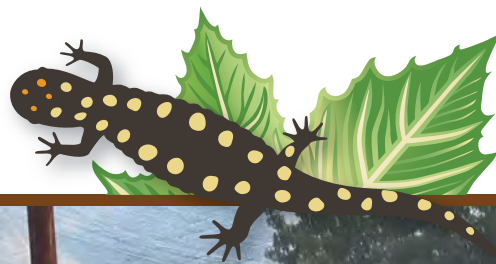
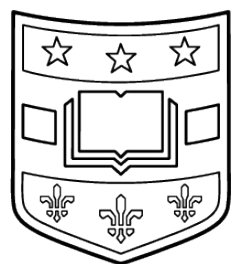


TYSON



RESEARCH CENTER



RESEARCH. EDUCATION. COMMUNITY.

2018-2019 Annual Report

Tyson Research Center is the environmental field station for Washington University in St. Louis. Located just 20 miles from the Danforth Campus on 2,000 acres at the edge of the Ozark Highlands, 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

The Tyson Conservation Corps (TCC) transplants native prairie seedlings at Shaw Nature Reserve. During fall 2019, the TCC incorporated some of the mature plants into a new native plant garden at Tyson with the guidance of Scott Woodbury and Angela Weber of Shaw Nature Reserve.



Highlights



Tyson featured in Post-Dispatch

Inter-disciplinary research, educational programming, and community building were just some of the unique aspects of our field station highlighted in an article in the St. Louis Post-Dispatch during summer 2019.

First summer seminar named in honor of former Tyson director Owen Sexton

Dr. Alan Covich (WashU BA '64) delivered the first annual Sexton Seminar, sharing essential points of advice about ecological research that he received from Owen's mentorship.



Tyson's first Artist-in-Residence expanded thinking about research in the forest

David Marchant (Professor of Practice in Performing Arts) shared his study of mindful movement in nature, encouraging the Tyson summer community to be thoughtful as they move through the woods.

Tyson Conservation Corps gains momentum with native garden and bush honeysuckle management



Tyson's student group dedicated to conservation and ecological restoration had a very active second year. The team led several volunteer-based projects. One project installed a native plant garden at Tyson in collaboration with experts from Shaw Nature Reserve. TCC students also hosted workdays with staff and faculty volunteers to remove invasive bush honeysuckle from key areas of Tyson.

Mosquitoes push northern limits with time-capsule eggs to survive winters

New research from the Medley lab showed that northern populations of the invasive Asian tiger mosquito in the U.S. have rapidly adapted to colder winters than they experience in their native range. This research furthers our understanding of how species evolve at their range limits, and provides important information for mitigation.





Tyson hosts Midwest Migration Network bird banding workshop

To address bird conservation challenges, researchers from throughout the country trained on new techniques, shared information, and streamlined field monitoring protocols.



Tyson maintenance implements brine

Using reclaimed materials, Tyson staff built a road brining system to treat icy roads, reducing rock salt usage by up to 80%. Runoff from road salt has negative impacts on wildlife in streams.

“Landscape Agents” form summer team investigating research gardens in public spaces

Micah Stanek (Lecturer in Landscape Architecture) mentored undergrad fellows in the study of Tyson research gardens to inform how ecological research might be conducted within urban St. Louis.



Living Earth Collaborative workshop held at Tyson

Scientists from 9 countries gathered to discuss Andean mountain forests in a workshop organized by Jonathan Myers (WashU), Sebastian Tello (Missouri Botanical Garden), and Selene Baez (Escuela Politécnica Nacional del Ecuador).

Tyson partners with USFWS on bat monitoring

Tyson staff scientists Solny Adalsteinsson and Beth Biro set up a monitoring program for the endangered Indiana and Gray Bats in collaboration with scientist Vona Kuczynska (USFWS and Wildheart Ecology). The monitoring includes winter bat surveys in Tyson caves, spring and fall acoustic monitoring, and summer mist net surveys. Student research fellows also take part in select activities.





From the director: A new decade of discovery ahead

As we reflect on the last decade, we applaud our students, faculty, and staff for achieving the goals laid out in our 10-year strategic plan. Some key successes include increasing the breadth of Tyson-based research by welcoming new investigators, including Micah Stanek and Alisa Blatter (Landscape Architecture), Jackson Potter (McKelvey School of Engineering), and Natalie Mueller (Anthropology). David Marchant (Performing Arts), a long-time Tyson researcher, took on a new role as our first artist-in-residence last summer and changed the way we think about research in the forest. Investigators in ecology and evolution continue to seek out Tyson for research and educational opportunities throughout the St. Louis area, the nation, and internationally (see the Tyson network, pg 10).

Our educational programs have continued to strengthen and grow; we began the decade with a new high school fellowship program that now supports 10-12 high school (TERF) fellows each summer through authentic research experiences, and provides important broader impacts to the St. Louis community. Our undergraduate fellowship program has grown from supporting 7 students in 2009 to upwards of 20-22 undergraduates today, and many of our first fellows have gone on to productive careers.

We have elevated our role as a permanent site for discovery by establishing new long-term research projects and collaborations in national and international data networks like UWIN (Urban Wildlife Information Network) and ForestGEO (Forest Global Earth Observatory—Smithsonian Institution).

And we have worked hard to promote diversity, equity, and inclusion, yet we acknowledge that while we have made substantial progress, we have much more work ahead.

We look forward to completing our 2020-2030 strategic plan with a renewed vision that builds an inclusive and equitable research community to advance discovery in a changing world. Please enjoy the wonderful work and people featured in this report, and thank you for your continued interest in Tyson Research Center.



