



RESEARCH. EDUCATION. COMMUNITY.

2016-2017 Annual Report

**Tyson Research Center** is the environmental field station for Washington University in St. Louis. Located just 20 miles from the main campus on 2,000 acres at the edge of the Ozarks ecoregion, Tyson provides opportunities for environmental research and education for students and faculty from Washington University and beyond. We facilitate multi-scale research and teaching opportunities and collaboration across disciplines, institutions, and levels of academic training.

### **On the cover**

Prescribed fire in experimental forest plots, winter 2017. The plots were established with grant funds awarded to Jonathan Myers and Marko Spasojevic from the National Science Foundation and through support from Tyson Research Center.









# Advancing discovery through collaboration

Through our integrated research and education programs, grant opportunities to seed collaborative research, expanding facilities, and strong community, Tyson continues to advance scientific discovery. In this report, we highlight some of the key collaborative achievements at Tyson over the last year (pg. 6) and share more detailed stories in our Research and Education sections.

We are pleased to report several key achievements in this report, including: growing collaborations among lab groups stimulated by a large-scale prescribed fire experiment initiated in 2015; perspectives on conducting research at Tyson from a visiting graduate student; undergraduate research achievements made possible through mentoring leadership; publications in top-tier scientific journals; developments in disease ecology research; and two new staff positions intended to guide the development of Tyson as a global leader in long-term environmental research.

Summer 2017 brought our largest cohort of undergraduate fellows to date as we continue to support the integration of summer education experiences with faculty research programs. Undergraduate fellows who conducted independent research projects at Tyson from 2015-2017 have submitted manuscripts to peer-reviewed journals, and a record number of Tyson undergraduates presented their work from summer 2017 at the Washington University Fall Undergraduate Research Symposium.

We are committed to expanding interdisciplinary research at Tyson, providing valuable and transformative environmental education opportunities for St. Louis area high school students, and maintaining a positive and supportive, yet rigorous, scientific community.

We welcome you to Tyson, and look forward to another great year for scientific and personal discovery.

Thank you for your continued support.

Sincerely,



**Kim Medley, PhD**  
**Director**  
Tyson Research Center









# 2016-2017 Highlights



Tyson Postdoc Joe LaManna (Myers Lab) published papers in *Science* and *Nature Ecology and Evolution*, revealing the role of conspecific negative density dependence on broad-scale patterns in biodiversity and biodiversity-productivity relationships across scales.



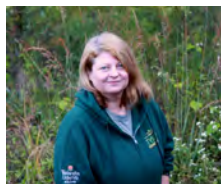
Summer 2017 brought the largest cohort of undergraduate fellows to date to spend their summer conducting research in the Tyson community.



Tyson added a new staff scientist position, filled by disease ecologist Solny Adalsteinsson. Her role will expand our long-term research and monitoring programs. (See more in our Research section.)



The CRETE House, designed by a WashU student team led by Hongxi Yin and Pablo Moyano, will become Tyson's first residence. The team competed in the Department of Energy's Solar Decathlon competition in Denver in October 2017.



Tyson Postdoc Katie Westby (Medley Lab) published her work on habitat age and holdover effects on mosquito life history in *Ecological Entomology*.



Matt Schuler, former Tyson graduate student and current postdoctoral research associate at Rensselaer Polytechnic Institute (Relyea Lab), published work from his dissertation in *Ecology* and in *Ecology and Evolution*.



The Tyson Interdisciplinary Faculty Seed Grant funded two collaborative projects led by Brent Williams and Jonathan Myers, and Dan Giammar and Jeff Catalano.



Chris Catano (Myers Lab) published work from his dissertation in *Ecology Letters* and co-authored work with Joe LaManna (*et al.*) in *Nature Ecology and Evolution*.



Tyson collaborated with The Nature Conservancy to restore a section of LaBarque Creek, an important tributary of the Meramec River that harbors substantial biodiversity. The work was featured on St. Louis local PBS station the NineNetwork.



Joshua Fisher (NASA Jet Propulsion Laboratory) and Jonathan Myers (Dept. of Biology) published research in *Global Change Biology* that evaluated tree-mycorrhizal associations detected remotely in the Smithsonian ForestGEO plot at Tyson.



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Tyson supported  
researchers from  
**7**  
WashU departments and  
**22**  
institutions around  
the world.

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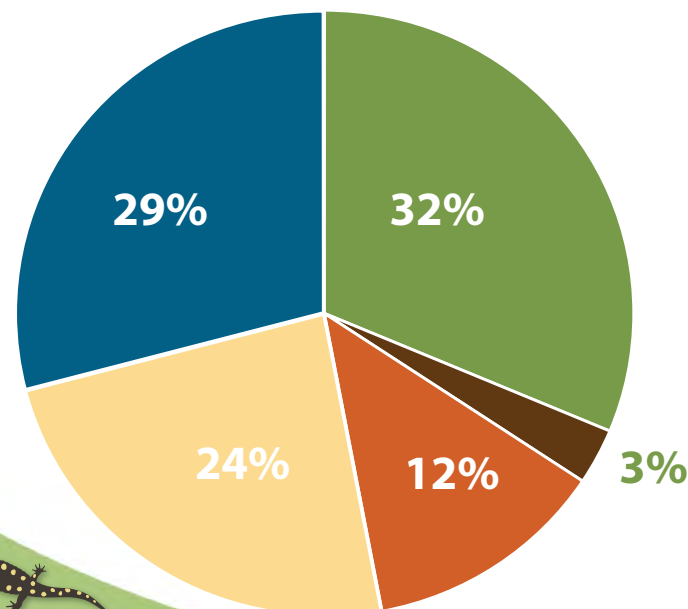
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Tyson studies led to  
**28**  
peer-reviewed  
publications and  
**1,701**  
citations in  
academic journals.

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### RESEARCHERS AT TYSON

High schoolers (39) ■  
Undergraduates (32) ■  
Graduate students (17) ■  
Post-doctoral associates (4) ■  
Faculty/Staff (43) ■



# Table of Contents

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Letter from director	4
2016-2017 Highlights	6
<b>Research .....</b>	
Miguel Redondo - A visiting student who planted a seedling and found a community	10
Prescribed fire experiment promotes synergy across labs, disciplines	12
Ecology and evolution of disease vectors	14
Expanding long-term research with new talent	16
Tyson veteran takes on new role to facilitate research	17
Peer-reviewed publications	18
<b>Education .....</b>	
The power of community	20
2016-2017 Participant demographics	21
Shaw Institute for Field Training	23
Tyson Environmental Research Fellowships	24
Tyson Undergraduate Fellowships Program	26
Claudia Stein - Helping Tyson undergraduates find their niche	28
<b>Community .....</b>	
The Tyson Team	30
<b>Appendices .....</b>	
A: Research use	32
B: Educational use	33
C: 2017 Summer Seminar Series	34









## Research



**Miguel Redondo**  
**Graduate student**  
Swedish University of  
Agricultural Sciences

## Miguel Redondo - A visiting student who planted a seedling and found a community

Summers always bring a vibrant community of scientists and scholars to Tyson Research Center. This past June, Miguel Redondo, a doctoral student at the Swedish University of Agricultural Sciences, began an internship studying plant-soil feedbacks with WashU Assistant Professor Scott Mangan's research group. Thanks to a travel grant from his home institution, Redondo was invited to design a three-month research project looking at how soil pathogens affect the growth of temperate tree species.

