Global Center for Aquatic Health and Food Security

Mississippi State University

Annual Report: January – December 2024

Contents

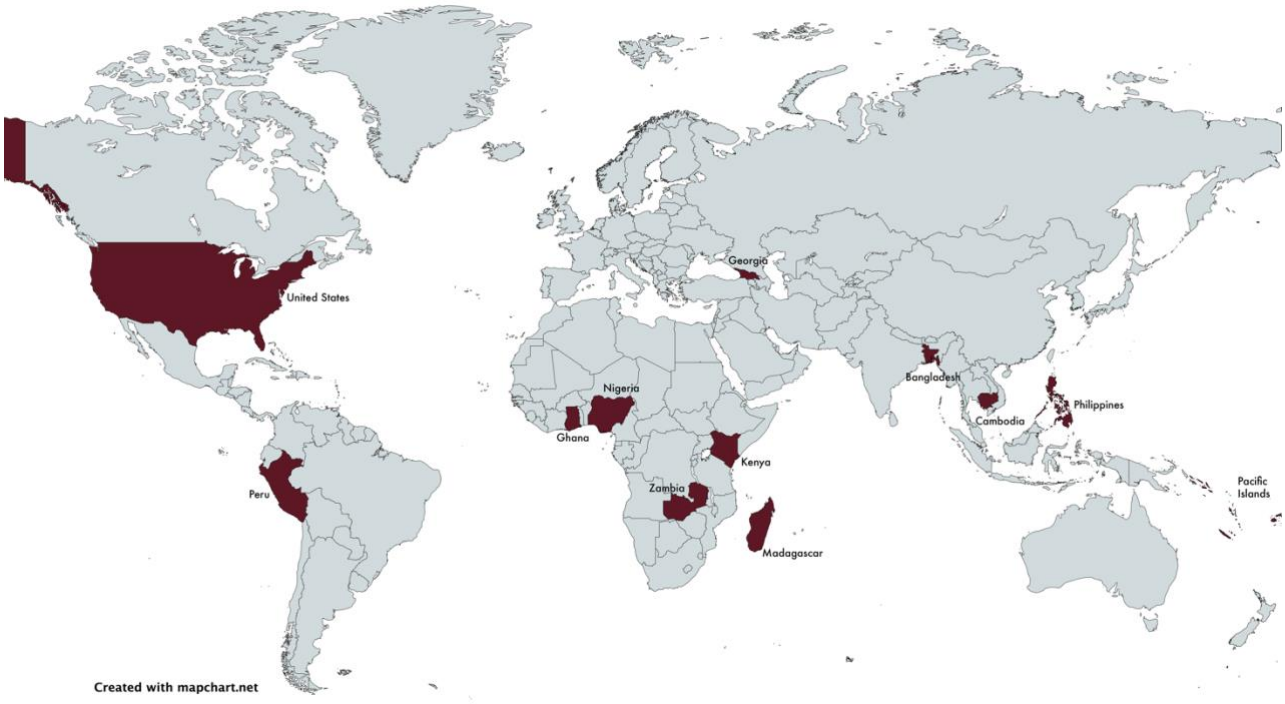
Mission

The Global Center for Aquatic Health and Food Security (GCAHFS) furthers the mission of Mississippi State University in service by engaging MSU faculty in domestic and international development. Faculty service aims at improving aquatic health, reducing world hunger, and building capacity to support healthy aquatic ecosystems and sustainable aquaculture and fisheries. GCAHFS furthers the university's mission in research by engaging MSU faculty in investigative research to address problems in aquatic health and food security. In addition, GCAHFS furthers the university's mission in teaching by promoting and supporting knowledge transfer and student exchange between the U.S. and other countries as well as increasing learning opportunities for students, staff, and faculty.

Vision

GCAHFS actively pursues development of aquatic health and food security in the U.S. and abroad. Because of the importance of aquaculture to the state of Mississippi, MSU has longstanding strength and expertise in aquatic health and food security. GCAHFS serves as a facilitator to engage MSU faculty, staff, and students in domestic and international development. Specifically, GCAHFS addresses the health of aquatic environments by improving the impact of these important ecosystems on the quality of life of humans, increasing food production and security, implementing aquatic animal disease mitigation strategies, supporting aquaculture technology development and adoption, and promoting sustainable aquatic resource management.

Countries with Activities



Food and Agriculture Organization of the United Nations Reference Center on Antimicrobial Resistance and Aquaculture Biosecurity

Mississippi State University is designated as a Food and Agriculture Organization of the United Nations (FAO) Reference Center on Antimicrobial Resistance (AMR) and Aquaculture Biosecurity, which is managed by GCAHFS. The reference center provides independent technical and scientific advice and supports FAO's mandate for agricultural and aquacultural development and food security. MSU and GCAHFS are committed to supporting and serving the needs of the Mississippi aquaculture industry, and the university's recognition as an FAO reference center will enable its experts to address the global issues of antimicrobial resistance, reducing the burden of disease in aquaculture.

Personnel

Name	MSU affiliation	FAO reference center role
Dr. Stephen Reichley	Assistant Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Head
Dr. Matt Griffin	Research Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Technical Working Group Member
Dr. Larry Hanson	Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Technical Working Group Member
Dr. Mark Lawrence	William L. Giles Distinguished Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Technical Working Group Member
Dr. Michael Sandel	Assistant Professor, Wildlife, Fisheries and Aquaculture, College of Forest Resources	Technical Working Group Member
Dr. Fernando Yamamoto	Assistant Research Professor, Wildlife, Fisheries and Aquaculture, College of Forest Resources	Technical Working Group Member

Successes and Impact

In 2024, the FAO Reference Center advanced global aquatic health through 26 publications and 52 presentations. Highlights included a workshop uniting six MSU departments, international training on genomic tools for AMR, and leadership in the Progressive Management Pathway for Aquaculture Biosecurity. Breakthroughs included identifying virulence genes in *Flavobacterium columnare* and *Edwardsiella ictaluri* and diagnosing a drug-resistant *Acinetobacter* infection in a

beaver with zoonotic implications. These efforts underscore MSU's leadership in addressing AMR challenges through research, collaboration, and global capacity-building in the One Health context. Learn more about the FAO Reference Center on AMR and Aquaculture Biosecurity at www.gcahfs.msstate.edu/projects/fao-reference-center-antimicrobial-resistance-and-aquaculture-biosecurity.

Student Engagement

Rideeta Islam Aishy, a graduate research assistant pursuing a Master of Science in veterinary and biomedical science with an infectious diseases concentration in the College of Veterinary Medicine, won the top prize for her poster presentation on AMR in *Edwardsiella ictaluri*, a key pathogen in channel catfish, at the American Society for Microbiology meeting for the South Central and Kentucky-Tennessee branches in the fall of 2024.

