

Radiocarbon and stable isotopes in post-fire fungi indicate that *Morchella* is saprotrophic

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Introduction

In this study, we investigated the mycorrhizal status of post-fire fungi collected in 2003 and 2004 in Oregon and Alaska. We hypothesized that stable isotopes would suggest that *Morchella* found in post-fire habitats is saprotrophic, and radiocarbon analyses would indicate that *Morchella* was assimilating old carbon, and not current-year photosynthate. (Figure 2.) Comparisons of radiocarbon and stable isotopes with concurrently collected foliage and with literature values will be used to determine likely isotopic values for mycorrhizal versus saprotrophic fungi. Plant $\delta^{13}\text{C}$ values for the local climate will be predicted from equations developed in Kohn (2010) and also compared against bulk sporocarp values.



A. *Morchella* (saprotrophic) B. *Geopyxis carbonaria* (mycorrhizal)
C. *Plicaria endocarpoides* (saprotrophic)

Collection Sites



Year Collected	State	Lat (°N)	Long (°W)	Elev (m)	Site #	MAT (°C)	MAP (mm)
5/2003	OR	42.54	123.99	469	1	11.3	1913
5/2003	OR	42.5	124.09	611	2	10.9	2079
5/2004	OR	44.57	121.69	1085	3	8.0	1291
5/2004	OR	44.57	121.73	1357	4	6.9	1526
6/2003	OR	44.63	121.56	1224	5	6.9	1500
4/2003	OR	44.72	123.31	121	6	12.0	1509
6/2003	AK	65.04	149.09	95	7	-1.7	352
6/2003	AK	65.04	146.09	609	8	-1.7	352
6/2003	AK	64.39	148.17	177	9	-1.7	352

Sites 3 and 4 were collected in B&B Fire Site (fire shown left)

Methods

Collections and Sample Locations: Numerous wildfires occurred throughout Oregon and Alaska in the early 2000s, and collections of postfire *Plicaria* were obtained from several locations to encompass a broad geographic distribution and diverse habitats. Sporocarps were collected from burned areas 1 to 2 years after wildfires. Collections were identified to the taxonomic level possible without the use of a compound microscope. Collections were then dried in portable dehydrators for between 12 and 24 hours.

Isotopic Methods: Stable isotope ratios were measured at the Macko laboratory at the University of Virginia and $\Delta^{14}\text{C}$ was measured at Woods Hole Oceanographic Institute.

Estimating local climate: Local climate (MAT and MAP) during the year of collection was determined by using the Daymet Single Pixel Extraction tool using the latitude and longitude of sample sites to create re-climactic data (daymet.org/nl.gov). However, the single pixel extraction tool only supports latitude and longitude within the Contiguous United States. Sites located in Alaska used data from local weather stations near sample site locations. Estimating local climate was important within this study to normalize ^{13}C data due to the water stress that occurs due to the size of stomates.

Results and Conclusions

Figure 1. Atmospheric $\Delta^{14}\text{C}$ curve for carbon dioxide from 1974-2006, illustrating the steady decline in the bomb spike ^{14}C peak over that period.

