Carbon rules them all, Carbon binds them all.

A story of the effect of C availability on a risk of N leaching from spruce forest soils

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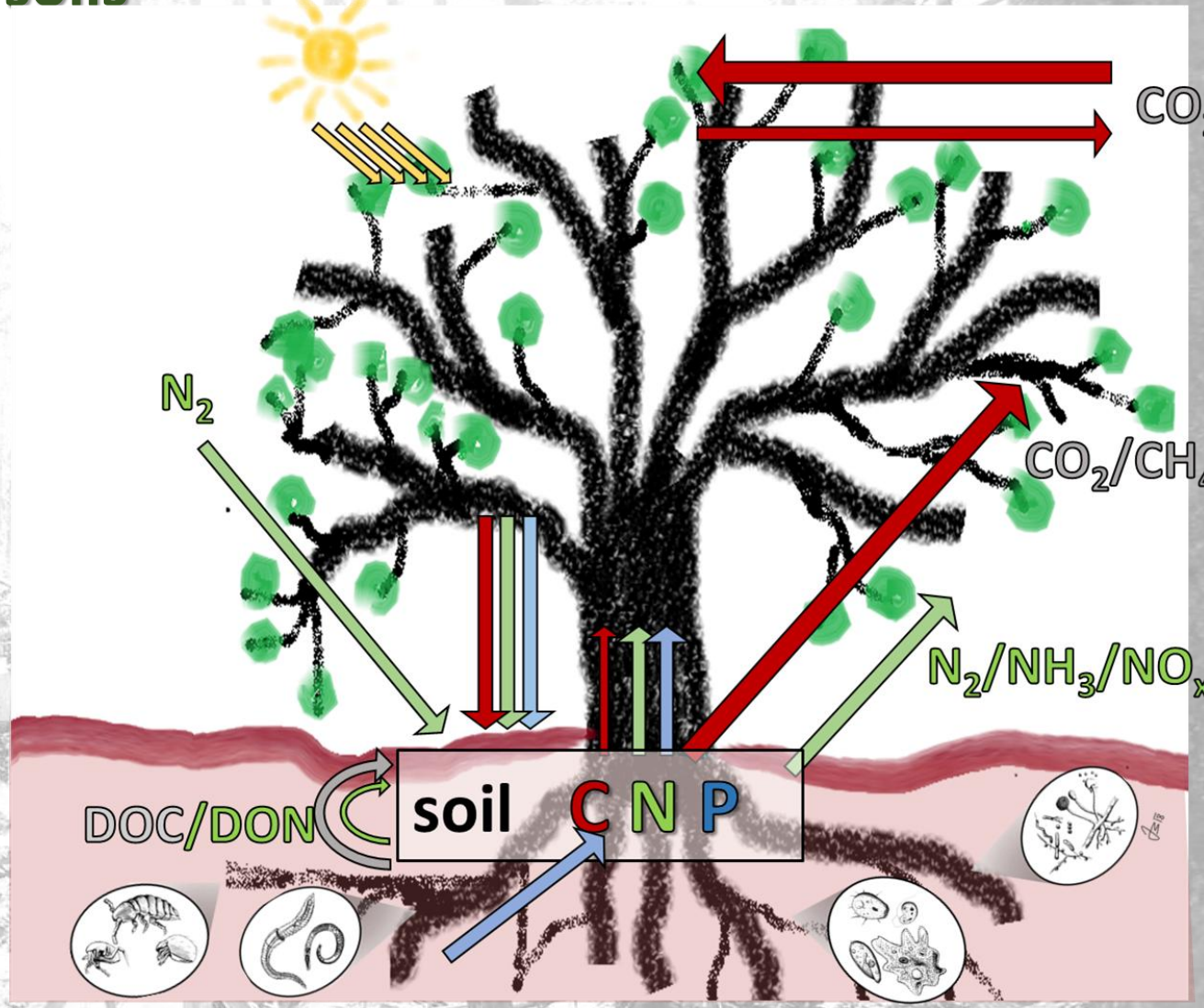

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Pedologické dny 2018

To preserve the quality of forest soils, it is essential to maintain microbial transformation of plant litter.

This includes minimizing mechanical disturbance, leaving organic matter after forest dieback or logging, and ensuring the subsequent input of easily decomposable litter (e.g., from deciduous trees).

Pedologické dny 2025

Microbial CN transformation is driven by microbial CN demand, **CN stoichiometry of available resources,** litter input and vegetation change.

Čertovo lake catchment (CT)

Acidified and N sarurated soils

Sampling sites
≈ 1100 m n.m.

