

Surprisingly rapid nitrogen cycling in tropical forest plantations on volcanically derived soils

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Acknowledgements

NSF DEB #0236502 and #0703561

- Dick Fisher and Eugenio Gonzalez, Texas A&M University
- Oscar Valverde, Kent State University
- Bill Parton, Colorado State Univ.
- Ricardo Bedoya, Gary Hartshorn, Liz Losos, ECOS and La Selva personnel, Organization for Tropical Studies

Study Site

- La Selva, Costa Rica
- 4000 mm annual rainfall, with no month averaging < 150 mm.
- ~26°C mean annual temperature.
- Decent soils
 - (Tropohumults)



Experiment established in 1988



Nature Precedings : doi:10.1038/npre.2010.5346.1 : Posted 30 Nov 2010

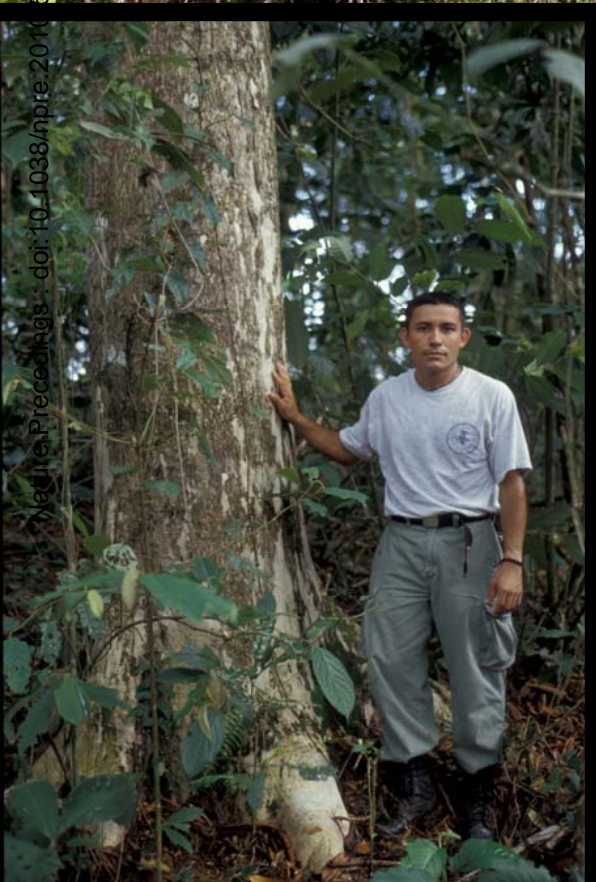
<http://www.nrem.iastate.edu/ECOS/>

Sixteen years later



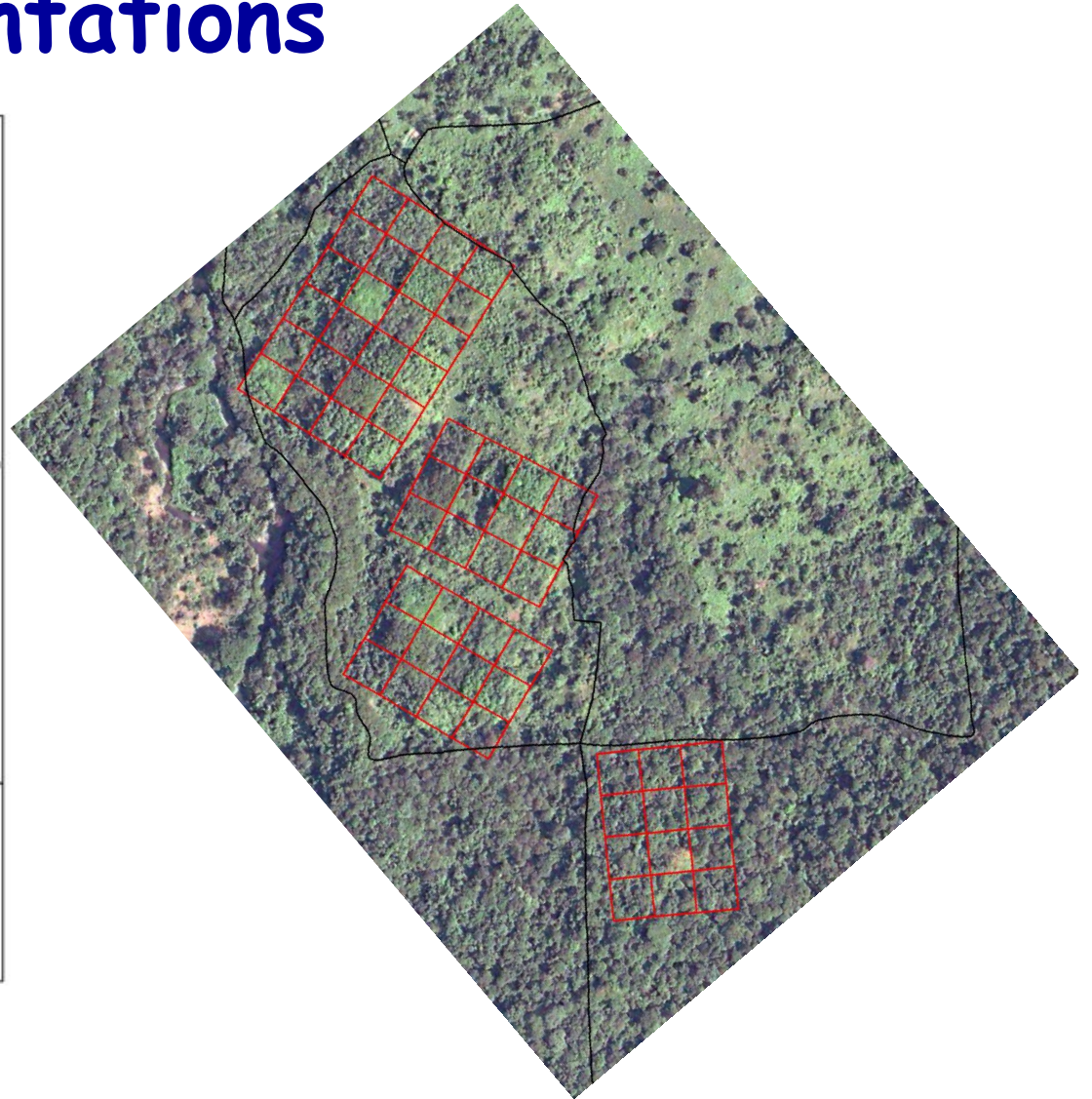
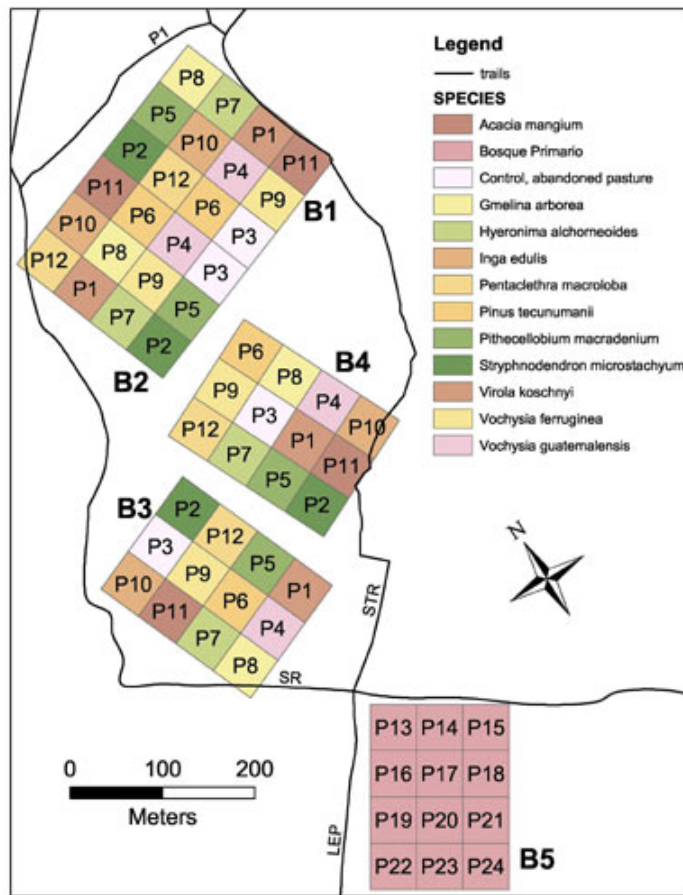
6346-1, Posted 30 Nov 2010