Kim Medley, PhD
Director

Tyson Research Center

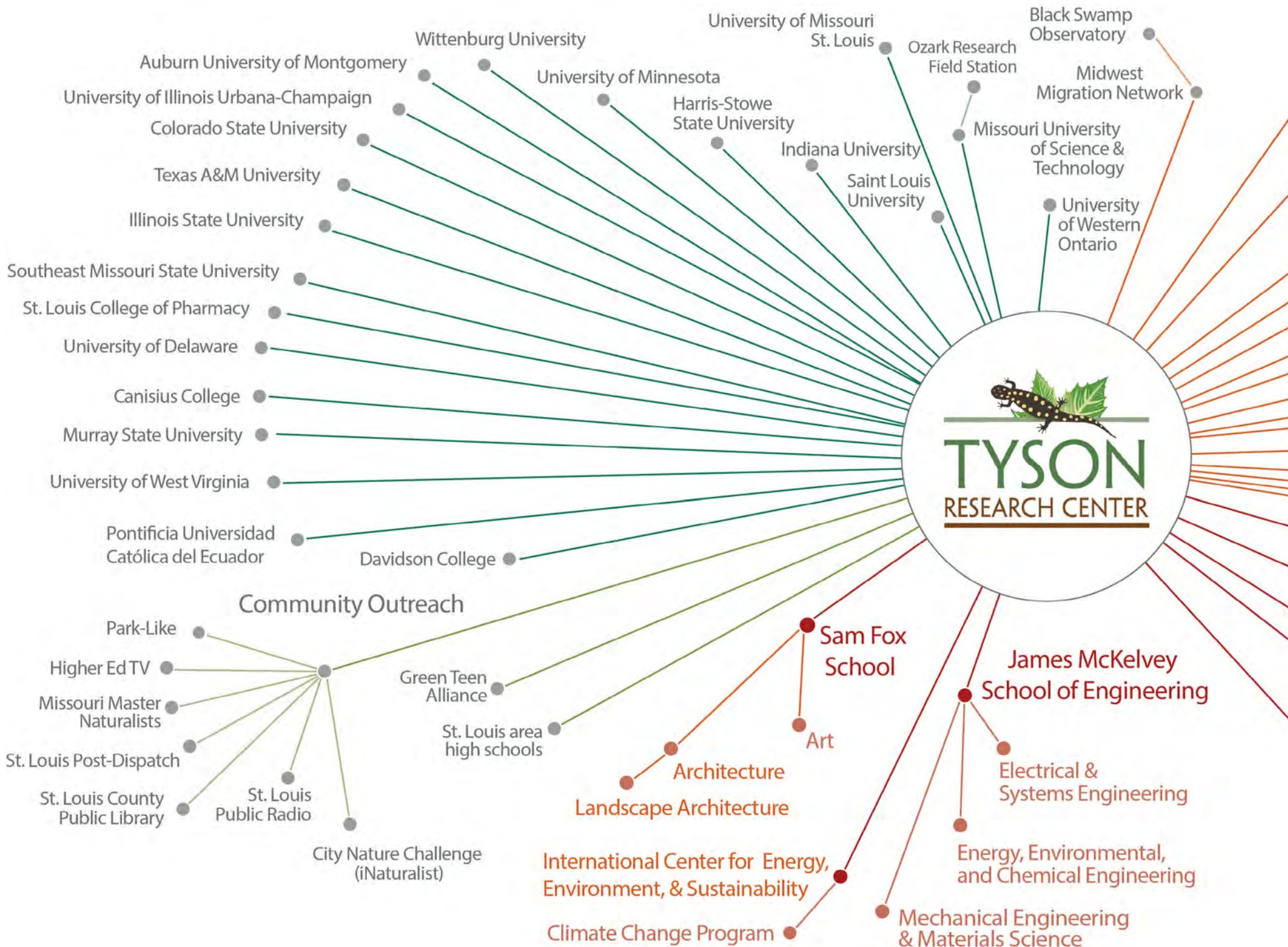


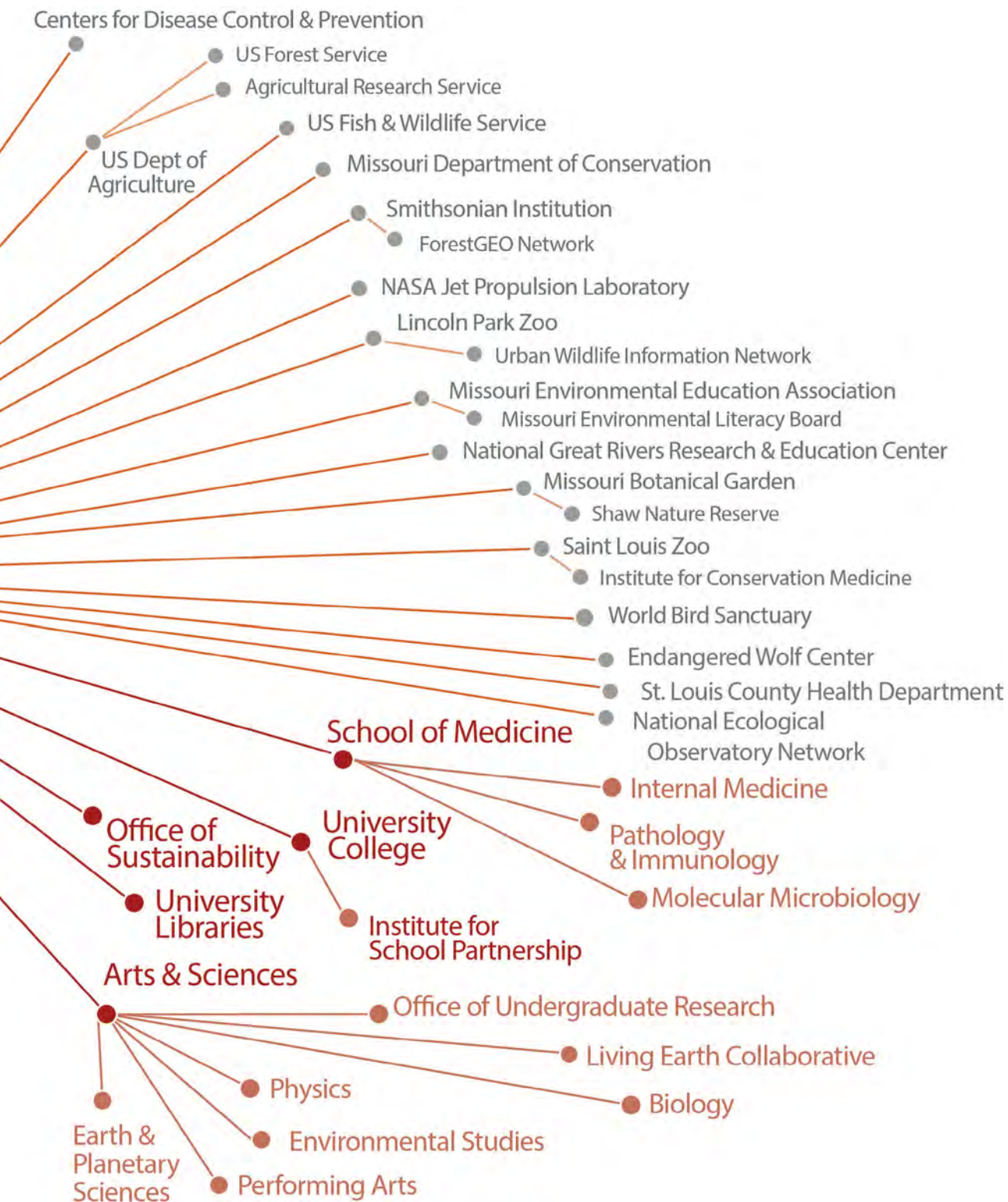
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Tyson Research Center serves as a hub of environmental research and education for numerous partners across the St. Louis region and the U.S. During 2018-2019, Tyson facilitated work across five Washington University schools, 19 Washington University departments or centers, 22 external universities, and 16 public agencies or private institutions. In addition, we created research opportunities for students from 28 high schools in the St. Louis metropolitan area, and communicated our work to the St. Louis community through 7 outlets.



RESEARCH

*Advancing
discovery of a
changing world*





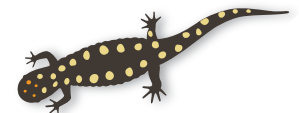
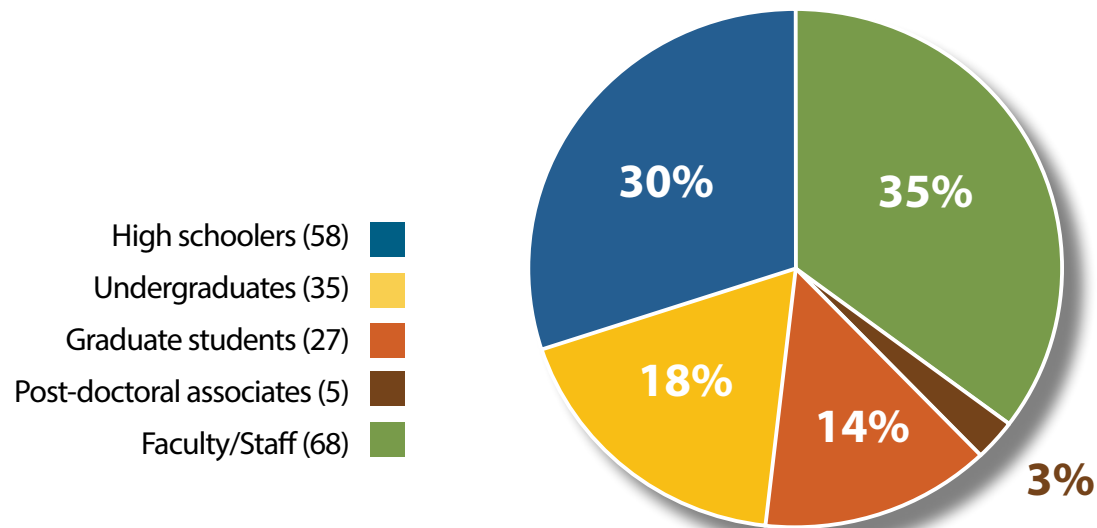
Tyson supported

researchers from
16
WashU departments and
28
institutions.

Tyson studies led to

32
peer-reviewed
publications and
2,479
citations in academic journals.

RESEARCHERS AT TYSON





Wildlife of Greater St. Louis comes into focus in new biodiversity project

At city parks, local forests, and even on the grounds of the Gateway Arch National Park, the creatures come out at night. And sometimes during the day, too.

To catalogue the animal residents of urban green spaces without disturbing them, researchers have set up 34 motion-activated cameras from the densely urbanized St. Louis Riverfront to the wilds of Route 66 State Park in Eureka, Missouri. Four times a year, these camera traps are opened up to snap pictures of wildlife living along the Henry Shaw Ozark Corridor.

The St. Louis Wildlife Project is a collaboration between St. Louis College of Pharmacy and Tyson Research Center at Washington University in St. Louis. The project aims to quantify biodiversity and improve the understanding of wildlife ecology in the greater St. Louis area. Through this project, St. Louis serves as a partner city in the Urban Wildlife Information Network, an initiative based at the Lincoln Park Zoo in Chicago that includes partner cities across North America.

“Currently, more than half of the global population lives in cities, and this portion is expected to rise,” said Solny Adalsteinsson, staff scientist at Tyson Research Center. “If we are to conserve biodiversity, we need to understand how we can better plan these cities to benefit wildlife and create more sustainable cities,” she said.



Beth Biro, MS
Staff Scientist
Tyson Research Center



Solny Adalsteinsson, PhD
Staff Scientist
Tyson Research Center



Whitney Anthonysamy, PhD
Assistant Professor
St. Louis College of Pharmacy

One of the greatest threats to biodiversity is urbanization. However, metropolitan areas such as St. Louis can play an important role in maintaining biodiversity. Habitat patches and green spaces can support species and protect diversity in urban areas. Understanding how wildlife utilize these habitats, and interact with each other and humans in an urban environment, is essential for minimizing human-wildlife conflict.

“St. Louis is unique because we have three rivers in this region — the Mississippi, the Missouri, and the Meramec,” said Whitney Anthony Samy, assistant professor of biology at St. Louis College of Pharmacy. “There’s already a lot of urban green space, and not far out of the city you immediately get into some Ozark habitats, which are also known for having a lot of species biodiversity.”

