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INDEPENDENT STUDY

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Alligator Management and Ecology Surrounding Avery Island, Louisiana: Revisiting E.A. McIlhenny's Observations in *The Alligator's Life History*

"Live a natural life, watch, listen, and think;
for the more of these three things you do,
the sooner you will realize that your
happy natural fate lies solely in yourself and your life on earth"

E. A. McIlhenny, 1935

Introduction

In 1935, my great, great-grandfather, the conservationist E.A. McIlhenny published his book *The Alligator's Life History*. It was a record of his lifetime's research and observations on the American alligator around Avery Island, Louisiana, and is still referred to as one of the most important early studies of the species. In 2019, McIlhenny was recognized by IUCN, The World Conservation Union for his contribution to alligator conservation. Most importantly, McIlhenny

identified that the near extermination of the alligator was a result of the unregulated hunting that took place during the 1880s and ‘90s. Through a better understanding of the ecology of the alligator, developing captive breeding protocols, and advocating for the protection of nesting sites and protected areas, McIlhenny kickstarted the sustainable conservation of the species. He called for a better understanding of alligator population dynamics, introducing hunting quotas, protected area management, law enforcement, and conserving alligator habitat.

McIlhenny was ahead of his time, as these were the principles that underpinned the alligator sustainable use “Marsh to Market” program that the Louisiana Department of Wildlife and Fisheries (LDWF) implemented in the 1970s. Today, the alligator is regarded as a commercial renewable natural resource (LDWF website). McIlhenny’s precise observations set the tone for what is now one of the most closely monitored species in the world (LDWF website, 2019). The Louisiana alligator industry is now worth an estimated $250 million per year from wild harvesting, commercial hunting, alligator farming, and tourism. Alligator conservation is globally recognized as a sustainable use success story, providing economic benefits not only for local communities, but also providing an incentive to preserve wild areas (IUCN Crocodile Specialist Group website).

This study traces the path of this story from McIlhenny’s early alligator observations and management decisions to their fruition as a multi-million dollar industry today. Using McIlhenny’s monograph as a historical foundation, this research contextualizes his work with a review of contemporary literature on alligator commercialization. The study analyzes recent alligator harvest records from Avery Island (2012-2024), correlating them with alligator nest mapping data, vegetation analysis, and field observations. This data is ground-truthed through key informant interviews with wildlife managers, policy experts, and alligator farmers. By examining recent trends in alligator management around Avery Island, this study presents the impact of the alligator industry on the area’s ecology and economy, providing insights into the industry’s current impact and the future of alligator populations in the region.

Literature review

Ecology

The American alligator, *Alligator mississippiensis,* is a keystone species in the Louisiana coastal ecosystem. It is descended from crocodilians that have existed for 180 million years. Alligators are mainly aquatic and live in freshwater, so their habitat is marshes, rivers, streams, ponds, and swamps. They have a long, scaly body, typically dark grey-green, although it changes according to its habitat (McIlhenny, 1935). It has bony plates, or osteoderms, making the skin hard to penetrate. Sexually dimorphic, the male is larger than the female and on average, 8-11 feet long, weighing up to 1,000 pounds, and living up to 50 years. Alligators have approximately 80 teeth that grow throughout their lifetime. They can stay underwater for 10-20 minutes and have two sets of eyelids – the inner set allowing them to see underwater. They have flaps that seal their ears and eyes underwater and have a palatal valve that closes at the back of their throat to keep water out. As they are cold-blooded and therefore ectothermic, they bask in the sun to warm themselves. They are territorial and become dormant in winter, digging themselves into a den or cave in a riverbank or pond. They communicate using high and low-frequency calls, both below water and through the air. Alligators are carnivorous and feed on fish, reptiles, birds, and mammals, typically once a week when the temperature is above 70 degrees F (McIlhenny, 1935; Hastings, 2025). Alligators lurk underwater with only their eyes and nostrils above the water so that they can go undetected and lunge at their prey. They are sensitive to vibrations and detect prey as it enters the water using their tails to propel themselves out of the water to predate animals in trees or on riverbanks. Alligators often drown their prey by dragging it underwater using their powerful jaws to break bones, swallowing it whole (McIlhenny, 1935).

Alligators reproduce sexually from when they are approximately 10 years old (or 6 feet in length) and are oviparous or egg-producing. Mating takes place in water, usually in the same area, and a male can mate with several females but usually mates only with one female over one breeding season (McIlhenny, 1935). In the spring, females build a large nest mound approximately 5 feet in diameter and lay 2-58 eggs approximately eight inches below the surface, burying them in vegetation that creates warmth, while also acting as an incubator and

protecting eggs from predators (McIlhenny, 1935). The breeding season lasts from April to June. The female alligator stays close by to protect her eggs from predators, and after about 63-65 days, the eggs hatch (McIlhenny, 1935). Juvenile alligators grow about 30cm a year in the first 5-9 years of their life.

Habitat

Alligators can be found mainly in the lowland areas of the state, such as bayous, lakes, swamps, and canals, but they are most commonly found in coastal marshes (McNease and Joanen, 1978). They require fresh, intermediate, and brackish marsh because they cannot osmoregulate when salinity levels become too high (Waddle, 2017). Alligators need water for foraging, thermal regulation, mating, and as a refuge from predators (McIlhenny, 1935; Waddle, 2017). They inhabit slow-moving water bodies near land. Research has shown that they prefer areas that are interspersed with land and open water (McNease & Joanen, 1974). This is because shores are necessary for nesting, hatchling alligators, and foraging. Therefore, a patchwork of shallow and deep water is an ideal alligator habitat because male alligators are highly territorial (Waddle, 2017).

