

FY2023-24 ANNUAL REPORT

**Center for the
Management,
Utilization
& Protection
of Water
Resources**



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- Center at a Glance
- Accomplishments/Awards
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TENNESSEE TECH

BACKGROUND PHOTO
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LETTER TO THE STAKEHOLDERS

This year marks the 40th anniversary of the Water Center at Tennessee Tech University. Established in July, 1984, the Center for the Management, Utilization, and Protection of Water Resources began with a vision to provide educational benefits to the citizens of the region; address diverse problems associated with water use; provide technical assistance to federal, state and local government agencies; and to promote the expansion of industry in the region and state by providing services related to water availability, use and waste disposal. Forty years later the Center continues our vision to enhance water quality and security through education, research, service and the water testing laboratory. We plan to commemorate this milestone with a gathering for our stakeholders, staff and guests on October 4, 2024, on the Tennessee Tech campus.

Water Center faculty, staff, post-doctoral researchers, students and other collaborators form a talented and dedicated team collectively devoted to fulfilling the Center's mission with projects in water treatment, biodiversity, emerging contaminants, hydrology modeling research, all of which are important to the management, utilization, and protection of our water resources. A noteworthy accomplishment this year was the activation of more than \$3.6 million in external grant award funding, representing a record high for

the Water Center and a 270% return on investment of the Center's State Appropriation. This further demonstrates the dedication of the team of faculty, staff, students and researchers to serve the residents of Tennessee in water-related research.

The Water Center recently completed a nationwide search for a new Director and is pleased to announce that Tennessee Tech Biology Professor, Dr. Justin Murdock, has accepted the challenge of leading the Water Center into the next phase beginning in September. With his diverse expertise in wetlands, limnology, nutrients, and emerging aquatic contaminants, Dr. Murdock will bring his interdisciplinary knowledge, along with his leadership experience as the previous interim Director, and a strong record of funded research to advance the Water Center toward further growth and excellence.

It has been a pleasure to serve as the interim Director of the Water Center over the last 12 months, and I look forward to watching the Center continue to thrive in the upcoming years under the leadership of Dr. Justin Murdock.

-- Dr. Hayden Mattingly, Professor and Interim Director

CENTER AT A GLANCE 2023-2024



Nick Brewer, fisheries technician with Amanda Rosenberger, biology

- State appropriation: \$1,344,800
- External grants (total includes direct and indirect costs): \$3,637,134
- Return per state dollar: \$2.70
- 9 staff members
- 3 faculty focus area leaders
- 14 faculty principal investigators
- 50 graduate students
- 43 hourly student workers
- 19 peer-reviewed publications
- 69 professional presentations

ACCOMPLISHMENTS & AWARDS

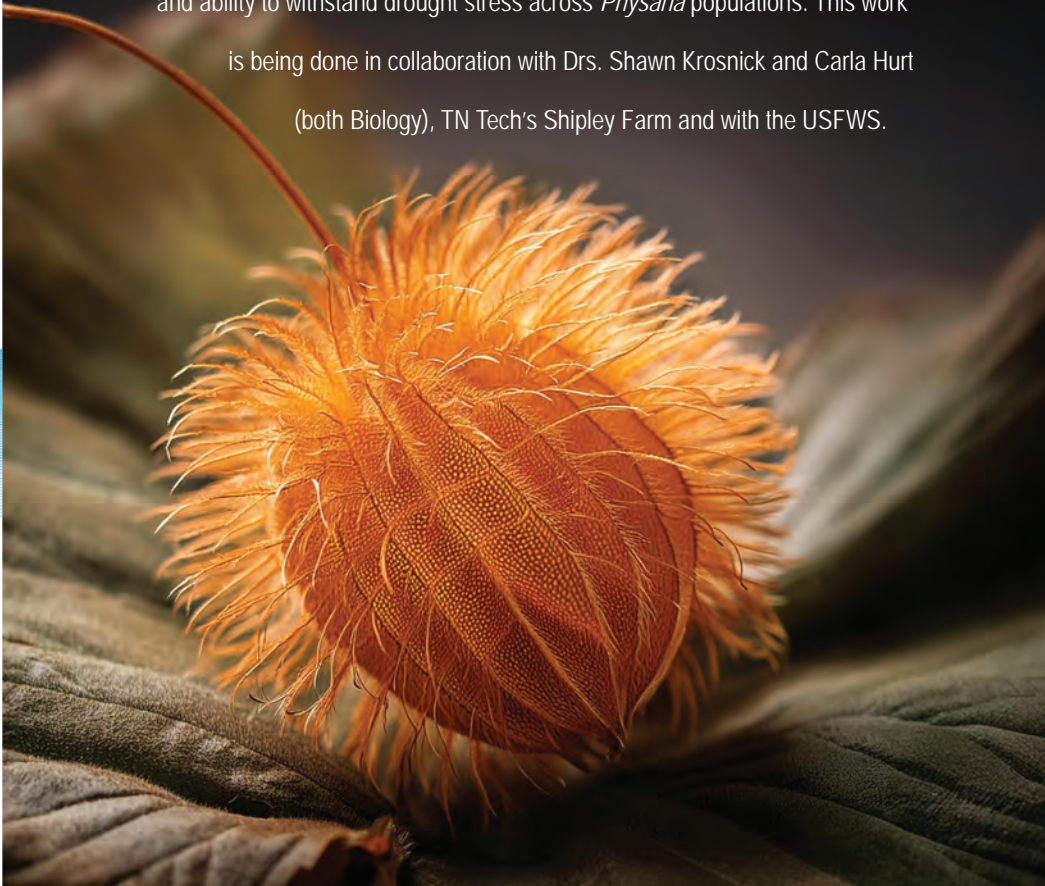
Justin Murdock, biology, earned the following media coverage for his work: (1) "Clash about Tennessee Wetlands Ends with 'Summer Study.'" Memphis Local, Sports, Business & Food News | Daily Memphian March 6, 2024 (2) "Tennessee Tech Research Team Project Probes Tennessee Wastewater Plants for Microplastics." Chattanooga Times Free Press. June 8, 2024. (3) *The Nature Conservancy*. "Wetland Monitoring Study." Sept. 2023. www.nature.org/en-us/about-us/where-we-work/united-states/kentucky/stories-in-kentucky/kentucky-wetland-monitoring-study/. (4) 102.3FM, Chattanooga, Tennessee. June 24, 2024. "Microplastics in our Waters with Professor Justin Murdock from Tennessee Tech University."

Brad Cohen, biology, earned a \$2.5 million grant from TWRA for a study titled "Increasing Landscape Connectivity for Waterfowl by Creating Private Land Rest Areas." Cohen also earned media coverage for his work: blogs.tntech.edu/techtimes/2023/research/cohens-research-part-of-permanent-exhibit-at-discovery-park-of-america/; outdoorlife.com/hunting/duck-flies-record-speed/; and blogs.tntech.edu/techtimes/2023/research/film-on-cohens-research-wins-award/.

RESEARCH HIGHLIGHTS

ENDANGERED *PHYSARIA GLOBOSA*

Biology graduate student Sarah Elliot, working with her faculty advisor Dr. Hannah Kinmonth-Schultz, is assessing the physiological constraints on the endangered *Physaria globosa*, a plant in the mustard family that is found only in Tennessee, Kentucky and Indiana. Elliot is using the LI-6400 and LI-600 portable photosynthesis system (Licor), a Water Center acquisition, to assess variation in photosynthetic rate and ability to withstand drought stress across *Physaria* populations. This work is being done in collaboration with Drs. Shawn Krosnick and Carla Hurt (both Biology), TN Tech's Shipley Farm and with the USFWS.





Kat Sallack, GRA
with Rosenberger

Ensuring the health of our state's and nation's waterways is paramount to the Water Center's mission. Therefore, supporting the efforts of the on-campus Tennessee Cooperative Fishery Research Unit seems a natural extension of that goal. The work of unit leader Mark Rogers, associate professor in biology, and assistant unit leader Amanda Rosenberger, associate professor in biology, has led to best-practices in managing and conserving the ecology and vitality of freshwater organisms.

Rogers and his research team evaluate the Tennessee fishing industry and its effect on existing fish populations, including rare species. They also explore the best ways to deal with invasive species that threaten to disrupt the ecology system of those rare species. Their research is sponsored by the Tennessee Wildlife Resources Agency (TWRA), the U.S. Geological Survey and others through studies ranging from evaluating the expansion of the Seacarp model for invasive carps in the Ohio and Tennessee rivers and their tributaries to informing stakeholders on the potential factors limiting the expansion of invasive carp in those river basins. Rogers and his team frequently present their work during the American Fisheries Society annual meetings.

Rosenberger and her team study a wide range of topics in the ecology and conservation of freshwater biota, including fish, mussels and crayfish.

