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ABSTRACT TITLE: Fungal functioning in a pine forest: evidence from a 15N-labeled and 13C-labeled global change experiment

ABSTRACT: We used natural and tracer carbon and nitrogen isotopes in a *Pinus taeda* Free Air CO₂ Enrichment experiment at the Duke Forest to investigate the functioning of ectomycorrhizal and saprotrophic fungi in carbon and nitrogen cycling over a six-year period. CO₂ enrichment (+200 ppm; resulting CO₂ decreased in δ¹³C by 12‰) began in 1996 and a ¹⁵N tracer was applied in 2003. Fungi were sampled in 2004 (natural abundance and tracer) and 2010 (just tracer) and δ¹⁵N and δ¹³C patterns compared against other ecosystem pools.

Ectomycorrhizal fungi with hydrophobic ectomycorrhizae (e.g., *Cortinarius*) acquired nitrogen from the Oea horizon whereas taxa with hydrophilic ectomycorrhizae (e.g., *Russula* and *Lactarius*) acquired nitrogen from the Oi horizon. ¹⁵N enrichment for *Cortinarius* and *Amanita* did not correspond to any measured bulk pool, suggesting that persistent pools of organic nitrogen supplied these two taxa. Saprotrophic fungi included those colonizing pine cones (*Baeospora*), wood, litter, and soil (*Ramariopsis*), with both δ¹⁵N and δ¹³C of taxa reflecting these source preferences. Fungal ¹⁵N enrichments relative to source nitrogen ranged from 4-9‰; these enrichments were linked in analytical equations to both increased allocation by fungi to hyphal development and decreased nitrogen transfer to host plants. The δ¹³C of ectomycorrhizal genera in ambient and elevated CO₂ plots correlated with a slope (4.3±1.2) greater than one, suggesting that these fungi assimilated carbon from two isotopically distinct sources, recent photosynthate and a second and smaller source derived from litter or soil. *Inocybe* and *Cortinarius* incorporated some soil-derived carbon whereas *Lactarius* and *Russula* incorporated some litter-derived carbon. Natural abundance and tracer isotopic labels proved useful for tracking nitrogen and carbon from different sources into fungal taxa and provided new insights into interpreting natural abundance patterns of both δ¹⁵N and δ¹³C.