"My research shows that antibiotic pressure drives genetic alterations in bacteria, such as single nucleotide polymorphisms or inversions and deletions, leading to AMR," Aishy said. "These selective pressures ensure the persistence of resistant pathogens, highlighting the complexity of AMR mechanisms. This suggests that antibiotics may lose efficacy over time, leading to the emergence of multidrug-resistant pathogens."

Learn more about Aishy's presentation and research here:
https://www.gcahfs.msstate.edu/news/2025/02/stopping-spread-antimicrobial-resistance

Divya Rose, a PhD candidate in veterinary biomedical science with a concentration in infectious disease in the College of Veterinary Medicine, gave two talks at the 2024 American Fisheries Society (AFS), Fish Health Section (FHS) annual meeting in Boise, ID. Rose received the virtual Summer Seminar Series "Best Student Presentation" award in 2023, which provided her travel support to attend the in-person meeting and present her work this year. The talks focused on how management strategies for bacterial disease outbreaks impact the environmental microbiome of catfish ponds and targeted approaches to identify potential environmental reservoirs of AMR in catfish production systems. Unraveling the complexities of microbial community dynamics in catfish ponds is an essential step in mitigating potential reservoirs of AMR within the industry.

"The virtual Summer Seminar Series organized by the AFS, FHS has been a great opportunity for students and early career professionals to share their research and network within the fish health community over the last four years," she said. "Personally, it has helped me a lot in terms of learning, sharing, and knowing what's happening in fish health."

Learn more about Rose's presentations here:
https://www.gcahfs.msstate.edu/news/2024/10/student-research-antimicrobial-resistance-assists-mississippi-delta-catfish-producers

Feed the Future Innovation Lab for Fish

Funded by the U.S. Agency for International Development (USAID), the Feed the Future Innovation Lab for Fish (Fish Innovation Lab) works to reduce poverty and improve nutrition, food security, and livelihoods in partner countries by supporting research on sustainable aquatic food systems. The Fish Innovation Lab supports and links research partners around the globe to identify, develop, and scale promising methodologies and technologies for local fish farming and to intensify and diversify major aquatic food production systems where the poor and undernourished are concentrated. Through competitive research subawards, the Fish Innovation Lab funds country-focused research and capacity-building activities. These subawards constitute an integrated, cooperative, multi-institutional research program that aims to produce applicable research results, increase the capacity of local partners, and support the adoption of new innovations.

Active Grants

1. M. L. Lawrence, S. R. Reichley, G. R. Mendez, P. Allen. 2023-2028. Feed the Future Innovation Lab for Fish. USAID (Feed the Future), $30,000,000.

Personnel

Name	MSU affiliation	Fish Innovation Lab role
Dr. Mark Lawrence	William L. Giles Distinguished Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Director
Dr. Stephen Reichley	Assistant Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Deputy Director
Dr. Peter Allen	Professor, Wildlife, Fisheries and Aquaculture, College of Forest Resources	Aquaculture Advisor
Alaina Dismukes	Communications Specialist, Pathobiology and Population Medicine, College of Veterinary Medicine	Communications Specialist
Dr. Gina Rico Mendez	Assistant Research Professor, Social Science Research Center	Research and Learning Manager
Joy Nabors	Communications Consultant and Intermittent Worker, Comparative Biomedical Sciences, College of Veterinary Medicine	Communications Consultant/Intermittent Worker (through August 2024)

Misty Nabors	Data Management Coordinator, Pathobiology and Population Medicine, College of Veterinary Medicine	Data Management Coordinator (as of March 2024)
Dr. Mary Read-Wahidi	Associate Research Professor, Social Science Research Center	Gender and Social Inclusion Specialist
Masey Smith	Program Manager, Pathobiology and Population Medicine, College of Veterinary Medicine	Program Manager
Kelly Stewart	Business Manager, Pathobiology and Population Medicine, College of Veterinary Medicine	Business Manager
Laura Zseleczky	Marketing and Communications Manager, Pathobiology and Population Medicine, College of Veterinary Medicine	Marketing and Communications Manager

Successes and Impact

The Feed the Future Innovation Lab for Fish (Fish Innovation Lab) was awarded a 5-year, up to $15 million extension in September 2023 after successful completion of its first 5-year phase from 2018–2023. In 2024, or Year 1 of Phase 2, the Fish Innovation Lab selected and launched six 1-year Startup and Scaling Activities (SSAs) through a rigorous application and review process. The selected activities operated in the Fish Innovation Lab's four primary focus countries: Bangladesh, Kenya, Nigeria, and Zambia. The activities addressed all three of the program's disciplines of aquaculture, fisheries, and nutrition and all three areas of inquiry: climate-smart aquatic system innovations, nutrition and food systems, and access to improved inputs. As the program's Management Entity, GFCAHFS provided administrative, fiscal, programmatic, and research support to partners during the SSA onboarding process and activity implementation to strengthen their capacity and reduce institutional and administrative barriers to implementing USAID-funded activities.

The Fish Innovation Lab's Request for Applications (RFA) for its Phase 2 research portfolio was informed by input from a variety of stakeholders and widely disseminated through the Fish Innovation Lab's communication channels and partner networks. This resulted in receipt of 162 concept notes. After review, full proposals were invited, and 40 were received. A rigorous review process was managed for the full proposals, with each proposal receiving four independent reviews, including one external reviewer for each. Fourteen proposals for 3-year research activities were contingently selected to proceed to a "co-creation" process involving input and feedback from the Management Entity before submission to USAID for official approval.

The Fish Innovation Lab Management Entity worked with SSA teams to strengthen capacity and set targets for standard USAID indicators used to measure program impacts. A new indicator on child nutrition, which emphasized efforts to improve health outcomes and livelihoods for

vulnerable populations, was adopted and implemented. Fish Innovation Lab research activities developed nine early-stage technologies, practices, and approaches in 2024. Across the SSAs, 60 individuals participated in U.S. Government (USG) food security programs, and 33 children under 5 years old were reached with nutrition-specific interventions. SSAs enrolled seven new individuals in USG-supported degree-granting, non-nutrition-related food security training programs, while 29 individuals participated in USG-supported nutrition-related professional training programs to improve nutrition-related professional skills. Additionally, research conducted by the Fish Innovation Lab resulted in 11 peer-reviewed articles.

The Fish Innovation Lab's Phase 2 External Advisory Board (EAB) members were selected. They are a diverse group of highly qualified specialists representing aquaculture, nutrition, and fisheries. The EAB members are world-renowned individuals who impact food systems and food security with almost 200 years of combined experience in relevant sectors and research for development.

These achievements were amplified through the Fish Innovation Lab's website, newsletter, and growing social media presence, which expanded from Facebook and X (previously Twitter) to include LinkedIn in 2024. This effort highlights the interwoven, synergistic potential between digital communication and on-the-ground efforts.