Madire, Precedings, doi:10.1038/npre.2010

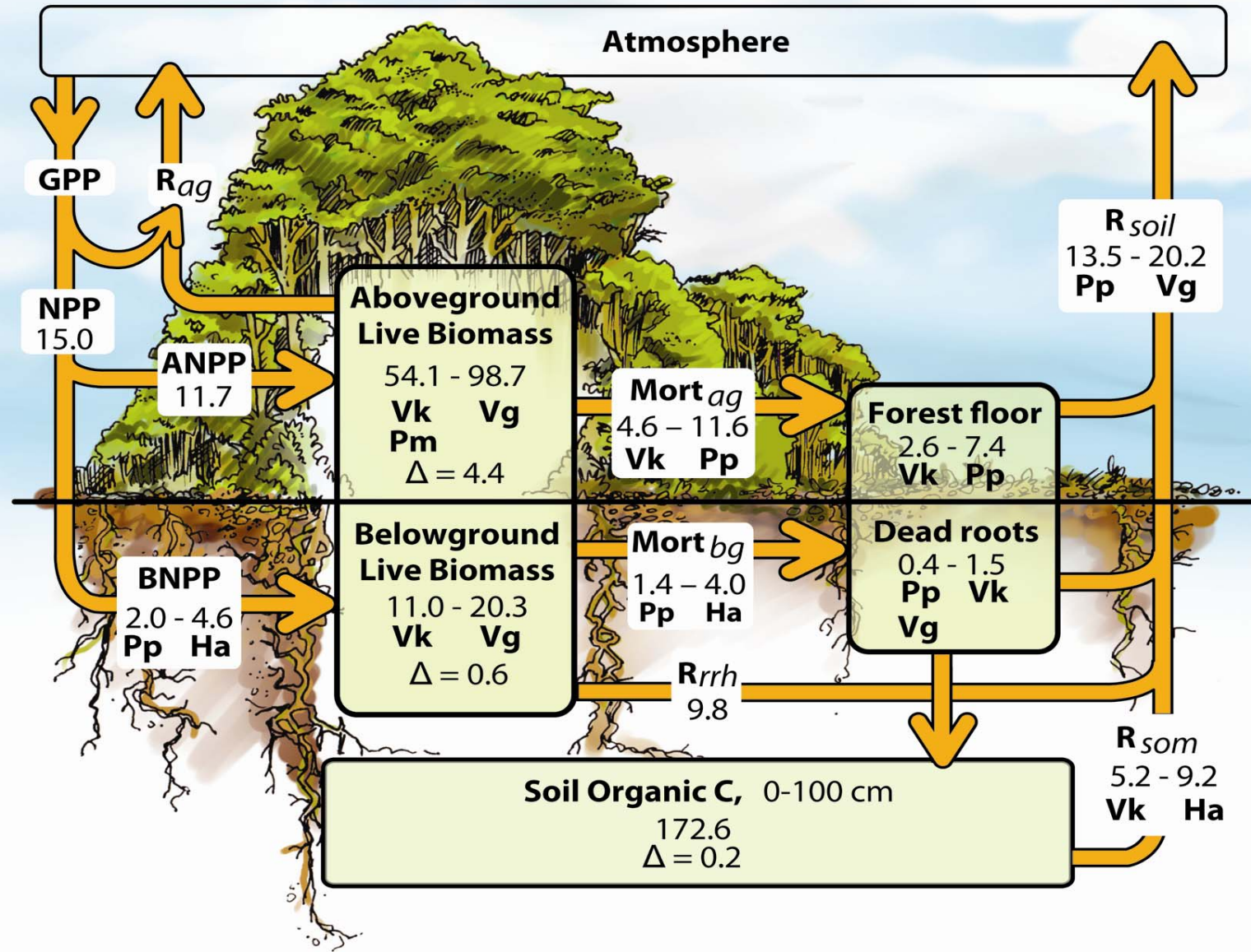


Experimental Design

- Randomized Complete Block (N=4)
- Monospecific plantations



High rates of C cycling

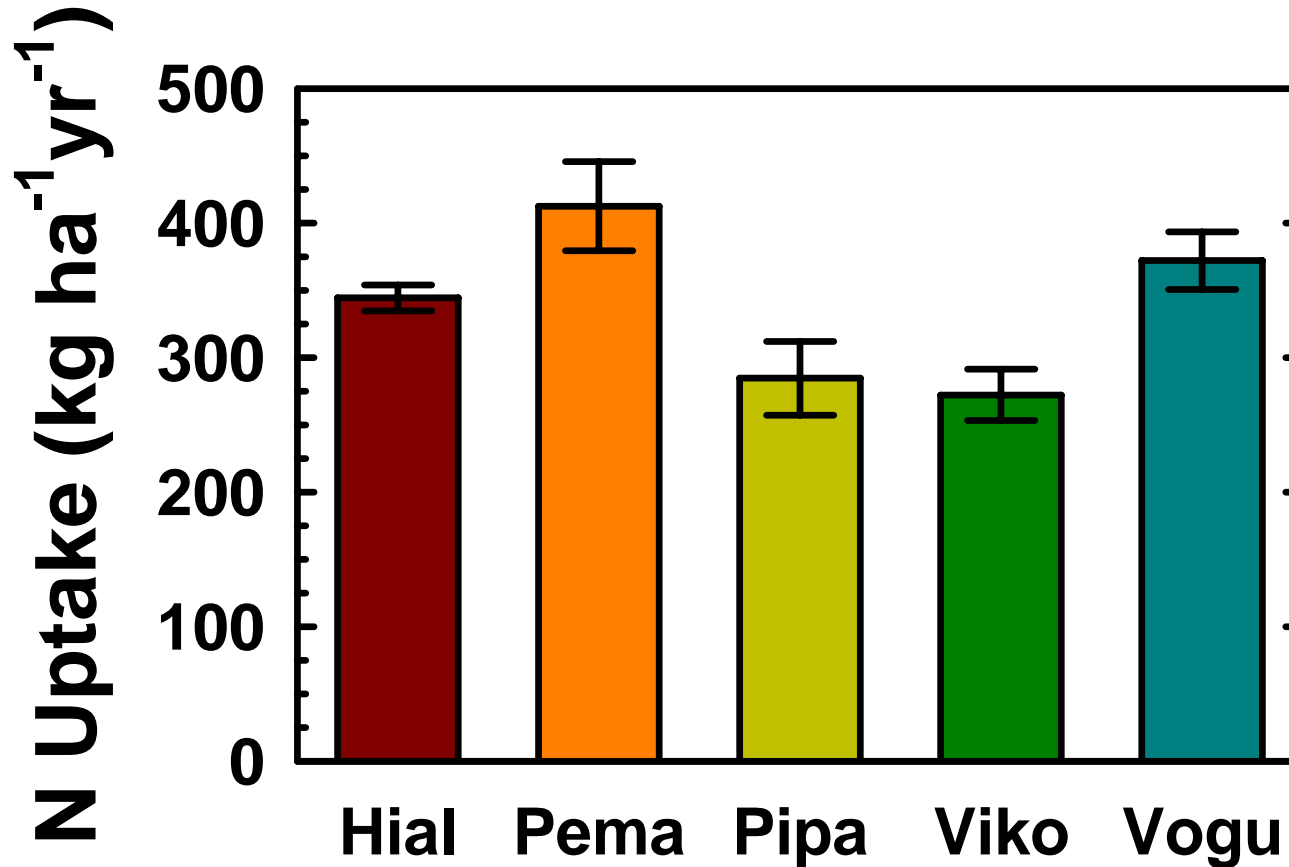