McIlhenny realized that protected habitat was key to their survival and he was instrumental in securing over 175,000 acres of wetlands for conservation, including the Louisiana State Wildlife Preserve (1911), Marsh Island Wildlife Refuge (1920), and the Rockefeller Wildlife Refuge (1920). Understanding alligator habitat is key to developing alligator management and conservation strategies. To maintain a stable alligator population that can be sustainably harvested, researchers realized that a healthy coastal habitat needed to be maintained, especially when 80% of the wetland habitat is on private land (Newsom, 1987). To this end, the federal government enacted the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) in 1990 to fund and protect coastal wetlands - which included alligator habitat. Fifteen years later, scientists at the Louisiana State Coastal Protection and Restoration Authority developed alligator habitat suitability models (Waddle, 2017). In addition to this, the sale of wild-harvested alligators and eggs acts as an economic incentive for landowners to maintain a healthy wetland habitat.

History of the Alligator in southern Louisiana

The alligator has a long history of being hunted and managed in southern Louisiana. Native American tribes used alligator hides for sport, food, and cultural purposes (Arthur, 1931). The first French settlers that established the Louisiana colony in 1699 identified the alligator as a resource. Pierre Le Moyne d'Iberville's diary mentioned, "We see a large quantity of crocodiles" (Jones, 2012). Dutch explorer Antoine-Simon Le Page DuPratz, in his *Histoire de la Louisiane* (1758), describes a 19-foot alligator he killed and refers to an encounter with a 22-foot alligator. An article in *Harper's New Monthly* magazine in 1853 depicts vast numbers of alligators in Louisiana (Jones, 2025). These anecdotal accounts suggest that the alligator population at this time in southern Louisiana was not only plentiful, but individuals were also very large. During the Civil War, the Confederate army used alligator leather for saddles, boot leather, and meat for rations (Davis, 2017). The Industrial Revolution saw the development of industrial tanneries, and by 1880, alligator leather had become extremely fashionable, being used for mass-produced luxury leather goods such as shoes and purses. Alligator oil was used as a lubricant for machinery, cotton mills, and riverboats (Davis, 2017).

In 1905, the *Lafayette Advertiser* warned the public about the consequences of killing alligators for their skins (Jones 2012). When the Louisiana State Department of Conservation published *Fur Animals of Louisiana* in 1931, it cautioned that the alligator was "doomed to certain extinction" if unregulated hunting continued (Arthur, 1931, p.166). A few years later, McIlhenny noted, "Man has caused the almost extermination of the alligator in large sections of Louisiana where once they swarmed. In the late 1870s and early 1880s, before there had been any hunting of alligators on the many thousands of acres belonging to my family surrounding Avery Island, they were present in unbelievable numbers (p.77). McIlhenny estimated that approximately 3.5 million skins were marketed from the area extending from Lake Charles, to Abbeville and on to New Iberia from 1880-1933 (p.79). Both Arthur (1931) and McIlhenny (1935) describe hunting methods in the early part of the 20th century: either using a carbide lamp to shine in alligator's eyes and then shooting them at close range, or during the day by hooking an alligator from its nest using a long pole with a hook and then killing it with a hand axe.

In the 1950s, a growing trend emerged for having small alligators as domestic pets. By 1960, about 18,000 individuals were harvested every year, and it was evident that alligator populations were declining at such a rate that from 1962-72 alligator trapping was stopped completely. This allowed law enforcement officials to step up efforts against illegal hunters and for scientists to take stock of the situation and conduct basic research on alligator habitat and nesting requirements. This formed the basis of the new LDWF alligator management strategy. The American Alligator was listed as endangered under the federal Endangered Species Act in 1967 and was classified as endangered on Appendix I of the Convention on Trade in Endangered Species (CITES), an international treaty ratified in 1975. Alligator populations quickly bounced back, and the species status was reclassified to threatened and downlisted to CITES Appendix II, which allowed the commercial trade of sustainably harvested skins. The first public alligator hunt took place in Cameron Parish in 1972. Alligator harvest was cautiously allowed in 12 coastal parishes, and when this program was successful, it was extended to the whole state in 1981 (Wolfson, 2014).

Economy

The alligator made a considerable contribution to the Louisiana economy from around the end of the 19th century. Since this time, there has been an active trade in wild-harvested alligator hides, with alligator farming beginning in 1973 (Brannan, 1991). The “Marsh to Market” program, which started in 1973 after a ten-year enforced break in trade, advocated sustainable commercialization of the alligator – encapsulated by the bumper sticker “Save an Alligator. Buy a Handbag” (Wolfson, 2014). Today, Louisiana is the leading producer of alligator skins. Consumptive alligator use (meat, hides, commercial alligator hunting) and non-consumptive use (tours, ecotourism, and photography) are estimated to be worth up to $245 million to Louisiana’s economy per annum (Fannin & Alexander, 2022).

Alligator Management in Louisiana

The Louisiana Department of Wildlife and Fisheries (LDWF) is responsible at the state level for managing both wild and farmed alligators. The Louisiana Alligator Advisory Council advises the Louisiana Department of Wildlife and Fisheries (LDWF) on alligator research and promotes the sustainable management of alligators, representing alligator farmers, landowners, and hunters. The Louisiana Alligator Management Program (LAMP) is a specific program within LWDF that is focused on alligator management. It regulates wild hunts, conserves alligators as part of the state's wetlands, and alligator hunters to capture "nuisance" alligators. It manages habitats, instigates alligator population surveys, and monitors and regulates wild and farmed alligator populations, ensuring that harvest offtake is both sustainable and traceable. This includes managing wild egg harvest, overseeing the raising of captive alligators, and tagging and releasing farm-raised alligators into the wild to ensure healthy populations. LDWF also ensures compliance with national and international alligator trade requirements (LDWF website).