Cross-activity learning and collaboration were advanced at the virtual Annual Meeting, which incorporated USAID's adaptive management approach to pause and reflect on SSA implementation and scaling plans. The event fostered a Fish Innovation Lab community of practice and included a specific focus on SSA teams engaging the Product Life Cycle to advance and promote scaling of technologies and improved practices.

Student Engagement

Katie Roman, an undergraduate animal and dairy science major at MSU, assisted Dr. Kathleen Ragsdale and colleagues on a trip to Zambia as part of the Fish Innovation Lab's Scaling Fish Powder in Zambia activity. Roman was an intern with MSU's Social Science Research Center, supported through the College of Agriculture and Life Sciences (CALS)/Mississippi Agricultural and Forestry Experiment Station (MAFES) Undergraduate Research Scholar Program. While in Zambia, she assisted Ragsdale and fellow researchers in implementing nutrition and food safety trainings as well as assisting with sensory panels to evaluate the acceptability of four varieties of Complementary Food for Africa+Dried Fish Powder (ComFA+Fish) instant porridge. Learn more in the blog post she wrote about her experience.

Gulf Coast Aquatic Health Lab

The Gulf Coast Aquatic Health Lab (GCAHL) operates from Gautier, Mississippi, and Starkville, Mississippi, and aims to protect and maintain the health of aquatic animals through cutting-edge veterinary care, innovative research, and sustainable solutions. Ongoing projects focus on support for marine mammal cause-of-death investigations and sea turtle conservation, recovery, and monitoring activities. Additional projects being developed in the GCAHL will focus on investigating the interrelationships among viruses, microorganisms, and aquatic animals, which significantly impact global biochemical cycles, aquatic animals, and ocean health.

Active Grants

1. Lawrence, M.L., S.R. Reichley, B. Peterman, D. Moore, K. McNulty, and A. Lee. 2023-2026. Enhance conservation of sea turtles in Mississippi state waters by strengthening capacity for science-based animal health and management. Mississippi Department of Environmental Quality (Natural Resource Damage Assessment), $2,175,000.

2. Lawrence, M.L., S.R. Reichley, B. Peterman, D. Moore, and K. McNulty. 2023-2026. Enhance conservation of bottlenose dolphins in Mississippi state waters by strengthening capacity for science-based marine mammal health and management. Mississippi Department of Environmental Quality (Natural Resource Damage Assessment), $2,044,500.

3. Reichley, S.R., B. Peterman, and M.L. Lawrence. 2023-2026. Establishing the Mississippi State University Gulf Coast Aquatic Health Laboratory. National Oceanographic and Atmospheric Administration, $1,800,000.

4. Lawrence, M. L., S.R. Reichley, D. Moore, T. Morgan, W. Epperson, A. Karsi, and D. Peterson. 2021-2024. Evaluation and monitoring of marine mammal and sea turtle abundance, population health, habitat delineation, and restoration resulting from the opening of the Bonnet Carré Spillway. Mississippi Department of Marine Resources (Gulf of Mexico Energy Security Act), $2,474,573.

Personnel

Name	MSU affiliation	Gulf Coast Aquatic Health Lab role
Dr. Mark L. Lawrence	William L. Giles Distinguished Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Leadership
Dr. Stephen Reichley	Assistant Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Leadership
Dr. Beth Peterman	Assistant Clinical Professor,	Project Manager

	Pathobiology and Population Medicine, College of Veterinary Medicine	
Mark Arick II (Tony)	Computer Specialist and Biocomputing Lead, Institute for Genomics, Biocomputing, and Biotechnology	Genomics Specialist
Dr. Caroline Betbeze	Associate Clinical Professor, Clinical Sciences, College of Veterinary Medicine	Ophthalmologist
Dr. Alexandra Emelianchik	Clinical Instructor I, Pathobiology and Population Medicine, College of Veterinary Medicine	Clinical Veterinarian
Dr. William Epperson	Professor and Head, Pathobiology and Population Medicine, College of Veterinary Medicine	Epidemiologist
Basant Gomaa	Postdoctoral Research Associate, Comparative Biomedical Sciences, College of Veterinary Medicine	Postdoctoral Research Associate
Jill Hudnall	Research Associate I, Pathobiology and Population Medicine, College of Veterinary Medicine	Research Associate I
Dr. Isaac Jumper	Assistant Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Epidemiologist
Dr. Barbara Kaplan	Associate Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Toxicologist
Dr. Attila Karsi	Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Geneticist
Dr. Alison Lee	Assistant Professor, Clinical Sciences, College of Veterinary Medicine	Radiologist
Dr. Kaylin McNulty	Assistant Clinical Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Pathologist
Dr. Paul Mickle	Co-Director, Associate Research Professor, Northern Gulf Institute	Ecologist

Dr. Todd Mlsna	Professor, Chemistry, College of Arts and Sciences	Chemist
Dr. Debra Moore	Assistant Clinical Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Clinical Veterinarian
Ryanne Murray	Research Associate I, Pathobiology and Population Medicine, College of Veterinary Medicine	Research Associate I
Dr. Daniel Peterson	Professor and Director, Institute for Genomics, Biocomputing, and Biotechnology	Genomics Specialist
Dr. Natalie Stilwell	Assistant Clinical Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Microbiologist
Kelly Stewart	Business Manager, Pathobiology and Population Medicine, College of Veterinary Medicine	Business Manager
Dr. John Thomason	Associate Professor, Clinical Sciences, College of Veterinary Medicine	Internist
Dr. Robert Wills	Professor, Comparative Biomedical Sciences, College of Veterinary Medicine	Epidemiologist
Dr. Arun Venugopalan	Assistant Research Professor, Pathobiology and Population Medicine, College of Veterinary Medicine	Researcher

Successes and Impact

Funding for GCAHL activities in 2024 was provided by the Natural Resource Damage Assessment (NRDA) administered by the Mississippi Department of Environmental Quality (MDEQ), the Gulf of Mexico Energy Securities Act (GOMESA) administered by the Mississippi Department of Marine Resources (MDMR), and the National Oceanographic and Atmospheric Administration (NOAA).

Initial funding for GCAHL began in 2018 through support provided by the National Fish and Wildlife Foundation (NFWF) which concluded on November 30, 2023. GCAHL transitioned seamlessly into NRDA funding on December 1, 2023. With this support through GCAHFS, the College of Veterinary Medicine (CVM) remains one of the few veterinary programs nationwide that provide all veterinary students with hands-on marine animal medicine experience.

Since its inception, the program has provided training of veterinary students or interns on diagnostic imaging of sea turtles. In 2017, nine students or interns received training in sea turtle diagnostic imaging interpretation; by 2023, all CVM veterinary radiology interns and residents were trained, and training continues for all incoming radiology interns and residents. This opportunity has not only expanded their education but also has increased their professional marketability.

