ECOSYSTEM RESPONSES TO A UNIQUE WHOLE-WATERSHED ISOTOPIC TRACER EXPERIMENT: WHERE DID THE $^{15}$N GO?

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Background

The Bear Brook Watershed in Maine

$^{15}$N natural abundances

$^{15}$N tracer enrichments

Conclusions
Most processes in the N cycle discriminate against $^{15}$N and favor $^{14}$N.

Products are depleted and substrates enriched in $^{15}$N.
Evidence of accelerated N cycling in West Bear:

increased net nitrification rates, NO$_3^-$ in soil solution and in stream water, and tree foliar N concentrations.

Uncomplete understanding of the mechanisms involved in altered N cycling.

Stable isotopes are useful in ecosystem ecology at two levels:

Natural abundance $^{15}$N, used as an indicator of net change in forest N cycling.

$^{15}$N enrichment, used to trace N transformations in ecosystems.

N+S additions as ammonium sulfate at WB (ongoing) 
Rate: 28.8 kg S and 25.2 kg N ha$^{-1}$ yr$^{-1}$
JUNE 2012 $^{15}$N PULSE-CHASE EXPERIMENT

$^{(15}\text{NH}_4)_2\text{SO}_4$ (98 atom-%)
(load: 0.402 kg ha$^{-1}$)
TWO-MONTH $^{15}$N TRACER ENRICHMENTS

Range of natural abundances

- Foliage
- Understory
- Loose Litter
- COF
- Fine O horizon
- B horizon

Ecosystem component $\delta^{15}$N (‰, ±S.E) in August 2012

- WB (treated)
- EB (reference)
CHASE $^{15}\text{N}$ TRACER ENRICHMENTS

Difference (treated West Bear $\delta^{15}\text{N}$ – reference East Bear $\delta^{15}\text{N}$)

Coarse organic fraction (COF)  Fine organic fraction

May 2012  Sept. 2013

May 2012  Sept. 2013

Chase sampling time after tracer application (days)
CONCLUSIONS

- The **natural abundance** results show an ecosystem shift towards accelerated N cycling (higher $\delta^{15}N$) in West Bear.
- The **tracer pulse-chase** short-term results show highest enrichment of the understory vegetation followed by the forest floor components.
- The fundamental understanding of the mechanisms at play in altered ecosystem N cycling will come with our multi-year chase enrichment results.
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