Louisiana Alligator wild harvest

The alligator is considered a commercial, renewable natural resource in Louisiana through LDWF's research and management of sustainable wild harvest and farming. Consequently, Louisiana's wild alligator population has increased from less than 100,000 to more than 2 million in the past 50 years (LDWF website). To set the harvest quota, LDWF biologists and wildlife managers begin preparing for the annual wild alligator season every June. Biologists conduct annual aerial nest surveys every July in a helicopter, surveying approximately 135,000 acres of coastal wetland habitat. The number of nests in each habitat survey is recorded, so the relative proportion of nests in each marsh habitat can be inferred (fresh, intermediate, or brackish marsh) (Waddle, 2017, p.9). Wildlife biologists use this data to calculate nest densities, which provide an index of alligator populations for individual management areas throughout the state. They also collect data on habitat conditions. The density of nests fluctuates depending on environmental conditions. For example, they can decline during a drought or flooding or increase during nesting seasons with optimal water levels. Wildlife managers and scientists review the nest density, and habitat assessments correlate it with past harvest statistics. They use this information to allocate tags and set the season's alligator offtake, allowing each area a particular

number of harvest tags. This controls the number of alligators that can be harvested from each area. It is essential to distribute quotas concerning an area's alligator population level.

Louisiana's wild alligator harvesting season begins in late August or early September and continues for 60 days. Breeding females are usually in their nests, so hunters only harvest males and non-breeding females. Before the wild alligator season starts, licensed alligator hunters are issued a certain number of tags on the property where they have permission to hunt. Each tag is property-specific and must be used on the property on the hunter's license. Each property has a tag based on the number of alligators that can be harvested on the property, and the quality and quantity of the habitat. Alligator hunters must have these tags to harvest alligators and attach them to alligators as soon as they are harvested. The tags are designed to ensure that any tampering can be detected once they have been attached to the alligator skin. LDWF monitors the use of tags to ensure the harvest does not exceed the quota. Wildlife managers keep tabs on information such as the number of tags used, where the tags were used, the length of tagged alligators, and if alligators had been released from farms in prior years. Hunters still use the non-selective daytime trapping method that McIlhenny described in 1935: "I had lines set, on which were tied heavy hooks baited with raw meat and hung about twelve inches above the water" (McIlhenny, 1927, p.59). Hunters typically select areas that male alligators frequent because they want to avoid places where female alligators nest with their young. Managers typically suspend a chicken carcass on a PVC or bamboo pole chicken approximately two feet above the water's surface along the edge of the bayou or shallow wetlands. When the alligator leaps to get the bait, it becomes impaled on a concealed hook which is tied to a heavy duty line that is attached to the river bank. From here, the individual can later be safely pulled onto the boat (Romero, personal communication, February 8th, 2025). Once harvested and tagged, the individual is either harvested or released. Alligators are transported to licensed facilities that process alligators for their meat, hides, and other commercially valuable parts. It is said that no species in the world is as closely monitored as the American alligator. About 24,000 alligators are now estimated to be sustainably wild harvested annually (LDWF website).

Farming

McIlhenny's original study demonstrated that farming alligators was not only feasible but could also be economically viable (McIlhenny, 1935). Alligator farming began in Louisiana in 1973. During the 1980s, the Louisiana Alligator Management Program developed an egg collection and alligator ranching program. Farmers can collect alligator eggs on private land and incubate them under ideal conditions. As McIlhenny had observed, these farmed alligators grew much more quickly than the wild population, reaching 4-12 feet in 18 months rather than in 3-4 years in the wild (McIlhenny, 1935). In 2013, a state-of-the-art alligator research station was established outside Baton Rouge. One of the key components of the scientist's research at the facility was to optimize what alligators are fed (Reigh *et al*.,2013). Similar to other commercial farming such as cattle, alligator farming operates at predetermined production levels (Brannan, 1991), and operations are closely monitored by the Louisiana Department of Wildlife and Fisheries (LDWF website). Alligators reach a length of four feet before they are processed, as this provides a financially viable return on the investment in feed costs. It also ensures they occupy less space and as they are younger, they are less territorial and have fewer scars and scratches on their hides, which is desirable in the leather goods market (Brannan, 1991). In 2019, Louisiana alligator farming had an estimated value of $86 million (LWDF website). Ten percent of healthy captive-raised juvenile alligators are categorized by sex, measured, tail-notched, tagged with nylon lockable tags, and returned annually to the wild to ensure a stable wild alligator population. Alligator farmers are then allowed to sell the rest of the alligators on international and domestic markets. There are now nearly one million alligators on farms in Louisiana (LDWF website).

Climate change

At a symposium held at Tulane University on Gulf Coast climate futures in November 2024, a team of interdisciplinary researchers established that not only does southern Louisiana have one of the largest energy footprints in the world because of its extraction and processing of fossil fuels, but it is also most likely to be on the forefront of dealing with the negative effects of climate change (Tulane University, 2024). Several authors have established the importance of habitat suitability to sustain stable alligator populations (McIlhenny, 1935; Newsom, 1987; Waddel, 2017). Other researchers have demonstrated that changes in climate and resulting

dramatic weather events such as hurricanes, flooding, and droughts significantly impact egg incubation (Waddel, 2017). For example, the 2006 drought was the worst in 111 years of recorded weather history and resulted in an alteration in nesting habitats, as did hurricanes Gustav and Ike in 2008 (LWDF website). More recently, in the summer of June 2024, tropical storms and Hurricane Beryl led to high tides that flooded 80% of alligator nests, meaning that farmers were only able to collect 30% of the required number of alligator eggs (Shirley, email, 22nd July 2024).

Louisiana's Coastal Protection and Restoration Authority (CPRA) has identified that sea level rise, changes in rainfall patterns, and storm frequency and intensity caused by climate change will affect the ecosystems that alligators inhabit, "species that depend on freshwater habitats, such as alligator […] showed significant decreases under the moderate and less optimistic climate change scenarios" (CPRA, 2023, p.88). In addition, saltwater intrusion negatively affects alligator habitat as the species cannot osmoregulate in saline environments. As Hartley (2017) has shown, there is a general trend across coastal Louisiana to saltier marshes. However, coastal restoration, as detailed by the CPRA, prioritizes managing and maintaining alligator habitat through the use of Habitat Suitability Index Models (Waddle, 2017). These models, originally developed by Newsom *et al.* (1987) synthesize raw data on alligator nest distribution, combined with hydrological models, mapping and aerial photography as well as literature review. They enable wildlife biologists and managers to create a framework to determine and manage suitable habitat for alligators, and more importantly, project and plan how future conditions might affect alligator habitat, ensuring the long term stability of alligator populations.