Russell et al. (2010) Ecol. Appl. 20: 1087.

N Uptake by Vegetation

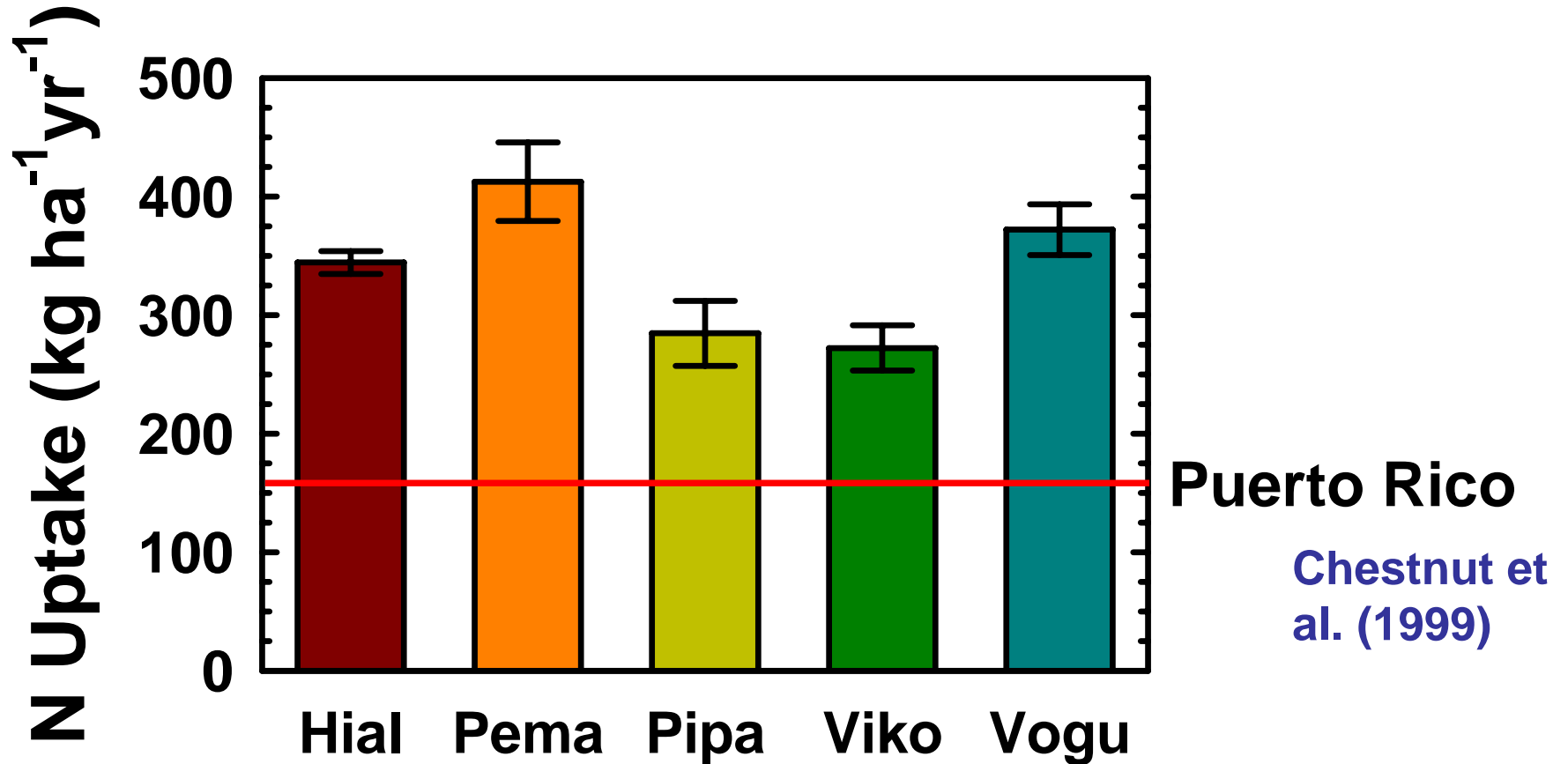
- *N Uptake =*
N Flux in Fine Litterfall +
N Flux in Branch fall +
 ΔN in Net Tree Growth +
N Flux in Fine Root Turnover

