Genetic variation in foundation tree species

Influences on litter quality, in-stream decomposition and interactions with nutrients and salmon carcasses

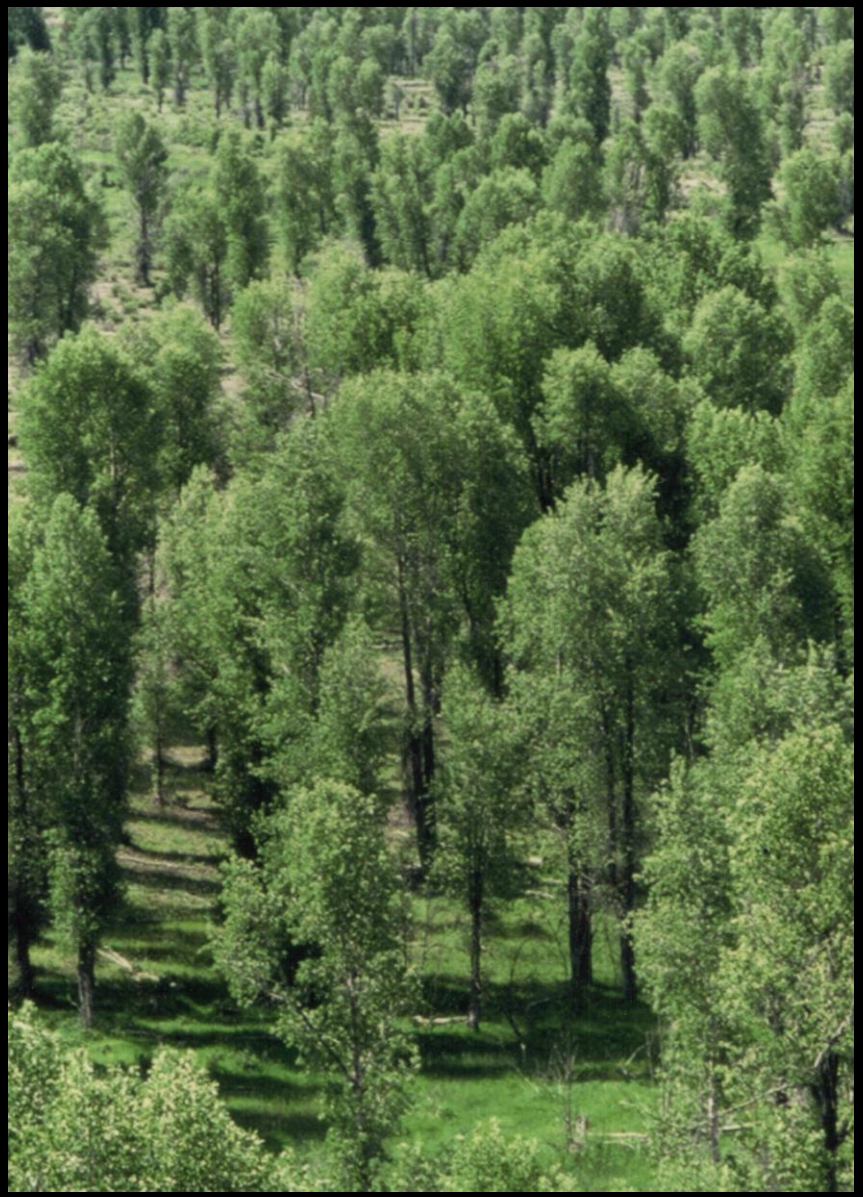
Carri J. LeRoy et al.

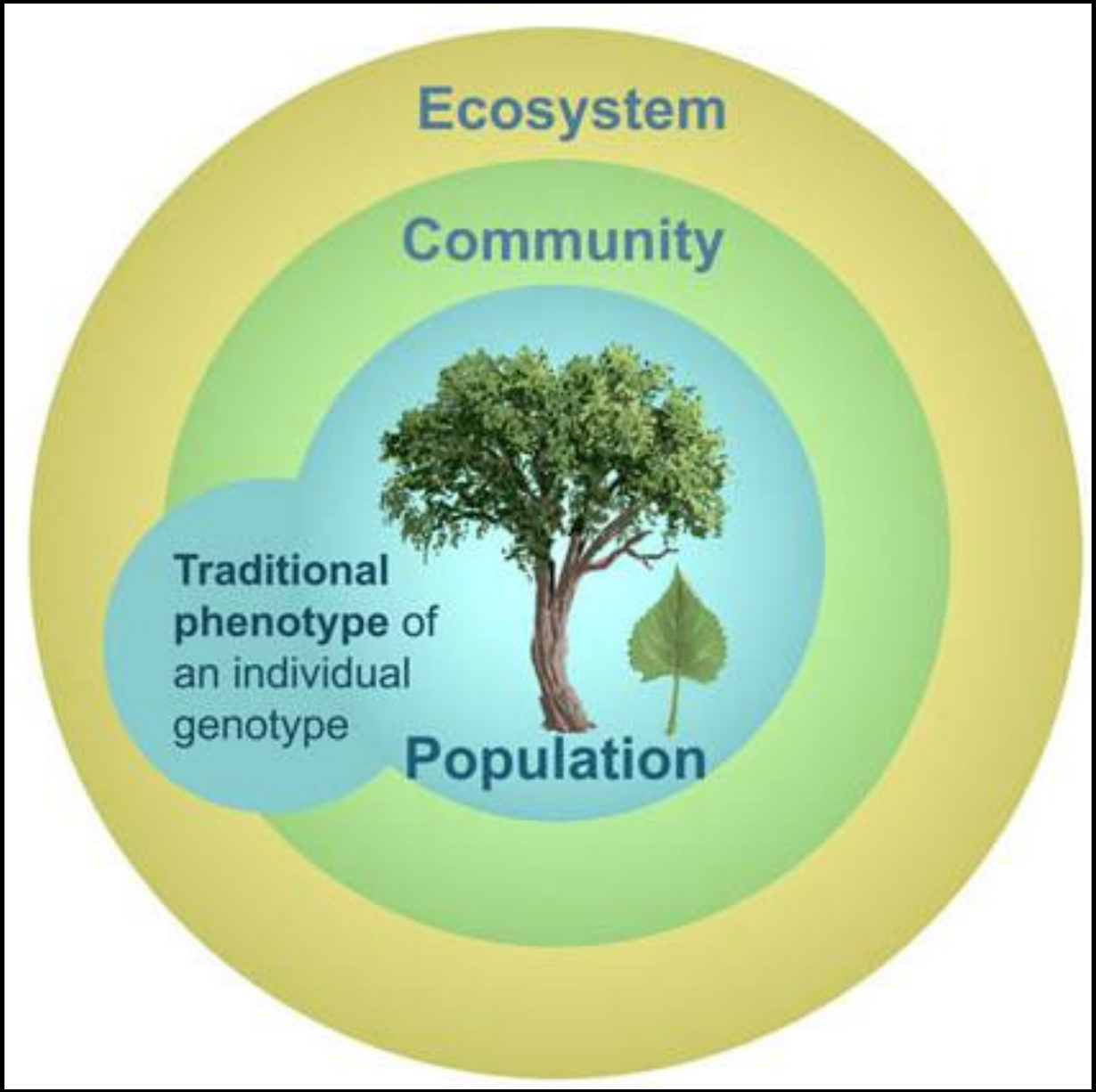
Genetic variation in foundation tree species

Crowd of people (same species)

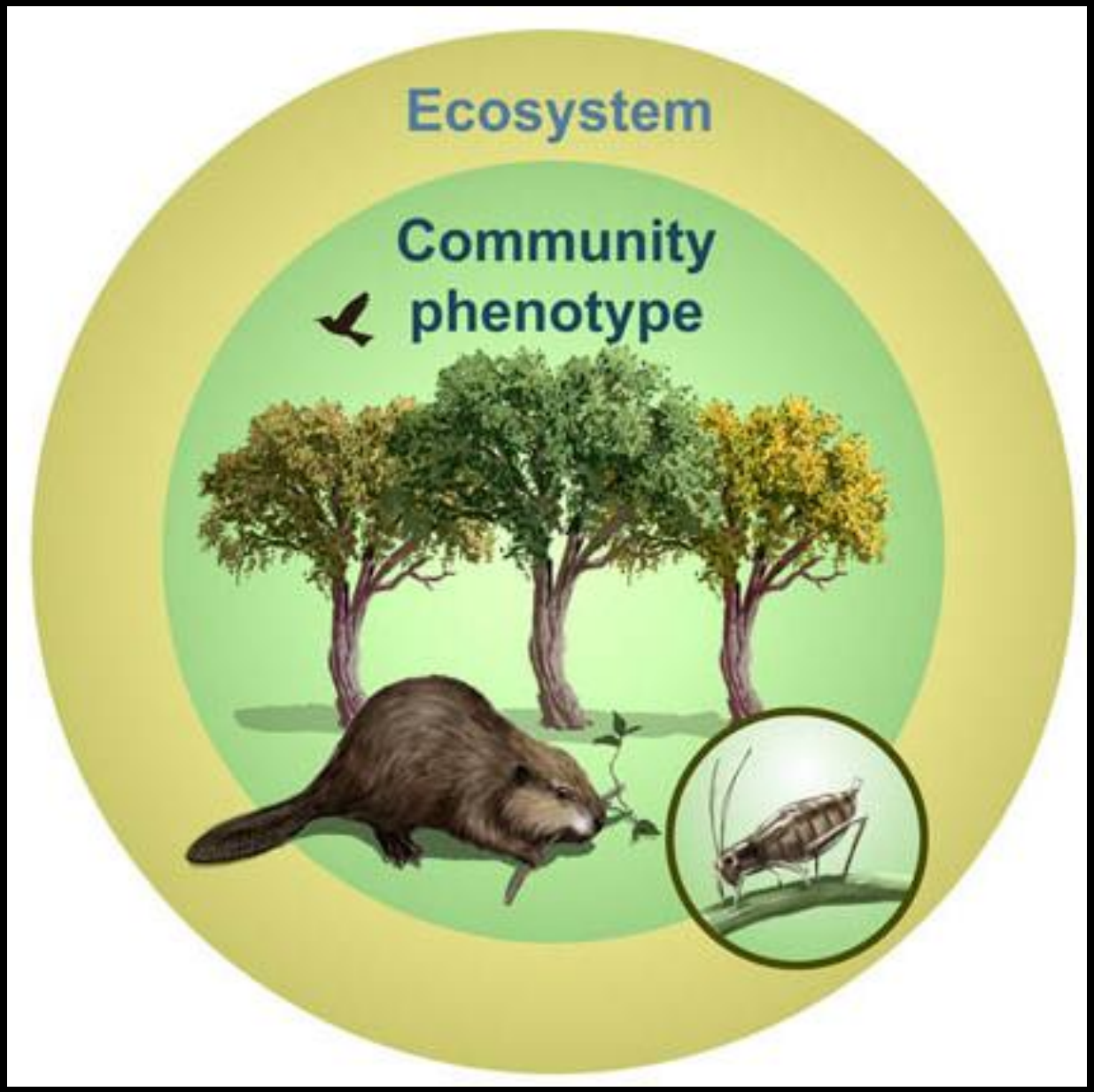
Crowd of people
(same species)

Crowd of Trees
(same species)





Cottonwood Ecology Group, NAU



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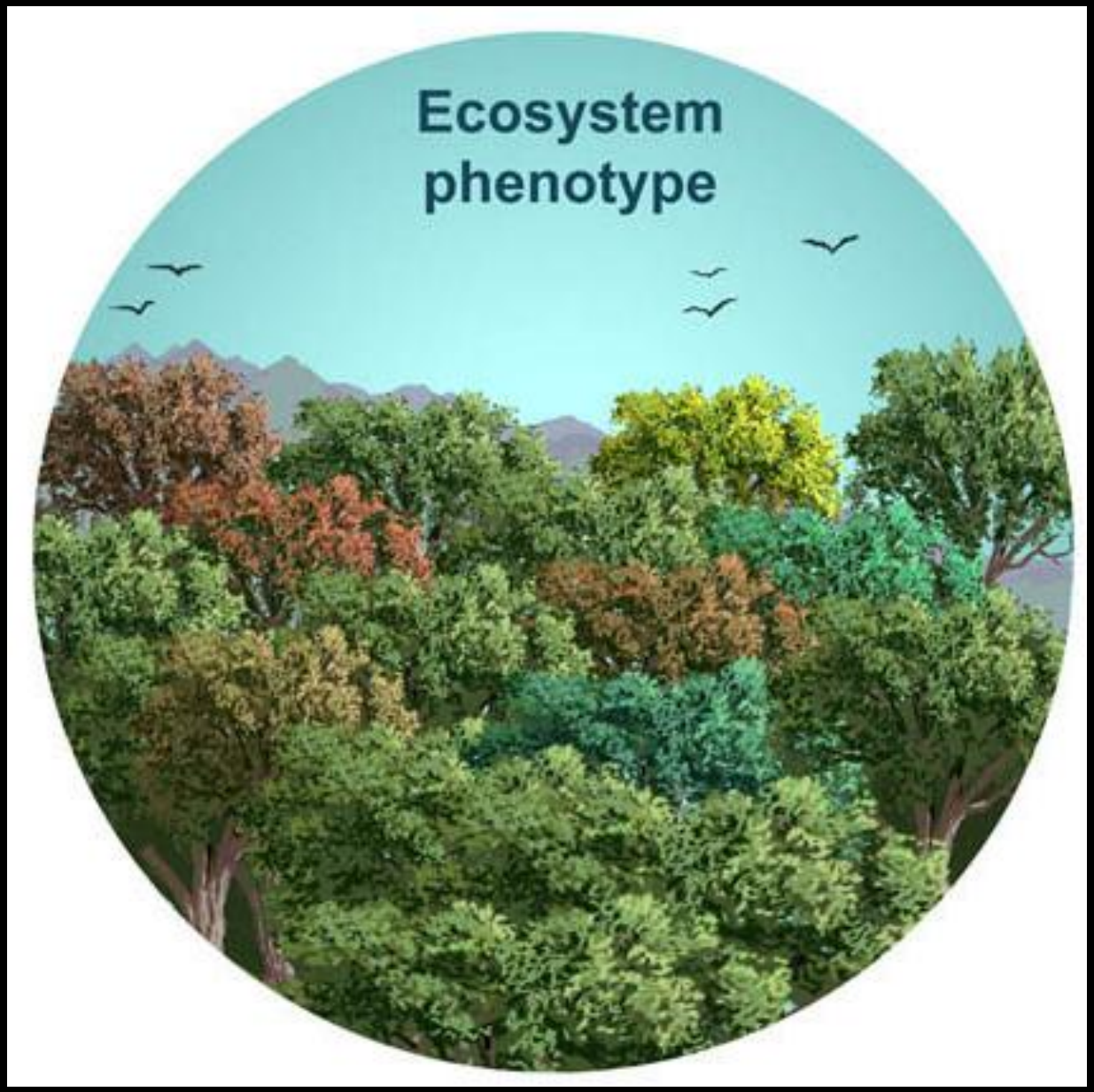