By studying how unique features of the St. Louis landscape — including rivers and parks — affect diversity and abundance of wildlife in the region, researchers can identify important elements that promote biodiversity and the coexistence of humans and wildlife.

These elements can be incorporated into sustainable design and planning for St. Louis while also informing a broader understanding of urban ecology and how best to conserve biodiversity through data-driven urban planning and development.

Students review the photos and identify the species caught on camera. So far, they have spotted squirrels, raccoons, opossums and deer — and even less common animals such as red foxes, turkeys, bobcats, river otters, skunks and armadillos.

Interested community members can volunteer for the St. Louis Wildlife Project.

-Talia Ogliore



See the video:





Living Earth Collaborative spurs new work, collaborations at Tyson

Tyson Research Center is a unique environmental field station — and it's also a hub for researchers active in the Living Earth Collaborative.

The Living Earth Collaborative is a partnership between Washington University in St. Louis, the Missouri Botanical Garden, and the Saint Louis Zoo. In 2017, these three leading institutions created the Living Earth Collaborative as a new academic center dedicated to advancing the study of biodiversity to help ensure the future of Earth's species in their many forms.

From digging in the dirt to convening international working groups at Tyson's Living Learning Center, scientists from all three local institutions have made good use of the laboratory, experimental facilities and 2,000-acre grounds at Tyson Research Center for their biodiversity-related research and collaboration.

But some of the biggest benefits are more intangible.

"As I was making my decision about where to do a postdoc, one of the reasons I was so interested in a fellowship position through the Living Earth Collaborative was Tyson," said Michael Moore, a biologist with expertise in the evolution of animal life cycles and mating interactions.

"I've spent the last 8 years in the Midwest, and I've met a lot of people who have worked at different field stations throughout this region and throughout the country," Moore said. "Every person I've met who has come through WashU or St. Louis raves about how great Tyson is and how lucky WashU is to have it."

"Everyone I've met who has come through WashU or St. Louis raves about how great Tyson is and how lucky WashU is to have it."

"These colleagues emphasized that it wasn't just about the natural resources or about the infrastructure — even though those things are exceptional," he said. "The thing that comes up again and again when you talk to folks who've spent time at WashU is just how much they loved the community at Tyson, and they loved coming to work out there."



In 2018 and 2019, seed grants from the Living Earth Collaborative helped spark new conservation connections, many of which were realized at Tyson Research Center.

Amanda Koltz, a postdoctoral researcher, and Rachel Penczykowski, both in biology in Arts & Sciences at Washington University, together with their Living Earth Collaborative project partner Sharon Deem, director of the Institute for Conservation Medicine at the Saint Louis Zoo, have twice convened their working group on quantifying the effects of parasites on ecosystem nutrient cycling at Tyson Research Center.

Sebastion Tello, assistant scientist from the Missouri Botanical Garden, and Jonathan Myers, associate

professor of biology in Arts & Sciences at Washington University are leading a Living Earth Collaborative project focused on synthesizing patterns and mechanisms of diversity and forest change in the Andes. They brought together 18 researchers — from 9 countries — for a productive working session at Tyson Research Center.

“Our working group has been a great opportunity to advance regional collaborations that can go beyond the work that any individual research group can do within a country,” Tello said. “During our meetings, we identified six specific knowledge gaps and have outlined research manuscripts to address each one of them.”

Other Living Earth Collaborative seed grants are helping researchers establish proofs of concept for new or relatively untried ideas, so that collaborators can then approach outside agencies for additional support.

Tyson Research Center provides the working grounds for all or parts of three such efforts — including projects focused on the microbiome of disease vectors, climate change ‘refugia’ and conserving rare Missouri plant species through ecological restoration.

“These are all really cool, important and different projects,” said Moore, the Living Earth Collaborative postdoctoral fellow. “It’s frankly kind of hard not to be inspired by the diversity of interesting stuff people are working on.”

-Talia Ogliore



Sacha Heath, PhD

LEC postdoc

sponsors: Solny Adalsteinsson (Tyson), Gerardo Camilo (Saint Louis University), Anne Tieber (Saint Louis Zoo)



Brett Seymoure, PhD

LEC postdoc

sponsors: Kasey Fowler-Finn (Saint Louis University), Anthony Dell (National Great Rivers Research and Education Center), and Amanda Koltz (WashU)



Michael Moore, PhD

LEC postdoc

sponsors: Kasey Fowler-Finn (Saint Louis University), Kim Medley (Tyson)



Getting to know Tyson's plant disease team

Tyson Research Center is a 2,000-acre forested gem situated near Eureka, Missouri. Each summer, the environmental research station is abuzz with high school, undergraduate, and graduate students, scientists, and faculty of diverse disciplines and interests.

As a member of the science communication team led by Suzanne Loui, lecturer in environmental studies, recent graduate Christian Fogerty and I developed projects to identify methods to best communicate the research happening at Tyson. Both of us shadowed a different research team in order to document and express the human elements that make their scientific work possible. I had the privilege of embedding with the plant disease team, led by Rachel Penczykowski, assistant professor of biology. I worked in the field with the team every day for two weeks while taking notes and capturing photos and video footage.

"Effective communication is key to increasing the public's appreciation for scientific research."

Penczykowski studies the ecology of infectious diseases, and her experiments at Tyson this summer examined the effect of diseases on food webs. Her focal species is the common roadside weed *Plantago lanceolata*, which her team experimentally subjected to caterpillar herbivory and pathogenic infection by powdery mildew.

"Learning about how hosts and parasites interact is especially pressing given that different types of human-driven global change are impacting ecological communities, including impacting the frequency of host-parasite interactions and which parasites are interacting with which hosts," Penczykowski said.

My video highlights the team's work through a communication channel unconventional for scientific research: videography. I wanted to recreate the observational way that I learned about the team's research while shadowing them.



Rachel Penczykowski, PhD
Assistant Professor
Department of Biology

The storytelling aspect the video provides familiarizes the audience and provides an opportunity for the researchers to learn how to convey their passion and the importance of their research to a lay audience. Effective communication is key to increasing the public's appreciation for scientific research.

-Selaam Dollisso, WashU '22

Watch Selaam's video:





ABOUT THE AUTHOR

Selaam Dollisso is a sophomore at WashU majoring in environmental policy with a minor in Korean — her third language in three semesters. She is passionate about engaging in diverse sustainability efforts on campus. She has worked with the Office of Sustainability, tutored elementary students with VERDE, is a shift captain with Campus Kitchen, participates in Fossil Free rallies, and now zealously throws waste into her suite's new compost bin.



PhD recipient Chris Catano: Studying conservation with an eye towards education

Humans depend on Earth's ecosystems to provide valuable resources essential for our way of life. This dependence caught Chris Catano's interest and motivated his graduate research in ecology and evolution.

"I became very interested in understanding the natural world in terms of its biodiversity," said Catano, who recently earned his doctorate in evolution, ecology, and population biology. "I felt an appreciation for that and was very interested in conservation and anything that might potentially help safeguard those natural heritages."

Understanding the dynamics of community interactions is critically important in developing strategies for conserving and restoring species and populations, Catano said. There are four major drivers of biodiversity within a system: dispersal, interactions among various species, chance demographic events, and evolutionary dynamics. Catano's research is innovative because he aims to evaluate all of these factors collectively.

"My research straddles the divide between understanding the causes of the biodiversity that we see and then trying to predict the consequences of changes in that biodiversity for ecosystem functions," he said.

As part of Jonathan Myers' research group at Washington University in St. Louis, Catano examined how abiotic resources, such as soil nutrients, water availability, light, and local plant population sizes contribute to variation in species compositions across habitats. At a small scale, he found that small population sizes caused the number of plant species present to vary greatly across space regardless of environmental resources.

"In habitats where population sizes had been reduced by things like intense shading from the overstory trees, which limits light availability, we found that these habitats have small populations that are subject to more chance events," Catano said.



Chris Catano, PhD '19
Postdoctoral Research Associate
Michigan State University



**"My experience really cemented the value
of working with undergrads"**

Using the findings from his graduate work, conservationists can make better predictions for how environmental change will impact species of interest.

“This study underscores the importance of considering multiple spatial scales and dimensions of biodiversity such as species and traits when trying to anticipate the effects of environmental change on biodiversity,” Catano said.

His experience at Tyson impacted him so greatly that his career goals pivoted...

Throughout his dissertation work, Catano had the opportunity to work with and mentor multiple undergraduate students at Tyson Research Center.

“My experience really cemented the value of working with undergrads,” he said. “For me it was easy to think that undergraduate students, who are often a little bit less experienced, need a lot of mentoring. However, what I realized right

away is that there are areas where we as mentors can be helpful, but there's actually so much we can learn from them as well. While working with these students, I probably learned as much from them as they did from me.”

His experience at Tyson impacted him so greatly that his career goals pivoted from being an agency scientist to a principal investigator at a research institution.

