IUCN-SSC Crocodile Specialist Group Student Research Assistance Scheme

Final Report

Identification of Toxins in the Tissue of American Alligators (*Alligator mississippiensis*) on Jekyll Island, Georgia

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Introduction

American alligators (*Alligator mississippiensis*) historically occupy aquatic habitats such as lakes, swamps, rivers, and wetlands. Due to the loss of many coastal aquatic habitats, alligators have resorted to inhabiting human-made stormwater lagoons on golf courses. Data on the abundance and distribution of *A. mississippiensis* on Jekyll Island, a barrier island off the coast of Georgia, indicate that approximately 75% of the population inhabits stormwater lagoons located on the island's golf courses (Skupien and Andrews, unpublished data). These golf courses are managed with the application of >50 chemicals, several which are known to contain heavy metals, such as copper and mercury, that may have adverse effects on long-lived reptiles. The detrimental effects of mercury on reptiles is well known (Schneider et al. 2013) and the distribution of copper and mercury has been widely documented in wild and farm-raised alligators (e.g. Guillory et al. 2011). However, copper and mercury concentrations have not been assessed in alligators inhabiting golf course lagoons.

The presence of other environmental contaminants, such as polychlorinated biphenyls (PCBs), has also been documented in *A. mississippiensis* (Cobb et al. 2002). The alligator population on Jekyll Island is subject to increased exposure to PCBs originating from Superfund sites in nearby Brunswick, Georgia. Brunswick is the location of four Superfund sites, identified by the Environmental Protection Agency. Three of these sites have been placed on the National Priorities List (NPL) and the fourth has been proposed to be placed on the NPL. Aroclor 1268, once manufactured in Brunswick, Georgia has been found in the tissues of other coastal predators, such as the bottlenose dolphin (Pulster and Maruya 2008). A similar compound, Aroclor 1242, has been shown to have endocrine disrupting properties in aquatic turtles (Willingham and Crews 1999) suggesting that Aroclor 1268 may also have detrimental health effects on wildlife health.

In coastal ecosystems where *A. mississippiensis* is an apex predator and ecosystem engineer, any health impairments caused by environmental contaminants may have complex ramifications for the entire barrier island ecosystem. Additionally, individual alligators can disperse off the protected state park. Harvest and consumption of contaminated alligators in non-protected coastal areas raises human health concerns. As such, we analyzed tissue samples collected from adult *A. mississippiensis* for the presence of copper and mercury. We are currently seeking additional funds to exam the concentrations of PCBs (i.e., Aroclor 1268) in alligator tissues. This research is an initial effort to identify environmental contaminants present in *A. mississippiensis* inhabiting stormwater lagoons on golf courses located on Jekyll Island, Georgia. This research will address how anthropogenic alterations of coastal ecosystems affect American alligators and other coastal species. Additionally, this research will allow us to better assess the impacts of human development and habitat alteration on other crocodilian species. Further, these

data will be used to inform golf course management strategies and mitigate wildlife exposure to heavy metals and PCBs. Given that *A. mississippiensis* is a game animal the results of this study will also be shared with the Georgia Department of Natural Resources.

Methods

Study Site.—Jekyll Island, a developed barrier island located off the coast of Georgia, USA, offers unique research opportunities to assess the concentrations of environmental contaminants in wildlife. Jekyll Island is located approximately 12 km from Brunswick, Georgia. As such, wildlife is subject to increased exposure to Aroclor 1268 and other PCBs originating from Superfund sites on the mainland. Further, wetland loss on many southeastern barrier islands has been pervasive due to development and drought. Stormwater lagoons on Jekyll Island golf courses now serve as critical habitat for *A. mississippiensis*. The golf courses are managed with >50 chemicals, making *A. mississippiensis* particularly vulnerable to increased exposure to heavy metals and other environmental contaminants.

