



H.J. Andrews Experimental Forest LTER

Photo credit: U.S. LTER

The H.J. Andrews Experimental Forest (AND) LTER is located in the Cascade Range of Oregon, and consists of 6,400 ha of conifer forest, meadows, and stream ecosystems. This mountain landscape experiences episodic disturbances, including fires, floods, and landslides. The question central to AND LTER research is: How do climate, natural disturbance, and land use, as influenced by forest governance, interact with biodiversity, hydrology, and carbon and nutrient dynamics?

Andrews LTER research illuminates the complexity of native, mountain ecosystems such as: forest-stream interactions; roles of dead wood; and effects of forest harvest and disturbance on hydrology, vegetation, and biogeochemistry over multiple time scales. Andrews LTER research has also been central to informing regional and national forest policy. Future research will address ongoing change in streams, forests, climate, and governance.



Between 2008-2018:

106 investigators

50 institutions represented

122 graduate students



Forest

Principal Investigator:

Michael P. Nelson

Oregon State University

Est. 1980

Funding Cycle:

LTER VII

NSF Program:

Biological Sciences /
Division of Environmental
Biology



Key Findings

Disturbance produces multi-decadal legacies.

The fire regime at AND LTER was previously believed to be dominantly stand-replacing. However, three quarters of 124 post-fire sites had multi-age cohorts of plant species, indicating mixed severity fires over the past 400 years [Product 9]. Pre-disturbance understory plant species persisted for decades after clear-cut logging and broadcast burning, contrary to the theory that severe disturbance would eradicate understory species [5].

Forest succession following clearcut harvest.

Due to increased shading from forest regrowth, streams in recovering forest experience declining temperatures, despite a warming climate [2]. Site history is essential to correctly interpreting climate change response to such trends.

Newly recognized stream responses to

warming trends. Cross-site comparisons reveal varying long term trends in nitrogen exports [1], and varying responses to warming trends [7]. Although theory predicts that streamflow should recover quickly after disturbance, paired watershed comparisons found decreases in summer flow (relative to undisturbed watersheds) in regenerating post-harvest forests 25 to 45 years old [8].

Carbon storage responds to forest growth, mortality, and climate.

Old-growth forest-stream ecosystems store enormous amounts of carbon. Andrews LTER researchers found that forest biomass accumulated at relatively linear rates over a century – counter to theoretical predictions that biomass accumulation would slow during forest succession [6]. They also found that climate change related mortality at Andrews is low compared to other forests in the western U.S. [10] and that forest harvest reduced stream dissolved organic carbon flux for over 50 years. According to predictions, valleys may be buffered from increasing temperature [4], but a warming climate could also push old-growth forests to become net carbon emitters.

Biodiversity losses and gains.

The northern spotted owl, an iconic species in federal lands policy, continues to decline. Over 4,000 invertebrate species have been recorded at AND LTER since 1991. Native climate-sensitive bird species appear to be persisting, despite multi-decade warming, likely because old forests buffer micro-climate [3].



Synthesis

Networking networks. Andrews LTER co-led two workshops on the integration of LTER, NEON, and CZO, resulting in a manuscript on research that combined LTER core areas and NEON core measurements.

Inter-site biogeochemistry and hydrology.

Andrews LTER led efforts to collect and make available data on stream chemistry (StreamChem) and climate and hydrology (Clim/hydroDB). Andrews researchers also led the planning process for a cross-site vegetation database (Veg-E).

Arts and humanities. Researchers and outreach specialists at AND LTER are leaders in the LTER Network-wide effort to engage arts and humanities. They have organized workshops, collaborated on social science publications, created a website, and co-organized multi-site art exhibits at NSF and Ecological Society of America meetings.



Photo credit: Lina DiGregorio

Ecosystem response to climate change.

Andrews LTER researchers led an effort to analyze climate change and hydrologic response at LTER sites [7] and are assembling ecosystem responses to climate change from all 28 LTER sites.



Data Accessibility

Since 1983, AND LTER data have been collected, managed, and archived through the Forest Science Data Bank (FSDB), which includes all active and legacy databases. Data are archived in the FSDB and the LTER Data Portal. Hydro-climatological data is collected using a radio telemetry system, allowing over 50 million records per year to be streamed. Andrews LTER also co-led a series of network-wide meetings on environmental sensor management and helped initiate the EnviroSensing Cluster in the Federation of Earth Science Information Partners (ESIP).

Photo credit: Erika Zambello

Partnerships

U.S. Forest Service, Pacific Northwest Research Station | Willamette National Forest | Oregon State University, College of Forestry



Broader Impacts



Fostering connections with the arts. Andrews LTER's environmental arts and humanities program develops lasting relationships with writers, artists, and musicians. Andrews LTER researchers have hosted some of the leading voices in the field ([The Forest Log](#)), shared work in major literary outlets (e.g., the *Atlantic* and *Orion* magazines), and published a book, [Forest Under Story](#). The ongoing Andrews History Project is archiving 70 years of historic documents and 55 oral histories.

Engaging middle school students. Andrews LTER partners with the University of Oregon Environmental Leadership Program, The Pacific Tree Climbing Institute, and the U.S. Forest Service Pacific Northwest Research Station to offer a curriculum, *Canopy Connections*, that integrates science, art, and creative writing and gives students an opportunity to climb into the canopy of an old-growth forest.

The Andrews Schoolyard LTER Program. A total of 84 K-12 teachers have worked with over 8,000 students per year in a program based on long term relationships with K-12 teachers and data from AND LTER.

LTER - Forest Service collaboration. For decades, scientific research at AND LTER has both influenced and been influenced by forest and stream management through joint field trips, symposia, and shared experiments.



Forest governance has changed. History and social science studies describe a long term change in forest management from a top-down governance system to one driven by local, bottom-up decision making. Pathways for science input to this new structure are less clear.

Photo credit: U.S. LTER

Top Products

1. Argerich, A and Johnson, SL et al. 2013. Trends in stream nitrogen concentrations for forested reference catchments across the USA. **Environmental Research Letters**. doi: 10.1088/1748-9326/8/1/014039
2. Arismendi, I and Johnson, SL et al. 2012. The paradox of cooling streams in a warming world: Regional climate trends do not parallel variable local trends in stream temperature in the Pacific continental United States. **Geophysical Research Letters**. doi: 10.1029/2012GL051448
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4. Daly, C et al. 2010. Local atmospheric decoupling in complex topography alters climate change impacts. **International Journal of Climatology**. doi: 10.1002/joc.2007
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6. Harmon, ME and Pabst, RJ. 2015. Testing predictions of forest succession using long-term measurements: 100 yrs of observations in the Oregon Cascades. **J Veg Sci**. doi: 10.1111/jvs.12273
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9. Tepley, AJ et al. 2013. Fire-mediated pathways of stand development in Douglas-fir/western hemlock forests of the Pacific Northwest, USA. **Ecology**. doi: 10.1890/12-1506.1
10. van Mantgem, PJ et al. 2009. Widespread increase of tree mortality rates in the western United States. **Science**. doi: 10.1126/science