***"In such a competitive field like science, inclusive communities like Tyson are remarkable and inspiring."***

Redondo's experiment involves growing seedlings from four tree species found at Tyson (*Quercus macrocarpa*, *Quercus rubra*, *Fraxinus pennsylvanica*, and *Acer rubrum*). The team planted the seedlings in soil collected from adult trees of their same species ("home soil") and soil from adult trees of each of the other three species ("away soil"). Half of the seedlings were treated with a biocide against *Phytophthora*, a fungus-like plant pathogen.



The expectation, Redondo said, is that plants growing in away soil will produce more biomass than plants growing in home soil (a pattern they do not expect to occur in the biocide-treated seedlings). That's because plants growing in home soil must fight against soil pathogens that have specifically adapted to that tree species, while seedlings growing in away soil face a less targeted variety of pathogens.

The team expects to harvest and measure the seedlings' biomass next year. Redondo also plans to set up an analogous experiment in Sweden using tree species from boreal ecosystems. Ultimately, he said, they will compare the strength and patterns of feedback in these two biomes with findings from a similar experiment Mangan completed in Panama last year.





"The best part of my summer was that I felt completely welcome in the Tyson community from the first minute of my arrival," Redondo said. "I am a Spanish scientist working and living in a very different country like Sweden. I know how important it is that your work community makes you feel that you are part of the team."

Other highlights, he said, included the Thursday seminar series, which gives Tyson students and scientists a chance to discuss research insights with visiting speakers. Working with undergraduate research students was another valuable experience. Their motivation and engagement were inspiring, Redondo said, and led him to realize the importance of mentoring students early in his scientific career. After completing his doctoral degree, Redondo plans to continue researching the ecology of plant pathogens and, likely, collaborating with the Mangan Lab as they continue their investigations at Tyson.

"Every activity at Tyson was just constructive, inclusive, and open," he said. "In such a competitive field like science, inclusive communities like Tyson are remarkable and inspiring."

- Crystal Gammon



**Scott Mangan, PhD**  
**Assistant Professor**  
Department of Biology



## Prescribed fire experiment promotes synergy across labs, disciplines

Washington University Assistant Professor Jonathan Myers and former Tyson Postdoc Marko Spasojevic began a large-scale experiment in 2015 with funds awarded by the National Science Foundation (DEB#1557094). Their primary research questions centered on species-pool functional diversity and community assembly. Fortunately for many researchers at Tyson, Myers and Spasojevic were also interested in understanding the role of fire in mediating the relationships they set out to investigate. Sixteen 2.5 hectare paired plots were established in the Tyson forest, and one plot from each pair was burned during early Spring 2017. Since then, the Myers Lab has established the species pool experiment within a subset of the paired plots (see [myersecologylab.com](http://myersecologylab.com)). But the large-scale fire experiment has proven a productive addition to the research infrastructure at Tyson, providing opportunities for additional collaborators to understand fire-related questions in multiple aspects of the forest ecosystem.

***Through transdisciplinary thinking...we are able to tackle some of the most pertinent scientific questions relevant to today's environmental challenges.***

### AIR QUALITY AND PLANT DIVERSITY

With funds from a Tyson interdisciplinary seed grant, Washington University Associate Professor Brent Williams collected smoke emitted during burns using a drone-suspended sampling device. Williams will use the data generated from the drone samples together with data collected by Myers to investigate links between plant-species-specific fire emissions and key molecular marker compounds found in resulting atmospheric particles. Williams and Myers aim to provide insight into the early-stage evolution of atmospheric particle composition and feedbacks between plant biodiversity and air quality.

### TICK-BORNE DISEASE ECOLOGY

Solny Adalsteinsson, Tyson staff scientist, initiated a long-term study investigating effects of the controlled burns on the ecology of tick-borne disease. Prescribed fire is potentially an effective management tool to reduce free-living tick populations and associated risks of tick-borne diseases. Ticks







may respond differently to prescribed fire depending on habitat, seasonal timing, and frequency. Fire likely has varying effects on different tick and vertebrate host species, with implications for determining overall tick-borne disease risk. Adalsteinsson and her collaborators Kim Medley (Tyson director), Katie Westby (Tyson postdoc), and Beth Biro (Tyson natural resources coordinator) are using a combination of field experiments and mathematical modeling approaches to disentangle mechanisms underlying tick population and pathogen dynamics. Adalsteinsson hopes to gain a holistic understanding of how prescribed fire affects tick-borne disease ecology through its many components.

## COLLABORATION, DIVERSITY, SYNERGY

Through transdisciplinary thinking and collaboration among scientists, Tyson is able to tackle some of the most of pertinent scientific questions relevant to today's environmental challenges. The prescribed fire experiment, with the collaborations it has inspired, is just one example of the kinds of synergy that can be generated in a field station community like Tyson.





## Research



**Kim Medley, PhD**  
**Director**  
Tyson Research Center

# Ecology and evolution of disease vectors: combining basic and applied approaches

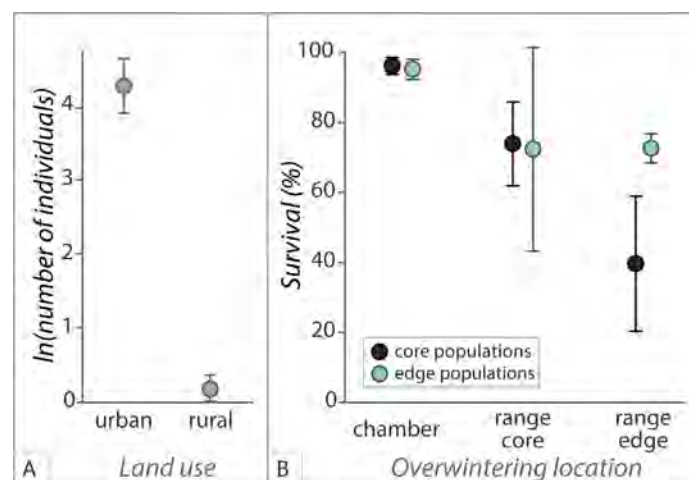
Kim Medley, Katie Westby, Solny Adalsteinsson, Beth Biro

Vectors of human and wildlife disease are widely studied because of important implications to human and wildlife health. While this is a valuable approach, vectors also invade new continents, respond to climate change, and interact in ecological communities. As a result, they can serve as model systems to test theory within ecology and evolution, and such research can simultaneously expand our knowledge of the vectors themselves.

Our recent work has investigated effects of human-driven land-use intensity and dispersal alterations on the invasive Asian tiger mosquito (*Aedes albopictus*). This species is a vector for numerous diseases (Zika, dengue, Chikungunya, La Crosse encephalitis) and has rapidly expanded its range in the US since its initial invasion in 1985 in Houston, TX. We conducted an overwintering experiment to evaluate the role of rapid climatic adaptation to its recent northward expansion in the US. Temperate populations of this species utilize egg diapause, a photoperiodically induced state of egg dormancy, to withstand cold and desiccation in temperate latitudes. Previous work has shown rapid adaptation in diapause incidence (the proportion of diapause eggs to directly developing eggs) along a latitudinal gradient in the US; we were particularly interested in variation in the overwintering capabilities of those dormant eggs exposed to range-edge winters and to milder winters near the core of the US range. We found that mosquitoes originating from the range-edge were more successful at overwintering harsher winters than those originating from further south in the US range, indicating not only rapid adaptation of the diapause trait itself, but evolved variation in the capability of diapause eggs to overwinter.