GCAHL supports hands-on training and experience in necropsy of marine mammals and sea turtles to veterinarians, students, and stranding network members through funding from NRDA. In addition, GCAHL provides instruction in the care of rehabilitating sea turtles, helping to build veterinary capacity in aquatic animal health. The program also supports veterinary student participation in CVM's Veterinary Medical Research Scholars (VMRS) program, offering opportunities to conduct research on marine mammals and sea turtles that would not have been available without this funding.

MSU collaborates with the Institute for Marine Mammal Studies to enhance stranding response and diagnostic capabilities for stranded marine mammals and sea turtles, supporting NRDA objectives. This partnership maintains timely and effective response stranding times for marine mammals and sea turtles across Mississippi's coastline.

GCAHL also analyzes baseline mortality trends and identifies common diseases impacting dolphin and sea turtle populations in the Mississippi Sound with support from NRDA. This information is important for making policy and management decisions that reflect the changing health and diseases affecting dolphins, sea turtles, and their environment in the northern Gulf of America.

The program has strengthened the stranding response and cause-of-death investigations of marine animals. CVM diagnostic laboratory system capacity has expanded by adding testing capabilities for Cetacean morbillivirus and *Brucella* sp. This testing has allowed for increased individual- and population-level health analysis. Additionally, the CVM diagnostic laboratory system can now conduct testing for marine mammals, extending the regional and national capacity for morbidity and mortality investigations.

GCAHL improves capacity and quality of veterinary care for sea turtles during rehabilitation with support from NRDA, resulting in greater numbers of rehabilitated sea turtles released in the Mississippi Sound. The establishment of the Sea Turtle Health Steering Committee has ensured high-quality care and assurance of sea turtle health when they are released in the Mississippi Sound. The sea turtles that were released during this project will help ensure long-term sustainability of the Kemp's ridley sea turtle population, and the established capacity at CVM will provide long-term support for the sea turtle population.

In 2024, GCAHL continued and finalized investigations into the increased dolphin and sea turtle mortalities that have occurred since the opening of the Bonnet Carré Spillway (BCS) in 2019. GCAHFS analyzed samples from marine mammal and sea turtle carcasses collected both before

and after the BCS openings. Epidemiological analysis incorporated findings from pathology, toxicology, and microbiology to determine likely causes of death for the affected animals and whether they were associated with the freshwater incursions. This work was funded through GOMESA until September 14, 2024. Funding for analysis to assess environmental factors affecting the health of dolphins in the Mississippi Sound (MSS) is being pursued for expansion of this project to examine the effects of freshwater from Mississippi River diversion compared to native Mississippi rivers draining into the MSS on mortalities of bottlenose dolphins. Common bottlenose dolphins are an important natural resource and, as apex predators, their health reflects the environmental health of the Mississippi Sound, which is a critical economic and natural resource for Mississippi. Findings will help to inform the Mississippi Department of Marine Resources (MDMR) for management decisions on mitigating threats to the health of fish, wildlife, and natural resources in Mississippi waters.

GCAHL is establishing a laboratory and support offices through funding from NOAA. The laboratory is strategically designed to be consistent with and support NOAA Fisheries' mission to provide responsible stewardship of the nation's ocean resources and their habitat. The laboratory will be used for research and diagnostic activities to support health of aquatic organisms in the Gulf of America. An active search for an assistant research professor began in September 2023 and continued into 2024, resulting in a successful hire to provide support for grant objectives. The assistant research professor began in July 2024.

Student Engagement

- All MSU CVM veterinary radiology interns and residents are trained in interpretation of sea turtle diagnostic imaging. This opportunity has not only expanded their education but has increased their professional marketability.

- Veterinary Medical Research Scholars (VMRS) program provides veterinary students research opportunities to investigate morbidity and mortality of marine mammals and sea turtles. Students who participated in 2024 are

    - Linda Marcano, DVM Class of 2027
    - Savannah Johnston, DVM Class of 2027

- The activities funded by the GCAHL under the CVM Laboratory Services Rotation have established an overnight trip for CVM veterinary students to Gulfport during the rotation. This rotation is part of the core curriculum for CVM's Doctor of Veterinary Medicine degree. This trip includes hands-on clinical and necropsy activities. In 2024, 120 students participated in the rotation. Because of this trip, CVM is able to provide every veterinary student hands-on exposure to marine mammal and marine animal medicine.

- Since 2022, GCAHFS has provided care for approximately 30 cold-stunned sea turtles in December from New England for rehabilitation. These turtles are transported to

Mississippi for specialized care and recovery before being released back into the MS Sound. This is an opportunity for DVM and VMT students to gain hands-on experience with sea turtle rehabilitation, and approximately 10 students have participated in the intake process each year.

- Sea turtle release events, commonly attended by students, staff, and faculty occur throughout the year. These events provide a wonderful opportunity to celebrate the work and care provided to be able to return the turtles to their habitat.
    - January 13, 2024 – 1 juvenile Kemp's ridley sea turtle
    - March 21, 2024 – 3 juvenile Kemp's ridley sea turtles
    - April 17, 2024 – 2 juvenile Kemp's ridley sea turtles
    - April 26, 2024 – 3 juvenile Kemp's ridley sea turtles
    - May 17, 2024 – 6 juvenile Kemp's ridley sea turtles
    - June 21, 2024 – 11 juvenile Kemp's ridley sea turtles
    - August 1, 2024 – 5 juvenile Kemp's ridley sea turtles
    - October 1, 2024 – 1 subadult loggerhead sea turtle
    - October 15, 2024 – 1 juvenile Kemp's ridley sea turtle
    - November 15, 2024 – 2 juvenile Kemp's ridley and 1 juvenile green sea turtle
    - December 30, 2024 – 1 subadult loggerhead sea turtle
- Marine Animal Health Canvas course: *Marine Monday!* is a monthly seminar series that brings in speakers from around the world to discuss contemporary topics relevant to marine health and is facilitated by Dr. Beth Peterman. Students, staff, and faculty participate in these discussions with world-renowned experts in many disciplines related to the marine environment.
    - January 2024 – "Interesting Cases from a Public Aquarium Veterinarian" presented by Dr. Julie Cavin
    - February 2024 – "Manatee Medicine in Rescue and Rehabilitation" presented by Dr. Stacy DiRoccio
    - March 2024 – "Marine Mammals and Some Things I Have Learned and Do for Them – An Ophthalmologist Perspective" presented by Dr. Carmen Colitz
    - April 2024 – "DolFUN Cases with Dr. McNulty" presented by Dr. Kaylin McNulty
    - May 2024 – "From Ocean to Aquarium – A Veterinary Focus on the Marine Ornamental Industry" presented by Dr. Natalie Stilwell
    - July 2024 – "The Spirits We Called – PFAS in the Marine Environment and Their Consequences" presented by Dr. Catharina Vendl
    - August 2024 – "Impact of a Freshwater Incursion on Chemical Contaminants in Tissues of Dolphins that Stranded in the MS Sound (MSS)" presented by Dr. Barb Kaplan
    - September 2024 – "Dental Disease in Marine Mammals" presented by Dr. Alex Emelianchik

