

# PENNSSTATE



College of Agricultural Sciences

***L.W. SCHATZ CENTER FOR TREE MOLECULAR GENETICS***  
**ANNUAL REPORT**  
**June, 2015 – June, 2016**

**Prepared by**

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## **L.W. SCHATZ CENTER FOR TREE MOLECULAR GENETICS**

### **ANNUAL REPORT, AUGUST 24, 2016**

The Louis W. Schatz Center for Tree Molecular Genetics at Penn State is a world leader in research and training in modern tree genetics, thanks to the generosity and foresight of Dr. Schatz' gifts and the support and interest of the Schatz family. The endowed support for post-doctoral fellows, visiting scholars, undergraduate research, student field trips, faculty travel, and the colloquium makes it possible for the Schatz Center to play a prominent role nationally and internationally in forest genetics. This past year has been particularly busy and productive, benefiting from increasing interactions and synergies of Schatz Center activities on the University Park and Mont Alto campuses.

## **UNIVERSITY PARK CAMPUS ENDOWMENTS**

### **THE SCHATZ UNDERGRADUATE RESEARCH AWARD IN TREE GENETICS:**

The Schatz Awards for Undergraduate Research continue to provide undergraduate students from various programs across the university with opportunities to experience research on molecular genetics with forest trees. In the 2015/16 academic year, three undergraduate students from Forest Management, Horticulture, and Environmental Resource Management participated in research projects in the Schatz Center. One of the Schatz Scholars, Environmental Resource Management student Lianna Johnson, again this year received an Undergraduate Research Grant from the College of Agricultural Sciences to further her research. She presented a posters on their projects at the College's annual research day. Recipients of Schatz Awards for Undergraduate Research this past academic year were:

#### **Alex Stanish**

Schatz Center: August 2014 – June, 2016

Penn State Major: Horticulture

Graduated: May 2016

Projects: Assisted with green ash tree genetic conservation trial.

Plans: Graduate School; Currently lab technician, University of Colorado



Alex

#### **Lianna Johnson**

Schatz Center: June 2015 – present

Penn State Major: Environmental Resource Management

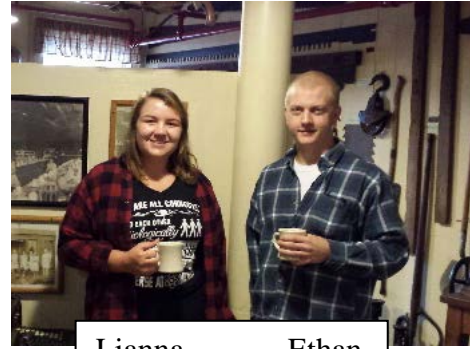
Graduated: May 2016

Projects: 1) Development of DNA markers for analysis of alder species and hybrids; 2) Assisting graduate student in construction of genetic map for green ash; 3) Development of DNA markers for buffalo nut genetic diversity.

Plans: Graduate School

### **Ethan Mansfield**

Schatz Center: January to June, 2016  
Penn State Major: Forest Resource Management  
Graduated: May 2016  
Project: Management of ash plantations.  
Currently: Manager of private forest reserve in PA



Lianna

Ethan

**New undergraduate student researchers** are being recruited for The Schatz Center for the new school year.

## **THE SCHATZ VISITING SCHOLARS PROGRAM:**

The Schatz Center continues hosting visitors from around the world for training and collaborative research through the Schatz Visiting Scholars program. In the 2015-16 academic year, The Schatz Center hosted scholars from the Philippines and China. Recipients this year of the Schatz Visiting Scholars program were:

- Tao Pang, Ph.D. student, Beijing Forestry University, China
- Geraldine Muncada, Ph.D. student, University of the Philippines

Both of the Schatz Scholars' continued their visits from the 2014-15 year, for an additional three months each, departing at the end of August in 2015. Mr. Pang completed a collaborative study with us on the genetic basis of drought tolerance in the woody desert shrub *Ammopiptanthus mongolicus*. The manuscript that he prepared while visiting The Schatz Center was published on August 27, 2015 by the journal PLOS One. Ms. Muncada created the first gene sequence databases for the tropical fiber plant Abaca, based on extensive gene expression studies. She discovered a new virus in the process, and information on mechanisms of infection and resistance to viruses that are threatening the economically important commercial production of banana and abaca in the Philippines. Ms. Muncada successfully defended her PhD thesis and graduated from the University of the Philippines in May, 2016. Dr. Muncada is now employed as a faculty member by the University of the Eastern Philippines where she is leading development of a new Life Sciences Research and Bioinformatics Center.

