2021 Annual Report

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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. The 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, the 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

The 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, Mississippi State University has longstanding strength and expertise in aquatic health and food security. The GCAHFS serves as a facilitator to engage MSU faculty, staff, and students in domestic and international development. Specifically, the GCAHFS addresses the health of aquatic environments by improving the impact these important ecosystems have on the quality of life of humans, increasing food production and security, implementation of aquatic animal disease mitigation strategies, and aquaculture technology development and adoption.

Update of Strategic Plan

After the formation of the Center, the scope of work under the Center has expanded. Previously, the Center was focused on aquaculture and fisheries to support food security (human consumption). The scope has since expanded to include health of protected and endangered aquatic species (environmental management), with considerable ongoing work focused on health of marine mammals and sea turtles in the Gulf of Mexico. Additionally, with the growth of the program and added aquatic animal health-focused faculty, growth is anticipated in projects related to other aquatic species important for environmental management. As a result, the Mississippi Board of Trustees of State Institutions of Higher Learning approved a name change from the Global Center for Aquatic Food Security to the Global Center for Aquatic Health and Food Security.

In recognition of the considerable expertise and experience in aquatic animal health, aquaculture, and fisheries at Mississippi State University, the Global Center for Aquatic Health and Food Security strategic plan incorporates two main goals:

1. To stimulate interaction and collaboration between MSU faculty in aquatic animal health, aquaculture, and fisheries for development of scholarly activity, education of students, and submission of grant proposals.
2. In collaboration with the United Nations Food and Agriculture Organization (UN FAO), to promote and engage MSU faculty in aquatic animal health, aquaculture, and fisheries activities in developing countries. These international activities will address sustainable aquaculture to reduce world hunger through capacity building, aquatic diagnostics, and investigative research.

Achievements

1. Active Projects
    a. Lawrence, M. L., S. 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.
    b. Lawrence, M. L., E. Torell, P. Allen, K. Ragsdale, S. Reichley, L. Iannotti, A. Humphries, M. Dey, and B. Crawford. 2018-2023. Feed the Future Innovation Lab for Fish, $15,200,000.
    c. Lawrence, M. L., S. Reichley, T. Morgan, and W. Epperson. 2017-2022. Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program. Mississippi Department of Environmental Quality

(National Fish and Wildlife Foundation), $6,573,033.

d. Lawrence, M. L., S. Reichley, D. Moore, T. Morgan, W. Epperson, A. Karsi, and D. Peterson. 2019-2021. 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), $1,250,000.

2. Past Projects

a. Lawrence, M. L. 2019-2020. Technical, operational, and logistics support to activities related to improving aquaculture biosecurity governance. UN Food and Agriculture Organization, $40,000.

b. Lawrence, M. L., A. Karsi, and H. Abdelhamed. 2017-2019. Safety and storage evaluation of an improved live attenuated *Edwardsiella ictaluri* vaccine. FishVet Group, $8,862.

c. Karsi, A., M. L. Lawrence, and H. Abdelhamed. 2017-2019. Safety and storage evaluation of a novel live attenuated *Edwardsiella ictaluri* vaccine. FishVet Group, $8,862.

d. Abdelhamed, H., M. L. Lawrence, A. Karsi, and W. Baumgartner. 2018-2019. Efficacy of BiOWiSH AquaFarm-MultiBio 3PS on Catfish Growth Performance. BiOWiSH Technologies, $104,278.

3. **Total Funding to Date for GCAHFS: $25,450,746**

4. Accomplishments and Activities. The major activities under the GCAHFS are:

a. Feed the Future Innovation Lab for Fish (Fish Innovation Lab), which is supported by a competitive 5-year, $15,000,000 award from USAID. Major accomplishments for the Fish Innovation Lab in 2021:

i. Continued administration of 13 competitively awarded research activities in Bangladesh, Cambodia, Kenya, Nigeria, and Zambia.
ii. Commissioning of 6 direct award research activities that were designed to address areas of need, complement ongoing work, foster strategic partnerships, and address the Fish Innovation Lab Theory of Change. These activities expand the geographic coverage of Fish Innovation Lab presence to include Malawi and Ghana.
iii. Accomplishments in advancing productivity include improving efficiency of aquaculture production, feed production, and fish processing in Nigeria; implementing integrated rice-fish farming experimental plots in Nigeria; and supporting improved genetics of carp species in Bangladesh through family selection and sperm

cryopreservation. Fisheries productivity was also advanced by implementing community-led fish landing monitoring activities in Kenya and developing a searchable photo identification catalog of freshwater fishes harvested in Cambodia.

iv. Risk reduction and mitigation accomplishments include conducting epidemiologic surveys and analyzing biological samples from private fish farms in Nigeria, completing surveillance for foodborne pathogens in fish processors in Dhaka City, and beginning a fish vaccination study in Zambia.

v. The Fish Innovation Lab improved human outcomes by conducting a census of aquaculture households, farmers, fish traders, and input suppliers in Bangladesh and developing an Aquaculture TV YouTube channel; launching a nutrition and food safety training for fish processors in Nigeria; surveying fishers, processors, and traders for assessing equitable access to fish and nutrition in Zambia; and implementing a social marketing campaign in Kenya about child nutrition, diet diversity, and sustainable fishing practices targeting caregivers and fishers.

vi. The Fish Innovation Lab subawardees and Management Entity worked to achieve impacts within four cross-cutting themes: capacity development, gender equity and youth engagement, nutrition, and resilience.