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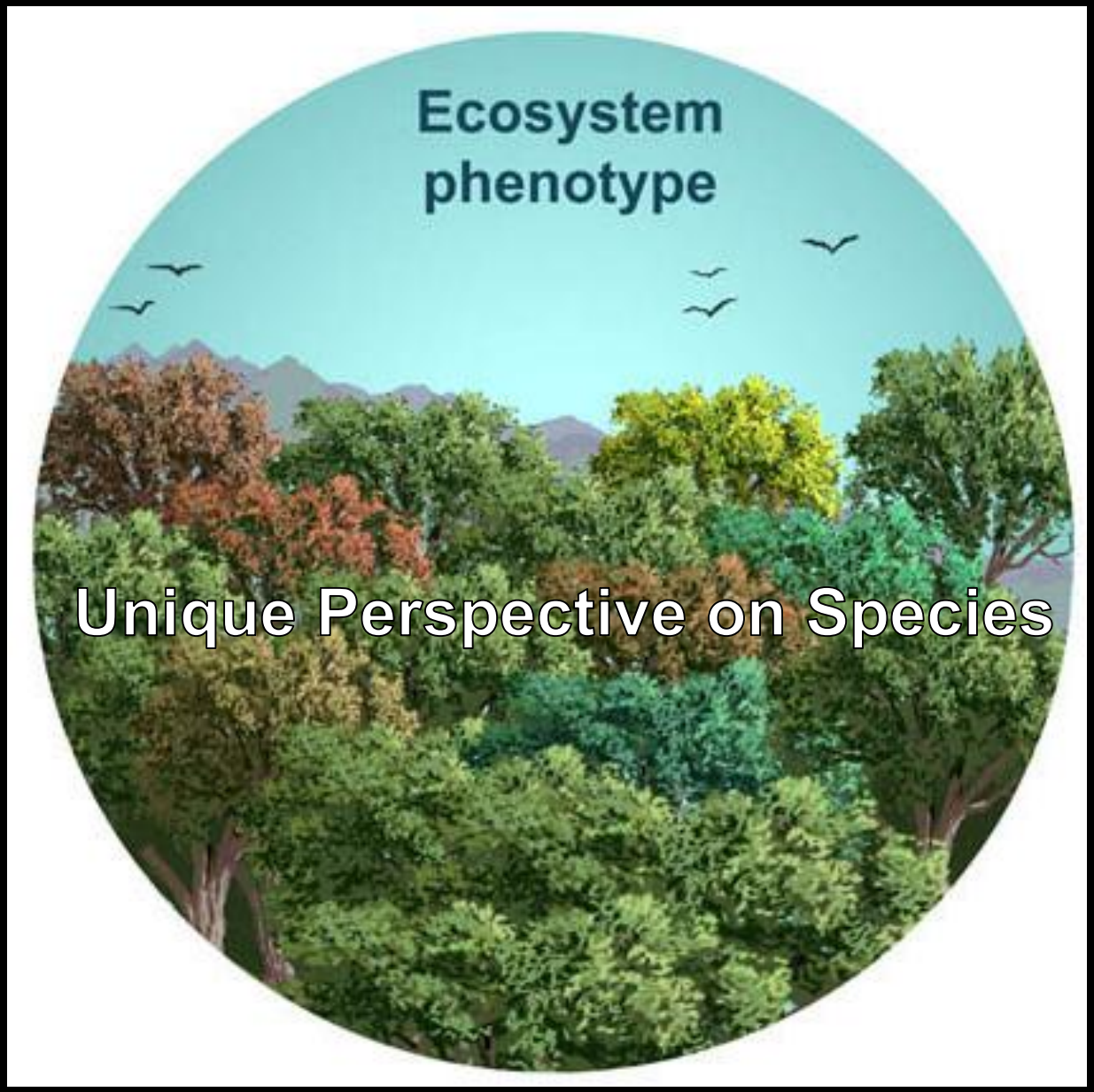
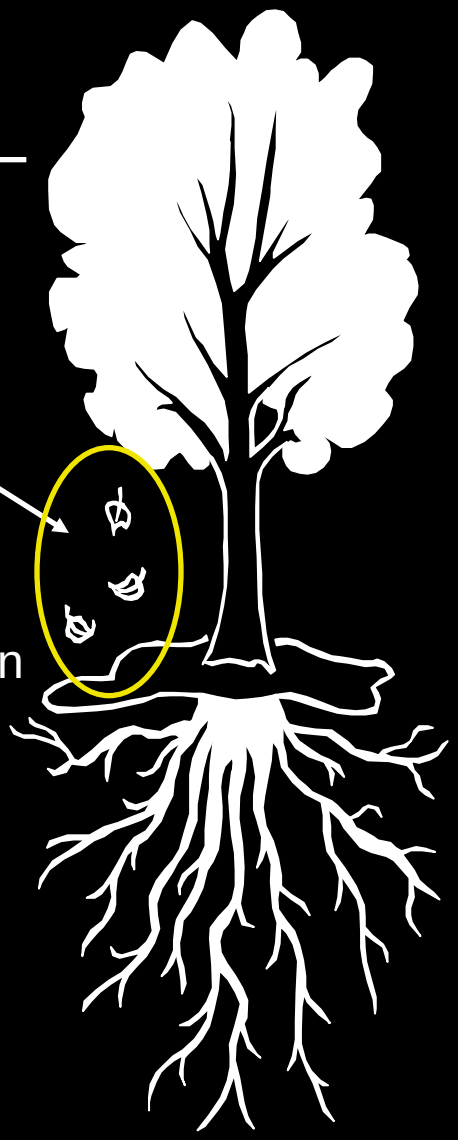
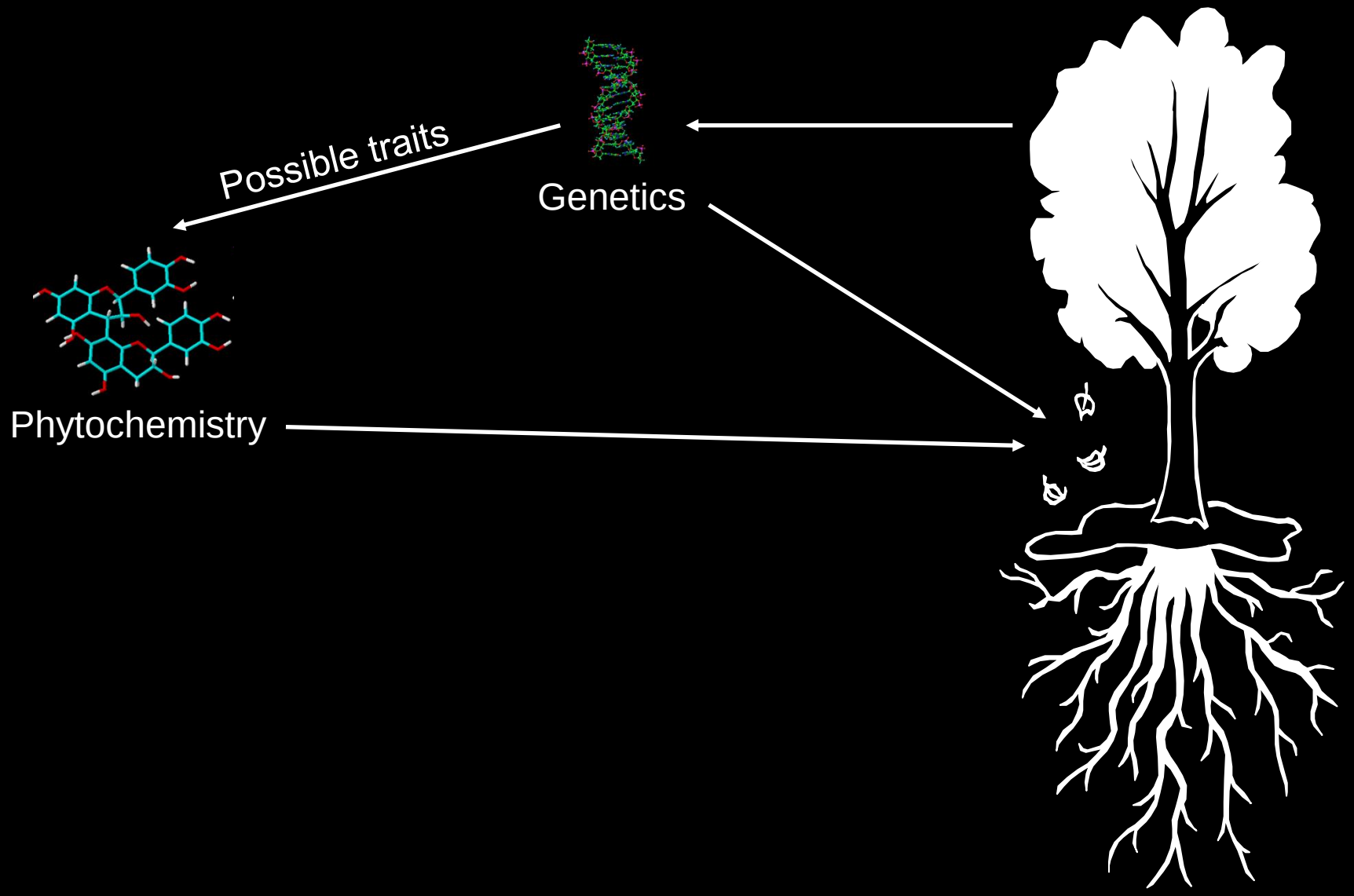

Ecosystem
phenotype
Unique Perspective on Species

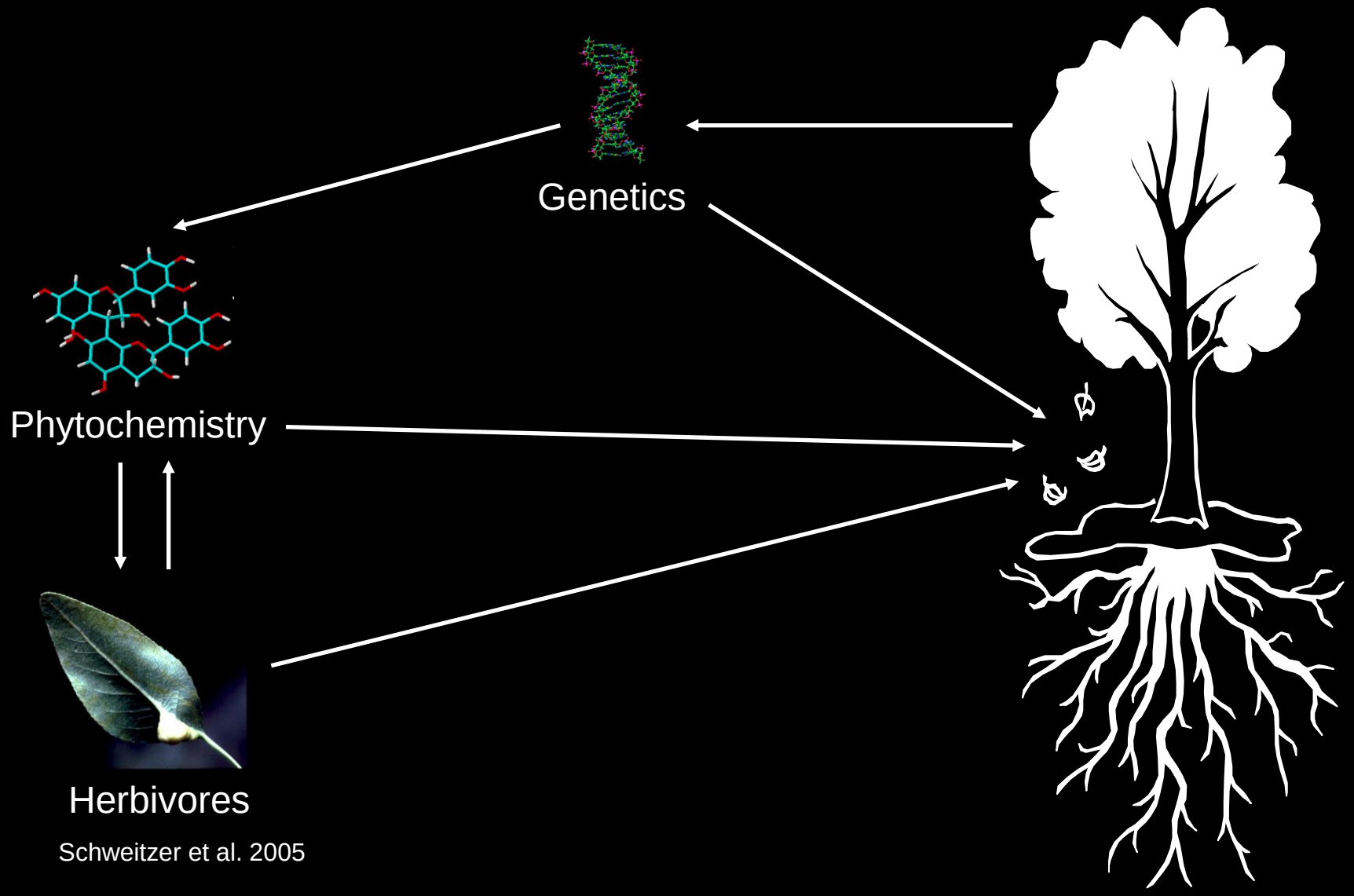
Major Research Questions:

Genetics

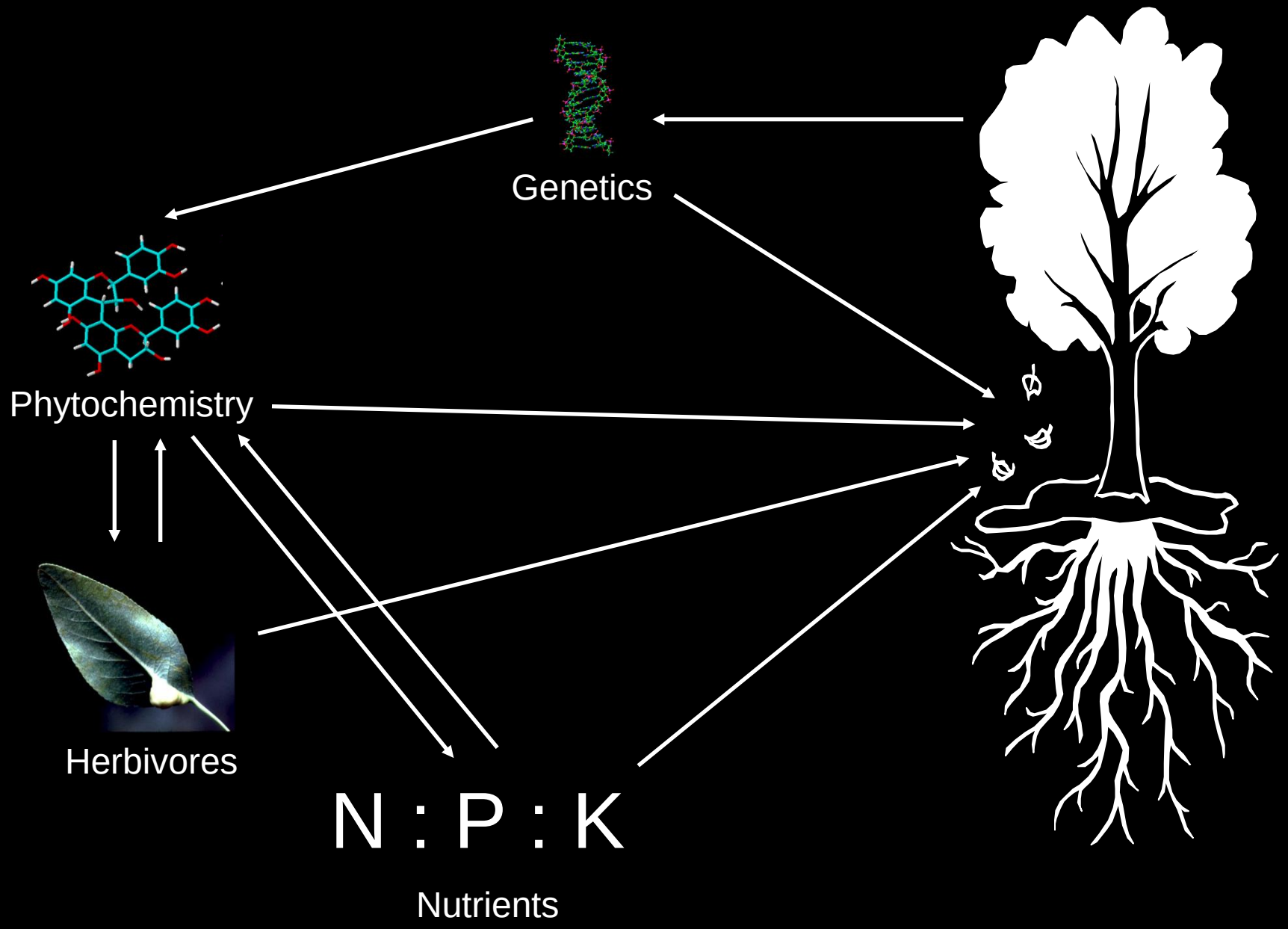


“after-life” effects on decomposition

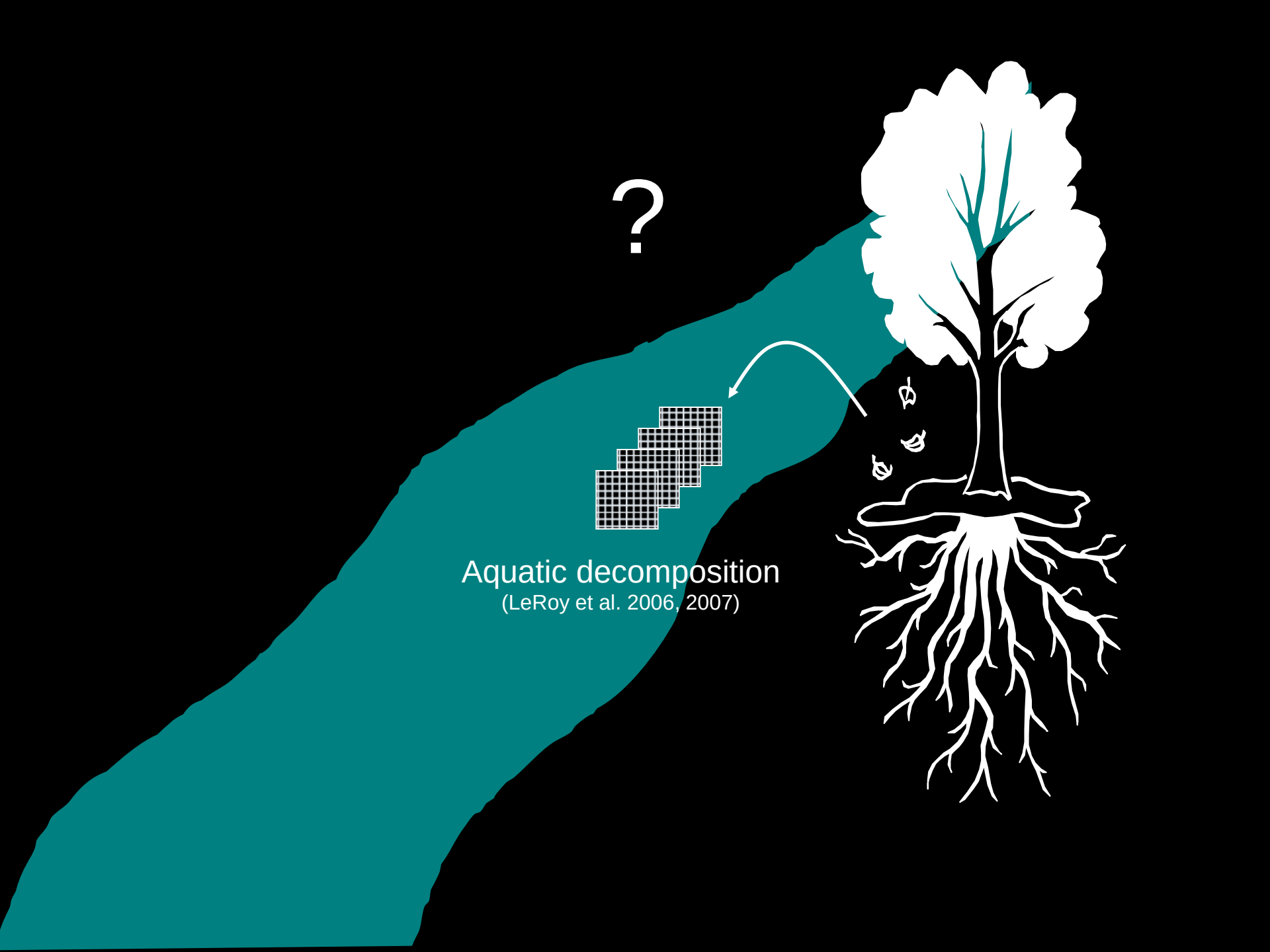

Possible traits
Genetics
Phytochemistry



Schweitzer et al. 2005

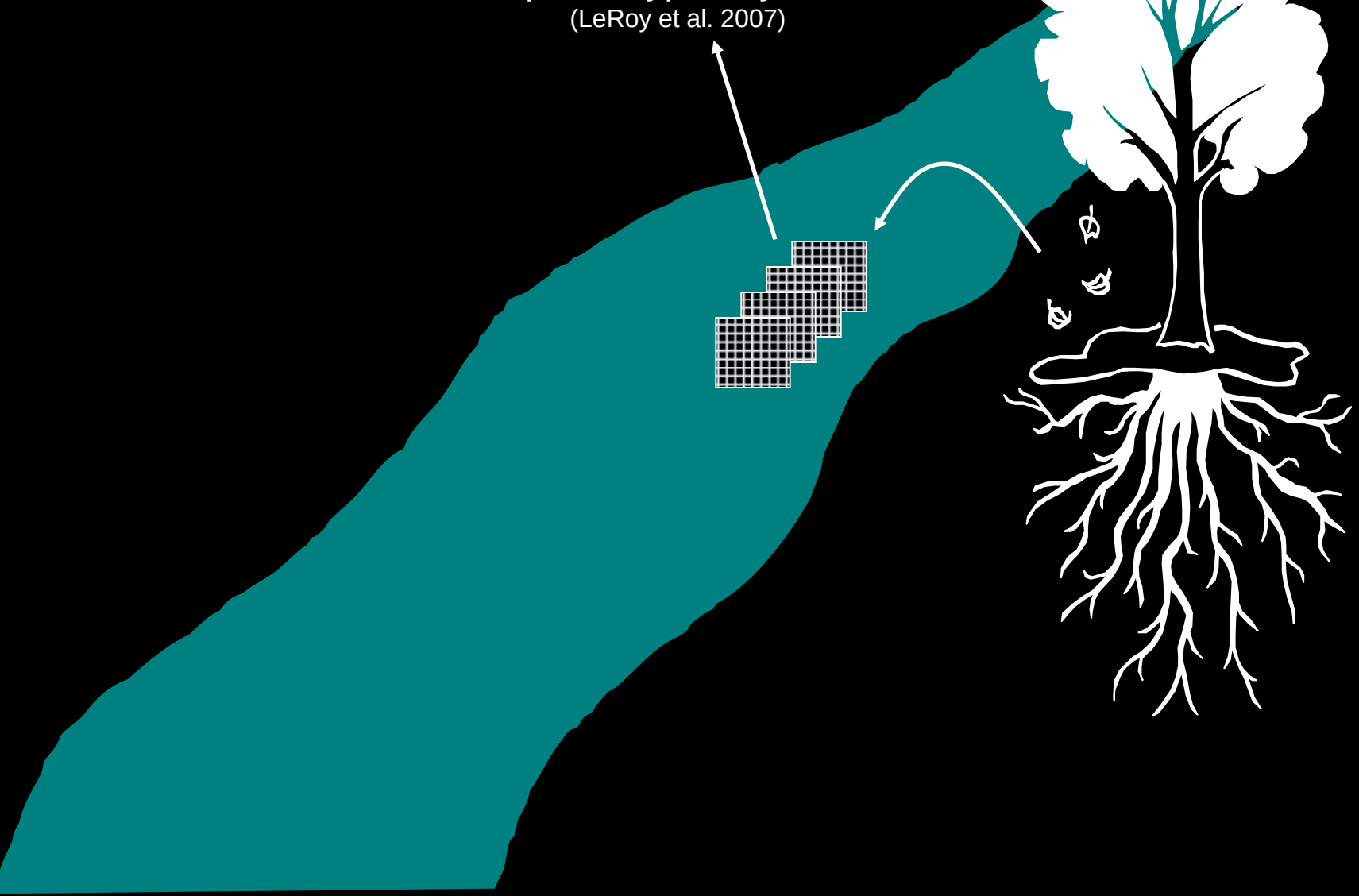


Madritch et al. 2009


?
Aquatic decomposition
(LeRoy et al. 2006, 2007)

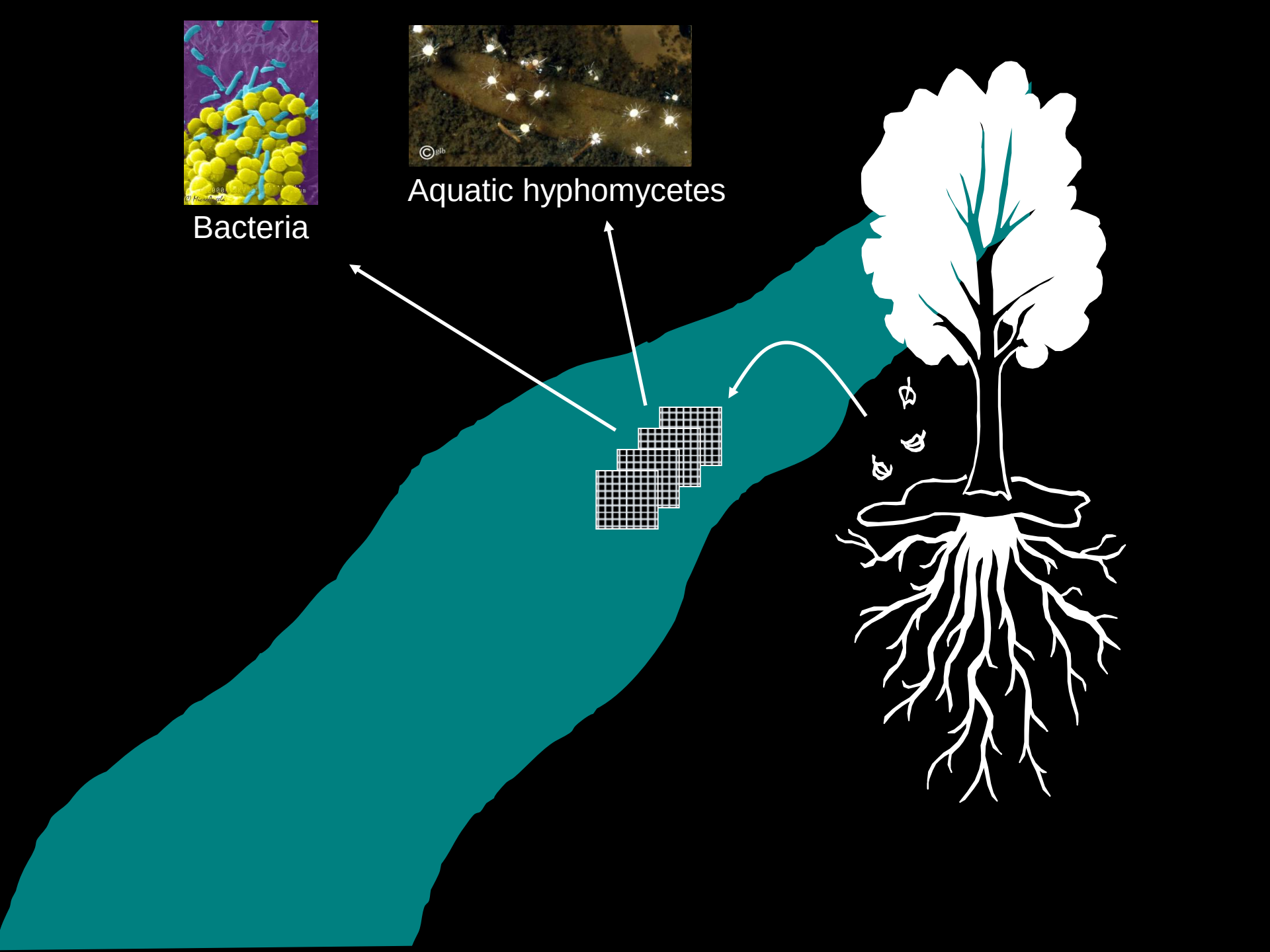
Aquatic hyphomycetes

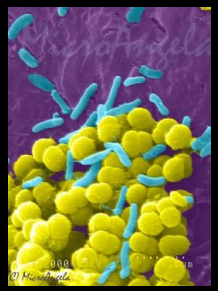
(LeRoy et al. 2007)