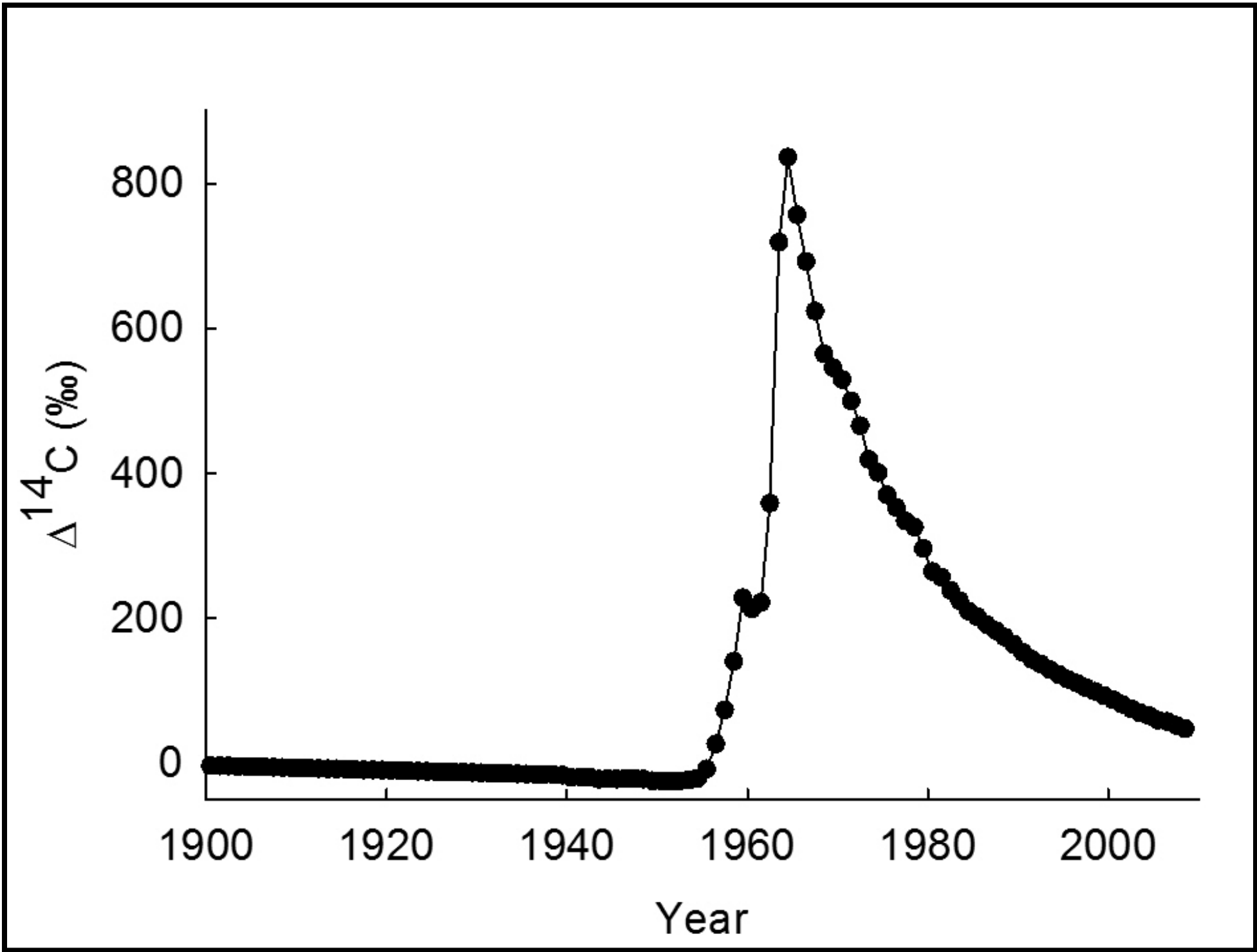


Figure 2. $\Delta^{14}\text{C}$ of fungi and foliage post-fire by year and month of collection. Fungi are designated with black M (*Morchella*) or P (*Plicaria*), foliage designated with green A (*Abies*), Ar (*Arbutus*), L (*Lithocarpus*), P (*Picea*), and Ps (*Pseudotsuga*). Line for $\Delta^{14}\text{C}$ of atmospheric CO_2 is also shown.