Methodology

In order to understand the effects of wild harvesting alligators in the marsh surrounding Avery Island since 2011, I entered quantitative alligator capture data into Google Sheets. The data records alligator capture and harvest in 187,000 acres in St. Mary, Iberia, and Vermilion parishes from 2011-2016 and 2023-2024. It should be noted that there was no harvest between 2016 and 2023 as an alligator management decision dictated by the Louisiana Department of Wildlife and Fisheries (LDWF). This data comprised alligator length, number, and in most cases,

sex. It should also be noted that alligator sex was not consistently collected and that LDWF instructed wildlife managers to attempt not to select breeding females for wild harvest. I also analyzed nest and egg harvest data from the LDWF.

I used my own observations of site visits while harvesting alligator eggs, identifying nests using a drone, and analyzing nest temperature and composition in June 2024. I also analyzed aerial photographs of alligator nest maps from 2014, 2020, and 2022, comparing it with alligator coast nest count data (1970 - 2022) (Linscombe, 2024).

Field observations of alligator nest drone censusing and egg monitoring in Rockefeller Wildlife Refuge, June 2024

I cross-referenced this data with qualitative research. I used in-depth, semi-structured interviews with four key informants to get insights from stakeholders involved in alligator conservation to record their first-hand experiences. The participants were selected based on their expertise and involvement in alligator conservation in the Avery Island area. The interviews were conducted in person in February and March 2025 on Avery Island. A semi-structured interview format was used, allowing for flexibility while ensuring that key topics were explored such as alligator management strategy, policy impacts, ecological and logistical challenges, as well as any follow-up questions and clarification (include questions in the appendix?). The interviews lasted approximately 45 minutes to 1 hour, and with the participant's consent, they were audio-recorded for accuracy. Notes were also taken to supplement the recordings. The audio recordings were transcribed via *Notta*, an audio-to-text app, and an analysis was conducted. Key themes were identified, and responses were categorized into relevant topics. The four selected participants were:

1) **Heath Romero,** Land Manager, McIlhenny Company, oversees the alligator conservation and harvesting program with neighboring landowners and organizations across 187,000 acres in St. Mary, Iberia, and Vermilion parishes. He oversees large-scale wetland restoration and coastal protection projects, including initiatives to combat coastal erosion that restore and protect marshlands surrounding Avery Island.

2) **Mark Shirley,** Aquaculture and Coastal Resources Specialist at the LSU AgCenter and Louisiana Sea Grant working with alligator resources in Vermillion and surrounding parishes. He started the Marsh Maneuvers program in the 1980s for 4 H students to learn about Louisisna's ecology and ecosystem. I participated in this program in 2023, where I met Mr. Shirley.

3) **Stephen Sagrera,** alligator farmer and the son of Wayne Sagrera, who pioneered Louisiana's alligator farming industry. His Vermilion Gator Farm in Abbeville is a globally recognized leader in sustainable alligator farming. Mr Sagrera works closely with industry leaders, local farmers, and international partners.

4) **Robert Hastings** is a marine biologist and a professor of zoology at Rutgers University. He was the director of the Turtle Cove Environmental Research Station at Southeastern Louisiana University in the upper Lake Pontchartrain estuary. He is the author of *The American Alligator: Abused, Protected, Restored (2025)*.

Deficiencies in the study need to be acknowledged. The recorded alligator wild harvest data around Avery Island only reflects eight years of data. A longer study would provide greater insights. Wildlife managers themselves admit that little is recorded during alligator harvest, and there are some gaps on the data collection forms. There is not much consistency as some data collection forms are computerized, while others are hand written. More systematic and consistent data collection would provide wildlife managers with better information to make decisions for future management of the area.

Alligator nest data was useful to corroborate the harvest data, but nests are identified by eye from a helicopter aerial survey, and subject to human error. GPS coordinates could have made nest mapping more accurate year on year. It should also be acknowledged that the responses from interviewees could be biased, particularly because of my connection to Avery Island. I attempted to mitigate this through numerous informal meetings before the formal interviews took place, gaining information that I could cross check against published literature and previous interactions. It can also not be ruled out that my questions could have stimulated biases. A more diverse group of interviewees including wildlife biologists such as Ted Joanen could have added another dimension to the study.

Data

Year	# Harvested	Average Size	Feet	Inches
2011	79	79	6	6
2012	72	80	6	7
2013	51	78	6	5
2014	51	76	6	4
2015	51	76	6	4
2016	57	72	6	0
2017	*nd*	*nd*	*nd*	*nd*
2018	*nd*	*nd*	*nd*	*nd*
2019	*nd*	*nd*	*nd*	*nd*
2020	*nd*	*nd*	*nd*	*nd*
2021	*nd*	*nd*	*nd*	*nd*
2022	*nd*	*nd*	*nd*	*nd*
2023	35	90	7	5
2024	69	98	8	1

Fig 1.1 Numbers of alligators harvested around Avery Island 2011-2016 and 2023-2024 and average sizes

