↓

Isothermic

Involves change of chemical composition and physical phase

↓

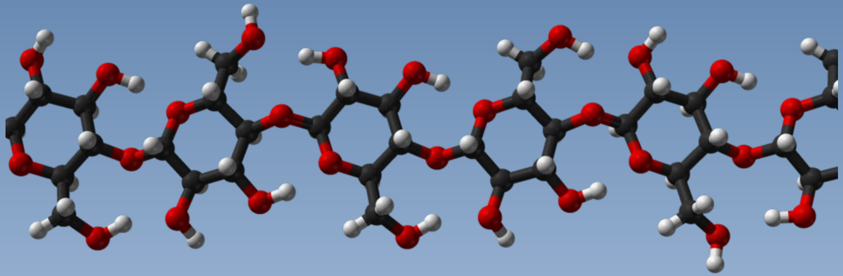
Irreversible

Cellulose ($C_6H_{10}O_5$) -> CO_2, H_2O + Energy, Chitin ($C_8H_{13}O_5N$) Sugars and ash.

Keepers of the Cold Fire

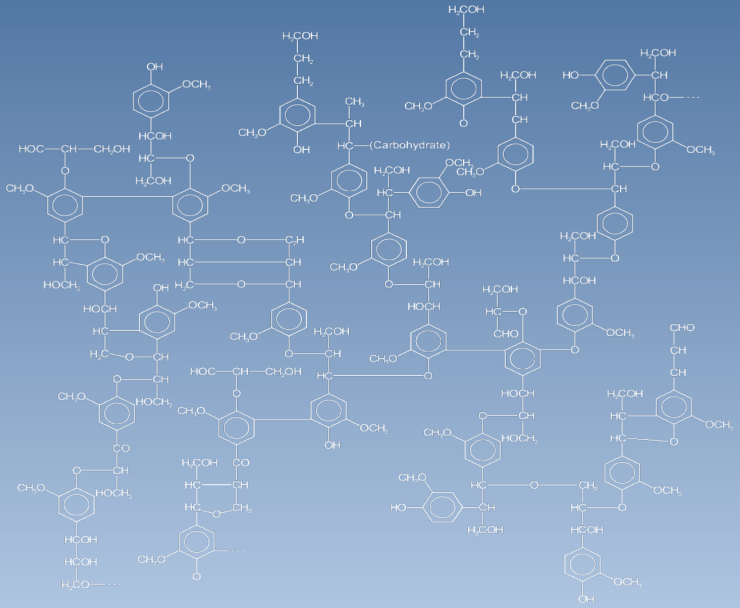
Saprotrophs and Detritivores

Brown Rot



Cellulose
$C_6H_{10}O_5$

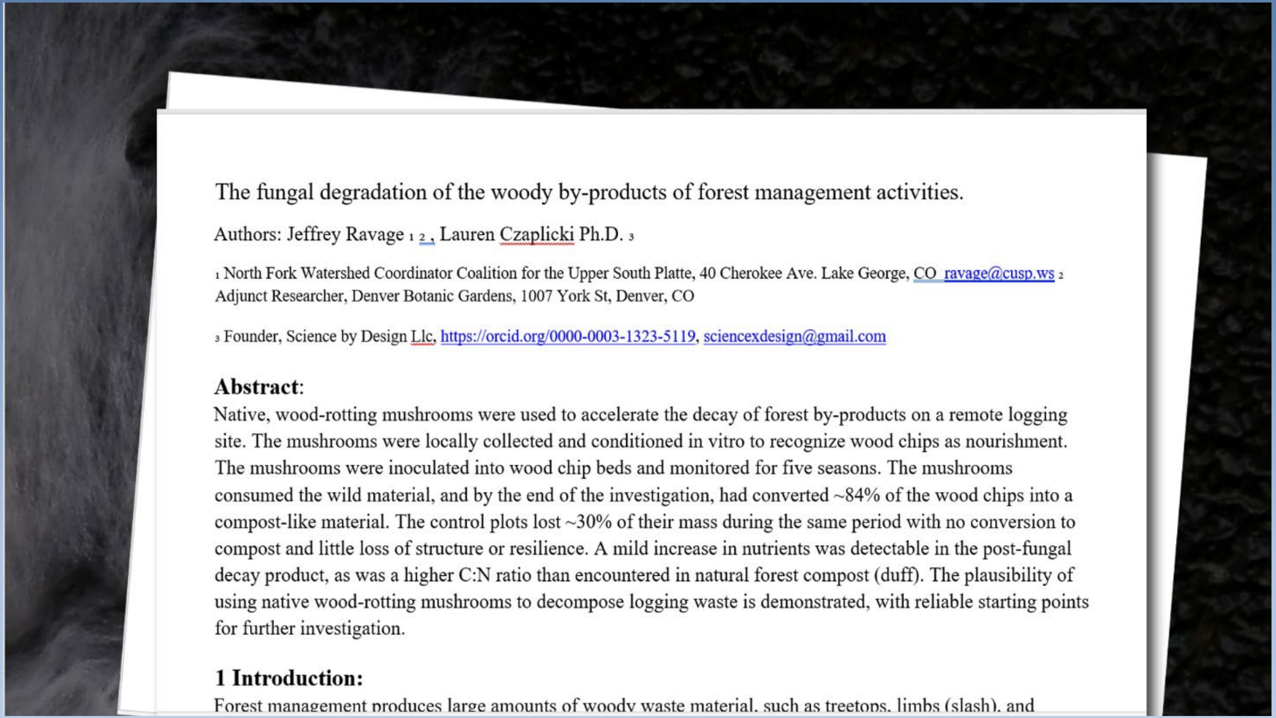
White Rot



Lignin

$C_9H_{10}O_2,C_{10}H_{12}O_3,C_{11}H_{14}O_4$

The fungal degradation of the woody by-products of forest management activities.