    1. Capacity development activities included recruiting and working with graduate students and implementing trainings for field research teams, community members (particularly for citizen monitoring of fisheries), and end-users.
    2. The gender and youth equity specialists implemented an online Gender Responsive Aquaculture/Fisheries Development Assessment (GRADA-FIL) to Fish Innovation Lab implementing partners, and they supported the research teams implementing activities aiming to address gender disparities in resource use, improve access to nutrition, and increase the involvement of women and youth in aquaculture and fisheries value chains.
    3. The Fish Innovation Lab collaborated with Advancing Nutrition on outreach and development of social marketing materials. Multiple activities strived to increase the availability and affordability of fish to improve household food and nutritional security.
    4. Ecologically, resilience was addressed for fisheries in Cambodia and Kenya, and in terms of biosecurity, resilience is an activity theme for aquaculture systems in Nigeria and Bangladesh.

vii. The Management Entity implemented several activities aiming to encourage cross-activity learning. This included quarterly virtual platform meetings/learning sessions, the annual principal investigator meeting, and meetings to finalize and plan for the implementation of the research strategy.
viii. The Fish Innovation Lab also received its first buy-in award to support the ongoing USAID Distant Water Fleet Research Agenda.

b. The GCAHFS manages collaborative programs between Mississippi State University and the Institute for Marine Mammal Studies (IMMS) in Gulfport, MS, which is primarily focused on marine mammal and sea turtle health and diagnostic investigations.
    i. The GCAHFS Director is the primary MSU liaison with the IMMS Director, Dr. Moby Solangi. The GCAHFS Director also liaises with the National Oceanic and Atmospheric Administration (NOAA), Mississippi Department of Environmental Quality (MDEQ), and Mississippi Department of Marine Resources (MDMR) administration to ensure a productive working relationship with scientists and administrative personnel who oversee marine mammal and sea turtle strandings and necropsies. The GCAHFS promotes MSU with the external entities to develop new programs for our faculty and students.
    ii. There are two major funding sources for this program:
        1. The program is primarily funded by a 5-year >$6.5M grant from the National Fish and Wildlife Foundation (managed by the Mississippi Department of Environmental Quality). This grant supports two full-time MSU-CVM faculty members stationed in Gulfport and partially supports other MSU-CVM faculty and staff participating in the program. MSU-CVM has a sub-grantee, IMMS, which also performs tasks under this program. The two major tasks of this program for MSU-CVM are:
            a. Conducting necropsies and determining cause of death for stranded marine mammals and sea turtles on the Mississippi coast.
            b. Conducting rehabilitation and release of live stranded sea turtles from the Mississippi coast.
        2. Two grants, totaling >$3.7M, were awarded to MSU-CVM from the Gulf of Mexico Energy Security Act (GOMESA). These projects investigate causes of death for dolphins and sea turtles that died due to a major freshwater incursion event in the Mississippi Sound during 2019. MSU-CVM contracts IMMS to perform tasks under this program.
    iii. The activities under this program have led to implementation of an overnight educational trip for MSU College of Veterinary Medicine

(CVM) DVM students to IMMS during their Laboratory Services rotation during the third year of their curriculum. This trip includes hands-on clinical activities and necropsy activities. Because of this trip, MSU CVM is one of only two veterinary schools in the nation providing all DVM students the opportunity work with marine mammals.

iv. The GCAHFS Associate Director initiated and leads *Marine Monday!*, a monthly seminar series that brings in speakers from around the world to discuss contemporary topics relevant to marine health.

c. The GCAHFS manages a collaborative relationship with the United Nations Food and Agriculture Organization (UN FAO) to exchange resources, expertise, experience, and knowledge to improve fish health, food and nutrition security, and alleviate poverty through sustainable aquaculture development efforts. Notable activities include:
   i. The GCAHFS Director serves on the Technical Working Group for the UN FAO-led Progressive Management Pathway for improving Aquaculture Biosecurity.
   ii. Due to the collaboration between GCAHFS and UN FAO, MSU is a candidate FAO Reference Center for Antimicrobial Resistance and Aquaculture Biosecurity.