Because these mosquitoes have a strong affinity for humans, coupled with the growing proportion of the global human population inhabiting urban areas, studying the urban ecology and evolution of disease vectors is of growing importance. Urban landscapes can be quite heterogeneous, and variation in habitat

***“We encourage undergraduate and high school fellows in our lab to develop independent projects that are not only valuable additions to our research program, but are also achievable.”***







availability/quality and temperature can present a strong gradient in selection pressure from high urban to rural habitat. During summer 2017, we investigated ecological differences of the Asian tiger mosquito from high urban to rural St. Louis. With the assistance of backyard volunteers and Tyson undergraduate and high school fellows, we deployed traps and collected mosquitoes for 12 weeks in 15 backyards. We found a strong trend in mosquito abundance by land-use type; rural locations were slow to develop populations of *Ae. albopictus*, compared to their urban and suburban counterparts. Follow-up water chemistry analyses revealed the rural habitats contained higher nutrient levels and harbored more stable water levels. Our next steps are to conduct reciprocal transplant experiments across land-use types to determine if local adaptation to urban-rural land-use types explains the variation in ecology across the urban landscape. Future plans are to evaluate the role of genetic structure, diversity, and gene flow to patterns in local adaptation at multiple spatial scales.



Within the larger questions under investigation in our lab, we encourage undergraduate and high school fellows to develop independent projects that are not only valuable to our research program, but are also achievable. Lab alum Thomas Van Horn (Tyson fellow '15-'16, TERFer '13-'14) currently has a manuscript under revision reporting his work investigating the spatial structure and local-scale environmental influences on lone star tick abundance patterns. Brenden Sweetman (Tyson fellow '15-'16) is currently preparing a manuscript reporting his research investigating effects of larval food quality on parasite infection in native treehole mosquitoes. We look forward to supporting many additional motivated fellows through the Tyson educational programs.



**Katie Westby, PhD**  
**Postdoctoral Research**  
**Associate**  
Medley Lab





## Research



**Solny Adalsteinsson, PhD**  
**Staff Scientist**  
Tyson Research Center

# Expanding long-term research with new talent

Solny Adalsteinsson joined Tyson Research Center in Summer 2016, as a postdoctoral researcher in Director Kim Medley's group studying tick-borne diseases. A year later Adalsteinsson was hired on full-time as Tyson's staff scientist. In this role, she'll be conducting research in her own area of expertise – tick-borne disease ecology – as well as helping to expand and support Tyson's long-term research infrastructure and its capacity as a major player in the international and regional ecological data networks.

Adalsteinsson says she's especially excited about developing and implementing some of the long-term research projects that have been on Tyson's radar – a unique aspect of her role at Tyson.

"One of the really difficult things in science, especially ecology, is being able to study phenomena on long-enough time scales to really understand what's going on," she said. "Climate, species range-shifts – to study these things, we really need long-term datasets. That type of research isn't always incentivized as much as it should be."

As an undergraduate at The Pennsylvania State University, Adalsteinsson joined a research group that studies the evolutionary history of amphibians and reptiles through DNA analyses; her senior project in that lab eventually grew into a master's thesis. After doing fieldwork in New Zealand and Costa Rica, "I got hooked on field ecology," she said.

This realization led Adalsteinsson to a job as an ornithological research technician in Iceland, where her family is from. She later started working with conservation groups in Hawaii, studying seabirds in the field, where she began to see how applied research could have direct implications for wildlife conservation and management.

***"Having...property that we can manipulate for experiments on a large and long-term scale provides a powerful basis for scientific inquiry."***

Delaware. Her dissertation research involved looking at how urbanization and invasive species affect populations of and interactions among ticks, wildlife hosts, and pathogens that cause human illnesses, such as Lyme disease.

Collecting valuable data and deciding how to use it is exactly what she and Director Kim Medley envision for her role as a staff scientist at Tyson. "This is a unique and exciting place to work," Adalsteinsson said. "Having a substantial area of private property that we can manipulate for experiments on a large and long-term scale provides a powerful basis for scientific inquiry."



"The longer I spent there," Adalsteinsson said, "the more I realized I wanted to be the one leading the research and figuring out what to do with the great data we were collecting." She eventually went on to earn a doctorate in entomology and wildlife ecology from the University of

-Crystal Gammon





# Tyson veteran takes on new role to facilitate research



Elizabeth Biro is Tyson's natural resources coordinator, a position created in Spring 2017 to manage landscape and research infrastructure for current and future research at Tyson. Biro helps with data collection for research projects in Director Kim Medley's lab, and she'll also be helping Staff Scientist Solny Adalsteinsson launch several long-term data projects.

"I help facilitate research needs, whatever they may be," Biro said. "Whether that's coordinating work at Shaw Nature Reserve, helping scientists learn the local flora and fauna, securing permits, or tweaking methods for working in the field at Tyson."

Biro first came to Tyson in 2006, when she began field research for a master's degree from the University of Missouri–St. Louis. Her thesis looked at how fish predation influences local and regional biodiversity in aquatic mesocosms. Before that, she earned a bachelor's degree in biology from the University of Missouri where

she helped with research projects on invasive aquatic species, like Asian carp, and endangered species, including the pallid sturgeon.

"I really, really enjoyed the work," Biro said. "That's when I knew I preferred fieldwork over lab studies."

Biro has been with Tyson in some capacity for more than a decade now. In that time, she has contributed to research on aquatic systems and biodiversity maintenance. She's also mentored students on aquatic ecology projects and served as manager of the Medley Lab.

In her new role, Biro says she's excited to shift to terrestrial ecology experiments.

***"St. Louis has a great research community, and I'm excited to see how we will continue to grow within it."***

"Although this is not necessarily a unique habitat, Tyson is a unique place in that researchers come here to do a lot of manipulative studies," Biro says. A major challenge with those, she says, will be to maintain balance between natural habitats and manipulative experiments, such as Tyson's prescribed burn plots.

As one of two new full-time staff members, Biro is enthusiastic about Tyson's growth. "It's great to have more staff devoted to developing Tyson as a player in the regional and national research scene," she said. "St. Louis has a great research community, and I'm excited to see how we will continue to grow within it."