The fungal degradation of the woody by-products of forest management activities.

Authors: Jeffrey Ravage [1 2], Lauren Czaplicki Ph.D. [3]

[1] North Fork Watershed Coordinator Coalition for the Upper South Platte, 40 Cherokee Ave. Lake George, CO ravage@cusp.ws [2] Adjunct Researcher, Denver Botanic Gardens, 1007 York St, Denver, CO

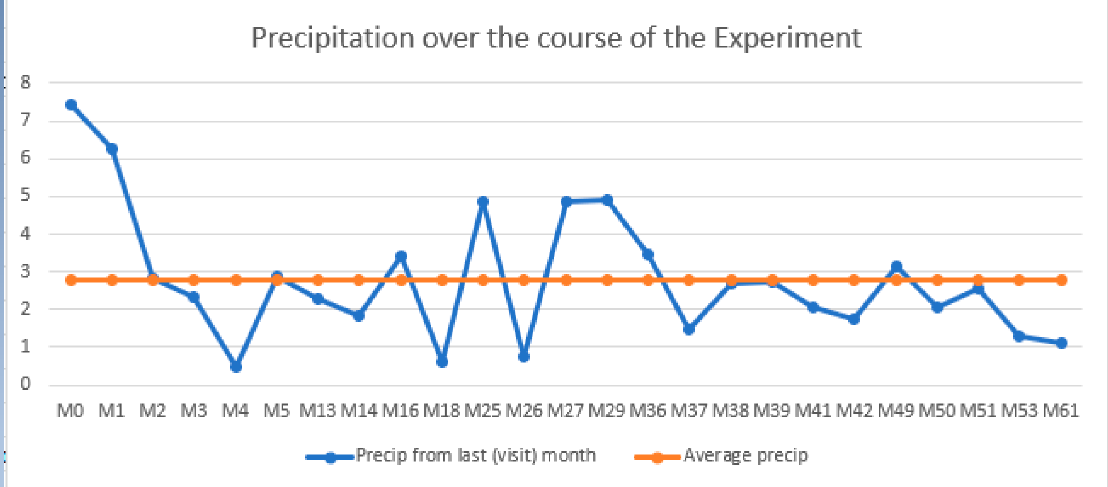
[3] Founder, Science by Design Llc, https://orcid.org/0000-0003-1323-5119, sciencexdesign@gmail.com