5. Personnel
   a. GCAHFS Faculty and Staff
      i. Dr. Mark L. Lawrence, Director and William L. Giles Distinguished Professor, Department of Comparative Biomedical Sciences
      ii. Dr. Stephen Reichley, Associate Director and Assistant Clinical Professor, Department of Pathobiology and Population Medicine
      iii. Dr. Debra Moore, Assistant Clinical Professor, Department of Pathobiology and Population Medicine
      iv. Dr. Christa Barrett, Clinical Instructor, Department of Pathobiology and Population Medicine
      v. Jared Dees, Grants and Contracts Specialist, Department of Comparative Biomedical Sciences

   b. Fish Innovation Lab Faculty and Staff
      i. Dr. Mark L. Lawrence, Director and William L. Giles Distinguished Professor, Department of Comparative Biomedical Sciences
      ii. Shauncey Hill, Program/Financial Manager for the Fish Innovation Lab, Department of Comparative Biomedical Sciences
      iii. Laura Zseleczky, Marketing and Communications Manager for the Fish Innovation Lab, Department of Comparative Biomedical Sciences
      iv. Alaina Dismukes, Communications Specialist for the Fish Innovation Lab, Department of Comparative Biomedical Sciences

v. Dr. Stephen Reichley, Assistant Clinical Professor and Risk Mitigation Specialist for the Fish Innovation Lab, Department of Pathobiology and Population Medicine
vi. Dr. Peter Allen, Associate Professor and Aquaculture Specialist for the Fish Innovation Lab, Department of Wildlife, Fisheries, and Aquaculture
vii. Dr. Mary Read-Wahidi, Assistant Research Professor and Gender/Youth Specialist for the Fish Innovation Lab, Social Science Research Center
viii. Dr. Kathleen Ragsdale, Research Professor and Gender/Youth Specialist for the Fish Innovation Lab, Social Science Research Center

c. Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program Faculty
   i. Dr. Mark L. Lawrence, Principal Investigator and William L. Giles Distinguished Professor, Department of Comparative Biomedical Sciences
   ii. Dr. Stephen Reichley, Co-PI and Assistant Clinical Professor, Department of Pathobiology and Population Medicine
   iii. Dr. Debra Moore, Co-PI and Clinical Assistant Professor, Department of Pathobiology and Population Medicine
   iv. Dr. Timothy Morgan, Co-PI and Professor, Department of Pathobiology and Population Medicine
   v. Dr. Bill Epperson, Co-PI and Professor and Head, Department of Pathobiology and Population Medicine
   vi. Dr. Christa Barrett, Clinical Instructor, Department of Pathobiology and Population Medicine

d. Affiliated Faculty
   i. Dr. Attila Karsi, Associate Professor, Department of Comparative Biomedical Sciences (PI of Fish Innovation Lab Quick Start project in Bangladesh and Co-PI of GOMESA-funded Bonnet Carré Spillway investigation grants)
   ii. Dr. Daniel Peterson, Professor and Director, Institute for Genomics, Biocomputing, and Biotechnology (Co-PI of Fish Innovation Lab Quick Start project in Bangladesh and Co-PI of GOMESA-funded Bonnet Carré Spillway investigation grants)
   iii. Dr. Julius Nukpezah, Assistant Professor, Department of Political Science and Public Administration (PI of Fish Innovation Lab Quick Start project in Nigeria)
   iv. Dr. Larry Hanson, Professor, Department of Comparative Biomedical Sciences (US PI of Fish Innovation Lab project in Nigeria)
   v. Dr. Robert Wills, Professor and Head, Department of Comparative Biomedical Sciences (US Co-PI of Fish Innovation lab project in Nigeria)
   vi. Dr. Terezie Tolar-Peterson, Associate Professor, Department of Food Science, Nutrition, and Health Promotion (US PI of Fish Innovation Lab project in Nigeria)

vii. Dr. Sandra Correa, Assistant Professor, Department of Wildlife, Fisheries, and Aquaculture (PI of Fish Innovation Lab project in Cambodia)
viii. Dr. Wes Neal, Extension/Research Professor, Department of Wildlife, Fisheries, and Aquaculture (Co-PI of Fish Innovation Lab project in Cambodia)
ix. Dr. Thu Dinh, Assistant Professor, Department of Animal and Dairy Sciences (Co-PI of Fish Innovation Lab project in Cambodia)
x. Dr. Justin Stilwell, Assistant Clinical Professor, Department of Pathobiology and Population Medicine (Pathologist for Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program)
xi. Dr. Caroline Betbeze, Associate Clinical Professor, Department of Clinical Sciences (Ophthalmologist for Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program)
xii. Dr. Alison Lee, Assistant Professor, Department of Clinical Sciences (Radiologist for Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program)
xiii. Dr. John Thomason, Associate Professor, Department of Clinical Sciences (Internist for Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program)
xiv. Dr. Natalie Stilwell, Assistant Clinical Professor, Department of Pathobiology and Population Medicine (Microbiologist for Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program)
xv. Dr. Patricia Gaunt, Professor, Department of Pathobiology and Population Medicine (lead scientist for candidate FAO Reference Center for Antimicrobial Resistance and Aquaculture Biosecurity)