- October 2024 – “Shoreline Conservation and Restoration” presented by Dr. Eric Sparks
- November 2024 – “Acute Phase Reactants in Marine Species Introduction and Applications” presented by Dr. Carolyn Cray
- December 2024 – “A Day in the Life of an Aquarium Veterinarian” presented by Dr. Ashley Kirby

- Marine Animal Veterinary Externships are available to third- and fourth-year veterinary students from MSU CVM and other veterinary schools with specific interest in marine animal medicine. Externs in 2024:
  - Sarah Ashlyn Barber – Mississippi State University College of Veterinary Medicine, April 8 – May 3, 2024
  - Hannah Renfroe – Mississippi State University College of Veterinary Medicine, May 28 – June 17, 2024
  - Jenna Balk – Virginia-Maryland College of Veterinary Medicine, July 1 – July 19, 2024

- In the College of Veterinary Medicine, an Aquatic Animal Health Certificate program was developed and launched in July 2024, with the first students participating that same month. The program provides introductory training to veterinary students and graduate veterinarians in diagnostic and clinical medicine of aquatic animal species. Many of the GCAHFS affiliated faculty participate in the program.

Other Activities

Active Grants

1. S. Reichley. 2022-. Bolstering Fish Health in Republic of Georgia. United States Department of Agriculture Foreign Agricultural Service. $75,000.

Successes and Impact

Bolstering Fish Health in the Republic of Georgia is a collaborative project between faculty at the University of Idaho, Dr. Stephen Reichley at Mississippi State University, and the Caucuses Agricultural Development Initiative (CADI) to increase rural income in the focus region of Adjara by institutionalizing support for small and medium-sized aquaculture trout facilities, with a focus on veterinary health. The project emphasizes gender equity and inclusion as well as climate adaptation and resiliency to improve the sustainability of the innovations implemented.

The project team made several visits to Georgia throughout 2024. During those trips, the team led outreach activities such as providing training seminars and one-on-one training and interactions with farmers and private-sector actors in Georgia.

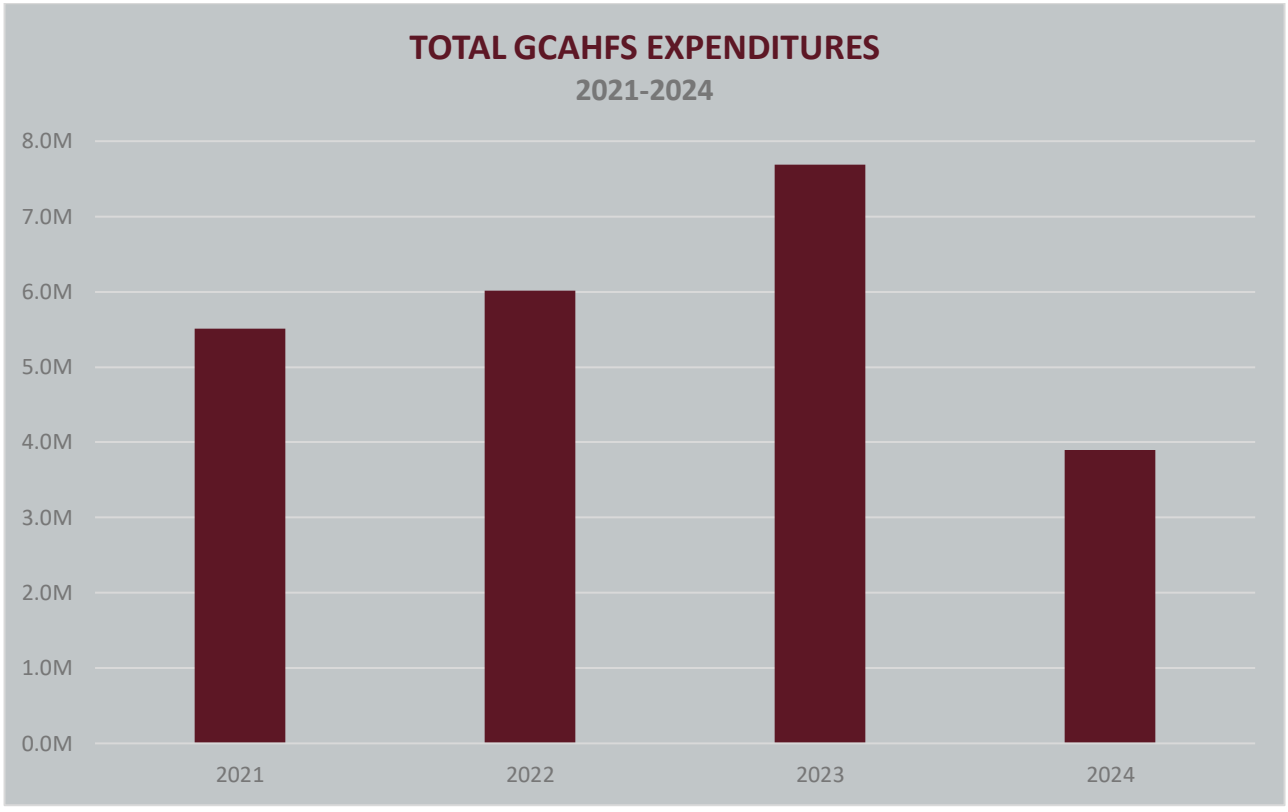
Student Engagement

Veterinary student Kathryn Rapp, along with graduate students Vandana Dharan (College of Forest Resources), and Divya Rose (College of Veterinary Medicine), traveled to the Republic of Georgia in the fall of 2023. They remained engaged with sample analysis in 2024.