Bacteria

Aquatic hyphomycetes

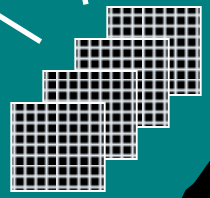


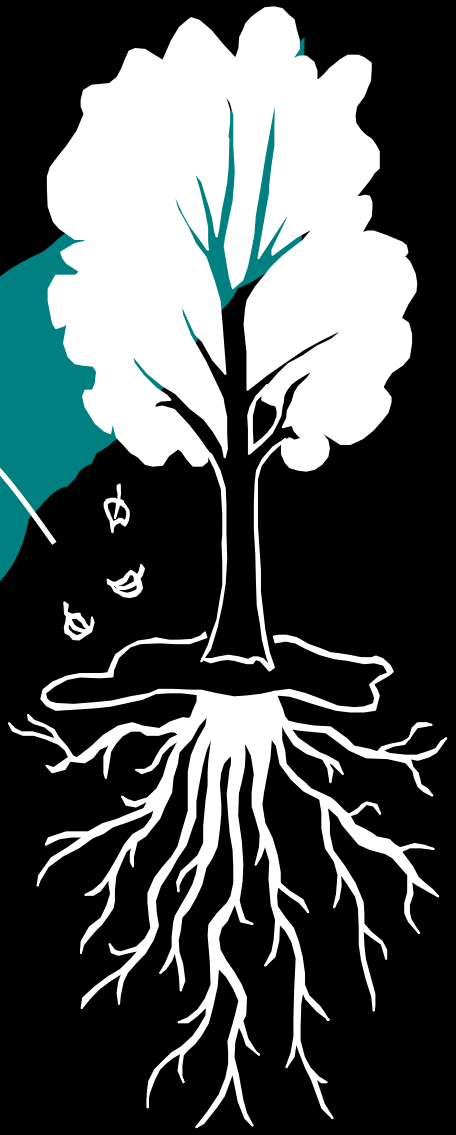


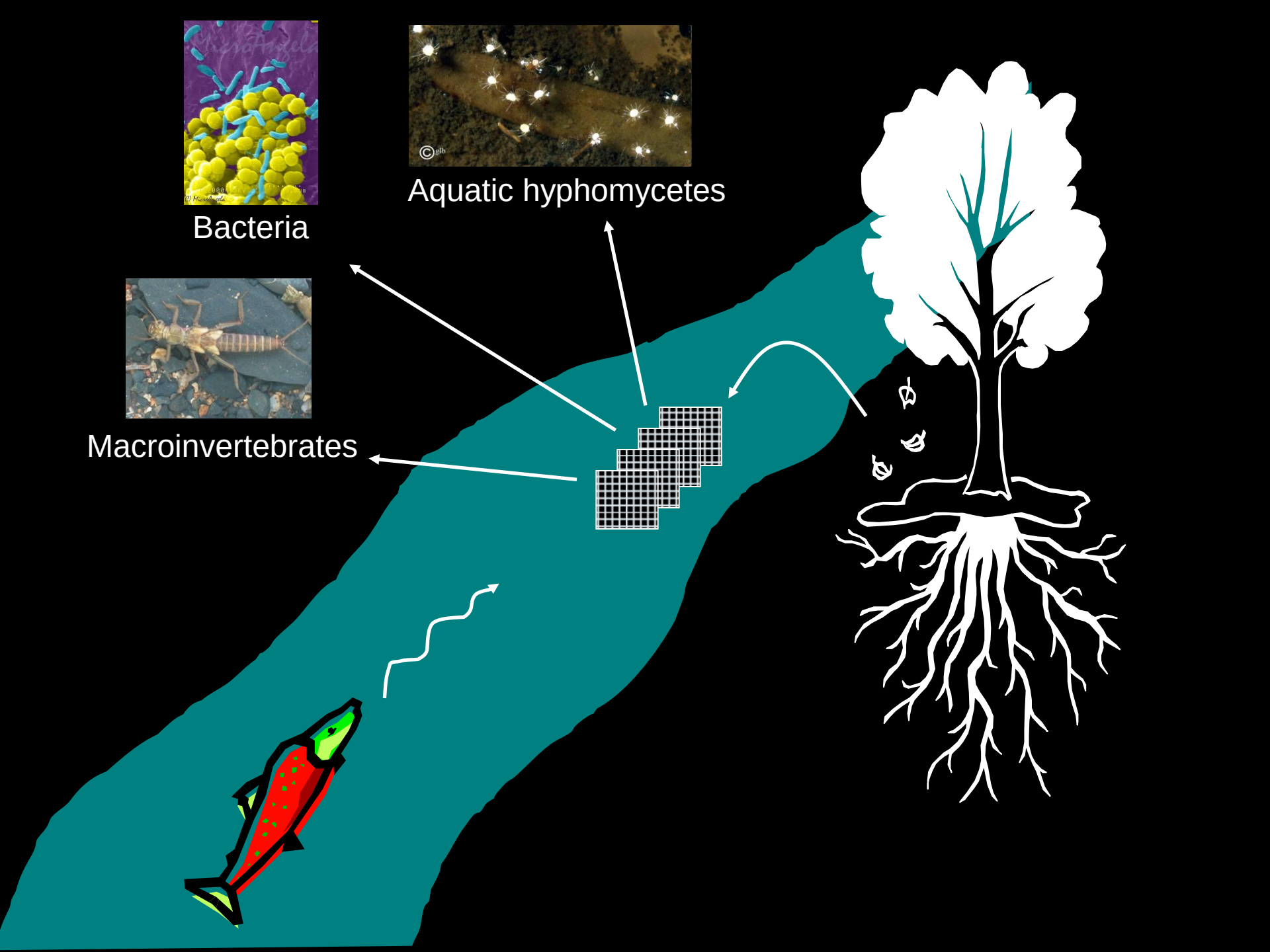
Bacteria

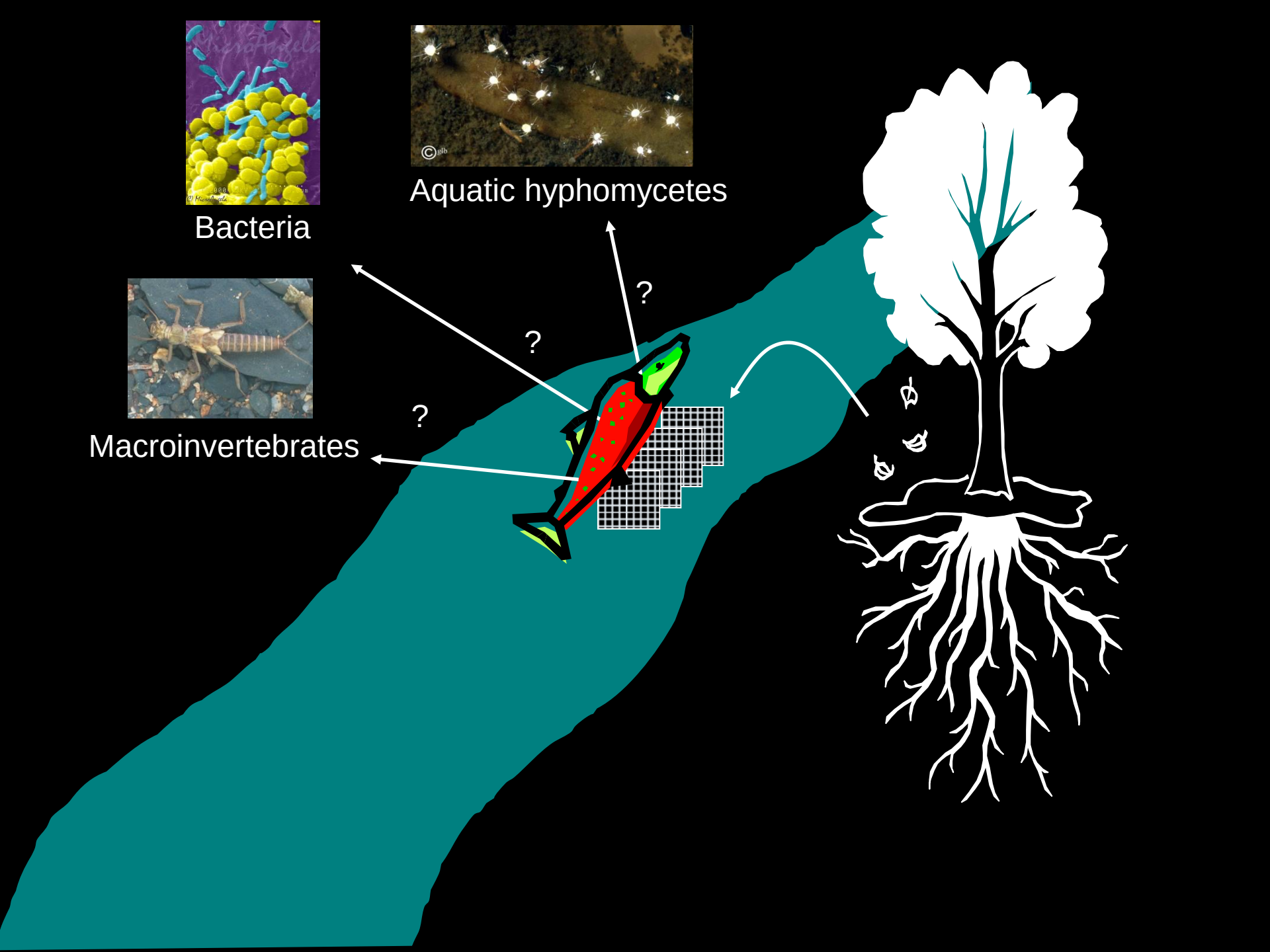
Aquatic hyphomycetes

Macroinvertebrates
(LeRoy et al. 2006)





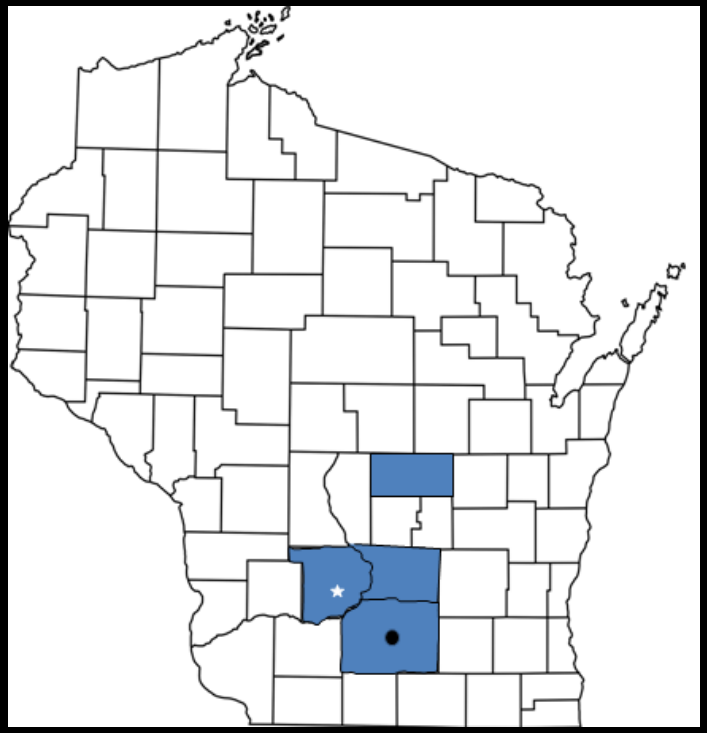

Bacteria
Aquatic hyphomycetes
Macroinvertebrates


Bacteria
Aquatic hyphomycetes
Macroinvertebrates
?
?
?

First – Wisconsin and aspens

Aspen genotypes

- 5 aspen clones collected from:
  - Dane County
  - Sauk County
  - Waushara County
  - Pine Island Wildlife Area, Columbia County
- Planted in a common garden