They particularly emphasize the role of ecological processing in shaping aquatic organisms' distributions, population characteristics, and community structure. Their research is sponsored by The Nature Conservancy, the TWRA and West Tennessee River Basin Authority, among others, and their projects have ranging historically assessing the mussel communities along the Duck River to performing an environmental DNA surveillance of the duskytail darter. Rosenberger and her team have published their research in the *Freshwater Mollusk Biology and Conservation* journal and presented their work during stakeholder meetings or mollusk conservation symposia.

The Water Center strongly supports these efforts that have such a lasting impact on the health of our waterbodies.

AQUATIC HEALTH

PRESERVING ENDANGERED SPECIES



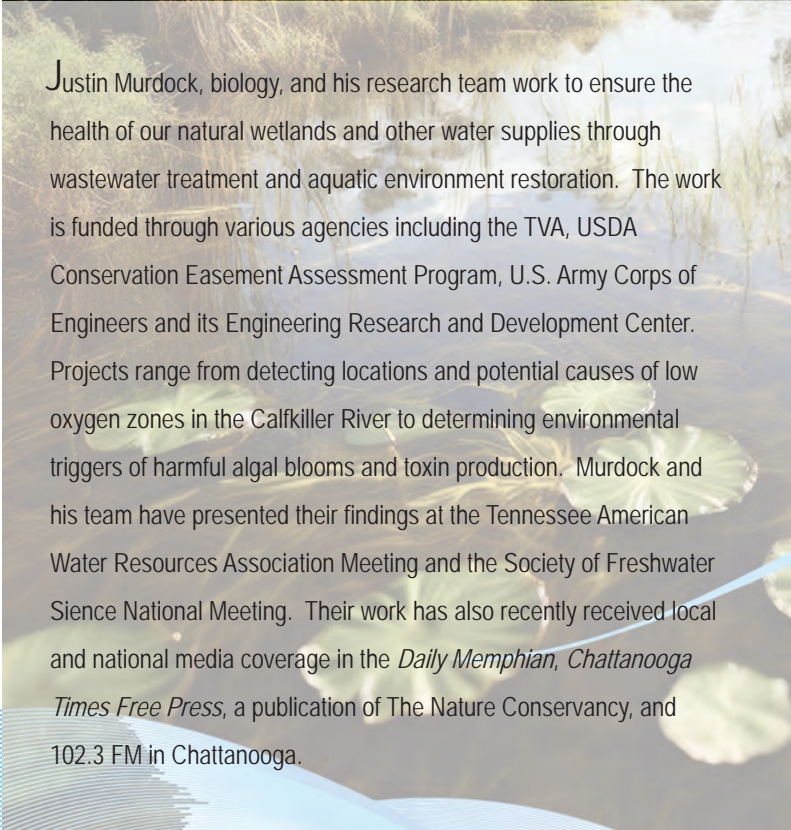
Jennifer Caudle, research specialist with Rogers

WATER FOWL PROTECTION

MONITORING BIRDS IN THE WILD



Brad Cohen, biology, and his research team work to protect the ecosystems of wildlife including marsh birds, mallards, wood ducks and wild turkeys. Their work is funded by grants through the TWRA, Kentucky Department of Fish and Wildlife Resources and the USFWS. One grant four-year grant (beginning in 2022) from the TWRA totaled \$2.5 million for a study titled "Increasing Landscape Connectivity for Waterfowl by Creating Private Land Rest Areas." Cohen's work is published in such peer-reviewed journals as *Ornithological Applications*, *Journal of Wildlife Management*, *Scientific Reports* and the *Wildlife Society Bulletin*. He and his students also present their findings during the meetings of the Southeast Wild Turkey Working Group, the North American Duck Symposium and the Wildlife Society Annual Meeting. Some of Cohen's students from the Biology Graduate Student Society also host fun campus-wide activities like the pickleball tournament featured above.



Justin Murdock, biology, and his research team work to ensure the health of our natural wetlands and other water supplies through wastewater treatment and aquatic environment restoration. The work is funded through various agencies including the TVA, USDA Conservation Easement Assessment Program, U.S. Army Corps of Engineers and its Engineering Research and Development Center. Projects range from detecting locations and potential causes of low oxygen zones in the Calfkiller River to determining environmental triggers of harmful algal blooms and toxin production. Murdock and his team have presented their findings at the Tennessee American Water Resources Association Meeting and the Society of Freshwater Science National Meeting. Their work has also recently received local and national media coverage in the *Daily Memphian*, *Chattanooga Times Free Press*, a publication of The Nature Conservancy, and 102.3 FM in Chattanooga.



WATER QUALITY

ENSURING WETLAND ECOSYSTEM HEALTH



WATERSHED MODELS

PREDICTING AND MANAGING STORMWATER

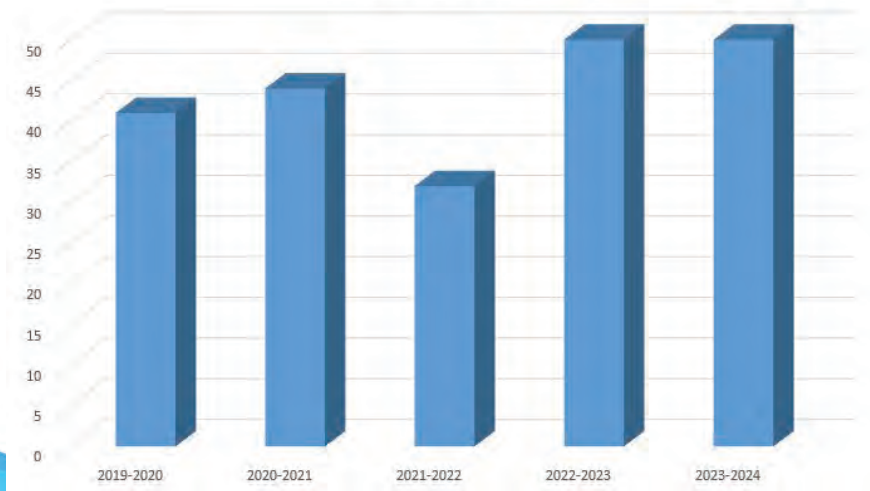
Alfred Kalyanapu, civil and environmental engineering, and his research team address concerns with stormwater management and flooding through hydrologic modeling. They have several Water Center projects, including one that involves modeling for dam breaches among high and significant Tennessee dams. In another project, the team partnered with the Lincoln County Emergency Management Agency to install the team's custom, low-cost and real-time water level sensors along the Elk River. In the Blackburn Fork Watershed, Kalyanapu and his team are developing a flood early warning system using machine-learning techniques in the Cummins Falls State Park area. They have also published their work in *Geosciences*, *Remote Sensing*, and the *Journal of Hydrology*, and have presented their results at state and national meetings.



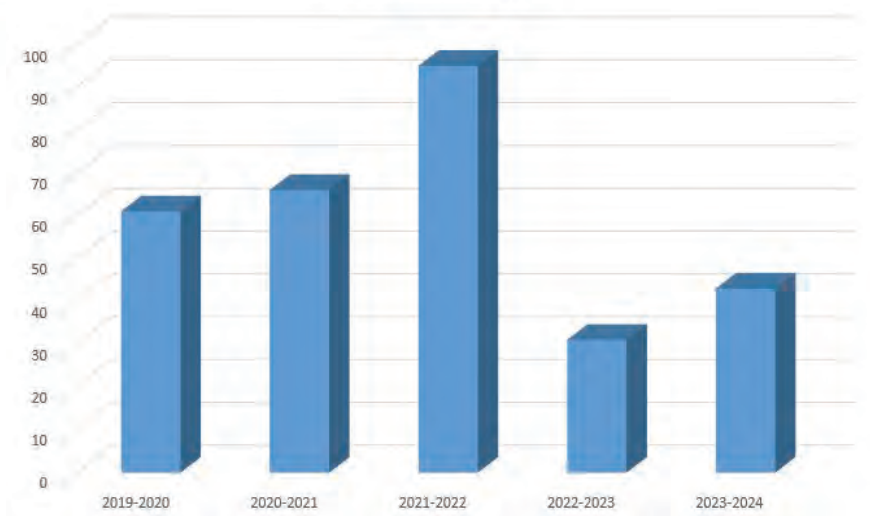
ENHANCING EDUCATION & RESEARCH

NUMBER OF STUDENTS SUPPORTED

Graduate Student Support



Hourly Student Support



*GRADUATE
STUDENTS
SUPPORTED*

Ph.D.

