Online Proceedings

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FOREST ECOLOGY AND EVOLUTION

Session Moderator: Gregory Ettl, Forest Resources
MGH 288
3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

A Molecular Phylogeny and Classification of Neospartoneae : The Evolutionary Relationships among *Diostea, Neosparton, and Lampaya*
Meng Lu, Junior, Exchange - Arts & Sciences
Mentor: Richard Olmstead, Biology, Burke Museum
Mentor: Laura Frost

The Verbenaceae, commonly known as the verbena family, consists of mainly tropical trees, shrubs, lianas, and herbs. Verbenaceae's diversity is highest in Latin America (where this family is primarily distributed) and Africa. Early classifications of this family relied on morphological traits. A molecular phylogenetic study was recently undertaken to assess and revise those classifications. Verbenaceae now include 35 genera and about 1000 species. In the current classification of Verbenaceae, there is one new tribe called Neospartoneae which consists of three small genera of Argentine species (*Diostea, Neosparton, and Lampaya*). According to the morphological traits, *Diostea and Neosparton* exhibit similar male reproductive characters and an ephedroid habit (many-branched shrubs with cylindrical, striate stems) while *Diostea and Lampaya* share fruit characteristics. Previous studies turned into the molecular data and tried to figure out the relationships between genera of this tribe by chloroplast DNA sequences (loci: ndhF, trnLF, ccsA, matK, rbcL, rpoC2, rps3). However, the evolutionary relationships remain are unresolved. In my study, I used nuclear DNA sequences (loci: ITS, ETS, PPR123, PPR42, PPR11, PPR70, PPR91) to provide a more robust molecular data and try to figure out the phylogenetic relationships in Neospartoneae. I extracted DNA from samples collected in Latin America. After doing PCR and purifying the PCR products, I conducted the sequencing reaction. After editing sequencing data manually, I aligned the nuclear DNA sequences to analyze data and produce the phylogenetic trees with maximum likelihood and Bayesian methods. The updated phylogeny improves our knowledge of evolutionary relationships among *Diostea, Neosparton, and Lampaya*.

The Drivers and Implications of Seed Masting: Pollination Efficiency and Nitrogen Cycling
Elise Michelle (Elise) Pletcher, Senior, Biology (General)
Mentor: Janneke Hille Ris Lambers, Biology

Seed masting occurs when seed production of a species is annually variable across large geographic regions, where years of extremely high seed production across individuals in a population is followed by one or more years of extremely low seed production. It occurs across large geographic regions and can occur within and amongst species. However, the drivers of masting and the implications of masting are often poorly known. Here, we use a long-term and spatially extensive data set of conifer seed production to A) test whether seed viability estimates are consistent with pollination efficiency (increased pollination success in high seed production years) driving masting; and B) explore the implications of masting for nitrogen dynamics. We found strong support for seed masting in six focal conifer species in Mt. Rainier national park from 7 years of data (2009-2015) collected from 18 locations. To further explore masting, we tested whether pollination efficiency is the driver of seed masting in *Tsuga heterophylla*, by testing whether seed viability (seed quality) is higher in mast years (using 4 years of data from 7 stands – which includes 2 mast years). Results indicate a higher proportion of filled seeds in mast years (i.e. higher viability), providing tentative support for pollination efficiency as the underlying cause of seed masting in these focal species. Germination tests of seeds in growth chambers will provide additional information. To determine the consequences of masting for nitrogen dynamics we measured the nitrogen content in seeds and leaf litter (across mast and non-mast years), and used these estimates to estimate total nitrogen content of leaf litter and seeds (i.e. nitrogen cycling). Understanding the mechanisms behind masting is important, as masting can control tree population demography, and influences ecosystem dynamics.

The Effects of Varying Light and Moisture Levels on Early Growth and Survival of Twelve Pacific Northwest Tree Species

Olivia Lorraine (Olivia) Moskowitz, Senior, Environmental Science & Resource Management

Mary Gates Scholar, Undergraduate Research Conference Travel Awardee

Mentor: Gregory Ettl, Forest Resources

Mentor: Matthew Aghai

In the Pacific Northwest, partial-cutting techniques are increasingly being used as "alternative silviculture" or "ecological forestry" approaches to improving structural and compositional diversity in even-aged Douglas-fir plantations. The resulting canopy gaps vary in size and distribution of the overstory, thereby causing differences in the amount of light and moisture available in the understory environment. A better understanding of how different species respond to varying levels of light and rhizosphere moisture is critical for species selection and successful regeneration efforts. This study examined the early growth dynamics and tolerances of seven tree species native to the west side and five species or varieties of species native to the east side of the Cascade Mountains. The experiment followed a nested factorial design in which seedlings were grown in large pots with three light levels created by shade cloth and three distinct tapered irrigation regimes. This component study paralleled an in situ experiment conducted at field sites around the state. Seedling responses were assessed by repeated measurements of survival and aboveground morphology for growth response. After one year, seedlings were destructively sampled for measurements of leaf area and dry shoot and root weight. The majority of morphological responses for each species were significantly ($p<0.05$) affected by light availability. Light was the significant ($p<0.05$) driver of above- and belowground growth of *Abies grandis, Larix occidentalis, Pinus monticola, Pseudotsuga menziesii, Tsuga heterophylla*, and the eastside varieties of *Pinus ponderosa* and *Thuja plicata*. The interaction between light and water treatments had a significant ($p<0.05$) impact on above- and belowground growth of *Alnus rubra* and the westside varieties of *P. ponderosa* and *T. plicata*. The highest mortality rates were observed for *Acer macrophyllum* and the westside variety of *P. ponderosa*, suggesting poor stock quality influenced early field potential.

Measuring Parent Cacao Seedling Growth in Hoja Nueva's Experimental Plots: A Case Study in the Lowland Peruvian Amazon

Megan Yoshiko (Megan) Schenck, Senior, Environmental Science & Resource Management

UW Honors Program

Mentor: Tim Billo, Program on the Environment

Mentor: Samantha Zwicker, School of Environmental and Forest Sciences

Cacao (*Theobroma cacao*) is a perennial crop grown in the tropics to produce chocolate worldwide. In the home country of cacao- Peru- wild varieties have been domesticated, cropped, and crossbred to create the optimal plant for specific climates. A study in the Valle Rio Apurímac-Ene (VRAE) region of Peru investigated 120 different varieties of cacao with diverse aromas and tastes, several of which have won awards for producing the best chocolate in the country. When members of these communities fled civil conflict five years ago and came to the Amazon, they brought several varieties not bred for this climate. My study measured the growth of one-year-old cacao seedlings in the experiment plots of Hoja Nueva, a nonprofit working in the lowland Peruvian Amazon. Although VRAE varieties are sun-grown, Hoja Nueva is growing these culturally significant varieties sustainably by keeping native shade trees, using biochar and biopesticides, and implementing reforestation programs that offset deforestation. This study is one of the first to be carried out in the field, since most growth studies have taken place in greenhouses. Environmental and abiotic factors play a pivotal role in seedling development. For 6 weeks abroad, I measured the temperature, light, overstory canopy cover, soil, and micro-climate within Hoja Nueva's cacao farms, along with the growth of individual parent cacao seedlings. Preliminary results show significantly more seedling growth in areas of higher light intensity and lower overstory canopy cover. This study will serve as the foundation for a replicated study next January, looking at one-year-old grafted cacao plants. Once grafted, it is hypothesized that seedlings will display equal growth in the shade and sun plots. The goal of this study long-term is to produce the same quality and yield of cacao per year as the community is currently, to limit deforestation, and eventually introduce shade-grown cacao varieties to the region.