“It’s one thing to teach in a classroom — which can be really exciting, and I really like doing that — but the research experiences are incredibly valuable and are an amazing opportunity for students,” Catano said. “So being able to provide that [to my mentees] is what made me change my mind. It also reinforced that I wanted to move into more of an academic setting. I don’t know that I would have reached that decision if I hadn’t had opportunities at Tyson to work with amazing students.”

In Catano’s current position as a postdoctoral research associate at Michigan State University, he continues to contribute to both conservation research and mentorship.

“I always felt like there are so many ways you can make a difference, whether or not it’s through research itself,” Catano said. “But I’ve now realized I could probably make a bigger, more important difference through education.”

-Marissa Locke





PhD recipient Sara Wright: Unraveling the genetic underpinnings of strategies to succeed

Seventy-five hundred plants, 2000 genetic markers, 20 sequencing libraries, two million flowers, terabytes of data, and one graduate student. This is how Sara Wright, who recently earned her doctorate in evolution, ecology, and population biology, tallies her time in graduate school. None of it would have been possible, she said, without the support of Tyson Research Center.

Wright's interest in plant diversity was first fueled by her experiences with the National FFA Organization. Later, as she started taking evolution classes, she realized that this was her passion.

"I love thinking about variation, how populations change over time, and how that contributes to the diversity that we see within and among species," Wright said.

Thus, Dr. Ken Olsen's lab was a perfect fit for her dissertation work at Washington University in St. Louis. Wright sought to answer one main question: What is the genetic basis of adaptation to highly varied climates? To answer this question, she used a common plant species, white clover (*Trifolium repens*). Specifically, Wright looked at the local adaptations of white clover across a latitudinal gradient in North America, with field sites in Minnesota, Florida, and at Tyson Research Center.

To complete her research goals, Wright took advantage of next generation sequencing and strategic breeding strategies to look for associations between traits, such as size and floral production, and genetic markers. Next generation sequencing is a technique that allows researchers to examine a large number of genome-wide markers of many organisms quickly and cost-effectively. This technique has revolutionized many fields, including population genetics.

"I came of age in a time where I could actually go out and collect all of this data and



Sara Wright, PhD '19
Lecturer
Rowan University

ask some of the questions that people have been asking for a long time but just didn't have the resources to test," said Sara.

After sorting through the data, Sara found that the life-history strategies of white clover varied in contrasting climates. White clover individuals in Minnesota, St. Louis, and Florida exhibited distinct life histories, or different strategies to succeed. In Minnesota and St. Louis, white clover plants prioritized growth during their first year and flowering during their second. In contrast, in Florida, white clover grew and flowered extensively during the first season before dying off. Wright mapped these tradeoffs to just a few gene clusters within the white clover genome.

During her thesis work, Tyson Research Center served as a home base for Wright and was instrumental in getting her project off the ground.

Tyson was "monumental in making all of this possible."

"Tyson helped me get my feet wet," she said.

"They helped me both financially and physically

in terms of equipment, personnel, and research assistance. They were monumental in making all of this possible."

Tyson staff also helped Wright hone her mentoring skills by pairing her with a large group of undergraduate and high school students. "I was able to give my students a well-rounded experience. They were learning field and lab techniques from me and then transferring that into their individual projects. With 11 students, it took a lot of time. But it's been really rewarding for me."

Since finishing her dissertation work, Wright has been working as a full-time lecturer at Rowan University. She is dedicated to her students' learning and has even incorporated her love of white clover into her courses. Wright's students collect white clover from around campus and analyze variation in a chemical defense trait in her classroom.

"It's a fun, hands-on activity that makes the students get out and look at plants, find a plant, and identify it," Wright said. "It's a good tool to hook them early in the semester, and then I can revisit the system over and over as we learn about different concepts in evolution."

- Marissa Locke



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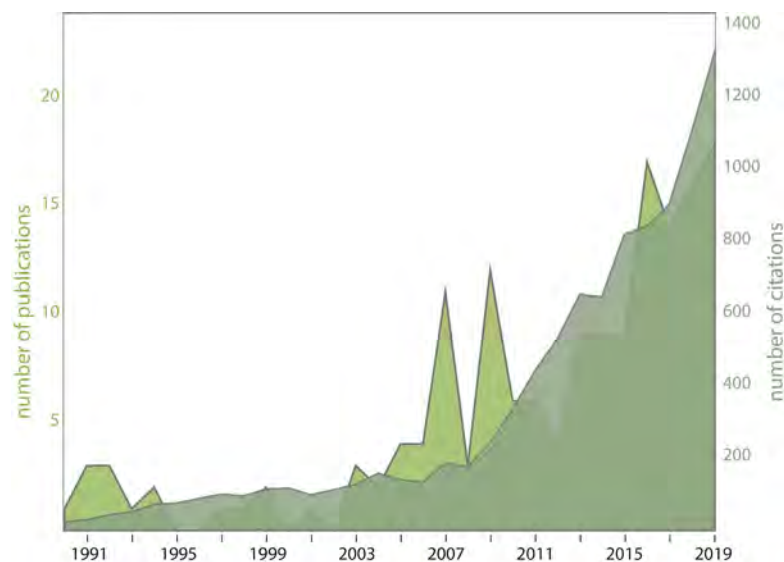
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EDUCATION

*Learning through
science in action*



"Tyson made me certain that I want to go into ecology; I have been happier and more excited about my work here than anywhere else."



At Tyson, we fully integrate our educational programming into our research and conservation activities. We provide enthusiastic pre-college and undergraduate students with hands-on research and applied experience in a variety of environmental disciplines from ecology and evolution to landscape architecture. These programs include SIFT and TERF (pgs. 27-31) for area high schoolers, the Tyson Undergraduate Fellows Program (pgs. 36-37), and the Tyson Conservation Corps (pg. 38).

SIFT & TERF: Authentic research experiences for St. Louis area youth

Through the Shaw Institute for Field Training (SIFT) and Tyson Environmental Research Fellowships (TERF) programs, St. Louis area high school students get paid to work directly with research scientists. As a partnership between Tyson Research Center and the Missouri Botanical Garden's ShawNature Reserve, these unique science education programs connect pre-college students directly to research scientists, allowing for deep and transparent career exploration.



St. Louis area
high school
students



SIFT:

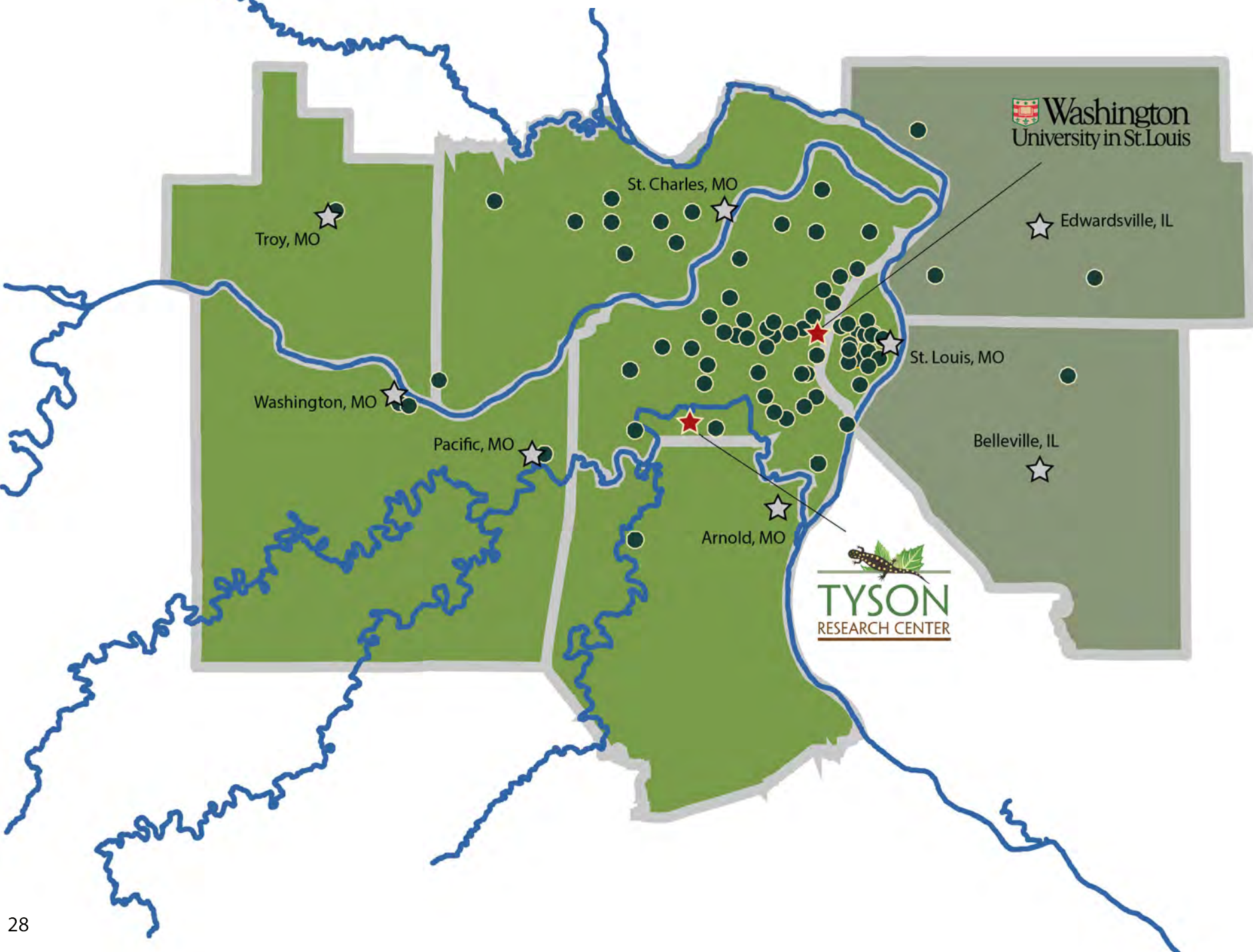
This program trains **St. Louis area high school students** in field safety and scientific exploration of the natural world at Shaw Nature Reserve. After their one-week summer training, SIFTers have **paid work opportunities** on projects at Shaw and Tyson, where they explore a variety of research projects during the summer and the following academic year. SIFTers are then eligible for the next step in the educational pathway: TERF.

