

Reporting Summary

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Statistical parameters

When statistical analyses are reported, confirm that the following items are present in the relevant location (e.g. figure legend, table legend, main text, or Methods section).

n/a Confirmed

- ☐ ☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
- ☐ ☒ An indication of whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☐ ☒ The statistical test(s) used AND whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☐ ☒ A description of all covariates tested
- ☐ ☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- ☐ ☒ A full description of the statistics including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- ☐ ☒ For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted
Give P values as exact values whenever suitable.
- ☒ ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- ☐ ☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- ☒ ☐ Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated
- ☐ ☒ Clearly defined error bars
State explicitly what error bars represent (e.g. SD, SE, CI)

Our web collection on [statistics for biologists](#) may be useful.

Software and code

Policy information about [availability of computer code](#)

Data collection No software was used to collect data for this paper.

Data analysis Data were analyzed in R 3.3.2.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers upon request. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

All data used in analyses are available to readers via Dryad.

Field-specific reporting

Please select the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences

☐ Behavioural & social sciences

☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/authors/policies/ReportingSummary-flat.pdf](https://www.nature.com/authors/policies/ReportingSummary-flat.pdf)

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description

In 2009, we published a paper that quantified relationships between foliar delta15N and a) climate relationships, b) foliar N concentrations, and c) mycorrhizal associations. Data for the paper were collected through 2006. Since then, over a decade of data has accumulated on foliar delta15N, but there has been no analysis to assess whether these relationships have held constant or changed. For example, rising atmospheric CO2 concentrations might be reducing N availability to plants, which would cause declines in both foliar N concentrations and delta15N. Alternatively, increased atmospheric N deposition could cause increases in both.

All hypotheses will separately tested for N2-fixing and non-N2-fixing plants.

H1) Have there been significant shifts in the relationships between foliar delta15N and a) mean annual temperature, b) mean annual precipitation, c) foliar N concentrations, and d) mycorrhizal associations? More specifically, has there been a significant change in the mean estimates for each parameter for data collected before 2006 and those collected after 2006?

H2) After accounting for mean annual temperature, mean annual precipitation, foliar N concentrations, and mycorrhizal association, has foliar delta15N either increased or decreased over time for N2-fixing and non-N2-fixing plants?

H3) After accounting for mean annual temperature, mean annual precipitation, and mycorrhizal association, has foliar delta15N either increased or decreased over time for N2-fixing and non-N2-fixing plants??

H4) How are any trends in foliar N concentrations contributing to any trends in foliar delta15N?

Research sample

An individual sample would be considered a single value of foliar d15N and [N] collected from a species at a given site in a given year.

Sampling strategy

Data were acquired from the literature and by contacting coauthors for unpublished data. Data collection proceeded until all data identified as appropriate had been collected to a certain date. Individual researchers were contacted via email twice for their data to limit the effort to acquire any one data set.

Data collection

Data were acquired by first identifying extant published data sets. wer

First, we searched Web of Science with the terms "(nitrogen isotope or 15-N) and (leaf or leaves or foliar)" for years 2006-present. Articles that potentially were associated with foliar 15N data were flagged for downloading and examination to see if foliar 15N data were collected. Articles were excluded if data are limited to:

- 1) urban areas
- 2) agricultural ecosystems
- 3) non-control samples of manipulative experiments
- 4) non-vascular plants
- 5) fertilized plants
- 6) semi-aquatic or aquatic plants
- 7) sites with mean annual precipitation < 50 mm

Planted trees were included if they were from plantations older than 5 years and met the above requirements.

Web of Science was searched for relevant datasets to included any papers that cite Craine et al. 2009.

In addition to identifying these datasets on Web of Science, we also searched Google Scholar using the same search terms and criteria to look for relevant articles.

After identifying articles that potentially report collection of foliar 15N data, we downloaded each article to examine whether relevant foliar 15N data were collected. For those that were, we first saw whether the data had been provided in an on-line repository. If not, we contacted the corresponding author and requested the data. Failures to respond were handled by contacting other authors on the paper. Unsuccessful attempts to request data will be noted in a log.

If an author was successfully contacted, we asked the researcher whether they have additional appropriate foliar 15N data that could be provided to the project.

Data were included in the final synthesis if data points were associated with a date of collection (at least to year), location data that could be used to generate site latitude and longitude, the identity of the species from which the leaves were collected, and both foliar N concentration and foliar d15N.

In parallel to obtaining data sets identified in the literature, additional datasets were sought from Dryad (datadryad.org) using the search terms "nitrogen isotope" and "15N".

Timing and spatial scale	Data were included if they were collected between 1980 and 2017. First emails were sent on October 3, 2017. Data collection ended January 10, 2018.
Data exclusions	For data that met the above criteria, no data were excluded from the analyses.
Reproducibility	All data were collected and analyzed once.
Randomization	All data were pre-assigned to mycorrhizal groups and climate parameters were assessed based on geographic location.
Blinding	All data were acquired before any statistical analyses were run. No blinding is involved in this study.
Did the study involve field work?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Reporting for specific materials, systems and methods

Materials & experimental systems

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> Unique biological materials
<input checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input checked="" type="checkbox"/>	<input type="checkbox"/> Palaeontology
<input checked="" type="checkbox"/>	<input type="checkbox"/> Animals and other organisms
<input checked="" type="checkbox"/>	<input type="checkbox"/> Human research participants

Methods

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> ChIP-seq
<input checked="" type="checkbox"/>	<input type="checkbox"/> Flow cytometry
<input checked="" type="checkbox"/>	<input type="checkbox"/> MRI-based neuroimaging