Name	Advisor
Dushmantha Abeysooriya, EVS	Wilson Gichuhi
Sahera Abumariam, ENGR	Pedro Arce/Robbie Sanders
Mary Adepoju, EVS	Jeannette Luna
Peter Blum, EVS	Justin Murdock
Bryant Davis, EVS	Andrew Callender
Shrijana Duwadi, EVS	Justin Murdock
Miranda Gaupp, EVS	Carla Hurt
Hoda Ghassab, ENGR	Robbie Sanders/Pedro Arce
Brooke Grubb, EVS	Hayden Mattingly
Cory Highway, EVS	Brad Cohen
Tanya Khan, EVS	Hayden Mattingly
Nicholas Masto, EVS	Brad Cohen
Thomas Miles, EVS	Mark Rogers
Zoe Porter, EVS	Justin Murdock
Sahar Salimi, EVS	Mostafa Rahnama
Sara Watkins, EVS	Brad Cohen

Master's

Name	Advisor
Ademola Adeoye, CHEM	Tammy Boles
Connor Ballard, BIOL	Mark Rogers
Joelle Ciriacy, BIOL	Kit Wheeler
Trevor Crawford, BIOL	Justin Murdock
Bruce Cunningham, CEE	Tania Datta
Grace Dadzie, ECE	Alfred Kalyanapu
George Fordjour, CEE	Alfred Kalyanapu
Andrew Gable, BIOL	Mark Rogers
Mateo Gannod, CSC	Brad Cohen
Holly Gothard, BIOL	Carla Hurt
Seth Haston, BIOL	Justin Murdock
Brandon Hein, BIOL	Mostafa Rahnama
Caroline Hitchcock, CEE	Tania Datta
Lydia Holmes, BIOL	Brad Cohen
Cole Howard, BIOL	Brad Cohen
Kirsten Humphries, BIOL	Kit Wheeler
Rachael Irby, BIOL	Mark Rogers
Tony Kumetis, BIOL	Kit Wheeler
Benjamin Lane, EVS	Peter Li
Joshua Loiacono, EVS	Samantha Allen
Catherine Murphy, ChE	Laura Chavez
Faria Nur, CEE	Alfred Kalyanapu
Jemima Obeng, CEE	Tania Datta
Abigail Riggs, BIOL	Brad Cohen
Mark Rine, BIOL	Mark Rogers
Cindy Scruggs, BIOL	Joshua Hall
Katelynn Sallack, BIOL	Amanda Rosenberger
Hannah Stowers, EVS	Samantha Allen
Hannah Swain, BIOL	Amanda Rosenberger
Jared Thompson, BIOL	Carla Hurt
Julia Thulander, BIOL	Joshua Hall
Delta Tryba, BIOL	Justin Murdock

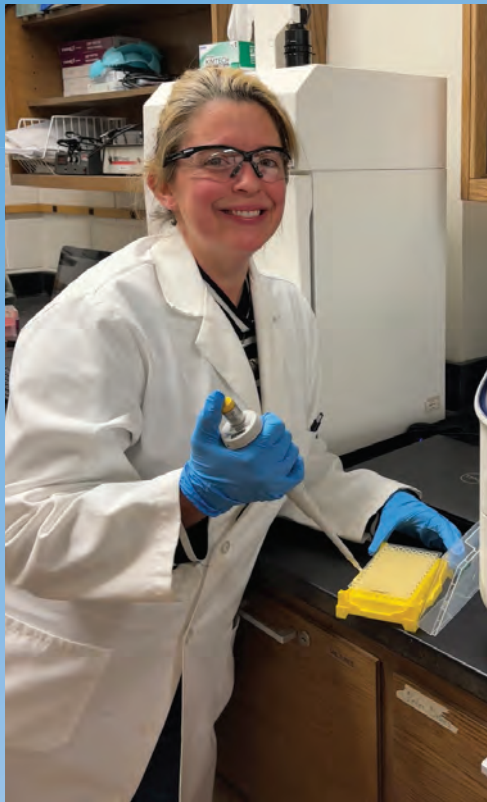
PROFESSIONAL SERVICE AND OUTREACH

Hayden Mattingly, biology professor, was a school-affiliated faculty member for National Science Foundation grant (\$3 million) to Tennessee Tech University: Gadugi and the food-water-energy nexus, National Research Traineeship program.

Brad Cohen, biology associate professor, participated in the following outreaches:

- Highway, C. J., and B. S. Cohen. Tennessee waterfowl research. Black Duck Joint Venture Field Workshop.
- Cohen, B. S. 2023. Higdon Outdoors TV – Banding Ducks. Television show aired 12/16/23 on Sportsman's Channel.
- Cohen, B. S. 2023. Under pressure. Film released at Chene Film Festival 10/21/23.
- Cohen, B. S. 2023. Waterfowl eyesight: seeing things for what they really are. Duck Season Somewhere Podcast.
- Cohen, B. S. 2023. Cohen Wildlife Lab on duck movement. The Dog House Podcast.
- Cohen, B. S. 2023. Is lack of winter weather keeping ducks up north? Zero Duck Thirty Podcast.
- Cohen, B. S. 2023. Living for ducks and turkeys. National Wildlife Federation Podcast.
- Masto, N. M., and B. S. Cohen. 2023. Ducks fly far but sit still: factors influencing mallard behaviors and distribution. U.S. Fish and Wildlife Service Waterfowl Webinar Series.

LAB CAPABILITIES



The Water Center offers unique analytical capabilities through its state-certified consulting lab, which has served homeowners, businesses and the research community in Middle Tennessee and the Upper Cumberland region for over 35 years.

ABOUT THE LAB:

- State-certified for drinking water parameters
- Enforces a quality control program that conforms to EPA standards
- Offers in-depth assistance when more than just analytical test results are needed
- Supported by the expertise of the Tennessee Tech research community

SERVICES INCLUDE:

- Drinking water and wastewater sampling and characterization studies
- Drinking water and wastewater treatability studies
- Stormwater sampling and characterization studies
- Flow and water quality analysis for streams and watersheds
- Geospatial analysis
- Chlorophyll analysis
- Microbial source tracking
- Microplastics characterization and quantification

ANALYTICAL CAPABILITIES:

- Biochemical oxygen demand (BOD)
- Chemical oxygen demand (COD)
- Total organic carbon (TOC)
- Trace and heavy metals
- Bacteria (E. coli and total coliform)
- Dissolved oxygen, conductivity, and pH
- Microbial source tracking
- Solids
- Anions
- Cyanide
- Oil and grease
- Nutrients
- Chlorophyll

FIELD SAMPLING AND MONITORING CAPABILITIES:

- SonTek ADP: stream velocity measurements, stream bed profiles and total flow
- Datasondes: log of water quality including DO, pH, temperature, conductivity, ORP
- GIS capabilities
- Discrete and composite autosampling
- Assistance with developing sampling strategies, including identifying appropriate analyses

The lab currently staffs Phillip Burr as the Commercial Lab Manager, Dr. Grace Tinker as the Research/Projects Lab Manager, Alex O'Neal as a Lab Analyst, and Gabriella (Gabi) Almeida as a Lab Technician.

LAB OUTREACH AND FIELD WORK



The Water Center lab staff have engaged in numerous outreach and fieldwork activities throughout the year. The activities range from performing on-location water monitoring (above) to exhibiting information during the Tennessee Section American Water Resources Association's annual symposium (top right). The students and staff also set up a display for Earth Day on the campus (right middle) and taught middle school students about water quality (lower right), specifically nutrient pollution. The students performed tests that measured turbidity and concentrations of ammonia and phosphorus to compare drinking water to surface water runoff.



SUPPORT STAFF

Our staff brings years of expertise in their respective areas of work, and they include Michelle Holm, office manager, who administers the financial reporting for the Center. Sandy Dodson, administrative associate, provides support in preparing travel claims, administering the Motor Pool, and purchasing supplies. Karin Kopinski-Gilbert, grants specialist, provides financial support to faculty in administering their grants, and Suzanne Meyer, grants analyst, provides bookkeeping support for grants. The Water Center Analytical Laboratory is managed by Grace McClellan, as the research/projects lab manager, and Phillip Burr is the commercial lab manager. Alex O'Neal is a lab analyst, and Gabi Almeida is a lab technician. Dongya Gao is a research scientist. Center staff are recognized across campus for excellence in their respective duties.

ADMINISTRATION AND FACULTY

Dr. Hayden Mattingly
Dr. Tania Datta

Dr. Alfred Kalyanapu

Dr. Justin Murdock

Interim Director
Research Focus Area Leader,
Associate Professor of Civil and
Environmental Engineering
Research Focus Area Leader,
Associate Professor of
Environmental Engineering
Research Focus Area Leader,
Associate Professor of Biology