Abstract:
Native, wood-rotting mushrooms were used to accelerate the decay of forest by-products on a remote logging site. The mushrooms were locally collected and conditioned in vitro to recognize wood chips as nourishment. The mushrooms were inoculated into wood chip beds and monitored for five seasons. The mushrooms consumed the wild material, and by the end of the investigation, had converted ~84% of the wood chips into a compost-like material. The control plots lost ~30% of their mass during the same period with no conversion to compost and little loss of structure or resilience. A mild increase in nutrients was detectable in the post-fungal decay product, as was a higher C:N ratio than encountered in natural forest compost (duff). The plausibility of using native wood-rotting mushrooms to decompose logging waste is demonstrated, with reliable starting points for further investigation.

1 Introduction:
Forest management produces large amounts of woody waste material, such as treetops, limbs (slash), and

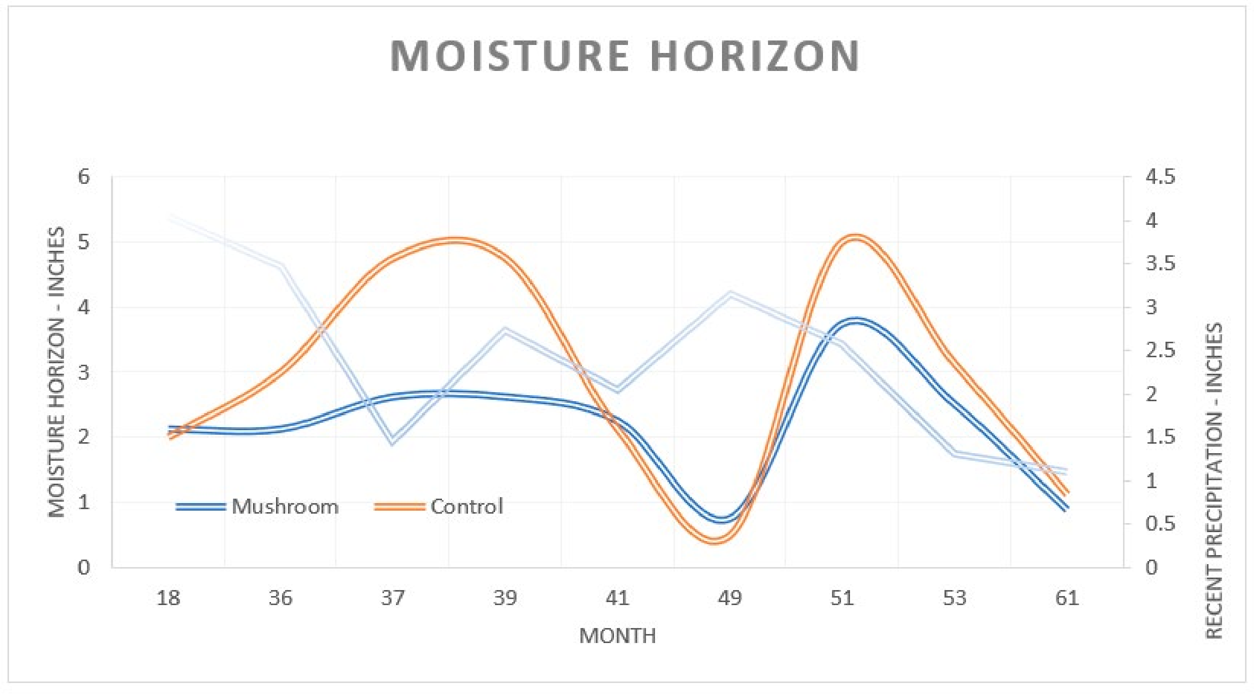
Methods

Baseline

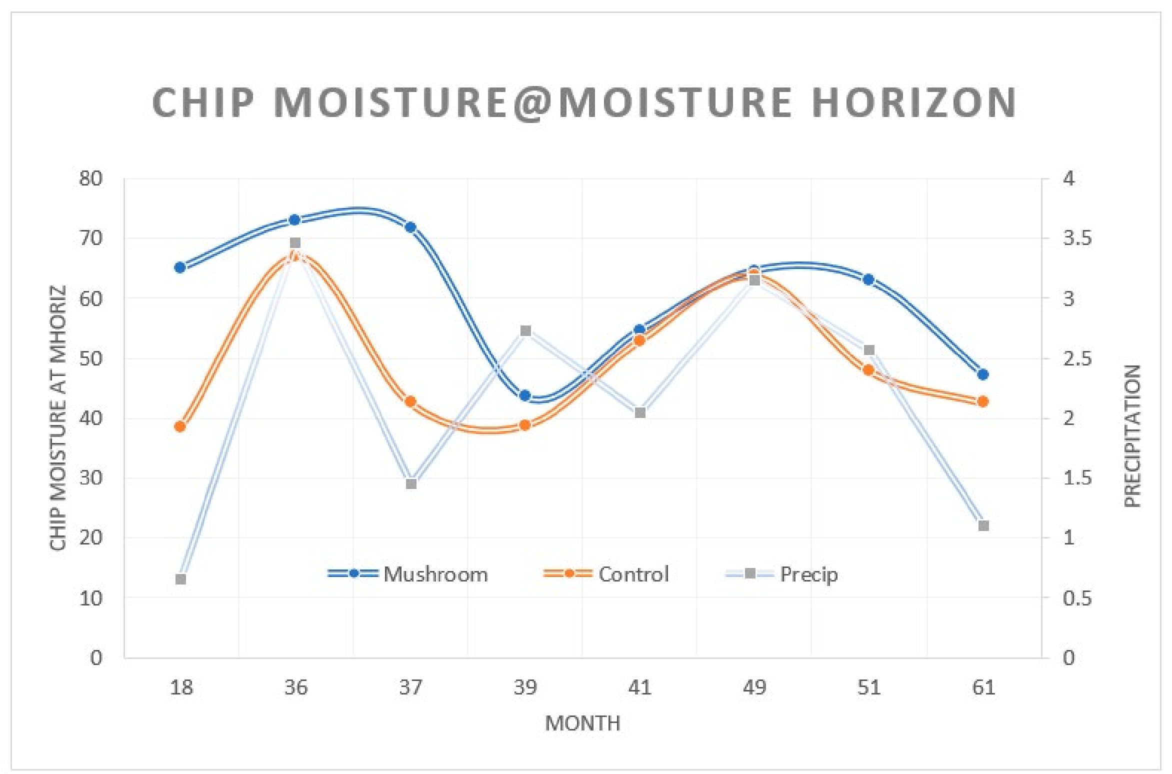


Precipitation over the course of the Experiment
8
7
6
5
4
3
2
1
0
M0 M1 M2 M3 M4 M5 M13 M14 M16 M18 M25 M26 M27 M29 M36 M37 M38 M39 M41 M42 M49 M50 M51 M53 M61
Precip from last (visit) month
Average precip