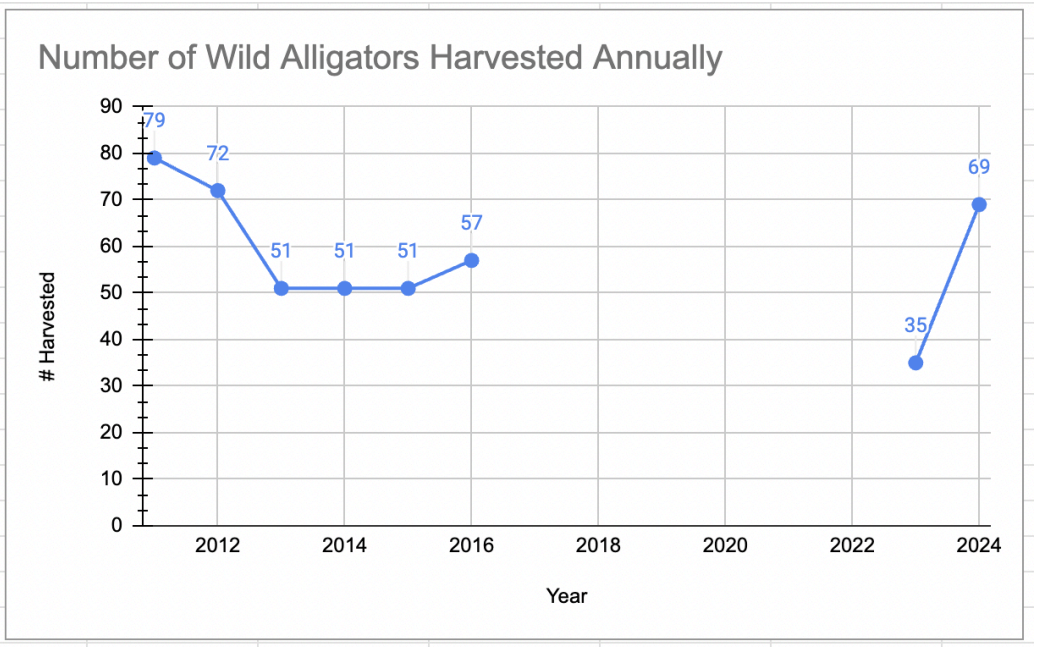


Fig 1.2: Numbers of alligators harvested around Avery Island 2011-2016 and 2023-2024

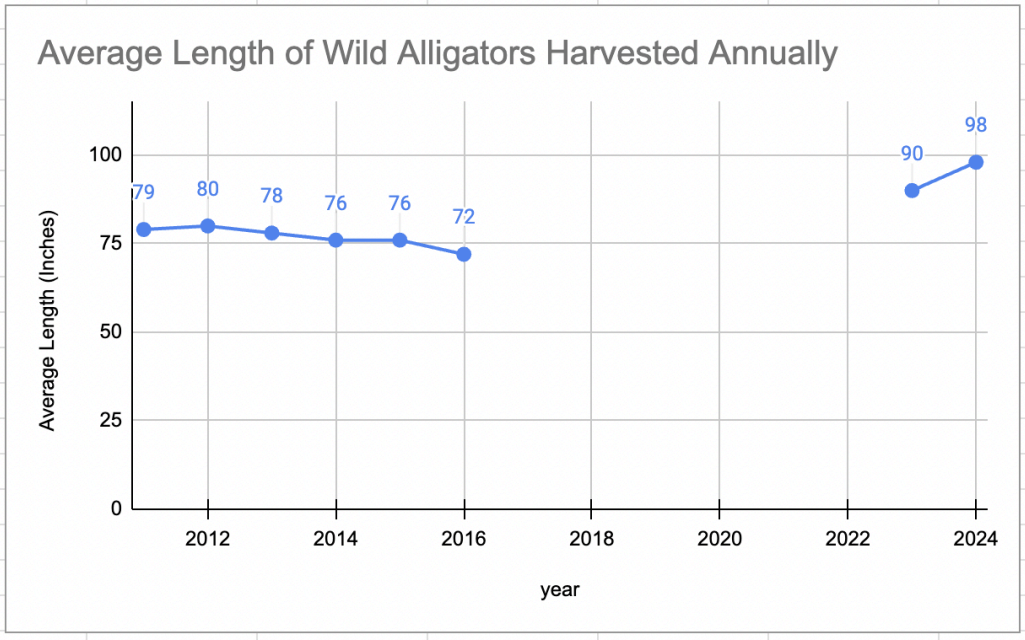


Fig 1.3: Average length of alligators harvested around Avery Island 2011-2016 and 2023-2024