Financial Highlights

GCAHFS Research Expenditures
2021-2024

2021	$	5,510,235
2022	$	6,013,712
2023	$	7,684,800
2024	$	3,898,851



Appendix 1: Publications, Presentations, and Outreach Activities

FAO Reference Center on AMR and Aquaculture Biosecurity

Abdelhamad, H. (2024, November 18–22). *Mechanisms of antimicrobial resistance (AMR) in aquatic bacteria in the USA* [Workshop presentation]. FAO Reference Center Hands-on Workshop on Utilization of Microbiome and Genomic Resources for Understanding and Mitigation of Antimicrobial Resistance in One Health Context, Nitte University Enclave, Medical Sciences Complex, Mangalore, India.
Abdelhamad, H. (2024, August 5). *Transfer and persistence of multidrug-resistance plasmids in the intestinal microbiota of catfish* [Conference presentation]. MSU Aquatic AMR Workshop, Mississippi State University, MS, United States.
Abdelhamed, H., Bin Mannan, S., Munshi, R., Riman, M., Tekedar, H. C., & Lawrence, M. L. (2024, July 19). Comparative analysis of three plasmids from *Plesiomonas shigelloides* strain MS-17-188 and their role in antimicrobial resistance. *JAC Antimicrobial Resistance, 6*(4).
Aisy, R. I., Patel, F., Reichley, S. R., Lawrence, M. L., Hanson, L. A., & Tekedar, H. (2024). *Exploring molecular determinants of antimicrobial resistance of* Edwardsiella ictaluri *to colistin through adaptive laboratory evolution* [Conference presentation]. South Central Branch of the American Society for Microbiology Annual Meeting, Memphis, TN, United States.
Adhikari, B., Raju, S., Awoyemi, R. F., Donnadieu, B., Wipf, D. O., Stokes, S. L., & Emerson, J. P. (2024). Synthesis and characterization of symmetrical N-heterocyclic carbene copper(II) complexes — An investigation of the influence of pyridinyl substituents. *Molecules, 29*(15), 3542.
Akgul, A., Kalindamar, S., Kordon, A., Abdelhamed, H., Ibrahim, I., Tekedar, H., & Karsi, A. (2024). The RNA chaperone Hfq has a multifaceted role in *Edwardsiella ictaluri*. *Frontiers in Cellular and Infection Microbiology, 14*, 1394008. https://doi.org/10.3389/fcimb.2024.1394008
Arce, K. S., & Yamamoto, F. (2024*). Dietary supplementation of microencapsulated essential oils and organic acids (EOOA) blend in fish: A new strategy to reduce antibiotic use and improve performance* [Conference presentation]. Latin America & Caribbean Aquaculture (LACQUA) 2024, Medellín, Colombia.
Attarroshan, M., Vázquez, B. C., Andrews, C. R., Stokes, S. L., & Emerson, J. P. (2025). *Selective copper-catalyzed 1,4-reduction of α,β-unsaturated ketones using Phenylsilane* [Manuscript in revision]. *Tetrahedron Letters*. (Original submission in 2024.)
Balami, S., Khoo, L. H., Older, C. E., Ware, C. C., Waldbieser, G. C., Richardson, B. M., Hawke, J.P., López-Porras, A., Heckman, T.I., Soto, E., Shoemaker, C.A., Camus, A.C., Lawrence, M.L., Peterman, M.A., Peterman, A.E., & Griffin, M. J. (2024). *Genomic analysis identifies a discrete fish-associated lineage of* Streptococcus dysgalactiae [Conference presentation]. South Central Branch of the American Society for Microbiology Annual Meeting, Memphis, TN, United States.
Balami, S., Ware, C., Wise, D. J., Hanson, L. A., Richardson, B. R., Ul-Huda, N., Rose, D., Huang, J., Poudel, A., Hawkins, A., Yamamoto, F., Soto, E., & Griffin, M. J. (2024, June 27). *Rifampin-resistant* Edwardsiella piscicida *as potential live attenuated vaccine candidates in*

*channel (*Ictalurus punctatus*) × blue catfish (*I. furcatus*) hybrids* [Conference presentation]. 2024 American Fisheries Society Fish Health Section Virtual Summer Seminar Series.
Balami, S., Ware, C., Ul-Huda, N., Yamamoto, F., Hanson, L. A., & Griffin, M. J. (2024, March 4–8). *In search of a polyvalent, orally delivered* Edwardsiella *vaccine in hybrid catfish (blue catfish ♂× channel catfish ♀)* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.
Billyard, T., Marchant, A., Ford, L., Petrie-Hanson, L., & Hanson, L. A. (2024, March 4–8). *Insights into the effects of microcystin-LR exposure on mannose receptors and gene expression of channel catfish* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.
Billyard, T., Marchant, A., Hanson, L., Petrie-Hanson, L., & Ford, L. (2024, November 7–9). *Microcystin-LR exposure and its impact on liver and spleen gene expression in channel catfish* [Conference presentation]. American Society for Microbiology South Central Branch Annual Meeting, Memphis, TN, United States.
Bosworth, B. G., Koshy, M. C., Ware, C., Yamamoto, F. Y., Byars, T. S., Griffin, M. J., & Wise, D. J. (2024). Susceptibility of Delta Select and Delta Control channel catfish lines to experimental *Edwardsiella ictaluri* and *Edwardsiella piscicida* infection. *North American Journal of Aquaculture, 86*(3), 313–321.
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Cook, K. A., Hawke, J. P., Groman, D. B., Pretto, T., Toffen, A., Hanson, L. A., Nguyen, D., Ford, L., & Baumgartner, W. A. (2024). Betanodavirus meningoencephalitis in an Atlantic blue marlin. *Journal of Veterinary Diagnostic Investigation, 36*(3), 389–392.
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Dharan, V., Griffin, M. J., Allen, P., Hanson, L. A., & Stilwell, J. (2024, March 4–8). *Investigation into the portals of entry, and disease progression, of Ictalurid herpesvirus 1 (IcHV1) in channel catfish, Ictalurus punctatus, blue catfish, I. furcatus, and channel X blue catfish hybrids* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.

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Hanson, L. (2024, March 4–8). *The history and mystery of channel catfish virus disease* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.
Huang, J., Jordan, H., Older, C. E., Silva, V. F., Griffin, M. J., Allen, P. A., Wise, D. J., Goodman, P. M., Reifers, J. G., & Yamamoto, F. Y. (2024). *Investigating the supplementation of* Lactococcus lactis *MA5 as an autochthonous probiotic on diets for hybrid catfish* Ictalurus punctatus × I. furcatus: *Effects on growth performance, immune modulation, and disease resistance* [Conference presentation]. Aquaculture America 2024, San Antonio, TX, United States.
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Jacobsen, K. L., Griffin, M. J., Phinney, B., Salemi, M., Yazdi, Z., Balami, S., Older, C., Rodriguez-Ramos, T., Dixon, B., & Soto, E. (2024, July 30–August 1). *Evaluation of immunogenic proteins for the development of a recombinant protein vaccine against* Edwardsiella piscicida [Conference presentation]. American Fisheries Society Fish Health Section & 63rd Western Fish Disease Workshop, Boise, ID, United States.