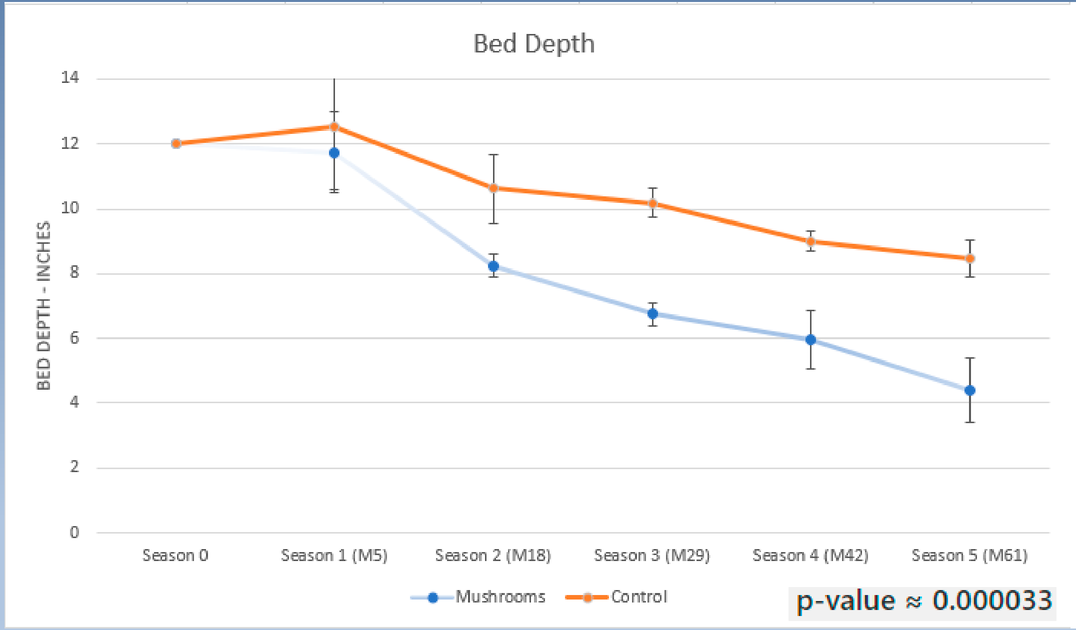
Results-Berrian Mountain



Results-Berrian Mountain



Results-Berrian Mountain



Results-Berrian Mountain

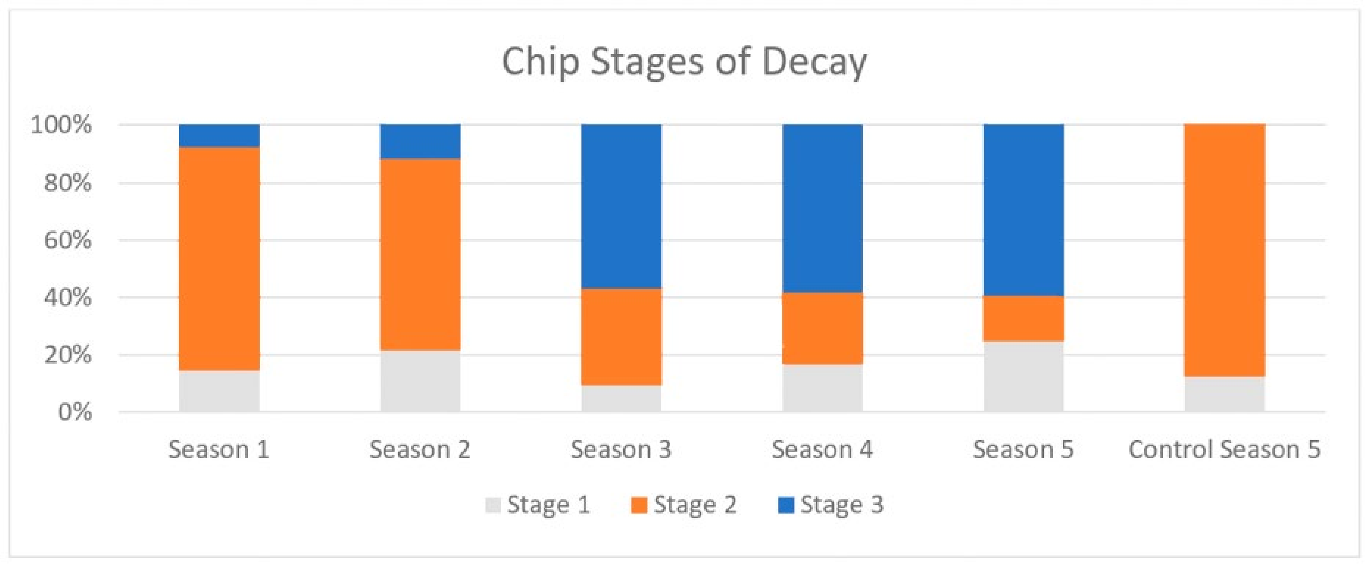
Chip Composition Stages

Results-Berrian Mountain

Chip Composition Stages

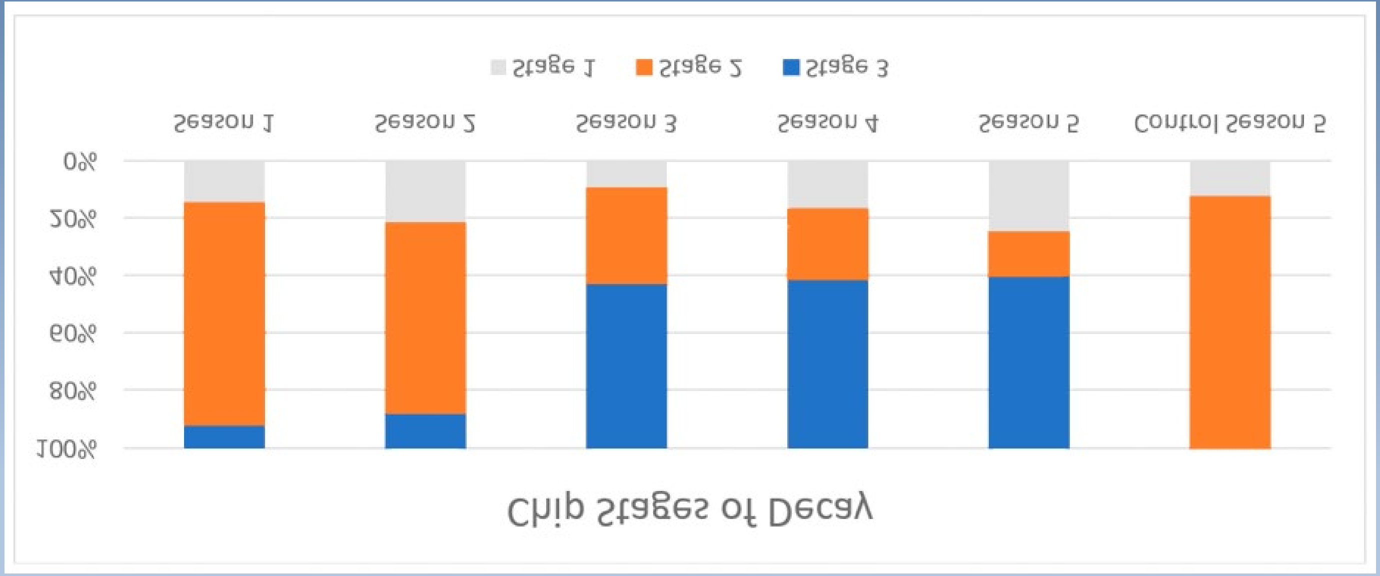
Results-Berrian Mountain

Chip Composition ratios



Results-Berrian Mountain

Chip Composition ratios

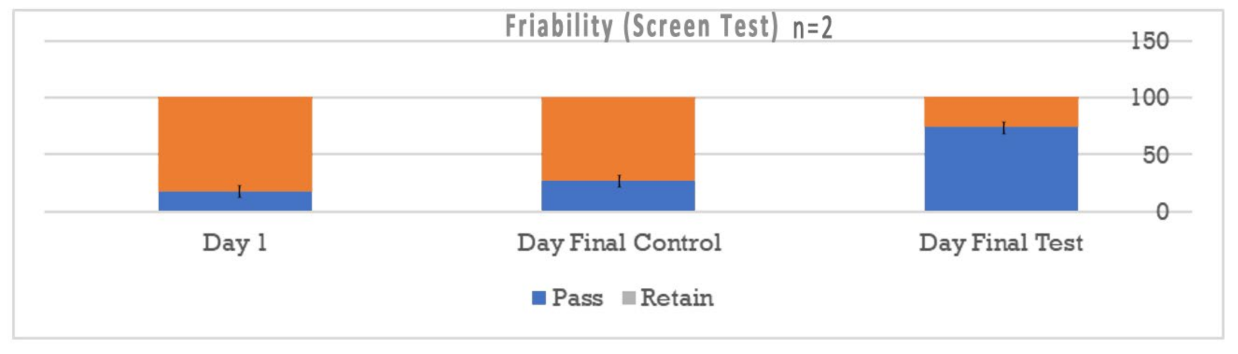


Results-Berrian Mountain

Friability

Results-Berrian Mountain

Screen test (1 Liter / 2 minutes)



Results-Berrian Mountain

Compost Profile

Metric	Raw wood chips (n=1)	Berrian Compost (n=2)	Conifer O.A. *
C:N	169:1	39.5:1 (s=7.77)	35.5