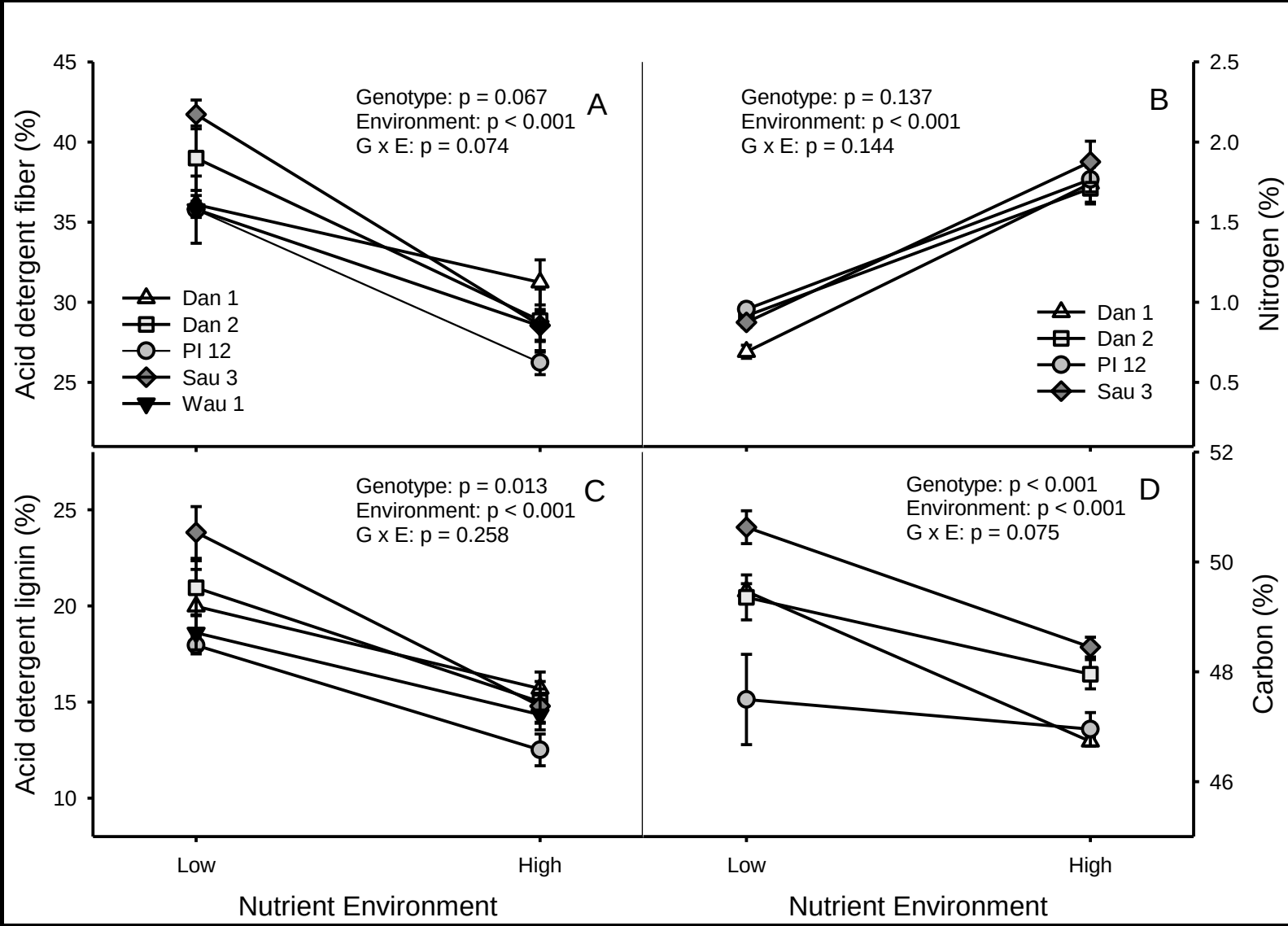


In-stream decomposition

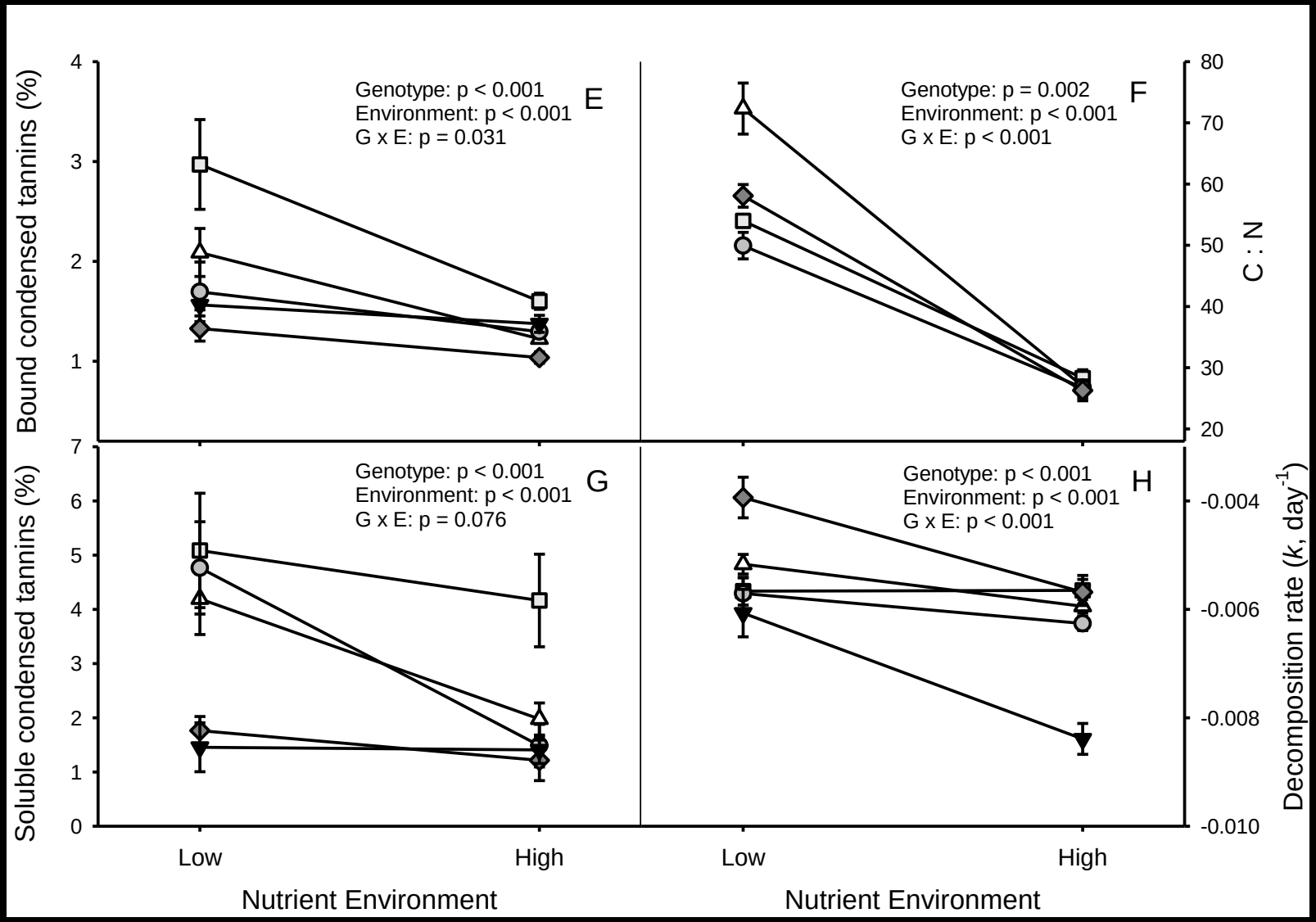
Photo: TNC

- 250 Litterbags placed in Otter Creek at Baxter's Hollow Nature Preserve
- Collected after 7, 15, 29, 57 and 112 days in-stream

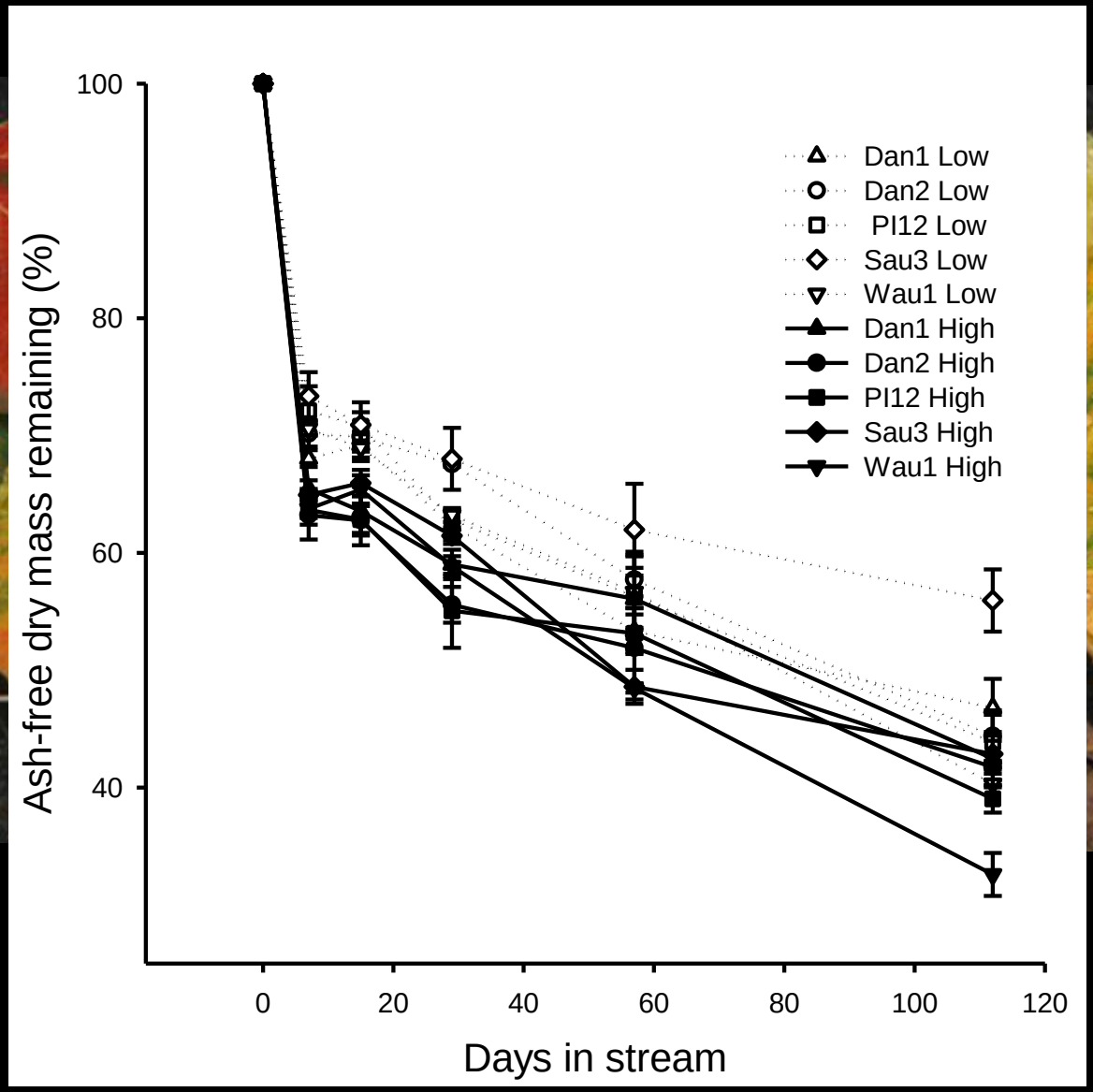
Phytochemistry I



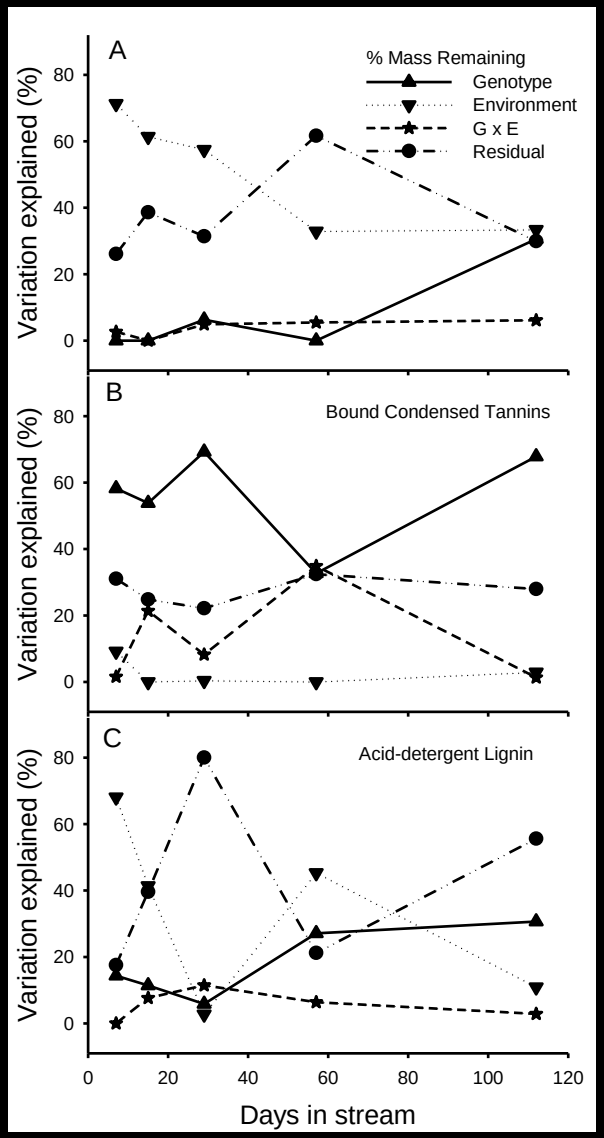
Phytochemistry II



Leaf litter decomposition



Genes or Nutrients?



N : P : K

More natural fertilizer?

Salmon Carcass Effects

- Changes to the macroinvertebrate community (Chaloner & Wipfli 2002, Winder et al. 2005)
- Changes to nutrient dynamics and primary productivity (Johnston et al. 2004, Payne & Moore 2006, Morley et al. in prep)
- Alters leaf litter decomposition (Zhang et al. 2003, Yanai & Kochi 2005, Claeson et al. 2006)
- But no studies have examined interactions with genetically diverse leaf litter…

Photos by Chili Hunt

REMEMBER
DEWALT

SAFEWAY
SAFEWAY

PANDORA

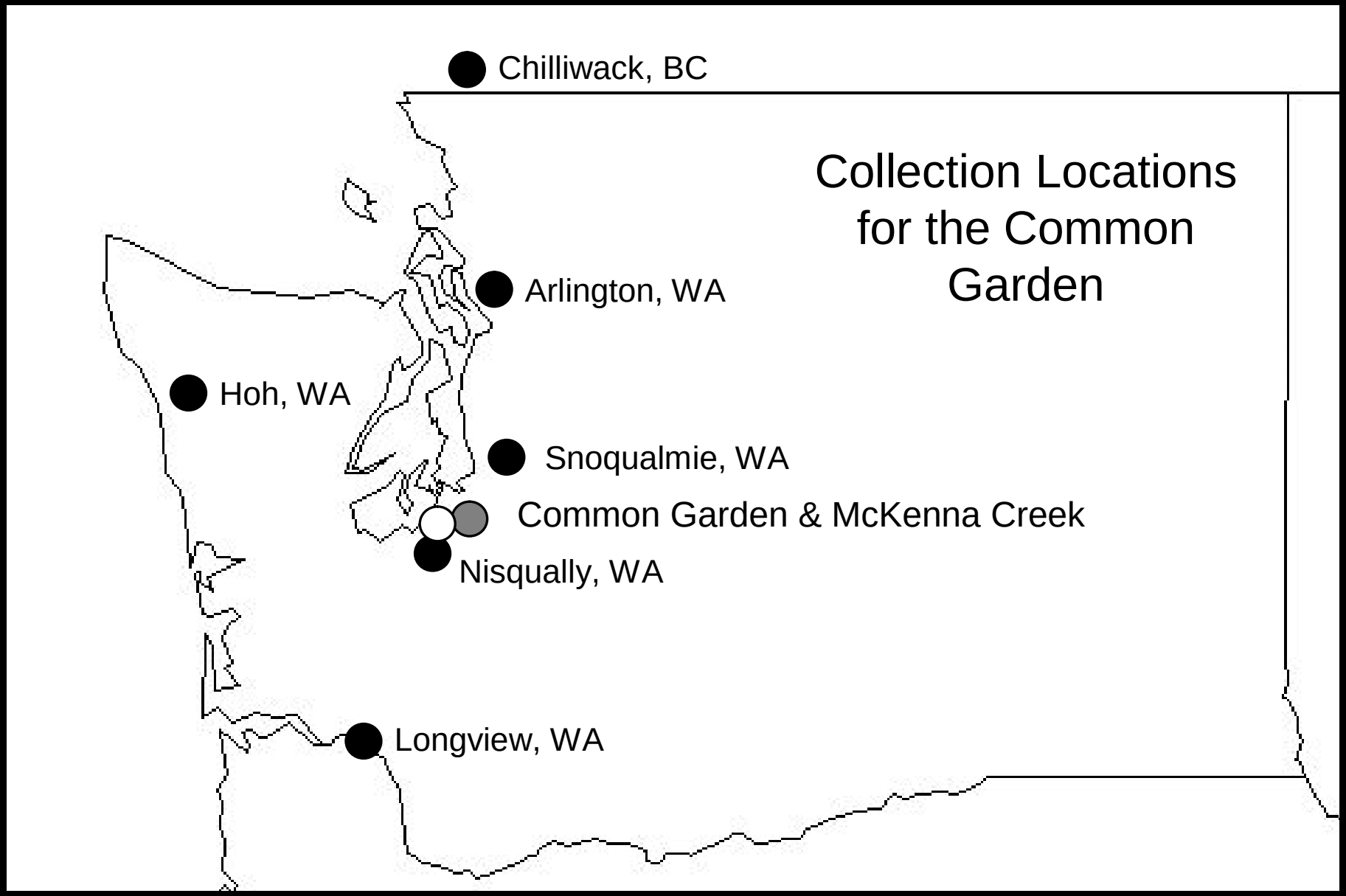
Experimental Carcass Manipulations

Testing for interactions between allochthonous salmon carcass (marine-derived) inputs and allochthonous leaf litter inputs