Tissue Collection and Analysis.— We captured 156 individual alligators during monthly capture-mark-recapture efforts between May 2012 and September 2014. Alligators were caught in human-made stormwater lagoons on golf courses located on Jekyll Island, Georgia. After capture, we manually restrained and blindfolded alligators. We then cleaned the alligator's tail using three alternating applications of Betadine Scrub® (Purdue Products L.P., Stamford, CT) and isopropyl alcohol. We removed one or two caudal tail scutes using a sterilized surgical blade. We placed tissue samples in Whirl-Paks® (Nasco, Fort Atkinson, WI) and immediately put the samples on ice before transferring them to a -70°C freezer located at the Georgia Sea Turtle

Center. The funds provided by the IUCN Crocodile Specialist Group allowed us to send 48 caudal tail scute samples to the University of Georgia Analytical Chemistry Laboratory where they were analyzed for copper and mercury by Dr. Tom Maddox and colleagues. I am currently collaborating with my former advisor and a perspective graduate student to secure additional funding to complete the PCB analyses originally proposed in my application.

Results and Discussion

Mercury and copper were detected in all 48 tail tissue samples analyzed by the University of Georgia Analytical Chemistry Laboratory. Copper tissue concentrations ranged from 0.322 to 2.590 μg/g (mean = 0.726, SD = 0.436). Mercury tissue concentrations ranged from 0.001 to 0.025 μg/g (mean = 0.003, SD = 0.004).

Concentrations (μg/g) of copper and mercury in the tail scutes of wild-caught American alligators on Jekyll Island, Georgia (n = 48)

Metal	**Mean ± SD**	**Range**
Cu	0.726 ± 0.436	0.322 to 2.590
Hg	0.003 ± 0.004	0.001 to 0.025

The mercury and copper tissue concentrations reported here are similar to concentrations reported elsewhere. Delany et al. (1988) analyzed samples of muscle tissue taken from wild-caught alligators from lakes in Florida. They found that copper tissue concentrations ranged from 0.28 to 6.03μg/g and that mercury tissue concentrations ranged from 0.04 to 0.61 μg/g. Copper

concentrations in the meat of wild-caught alligators from southwest Louisiana have been reported to be as high as 13.1 μg/g (Guillory et al. 2011). Mercury concentrations in the tail scales of wild-caught alligators from the Florida Everglades ranged from 0.40 to 1.86 μg/g (mean = 1.03, SD = 0.42) (Heaton-Jones et al. 1997).

Given our limited sample size the environmental implications of these heavy metal tissue concentrations are difficult to assess. Additionally, we performed analyses on caudal tail scutes. Previous research has shown that the analysis of other tissue samples (e.g., liver, kidneys, tail muscle) may provide a more complete understanding of contaminant levels in wild-caught alligators (Heaton-Jones et al. 1997).

Alligator inhabiting Jekyll Island have been shown to move off of the protected barrier island and into public waterways where they may be legally harvested during the hunting season. The results of this study indicate that the consumption of alligator meat originating from Jekyll Island may pose little threat to human health as the mercury contaminant concentrations in alligator tissues from Jekyll Island are less than the allowable amount set by the U.S. Food and Drug Administration (US FDA 2000).

Future Research

The results of this assessment have been provided to the Jekyll Island Authority, the governing body of Jekyll Island State Park, and may be used to adapt the golf course management regime on the island. Further, these data have been discussed with wildlife biologists at the Georgia Department of Natural Resources for purposes of alligator management and their harvest program. The results of this initial study will be used to direct future research questions. Currently, I am working with my advisor and a perspective graduate student to procure

additionally funding in order to analyze additional samples. The PCB analyses first proposed in my application to the IUCN SRAS proved to be cost restrictive (>$100 per sample). Future efforts will focus on determining the concentrations of PCBs, such as Arocolor 1268, in the tissues of wild-caught American alligators on Jekyll Island, Georgia. This PCB study will form the basis of the perspective student's Master's thesis and will be a study that I continue to be involved with in the coming years.

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