TERF:

The TERF program places SIFT graduates as summer fellows on teams at Tyson Research Center, where they work **side-by-side with research scientists**. TERFers are immersed in the field station community and gain important scientific communication skills. The combined SIFT and TERF experience provides youth with the skills and confidence to pursue STEM college majors, Tyson undergraduate fellowships, and many other opportunities in environmental disciplines.

AUTHENTIC CAREER EXPLORATION AND WORKFORCE DEVELOPMENT PATHWAY

SIFT & TERF participant high schools: 2007-2019



A group of students are participating in a field study in a stream. They are wearing various colored shirts (blue, orange, red, white) and some have backpacks. Some students are crouching by the water, while others are standing. The stream is rocky and surrounded by trees and vegetation.

SIFT & TERF have provided opportunities for

411

students from

77

high schools and

23

St. Louis area school districts.

A conceptual design for exploring natural generalist predation on unfed adult *Amblyomma americanum* ticks

Elora Robeck, Rockwood Summit High School 20
Sofya Adalsteinsson, Tyson Research Center
Washington University in St. Louis

Introduction

With climate change, evidence rates increase, we will face a better understanding of many ecological factors that regulate tick abundance. Ecological research has focused on target or generalist predators, but little attention has been paid to the role of ticks predators (Graham & Anderson, 2019). Generalist predators are known to specialize on ticks as prey. Some have demonstrated the ability of generalist predators to reduce tick abundance (Szymanski et al., 2012). Other studies (e.g., Lounibos and Sullivan, 2010) suggest that generalist predators (e.g., *Chironomidae*) could potentially be used as biological control agents for ticks.

Methods

Choice Chamber
To explore whether predators will eat ticks, we will conduct a choice experiment using plastic chambers. Each chamber will contain a single unfed adult *Amblyomma americanum* tick and the other an alternative prey item. We will use 100 ticks with each predator and 100 ticks with each prey item. The trial will last for 24 hours. The trial will last for 24 hours. The trial will last for 24 hours. The trial will last for 24 hours.

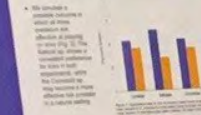
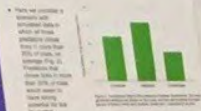
Field Microcosms

Following the choice chamber experiment, we will use field microcosms to test the ability of predators to reduce tick abundance in a natural setting. We will use 100 ticks with each predator and 100 ticks with each prey item. The trial will last for 24 hours. The trial will last for 24 hours. The trial will last for 24 hours. The trial will last for 24 hours.

Too little is known about tick predators and their potential for tick control.



Results



Discussion

Research from this experiment will contribute to the understanding of the role of ticks predators in tick control. This information will be used to develop strategies for tick control. This information will be used to develop strategies for tick control. This information will be used to develop strategies for tick control.

References

Graham, L.C., & Anderson, J.L. (2019). The role of ticks predators in tick control. *Journal of Medical Entomology*, 56(1), 1-10.

Acknowledgments

We thank the Tyson Research Center for providing the facilities and equipment for this experiment.



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Tyson Environmental Research Fellowships (TERF)



Graduates of the SIFT program may apply to spend four weeks as members of Tyson-based research teams. Modeled on Tyson undergraduate fellowships, TERF includes journal article discussion, seminars by visiting scientists, poster presentation training, and stipend support. During the fall semester TERFers work with their mentors to develop scientific posters and present results of research at the Washington University fall undergraduate symposium and a winter TERF symposium at Tyson.

Tyson has supported

165

TERF participants who have presented

87

posters at the WashU undergraduate research symposium.

SIFT & TERF alumni:

- **have increased knowledge of self**
- **gain realistic understanding of career paths**
- **have improved environmental literacy**
- **establish relationships with role models**

Often leading to pursuit of:

- **additional research experiences**
- **environmental STEM college majors**
- **Tyson undergraduate fellowships**



Tess Rogers: St. Louisan finds career success through Tyson training

As one of the earliest participants in our high school programs, Tess Rogers knows SIFT and TERF inside out. And she knows how important it is for SIFTers and TERFers to have casual conversations with environmental professionals about their career paths. Rogers often brings along a bird when she shares her personal journey from Maplewood-Richmond Heights high school student to field studies coordinator at the World Bird Sanctuary, where she now collaborates with Tyson scientists through bird research.

Starting the SIFT program as a rising sophomore during summer 2008, Rogers remembered being struck by the mix of students from so many different schools. "Finding a community of people who were also interested in nature and biological questions, to suddenly have a group of peers who were also interested in similar things, was rather validating!"

"To suddenly have a group of peers who were also interested in similar things was rather validating!"

She went on to join the Tyson community as a TERFer in summer 2009. "TERF was amazing because you actually got to experience field research in its entirety." Rogers explained how it wasn't a shadowing opportunity. "I actually got to feel what that work would be like because it was several weeks of fully being a part of the team."



There were fun moments of catching frogs and sorting aquatic macroinvertebrates, but also challenges like spending every day hiking long distances on rough terrain and surviving St. Louis summer heat in field gear. "By the end of TERF I felt I had a wholly complete idea of what a job as a field research technician would be, as well as a sense of whether it would be a good fit for me."

Learning from mentoring scientists is the key to Tyson experiential education programs. "The material wasn't ever watered down for us and for me that was a total first — to be treated as though I was already fully capable of understanding large-scale ecological topics and having mentors who helped me understand, rather than skim over the material that was more complex."

Her time at Tyson definitely influenced her college decisions. "After TERF I was just absolutely in love with field biology and knew that was the path I would be the happiest in." Rogers went on to complete a major in ecology, evolution, and animal behavior with a minor in fisheries and wildlife at the University of Minnesota, and during that time she returned to Tyson for two more summers of field research. "Through college, and even after, the Tyson community continuously helped me gain more experience and better insight into my personal career goals."

"TERF is still one of the best summers I ever had as a teenager, and now when I return to Tyson to do bird surveys or attend a seminar it still feels a little bit like coming home. Ticks and all."

-Susan Flowers



Tess Rogers, Field Studies Coordinator

World Bird Sanctuary

SIFT participant '08

TERF participant '09

Undergraduate fellow '13, '15

Home: Maplewood, MO



Moving forward on diversity and inclusion

Just over a year ago, recommendations from education fellow Mariel Lutz's independent project challenged us to change some practices with the goal of enhancing diversity and inclusion at Tyson. I'm pleased to share some actions we have taken with our undergraduate fellows program to recruit for greater diversity, attain a more diverse summer community, and maintain a culturally sensitive and inclusive environment that supports the presence of underrepresented students.

RECRUIT To increase diversity within our applicant pool we adjusted our efforts to include several St. Louis area colleges, especially those with greater proportions of minority student enrollment, and we added strategic language to the program website encouraging application from underrepresented students. We saw immediate results in the composition of interested students attending our fall information session and in applications to the program for this past summer.

ATTAIN Over last winter Tyson mentors discussed the need to prioritize selection of underrepresented students and staff for our summer teams. And at the same time, scholarship funds were allocated to supplement stipends for low income (Pell grant eligible) students. The resulting undergraduate cohort for summer 2019 was 73% female identifying, 5% non-binary gender identifying, 23% low income, and 45% students of color (18% Black, 18% Asian, 9% Latinx).

MAINTAIN An inclusive community does not inherently result from the presence of diverse people. To elevate inclusivity, our mentors have explored articles on the differing experiences of women and minority students within undergrad research experiences, how microaggressions manifest in the sciences, and the importance of relationship building in the scientific workplace. For the first time we held our pre summer meeting on site at Tyson, giving our newest community members a chance to get early familiarity with place and people. We honor the preferred names and pronouns of our folk and celebrated the diversity of our community at the end of June (Pride Month). These kinds of small steps can have a large impact.