-Crystal Gammon



**Beth Biro, MS**  
**Natural Resources**  
**Coordinator**

Tyson Research Center





# Peer-reviewed publications

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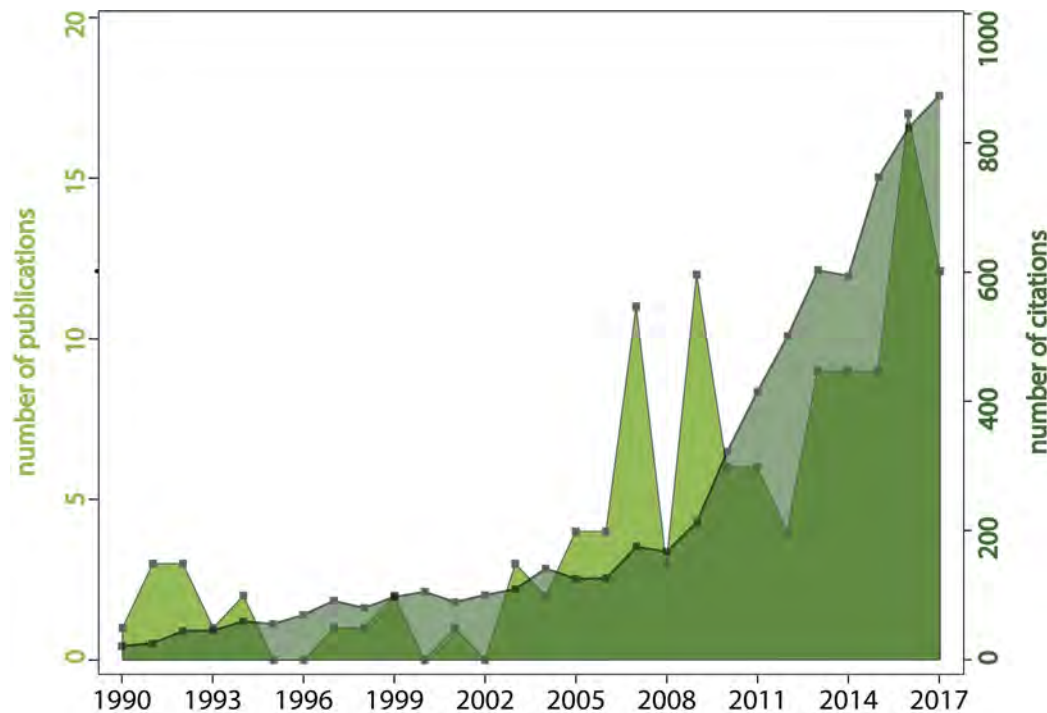
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## Education



**Susan Flowers, MA**  
**Education & Outreach**  
**Coordinator**  
Tyson Research Center

# The power of community

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At Tyson we have a tag line: *Research. Education. Community.* I would like to argue that it is more of a formula: Research + Education = Community. By interweaving our education programs within our research activities, we have created a unique and powerful sum: a supportive, multi-layered community that fosters the personal growth of our young people.

Like our scientific research, our educational programming is data driven. We capture multiple perspectives at multiple time points through multiple methods. So we have confidence that the SIFT, TERF, and Tyson Undergraduate Fellows programs are grounded in a community-based framework and provide for individual progression. We know that time spent at Tyson is more than a summer job. As one high school TERFer wrote at the end of this past summer, "I definitely grew as a person in general and learned a lot about myself, other people, ecology, and college."

When our undergraduate fellows work side-by-side with our TERFers, they develop important soft skills and cement their scientific knowledge. Here are some of their comments captured after the 2017 field season: It is "fun to see yourself in younger people and be able to give them advice." "I can gauge where my understanding is by explaining to younger students." I find "having someone younger than you to counsel helps you reflect on your own experience and what you've learned." I am now "better able to communicate complex ideas to various audiences."

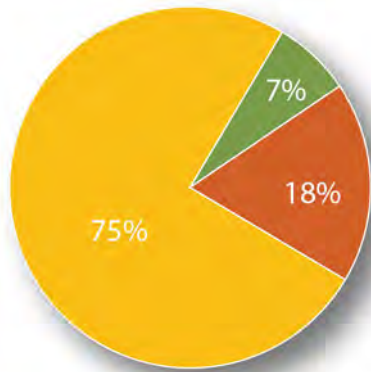
After another year at Tyson I remain convinced that experiential education within a professional community context is the best way for young people to explore possible career paths. I will leave you with a final thought from an undergrad fellow about the powerful sum that is the Tyson community: "It is wonderful, open, accepting, hardworking, and rewarding."

Sincerely,

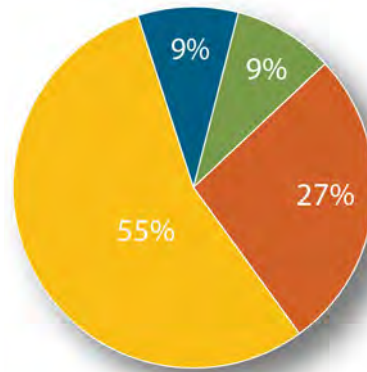
SUSAN



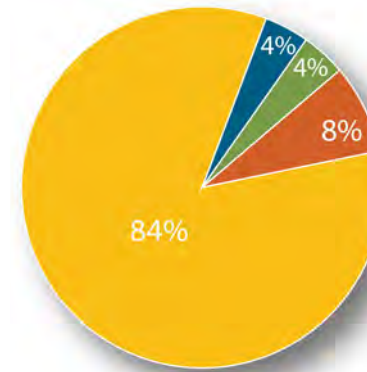
# 2016-2017 Participant demographics



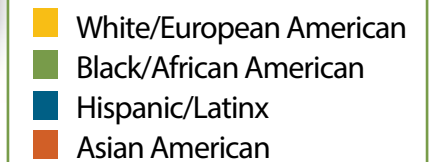
**HIGH SCHOOL  
SIFTers**



**HIGH SCHOOL  
TERFers**



**UNDERGRADUATE  
Fellows**



**62%**

of high school program  
participants were  
female.

**76%**

of undergraduate program  
participants were  
female.

Students represented

**30**

high schools in the  
St. Louis area and

**8**

colleges/universities.









# Shaw Institute for Field Training (SIFT)



## Education

Through collaboration with the Missouri Botanical Garden's Shaw Nature Reserve, local teenagers may assist Tyson-based researchers with projects during the summer field season and sometimes within the academic year. SIFT is an introductory field skills training program that engages participants in scientific exploration of the natural world and includes opportunities to help with real field work. Accepted participants come from a wide cross-section of the St. Louis, Missouri community including urban, suburban, and rural areas. **Over the ten years since the program began, a total of 365 students from 72 high schools have participated in SIFT.**

### FALL/WINTER 2016-17

*Tyson-based research teams hosted 33 paid work opportunities for SIFTers from late-August 2016 through March 2017.*

**Soil sampling in experimental tallgrass prairie mesocosms**  
*(Dr. Claudia Stein, WashU Mangan Lab)*

**Plant biomass harvest and reproductive success measurement in experimental tallgrass prairie mesocosms**  
*(Dr. Claudia Stein, WashU Mangan Lab)*

**Root biomass harvesting and drying from experimental tallgrass prairie mesocosms**  
*(Dr. Claudia Stein, WashU Mangan Lab)*

**Experimental clover project data collection and plot maintenance in Tyson research garden**  
*(Sara Wright, WashU Olsen Lab)*

**Mammal exclusion cage construction for experimental forest plots**  
*(Becky Roper, WashU Myers Lab)*

**Plant and soil sampling in Nutrient Network plots**  
*(Dr. Amanda Koltz, WashU Biology)*

**Prairie plant pesticide treatment experiment set up and initial data collection**  
*(Dr. Claudia Stein, WashU Mangan Lab)*

### SUMMER 2017

*After completing a week-long training at Shaw Nature Reserve in June, SIFTers helped on 52 paid work opportunities with Tyson-based research teams.*

**Prairie plant pesticide treatment experiment data collection and harvest**  
*(Dr. Claudia Stein, WashU Mangan Lab)*

**Experimental clover project data collection, sample processing, and plot maintenance in Tyson research garden**  
*(Sara Wright, WashU Olsen Lab)*