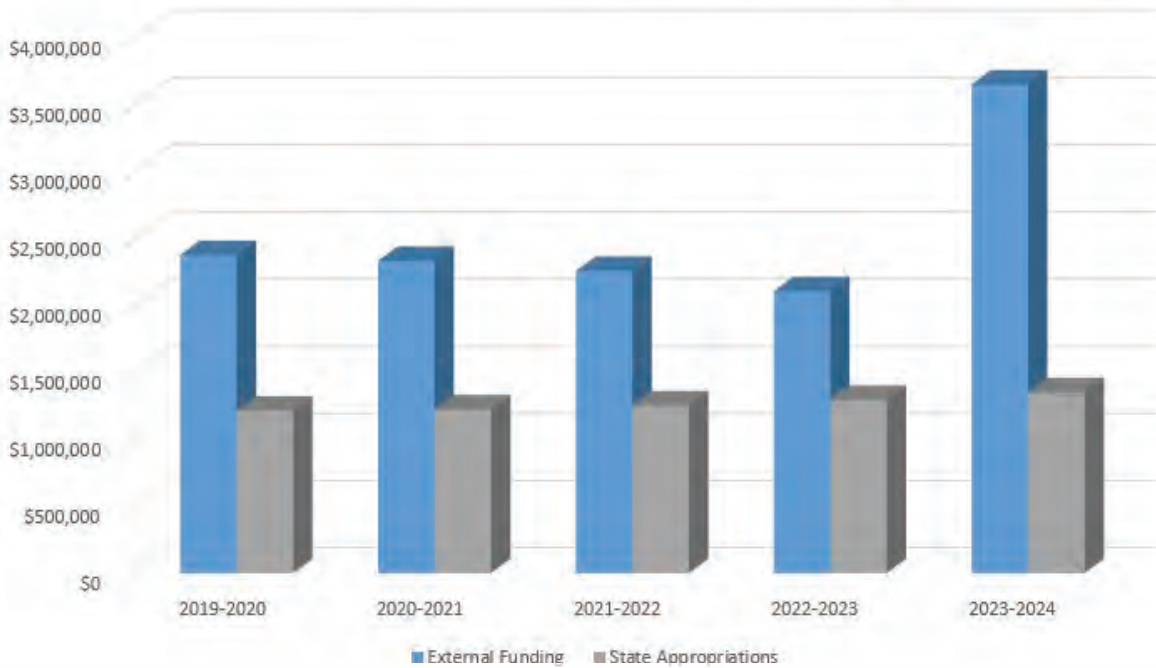
SUPPORT STAFF

Michelle Holm
Sandy Dodson
Karin Kopinski-Gilbert
Suzanne Meyer
Grace McClellan
Phillip C. Burr
Alex O'Neal
Gabi Almeida
Dongya Gao

Office Manager
Administrative Associate 3
Grants Specialist
Grants Analyst
Research/Projects Lab Manager
Commercial Lab Manager
Lab Analyst
Lab Technician
Research Scientist

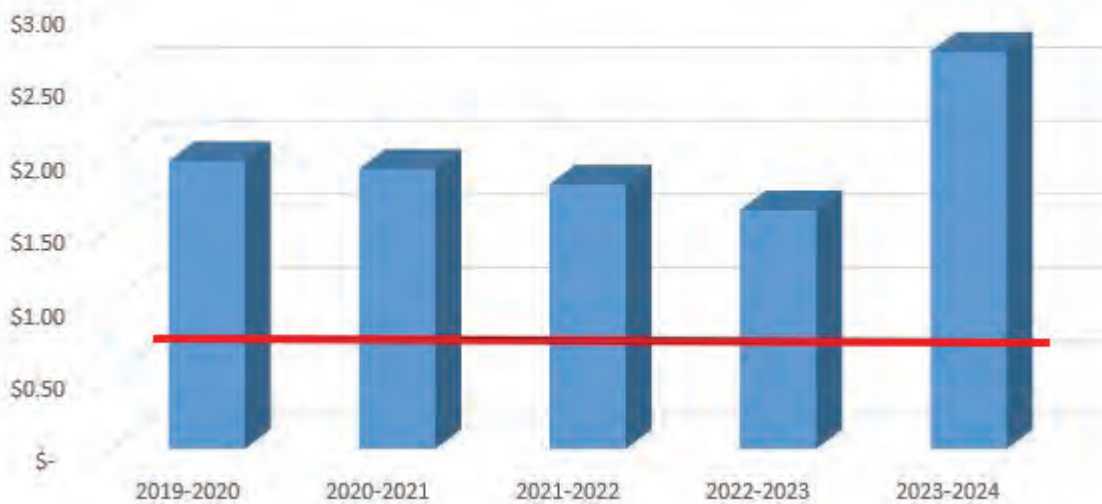
STATE APPROPRIATIONS VS. EXTERNAL FUNDING

State Appropriations vs. External Funding



**The total external funding includes both direct and indirect costs awarded.*

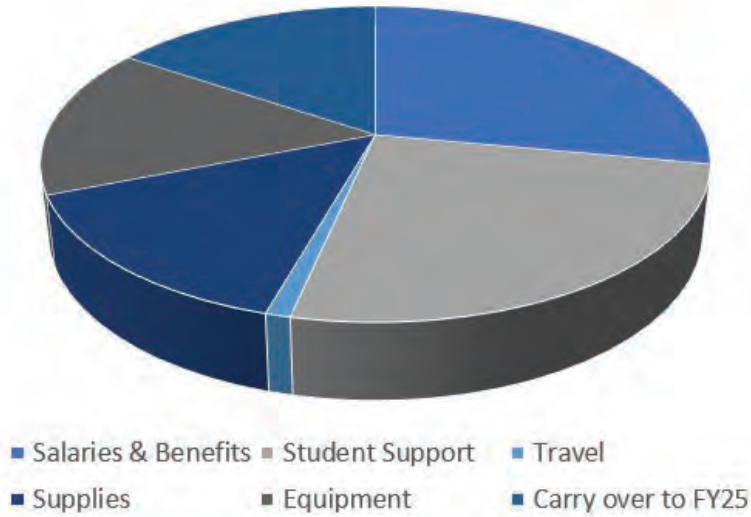
External Funding Return Per State Dollar



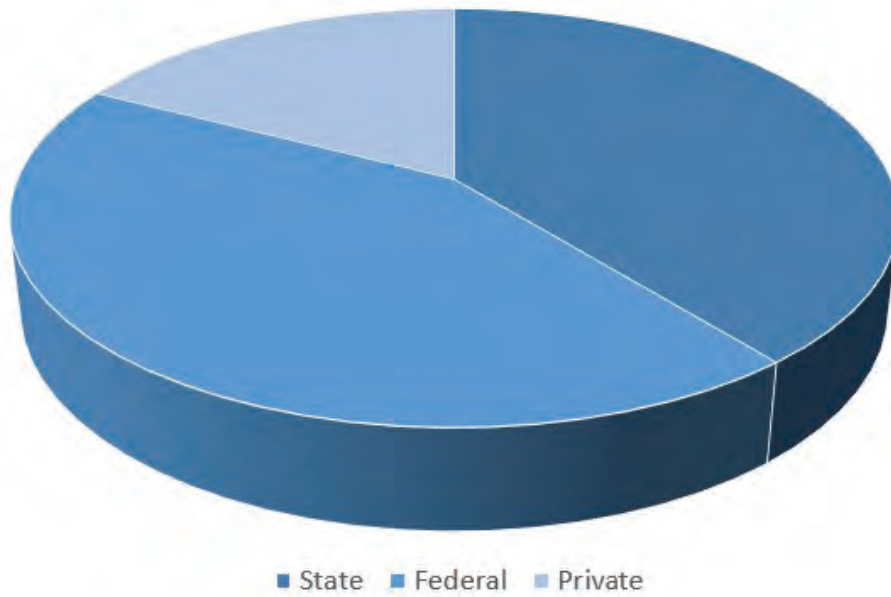
**Red line indicates the State-required return.*