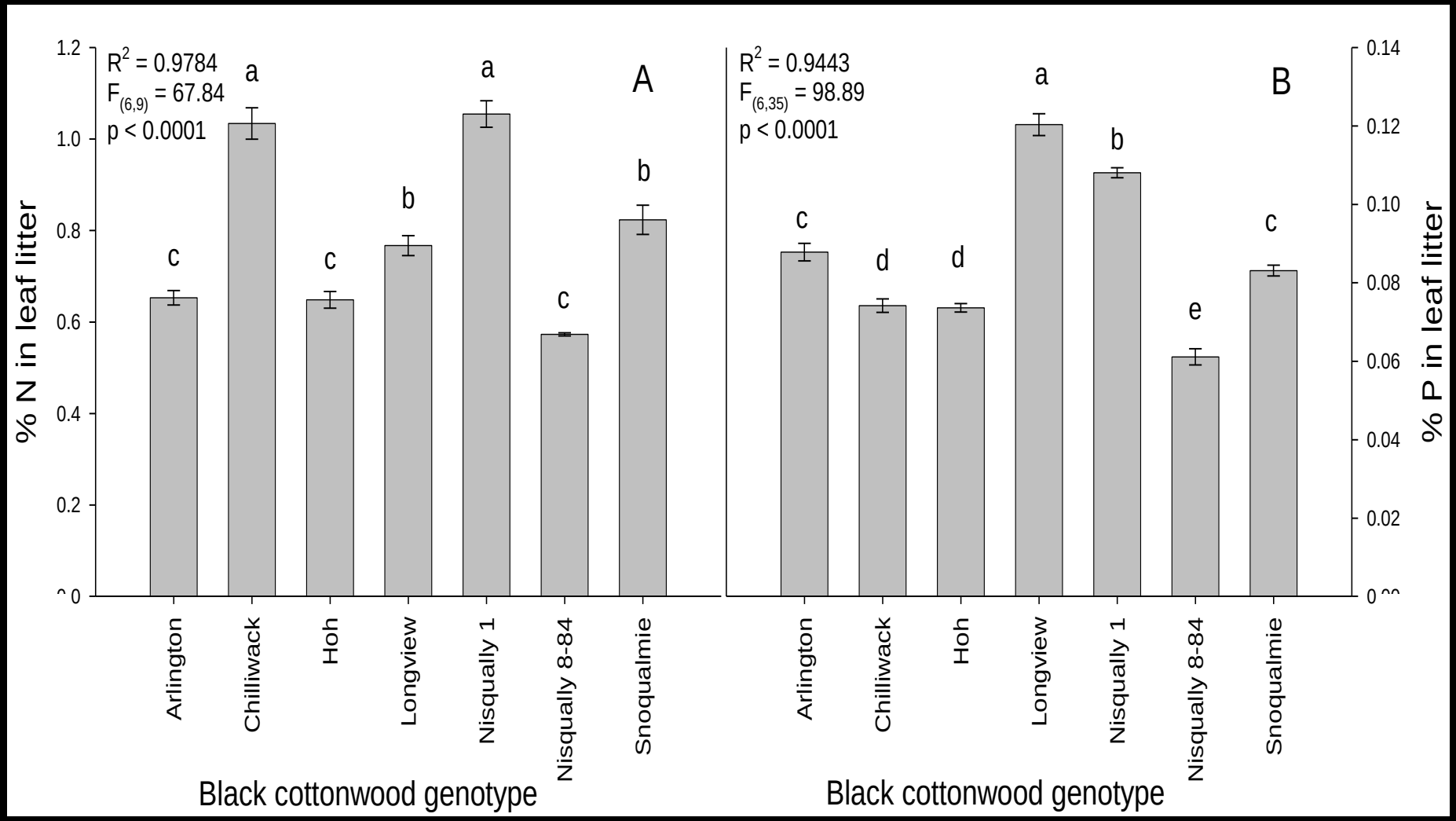
Litter bag Methods

- 2-4g leaf litter/bag
- Coarse (>6.4mm) mesh
- Attached to rebar and anchored in stream
- Harvested through time
- Ergosterol analysis for fungal biomass estimates
- Leaves oven-dried and combusted for AFDM
- Macroinvertebrates collected, identified and enumerated
- Community analysis, NMDS, Indicator Species

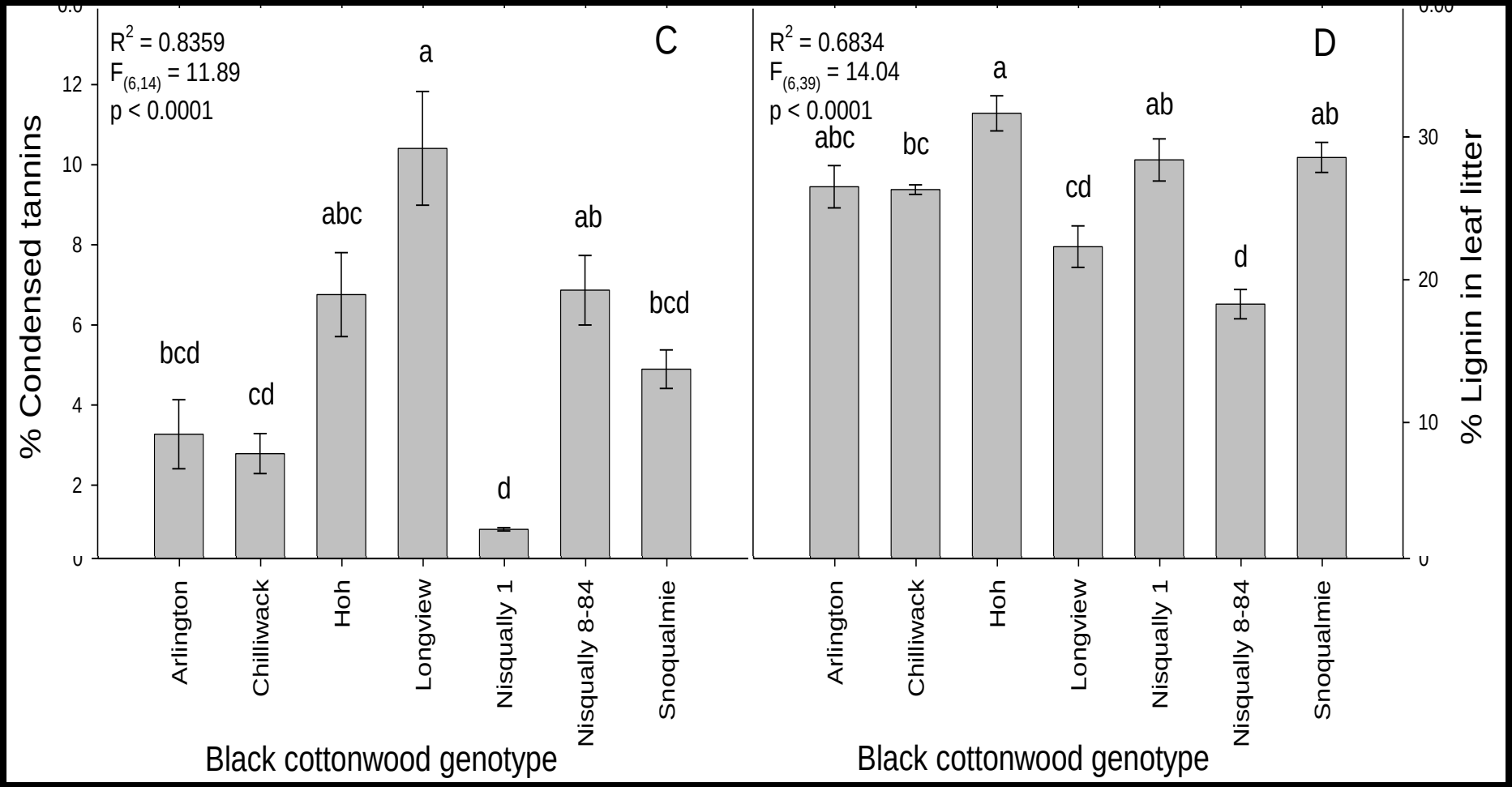
Common Garden –
Puyallup, WA


Chilliwack, BC
Collection Locations for the Common Garden
Arlington, WA
Hoh, WA
Snoqualmie, WA
Common Garden & McKenna Creek
Nisqually, WA
Longview, WA