Plešné lake catchment (PL)

- *Biomass left on the place*

Bark beetle attack 2007-2008

- *90 % dead trees*

Soil sampling:

- 6 week interval from 2008 to 2018, then every 2 - 3 months till 2023
- 2 organic layers (forest floor and uppermost organo-mineral horizon)
- 6 sampling pits (15 x 15 cm, composite sample from 2 random pits for each layer)

Measured and presented parameters:

- microbial biomass C (C_{MB}) and N (N_{MB})
- food resources = water extractable C (DOC) and N (DN = NO_3 +NH_4 +DON)
- net nitrification

CN critical for microbial growth

(CN_{CR})

To grow, microbes need a food CN ratio (**CN critical, CN_{CR}**) that covers the CN requirements for biomass formation. If the CN stoichiometry of the available resources does not match this ratio, C or N limitation occurs.

$$CN_{CR} = A_N [(C_{MB}/N_{MB})/CUE]$$

A_N – assimilation efficiency of N; set up to 0.5 (Zhang et al. 2019)
$C(N)_{MB}$ - C(N) in microbial biomass

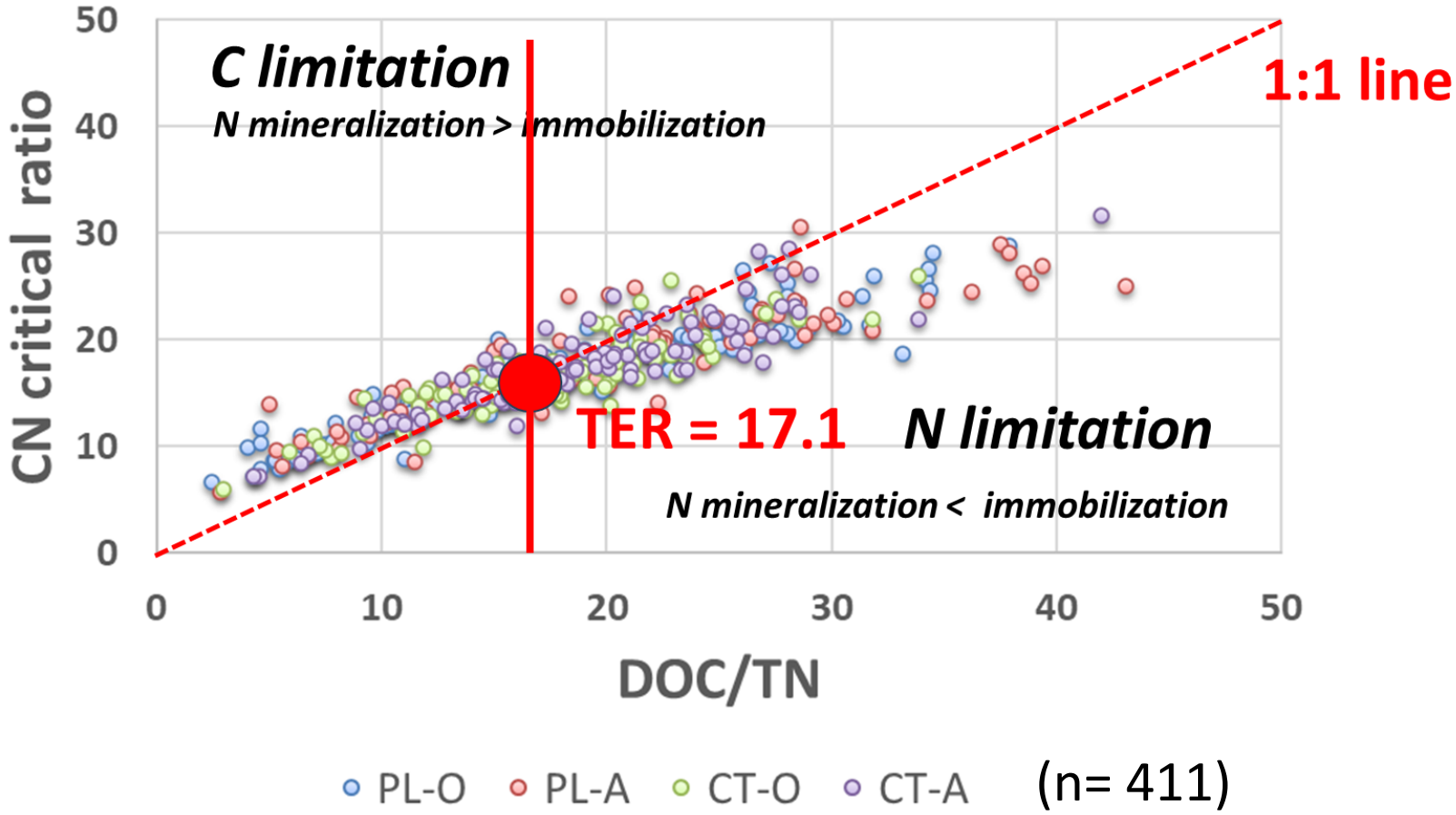
Microbes can adapt to changing CN food resource ratio by:

- *Changing microbial CN ratio (eg. bacteria : fungi ratio)*
- *Changing C use efficiency on physiological level*

} **CN_{CR}** fluctuates to some extent depending on food supply

If microbes are N limited, N is immobilized. When N limitation turns into C limitation N mineralization occurs. The point at which C limitation changes to N limitation is called the **terrestrial threshold ratio (TER)** and can be estimated from CN_{CR}

*To grow, microbes need a food CN ratio (**CN critical**) that covers the CN requirements for biomass formation. If the CN stoichiometry of the available resources does not match this ratio, C or N limitation occurs. The point at which C limitation changes to N limitation is called the terrestrial threshold ratio (TER)*



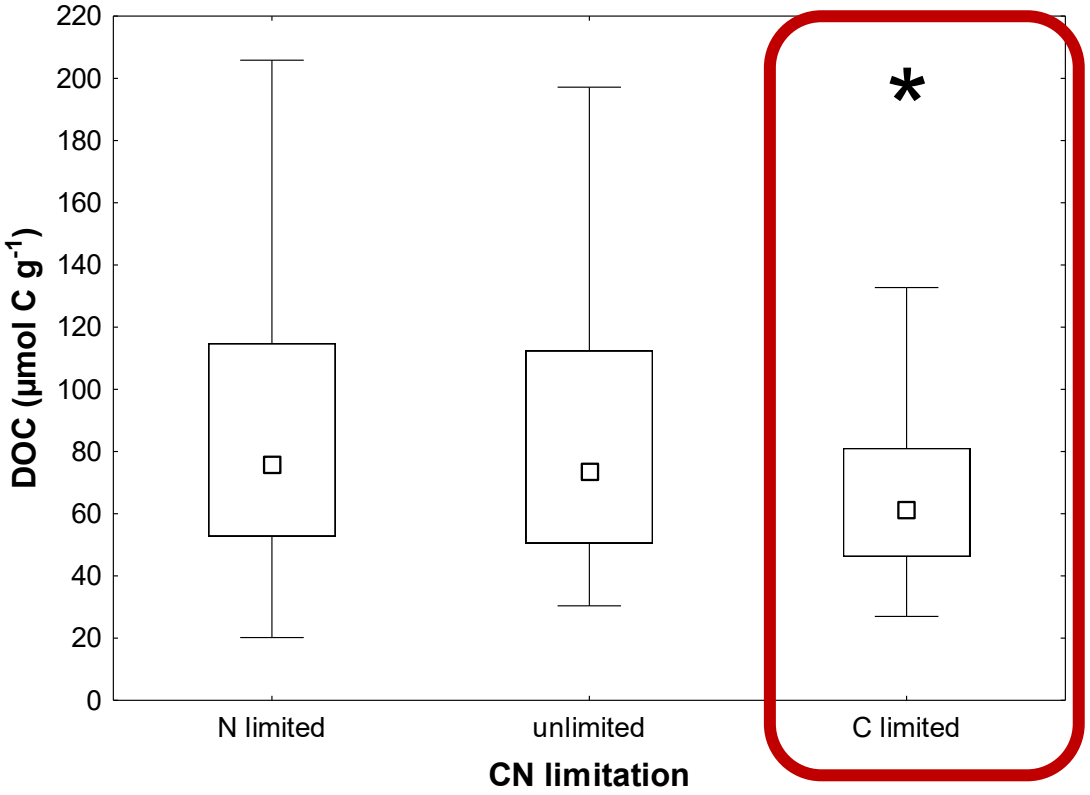
Microbial N limitation is switched to C limitation when food CN ratio is 17.1

$$CN_{CR} > TER \text{ - N limitation}$$
$$CN_{CR} < TER \text{ - C limitation}$$