N uptake by Vegetation



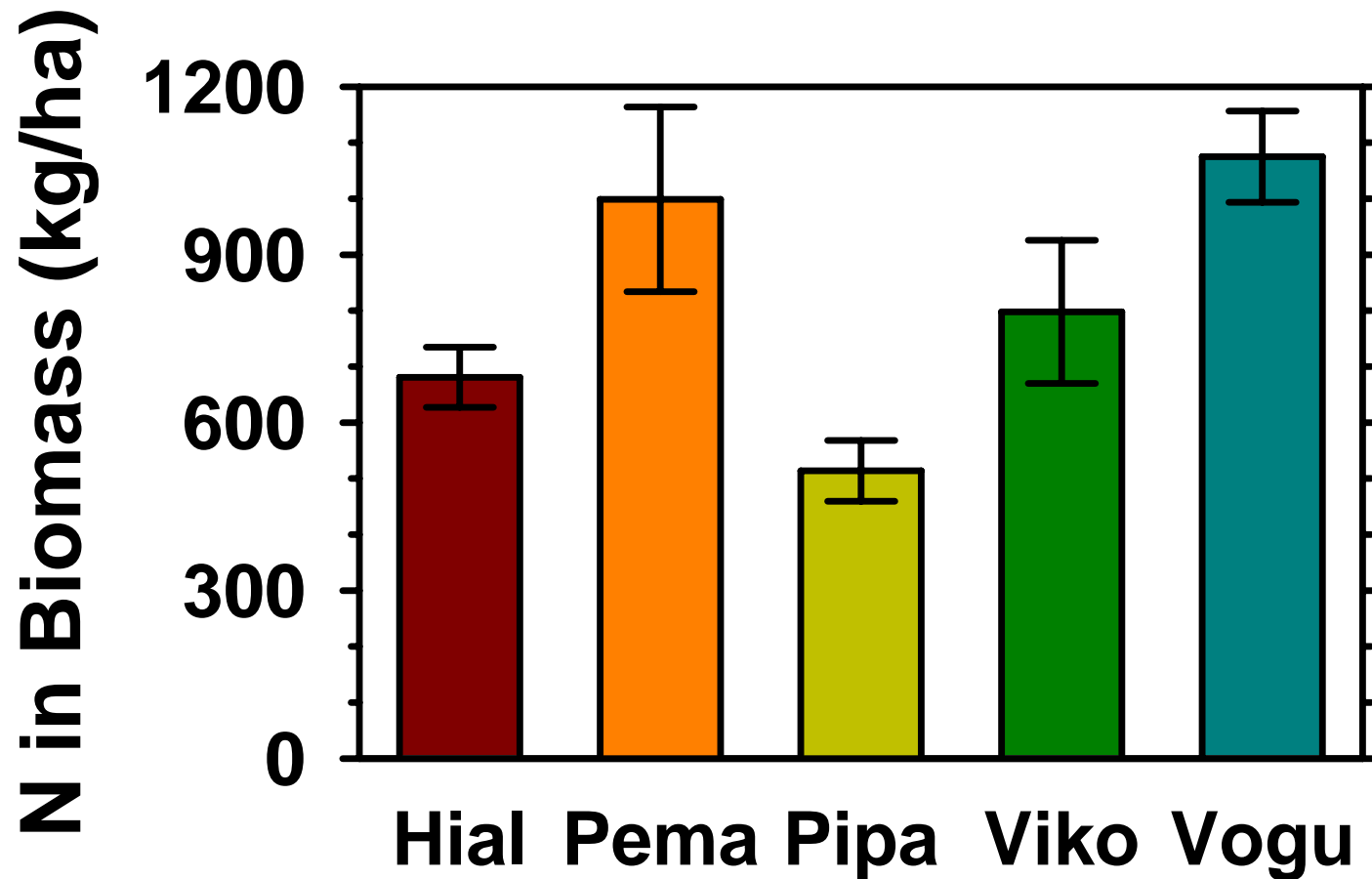
- **Mean N Uptake: 340 kgN ha⁻¹ yr⁻¹**

N uptake by Vegetation



- **Mean N Uptake: 340 kgN ha⁻¹ yr⁻¹**

Also Large Amounts of N in Biomass



- Net annual accretion: $50 \text{ kgN ha}^{-1} \text{ yr}^{-1}$

Where does all this N come from?

N uptake reaches:

400 kg N ha⁻¹ yr⁻¹

N sequestration reaches:

60 kg N ha⁻¹ yr⁻¹

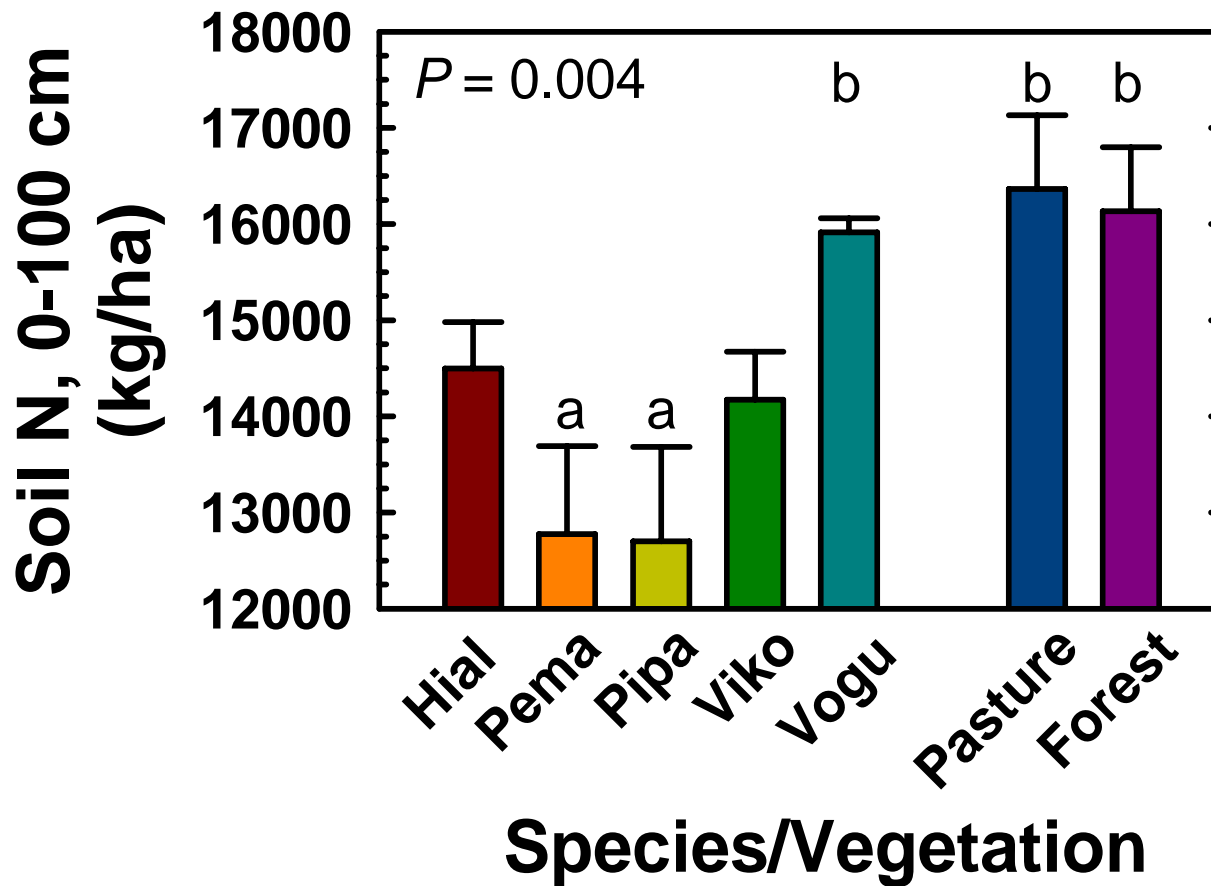
N Flux Information from La Selva

Atm. Deposition:	10 kgN ha ⁻¹ yr ⁻¹
Throughfall (in forest):	17
Leaching (from forest):	7
N-gas Losses:	?
N needed (average):	50-60 kgN ha ⁻¹ yr ⁻¹

