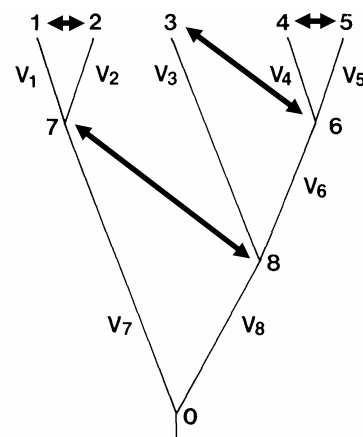


**Kurokawa and Nakashizuka 2008. LEAF HERBIVORY AND DECOMPOSABILITY
 IN A MALAYSIAN TROPICAL RAIN FOREST.**

1. What is the relationship between leaf palatability and decomposability? Leaf traits that influence herbivory carry over into litter traits that influence decomposability, so palatability is correlated with decomposability ... right?
2. The relationships between species' traits and palatability and decomposability can be modified by:
 - Phylogenetic relatedness – more closely related species tend to be more similar simply due to shared ancestry, so species are not independent; this can exaggerate or obscure associations between traits
 - Plant functional groups – differences between groups may obscure trends within them
 - Patterns of leaf emergence - Continuous / Synchronous
 - Evergreen / Deciduous
3. Measured traits of leaves and litter; leaf palatability; and leaf litter decomposability
 - Toughness, LMA, total phenolics, condensed tannins, lignin, N, C:N, leaf life
4. What did they find?
 - Leaf traits are linked to litter traits (Fig. 1)...
 - But the leaf traits influencing palatability (toughness) don't match the litter traits influencing decomposition (LMA, lignin:N, condensed tannins, Toughness [?]: Table 1, Fig. 3) ...
 - So *no strong general relationship between decomposition and herbivory* (Fig. 2a), but the relationship emerges *within* functional groups:
 - In *continuous-leaving species*, but *not synchronous-leaving species*, high tannin concentrations for leaf defense led to high litter tannin to N ratios, both deterring herbivores and slowing decomposition rates (hence a positive and significant *correlation between decomposition and herbivory rates* – Table 2; Fig 2b).
 - Considering phylogeny strengthened relationships between palatability and N and C:N, but didn't change the other results.



Phylogenetically independent contrasts (PICs), adapted from Felsenstein (1985) Am. Nat.

QUESTIONS from the audience:

- Would you expect that there would be better correlation between herbivory and decomposition rates in an environment in which there were less species diversity (compared to the diversity found in a tropical rainforest) ?
- The authors conclude that “herbivory may not generate a positive feedback for carbon and nutrient cycling in this type of ecosystem.” I had 2 thoughts about this.
 - Herbivory itself can stimulate growth, creating a positive feedback in carbon assimilation into plant material.
 - Carbon sequestration and cycling included more than just plant tissues. The herbivores themselves and things that eat them also assimilate carbon and are part of the cycle. On a biomass basis, they are clearly a smaller component of the system. I was wondering how considering the biomass of herbivores and higher trophic levels may affect the results.
- The authors reported that herbivory was measured by determining the percent of leaf matter lost compared to an intact leaf. They mentioned that this may have underestimated the herbivory rate because leaves that were completely lost to herbivory were not included. If there was a more precise way to determine area lost (possibly data collection in shorter intervals), would we see a stronger correlation between herbivory and decomposition rate?
- Taking phylogeny into account strengthened the relationship between palatability and N and C:N (Table 1); this “suggests that the C:N ratio in leaves is related to herbivory within closely related trees and that the nature of these relationships depends on the taxon considered, implying that plant–herbivore interactions are taxon specific” (p. 2653)... I don't understand this inference.
- “...plausible that the range of defensive strategies in this forest is highly diverse due to the high level of tree diversity. Therefore, the herbivory rate across species may not be strongly related to single leaf traits in this ecosystem” (p. 2653): If herbivory is important in structuring communities, does this mean that the quest to understand community structure using traits is futile?

**DeDeyn et al 2008. PLANT FUNCTIONAL TRAITS AND SOIL CARBON SEQUESTRATION IN
 CONTRASTING BIOMES.**

Soil carbon pool = C input (primary productivity) – C output (decomposition, burning, etc.).

Maximum C sequestration is set by abiotic soil properties; actual sequestration is determined by biotic community.