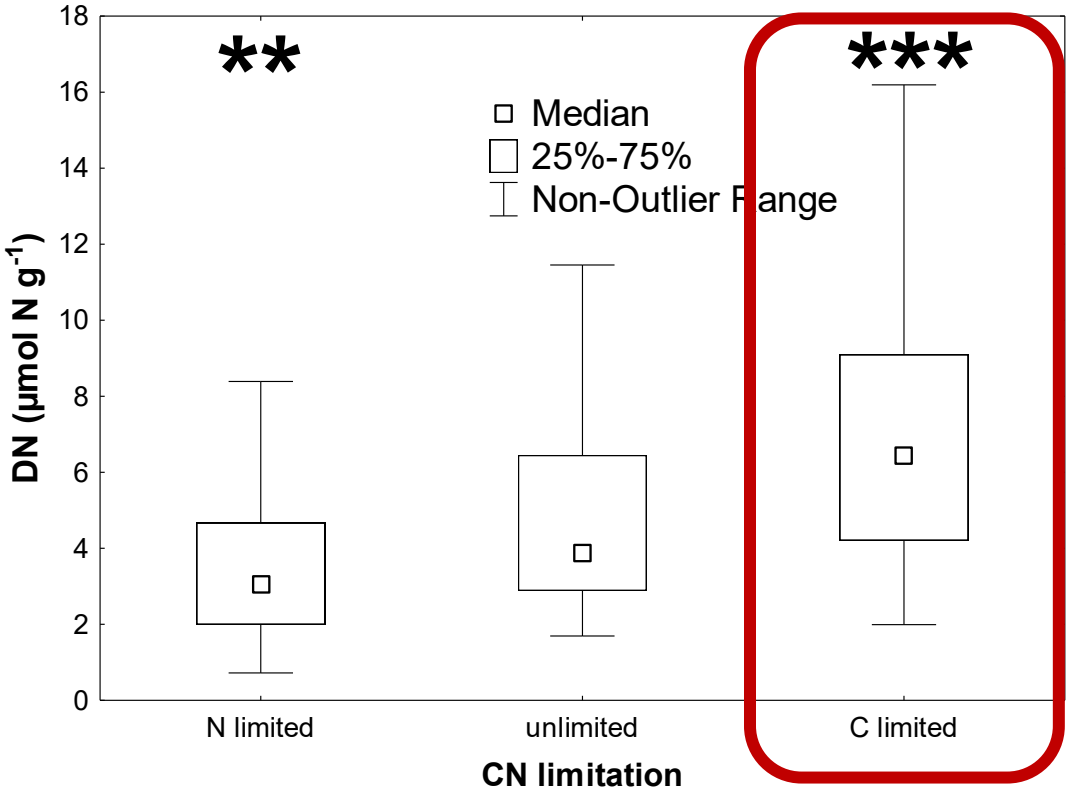
Soils from both sites and layers were divided on C limited and N co-limited

Available C and N (food resource)