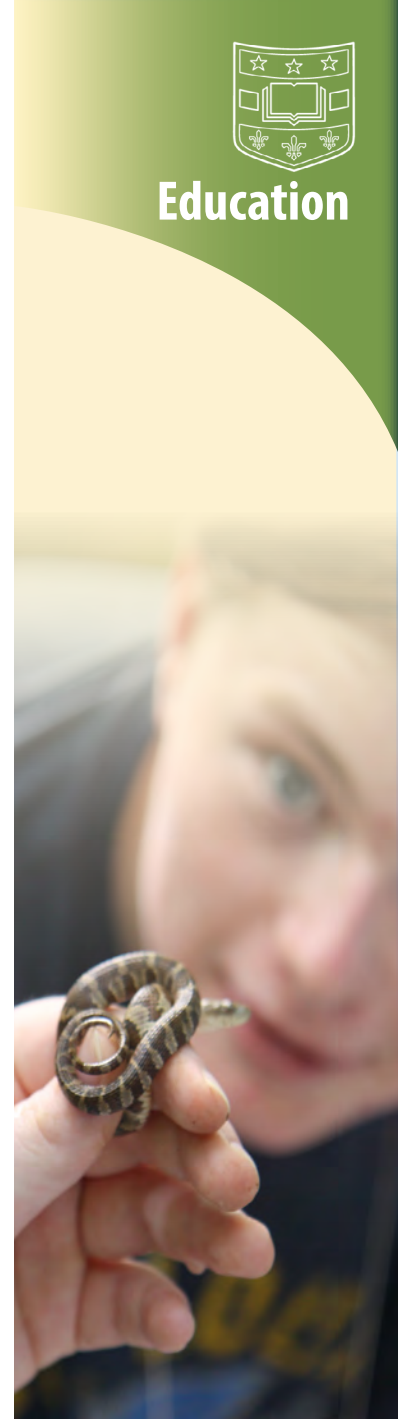
**Above-ground plant pathogen census in experimental tallgrass prairie mesocosms**  
*(Aspen Workman, Dr. Claudia Stein, WashU Mangan Lab)*

**Measurement of phenology traits in experimental tallgrass prairie mesocosms**  
*(Sarah Elizabeth Stockman, Dr. Claudia Stein, WashU Mangan Lab)*

**Pollen collection, hand-pollination, and natural pollination observation in experimental tallgrass prairie mesocosms**  
*(Savannah Fuqua, Dr. Claudia Stein, WashU Mangan Lab)*

**Assessment of nutrient dynamics in soil samples from experimental tallgrass prairie mesocosms**  
*(Dr. Claudia Stein, WashU Mangan Lab)*

**Assessment of carbon sequestration in soil samples from experimental tallgrass prairie mesocosms**  
*(Erin Carroll, Sarah Elizabeth Stockman, Dr. Claudia Stein, WashU Mangan Lab)*





## Education



# Tyson Environmental Research Fellowships (TERF)

During the summer, successful graduates of the SIFT program may apply to work for at least four weeks as members of research teams alongside WashU scientists, postdoctoral researchers, technicians, graduate students, and undergraduate students. The TERF program provides a cultural apprenticeship in university-based environmental biology research and training in scientific communication. It is an advanced summer experience modeled on Tyson undergraduate research fellowships, including journal article discussion, seminars by visiting scientists, and stipend support. TERFers work with their mentors to develop scientific posters and present results of research at the Washington University Fall Undergraduate Research Symposium and a winter TERF Symposium at Tyson. Some are invited to present at their high schools and many enter honors divisions for local and regional science fairs. **To date, 141 high school level summer internships have been provided.** Sixty-five percent of the students who have participated in TERF identify as female and 23% are from ethnic groups underrepresented in STEM.

## SUMMER 2017

*Tyson hosted 11 TERFers from nine different high schools on the following four teams during Summer 2017:*

### Interactions between plants and soil microbial communities

(Dr. Scott Mangan, Dr. Claudia Stein, WashU)

Genesis Dancer, Fort Zumwalt North High School '18  
Anna Grimenstein, homeschool/Eureka High School '18  
Owen Kathriner, Kirkwood High School '18  
Nicole Wang, Parkway West High School '18

### Temperate forest dynamics and biodiversity

(Dr. Jonathan Myers, Dr. Joe LaManna, WashU)

Kevin Qi, Lafayette High School '18  
Ishan Singh, Lafayette High School '18  
Amy Stimmel, Marquette High School '18  
Paige Waskow, The Collegiate School of Medicine and Bioscience '18

### Disease vector ecology

(Dr. Kim Medley, Dr. Katie Westby, Dr. Solny Adalsteinsson, Tyson)

Delilah Sayer, Rockwood Summit High School '18



### White clover cyanogenesis and adaptation

(Sara Wright, PhD candidate, WashU)

Julia Beliz, Clayton High School '18  
Eileen Kosola, Lafayette High School '18





## FALL/WINTER 2016-2017

For several weekends in September and October, TERFers gathered at Tyson to work on data analysis and poster construction with guidance from their research mentors. The resulting 11 TERF posters were presented at the WashU Fall 2016 Undergraduate Research Symposium on October 29. This group of TERFers presented their posters again, along with formal slide presentations, during their own TERF Symposium held at Tyson on January 21, 2017.

### Lexie Beckermann, Eureka High School '17

Interspecies differences in prey vulnerability are not mediated by habitat structure

(Dr. Katie Westby and Dr. Kim Medley, Tyson)

### Katie Buatois, Eureka High School '17

Comparison of shell temperature shows rural box turtles are better thermoregulators than urban box turtles

(Dr. Stephen Blake, Saint Louis University, and Dr. Sharon Deem, Saint Louis Zoo)

### Melissa Gastelum, Clayton High School '17

Impact of soil microbes on seed viability and germination of *Echinacea purpurea*

(Dr. Claudia Stein and Dr. Scott Mangan, WashU)

### Devin Haas, Marquette High School '18

### Hayley Huntley, Eureka High School '17

Effects of an invasive plant species (*Lonicera maackii*) on the recruitment and diversity of native plant species in Missouri oak-hickory forests

(Dr. Joe LaManna and Dr. Jonathan Myers, WashU)

### Mya Miranda, Hazelwood West High School '17

Observations of orb weavers (*Micrathena* spp.) in a Missouri oak-hickory forest research plot

(Dr. Joe LaManna, WashU)

### Athena Oakes, Fort Zumwalt North High School '17

The effect of plant diversity on pollinator visits

(Dr. Claudia Stein and Dr. Scott Mangan, WashU)

### McKenzie Ruff, Eureka High School '17

### Lara Tapy, Marquette High School '17

Plant diversity influences drought stress responses of *Monarda fistulosa*

(Dr. Claudia Stein and Dr. Scott Mangan, WashU)

### Delilah Sayer, Rockwood Summit High School '17

Native and invasive plants differentially affect mosquito development

(Dr. Katie Westby and Dr. Kim Medley, Tyson)

### Bailey Saylor, Fort Zumwalt North High School '17

Does prescribed burning reduce invasive earthworm abundance?

