frontiers | Frontiers in Forests and Global Change

TYPE Editorial
PUBLISHED 17 July 2023
DOI 10.3389/ffgc.2023.1248734

OPEN ACCESS

EDITED AND REVIEWED BY
Heather R. McCarthy,
University of Oklahoma, United States

*CORRESPONDENCE
Lucy Kerhoulas
lucy.kerhoulas@humboldt.edu

RECEIVED 27 June 2023
ACCEPTED 06 July 2023
PUBLISHED 17 July 2023

CITATION
Kerhoulas L, Chin A, Csank A and Mathias J (2023) Editorial: Understanding forest ecosystems: the use of stable isotopes and physiological measurements.
Front. For. Glob. Change 6:1248734.
doi: 10.3389/ffgc.2023.1248734

Editorial: Understanding forest ecosystems: the use of stable isotopes and physiological measurements

Lucy Kerhoulas[1]*, Alana Chin[2], Adam Csank[3] and Justin Mathias[4]

[1]Department of Forestry, Fire, and Rangeland Management, California State Polytechnic University, Humboldt, Arcata, CA, United States, [2]Plant Ecology Group, Institute of Integrative Biology, Eidgenössische Technische Hochschule (ETH)-Zürich, Zürich, Switzerland, [3]Department of Geography, University of Nevada-Reno, Reno, NV, United States, [4]Department of Forest, Rangeland, and Fire Sciences, University of Idaho, Moscow, ID, United States

KEYWORDS

climate, drought, gas exchange, tree, water potential

Editorial on the Research Topic
Understanding forest ecosystems: the use of stable isotopes and physiological measurements

Forest ecosystems are complex and dynamic and can be challenging to comprehensively understand. Measurements of forest physiology and stable isotopes can provide unique perspectives into forest functions, often revealing mechanisms driving observed trends. For example, predawn water potential can provide information about plant-available water to help explain variability in tree drought resistance. Photosynthesis, respiration, stomatal conductance, and sap flow are other common physiological metrics that can inform on forest function when linked to climatic and stand conditions or demographic stages. Stable isotope signatures can help integrate physiological and ecological measurements. Deuterium and ^{18}O signatures in xylem sap water compared to potential source waters (e.g., soil, streams, ground, precipitation, snow, and fog) can inform about current tree water use, while ^{18}O signatures in tree-rings can inform about tree source-waters in the past. The relative abundance of ^{15}N allows for the exploration of N acquisition strategies and interpretation of shifts in community composition and species range as climatic conditions change. Additionally, ^{13}C in plant tissue can serve as an integrated measurement of longer-term water stress and reflect processes related to both photosynthesis and stomatal conductance helping us link climate to forest function.

Collectively, measurements of physiology and stable isotopes have great potential to improve our understanding about the mechanisms driving forest responses to climate and management, especially when integrated and placed in their ecological context. However, these types of measurements often require specialized training and expensive equipment and can be quite time- and labor-intensive. Nevertheless, forests are such an important component of our landscape in terms of renewable resources, wildlife habitats, carbon storage, aesthetics, and human health and recreation, that we feel the value of knowledge gained via these types of measurements warrants the extra cost, time, and effort associated with these measurements. Understanding the mechanisms driving forest trends will maximize our ability to effectively steward forests through synergistic challenges such as climate change, wildfire risks, increasing demands for wood products and urban development, and stressful forest conditions that have arisen due to overgrazing, fire suppression, and past overharvesting and high-grading. Fortunately, technologies are improving to make physiological and stable isotope measurements more accessible, via new advances such as the LiCor 6800 and laser-based isotope instruments (e.g., those made by Picarro and Los Gatos Research).

The scope of this Research Topic is to showcase how measurements of physiology and stable isotopes can improve our understanding of forest function. Ultimately, improved understanding of forest function will maximize our ability to understand and predict forest responses to climate and management. In turn, improved understanding of forest responses to climate and management will strengthen our ability to shepherd forests through the suite of interacting and challenging conditions that currently threaten forest perpetuation. As these conditions are largely human-induced, we have a duty to mitigate these stressors via adaptive and effective management efforts. To this end, this collection of papers demonstrates how different aspects of forests can be better understood via complementary measurements of physiology and stable isotopes across a broad range of forest types and geographic locations. A key shared feature of these studies is the integration of natural abiotic factors with measurements conducted in the field, while they may support their work with glasshouse studies (e.g., Ramesh et al.), they keep the focus on juvenile and mature trees in real forests.

More specifically, our collection of papers showcases how stable isotopes and physiological measurements can be used to evaluate complex and diverse forest dynamics across a range of locations and species. Water stable isotopes were used to demonstrate the importance of monsoon and winter precipitation inputs for conifers, hardwoods, grasses, and regenerating overstory cohorts in the southwestern United States (Kerhoulas et al.; Samuels-Crow et al.). An evaluation of energy-limited high elevation conifers found that warming temperatures may enhance growth and defense in trees (Kichas et al.). In the tropics, an evaluation of hardwood tree species found that upland species had relatively low sensitivity to temperature, low flexibility in nitrogen acquisition, and high root-to-shoot ratios (Ramesh et al.). Finally, a suite of physiological measurements found that strategies for coping with summer water stress differed among coexisting hardwood species and between juvenile and adult trees (Bryant et al.). This collective body of work demonstrates that while measurements of tree physiology and stable isotope ecology can be time consuming, expensive, and require specialized expertise, they can uncover important and unique insights into forest dynamics that bring a mechanistic lens to forest ecology.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Acknowledgments

We thank all of the contributors to this Research Topic.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.