Significance of Existing Activity

1. The **Fish Innovation Lab** aims to reduce poverty and improve nutrition, food security, and livelihoods in developing countries by supporting the sustainable development of aquaculture and fisheries. Fish are a nutrient-rich and highly traded food commodity; as such, they are a unique global resource that offers opportunity to accomplish the goals of sustainable and equitable agriculture-led economic growth, strengthened resilience in people and systems, and improved nutrition—particularly for women and children. In the developing world, more than 2.6 billion people depend on aquaculture products and captured fish for more than 20% of their total animal protein — and in the countries of Bangladesh, Cambodia, Ghana, Sierra Leone, and Indonesia, fish constitute over 50% of animal protein intake. To meet the growing demand for food and quality protein (especially animal source protein), reduce potential conflicts over natural resources, and ensure equitable access to fish in developing countries, innovations are needed in both aquaculture and fisheries to foster sustainable, resilient, inclusive, and profitable production and marketing systems.

2. The **Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program** bolsters the capacity of Mississippi's marine mammal and sea turtle stranding network, improves response to injured and dead animals, and develops a consistent scientific understanding of the causes of mortality to inform management actions in the state. The Mississippi Sound and adjacent waters harbor the largest estuarine bottlenose dolphin population in the United States and are an important nursery for juvenile dolphins. The Mississippi Sound also serves as an important developmental habitat for the most endangered sea turtle species, the Kemp's ridley. As top predators, dolphins and sea turtles are a biological indicator of the environment. Therefore, they serve as a good model and indicator to determine the overall ecological health of the Mississippi Sound and adjacent habitats. Specific project objectives include: 1) bolster state partnerships and enhance stranding network capacity, 2) perform health and mortality assessments, 3) rehabilitate and release injured sea turtles, where appropriate, and 4) use satellite telemetry tagging to assess habitat utilization and validate rehabilitation success.

3. Joining hands in partnership since 2010, **FAO and the MSU GCAHFS** are collaborating to exchange resources, expertise, experience, and knowledge to improve food and nutrition security and alleviate poverty through sustainable aquaculture development efforts. FAO and the GCAHFS have brought together international experts to collaborate on research on emerging aquatic animal diseases, which are a major impediment to aquaculture and food security globally. The GCAHFS provides expertise to support the FAO-led Progressive Management Pathway for improving Aquaculture Biosecurity (PMP/AB), which provides guidance and assessment tools needed to monitor biosecurity at the farm, regional, and national levels. MSU GCAHFS is also one of four candidates to be named a FAO Reference Centre on Antimicrobial Resistance and Aquaculture Biosecurity.

Overall Competitiveness

1. The Fish Innovation Lab is a competitively awarded program. It is one of 21 Feed the Future Innovation Labs nationally, which places Mississippi State University in an elite group of land grant universities that host a Feed the Future Innovation Lab. As such, Mississippi State University provides leadership in research for development to support nutrition and food security in vulnerable populations of developing countries. The Global Center for Aquatic Health and Food Security provided an umbrella for a group of multidisciplinary faculty and staff from across the MSU campus to work together and compete successfully for the Fish Innovation Lab program. The GCAHFS continues to provide interdisciplinary support to ensure successful implementation and outcomes from the Fish Innovation Lab.

2. The Mississippi Marine Mammal and Turtle Conservation, Recovery, and Monitoring Program and the 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 research project were awarded to the MSU GCAHFS by the Mississippi Department of Environmental Quality and the Mississippi Department

of Marine Resources, respectively. These awards are a reflection of the expertise and capabilities of veterinarians and scientists in the MSU College of Veterinary Medicine, particularly in aquatic animal health. The productivity of these programs are establishing MSU as a leader in marine animal health in the Gulf of Mexico region. They are also fostering relationships with NOAA in marine mammal and sea turtle health, which is bringing MSU, the College of Veterinary Medicine, and the Global Center for Aquatic Health and Food Security into national prominence in health of these important marine animals.

3. Through the efforts of GCAHFS faculty in the College of Veterinary Medicine, Mississippi State University has been selected to be a candidate FAO Reference Centre for Antimicrobial Resistance and Aquaculture Biosecurity. Only four institutions internationally were selected to serve in this capacity, and it is international recognition of Mississippi State University's expertise and capacity in aquatic animal health and biosecurity.