C availability is lower C limited soils

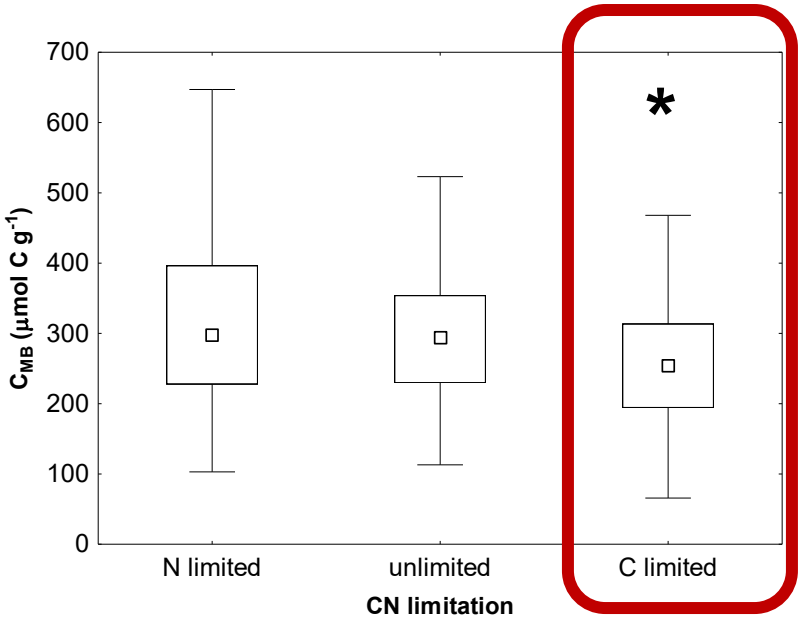


N availability is higher in the C limited soils

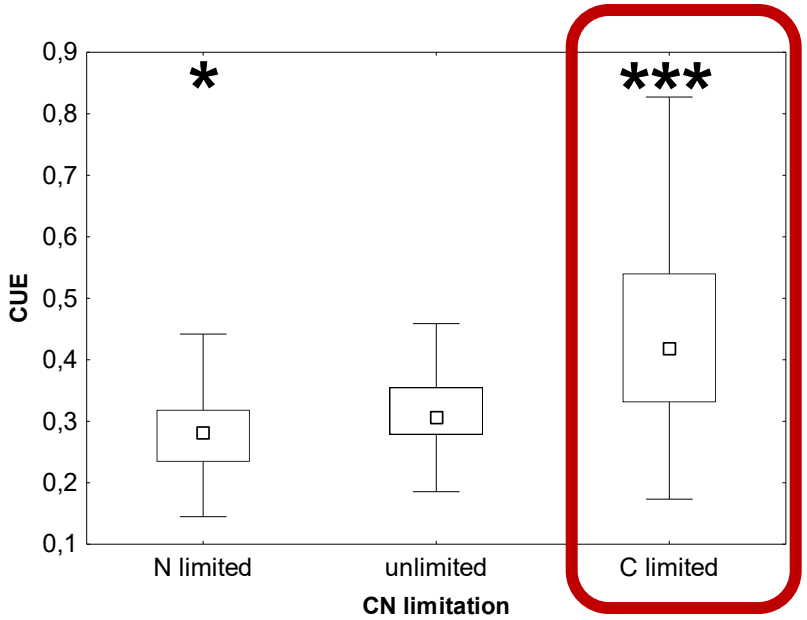


Microbes and their activity in C limited soils