We plan to keep moving forward with our commitment to building community at Tyson that better reflects the human diversity of St. Louis and the U.S. at large.

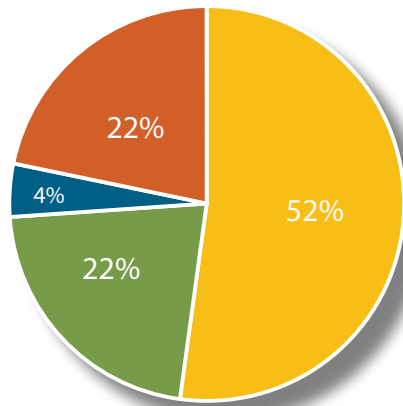


Susan Flowers, MA
Education & Outreach
Coordinator

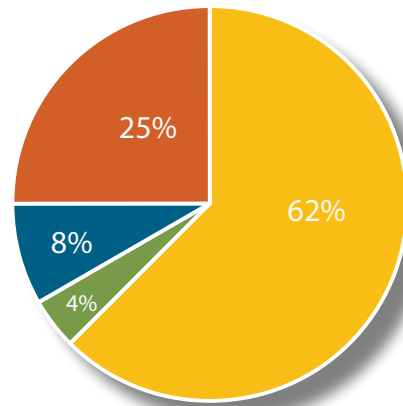
Tyson Research Center

SUSAN

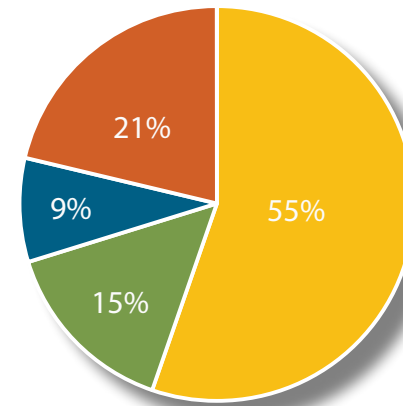
2018-2019 Education program demographics



**HIGH SCHOOL
SIFTers**



**HIGH SCHOOL
TERFers**



**UNDERGRADUATE
Fellows**

Racial/Ethnic/Cultural Self-Identification



56%

of high school program participants were female.

62%

of undergraduate program participants were female.

Participants represented

28

high schools in the St. Louis area and

7

colleges/universities.



Tyson Undergraduate Fellows Program

For 11 weeks in the summer, undergraduate students are given the opportunity to work elbow-to-elbow with a research mentor on current field-based research projects. Advanced or returning undergraduate fellows are supported in the design and execution of their own field-based ecological research. Weekly colloquium sessions provide training in research ethics, photography, Excel and basic statistical analysis, journal article discussion, environmental career options, and scientific communication via poster and formal slide presentation. Some fellows present the results of their research at either the WashU undergraduate research symposium or another similar symposium at their own undergraduate institution.

Tyson hosted

22

research fellows from

7

universities for

11

weeks during summer 2019.

Tyson undergraduate fellows:

- **conduct rigorous field and lab research**
- **learn to work in a collaborative environment**
- **learn to be collegial and provide peer review**
- **learn to think iteratively**
- **practice communication skills**
- **understand the necessity of detailed work contributing to broad concepts**
- **often mentor SIFT and TERF participants as near-peers**



"I really liked having the high schoolers there. I feel like they taught us as much as we taught them."



WashU undergraduate leads student conservation team

In middle school, Jacob Longmeyer asked his parents for a plant for Christmas.

"It's called a pregnant onion, but it isn't actually an onion," explained Longmeyer. "It's also not pregnant." His unconventional gift request was granted, and by the end of high school, he had collected more than 80 different species of plants.

Now a senior at Washington University majoring in environmental biology, Longmeyer's fascination with plants eventually led him to Tyson Research Center, where he has contributed to several research projects and conservation efforts since his sophomore year.

"It's cool to bring people out to Tyson and watch them become interested in the nature around them."

Longmeyer began working at Tyson as part of Scott Mangan's (Assistant Professor of Biology) research group, which studies interactions among soil organisms and plants. The next summer, he joined a landscape architecture project led by Micah Stanek (Lecturer in Architecture), in

which the team laid groundwork for designing a research garden. Most recently, Longmeyer has taken a leadership role in the Tyson Conservation Corps (TCC), a student-led organization dedicated to conservation and ecological restoration.

"We realized that not enough students know what Tyson Research Center is," said Longmeyer. The goal of TCC, he said, is to give students education and training in hands-on conservation and ecological restoration projects and long-term monitoring techniques. Longmeyer credits a course taught by Doug Ladd, Applied Conservation Biology, for introducing him to many of these methods and the importance of careful monitoring and observation in ecological research.

"A lot of people at WashU are not from St. Louis, so many of them aren't familiar with this environment and the plants that grow around here," said Longmeyer. "It's cool to bring people out to Tyson and watch them become interested in the nature around them."

A native of Rolla, Missouri, Longmeyer said that part of Tyson's appeal is that it reminds him of the forests and hills he grew up around. Another part, he noted, are the people he's worked with over the past three years.

"The sense of community at Tyson is my favorite part," said Longmeyer. "Everyone there — and especially Susan Flowers — is so friendly and helpful, and they genuinely care about you. It's a very welcoming place."

-Crystal Gammon



A portrait of Jacob Longmeyer, a young man with dark, curly hair and a light beard, smiling warmly. He is wearing a dark-colored t-shirt. The background is a dense, out-of-focus green foliage, likely trees or bushes, with some light filtering through the leaves.

Jacob Longmeyer, '20

Tyson undergraduate fellow '18, '19

Tyson Conservation Corps student coordinator '19

Home: Rolla, MO



McKelvey School of Engineering students expand solar at Tyson

Washington University in St. Louis students Kyle Cepeda, Sarah Chen and Maya Coyle have learned about their field by going into the woods — the woods of Tyson Research Center.

The trio, all seniors majoring in electrical and systems engineering (ESE) at the McKelvey School of Engineering, said that the university's environmental field station located 20 miles southwest of the Danforth Campus has provided them an invaluable opportunity to study renewable energy and sustainable power systems — and help the center in the process by installing solar panels.

“Working at Tyson has given us a lot of real-world experience in engineering,” Chen said. “We were able to learn what goes on beyond proposing an installation — things like permit requirements and working with other contractors.”

“Some of my good friends have worked there doing environmental biology and ecology research,” Coyle said. “Ours is definitely a different experience than the research typically done at Tyson and was also pretty unconventional for an ESE senior design project.”

This unconventional project also was a desperately needed one. For all its beauty and research capabilities, Tyson suffers from a failing power grid. With frequent outages — some lasting a full day — and no available backup generating capabilities, the lack of reliable power inhibits research.

As part of their senior design capstone course, Cepeda, Chen and Coyle designed a sustainable power system for the center using materials from previous projects, including the university's entry in the 2017 Solar Decathlon. The team got so invested in the design that they decided to continue their work the following semester as an independent study course.

Along with the staff and researchers at Tyson, the team also is collaborating with professionals within the industry, including EFS Energy.



Kyle Cepeda, BS '19
Maya Coyle, BS '19
Sarah Chen, BS '19
McKelvey School of Engineering

And, this spring, team members worked with the Office of Sustainability to install a row of solar panels to expand the center's power capabilities.

"Once our project was approved by facilities management, it started moving very quickly," Chen said. "A lot of groundwork had already been done by Tyson, as well as the electricians they were partnered with. We had the opportunity to help install a few of the remaining uninstalled solar panels, as well as speak with the electricians to confirm our schematics."

"We gained experience communicating technical ideas with fellow engineers at EFS Energy, the director of Tyson, and representatives from the Office of Sustainability and the facilities department," Cepeda said. "The lessons learned are not things that can be learned through exams or problem sets in class, yet they are still very much part of the holistic engineering design process that takes place in industry."

"Working at Tyson has given us a lot of real-world experience in engineering."

From the recycled materials to the solar-powered grid, the entire project aligns neatly with the center's mission of sustainable operations.

"As engineers, we have a responsibility to advance research on renewables to ensure a sustainable and reliable energy future, while being mindful of the ethical implications of the resources we use," Coyle said. "Maybe a 10-kilowatt solar array is a drop in the bucket, but I hope it will engage engineering students and encourage research on microgrids and renewables."

Coyle and Cepeda each had experience designing electrical systems but had never worked with solar or battery storage. They credit their work at the center with helping them develop the real-world skills needed to engineer such a complex project.

"I've learned so much, not just about engineering and design, but also about navigating local energy policies and bureaucratic slowdowns that make renewable energy projects challenging," Coyle said. "In any engineering work, there is always more than just the technical aspect of a project, so it's important to understand what all goes into creating something."

"Renewable energy will have to be the future of our world's energy infrastructure if we wish to continue living the type of lifestyles we are currently accustomed to," Cepeda said. "People all around the world are realizing the need for a more sustainable future and, with this, the race to create the best renewable technologies is just beginning."