1. Plant traits influence C input and output.
 - a. Fast-growing plants and plants with high-nutrient tissues contribute large amounts of root exudates and litter, but have higher respiratory C loss and faster litter decomposition.
 - b. Slower-growing plants contribute mostly low-quality litter.
 - c. Other plant traits (e.g. waterlogging tolerance) can impact deposition of plant C into soil.
 - d. Symbiosis (rhizobia, mycorrhizae) can increase C contribution by increasing primary productivity.
 - e. Leaves and roots may emit volatile organic compounds (VOCs).
 - f. Recalcitrant structures (e.g. lignin) limit soil C loss to decomposition.
 - g. Root and leaf traits may be unrelated or even reciprocal.
2. Decomposition, soil respiration, sequestration and primary productivity all interact with, and are driven by, the composition of the soil community, including bacteria, fungi, and engineers.

Long-term C storage is driven by plant/soil feedback loops in each biome.

1. Climate selects plants with particular traits, but plant canopy and physical traits can alter abiotic (temperature, moisture) characteristics of soils.
2. Herbivory or plant/microbe nutrient competition can result in greater input of recalcitrant litter.
3. High plant diversity does not necessarily mean large soil C reserves; interactions between plant traits are context-specific.
4. There is no consistent, straightforward relationship between temperature and moisture gradients and stored soil C pool size.

Biome	Major plant stressors	Favorable plant traits for C input	C pools
Tundra	Low T, short growing season, waterlogging	Associations with mutualistic fungi, secondary chemicals, high root and rhizome biomass	Old large pools, most allocation in plants belowground, output is slow due to poor litter quality and temperature
Boreal forest	Low T _{min} , nutrient availability, light, fire	Deciduousness, mutualist symbionts, reduced flammability and resilience to fire, unpalatability, diverse litter effects	Large in soils, slow cycling, most allocation in plants is aboveground
Temperate forest	Moderate frost and regular precipitation, fire	Mutualistic symbionts, tree height, complementarity in light interception, resistance/resilience to fire, herbivores	Plant biomass stored in woody organs exceeds SOC, rapid rates of C mineralization
Tropical forest	Favorable climate for growth and decomposition	Deep roots, AM fungi, stimulation of soil fauna, complementarity in light, water and nutrient interception, resistance/resilience to disturbance, persistence until canopy opening	Large and diverse, high rates of cycling, more C in vegetation than soils
Temperate grassland	Water and N-P availability, herbivory	Slow growth traits, escape, deterrence, regrowth, high quality litter for soil fauna	High [SOC], small pools in aboveground vegetation (no woody structures)
Tropical savanna	Low water availability, fire, herbivory	Deep rooting, woody structures, herbivore defense traits, fire resistance/resilience, low C:N for termites, mutualist symbionts	Lower C content than temperate (more C mineralization), deeper rooting
Desert	Soil moisture	Deep and slow decomposing roots, quick growth and reproduction, dormancy, water storage, resistance to oxidation through solar radiation	Small pools (high in cold deserts), C in soils exceeds C in vegetation

QUESTIONS from the audience:

- What are volatile organic compounds? Do they really contribute much to carbon cycling (in terms of mass)?
- In regard to figure 3, will future forestry strategies then focus on maximizing C sequestration in their management? (except for the boreal forest) does this approach get away from managing with disturbances?
- In light of the two papers, it seems we have a option/choice for managing the tropical forests. Do we manage what is left to maximize C sequestration and perhaps sacrifice biodiversity, or do we leave the biodiversity as is and not necessarily maximize C sequestration?
- “Soil fauna, such as earthworms...promote carbon sequestration by redistributing carbon through the soil profile...” (pg 520, bottom left). Don’t earthworms facilitate more rapid decomposition by fragmenting the detritus to start the process and moving the material into the soil where microbes would more readily have access to decompose detritus?
- One of the papers we read takes a biome-level perspective and the other takes a species-level perspective - how much variation (in decomposition rate) is there within one type of habitat? What is the typical scale of significant variation?
- The readings mentioned a lot of factors that influence decomposition, some of which did not have consistent effects in different biomes or different species. Are there broad generalizations that can be made about the factors influencing decomposition rate?
- From the carbon sequestration paper, I would like to hear more about trait complementarity and how these reciprocal trait combinations can override competition between species.
- Since there isn't a consistent relationship between temperature/precipitation gradients and soil C pool size, does that mean that there's some other factor or combination of factors driving the input/output balance, or could it mean that ecosystems tend to fall into one or another feedback loop simply by historical contingency (first colonizers, or something)? If contingency plays a role, how easily could the behavior of the ecosystem be permanently flipped from an accumulating to a non-accumulating state (or vice versa) by a single event interrupting the feedback loop—for example, a fire or a fertilizer application?