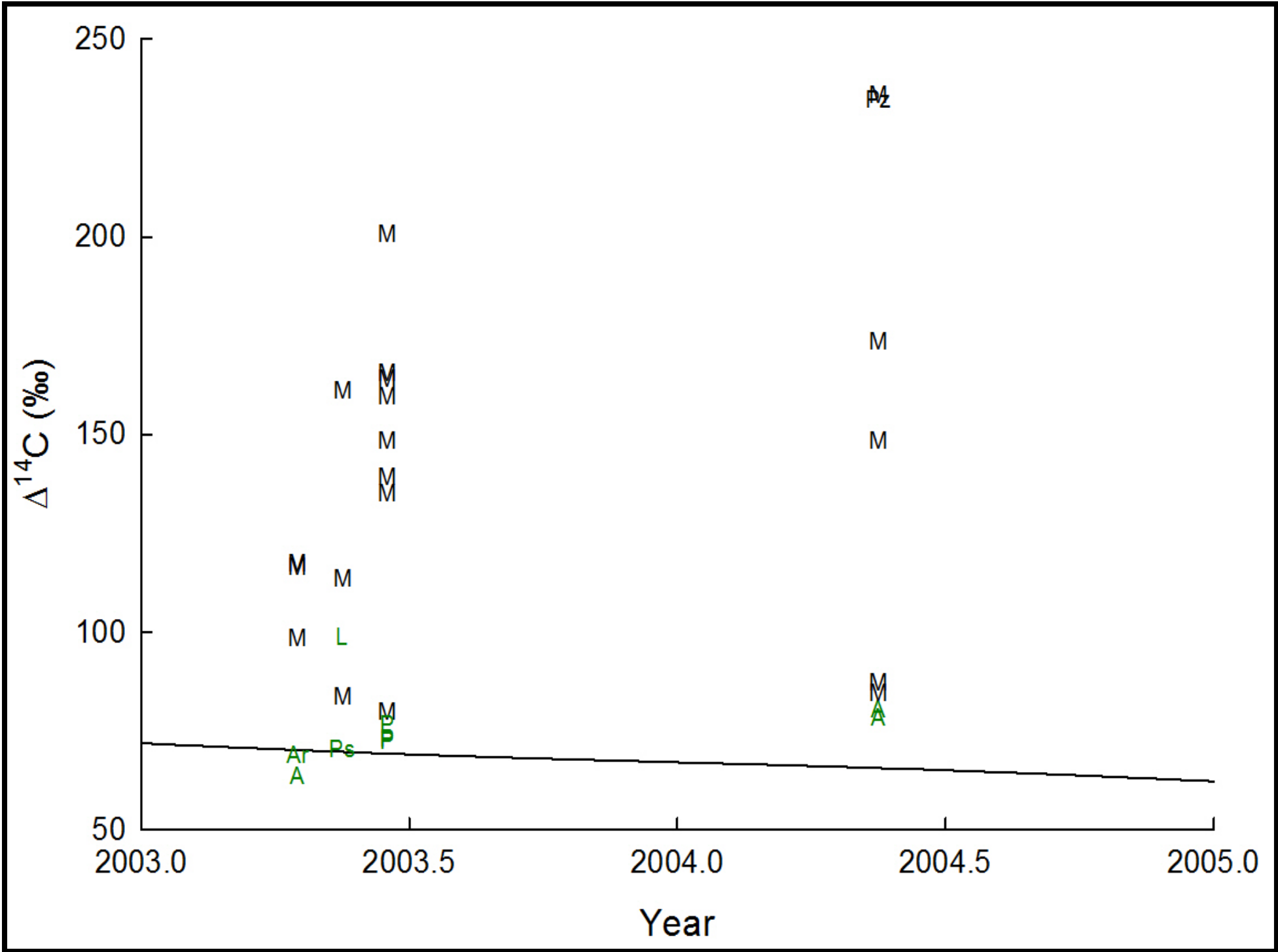
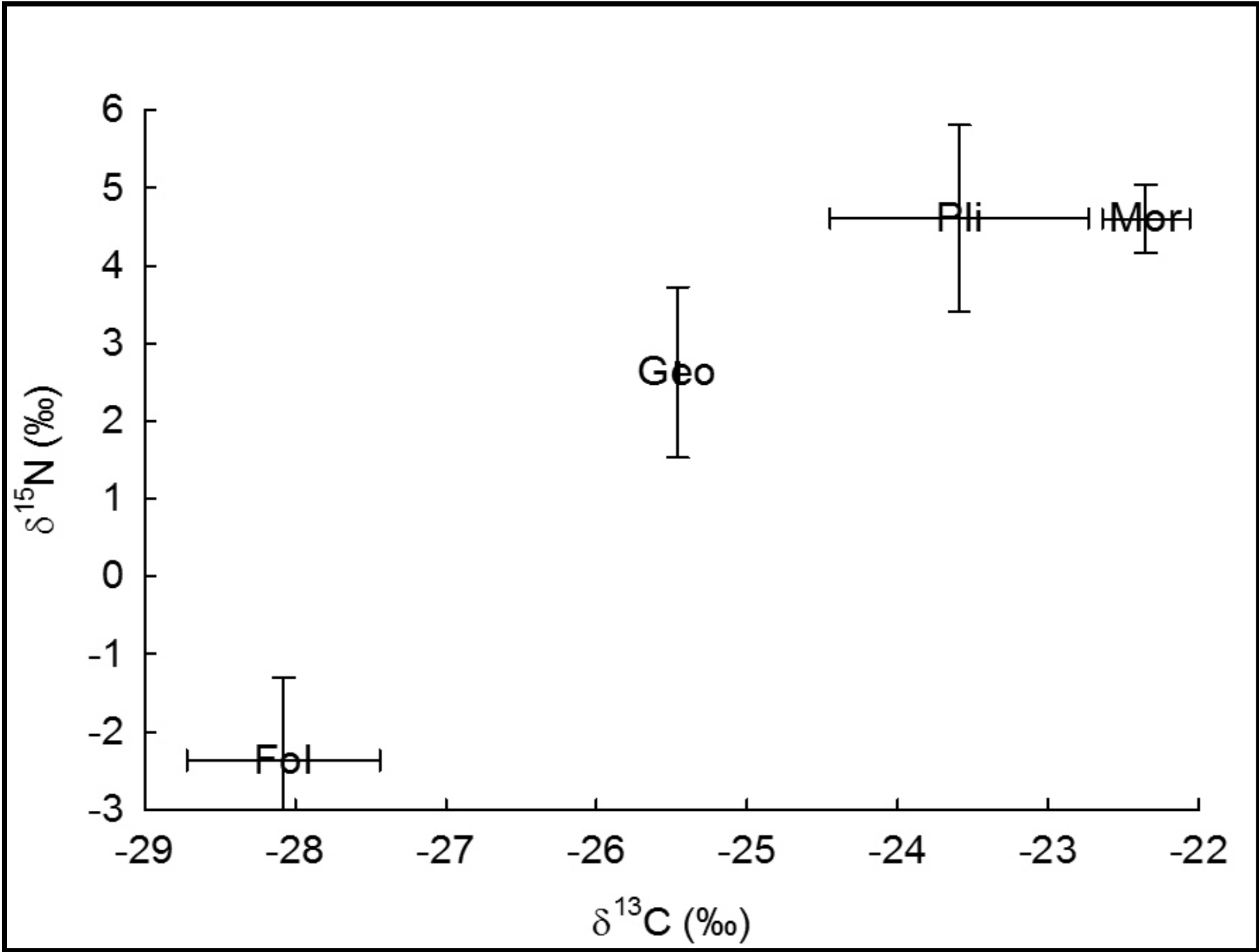