-Danielle Lacey



COMMUNITY

*Diverse ideas,
diverse people,
one community*





Growing the Tyson community: new people, new roles



Mahal Bugay

Mahal is a graduate student in the lab of Rachel Penczykowski, Assistant Professor of Biology.



Paul Elliot

Paul is a field technician in the lab of Jonathan Myers, Associate Professor of Biology. Paul is a WashU alum and former undergraduate fellow.



Quinn Fox

Quinn is a graduate student in the lab of Rachel Penczykowski, Assistant Professor of Biology.



Sacha Heath

Sacha is a Living Earth Collaborative postdoc with Solny Adalsteinsson, Tyson staff scientist, Gerardo Camilo, Saint Louis University, and Anne Tieber, Saint Louis Zoo..



Jacob Longmeyer

Jacob was an undergraduate fellow during summers '18 and '19 and is currently the student coordinator for the Tyson Conservation Corps.



David Henderson

David is a graduate student in the lab of Jonathan Myers, Associate Professor of Biology.



David Marchant

David is a professor of practice in Performing Arts and was Tyson's first Artist-in-Residence during summer 2019.



Natalie Mueller

Natalie is an assistant professor of Anthropology and is setting up field experiments at Tyson using modern complements of lost crops.



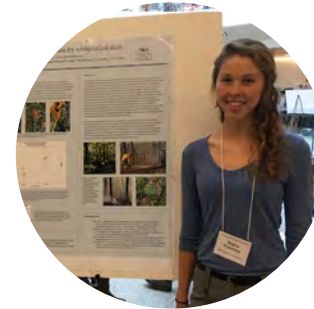
Elise Nishikawa

Elise is a technician in the lab of Solny Adalsteinsson, Tyson staff scientist. Elise conducts research in Tyson's experimental forest plots.



Erin O'Connell

Erin is the lead technician in the lab of Jonathan Myers, Associate Professor of Biology.



Hanna Peterman

Hanna was a Tyson undergraduate fellow during 2017 and moved into the leadership role of TCC student coordinator during 2018-2019.



Jackson Potter

Jackson is a lecturer in the McKelvey School of Engineering. His team designs tools for automated data collection.



Micah Stanek

Micah is a lecturer in the School of Architecture and led the first landscape architecture research team at Tyson during summer 2019.



Philippa Tanford

Philippa is a graduate student in the lab of Rachel Penczykowski, Assistant Professor of Biology.



Anna Wassell

Anna is a technician in the lab of Jonathan Myers, Associate Professor of Biology.



Aspen Workman

Aspen is a technician in the lab of Scott Mangan, Assistant Professor of Biology. Aspen is also an alum of the SIFT, TERF, and undergraduate fellows programs.



The Tyson Team



Solny Adalsteinsson, PhD
Staff scientist



Tim Derton
Maintenance technician



Andrew Johnstone
Business manager



Beth Biro, MS
Staff scientist/natural resource coordinator



Susan Flowers, MA
Education and outreach coordinator



Katie Westby, PhD
Postdoc



Ruth Ann Bizoff
Administrative coordinator



Pete Jamerson
Facilities manager



Dan Walton
Maintenance technician



Kim Medley, PhD
Director

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*Executive Vice Chancellor and Chief Administrative Officer
Professor of Practice*

Kim Medley

Director, Tyson Research Center

Special thanks to Crystal Gammon,
Director of Science Communications
in Arts & Sciences, for her important
contributions to this report.



Appendix A: Research use

INSTITUTION	FACULTY/ STAFF	POSTDOCS	RESEARCH SCIENTISTS	GRADUATE STUDENTS	TECHNICIANS	UNDERGRADUATE STUDENTS	EXTERNAL FUNDING
Washington University in St. Louis						13	
Anthropology	1						
Art	2						
Architecture	2						
Biology	4	2		5	5		NSF
Earth & Planetary Sciences	3			1			
Electrical & Systems Engineering	1			1			
Energy, Environment, & Chemical Engineering	2			9			
Mechanical Engineering & Materials Science	1						
Environmental Studies	1						
Medicine, Division of Infectious Disease	1						NIH
Molecular Microbiology	1						
Physics	4			2			NSF
Pathology & Immunology		1					NIH
Performing Arts	1						
Pediatrics	1						NIH
Tyson Research Center	3	1					CDC, PRIVATE



INSTITUTION	FACULTY/ STAFF	POSTDOCS	RESEARCH	GRADUATE STUDENTS	TECHNICIANS	UNDERGRADUATE STUDENTS	EXTERNAL FUNDING
External Institutions							
Auburn University in Montgomery	1					1	
Centers for Disease Control	3						
Colorado State University	2			1			NSF
Davidson College	1					5	
Harris-Stowe State University						2	
Illinois State University	1			3			
Indiana University	3		1				US DOE
Lincoln Park Zoo	1						
Maryville University	1						
Missouri Department of Conservation	1						
Missouri University of Science & Technology	1			1			
Murray State University						1	
NASA Jet Propulsion Laboratory			1				US DOE
National Great Rivers Research and Education Center	1	1					
Pontificia Universidad Católica del Ecuador						1	
Southeast Missouri State University					1	3	
St. Louis College of Pharmacy	1					2	
Saint Louis University	1			1			
SaintLouis Zoo Institute for Conservation Medicine	1		4		1	6	
Texas A&M	2			1			NSF
United States Fish & Wildlife Service	2						
University of Illinois Urbana-Champaign	1			1			
University of Minnesota						1	
University of Missouri – St. Louis	1			2			
University of West Virginia	1						US DOE
University of Western Ontario	1						
Wittenburg University	1						

Appendix B: Courses and other usage

WORKSHOPS/TOURS/RETREATS

Auxin Group Annual Meeting
Bear Beginnings Small Group Experience planning retreat
Endangered Wolf Center Annual Wolf Fest
Forest Park NatureWorks tour of Tyson
Forest Park NatureWorks tour of Tyson
Harris-Stowe State University visit and tour of Tyson
Living Earth Collaborative: Andean Forest Diversity and Dynamics
Living Earth Collaborative: Effects of Parasites on Nutrient Cycling
Midwest Migration Network bird banding workshop
Missouri S&T Ozark Research Field Station tour of Tyson
St. Louis Audubon Society meeting
Writing retreat (Amanda Koltz)
WashU Alumni tour of Tyson
WashU Emergency Management Staff retreat
WashU Police Department retreat
Soldan High School tour of Tyson
Tyson Conservation Corps bush honeysuckle removal event
Tyson Writing Retreat for Women in Ecology & Evolution
University of Missouri – St. Louis-Conservation Biology class
University of Missouri St. Louis-Ornithology class

WASHU COURSES USING TYSON AS A FIELD LABORATORY

Art 1186: Black and White Photography
Stan Strembicki
Art 583C: Special Topics
Stan Strembicki
Arts & Sciences L61 Focus 2431: Missouri's Natural Heritage
Dr. Stan Braude
Biology 4193: Methods in Experimental Ecology
Dr. Scott Mangan
Electrical & Systems Engineering 498/499: Senior Design
Dr. Jim Feher
Earth & Planetary Sciences 413: Introduction to Soil Science
Dr. Jeff Catalano
Environmental Studies 215: Introduction to Environmental Humanities
Dr. Suzanne Loui
Environmental Studies 365: Applied Conservation Biology
Doug Ladd
Chemical Engineering 408: Environmental Engineering Laboratory
Dr. Dan Giammar
Landscape Architecture 553: Integrated Planting Design
Carolyn Gaidis
University College U65 English Literature 313: Topics in English and American Literature: Nature and the American Literary Imagination
Dr. Matthew DeVoll
University College U29 Biology 323: Advanced Wilderness Medicine
Dr. Stanton Braude

Appendix C: 2019 summer seminar series



May 23: Inaugural Owen Sexton Seminar: Alan Covich (*University of Georgia*)

How do temperate and tropical ecosystems differ? What I learned from Owen Sexton

May 30: Natalia Umaña (*University of Michigan*)

Tropical diversity along environmental gradients: insights from functional ecology

June 6: Angélica González (*Rutgers University*)

The chemistry of life: understanding the structure and function of ecological systems

June 13: Michelle Tseng (*The University of British Columbia*)

Species interactions and adaptation to the thermal environment

June 20: James Aronson (*Missouri Botanical Garden*)

Restoration science, policy and practice (2021-2030): a seventh generation perspective

June 27: Rachel Nuwer (*freelance journalist*)

Behind the scenes of *Poached* with science journalist Rachel Nuwer

July 11: Tanya Cheeke (*Washington State University*)*

Harnessing the power of soil microbes for ecological restorations

July 18: Letícia Soares (*University of Western Ontario*)

Traveling while diseased: ecology and evolution of migratory birds and their malarial parasites

July 25: John Grady (*National Great Rivers Research and Education Center*)

Biological power and the diversity of life

August 1: Catherine Searle (*Purdue University*)

How biotic and abiotic changes to freshwater communities affect infectious disease