As stipulated in the Schatz Visiting Scholars guidelines, and kindly endorsed through a letter from Gordon Schatz, funds can also partially support Penn State staff to assist the Schatz Visiting Scholars during their stay. In the 2015-16 year, the Visiting Scholars fund supported part-time wages for The Schatz Center's lab manager Nicole Zembower, and one semester's stipend for the director's PhD student Di Wu (from the Beijing Forestry University in China) and half of the stipend for domestic PhD student Nathaniel Cannon who provided bioinformatics training for the visiting scholars and as manager of the bioinformatics server (unix computer) for The Schatz Center. Ms. Zembower provided both administrative and research support, making

all of the arrangements for travel, housing, university appointments, safety training, supplies, and research services for the Schatz Scholars. Ms. Zembower was also arranged for and assisted in the Schatz Center's summer work, including extensive greenhouse and field trials, watering of transplanted seedlings, and a summer full of vegetation management (mowing).

**The Schatz Visiting Scholar for the 2016-17 year will be Dr Isacco Beritognolo**, Researcher in the National Research Council, Institute of Biology and Agro-Forestry, in Porano, Italy. Dr. Beritognolo works with Dr. Rita Costa on the genome of European chestnut. His visit will initiate a new research collaboration between The Schatz Center and the Italian National Research Council which will advance the development of disease resistance in chestnuts internationally. Additional invitations for Schatz Visiting Scholarships for the 2016-17 were provided to a genetics faculty member from the University of the Philippines (Dr. Eureka Campos) and a biology instructor at Xiaozhuang University, in Nanjing China, with a Ph.D. in Bioinformatics and molecular biology from Nanjing Forestry University. However both of these scholars had to cancel their visits at the last moment for personal reasons. Those funds may now be used to partially support PhD students in The Schatz Center who will assist Dr. Beritognolo to learn research methods, and who will work with him to conduct detailed comparisons of results from our different species.

## **SCHATZ POST-DOCTORAL FELLOWSHIP IN TREE GENETICS:**

The recipient of the Schatz Post-Doctoral Fellowship in fiscal year 2015-16 was Dr. Teodora Orendovici Best, whose position in the Schatz Center continued from the 14-15 fiscal year. Dr. Best completed several projects on the effects of ozone air-pollution on trees as a member of the Schatz Center. In the large NSF-supported Hardwood Genomics Project, Dr. Best led the work on gene sequence database development and effects of ozone on gene expression in eight hardwood tree species. Dr. Best also took responsibility for supervising many undergraduate student researchers, including ten minority summer research interns from the University of West Alabama. Dr. Best also taught Visiting Scholars in lab techniques and the use of bioinformatic software for plant gene expression studies. After completing her positions as Schatz Visiting Scholar and then as Schatz Post-Doctoral Fellow, Dr. Best obtained a position permanent position with the Pennsylvania State University Genomics Core Facility.

**The plan for the 2016-17 fiscal year** is to provide the Schatz Post-Doctoral Fellowship to current PhD student Nathaniel Cannon, upon his graduation in Fall 2016 semester. The fellowship may also likely be advertised nationally. Nathaniel Cannon will 1) provide bioinformatics support and training for visiting scholars and students in the Schatz Center, 2) serve as unix systems manager for the Schatz Center's bioinformatics server, and 3) will continue his research to improve the chestnut genome and to develop genomics resources for Pacific Coast Redwood trees. The Schatz Post-Doctoral Fellowship endowment will also be used early in the 2016-17 year to complete production of chestnut genomic sequence data which the Schatz Post-Doctoral Fellow will use to assemble a final version of the Chinese chestnut genome for publication.

## **SCHATZ CENTER FACULTY TRAVEL FUND:**

The Louis and Merry Schatz Faculty Travel Fund supported travel this fiscal year by Dr. Carlson to participate in two research meetings that were highly relevant to the Schatz Center goals. Attending such meetings is an important national and international outreach component of the Schatz Center, in which we inform the research community about results from the projects underway in the Schatz Center, and where we learn the latest research results and approaches from other forestry and molecular genetics groups.

**For the 2016-17 fiscal year**, Dr. Carlson will, as always, entertain requests for travel support from faculty associated in the ESM department, and in the event of no such requests will use the funds to attend the international Plant and Animal Genome Conference in San Diego in January.