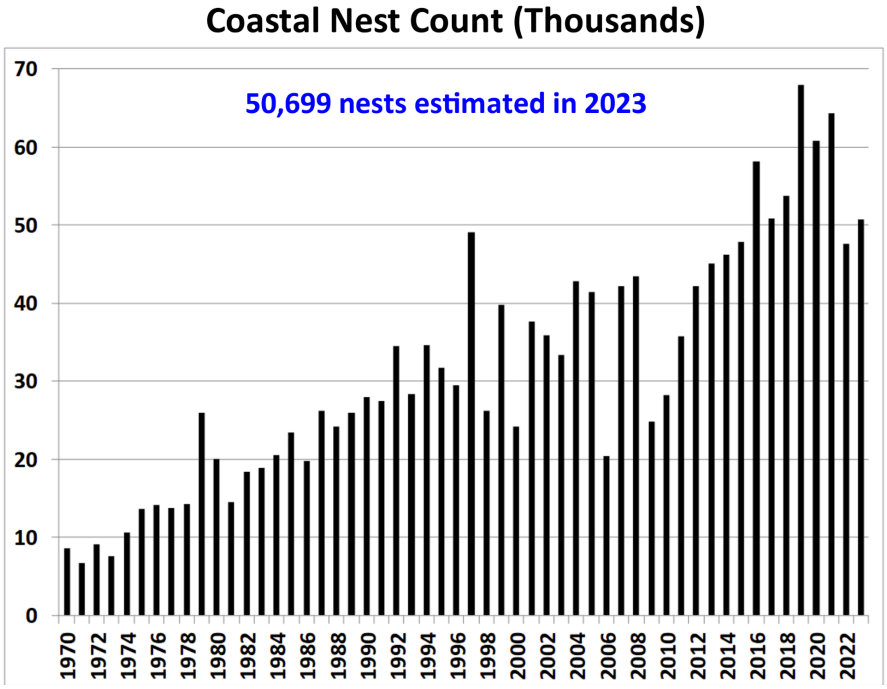
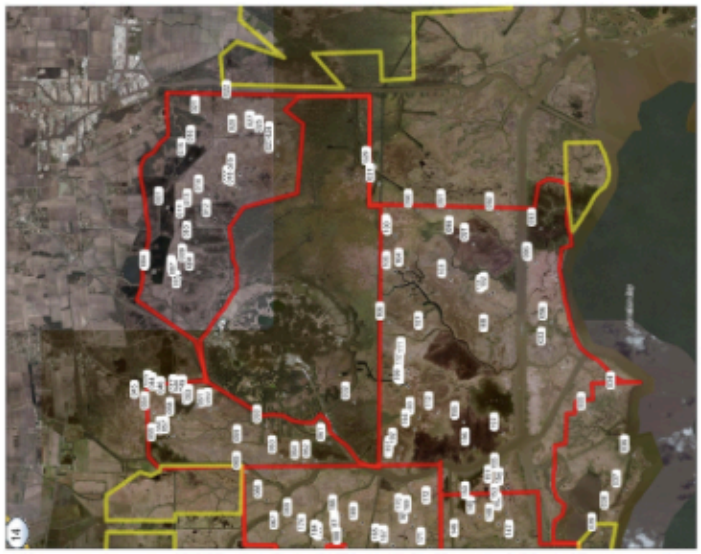
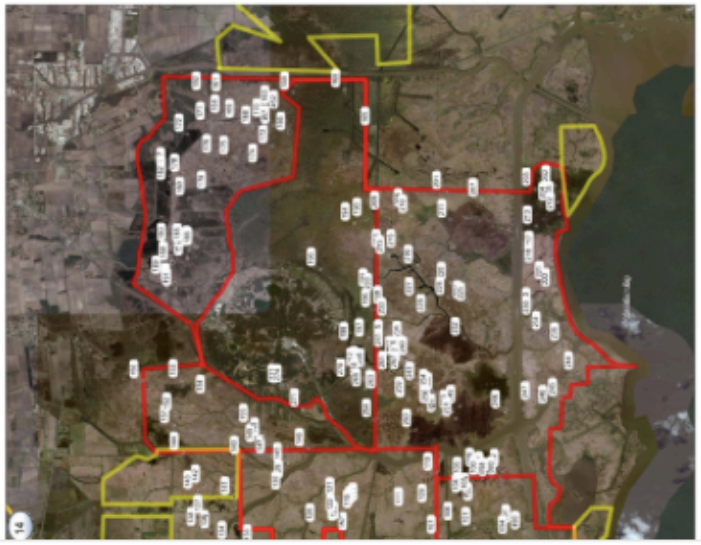


Figure 2.1 Louisiana coastal alligator nest count from Linscombe, (2024)

Fig 2.2: Aerial survey maps of alligator nests around Avery Island 2014, 2020 and 2022



2022: 76 nests



2020: 148 nests

2014: 113 nests

Data Analysis

Between 2011-2016 and 2023-2024, 465 alligators were wild harvested in the Avery Island area. 79 alligators were harvested in 2011, representing the largest number in the testing samples. The lowest number (35) harvested was in 2023. Between 2011 and 2016 harvest numbers were relatively stable.

The average length across the years was 6’7." The smallest alligator harvested was 5’6” in 2011 (Tag # 31027). The largest recorded male alligator in the dataset was 11’4” harvested in 2024 (Tag # 10367). The largest female alligator harvested in the dataset was harvested in 2015 and measured 7’10” (Tag # 10822).

The year with the smallest average length of alligators was before the break in 2016, averaging 6’0." Pre-2016 data shows a strong focus on harvesting alligators under 6 feet. In 2023-2024, the average size increased, with several specimens exceeding 8 feet. The largest alligators harvested in general were in 2024, averaging 8’1." The year with the largest alligators harvested in the dataset was in 2024, averaging 8’1." Male alligators consistently made up the majority of harvested alligators (~60-78%). No females were harvested in 2023, and 2 non-breeding females were harvested in 2024.

Egg and nesting analysis

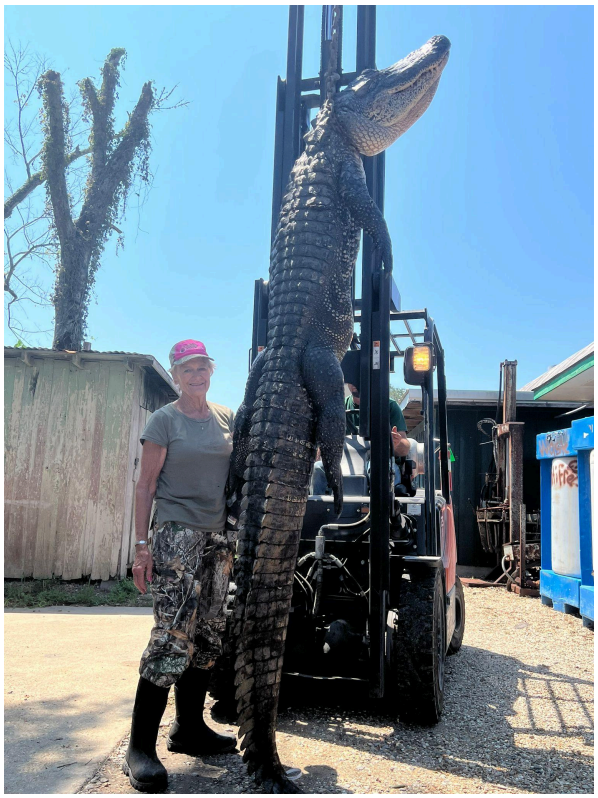
LDWF alligator survey data shows an increase in nest numbers from 8,000 nests in 1970 to 50,699 nests in 2023 (fig. 2.1) (Liscombe, 2024). Aerial survey nest data from the specific Avery Island area in 2014, 2020 and 2022 shows a slight decrease in alligator nests from 113 nests in 2014 to 76 nests in 2022 (fig. 2.2), but these fluctuations can also be attributed to high water levels from storms flooding nests in 2022.