Ph	4.94	6.8 (s=0.289)	5.7
N	0.279%	0.247% (s=0.024)	0.24%
P	0.010%	0.0335% (s=0.0091)	0.005%
K	0.021%	0.055% (s=0.0077)	0.026%
Org. Matter	89.2%	13.5% (s=4.666)	8.8%

* From: (Buck & St Clair, 2012)

Results-Berrian Mountain

Topsoil Production

Pertinent Questions

What's the cost per acre? We ,measure cost per cubic yard of material

At what scale can it be done: one acre, 5 acres, hundreds? Once our facility is complete we want to produce at a scale of about 6 tons of spawn/week. This is equivalent to about 300 tons of material application/week

Is it a liquid? Can it be sprayed aerially? Can you use planes or drones to apply it? We use liquid inoculant in intermediary stages. Liquid is too fragile to introduce into the wild, we have verified that.

More questions

Is the process like a BMP, or is it in a trial phase? We are developing BMP’s and our study outlines the technique so that mycologists can reproduce it. It has been incorrectly applied by hobbyists, and they may (or may not) use native species.

Any effects on wildlife? They eat it , accelerating the decomposition through mechanical processes.

Any health hazards in applying it? Care should be taken both for the people applying it and the spawn itself. Simple PPE- gloves and face masks. Improper applications could lead to inhalation of spores. Improper growth could facilitate this. This is why we want to train people for now.