data from multiple publications

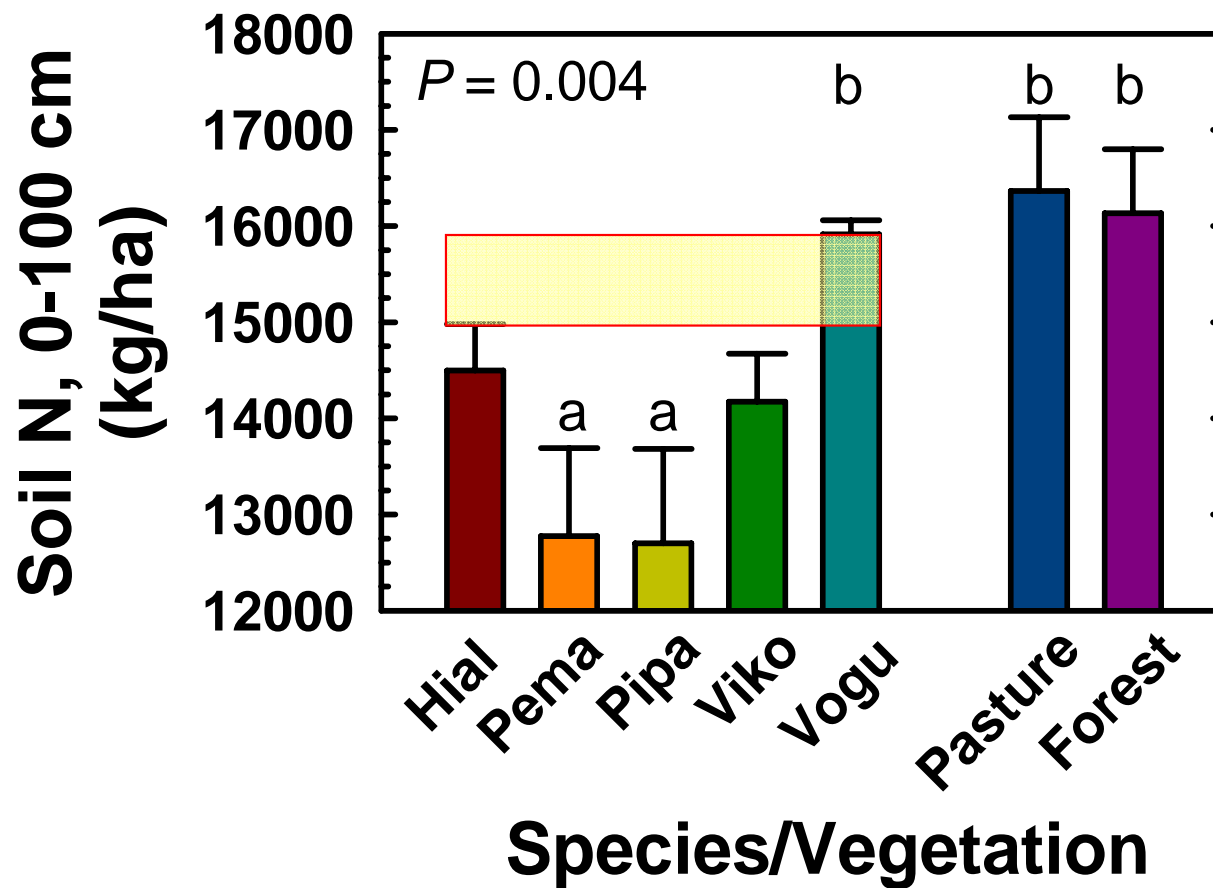
Soil Nitrogen

- Mean SON: 14,000 kg/ha
- Mean Biomass N: 800 kg/ha

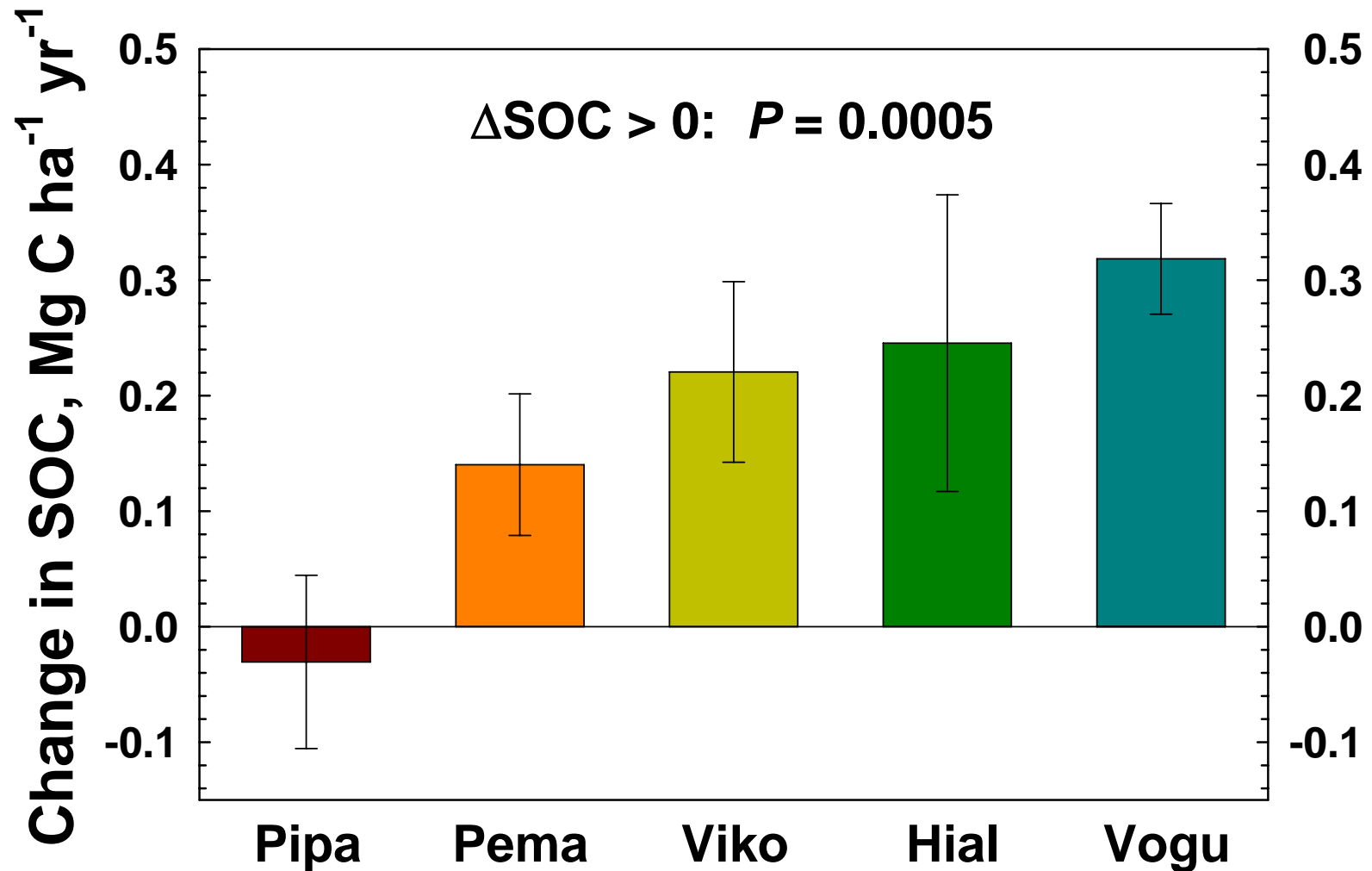


Soil Nitrogen Mining

- Mean SON: 14,000 kg/ha
- Mean Biomass N: 800 kg/ha

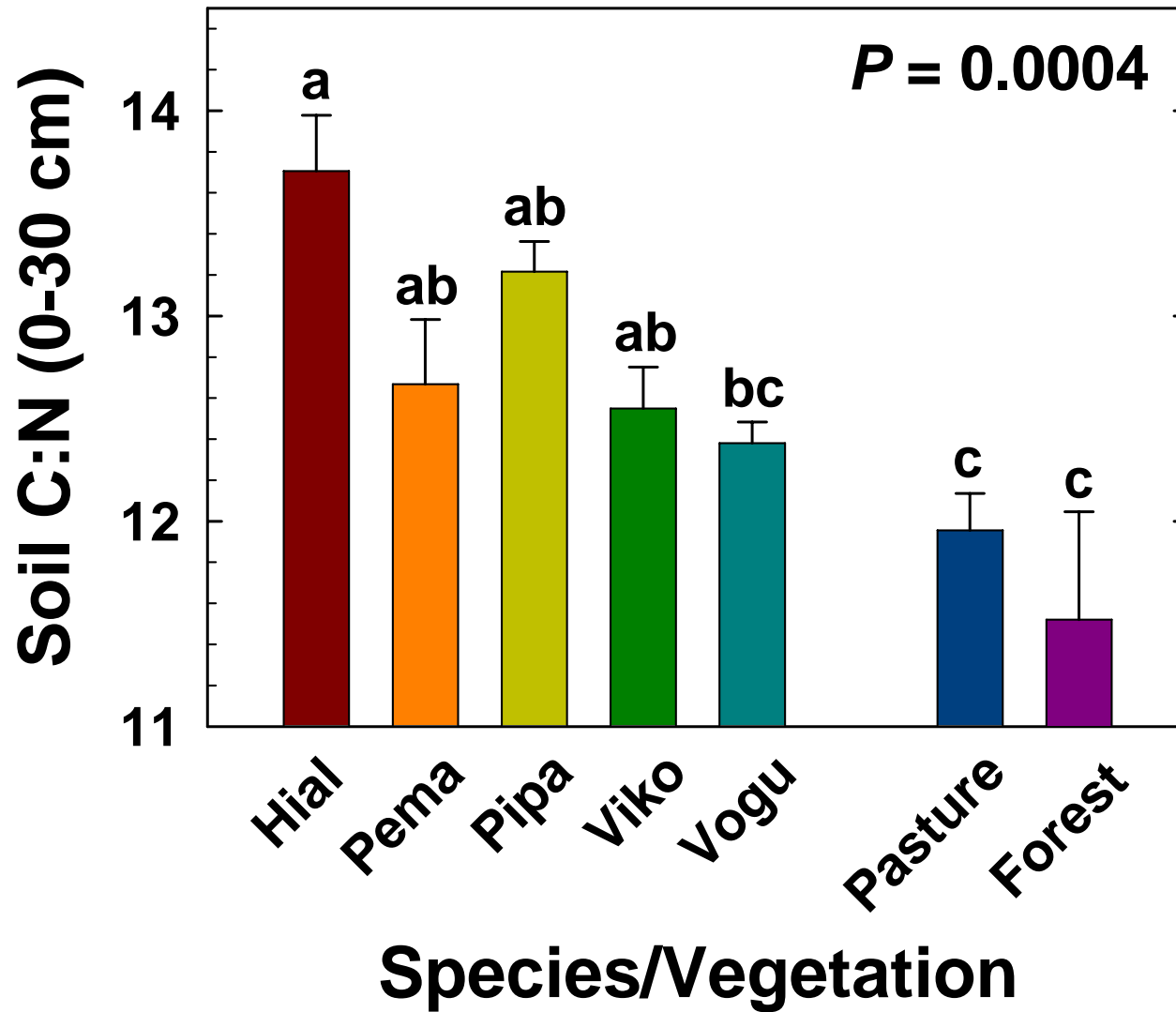


Soil Carbon is Sequestered



Russell et al. (2007) SSSAJ

Soil C:N



Summary

- Soil mining of N seems to be important.
- In contrast, the soil is sequestering C.
- No apparent soil mining of N by the fastest N-Cycler: *Vochysia*
 - Can asymbiotic N fixation dependably provide $60 \text{ kgN ha}^{-1} \text{ yr}^{-1}$ to *Vochysia*?
- Why is there less N in the only N-fixer plots, containing *Pentaclethra*?

Thank You !