**2025 Andrews Forest LTER GRA Support Award Proposal**

**“Quantifying Growth of Scorched Western Hemlocks Following the 2021 Heat Dome”**

**Principle Investigator:** Chris Still, Professor

**Department:** Forest Ecosystems & Society

**College:** OSU College of Forestry

**Graduate Research Assistant:** Gabhriel John, PhD Student

**Department:** Forest Ecosystems & Society

**College:** OSU College of Forestry

Application Deadline: Friday, January 24, 2025, by 5 PM, PST

The Andrews will award four Graduate Student GRA terms of funding support. Each of the four awards will provide full graduate-student support (stipend and tuition for MS or PhD) for one term at OSU. A faculty member, not a current or prospective student, must submit the application.

Selection Criteria:

1. Alignment with LTER8. Proposed research and activities must support the goals and research activities in the LTER8 proposal. Please make specific mention of how the proposed research relates to LTER8 goals (below), and to relevant LTER8 research activities found in the proposal.

• Goal I: To understand how disturbance legacies interact with environmental change to influence ecosystems.

• Goal II: To understand how species interactions influence population and community responses to environmental change.

• Goal III: To understand how interactions of science, values, and ecological conditions influence land-use decisions.

2. Focus on fire: Research could incorporate regional datasets or perspectives. Connection to long-term datasets is encouraged.

3. Enhancement of LTER community. We look to enhance the Andrews Forest research community – based on the past and likely future contributions of the PI and the student to the Andrews Forest Program. We welcome proposals that support our commitment to diversity, equity, and inclusivity.

4. Student support. Explain how this term of GRA funding would enable new effort beyond existing plans. Applicants are invited to briefly mention if, and in what ways, this award would be leveraged with other existing funds and projects. Extra consideration will be given to students whose work was impacted negatively by closures to the HJA site in 2023 and 2024 due to wildfire; please explain if and how the student has been impacted by site closures and wildfire at research locations.

2. Proposal. In not more than two pages, total:

a. Explain how the proposed work and activities support selection criteria listed above.

b. Describe, briefly, what the student will do during the period of funding, and what you expect the student to accomplish.

c. Specify the term of support being requested (e.g., Spring 2025 term).

d. Indicate a timeline for the proposed activities including when products will be presented/published.

3. Send to Lina DiGregorio (lina.digregorio@oregonstate.edu) by the application deadline.

At the end of the funding period, the awardee will be asked to provide a report on how the funds were used and the benefits gained from the activities.

Awardees will be expected to present their work at an Andrews Forest LTER Monthly Meeting.

Applications materials should be sent to Lina DiGregorio ([lina.digregorio@oregonstate.edu](mailto:lina.digregorio@oregonstate.edu)).

***Overview of the proposed project and graduate student***

A paper produced with support from LTER8 funding highlights the widespread and dangerous

effects of the 2021 Heat Dome on tree health in the Pacific Northwest (Still et al., 2023).

Similar extreme climates are likely in the future and necessitate more research to provide better predictions for future ecological and physiological responses by trees and forests in places like the Andrews Forest. A vital aspect of tree function is stem growth, yet there are many unknows in understanding and predicting its response to historically unprecedented climate conditions. This work forms the basis of Gabby John’s research. In the fall of 2023, she joined Oregon State University to begin a master’s project with LTER8 funding. She is using LTER8 funds to analyze tree cores along with high-resolution data from meteorological stations and automated dendrometers at the Andrews to understand the extent to which Douglas-fir (*Pseudotsuga menziesii*) and western hemlock (*Tsuga heterophylla*) growth is affected by heat wave and drought events. Specifically, John is focusing on the potential residual effects of the Heat Dome on Douglas-fir basal area growth based on dendrometer records of stem diameter expansion and contraction. This research is imperative and timely as both climate phenomena are interlinked and threaten the capacity for Pacific Northwest forests to provide microclimate refugia and store carbon (Davis et al., 2023; Duarte et al., 2016).

Over the last year, John’s project has identified more questions than she can answer within two years, and she would like to pursue similar work in a PhD at OSU. Thus, as she changes her degree to a Ph.D., this proposal is an opportunity to help fund her additional at the Andrews Forest that can be seamlessly integrated into her degree program. For example, with the help of her co-advisor and Andrews Forest Director, Mark Schulze, John has identified a stand of western hemlock trees near the Discovery Trail that experience varying levels of afternoon sun exposure through gaps in the surrounding canopy of Douglas-firs. These gaps resulted in a unique and clear gradient of leaf mortality (foliar “scorch”) ranging from mild (e.g., TSHE 646) to severe (e.g., TSHE 652) following the Heat Dome. Just as heat effects are often overshadowed by drought, so too are western hemlocks overshadowed by Douglas-fir. Notably, hemlocks were among the most heat-sensitive species in many locations, as their canopies typically experienced the greatest leaf mortality from the Heat Dome. Consequently, the proposed project serves to identify whether and how each degree of scorch affected seasonal growth of a species in need of additional attention.

