

11TH U.S. SYMPOSIUM ON HARMFUL ALGAE

REU EXPERIENCES IN CIGUATERA RESEARCH: EVALUATING TOXINS FROM THEIR SOURCE, THROUGH MARINE FOODWEBS, AND BEHAVIORAL OUTCOMES IN FISH

Ciguatera poisoning (CP) is a complex seafood illness caused by the consumption of fish contaminated with algal derived toxins known as ciguatoxins (CTX), produced by benthic dinoflagellates of the genus *Gambierdiscus*. In addition to CTX, many *Gambierdiscus* spp. have been reported to produce maitotoxin (MTX) and both toxins rank in the top five most potent natural toxins known. These toxins enter food webs via herbivory and bioaccumulate following trophic interactions, potentially causing behavioral changes in exposed fish. The goal of this work was to train the next generation of scientists and in doing so examine toxins associated with CP from multiple angles: 1) factors that affect toxigenic benthic algal growth and toxicity; 2) factors that influence Caribbean CTX (C-CTX) prevalence in economically important fish species, and; 3) the behavioral responses of fish following C-CTX exposure. First, bioactivity of secondary metabolites was examined in six benthic dinoflagellate species known to live within the macroalgal epiphytic community. Extracts from the dinoflagellates investigated exhibited hemolytic activity, ranging from 0.43 – 30.47 ng MTX equivalent mL⁻¹ during stationary phase. Intraspecies variability in hemolytic activity in the three *Gambierdiscus* spp. studied was observed. Then, prevalence of CTX was examined in the Queen Triggerfish, *Balistes vetula* and was substantial with >84% of fish samples identified as toxic via the mouse neuroblastoma (N2a) assay. While no statistical relationships were observed between fish toxicity, reproductive phase, age, sex, weight, or fork length, bulk isotope analysis highlighted site and potential dietary shifts. Research on behavioral response of a marine model species was investigated in the Gulf killifish, *Fundulus grandis*, following a 14-day CTX exposure. Fish fed a CTX-diet showed reduced activity (i.e., distance travelled) following a startle response, increased thigmotaxis, and a higher frequency in their color-morph compared to fish fed a control diet. Collectively, these three studies highlight the connectiveness of toxin production, prevalence in fish, and behavioral responses and help us better understand the complexity of ciguatera.

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Terrance Mitchell completed a REU internship in 2019 at the Dauphin Island Sea Lab (DISL) with Dr. Alison Robertson working on the behavioral effects of CTXs in marine fish. Terrance graduated with a BS from Tuskegee University in 2020 and is currently in the Veterinary Sciences program in the TU College of Veterinary Medicine. Terrance was a 2021 Animal and Plant Health Inspection Foreign Service Veterinary Fellow and is involved with the SAVMA's International Veterinary Student Association. Sydney Markham completed a REU internship in 2020 at DISL with Dr. Robertson on the prevalence and distribution of CTXs in *Balistes vetula*. Sydney completed a BS in Spring 2022 from Oklahoma State University. Sydney was honored as a McNair Scholar, Niblack Research Scholar, OK-LSAMP Scholar at OSU. Sydney is currently seeking PhD opportunities in environmental health sciences. Charlie Dvergsten completed his REU in 2021 at DISL with Drs. Molly Miller and Robertson on the growth and hemolytic toxicity of benthic dinoflagellates. Charlie is pursuing a BS in Biology from Carleton College. He completed research in the Central Pacific Ocean relating Bergmann's Phenomenon to myctophids along a 16° latitudinal shift. He plans on pursuing an MD or MD/PhD in the future. Kenneth Murage completed a REU internship in Summer 2022 at DISL with Dr. Miller. Kenneth is currently attending Talladega College majoring in Biology. With an interest in ecology, Kenneth enjoys learning about the "how" and "why" things work in nature. Kenneth is anticipating graduating with his BS in May 2025.

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