Discussion

The wild harvesting of alligators has a long history in the area surrounding Avery Island, starting with McIlhenny's experiments with alligator farming on Avery Island in the 1920s and '30s. The move to commercial alligator farming in the 1970s and '80s undermined the market for wild harvested skins. Shirley said that "The tanneries lost interest in wild skins because the skins just weren't pristine enough." The pause in the data between 2017 and 2022 reflects the continued lack of profitability in the wild-harvested alligator skin market. The desire for high-end leather particularly in export markets made wild alligator harvest unprofitable. Romero confirmed that "The alligator skin market crashed making wild harvesting financially unviable." Shirley said that trappers could not pay for gas or bait for wild harvest and buyers could not afford to pay trappers, making it financially unfeasible to harvest. He explained that the oversupply of farmed skins also lowered prices and decreased demand for wild alligator skins. Romero clarified that the alligator harvest was not impacted by COVID-19. The change was purely an economic issue. However, the harvest resumed in 2023-2024, reflecting a potential bounce-back in demand. As the data shows, the market for wild skins remains low, but interviews indicated that the small market for meat from wild-harvested alligators is growing. In addition, unlike the market for high-end leather goods in Europe and Asia, the interviews with Shirley confirmed that the market for locally made "Western wear" cowboy boots, belts, gun scabbards, and holsters is still there, where craftspeople can avoid scratches and holes in wild harvested skins. In addition, alligator wild harvesting is a cultural activity that is regarded as rewarding and fun by many Louisiana residents.

Shirley further contextualized the downturn in wild harvesting when he explained that alligator farming is driven by demand from luxury international brands such as Hermes and Gucci. Farmed skins are preferred by these luxury leather markets due to their uniform size and because they are high quality and free of scratches. This was confirmed by Sagrera who commented that the watch strap industry initially drove the alligator industry in Louisiana, preferring 3.5-4' alligators. He revealed that in about 2005, "the trend shifted to smaller handbags and leather goods that required 4.5-5' alligators" . This meant that farmers required

more space so farmers expanded their facilities or cut their numbers. He confirmed that in the past 12-15 years, most farmers reduced their numbers because larger alligators fetch nearly four times the price of smaller ones, and the wild market has become saturated. Shirley also commented that currently, six foot skins are preferred because if an alligator is scratched after two years of growth, the value drops dramatically, "A six-foot farmed skin can be worth $600-700 compared to $125 for a four-foot skin." He also commented that, "It's all about exclusivity – fewer high-end products sold at premium prices" and that high-end brands sell a few high-priced items rather than thousands of bags or watches. Shirley said, "They don't want independent producers making large alligator tote bags that compete with their luxury brands […] they prefer to control the market by limiting supply." Shirley also commented that tanneries have also tightened grading standards and that "now it's closer to 100% needing to be perfect […] if they don't meet the top grade, they aren't paid for at all." There are currently five alligator farms in Louisiana that supply 99% of all the farmed skins.



Alligator from Trophy Hunt, 2023

Mr. Heath Romero on alligator harvest, 2023

This research shows that alligator farming has had a positive impact on wild alligator populations. Through careful management of egg harvesting and the hatchling release program, wildlife managers such as Romero and farmers like Sagrera believe the populations have stabilised. As Sagrera explained, “The farming system uses a return system - originally farmers had to release 17% of what they hatched back into the wild. Over time, as populations recovered that percentage dropped to 5%." This is confirmed by data presented in the Louisiana Alligator Farmers and Ranchers Association report (Linscombe, 2024). An analysis of the alligator nest maps shows there has only been a slight decline in the number of nests from 2014 to 2022, but the number of nests are relatively stable. Some nests are in the same location, year after year suggesting it could be the same female producing eggs. Sagrera commented: “By collecting wild eggs we save about 85% of the hatchlings that would otherwise die in the wild. In the wild, the survival rate of the alligator hatchlings is around 5-10%. On farms we have a 90% hatch rate and over 99% of those survive. This takes a resource that would otherwise be lost and turns it into a valuable product." Sagrera said “The return program is one of the main reasons the wild alligator populations have rebounded so successfully."

It is likely that the Louisiana Department of Wildlife and Fisheries (LWDF) alligator wild harvesting and farming management program has had an impact on alligator ecology surrounding Avery Island from 2011-2024. Harvest data shows that post-break harvests (2023-2024) - dictated by LWDF - saw an increase in alligator size. Very large specimens (>8 feet) were harvested from 2023 to 2024, compared to before the 2016 season. As Shirley said, “LWDF regulated harvesting helps control the population structure." Romero further explained that larger alligators were harvested in commercial trophy hunts, which provide considerable income to hunters and the state. Both Shirley and Romero said that a probable cause for larger alligators was the lack of harvesting between 2016 and 2023 which allowed more alligators to grow to larger sizes. Shirley also explained that larger alligators prey on smaller alligators, so annual removal of large alligators - either by sport hunting or by wildlife managers such as Romero - helps to support the smaller alligators to mature and for numbers to increase. In addition, post-2023, the percentage of males harvested also increased. Romero confirmed that drought and high salinity levels caused females to retreat into deeper waters, making males more available in the harvest zones during the management season.

Wild alligator harvesting around Avery Island is therefore a finely balanced process and is based not only on LDWF policy, but also local knowledge and many years of expertise, not only by scientific researchers but also by wildlife managers. Land managers such as Romero know that breeding females are to be avoided, and this naturally leads to a higher percentage of males in the harvest. However, if unproductive females are in the population, these individuals will be removed, as seen in 2024. As the data reflects and Romero confirmed, alligator harvest numbers were already declining gradually from 2012 to 2016. Romero stated that this was also due to natural population fluctuations, not just economic factors.