Therefore, receipt of this award will allow John to explore the following research questions at the Andrews Forest:

1. How did the degree of foliar scorch affect growth of western hemlock along the Discovery Trail?
2. Is the proportion of scorched crown volume related to growth rate reductions?
3. Did growth significantly differ among scorched vs. non-scorched western hemlocks?

***How the proposed project achieves LTER8 goals***

The proposed project builds upon knowledge and analysis acquired over the last year and directly supports the mission of LTER8 to provide quantifiable evidence of ecological responses to unprecedented climate. Consequently, this proposed project best supports Goal I of LTER8. The future of plant-carbon dynamics, forest modeling, and forest management depends on a thorough understanding of how those plants respond to climate disturbances. The Heat Dome represents a clear instance of extreme environmental change with profound and perhaps long-lasting impacts. High temperatures often lead to foliar damage and mortality, which affects a tree’s ability to assimilate carbon (Teskey et al., 2014).

***Fire impacts on student’s work to date***

For the microclimate analyses needed to contextualize growth patterns at the Andrews, John has relied on long-term remote sensing data procured from the Andrews Provisional Data Portal. The Lookout and Ore Fires caused partial data losses during the summer, which is disproportionately important for John’s analyses since the summer months are when heat wave and drought impacts are most prominent. The Ore Fire also delayed John’s ability to conduct field work and communicate with co-advsior Schulze who was coordinating the Andrews’ fire response efforts.

***Proposed methodology for the student to complete during the funding period***

If selected for this award, we request that John be supported for the fall 2025 quarter. During this time, she will collect and analyze relevant data, prepare the data for publication, and improve data management practices for herself and other Andrews researchers. Her present project requires her to pull data from multiple large databases (e.g., MS001, MS005, and MV005). Through academic courses on version control repositories and Andrews workshops on best practices for data management, she is developing skills to compile, merge, and quality control gigabytes of data from the Provisional Data Portal into a single data frame available via Shiny. John will also be able to continue utilizing novel R packages for data cleaning and visualizing dendrometry data. Making existing data more accessible for other researchers ensures that other projects have the best chance possible to succeed.

Through her current work, John has already collected and mounted eight hemlock cores at the Discovery Trail, including TSHE 646 and 652. With fall funding, John can collect and analyze additional cores from both scorched and unscorched hemlocks. Paired with manual and new automated dendrometry datasets, these methods will convey long-term growth patterns and stress responses. We expect to observe relative decreases in growth band size in all years since the Heat Dome. To take this proposed analysis further, John will apply an allometric equation to tree ring samples to estimate biomass and carbon allocation. As seen in Acosta-Hernández et al., 2020, this practice would allow researchers and forest managers to more concretely convey the relationship between climate change and carbon storage.

An important and sometimes overlooked aspect of science is engaging and communicating with the public. Over the last year, John has presented her research at two symposia, and she applied for the 2025 cohort of LTER graduate student science writers. She will continue to find opportunities to share her work for the proposed project. New engagement pathways include mentoring new students in the Still-Albert-Vargas joint lab group.

***Timeline of student expectations and deliverables for the proposed project***

John is expected to complete and submit a publication from her current LTER8 work on Douglas-fir Heat Dome growth responses in summer 2025, allowing for a natural transition to focus on the proposed western hemlock project in fall 2025. Except for summer 2024, John has relied on Teaching Assistantships. This funding would give John a unique opportunity to spend the fall term exclusively focused on research. This is especially valuable since the fall is ideal for collecting tree cores as this is at the end of the water year and is less likely to be hindered by wildfire. Freedom from other obligations such as courses or teaching assistantships puts her in a position to prepare her quality-controlled dataset and have a publication of the proposed project ready before the conclusion of the winter 2026 term.

In line with the expectations outlined in this proposal’s criteria, John is expected to be closely involved with Andrews personnel and activities as she shares updates on her proposed project. Thanks to the current LTER8 work, John and Still are familiar with what this entails. For example, John gave a graduate student flash talk at the December 2024 LTER Monthly Meeting, and she is registered for the Early Career Critical Zone Workshop at the Andrews this March. She is prepared to present the results of the proposed project at another monthly meeting whenever it is appropriate to do, likely during the winter or spring of 2026. Upon completion of the proposal funding period, John and Still will complete necessary NSF annual reporting forms, another practice they have completed through the present research.

***References***

Acosta-Hernández et al., 2020. *Forests* 11:1134. <https://doi.org/10.3390/f11111134>

Davis et al., 2023. *Fifth National Climate Assessment*. <https://doi.org/10.7930/NCA5.2023.CH32>

Duarte et al., 2016. *J. Plant Physiol.* 205:57–66. <https://doi.org/10.1016/j.jplph.2016.08.012>

Still et al., 2023. *Tree Physiology* 43(2), 203–209. <https://doi.org/10.1093/treephys/tpac143>

Teskey et al., 2014. Plant, Cell & Environment 38:1699–1712. <https://doi.org/10.1111/pce.12417>