(Dr. Solny Adalsteinsson and Dr. Kim Medley, Tyson)

### Calvin Schaefer, Metro Academic and Classical High School '17

An observational study of herpetofauna in a Missouri oak-hickory forest

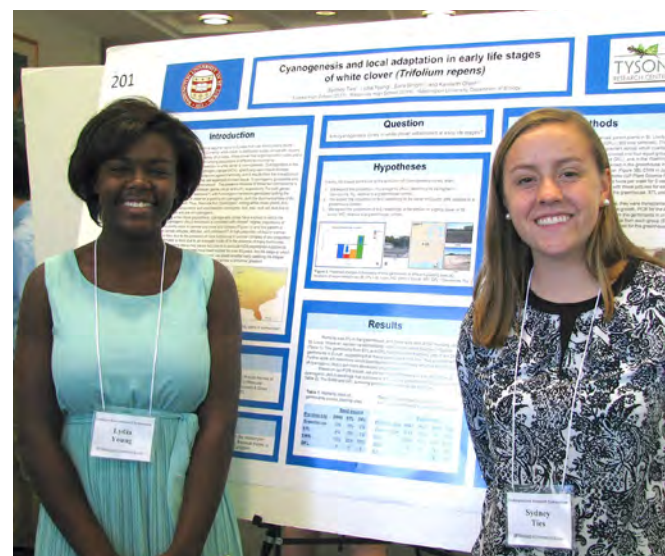
(Dr. Joe LaManna, WashU)

### Sydney Ties, Eureka High School '18

### Lydia Young, Pattonville High School '18

Cyanogenesis and local adaptation in early life stages of white clover (*Trifolium repens*)

(Sara Wright, WashU)





# Tyson Undergraduate Fellows Program

In this 11-week summer program, undergraduate students are given the opportunity to work elbow-to-elbow with a faculty member, postdoctoral scientist, staff scientist, or graduate student mentor on current field-based research projects. First-time fellows typically have an interest in ecological research but may not yet have the experience needed to conduct their own mentored research projects. Advanced or returning undergraduate fellows are often given the opportunity to design and execute their own field-based ecological research under the guidance of a mentor.

After completion of the summer field season, fellows often present the results of their research at the Washington University Undergraduate Research Symposium or similar symposium at their own undergraduate institution. Former fellows have presented their research at regional and national meetings, and several projects have resulted in peer-reviewed publications. Many of our former fellows have entered graduate programs or careers in the environmental sciences.

Support for the Tyson Undergraduate Fellows Program is provided by grants from the National Science Foundation and Howard Hughes Medical Institute; Washington University Arts & Sciences; the International Center for Energy, Environment, and Sustainability; and Tyson Research Center.

## FALL/WINTER/SPRING 2016-2017

*Three of the 18 undergraduate fellows from summer 2016 presented posters at the WashU Fall 2016 Undergraduate Research Symposium on October 29 and one presented at the spring symposium on April 1.*

**Ashley Knudson, WashU, Environmental Biology '17**  
**Biodiversity-ecosystem function relationships are mediated by the environment and functional trait assembly**  
(Chris Catano and Dr. Jonathan Myers, WashU)

**Madeleine Mullen, WashU, Biology '18**  
**Assessing differences in boldness, an evolutionarily important personality trait, among rural and urban box turtles**  
(Dr. Stephen Blake, Saint Louis University)

**Brenden Sweetman, WashU, Biology & Computer Science '18**  
**Host-parasite interactions: effects of larval habitat on *Ascogregarina barretti* infection in *Aedes triseriatus***  
(Dr. Katie Westby and Dr. Kim Medley, Tyson)

**Thomas Van Horn, WashU, Chemistry '18**  
**Landscape physiognomy predicts abundance of the Lone Star tick, *Amblyomma americanum*, in Ozark forests**  
(Dr. Kim Medley and Dr. Solny Adalsteinsson, Tyson)





## SUMMER 2017

*During summer 2017, Tyson hosted 17 undergraduate fellows from Washington University and 8 from other US universities. These 25 fellows participated in mentored research on the following six teams:*

### Interactions between plants and soil microbial communities

(Dr. Scott Mangan, Dr. Claudia Stein, WashU)

**Erin Carroll** – WashU, Environmental Policy '18

**Savannah Fuqua**<sup>1</sup> – WashU, Biology (Ecology and Evolution) '19

**Hanusia Higgins** – WashU, Biology (Ecology and Evolution) '18

**Sarah Elizabeth Stockman** – Houston Community College, Biology '20

**Aspen Workman\*** – University of Louisville, Biology (Ecology Track) '21

### Disease vector ecology

(Dr. Kim Medley, Dr. Katie Westby, Dr. Solny Adalsteinsson, Tyson)

**Lexie Beckermann\*** – Southeast Missouri State University, Environmental Science '21

**Aaron Heisey**<sup>2</sup> – Wells College, Biology '18

**Hanna Peterman**<sup>3</sup> – WashU, Environmental Earth Science '19

**Leslie Sterling** – WashU, Environmental Biology '18

### Temperate forest dynamics and biodiversity

(Dr. Jonathan Myers, Dr. Joe LaManna, WashU)

**Emily Dewald-Wang** – WashU, Environmental Biology '19

**Liam Engel**<sup>4</sup> – WashU, Biology (Ecology and Evolution) '19

**Hayley Huntley\*** – Southeast Missouri State University, Environmental Policy '21

**Mariel Lutz** – WashU, Environmental Biology '19

**Jacqueline Reu** – WashU, Environmental Biology '19

**Maya Samuels-Fair** – WashU, Environmental Biology '20

**Emma Waltman**, WashU, Biology (Ecology and Evolution) '19

<sup>1</sup> WashU International Center for Energy, Environment, and Sustainability (InCEES) Fellow

<sup>2</sup> National Great Rivers Research and Education Center (NGRREC) Fellow

<sup>3</sup> Tyson Coles Fellow; <sup>4</sup> Tyson Sexton Fellow; <sup>5</sup> Tyson Lennette Fellow; \* SIFT and TERF alumni

### White clover cyanogenesis and adaptation

(Sara Wright, PhD candidate, WashU)

**Brenda Alvarado\*** – WashU, Environmental Biology '19

**Maya Dutta**<sup>5</sup> – WashU, Environmental Biology '19

**August Gremaud** – WashU, Environmental Policy '18

**Alexander Mahmoud** – WashU, Biology and Chemistry '19

**Samantha Myers** – WashU, Environmental Biology '19

**Erin Rowland** – Concordia University, Biology and Chemistry '19

### Informal environmental education

(Susan Flowers, Tyson)

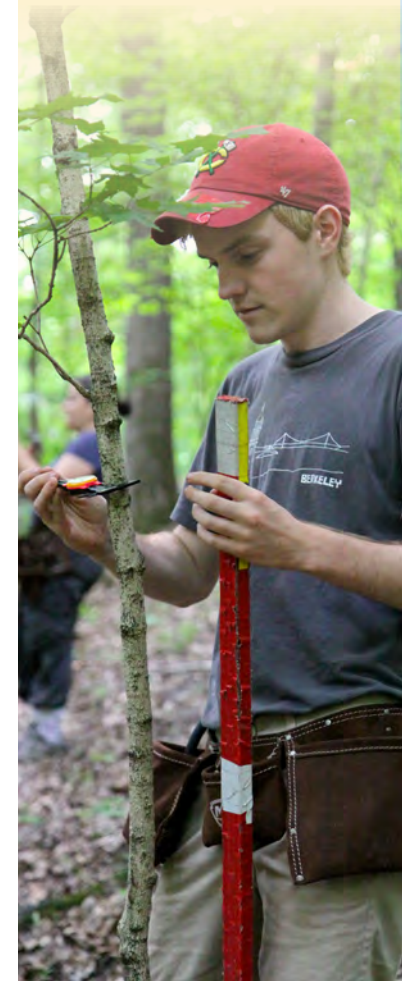
**Adam Vorel\*** – Missouri State University '19

### Box turtle movement and health

(Dr. Stephen Blake, Saint Louis University; Dr. Sharon Deem, Saint Louis Zoo)

**Katie Buatois\*** – Purdue University '21

**Madeleine Mullen** – WashU, Biology '18





# Claudia Stein - Helping Tyson undergraduates find their niche

When Claudia Stein joined WashU Assistant Professor Scott Mangan's Lab as a postdoctoral fellow in 2013, she already had years of experience mentoring students. "Since starting my doctoral research, I've always managed big research teams," she said, "including students who helped me in the field and in the lab." Working with those students not only bolstered Stein's mentoring skills, it also helped those students gain field experience and, likely, helped inspire future scientists.