ALLOCATION OF APPROPRIATIONS AND SOURCES OF EXTERNAL FUNDING

Allocation of State Appropriations

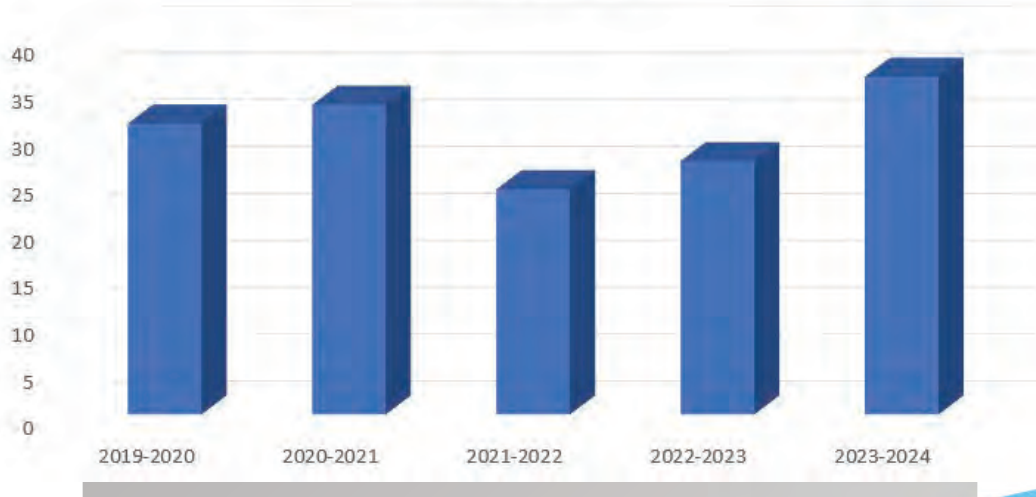


Sources of External Funding

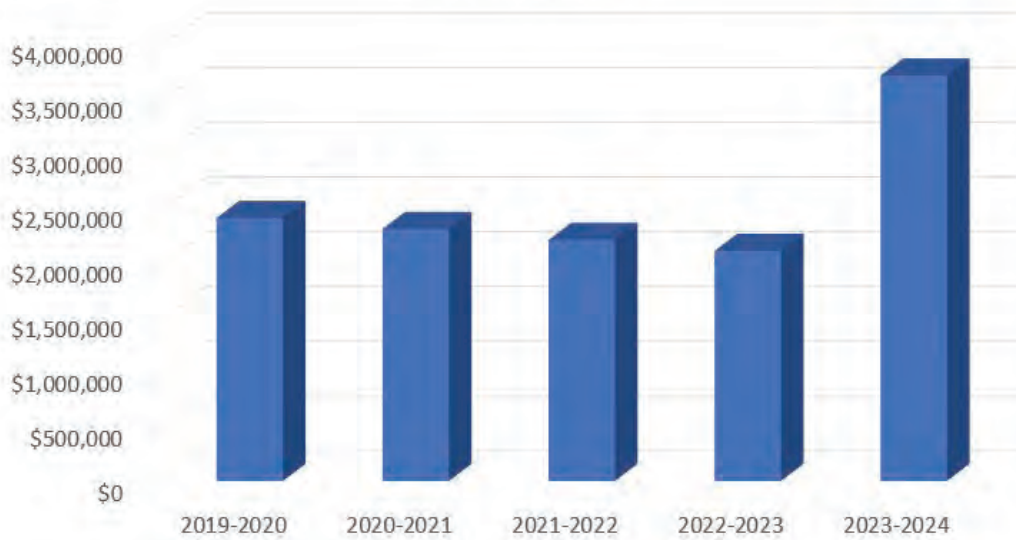


ACTIVATION AMOUNT AND NUMBERS OF ACTIVATIONS

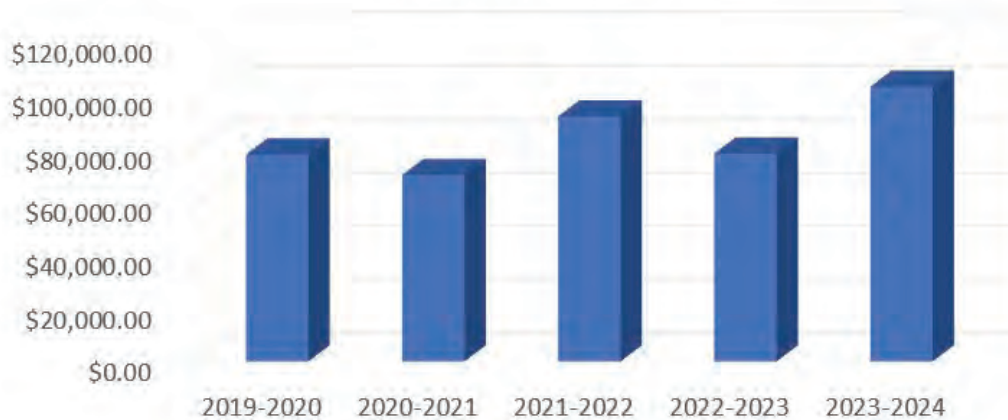
Number of Activations



Activation Amount



Average Amount Per Award



**The total activations includes both direct and indirect costs awarded.*

EXTERNALLY FUNDED PROJECTS ACTIVATED IN FISCAL YEAR 2023-2024

Aquatic Research, Sportfish Restoration
Mark Rogers/TWRA
Activation This Year: \$106,000

Asian Carp Controls TN Cumberland River
Mark Rogers/USGS
Activation This Year: \$5,000

Banding Project - Gobbler Harvest
Brad Cohen/KDFWR
Activation This Year: \$53,210

Barrens Topminnow
Kit Wheeler/TWRA
Activation This Year: \$21,034

Bat Food Sources
Justin Murdock/USACE
Activation This Year: \$206,611

Bighead and Silver Carp
Mark Rogers/USGS
Activation This Year: \$24,845

Channel Catfish and Blue Catfish
John Liu/USDA
Activation This Year: \$612,284

Chucky Madtom
Amanda Rosenberger and Robert Paine/TWRA
Activation This Year: \$45,270

Cub Creek (Lone Oak) Phase II
Amanda Rosenberger/TDEC
Activation This Year: \$115,860

Distribution of the Pale Lilliput
Amanda Rosenberger/TWRA
Activation This Year: \$52,791

Ducks Unlimited Scholarship
Brad Cohen/Ducks Unlimited
Activation This Year: \$8,816

Duskytail Darter
Amanda Rosenberger/VDWR
Activation This Year: \$30,060

Environmental Justice in TN
Peter Li/USEPA via TDOA
Activation This Year: \$92,273

Freshwater Mussel Database into West TN Drainages
Amanda Rosenberger/WTRBA
Activation This Year: \$76,737

Gobbler Harvest
Brad Cohen/USFWS via TWRA
Activation This Year: \$62,318

Ground Truthing Habitat-Heelsplitter
Amanda Rosenberger/USGS
Activation This Year: \$20,881

Harmful Algal Blooms
Justin Murdock/Marshall University
Activation This Year: \$140,000

Harvest Management -- Deer Turkey
Brad Cohen/TWRA
Activation This Year: \$115,632

Invasive Carp Populations
Mark Rogers/TWRA
Activation This Year: \$350,059

Low Oxygen Zones in the Calfkiller River
Justin Murdock/TVA
Activation This Year: \$62,507

Modeling for Dam Breach Analysis
Alfred Kalyanapu/TDEC
Activation This Year: \$49,664

Mussel Communities Along the Duck River
Amanda Rosenberger/TNC
Activation This Year: \$47,495

Mussel Communities in the Hatchie River
Amanda Rosenberger/USGS
Activation This Year: \$14,150

Mussel Distributions - Hatchie River
Amanda Rosenberger/WTRBA via TDEC
Activation This Year: \$49,402

Nutrient Reduction Strategy
Tania Datta/TDEC
Activation This Year (state): \$25,000
Activation This Year (federal): \$96,664

Sanctuary Use by Mallards
Brad Cohen/USFWS
Activation This Year: \$4,276

Secretive Marshbird Monitoring
Brad Cohen/TWRA
Activation This Year: \$8,555

Streamside Salamander Impact
Carla Hurt and Amanda Rosenberger/USFWS via TWRA
Activation This Year: \$41,528

Thermal Responses -- Streamside Salamanders
Joshua Hall/TWRA
Activation This Year: \$26,808

Tradeoffs in WRP Restorations
Justin Murdock and Alfred Kalyanapu/USDA
Activation This Year: \$115,607

Wastewater Systems in Rural TN
Tania Datta/UTK/EPA
Activation This Year: \$45,096

Waterfowl Monitoring Protocols
Brad Cohen/USFWS
Activation This Year: \$16,183

Waterfowl Rest Areas/Connectivity
Brad Cohen/TWRA Pittman
Activation This Year: \$616,000

Watershed-Wide Stormwater Management
Tania Datta/City of Gainesboro
Activation This Year: \$69,593

Wild Turkey Reproductive Study
Brad Cohen/Comm. of KY
Activation This Year: \$251,571

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- Gangrade, S., Ghimire, G. R., Kao, S.-C., Morales-Hernández, M., Tavakoly, A. A., Gutenson, J. L., Sparrow, K. H., Darkwah, G. K., Kalyanapu, A. J., and Follum, M. L. (2023). Unraveling the 2021 Central Tennessee flood event using a hierarchical multi-model inundation modeling framework. *Journal of Hydrology*, 625, 130157. <http://dx.doi.org/10.1016/j.jhydrol.2023.130157>
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- Howard, C. A., N. M. Masto, A. J. Hitchcock, B. S. Cohen, N. Wirwa, D. McCarty, H. M. Hagy, and B. S. Cohen. 2024. Rapid yield estimation methods for unharvested rice planted for migratory and wintering waterfowl. *Journal of the South-eastern Association of Fish and Wildlife Agencies* 11:119-126.
- Hudson R.R., K. Wheeler, M. White, and J.N. Murdock, 2023. Migratory redhorse suckers provide subsidies of nitrogen but not phosphorus to a spawning stream. *Ecology of Freshwater Fish* 33: e12758.
- Kalyanapu, A. J., and Datta, T. (2023). Feasibility of monitoring floods using cost-effective devices (1st ed., vol. 25, pp. 13-14). Cookeville: ASCE. 1020 Stadium Drive.
- Kalyanapu, A., C. Owusu, T. Wright, and T. Datta. (2023). Low-Cost Real-Time Water Level Monitoring Network for Falling Water River Watershed: A Case Study. *Geosciences*, 13(3), 65. <http://dx.doi.org/10.3390/geosciences13030065>
- Masto, N. M., A. G. Blake-Bradshaw, C. J. Highway, A. C. Keever, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Human access constrains optimal foraging and habitat availability in an avian generalist. *Ecological Applications* 34:e2952.
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REFEREED PUBLICATIONS (CONT.)