## **THE SCHATZ STUDENT FIELD TRIP FUND:**

Our biennial trip to visit Gordon and Karen Schatz, and the beautiful forests of Northern California and The L.W. Schatz Demonstration Tree Farm at Humboldt State University, occurred on June 6 - 8 2016. This time, 6 undergraduate students 4 PSU faculty and staff chaperones, participated in the trip:

- Penn State University Park students: Lianna Johnson, Ethan Mansfield, Alex Storm
- Penn State Mont Alto students: Josh Hersl, Ryan Karroll, Jeremy Newman
- PSU faculty/staff: Dr. John Carlson, Dr. Beth Brantley, Craig Houghton, Nicole Zembower

On day one, we met Mr. Gordon and Mrs. Karen Schatz at their home in Trinidad, then toured and hiked in the Redwood National and State Parks, ending a great day at a Pacific Ocean beach. On day two, we toured the Green Diamond Resources/Simpson Lumber Company nursery and tissue culture facility with Gordon Schatz; followed by a guided hike with the Schatz's through the L.W. Schatz Demonstration Tree Farm (Humboldt State University). On day 3, we toured the FSC/Smartwood certified 2<sup>nd</sup> growth Arcata community forest with Gordon. The students provided their impressions and thoughts on the trip in a detailed report to Mr. and Mrs. Schatz. Please see some photo memories of the trip on page 6 below. We look forward to our next trip to California to visit the Schatz's with our students, planned for 2018, to coincide with the next Schatz Tree Genetics Colloquium.



**PHOTOS FROM THE 2016 STUDENT FIELD TRIP TO HUMBOLDT, CA**



## MONT ALTO CAMPUS SCHATZ CENTER ENDOWMENTS

### THE SCHATZ TREE GENETICS COLLOQUIUM

Dr. Beth Brantley leads the Schatz Center programs at Penn State's Mont Alto campus. The Mont Alto campus' endowment for the Schatz Tree Genetics Colloquium provides an outreach and education component for the Schatz Center with a high level of visibility and impact. Dr. Brantley, Dr. Carlson, and lab manager Nicole Zembower worked closely together to plan and host the Colloquium for 2015. On October 23 and 24, 2015, Schatz Center for Tree Molecular Genetics' Schatz Colloquium hosted the Annual Meeting of the American Chestnut Foundation at the Penn State conference center on the University Park campus. The theme of the meeting was "Integrating Genomics Tools in American Chestnut Restoration." The Schatz Center sponsored leading tree genomics researchers from around the world as guest speakers, who covered all aspects of chestnut genomics tool development and applications for the TACF breeding program. The second day featured a series of workshops for the TACF membership to obtain hands-on experience with DNA extraction and bioinformatics, tours of the chestnut trials at Penn State, and a facilitated discussion with the experts on use of the new genomics tools. The central feature of the conference was the new genome sequence for blight-resistant Chinese chestnut that was developed in The Schatz Center, and which will serve as a reference for the genome-wide selection programs being developed by TACF and collaborators. The meeting was a great success, attended by more than 250 chestnut enthusiasts from all walks of life across the eastern US who expressed heart-felt appreciation to the College and The Schatz Center for hosting such an extraordinary and well-delivered meeting for the benefit of our TACF stakeholders. Please see some photos of the event below.



For such a large undertaking, it was necessary to provide partial salary support from the colloquium fund for Dr. Carlson's lab manager Nicole Zembower for her assistance in making arrangements for the meeting. Ms. Zembower was responsible for all the travel arrangements for the guest speakers, for obtaining abstracts from the speakers, for communicating with the conference center, lining up buses for tours, and for preparing supplies and training students to help with the workshops. The cost of materials and supplies to prepare for the tours and workshops was provided from the Colloquium fund, along with wages for Dr. Carlson's PhD student Nathaniel Cannon who helped prepare a bioinformatics demonstration and training for attendees to learn how to use genomics tools developed in the Schatz Center. The detailed expense accounting for preparations of the Schatz Tree Genetics Colloquium will be included in the Mont Alto campus report.



## SCHATZ CENTER RESEARCH UPDATE FOR 2016

The Schatz Center endowments continue to support a variety of research projects at different stages in their development, including obtaining data from preliminary projects prior to submission of grant applications for external support. During the past year, the large Hardwood Genomics Resources Project, which Dr. Carlson led for 4 years, was successfully completed. The project produced gene sequence databases and genetic maps for 8 important hardwood (deciduous) tree species which are available to the public at the project's open website ([www.hardwoodgenomics.org/](http://www.hardwoodgenomics.org/)). The Schatz Center also continued to research over the past year to complete the Chinese chestnut reference genome, and to begin the process of integrating the genomic tools into The American Chestnut Foundation's blight resistance breeding program. The Chestnut Genome is available to the public at pages on the hardwood genomics website ([www.hardwoodgenomics.org/chinese-chestnut-genome](http://www.hardwoodgenomics.org/chinese-chestnut-genome)). A third major project in which the Schatz Center continued to participate in is the "NEWBio" perennial biomass energy project (website <http://www.newbio.psu.edu/>). We are collaborating with researchers across the Northeast to identify the best willow and switchgrass cultivars for productivity on poor, marginal growing sites in the east. For the NEWBio project we are also studying the role of soil microbial communities in promoting growth and environmental stress resistance in bioenergy tree crops. For more details of these and other projects see the Schatz Center website (<http://ecosystems.psu.edu/research/centers/schatz>).