Stein has continued that tradition at Tyson, where undergraduate research students power many of the long-term, data-intensive projects that are underway. Over the past 5 field seasons, Stein has mentored dozens of students as they delve into field research and learn to navigate the intricacies of Tyson's flora and fauna.

***"It's fascinating to watch the students grow personally and professionally...some students discover their talent in guiding younger students, while others become passionate about conducting research."***

One of those students is Anna Liang, who graduated from Washington University in 2016 with a degree in environmental biology. Liang worked with Stein and Mangan throughout her four years at the university, developing an independent research project on the behavior and impact of snails in the environment. Initially spurred by a simple observation – why are there so many snail shells around? – Liang's project eventually evolved into an examination of how the grazing of snails and deer affects forest dynamics.

"We showed that snails do have feeding preferences, which was cool and something we didn't know before," said Liang. "Snails typically will feed on seedling plants, so they have a bigger effect on what survives and grows up compared to deer, which eat taller plants."

Liang, who is now a dental student, is in the final stages of preparing her manuscript (she will be first author) for publication in a peer-reviewed journal. She said her time at Tyson helped her hone important skills for success in any career – whether that's field research or dentistry.

"Research experiences really help you learn things like long-term planning, organization, and how to communicate with a variety of audiences. You also learn how to ask the right questions," Liang said – a nod to her initial observation about Tyson's abundant snail shells.

Another Tyson success story is Molly Kuhs, who graduated from Washington University in 2017 with a degree in environmental biology. She spent summer 2015 at Tyson, where she became particularly interested in invasive species.



**Claudia Stein, PhD  
Research Scientist**  
Department of Biology







"I knew I wanted to do environmental science when I was a freshman," Kuhs said, "but I didn't know Tyson existed. I kind of stumbled upon it." Among Tyson's many charms, she said, is its location outside of, yet near, the city of St. Louis. "Definitely one of the coolest parts is being able to go to a school with a great biology department in the city, while also being able to go out to the forest and do great fieldwork." Many other field research centers are farther from their academic counterparts, she notes, making it difficult for students to pursue fieldwork during the academic year.

While working at Tyson, Kuhs developed her own senior thesis project examining how belowground arthropods and fungi influence exotic and native plant populations. Her research, which combines field studies with greenhouse experiments, is based on the idea that exotic species are particularly successful in some cases because they've escaped their enemies by moving to a new locale.

Kuhs, along with her collaborators, plans to publish the results in a peer-reviewed journal. Currently a laboratory technician at the Donald Danforth Plant Science Center, she is planning to apply to graduate programs in ecological fieldwork.

"Tyson led me to Danforth, where I've been learning molecular biology techniques," Kuhs said. "I'm excited to take the skills I've learned here and push them back into the field."

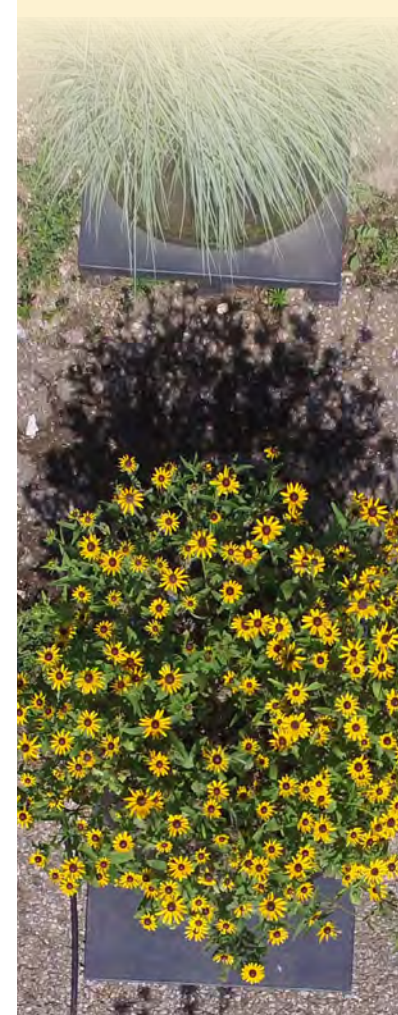
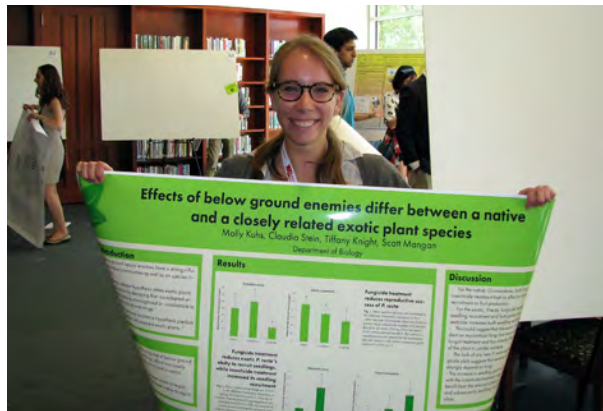
While the Tyson experience undoubtedly benefits students like Kuhs and Liang, Stein stressed that it's a mutually beneficial relationship. "All our work is dependent on undergrads," she said. "Undergrads take critical data for us, which helps answer questions essential to our research. Because we have a big team, our research projects can be more ambitious."

A mesocosm experiment under Mangan and Stein's direction, for example, involves 168 individual, 65-gallon pots. Collecting and analyzing data from the experiment – such as seed counts and biomass assays – is meticulous, labor-intensive work, most of which is completed by student researchers at Tyson. Beyond Mangan's original research

questions, though, these talented students have proposed and investigated exciting questions of their own, collecting data on carbon sequestration, leaf diseases, and pollinator behavior, for example.

Tyson provides a unique venue for those student researchers to develop their skills, including mentorship skills of their own, said Stein. "It's fascinating to watch the students grow personally and professionally during their time at Tyson. Some students discover their talent in guiding younger students, while others become passionate about conducting ecological research," she said. "Students working here really find out where their strengths and interests lie."