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Muraco, H. (2024, November 19). *Increasing offshore research capacity in the Northern Gulf of Mexico* [Poster presentation]. Bays and Bayous — Mississippi-Alabama Sea Grant, Biloxi, MS, United States.
Muraco, H. (2024, October 16). *Saving the whales of the Gulf of Mexico* [Conference presentation]. GOMA Water Resources Mid-Year Meeting, Gulf of Mexico Alliance (GOMA).
O'Donald, S., Patel, F., Keen, P., Hanson, L. A., Cunningham, F., Lawrence, M. L., & Tekedar, H. C. (2024, November 7–9). *Investigating the role of double-crested cormorants in aquaculture bacterial pathogen transmission through Hi-C sequencing* [Conference presentation]. American Society for Microbiology South Central Branch Annual Meeting, Memphis, TN, United States.
Older, C. E., Griffin, M. J., Richardson, B. M., Waldbieser, G. C., Reifers, J. G., Goodman, P. M., Ware, C., Gatlin, D. M. III, Wise, D. J., & Yamamoto, F. Y. (2024). Influence of probiotic and prebiotic supplementation on intestinal microbiota and resistance to *Edwardsiella ictaluri*

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Patel, F., Griffin, M. J., Hanson, L. A., Kumru, S., Ekiz, A., Kayacan, H., Petrie-Hanson, L., & Tekedar, H. C. (2024, June 13–17). *Evaluation of Tad operon in* Aeromonas hydrophila *by single-cell transcriptomics* [Conference presentation]. ASM Microbe 2024, Atlanta, GA, United States.
Patel, F., Griffin, M. J., Hanson, L. A., Kumru, S., Ekiz, A., Kayacan, H., & Tekedar, H. C. (2024, November 7–9). *Single-cell analysis of gill immune response in channel catfish during virulent* Aeromonas hydrophila *infection* [Conference presentation]. American Society for Microbiology South Central Branch Annual Meeting, Memphis, TN, United States.
Petrie-Hanson, L. (2024, August 5). *The use of trained immunity to reduce antibiotic therapy in aquaculture* [Workshop presentation]. MSU Aquatic Antimicrobial Resistance Workshop, Bost Conference Center, Mississippi State University, MS, United States.
Petrie-Hanson, L., Muire, P., Peterman, B., Bailey, S., Billyard, T., Knight, H., & Hanson, L. A. (2024, March 4–8). *Trained immunity and early innate immune responses associated with disease resistance* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.
Petrie-Hanson, L., & Peterman, A. E. B. (2024). Evaluating the effects of biotoxins on immune cell functions in zebrafish. *J Vis Exp* (1), e64494. https://doi.org/10.3791/64494
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Pye, H. M., Fast, K. M., Jordan, H. R., Ruiz-Aravena, M., Drymon, J. M., & Sandel, M. W. (2024, November 21). *Novel aquatic pathogen in red drum (*Sciaenops ocellatus*) in the Gulf of Mexico* [Conference presentation]. Southeastern Fishes Council 50th Annual Meeting, Little Rock, AR, United States.
Pye, H. M., Fast, K. M., Scott, M. E., Rakestraw, A. W., Dogbe, M., Jordan, H. R., Chevillon, C., Guegan, J.-F., Pechal, J. L., Benbow, M. E., Ruiz-Aravena, M., Drymon, J. M., & Sandel, M. J. (2024, May 23). Mycobacterium ulcerans *detection in the Northern Gulf of Mexico* [Webinar]. American Fisheries Society, Fish Health Section, Fish Health Online Seminar Series.
Ramachandran, R., Ford, E., Gomaa, B., & Abdelhamad, H. (2024). Trans-cinnamaldehyde primes more robust channel catfish immune responses to *Edwardsiella ictaluri* infection. *Pathogens, 13*(4). PMCID: PMC11054112. PMID: 38668265. https://doi.org/10.3390/pathogens13040310
Rahman, M. M., Pirim, H., Akbulut, Y., Rahman, Z., Tekedar, H., Hanson, L., & Griffin, M. (2024, November 21). *Advancing protein function prediction for* Flavobacterium covae *using graph neural networks and sequence embeddings* [Conference presentation]. Annual ND EPSCoR State Conference, Grand Forks, ND, United States.

Rose, D., Older, C. E., Hawkins, A., Balami, S., ul-Huda, N., Ware, C., Byars, T., Yamamoto, F., Khoo, L., Waldbieser, G. C., Tekedar, H., Perkins, A., Hanson, L. A., Rosser, T. G., Wise, D. J., & Griffin, M. J. (2024, June 27). *Searching for the environmental reservoirs of antibiotic resistance in commercial catfish ponds in the Mississippi Delta* [Conference presentation]. American Fisheries Society Fish Health Section Virtual Summer Seminar Series.
Rose, D., Older, C. E., Hawkins, A., Balami, S., ul-Huda, N., Ware, C., Byars, T., Yamamoto, F., Khoo, L., Waldbieser, G. C., Tekedar, H.C., Perkins, A., Hanson, L. A., Rosser, T. G., Wise, D. J., & Griffin, M.J. (2024, July 30–August 1). *Searching for the environmental reservoirs of antibiotic resistance in commercial catfish ponds in the Mississippi Delta* [Conference presentation]. American Fisheries Society Fish Health Section & 63rd Western Fish Disease Workshop, Boise, ID, United States.
Rose, D., Older, C. E., Hawkins, A., Balami, S., ul-Huda, N., Ware, C., Byars, T., Yamamoto, F., Khoo, L., Waldbieser, G. C., Tekedar, H., Perkins, A., Hanson, L. A., Rosser, T. G., Wise, D. J., Griffin, M. J. (2024, November 7–9). *Searching for the environmental reservoirs of antibiotic resistance in commercial catfish ponds in the Mississippi Delta* [Conference presentation]. American Society for Microbiology South Central Branch Annual Meeting, Memphis, TN, United States.
Rose, D., Older, C. E., Richardson, B. M., Ware, C., Lewis, M., Waldbieser, G. C., Khoo, L. H., Tekedar, H. C., Perkins, A., Hanson, L. A., Rosser, T. G., Balami, S., Slifka, C., Wise, D. J., & Griffin, M. J. (2024, February 14–16). *Microbial diversity analysis of commercial catfish farms in the Mississippi Delta that employ different management strategies* [Conference presentation]. 50th Annual Meeting of the Mississippi Chapter of the American Fisheries Society, Tupelo, MS, United States.
Rose, D., Older, C. E., Richardson, B. M., Ware, C., Lewis, M., Waldbieser, G. C., Khoo, L., Tekedar, H., Perkins, A., Hanson, L. A., Rosser, T. G., Balami, S., Slifka, C., Wise, D. J., & Griffin, M. J. (2024, March 4–8). *Investigating the catfish pond microbiome: Bacterial taxa, plasmids, and antibiotic resistance genes* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.
Rose, D., Older, C. E., Richardson, B. M., Ware, C., Lewis, M., Balami, S., Slifka, C., Waldbieser, G. C., Khoo, L., Tekedar, H. C., Perkins, A., Hanson, L., Rosser, T. G., Wise, D. J., & Griffin, M. J. (2024, July 30–August 1). *Analysis of catfish pond water microbiome: A comprehensive study from the Mississippi Delta* [Conference presentation]. American Fisheries Society Fish Health Section & 63rd Western Fish Disease Workshop, Boise, ID, United States.
Rostami, S., Mannan, S. B., Tekedar, H. C., Lawrence, M. L., & Abdelhamad, H. (2024). *Genomics analysis of multidrug-resistant* Plesiomonas shigelloides *strain MS-17-188* [Conference presentation]. Conference of Research Workers in Animal Diseases (CRWAD), Chicago, IL, United States.
Sandel, M. W. (2024, May 23). *Godzilla was a fish: A primer on zoonotic potential of aquatic pathogens* [Webinar]. American Fisheries Society, Fish Health Section, Fish Health Online Seminar Series.
Sandel, M. W., & Fast, K. M. (2024, August 5). *Antimicrobial resistance in acid-fast bacteria: A review and prospectus* [Workshop presentation]. MSU Aquatic AMR Workshop, Bost Conference Center, Mississippi State University, MS, United States.