Paine, R.T.R., M.W. Rogers, and A.E. Rosenberger. 2024. Early detection and rapid response to the African Walking Catfish in Puerto Rico. Identification and Removal. Final Report to the U.S. Fish and Wildlife Service.

Roberts, A.D., J. Besser, J. Hundley, D.E. Mosby, A.E. Rosenberger, *K.L. Bouska, B.R. Simmons, S.E. McMurray, S. Faiman, and L. Lueckenhoff. 2023. An assessment of the relation between metal contaminated sediment and freshwater mussel populations in the Big River, Missouri. *Science of the Total Environment* 876: <https://doi.org/10.1016/j.scitotenv.2023.162743>. (IP-138980)

Roth, A., P. Wightman, N. M. Mastro, J. Cantrell, C. Ruth Jr., B. S. Cohen, M. J. Chamberlain, and B. A. Collier. 2024. Sex-specific resource use by wild turkeys in response to hunting activity. *Journal of Wildlife Management* 88:e22567.

Sava, E., G. Cervone, and A.J. Kalyanapu. (2023). Multiscale Observation Product (MOP) for Temporal Flood Inundation Mapping of the 2015 Dallas Texas Flood. *Remote Sensing*, 15(6), 1615. <http://dx.doi.org/10.3390/rs15061615>

Sharif, M. B., Hines, T., Ghafoor, S. K., Morales-Hernández, M., Dullo, T., and Kalyanapu, A. J. (2023). A Performance Prediction Model for Structured Grid Based Applications in HPC Environments. 2023 22nd International Symposium on Parallel and Distributed Computing (ISPDC). IEEE. <http://dx.doi.org/10.1109/ispdc59212.2023.00016>

Teitelbaum, C. S., N. M. Mastro, J. D. Sullivan, A. C. Keever, R. L. Poulson, D. L. Carter, A. G. Blake-Bradshaw, C. J. Highway, J. C. Feddersen, H. M. Hagy, R. W. Gerhold, B. S. Cohen, and D. J. Prosser. 2023. North American mallards naturally infected with highly pathogenic avian influenza show few signs of altered local or migratory movements. *Scientific Reports* 13:14473.

PUBLICATIONS IN PRESS/ PENDING

Blake-Bradshaw, A. G., N. M. Mastro, C. J. Highway, A. C. Keever, P. T. Link, J. C. Feddersen, H. M. Hagy, D. C. Osbourne, and B. S. Cohen. 2024. Caught out in the cold: *Anas platyrhynchos* (mallard) survival decreased during an extreme climactic event. *Ornithological Applications*. In press.

Keever, A. C., J. D. Kelly, and B. S. Cohen. Estimating abundance of harvested populations at the management unit scale. *Journal of Applied Ecology*. In revision.

Mastro, N. M., A. C. Keever, A. G. Blake-Bradshaw, C. J. Highway, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Proximity among protected area networks promotes functional connectivity for wintering waterfowl. *Scientific Reports*. In press.

Mastro, N. M., A. G. Blake-Bradshaw, C. J. Highway, A. C. Keever, J. C. Feddersen, P. T. Link, H. M. Hagy, D. C. Osbourne, and B. S. Cohen. Mallard pre-breeding migration strategies necessitate individual time-energy tradeoffs despite wintering origins or migratory destinations. *Ornithological Applications*. In revision.

Szafranski, N., A. G. Blake-Bradshaw, R. Poulson, N. M. Mastro, C. J. Highway, J. C. Feddersen, H. M. Hagy, D. L. Carter, B. S. Cohen., R. W. Gerhold. 2023. Earliest detection of highly pathogenic avian influenza (H5) in Mississippi Flyway wild waterfowl, 2022. *Avian Diseases*. In press.

PRESENTATIONS

Askren, R., P. Lavretsky, A. G. Blake-Bradshaw, C. J. Highway, A. C. Keever, H. M. Hagy, J. C. Feddersen, D. C. Osborne, and B. S. Cohen. 2024. Understanding effects of domestic and wild mallard introgressive hybridization on spring migratory behavior. 9th North American Duck Symposium, Portland, OR, USA.

Ballard, C.E. and M.W. Rogers. 2023. Contributions of stocked and naturally reproduced Rainbow Trout to two Tennessee trout fisheries. Southern Division of the American Fisheries Society Annual Meeting, Norfolk, VA.

Blake-Bradshaw, A. G., N. M. Masto, C. J. Highway, A. C. Keever, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Influence of sanctuary disturbance on waterfowl harvest opportunity. 9th North American Duck Symposium, Portland, OR, USA. Plenary talk.

Blake-Bradshaw, A. G., Masto, N. M., C. J. Highway, A. C. Keever, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2023. Influence of sanctuary disturbance, weather, and landscape characteristics on waterfowl harvest opportunity. 30th The Wildlife Society Annual Conference, Louisville, KY, USA. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.

Blum, P. and J. Murdock. Freshwater Insect-Mediated Polychlorinated Biphenyl Transfer from Freshwater and Terrestrial Ecosystems. Society of Freshwater Science national meeting. Philadelphia, PA.

Ciriacy, J.E. and K. Wheeler. Where the river chubs spawn: a study of Nocomis micropogon nesting habitats. Southern Division, American Fisheries Society annual meeting - 2024.

Cohen, B. S., N. M. Masto, C. J. Highway, P. T. Link, K. Torrance, C. R. Hurt, P. Lavretsky, J. C. Feddersen, D. C. Osborne, and H. M. Hagy. 2024. Hunting as a selective force on migration phenology and a mechanism for stale ducks. 9th North American Duck Symposium, Portland, OR, USA.

Elliot, S. and H. Kinmonth-Schultz presented Characterizing environmental constraints and flowering in endangered *Phytolacca globosa* (*P. globosa*) at the annual Botany meeting in Grand Rapids, MI in June of 2024.

Falke, J.A., J.B. Dunham, A.E. Rosenberger, R.F. Thurow, A. Dolloff, P.J. Howell, and W.C. Saunders. 2024. Standardized sampling of coldwater fish in wadable streams in North America. World Fisheries Congress, Seattle, WA.

Fowler, D., N. M. Masto, S. C. Stemaly, A. C. Keever, M. L. Schummer, P. Lavretsky, A. G. Blake-Bradshaw, C. J. Highway, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Integrating GPS telemetry and 2H isoscapes to identify breeding ground fidelity and dispersal by mallards. 9th North American Duck Symposium, Portland, OR, USA.

Gannod, M., N. M. Masto, C. Owusu, C. J. Highway, K. E. Brown, A. G. Blake-Bradshaw, A. C. Keever, J. C. Feddersen, H. M. Hagy, D. A. Talbert, and B. S. Cohen. 2024. Semantic segmentation of flooded unharvested agriculture using dynamic world, satellite imagery, and machine learning. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.

Gannod, M., N. M. Masto, C. Owusu, C. J. Highway, K. E. Brown, A. G. Blake-Bradshaw, A. C. Keever, J. C. Feddersen, H. M. Hagy, D. A. Talbert, and B. S. Cohen. 2023. Semantic segmentation of flooded unharvested agriculture for waterfowl using multispectral imagery and deep learning architectures. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.

Grubb, B., C.R. Hurt, K. Wheeler, and H.T. Mattingly. The Reticulate Crayfish complex: an example of shifting perspective on crayfish morphology and taxonomy. Tennessee Tech Biology and Environmental Sciences Student Research Colloquium - 2024.

Grubb B, Hurt C, Wheeler K, and Mattingly HT. "An exploratory assessment of crayfish morphology for phylogenetic inference within species complexes." Oral presentation at Southeastern Fishes Council Annual Meeting, Chattanooga, TN. November 2023.

PRESENTATIONS (CONT.)

Grubb B, Hurt C, Wheeler K, and Mattingly HT. "An exploratory assessment of crayfish morphology for phylogenetic inference within species complexes." Oral presentation at Southeastern Meeting of the Society for Freshwater Science, Georgia. November 2023.

Grubb B, Hurt C, Wheeler K, and Mattingly HT. "The Reticulate Crayfish complex: an example of shifting perspective on crayfish morphology and taxonomy." Oral presentation at the American Fisheries Society Southern Division Meeting, Chattanooga, TN. February 2024.

Grubb, B., C.R. Hurt, K. Wheeler, and H.T. Mattingly. An exploratory assessment of crayfish morphology for phylogenetic inference within species complexes. Southeast Chapter, Society for Freshwater Science 2023.

Highway, C. J., A. G. Blake-Bradshaw, N. M. Mastro, and B. S. Cohen. 2023. Hunting constrains wintering mallard response to habitat and environmental conditions. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.

Highway, C. J., N. M. Mastro, A. C. Keever, A. G. Blake-Bradshaw, J. C. Feddersen, H. M. Hagy, D. L. Combs, and B. S. Cohen. 2023. Depletion of unharvested flooded corn by wintering waterfowl. 77th Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Corpus Christi, TX, USA.