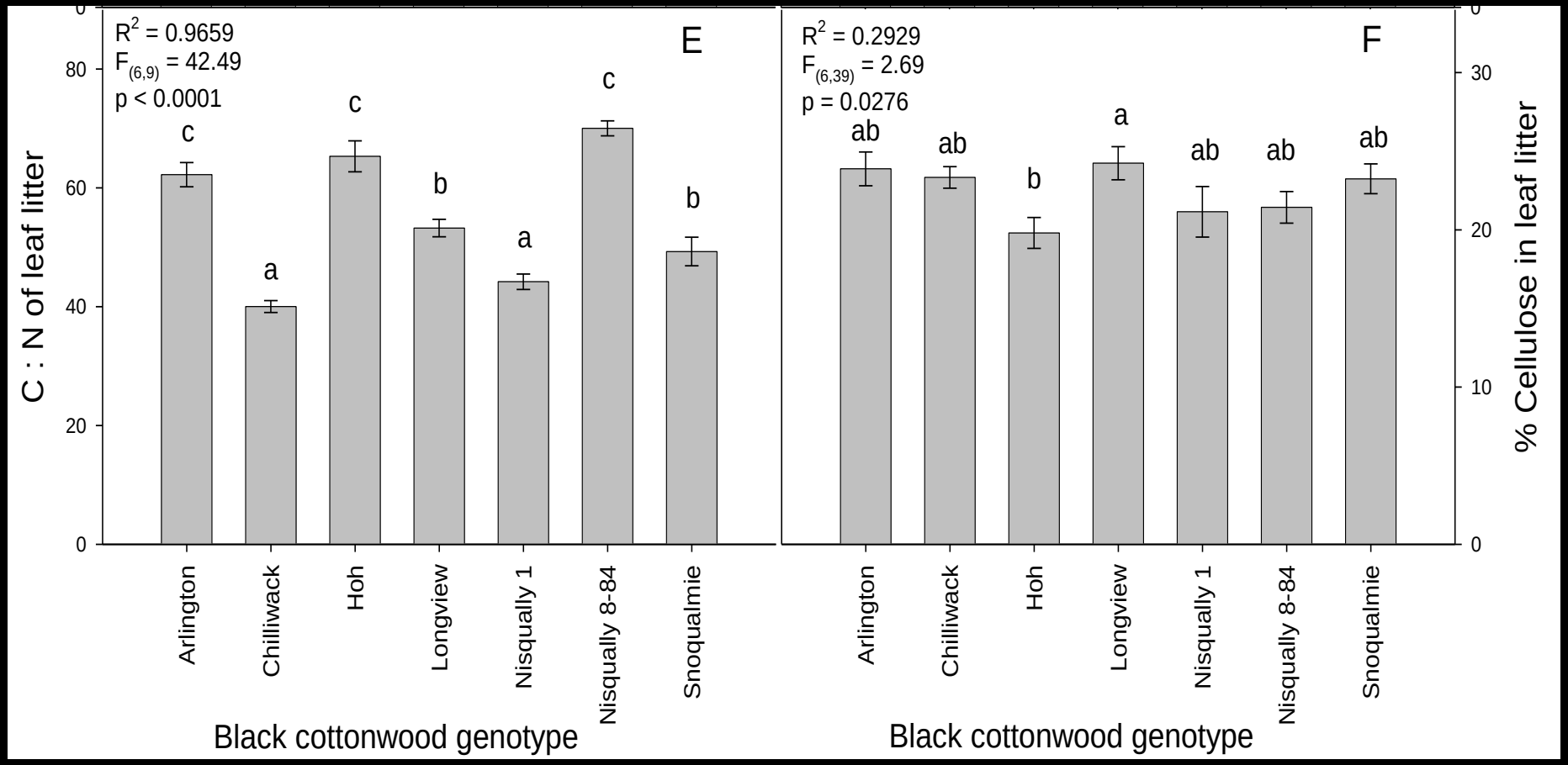
% N & % P vary by genotype



Condensed tannin & lignin, too

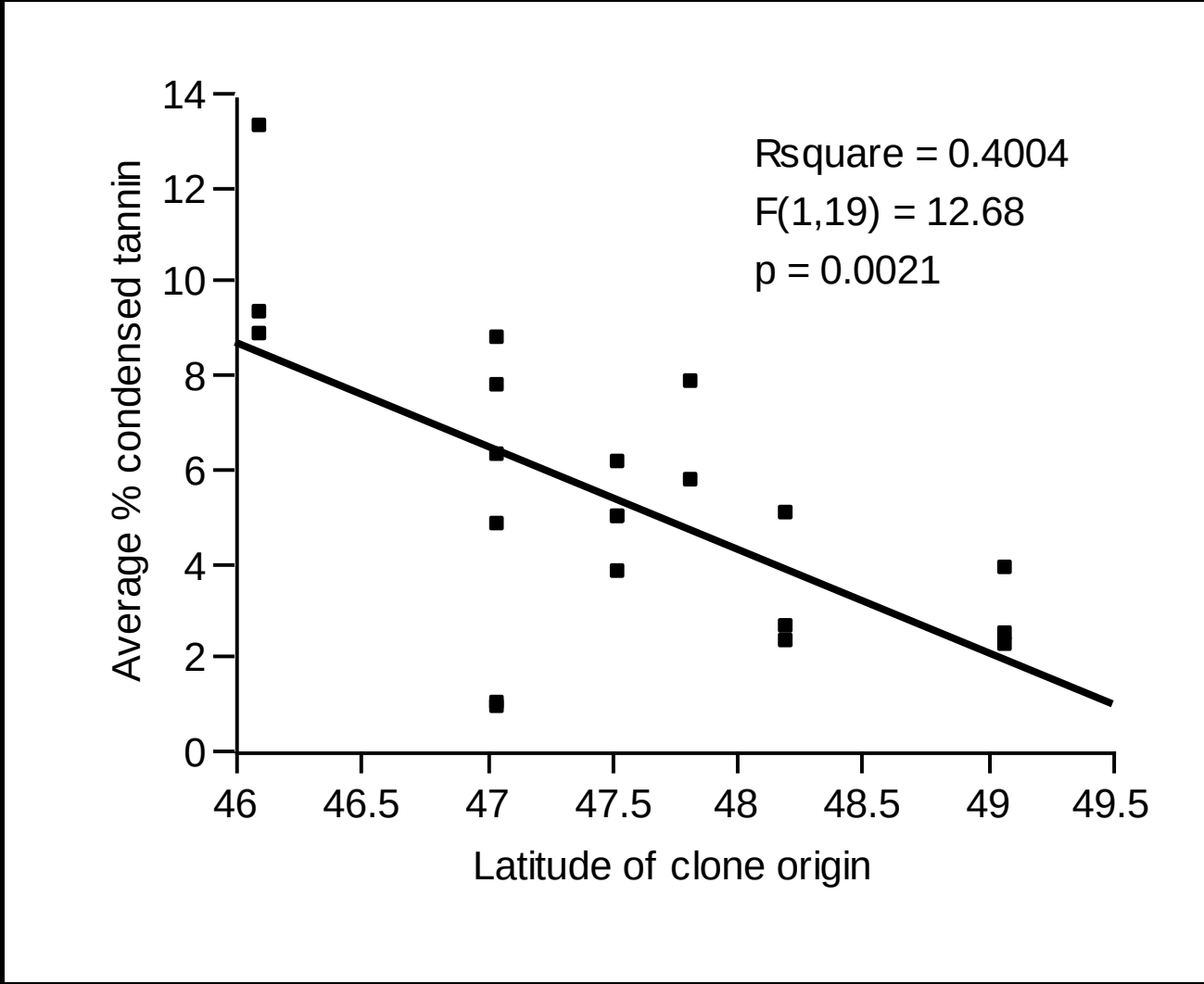


C:N ratios and Cellulose

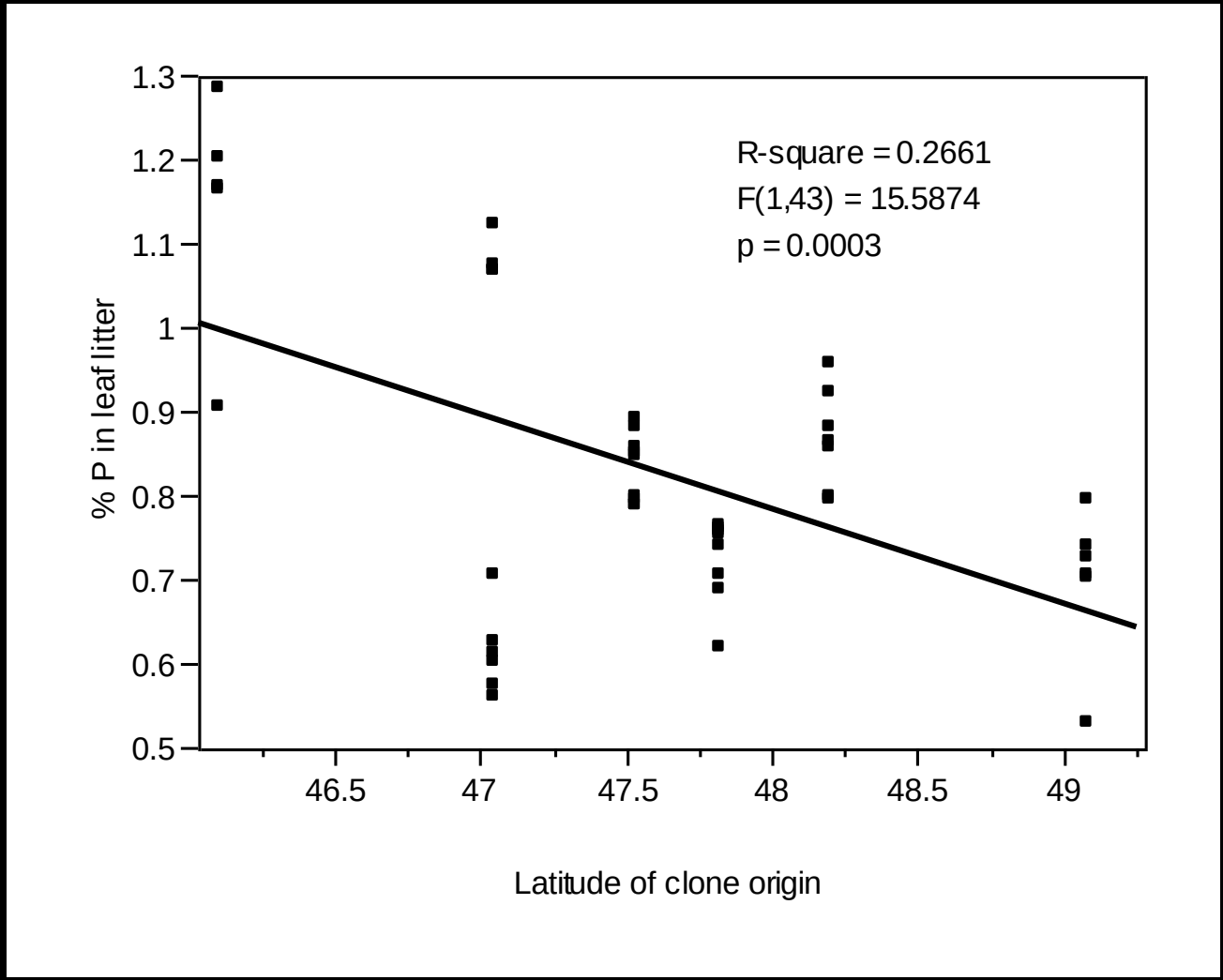


Cellulose is not as variable as other measures

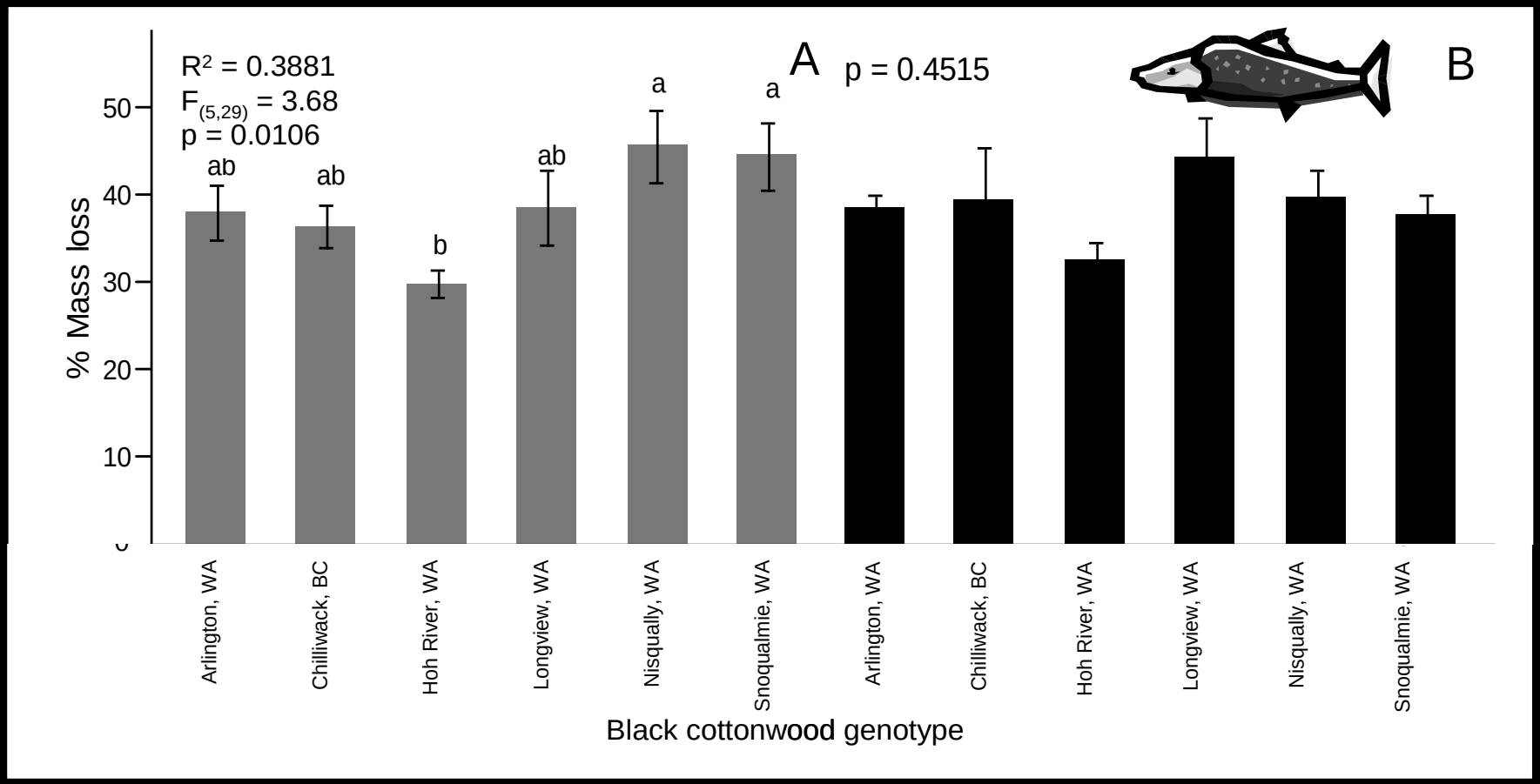
Condensed tannins significantly related to the latitude of clone origin



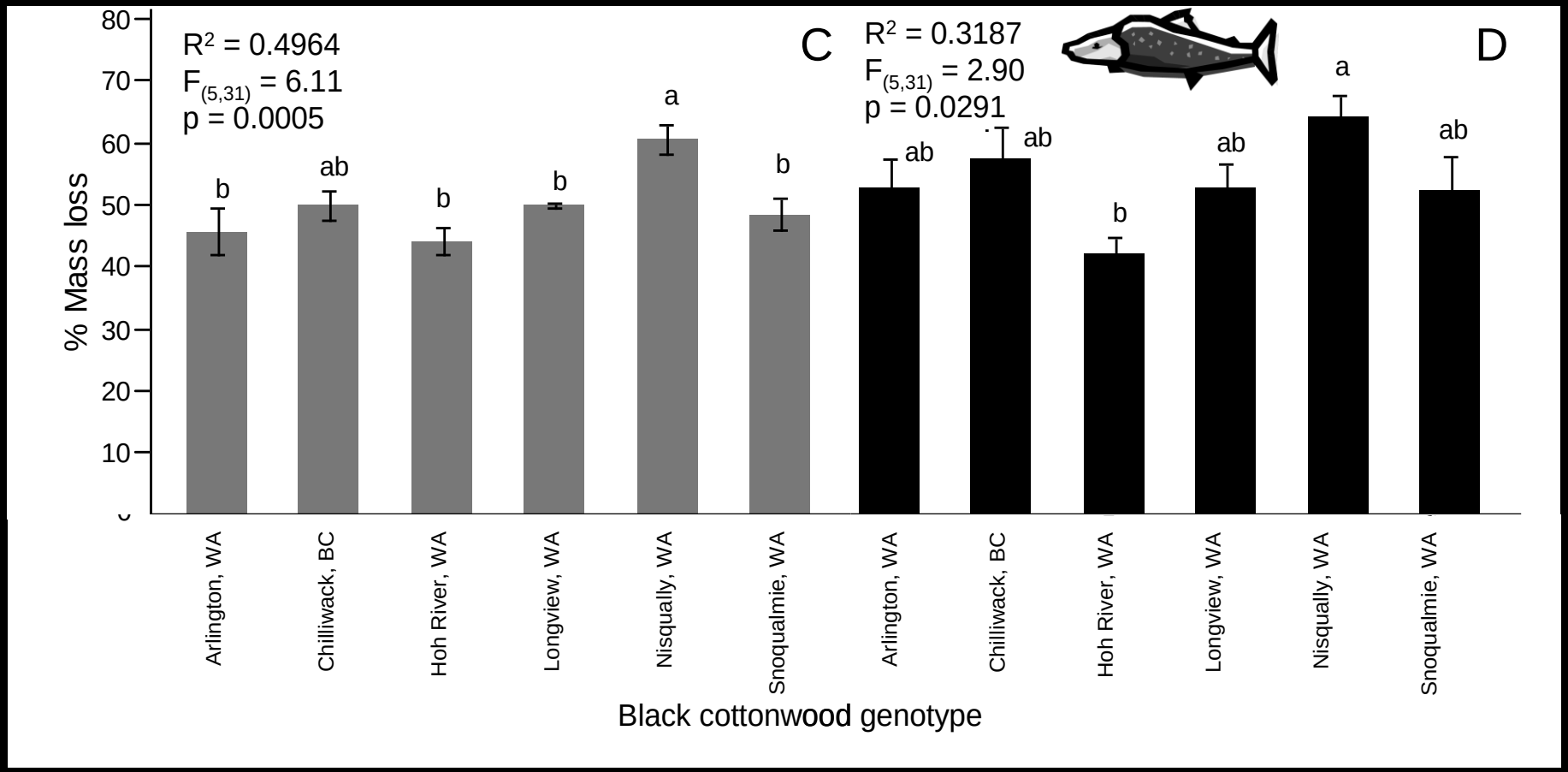
% P significantly related to Latitude of clone origin



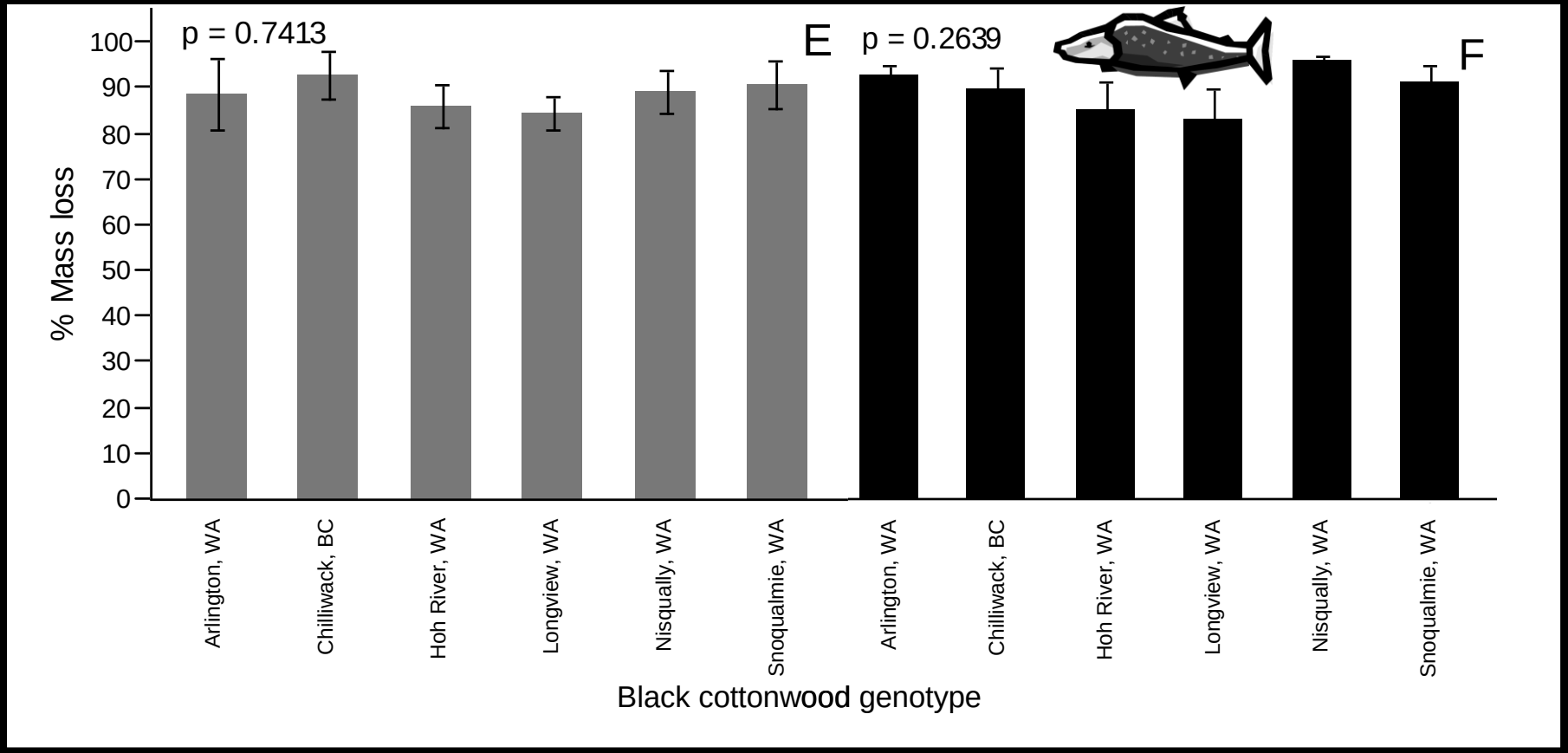
Day 14: Geno effect only in absence of salmon