During the 15-16 year, Dr. Carlson and Schatz Center members presented invited talks at 1) The American Chestnut Foundation's 32<sup>nd</sup> Annual Meeting, 2) the IUFRO 2016 Genomics and forest genetics conference, in France, and 3) seminar series at other universities including The University of Pennsylvania. The Schatz Center students presented 7 posters at research conferences and we published 10 peer-reviewed papers in leading scientific journals.

1. Herr JR, Scully ED, Geib SM, Hoover K, Carlson JE, Geiser DM. 2016. Genome sequence of *Fusarium* isolate MYA-4552 from the midgut of *Anoplophora glabripennis*, an invasive, wood-boring beetle. *Genome Announcements* 4(4):e00544-16, 2 pages.
2. Carroll RA, Jones C, Best T, Shumaker K, Carlson J. 2016. Gene expression in hardwood trees species exposed to ozone. *Journal of Undergraduate Research and Scholarly Excellence*, Volume VII, 4 pages, (manuscript #J498SP15-1).
3. Odom T, Williams KN, Best T, Zembower N, Shumaker K, Carlson J. 2016. An analysis of gene expression induced by elevated atmospheric ozone in hardwood trees native to Eastern North America. *Journal of Undergraduate Research and Scholarly Excellence*, Volume VII, 5 pages. (manuscript # J498SP15-2).
4. Owusu S, Schlarbaum S, Carlson J, Gailing O. 2016. Pollen gene flow and molecular identification of full-sib families in small and isolated population fragments of *Gleditsia triacanthos* L. *Botany*, 94: 523–532 (10.1139/cjb-2015-0244).
5. Staton ME, Best TO, Khodwekar SD, Owusu SA, Xu T, Yu Y, Jennings TN, Knaus BJ, Cronn RC, Arumuganathan AK, Coggeshall MV, Gailing O, Liang H, Romero-Severson J, Schlarbaum SE, Carlson JE. 2015. Preliminary genomic characterization of ten hardwood tree species from multiplexed low coverage whole genome sequencing. *PLoS ONE* 10(12): e0145031, 14 pages. (doi:10.1371/journal.pone.0145031).



6. Staton M, Zhebentyayeva T, Olukolu B, Fang GC, Nelson D, Carlson JE, Abbott AG. 2015. Substantial genome synteny preservation among woody angiosperm species: comparative genomics of Chinese chestnut (*Castanea mollissima*) and plant reference genomes. *BMC Genomics*. 16:744, 13 pages (DOI: 10.1186/s12864-015-1942-1).
7. Pang T, Guo L, Shim D, Cannon N, Tang S, Chen J, Carlson JE, Xia X, Yin W. 2015. Characterization of the transcriptome of the xerophyte *Ammopiptanthus mongolicus* under drought stress by 454 pyrosequencing. *PLoS ONE* 10(8): e0136495, 25 pages. (doi: 10.1371/journal.pone.0136495).
8. Zhang X, Carlson A, Tian Z, Staton M, Schlarbaum SE, Carlson JE, Liang H. 2015. Genetic characterization of *Liriodendron* seed orchards with EST-SSR markers. *Journal of Plant Science and Molecular Breeding*. 4:1, 9 pages (<http://dx.doi.org/10.7243/2050-2389-4-1>).
9. Dinningrat, D.S., Widiyanto, S.M., Pancoro, A., Shim, D., Panchangam, B., Zembower, N. and Carlson, J.E., 2015. Identification of Terminal Flowering1 (TFL1) Genes Associated with the Teak (*Tectona grandis*) Floral Development Regulation Using RNA-seq. *Research Journal of Botany*, 10(1): 1-13. (DOI: 10.3923/rjb.2015.1.13).
10. Dinningrat, D.S., Widiyanto, S.M., Pancoro, A., Shim, D., Panchangam, B., Zembower, N. and Carlson, J.E., 2015. Transcriptome of Teak (*Tectona grandis*, Lf) in Vegetative to Generative Stages Development. *Journal of Plant Sciences*, 10(1): 1-14 (doi: jps.2015.1.14&org=10).