*graduate student invited speaker

Appendix D: Education program participants

2019 SUMMER FELLOWS: HIGH SCHOOL AND UNDERGRADUATE FELLOWS BY TEAM



Tick and wildlife ecology (Dr. Solny Adalsteinsson, Tyson)

Elora Robeck, Rockwood Summit High School '20

Laura Tayon, Parkway Central High School '21

Anahi Gamboa, Southeast Missouri State University, Environmental Science: Environmental Health '19

Derek McFarland, Harris-Stowe State University, Biology '20

Rachel Novick, WashU, Biology '21

Rossana Romo, Pontificia Universidad Católica del Ecuador '18



Interactions between plants and soil microbial communities (Dr. Scott Mangan, WashU Biology; Dr. Claudia Stein, Auburn University at Montgomery)

Adina Cazacu-De Luca, John Burroughs School '20

Margie Lodes, St. Joseph's Academy '20

Robert Zhang, Marquette High School '21

Kit Lord, WashU, Philosophy '21

Flora Perlmutter, WashU, Environmental Biology '22

Raegan Rainey, Auburn University at Montgomery, Environmental Science '21

Anna Thomas*, Murray State University, Environmental Science '22



Plant-pathogen coevolution (Dr. Rachel Penczykowski, WashU Biology)

Bernie Bergman, Visitation Academy '20

Vlada Gladun, Fort Zumwalt North High School '19

Kate Pogue, Marquette High School '20

Emma Waltman¹, WashU, Biology '19

Laura Goh², WashU, Environmental Biology '21

Elly Grant, WashU, Biology '20

Taewon Lee², WashU, Economics/Biology '21



Mosquito ecology (Dr. Kim Medley, Dr. Katie Westby, Tyson)

Tullaia Powell, Collegiate School of Medicine and Bioscience '19

Adnan Shaik, Collegiate School of Medicine and Bioscience '21

Lois Mack, Harris-Stowe State University, Biology '20

Delilah Sayer*, Southeast Missouri State University, Environmental Science: Biology '22



Temperate forest dynamics and biodiversity (Dr. Jonathan Myers, WashU Biology)

Annie Grimshaw, Eureka High School '19

Casimir Buttar-Miller, Clayton High School '19

Katie Skinker, Southeast Missouri State University, Environmental Science: Biology '20

Alice Xu, WashU, Philosophy/Environmental Biology '20

Max Yusen, University of Minnesota, Environmental Sciences, Policy & Management '21



Designing research gardens (Micah Stanek, Alisa Blatter, WashU Landscape Architecture)

Brooke Bulmash, WashU, Architecture '21

Jacob Longmeyer, WashU, Biology '20

Humanities in science communication (Dr. Suzanne Loui, WashU Environmental Studies)

Selaam Dollisso, WashU, Environmental Policy '22

Christian Fogerty, WashU, Geophysics '19

Informal science education (Susan Flowers, Tyson)

Kayla Mans, WashU, Environmental Policy '21

1 Tyson Sexton Fellow; 2 Tyson Lennette Fellow; * SIFT and TERF alumni

Appendix E: Undergraduate Research Symposium Posters

High school authors

A projection of forest biodiversity based on tree mortality due to invasive species

Juan Alega, Francis Howell North High School '19

Vlada Gladun, Fort Zumwalt North High School '19

Farhan Hassan, Parkway West High School '19

Mentors: Ben Chase, Dr. Jonathan Myers (WashU Biology)

How the abundance of invasive trees changes over time

Hannah Barry, Washington High School '20

Mentors: Ben Chase, Dr. Jonathan Myers (WashU Biology)

Effect of prescribed fire on bird nest predator community

Julia Berndt, Webster Groves High School '19

Anirudh Gandhi, Washington University '20

Mentor: Dr. Solny Adalsteinsson (Tyson)

Differences in pollinator behavior and identity are negligible between experimental and natural plant communities

Daniel Hull, North County Christian School '19

Rebecca Kiesel, Washington University '20

Mentors: Dr. Claudia Stein (Tyson), Dr. Scott Mangan (WashU Biology)

The indirect effects of soil pathogens on seed viability

Margie Lodes, St. Joseph's Academy '20

Anna Thomas, Eureka High School '18

Rebecca Kiesel, WashU '20

Mentors: Dr. Claudia Stein (Tyson), Dr. Scott Mangan (WashU Biology)

Exploring influence of soil microbial communities on soil pH in tall grass prairie communities

Raj Pandya, Warrenton High School '20

Ivan Ginsberg, WashU '19

Mentors: Dr. Claudia Stein (Tyson), Dr. Scott Mangan (WashU Biology)

Bush honeysuckle and gregarine parasites interact to reduce larval mosquito survival

Tullaia Powell, Collegiate School of Medicine and Bioscience '19

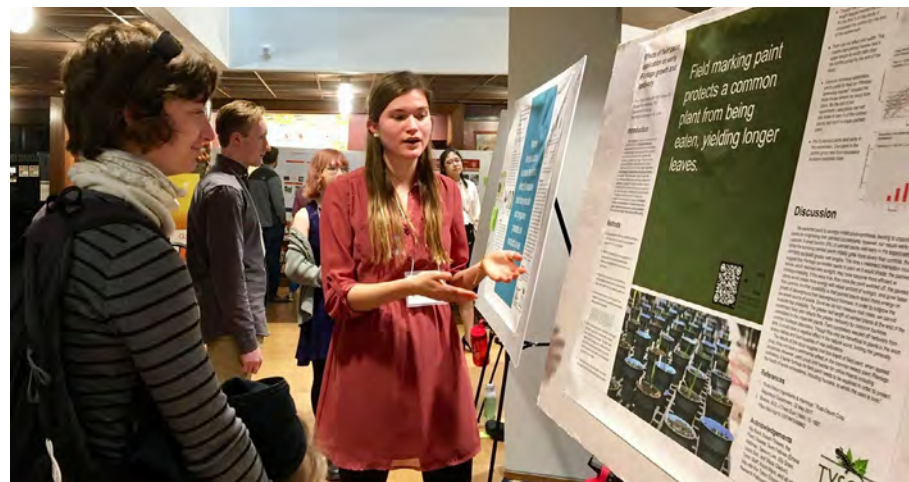
Lexie Beckermann, Southeast Missouri State University '21

Mentors: Dr. Katie Westby, Dr. Kim Medley (Tyson)

Does uropygial gland size affect tick burdens on passerine birds?

Kayla Wallace, Hazelwood West High School '18

Mentors: Dr. Leticia Soares (Saint Louis University Biology), Dr. Solny Adalsteinsson (Tyson)





Undergraduate authors

Untangling the effects of mutualistic and antagonistic soil microbes on Missouri native tallgrass species

Luiza Bergue Durante Alves, WashU '19

Mentor: Dr. Scott Mangan (WashU Biology)

Direct and indirect effects of plant diversity and soil microbes on plant-pollinator interactions

Savannah Fuqua, WashU '19

Mentors: Dr. Claudia Stein (Tyson), Dr. Scott Mangan (WashU Biology)

Soil microbes and plant-pollinator interactions as determining agents of seed viability

Rebecca Kiesel, WashU '20

Mentor: Dr. Scott Mangan (WashU Biology)

Effects of soil microbes on population dynamics of native tallgrass prairies under drought

Jacob Longmeyer, WashU '20

Mentors: Dr. Claudia Stein (Tyson), Dr. Scott Mangan (WashU Biology)

Humans of Tyson: Exploring the humanity of science

Kit Lord, WashU '21

Mentor: Dr. Suzanne Loui (WashU Environmental Studies)

Enhancing human diversity at an environmental field station

Mariel Lutz, WashU '19

Mentor: Susan Flowers (Tyson)

Prevalence of *Babesia sp.* parasites in a population of Carolina wren

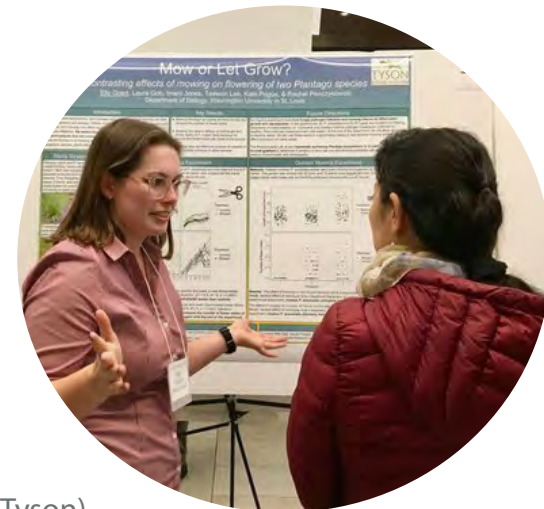
Derek McFarland, Harris-Stowe State University '20

Mentors: Dr. Letícia Soares (Saint Louis University Biology), Dr. Solny Adalsteinsson (Tyson)

How high do spores fly: Quantifying fungal pathogen spores across variations in altitude

Arjun Puri, WashU '20

Mentor: Dr. Rachel Penczykowski (WashU Biology)





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