Scott, M. E., Fast, K. M., Rakestraw, A. W., Dogbe, M., Jordan, H. R., Picq, S., Receveur, J., Waters, K., Chevillon, C., Guégan. J-.F., Pechal, J. L., Benbow, M., & Sandel, M. W. (2024, May 23). *Internal microbiomes of Amazonian fishes* [Webinar]. American Fisheries Society, Fish Health Section, Fish Health Online Seminar Series.
Sharma, M., Perkins, A. M., Awoyemi, R. F., Raju, S., Schmittou, A., Pierce, B. S., Donnadieu, B., Wipf, D. O., Stokes, S. L., & Emerson, J. P. (2024). Steps towards enantioselective ketone reduction with silanes catalyzed by DNA-copper(II) N-heterocyclic carbene-based hybrid catalysts via copper hydride formation. *Dalton Transactions, 53*(7), 3180–3190.
Silva, V., Billyard, T., Bailey, S., Petrie-Hanson, L. (2024, November 7–9). *Comprehensive morphological and functional characterization of non-specific cytotoxic cell receptor protein-1+ cells in catfish* [Conference presentation]. American Society for Microbiology South Central Branch Meeting– Annual Meeting, Memphis, Tennessee.
Suarez, C. C., Huang, J., Griffin, M.J, Jordan, H. R., Goodman, P. M., Reifers, J. G., & Yamamoto, F. Y. (2024). *Evaluation of the antimicrobial activity of carvacrol, thymol, and citral against catfish bacterial pathogens* [Conference presentation]. Aquaculture America, San Antonio, TX, United States.
Suarez, C. C., Jordan, H. R., Older, C. E., Griffin, M. J., & Yamamoto, F. Y. (2024). *In vitro assessment of carvacrol, thymol, and citral: Exploring their potential to inhibit fish pathogens* [Conference presentation]. American Fisheries Society Fish Health Section Virtual Summer Seminar Series.
Suarez, C. C., Jordan, H. R., Older, C. E., Griffin, M. J., Soto, E., & Yamamoto, F. Y. (2024, March 4–8). *Evaluating the phytocompounds carvacrol, thymol, and citral in vitro: Potential antagonism of fish pathogenic bacteria* [Conference presentation]. 47th Eastern Fish Health Workshop, Gulfport, MS, United States.
Suarez, C. C., Jordan, H. R., Older, C. E., Griffin, M. J., Soto, E., & Yamamoto, F. Y. (2024). *The legacy of traditional medicine: Evaluation of phytocompounds against fish pathogenic bacteria* [Conference presentation]. Latin America & Caribbean Aquaculture (LACQUA) 2024, Medellín, Colombia.
Sylla, A., Chevillon, C., Djidjiou-Demasse, R., Seydi, O., Campos, C. A., Dogbe, M., Fast, K. M., Pechal, J. L., Rakestraw, A., Scott, M. E., & Sandel, M. W. (2024, September 10). Understanding the transmission of bacterial agents of sapronotic diseases using an ecosystem-based approach: A first spatially realistic metacommunity model. *PLOS Computational Biology, 20*(9), e1012435.
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Tekedar, H. C., Patel, F., Blom, J., Griffin, M. J., Waldbieser, G. C., Kumru, S., Abdelhamed, H., Dharan, V., Hanson, L. A., & Lawrence, M. L. (2024). Tad pili contribute to the virulence and biofilm formation of virulent *Aeromonas hydrophila*. *Frontiers in Cellular and Infection Microbiology, 14*. https://doi.org/10.3389/fcimb.2024.1425624
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Thompson, C., Lourenço-Marques, C., Soares, F., Pousão-Ferreira, P., Hanson, L., Zhang, X.-H., Gomez-Gill, B., Varaste, T., Lima, M., Araujo, T., Souza, W. D., & Thompson, F. (2024). Understanding the role of microbes in reared aquatic organism health and disease. *Marine Life Science & Technology, 6*, 579–609. https://doi.org/10.1007/s42995-024-00248-8
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Alarape, S. (2024, July) *Improving biosecurity: A science-based approach to manage fish disease risks and increase the socioeconomic contribution of the Nigerian catfish and tilapia industries* [Conference presentation]. International Association of Food Protection (IAFP) Annual Meeting 2024, Long Beach, California.
Allen, P., Correa, S., Iannotti, L., Jordan, J., Kahan, T., Kent, K. (2024, August 24). *Panel discussion* [Presentation]. The Feed the Future Innovation Lab for Fish: Creating Global Solutions for Our Collective Future.
Amin, M. B. (2024, April) *Supporting food safety, reducing loss and waste, & ensuring nutrition* [Conference presentation]. Annual Feed the Future Innovation Labs Council Regional Partners Meeting, Kathmandu, Nepal.
Amin, M. B., Talukdar, P. K., Sraboni, A. S., Islam, M. R., Mahmud, Z. H., Berendes, D., Narrod, C., Parveen, S. & Islam, M. A. (2024). Prevalence and antimicrobial resistance of major foodborne pathogens isolated from pangas and tilapia fish sold in retail markets of Dhaka City, Bangladesh." *International Journal of Food Microbiology*, 110717. https://doi.org/10.1016/j.ijfoodmicro.2024.110717.
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Hossian, S., Reza, M. F., Rahman, M. M., Mariom, Alam, M. J., Razzak, M. A., Mollah, M. F. A., Tiersch, T. R., & Sarder, M. R. I. (2024). Use of cryopreserved sperm of grass carp (*Ctenopharyngodon Idella*) for seed production at the hatchery level of Bangladesh—A need for development of germplasm repositories. *Aquaculture Research*, no. 1. https://doi.org/10.1155/2024/9655558.
Hussain, M.G. (2024, February). *Implementation of Fish Innovation Lab funded projects in Asia region: Role and impacts on aquaculture and fisheries development in Bangladesh and Cambodia* [Conference presentation]. Aquaculture America 2024, San Antonio, Texas.
Hussain, M.G. (2024, November 8). *Sustainable fisheries and mariculture: Enhancing food security, livelihood and protecting marine ecosystems in Bangladesh* [Conference presentation]. Blue Economy of Bangladesh: Integrating Economic Growth and Ocean Health, Dhaka, Bangladesh.
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