Current experiment

Carbon sequestration potential of fungally produced composts

By Jeff Ravage and Andrew Wilson

and 16 other backers

$10,635

Raised of $10,435 Goal

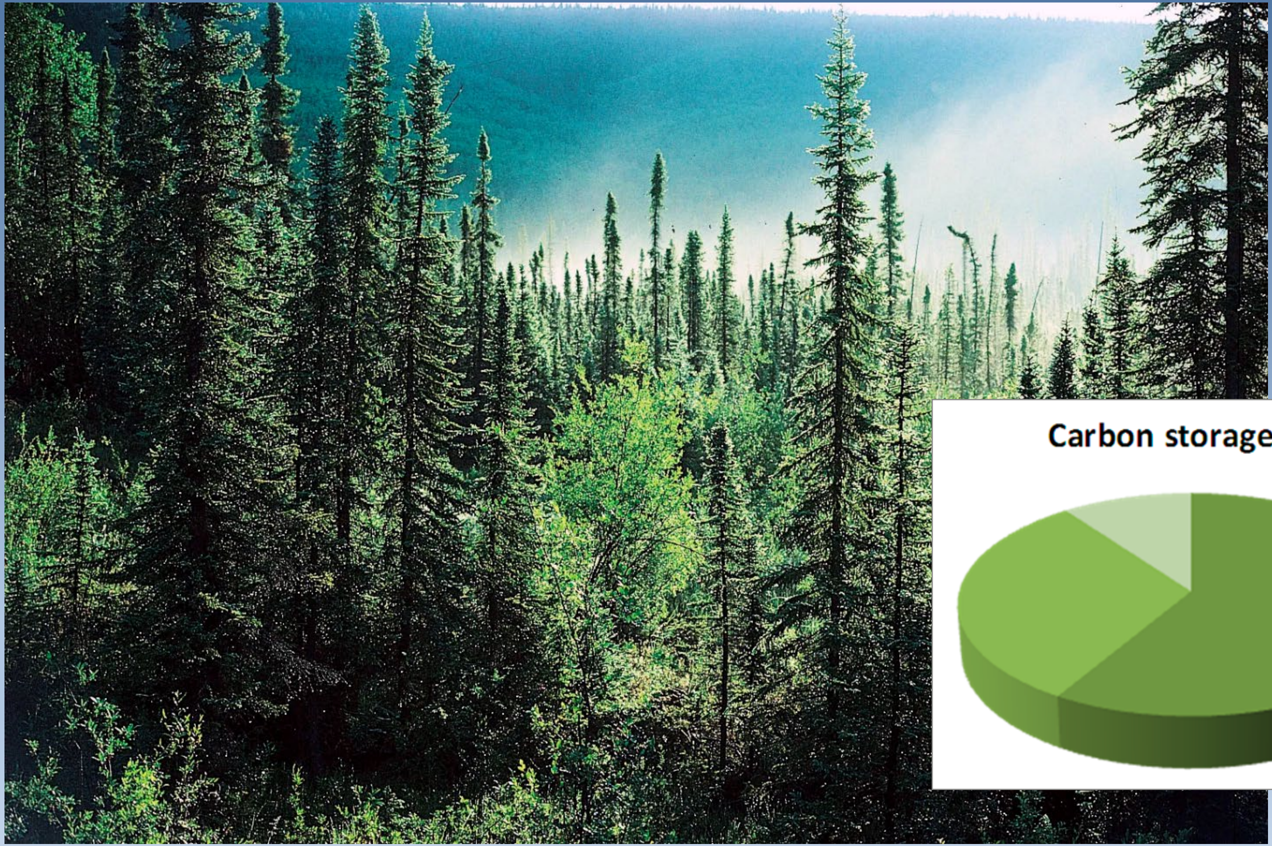
101%

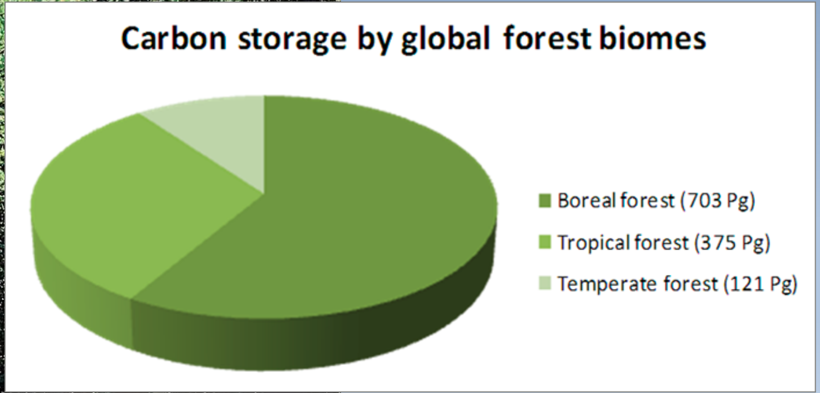
Funded on 8/30/22

Successfully Funded

How does this work?

Boreal Forest (Taiga)





https://coldfireproject.com

SCAN ME