Highway, C. J., N. M. Mastro, A. G. Blake-Bradshaw, A.C. Keever, J. C. Feddersen, H. M. Hagy, D. L. Combs, and B. S. Cohen. 2024. Factors affecting use and depletion of unharvested flooded corn by wintering waterfowl. 9th North American Duck Symposium, Portland, OR, USA.

Highway, C. J., A. G. Blake-Bradshaw, N. M. Mastro, A.C. Keever, J. C. Feddersen, H. M. Hagy, D. L. Combs, and B. S. Cohen. 2024. Hunting constrains wintering mallard response to habitat and environmental conditions. 9th North American Duck Symposium, Portland, OR, USA. Awarded "3rd Place Best PhD Student Presentation."

Highway, C. J., J. C. Feddersen, A. C. Keever, N. M. Mastro, A. G. Blake-Bradshaw, H. M. Hagy, B. S. Cohen. 2024. Impacts of refuge connectivity on waterfowl distribution and hunting opportunities in western Tennessee. 9th North American Duck Symposium, Portland, OR, USA.

Highway, C. J., A. G. Blake-Bradshaw, N. M. Mastro, A.C. Keever, J. C. Feddersen, H. M. Hagy, D. L. Combs, and B. S. Cohen. 2024. Wintering mallard response to habitat and environmental conditions when predation risk drives activity patterns. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.

Highway, C. J., J. C. Feddersen, A. C. Keever, N. M. Mastro, A. G. Blake-Bradshaw, H. M. Hagy, B. S. Cohen. 2024. Impacts of refuge connectivity on waterfowl distribution and hunting opportunities in western Tennessee. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.

Holiman, H., A. C. Keever, D. Hanni, B. S. Cohen. 2024. Habitat associations and occupancy of secretive marsh birds in west and central Tennessee. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.

Holiman, H., A. G. Blake-Bradshaw, A. C. Keever, D. Hanni, and B. S. Cohen. 2023. Integrating multiple survey methods to monitor rare marsh bird species in Tennessee. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.

Howard, C. A., H. M. Hagy, and B. S. Cohen. 2024. Rapid assessment models with standardized applications to support bioenergetics modeling. 9th North American Duck Symposium, Portland, OR, USA.

Howard, C. A., A. C. Keever, A. C. Greenawalt, P. R. Garrettson, H. M. Hagy, and B. S. Cohen. 2024. An assessment of wood duck banding needs for the Mississippi and Atlantic Flyways. 9th North American Duck Symposium, Portland, OR, USA.

Howard, C. A., N. M. Mastro, A. J. Hitchcock, N. Wirwa, D. McCarty, H. M. Hagy, and B. S. Cohen. 2023. Rapid yield estimation methods for unharvested rice planted for migratory and wintering waterfowl. 77th Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Corpus Christi, TX, USA.

PRESENTATIONS (CONT.)

- Howard, C. A., A. C. Keever, A. C. Greenawalt, P. R. Garrettson, H. M. Hagy, and B. S. Cohen. 2024. A wood ducks banding needs assessment for the Mississippi and Atlantic Flyways. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.
- Humphries, K. and K. Wheeler. The Middle Collins River is not as barren as we thought: assessment of a newly discovered population of the Barrens Topminnow (*Fundulus julisia*) - poster.
- Humphries, K. and K. Wheeler. The Middle Collins River is not as barren as we thought: assessment of a newly discovered population of the Barrens Topminnow (*Fundulus julisia*) - poster Southeastern Fishes Council annual meeting - 2023.
- Kao, S.-C., Gangrade, S., Morales-Hernandez, M., Ghimire, G., Kalyanapu, A. J., AGU Annual Meeting 2023, "Scaling Up Hydrodynamic Inundation Simulation—How Far Can We Go?," American Geophysical Union, George R. Moscone Convention Center, San Francisco, CA, United States. (December 2023).
- Keever, A.C., G.B. Clevinger, R. Shields, M. K. McBride, J. Sweaney, and B. S. Cohen. 2024. Developing an adaptive harvest management approach for deer and turkey in Tennessee. 50th Annual Meeting of the Southeast Wild Turkey Working Group.
- Keever, A. C., G. B. Clevinger, R. Shields, M. K. McBride, J. Sweaney, and B. S. Cohen. 2024. Developing an adaptive harvest management approach for deer and turkey in Tennessee. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.
- Keever, A. C., J. D. Kelly, and B. S. Cohen. 2023. Estimating abundance of harvested populations at the management unit scale. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.
- Kumetis, T.J. and K. Wheeler. New vs. old: comparing eDNA metabarcoding with conventional electrofishing sampling to monitor fishes in headwaters of western Tennessee.
- Kumetis, T.J., K. Wheeler, R.T. Paine, K. Key, and A. Rosenberger. New vs. old: comparing eDNA metabarcoding with conventional electrofishing sampling to monitor fishes in headwaters of western Tennessee - poster. WTRBA Water Resource Symposium - 2024.
- Kumetis, T.J., K. Wheeler, R.T. Paine, K. Key, and A. Rosenberger. New vs. old: comparing eDNA metabarcoding with conventional electrofishing sampling to monitor fishes in headwaters of western Tennessee - poster
- Kumetis, T., K. Wheeler, R. Paine, K. Key and A. Rosenberger. 2023. New vs old: comparing eDNA metabarcoding with conventional electrofishing sampling to monitor fishes in headwaters of Western Tennessee. SEAFWA Annual Conference. Atlanta, GA.
- Li, J., Dalton Tryba, Justin Murdock. Effects of Changes in Nitrogen and Phosphorus on the Selection of Dominant Algal Genera and Microcystin Production in Rivre Water. Society of Freshwater Science national meeting. Philadelphia, PA.
- Masto, N. M., A. C. Keever, A. G. Blake-Bradshaw, C. J. Highway, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Functional connectivity of waterfowl sanctuaries for wintering mallards in the Mississippi Alluvial Valley. 9th North American Duck Symposium, Portland, OR, USA. Plenary talk. Awarded "Best PhD Student Presentation."
- Masto, N. M., A. G. Blake-Bradshaw, C. J. Highway, A. C. Keever, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Human access constrains optimal foraging and habitat availability of mallards in an agriculturally-dominated landscape. 9th North American Duck Symposium, Portland, OR, USA.
- Masto, N. M., A. C. Keever, A. G. Blake-Bradshaw, C. J. Highway, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2024. Functional connectivity of waterfowl sanctuaries for wintering mallards in the Mississippi Alluvial Valley. 56th Annual Meeting of the Tennessee Chapter of The Wildlife Society, Paris, TN, USA.
- Masto, N. M., A. G. Blake-Bradshaw, C. J. Highway, A. C. Keever, J. C. Feddersen, H. M. Hagy, and B. S. Cohen. 2023. Human access constrains optimal foraging and habitat availability in an avian generalist. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.

PRESENTATIONS (CONT.)

Mattingly, H.T. Ichthyology Guest Lecturer. "Fish conservation research in the School of Environmental Studies at Tennessee Tech University." Department of Biology, The University of the South, Seawane, TN. October 2023.

Mosel, K., W. Budnick, J. Vallazza, D.K. Gibson-Reimemer, J. Tompkins, T. Spier, M. Rogers, C. Harty, D. Appel, M.K. Brey, and A. Fritts. 2024. Assessing Silver Carp passage at three locks and dams on the Tennessee and Cumberland rivers. Southern Division of the American Fisheries Society Annual Meeting, Chattanooga, TN.

Murdock, J. Evaluating the success of wetland functional recovery can depend on when and where data are collected. West Tennessee Water Resources Symposium. Jackson, TN.

Murdock, J. Measuring the trajectory of ecosystem functional return in restored agricultural wetlands: When is a wetland restoration goal reached? Tennessee American Water Resources Association Meeting. Montgomery Bell State Park, TN.

Murdock, J. Evaluating the success of wetland functional recovery can depend on when and where data are collected. Society of Freshwater Science national meeting. Philadelphia, PA.

Paine, R.T.R., M.W. Rogers, and A.E. Rosenberger. 2024. Early detection and rapid response to the African Walking Catfish in Puerto Rico. Identification and Removal. Final Report to the U.S. Fish and Wildlife Service.

Paine, R.T.R., M.W. Rogers, and A.E. Rosenberger. 2024. Environmental DNA surveillance of a *Clarias* catfish in southeastern Puerto Rico. September 2024. American Fisheries Society Annual Meeting.

Paine, R.T.R., M.W. Rogers, C.R. Harty, and T.J. Flanagan. 2024. Molecular surveillance of invasive carp reproduction in Tennessee reservoirs. September 2024. American Fisheries Society Annual Meeting.

Porter, Z. and J. Murdock. Identifying Tradeoffs in Ecosystem Services due to Restoration Practices in Restored Agricultural Wetlands. Society of Freshwater Science national meeting. Philadelphia, PA.

Porter, Z. and J. Murdock. Identifying Tradeoffs in Ecosystem Services Due to Restoration Practices in Restored Agricultural Wetlands. Tennessee American Water Resources Association Meeting. Montgomery Bell State Park, TN.