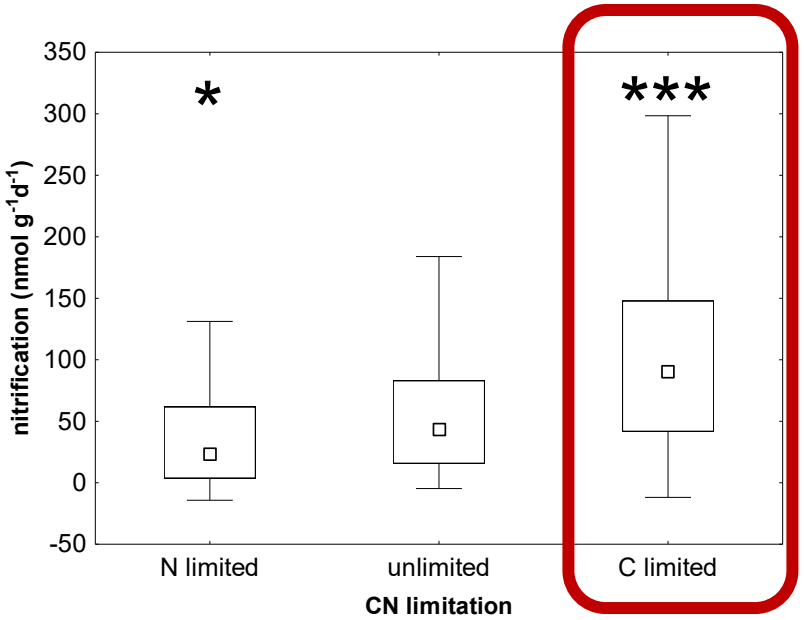
Microbial biomass is lower



CUE is higher



nitrification is higher

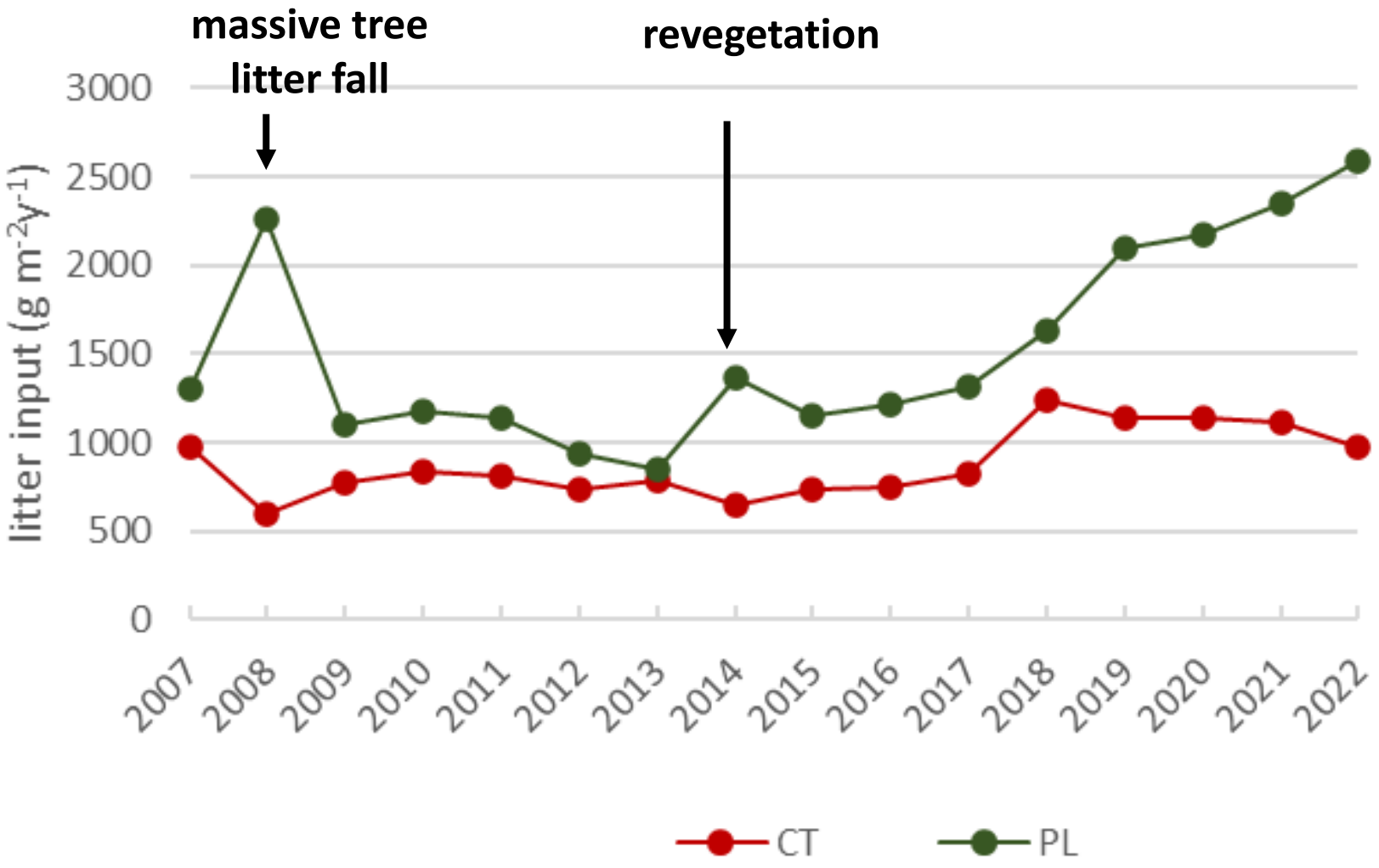