Figure 3. Stable Isotopes of *Morchella* are similar to *Plicaria* (saprotrophic) and differ from *Geopyxis* (mycorrhizal) and Foliage.



- Morchella* averaged 5‰ enriched in ^{13}C and 5‰ enriched in ^{15}N relative to foliage. This contrasts to the ^{13}C enrichment of 6.3‰ in wood decay fungi, 4.8‰ in litter decay fungi, and 2.4‰ in ectomycorrhizal fungi relative to Douglas-fir foliage in the Oregon Coast Range.
- High ^{15}N enrichment in *Morchella* suggested that recent litter was not the primary source for *Morchella* nitrogen, and similar ^{13}C and ^{15}N enrichments suggest that *Morchella* may assimilate its carbon and nitrogen similarly to that of the saprotrophic *Plicaria endocarpoides*.
- Carbon in *Morchella* averaged 11 ± 6 years old whereas carbon in foliage averaged 1 ± 2 years old, clearly indicating that *Morchella* was assimilating old carbon. (Figure 2.)
- Stable Isotope analysis showed *Morchella* is similar to *Plicaria* (Saprotrophic) and differs from *Geopyxis* (mycorrhizal) and Foliage. (Figure 3.)
- We concluded that *Morchella* in post-fire environments is saprotrophic.

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