Riggs, A., A. C. Keever, Z. Danks, R. Shields, and B. S. Cohen. Harvest of survival rates of male eastern wild turkeys in Kentucky and Tennessee. 50th Annual Meeting of the Southeast Wild Turkey Working Group.

Riggs, A. M., A. C. Keever, S. Watkins, R. Shields, Z. Danks, and B. S. Cohen. 2023. Variation in harvest and survival rates of male eastern wild turkeys in Kentucky and Tennessee. 30th The Wildlife Society Annual Conference, Louisville, KY, USA.

Rine, M.A., and K. Wheeler. Spatiotemporal fish assemblage patterns associated with fluctuating flow in a Cumberland River watershed in Tennessee (3rd place, best student presentation). Tennessee Geographic Information Council annual conference - 2024.

Rine, M.A. and K. Wheeler. Temporal fish assemblage patterns associated with fluctuating flow in a Cumberland River watershed in Tennessee - poster.

Robinson, O., N. M. Masto, M. G. Brasher, A. G. Blake-Bradshaw, C. J. Highway, A. C. Keever, J. C. Feddersen, H. M. Hagy, D. C. Osborne, D. L. Combs, and B. S. Cohen. Validating eBird using GPS telemetry to inform waterfowl responses to extreme weather event. 9th North American Duck Symposium, Portland, OR, USA.

Rosenberger, A.E. 2023. Direction of mussel research in Tennessee: A strategic approach and instream flow. Tennessee River Basin Network Annual Meeting. Florence, AL.

Rosenberger, A.E. and K.I. Womble. 2023. The history of freshwater mussels in the Duck River, Tennessee. Presentation to the Duck River Agency Annual Meeting, Henry Horton State Park, TN.

PRESENTATIONS (CONT.)

Sallack, K., K.N. Key, K. Irwin Womble, and A.E. Rosenberger. 2023. Initiating freshwater mussel research in the Hatchie River. Tennessee Chapter of the American Fisheries Society Annual Meeting. Chapel Hill, TN.

Sallack, K., K.N. Key, K. Irwin Womble, and A.E. Rosenberger. 2023. Initiating freshwater mussel research in the Hatchie River. West Tennessee Water Resources Symposium. Jackson, TN.

Torrance, K., M. Rogers, C. Hurt, and J. Hammonds. 2023. Genetic Contributions of Hatchery-Stocked Walleye to Douglas Reservoir, Southern Division of the American Fisheries Society Annual Meeting, Norfolk, VA.

Tryba, D., Li, J., and Murdock, J. Identifying Thresholds and Optimal Ranges of Light for Algal Growth in Large Rivers. Society of Freshwater Science national meeting. Philadelphia, PA.

Tryba, D. and J. Murdock. Identifying optimal ranges of light for harmful algal growth in riverine algae. Tennessee American Water Resources Association Meeting. Montgomery Bell State Park, TN.

Womble, K.I., A.E. Rosenberger, and K.N. Key. 2024. Expansion of a comprehensive freshwater mussel database for the state of Tennessee. Compiling mussel assemblage information for West Tennessee drainages. Poster presentation for West Tennessee River Basin Conference. Jackson, TN.

Womble, K.I., A.E. Rosenberger, and G.R. Dinkins. 2023. A comprehensive freshwater mussel database for the Duck River drainage, Tennessee: The history of mussels in a priority watershed. Freshwater Mollusk Conservation Society Symposium. Portland, OR.

HOURLY STUDENT SUPPORT

Name	Department
Nayaf Alshammari	CEE
Bobbie Baker	CEE
Matthew Boyd	EARTH SCI
Nicholas Brewer	BIOL
Amelia Browder	CEE
Lydia Burton	EVS
Grace Butler	CEE
Lillian Caldwell	BIOL
Abigail Clagg	BIOL
Gabriela DeAlmeida	EVS
Tori Denney	CEE
Jeremy Eduave	CEE
Gavin Erger	BIOL
Mason Fike	BIOL
Sarah Finkle	CEE
Connor Gardner	WFS
Zoe Gibson	CEE
Abigail Harold	CEE
Margaret Hartley	CEE
Garrett Hayes	CSC
Harley Haynes	BIOL
Isaac Hollingsworth	CEE
Kennedy Irwin	WFS
Dylan Johnson	BIOL
Kyle Kigar	ES
Anthony Lamantia	ES
Elizabeth McCurry	EVS
Dominic Olson	CEE
Alexander Peeler	CEE
Richard Prosser	CEE
Peyton Purgiel	ES
Mason Pyburn	BIOL
Hannah Rockensock	CEE
Connor Rollins	BIOL
Eduardo Toala-Hidalgo	WFS
Maggie Uehling	CEE
Victoria Weldon	WFS
Nathan Whiteaker	CSC
Effie White	CEE
Riley Widdiefield	BIOL
Katherine Wiczorek	BIOL
Nicholas Wiegand	BIOL
Annabella Wilhelm	CEE

SCHEDULE 7

CENTERS OF EXCELLENCE ACTUAL, PROPOSED AND REQUESTED BUDGET

Expenditures	FY 2023-24 Actual			FY 2024-25 Proposed			FY 2025-26 Requested		
	Matching	Appropri.	Total	Matching	Appropri.	Total	Matching	Appropri.	Total
Salaries									
Faculty	\$170,798	\$53,470	\$224,258	\$154,558	\$0	\$154,558	\$157,650		\$157,650
Other Professional	\$399,372	\$273,486	\$672,858	\$235,135	\$458,585	\$693,720	\$239,840	\$410,667	\$650,507
Clerical/Supporting	\$65,800	\$57,452	\$123,252	\$170,715	\$40,620	\$211,335	\$174,130	\$43,465	\$217,595
Assistantships	\$747,543	\$307,042	\$1,054,585	\$331,563	\$338,101	\$669,664	\$338,195	\$347,108	\$685,303
Total Salaries	\$1,383,503	\$691,450	\$2,074,953	\$891,971	\$837,306	\$1,729,277	\$909,815	\$801,240	\$1,711,055
Fringe Benefits	\$437,461	\$354,865	\$792,326	\$265,565	\$382,410	\$647,975	\$271,343	\$367,162	\$638,505
Total Personnel	\$1,820,964	\$1,046,315	\$2,867,279	\$1,157,536	\$1,219,716	\$2,377,252	\$1,181,158	\$1,168,402	\$2,349,560
Non-Personnel									
Travel	\$192,708	\$17,925	\$210,633	\$172,686	\$23,663	\$196,349	\$176,140	\$21,000	\$197,140
Software		\$21,334	\$21,334			\$0		\$6,000	\$6,000
Books & Journals			\$0			\$0			\$0
Other Supplies	\$797,250	\$135,921	\$933,171	\$642,925	\$230,442	\$873,367	\$855,784	\$209,315	\$865,099
Equipment	\$30,000	\$270,735	\$300,735	\$64,000		\$64,000	\$65,280	\$25,000	\$90,280
Maintenance		\$98,875	\$98,875			\$0			\$0
Scholarships	\$8,816		\$8,816			\$0			\$0
Consultants	\$241,593	\$1,313	\$242,906	\$165,000		\$165,000	\$177,500		\$177,500
Renovation			\$0			\$0			\$0
Other (Specify):			\$0			\$0			\$0
			\$0			\$0			\$0
			\$0			\$0			\$0
			\$0			\$0			\$0
Total Non-Personnel	\$1,270,367	\$546,103	\$1,816,470	\$1,044,611	\$254,105	\$1,298,716	\$1,074,704	\$261,315	\$1,336,019
GRAND TOTAL	\$3,091,331	\$1,592,418	\$4,683,749	\$2,202,147	\$1,473,821	\$3,675,968	\$2,255,862	\$1,429,717	\$3,685,579
Revenue									
New State Appropriation		\$1,344,800	\$1,344,800		\$1,377,500	\$1,377,500		\$1,429,717	\$1,429,717
Carryover State Appropriation		\$557,817	\$557,817		\$310,199	\$310,199			\$0
New Matching Funds	\$3,091,331		\$3,091,331	\$2,202,147		\$2,202,147	\$2,255,862		\$2,255,862
Carryover from Previous Matching Funds			\$0			\$0			\$0
Total Revenue	\$3,091,331	\$1,902,617	\$4,993,948	\$2,202,147	\$1,687,699	\$3,889,846	\$2,255,862	\$1,429,717	\$3,685,579



Budget Note: The Center for the Management, Utilization and Protection of Water Resources requests a five percent budget increase for the 2024-2025 fiscal year to accommodate potential increases in salaries and other supplies and equipment expenses.

Center Director and Contributor: Dr. Hayden Mattingly
Designer/Writer: Dr. Amy Hill

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August 2024

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Inquiries regarding Title IX may be referred to Tennessee Tech's Title IX Coordinator, Derryberry Hall 256, 931-372-3112, TitleIX@tntech.edu, or to the U.S. Department of Education Office of Civil Rights, 800-421-8339, OCR@ed.gov.