In C limited soils (CN_{CR} < TER) microbial biomass decreases and nitrification is enhanced

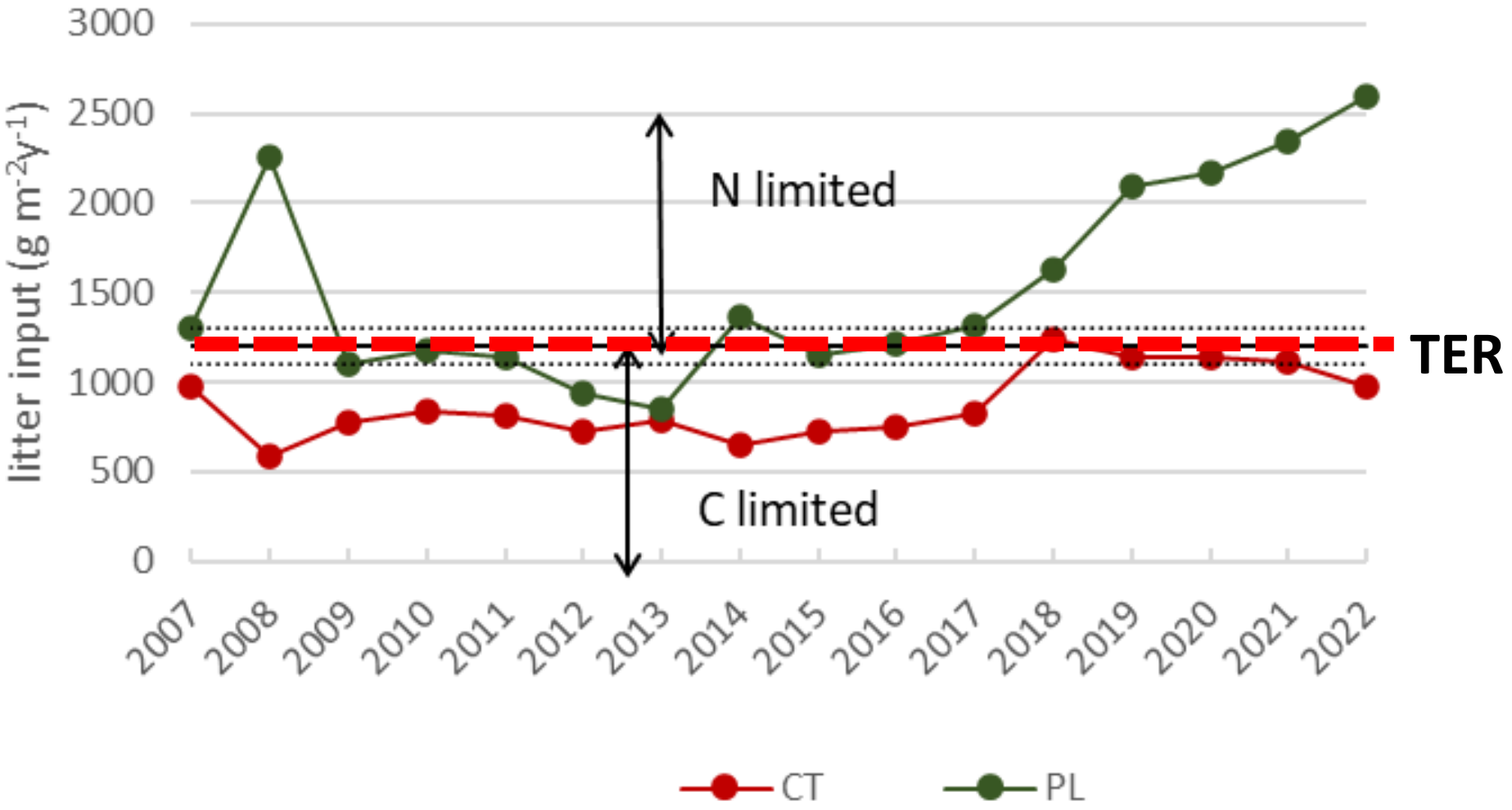
What is relationship between microbial C or N limitation and vegetation development ?