*-Crystal Gammon*





# The Tyson Team

## EXECUTIVE COMMITTEE

**Barbara Schaal**  
*Dean of the Faculty of Arts & Sciences*  
*Mary-Dell Chilton Distinguished Professor*  
*Department of Biology*

**Holden Thorp**  
*Provost & Executive Vice Chancellor for*  
*Academic Affairs*  
*Rita Levi-Montalcini Distinguished University*  
*Professor*

**Henry S. Webber**  
*Executive Vice Chancellor for Administration*  
*Professor of Practice*  
*Sam Fox School of Design & Visual Arts*  
*Brown School of Social Work*

**Kim Medley**  
*Director*  
*Tyson Research Center*

## ADVISORY COMMITTEE

**Solny Adalsteinsson**  
*Staff Scientist*  
*Tyson Research Center*

**Rod Barnett**  
*Chair & Professor*  
*Landscape Architecture Program*

**David Fike**  
*Associate Professor*  
*Director, Environmental Studies Program*  
*Associate Director, InCEES*  
*Department of Earth and Planetary*  
*Sciences*

**Susan Flowers**  
*Education & Outreach Coordinator*  
*Tyson Research Center*

**Dan Giammar**  
*Walter E. Browne Professor of*  
*Environmental Engineering*  
*Department of Energy, Environment,*  
*and Chemical Engineering*

**Pete Jamerson**  
*Facilities Manager*  
*Tyson Research Center*

**Andrew Johnstone**  
*Business Manager*  
*Department of Biology*

**Scott Mangan**  
*Assistant Professor*  
*Department of Biology*

**Kim Medley**  
*Director*  
*Tyson Research Center*

**Kathy Miller**  
*Chair & Professor*  
*Department of Biology*

**Jonathan Myers**  
*Assistant Professor*  
*Department of Biology*

**Brent Williams**  
*Raymond R. Tucker Distinguished InCEES*  
*Career Development Associate Professor*  
*Director, Washington University Climate*  
*Change Program*  
*Department of Energy, Environment,*  
*and Chemical Engineering*

## STAFF

**Kim Medley**  
*Director*

**Solny Adalsteinsson**  
*Staff Scientist*

**Elizabeth Biro**  
*Natural Resources Coordinator &*  
*Staff Scientist*

**Ruth Ann Bizoff**  
*Administrative Coordinator*

**Tim Derton**  
*Maintenance Technician*

**Susan Flowers**  
*Education & Outreach Coordinator*

**Pete Jamerson**  
*Facilities Manager*

**Andrew Johnstone**  
*Business Manager*

**Nancy Schulte**  
*Administrative Assistant*

**Katie Westby**  
*Postdoctoral Research Associate*







# Appendix A: Research use

INSTITUTION	FACULTY/ STAFF	POSTDOCS	RESEARCH SCIENTISTS	GRADUATE STUDENTS	TECHNICIANS	UNDERGRADUATE STUDENTS	HIGH SCHOOL STUDENTS	EXTERNAL FUNDING
<b>Washington University in St. Louis</b>						17		
Art	1							
Biology	6			2	4			NSF (5)
Earth and Planetary Sciences	2			1				
Electrical & Systems Engineering	1							
Energy, Environment, & Chemical Engineering	2			7				
Physics	4							NSF
Tyson Research Center	3	2	2					
<b>St. Louis area high schools (30)</b>							39	
Chongqing University	1							
Concordia University						1		
Federation University Austrailia				1				
Houston Community College						1		
Indiana University	1		1	1	2			US Dept. of Energy
Missouri Botanical Garden			1					
Missouri State University						1		
Morton Arboretum	1				1			US Dept. of Ag
NASA Jet Propulsion Laboratory			1					US Dept. of Energy
National Great Rivers Research and Education Center	1	2				1		
Purdue University						1		
Saint Louis University	1							
Southern Illinois University Edwardsville	1			1				
Southeast Missouri State University	1			1		2		
Saint Louis Zoo Institute for Conservation Medicine			1		1	6		
Swedish University of Agricultural Sciences				1				
University of Louisville						1		
University of Minnesota	1			1				
University of Missouri—St. Louis	2							
University of West Virginia	1							US Dept. of Energy
Wells College						1		



# Appendix B: Educational use

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## COURSES USING TYSON AS A FIELD LABORATORY

### Arts & Sciences L43 160: The Tyson Seminar: Grounding Research in Nature

(Dr. Suzanne Loui)

### Arts & Sciences L61 Focus 2431: Missouri's Natural Heritage

(Dr. Stan Braude)

### Biology 419: Community Ecology

(Dr. Jonathan Myers)

### Biology 4193: Experimental Ecology Laboratory

(Dr. Scott Mangan)

### Chemical Engineering 408: Environmental Engineering Laboratory

(Dr. Dan Giammar)

### Design & Visual Arts 317/417: Digital Imaging and Photography

(Stan Strembecki)

### Earth & Planetary Sciences 413: Introduction to Soil Science

(Dr. Jeff Catalano)



## SITE VISITS/TOURS

1. Advanced Placement Environmental Science teacher workshop and tour
2. Endangered Wolf Center and Arkansas State University Red Wolf Conservation meeting (Living Learning Center)
3. Endangered Wolf Center Teen Camp event hosted at Mincke Pond
4. Gateway Greening staff meeting (Living Learning Center) and tour
5. Hellmuth + Bicknese architects tour of Living Learning Center
6. Historic oak trees from Danforth Campus Brookings Drive milled at Tyson
7. Missouri Association of Physical Plant Administrators conference and tour
8. Missouri Botanical Garden and Shaw Nature Reserve education staff tour of current research programs
9. Missouri Master Naturalist Tri-chapter meeting (Living Learning Center)
10. Missouri Representative Shamed Dogan tour
11. Tyson Annex media event for LaBarque Creek bank restoration (The Nature Conservancy, MO Department of Natural Resources, US Fish and Wildlife Service, US Army Corps of Engineers, PBS Nine Network)
12. WashU Alumni & Development staff retreat
13. WashU Biology Department Community meeting (Living Learning Center)
14. WashU HS Environmental Studies and Sustainability Institute tour
15. WashU Office of Sustainability staff retreat
16. WashU Office of Sustainability interns tour
17. WashU Plant and Microbial Biosciences annual retreat (Living Learning Center)

# Appendix C: 2017 summer seminar series

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**May 25: Nathan Muchala**

*University of Missouri–St. Louis*

Bats, birds, and bellflowers: specialization and speciation in Neotropical plant-pollinator mutualisms

**June 1: Saara DeWalt**

*Clemson University*

Good plants gone bad? The ecology and evolution of invasive plants

**June 8: Manuel Leal**

*University of Missouri*

Cognition outside the box: behavioral flexibility and homing behavior in *Anolis* lizards

**June 15: Richard Phillips**

*Indiana University*

Seeing the forest below the leaves: mycorrhizal associations as trait integrators of carbon and nutrient dynamics

**June 22: Nick Haddad\***

*North Carolina State University*

Plant community responses to global change drivers

**June 29: Helen Alexander**

*University of Kansas*

Effects of viruses on plant fitness: a plant ecologist's foray into plant virus ecology

**July 6: Jason Munshi-South**

*Fordham University*

Population genomics of rodents in New York City

**July 13: Kasey Fowler-Finn**

*Saint Louis University*

Mating is difficult in a warming world

**July 20: Claudia Stein**

*Washington University in St. Louis*

Natural enemies: maintenance of species diversity and ecosystem function under global climate change

**July 27: Carl Cloyd**

*National Great Rivers Research and Education Center*

The effects of body size and temperature on locomotor performance: combining macro- and micro-ecological approaches

**August 3: Amanda Gorton**

*University of Minnesota*

Exploring patterns of adaptation to climate in common ragweed

\*graduate student invited speaker









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 Washington University in St. Louis