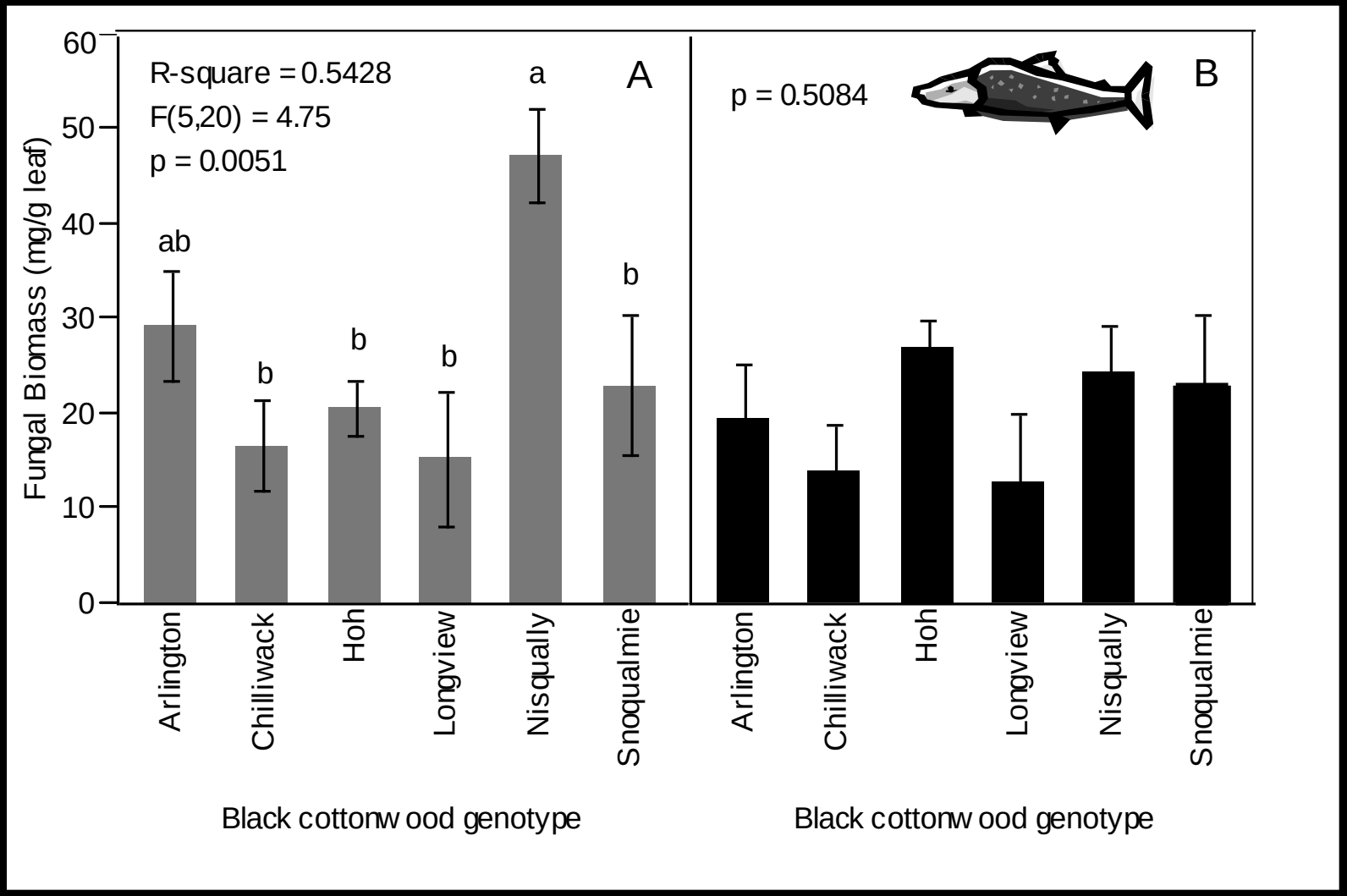
Day 28: Geno effect in both no-salmon & salmon treatments



Day 78: Geno effect disappears

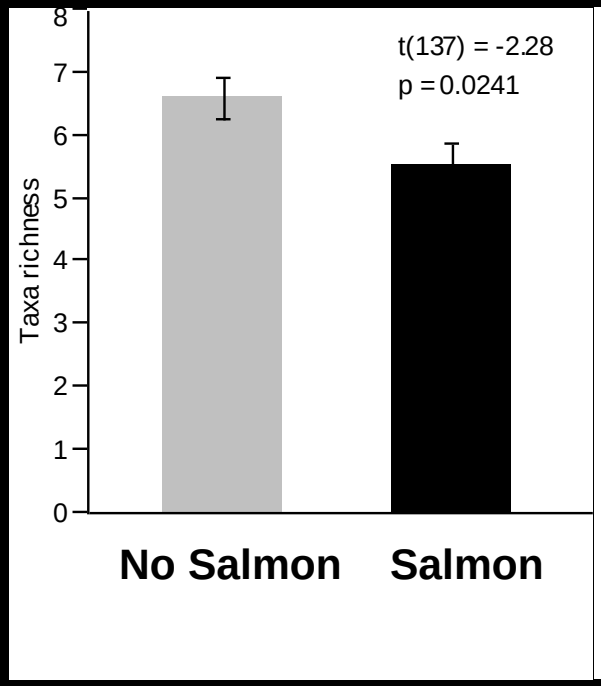


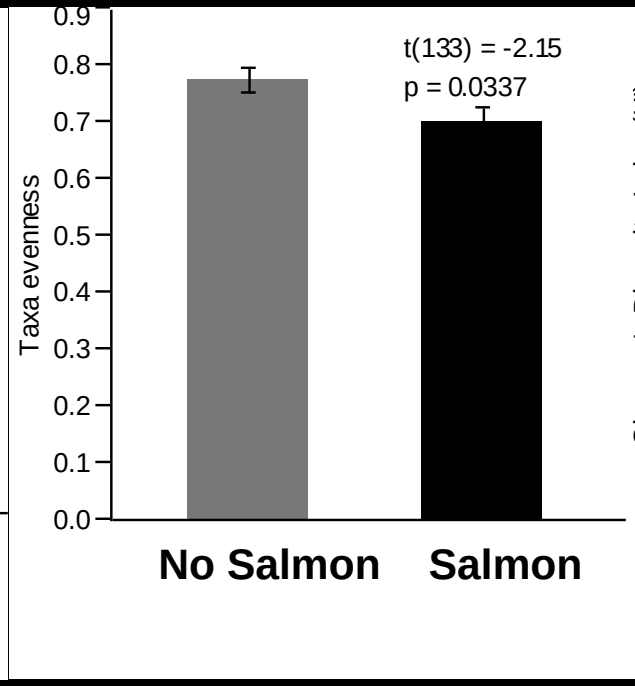
Genotype influences fungal biomass – only in the absence of salmon

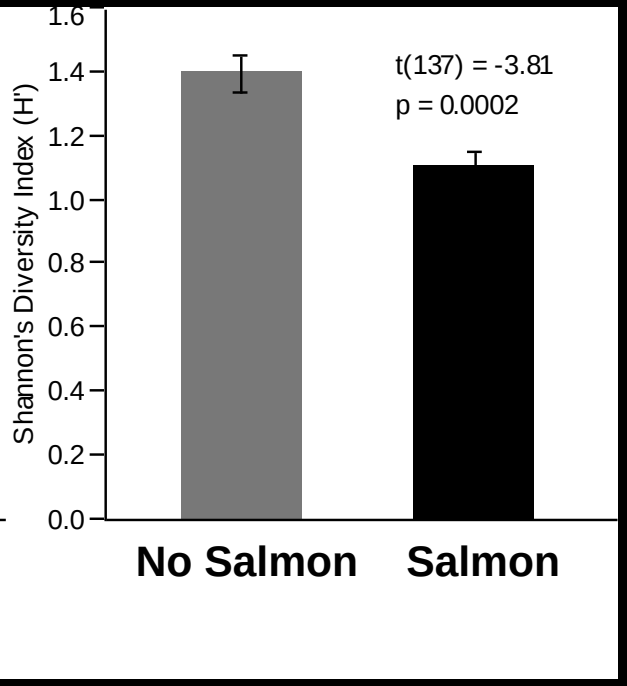


No genotype influence on macroinvertebrates

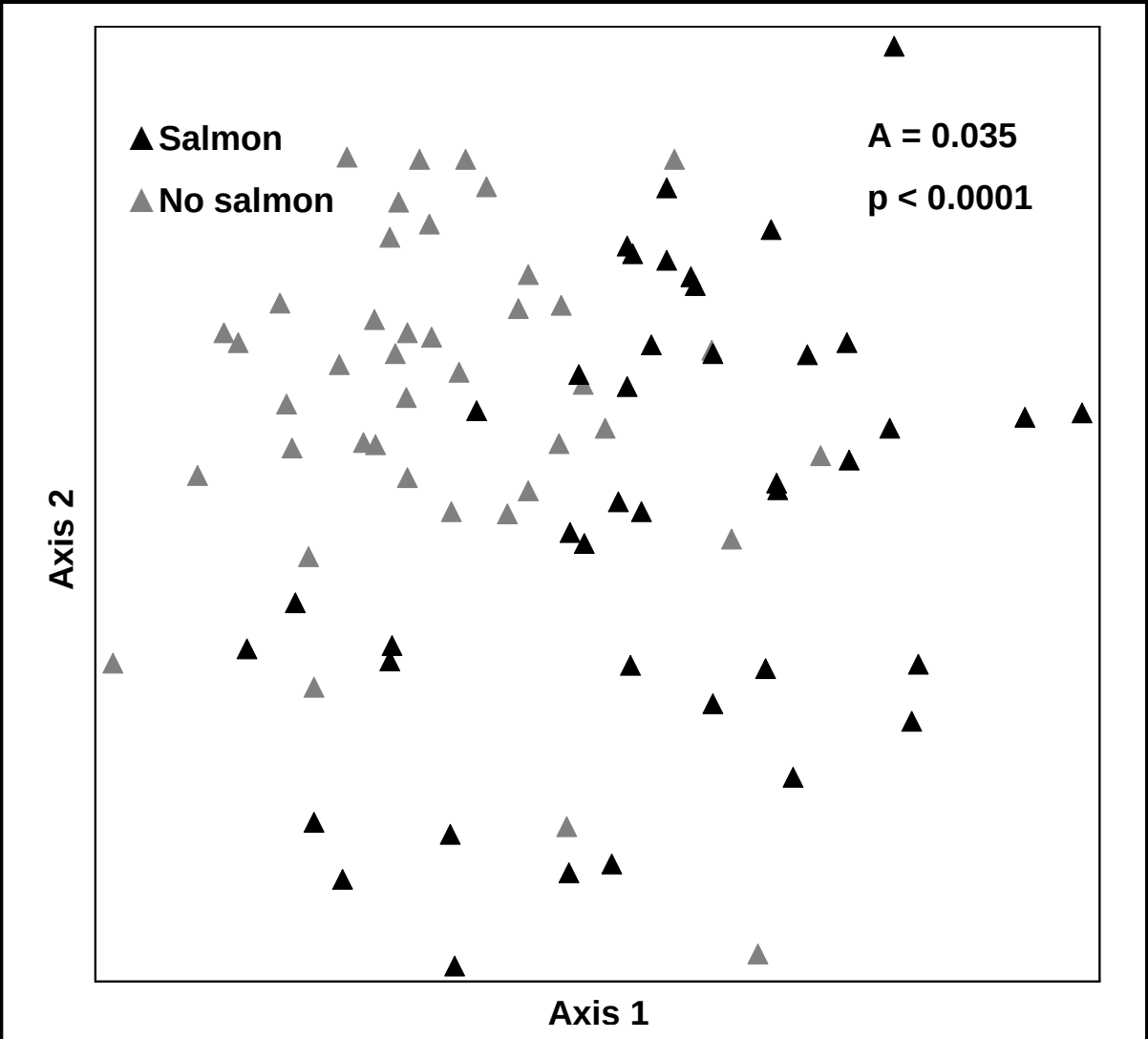
But, macroinvertebrate richness, evenness and diversity are higher in no-salmon controls







Salmon carcass effects on macroinvertebrate communities



Indicator species analysis

Salmon Treatment

Macroinvertebrate	***P* value**
Malenka Ricker	0.0480
Onocosmoecus	0.0010
Psychodidae	0.0130
Snail, "conical"	0.0020

No salmon treatment

Macroinvertebrate	***P* value**
Lepidostoma	0.0010
Tipulidae	0.0050
Simuliidae	0.0100
Planorbidae	0.0010
limpets	0.0020
snail, "horn-shaped"	0.0010

Indicator species analysis

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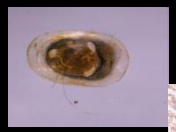


Implications & Future work

- Linkages between terrestrial genes & aquatic ecosystems (Whitham et al. 2006, *Nature Reviews Genetics*)
- Mapping ecosystem and community traits onto plant genomes (*Populus* Genome Project: Tuskan et al. 2006, *Science;* Woolbright et al., *in prep*)
- Genetically modified poplars – reduced decomp rates for lignin-reduced poplars (Axelsson, Hjalten, LeRoy, et al. 2009)
- Global Change: Climate-induced shifts in plant communities may alter stream function across the globe

A new focus on my research…

Bringing science into prisons

www.sustainableprisons.org

Sustainable Prisons Project

Lecture series

Photos by Benj Drummond

Sustainable Prisons Project

Sustainable operations

Photos by Benj Drummond

SPP
Sustainable Prisons Project

Green Job Training

Conservation projects

- Rare and endangered prairie plants

Photos by Benj Drummond

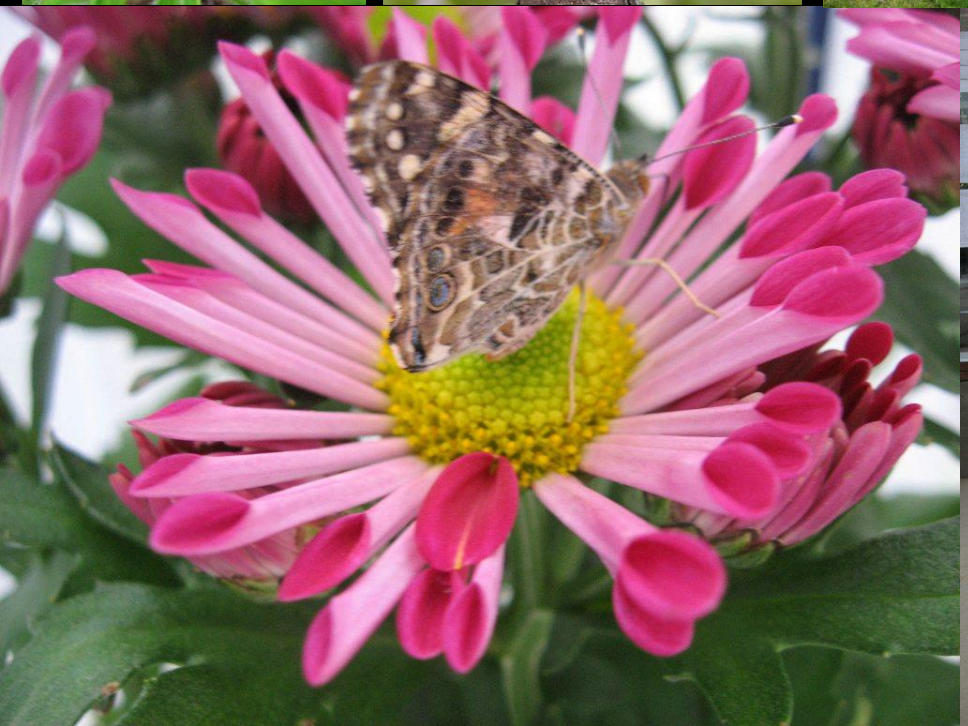
Conservation projects

- State Endangered Oregon Spotted Frogs

Photos by Benj Drummond

Conservation projects

- Threatened Taylor's Checkerspot Butterfly



Photos by Benj Drummond & Dennis Aubrey

National movement

- Expansion of SPP across the US
- National conference in spring 2012
- Decreasing prison costs across the nation
- Increased science education for adults
- 1% of the US population is incarcerated

EVERGREEN
THE EVERGREEN STATE COLLEGE
OLYMPIA, WASHINGTON

EVERGREEN FIELD ECOLOGY LABORATORY

SPP
Sustainable Prisons Project

Thank you to:

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DOC staff, incarcerated men and women

www.sustainableprisons.org

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