Tree litter input – frame traps, three times a year
Understory aboveground biomass – annually
Root/shoot ratio – in 2006
Litter input related to annual averages of CN_{CR}

] *turnover rate from literature*

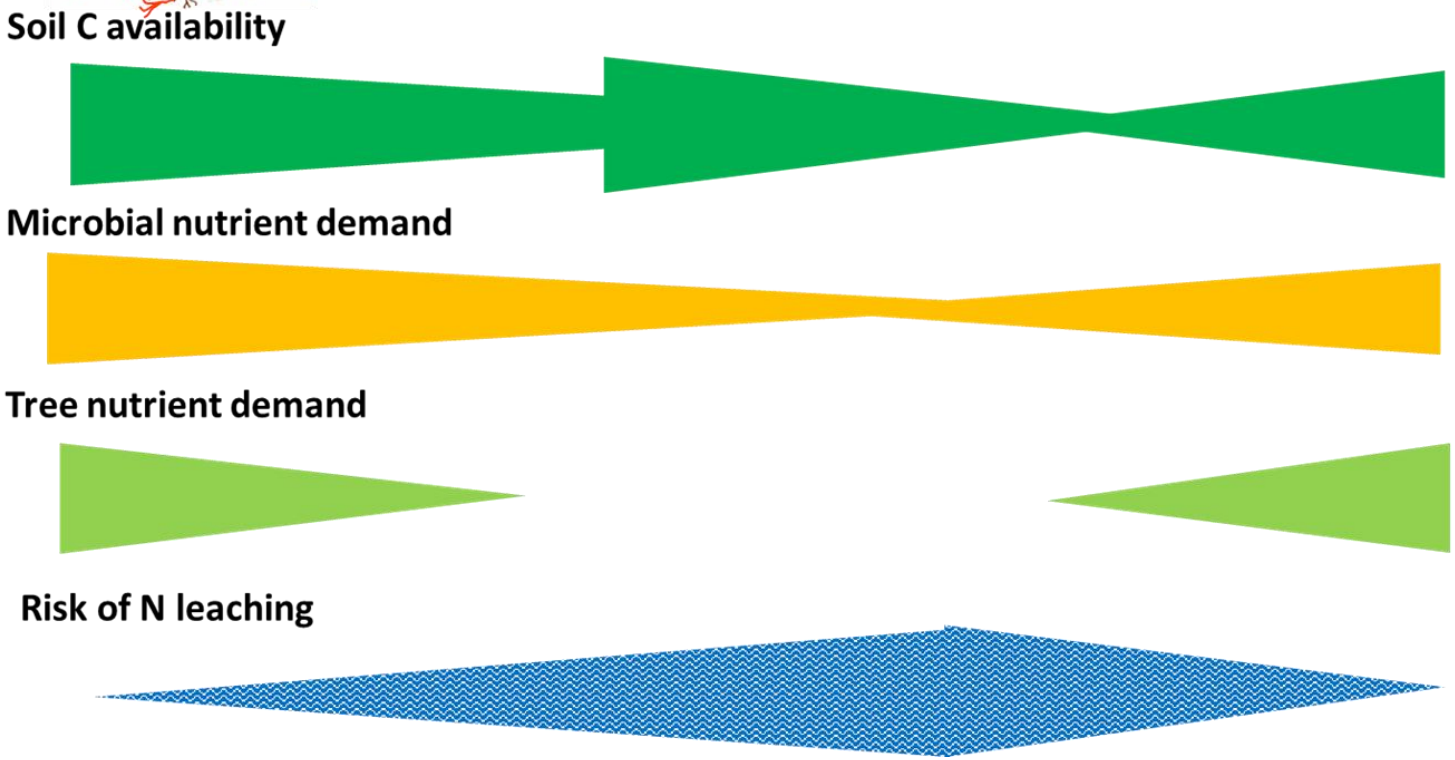


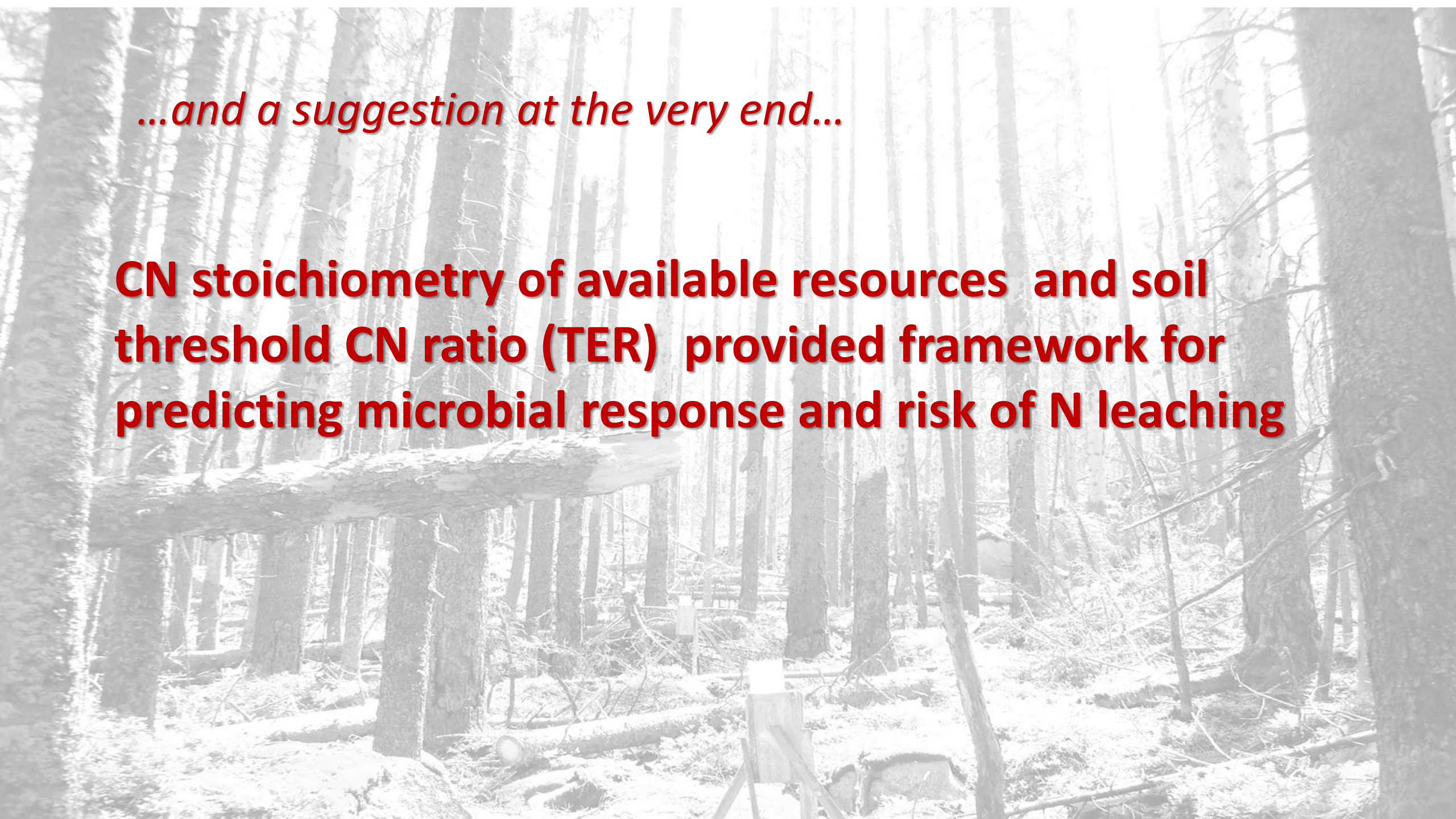
CN_{CR} = 12.5 + 0 .00389 * plant litter input; p> 0.0005



If the input of organic matter from plant litter was low, microbes were limited by C and nitrification was enhanced

In conclusion – story of disturbed mountain spruce forest





…and a suggestion at the very end…

CN stoichiometry of available resources and soil threshold CN ratio (TER) provided framework for predicting microbial response and risk of N leaching

Děkuji za pozornost/ thank you for your attention

“The world has changed.
I see it in the water.
I feel it in the Earth.
I smell it in the air.
Much that once was is lost…“

Tolkien

…. much can be undone with good will.