In addition, to monitor alligator populations, the LDWF alligator management strategy introduced a system of "bonus" tags that are adjusted based on population assessments by wildlife managers and scientists. Romero described how harvest quotas are adjusted based on surveys of alligator populations and how bonus tags for smaller alligators help track health and growth in the wild. Bonus tags appeared in the 2023-2024 data, specifically targeting alligators under six feet. The optimum size for harvest is under 6 feet, as smaller alligators have softer, more desirable skin for alligator skin markets. Romero clarified that these tags help biologists monitor the health of smaller alligators, a portion of which are re-released for research. In addition to this, Romero verified they have implemented tail notching as a permanent tracking system to monitor caught individuals, allowing biologists to monitor the growth and health of individuals in a given area (see photograph below). This is where one of the scales on the end of the tail is broken off to indicate when the alligator was caught and released back into the wild. Notching does not indicate from what farm the alligator was released, but because the scales are coded alphabetically, management officials and biologists can identify on which year the individual was released.

This research also indicates that there is a relatively similar number of nests in 2014 as were present in 2022. Female alligators nest in relatively shallow, low-salinity areas with adequate protection from predators and therefore tend to stay in the same general vicinity each egg-laying season. This indicates that the alligator population is stable. This consistency in the number and location of nests was confirmed by Shirley and corroborated by the alligator aerial

survey maps that locate alligator nests present in the Avery Island ecosystem (Mark Shirley, email Nov 18th, 2024). The upward trend in nest numbers is also shown in the LDWF coastal nest data collected annually from 1970 onwards.

10-15% of Alligator hatchlings are released back into the wild March 28th, 2025, Live Oak Farm

This research shows that weather events possibly caused by climate change could have affected alligator ecology between 2011 and 2024. Hastings identified climate change affecting alligator habitat as one of the biggest threats to maintaining alligator populations. Shirley and Romero both mentioned how changes in water levels, salinity, and habitat conditions affect alligator nesting and harvesting. Shirley said that alligators avoid nesting in areas where salinity exceeds 10 parts per thousand. “Coastal erosion, habitat deterioration, and saltwater intrusion all play a role” pushing alligators inland and changing nesting locations. “A big storm surge can tear up the marsh – almost like ripping up a carpet. What was once a fresh or intermediate marsh can turn into hundreds of acres of open water overnight.” Similarly, Romero also observed that after hurricanes, alligator populations temporarily increased in some areas, but many later returned to their original locations. For example, the high water and storm surge around Marsh Island in

2005 around Hurricane Rita temporarily increased alligator populations in the Avery Island area because many of the alligators migrated to lay their eggs in preferable conditions. However, over time, they migrated back to Marsh Island to lay their eggs in the following seasons. Romero also observed that during droughts, females move to deeper water, impacting where trappers find them.

It was interesting to note that Shirley and Sagrera both noted that another major challenge to the success of maintaining stable alligator populations in Louisiana is public perceptions of sustainable use. Sagrera said “People hear about alligators being killed for luxury handbags and don’t understand the full picture. That handbag represents a massive economic supply chain that supports landowners, farm workers, tanners, truck drivers and conservation efforts. Without a financial incentive, landowners would have a reason to protect wetlands. Sustainable use ensures that these habitats remain intact." Shirley also noted that negative perceptions towards sustainable use could be a problem because “The success of alligator conservation efforts both in Louisiana and worldwide is directly tied to the alligator leather industry. The strict regulations on tagging, harvesting, and accountability help protect other crocodilian species at risk.” Shirley concluded that animal rights activism had the potential to undermine the sustainable use of the species and therefore its survival because without an economic incentive, local communities have little reason to protect the alligator, or its habitat.

In order to build on this study, future work could include the correlation of alligator nesting and wild harvest data. Building a more consistent and systematic monitoring program would provide more information for wildlife managers, particularly as climate related weather events may happen with increasing frequency. Research could look into mitigation measures to provide stability of alligator populations in the presence of e.g. sea level rise or salinity incursion. AI and drones technology could be used to map and predict the location of alligator nesting sites. It would also be useful to monitor the impact of tariff implications on the international alligator skin trade.

Despite the changes in alligator harvest size and numbers that are reflected in the data, a balanced population of alligators has been maintained around Avery Island. This indicates that carefully monitored and sustainable management practices have been taking place. In addition, Romero confirmed that unused tags are returned yearly, poor egg-laying females are removed from the population, and fewer territorial fights occur due to controlled population density, which leads to better skin quality and overall health of the population.

Conclusion

E.A McIlhenny realized that the area surrounding Avery Island provides an ideal habitat for many species, particularly the American alligator. As Waddle (2017) described in his alligator Habitat Suitability Index, it is a perfect patchwork of deep water favored by territorial males and a shoreline favored by nesting females and juveniles, with optimal salinity levels. The area is managed collaboratively by land managers, policy experts and alligator farmers, with expert technical scientific advice and monitoring and policy frameworks provided by the Louisiana Department of Wildlife and Fisheries. This culminates in a deep understanding of this fine ecological balance by people who also share a lifelong commitment to the marsh.

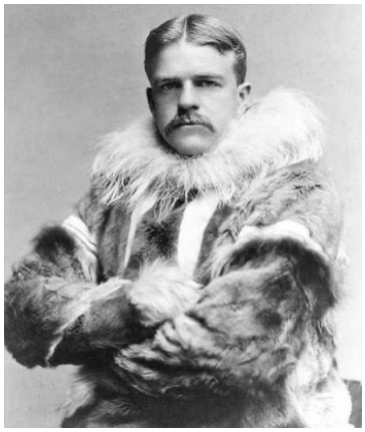
This study confirmed that Avery Island maintains a balanced alligator population because it is well monitored with minute adaptations made by experts year after year, based on trial and error and past experience. This indicates that there is harmony within the alligator population surrounding the Island, and by letting the natural predator-prey cycle continue while precisely managing the population, the individuals are able to cohabitate without conflict while still maintaining a healthy balance with populations of other species. This is shown from the data trends of this study that align closely with Romero's firsthand experiences. Similar to McIlhenny's day, there are many internal and external factors such as the economic crash, natural population cycles, and environmental factors like hurricanes and droughts all shape alligator harvest patterns. McIlhenny recognized that close attention needed to be paid to understanding alligator ecology and population dynamics. New management tools like censusing, bonus tags, and notching systems have been implemented, therefore, enabling managers to more closely

monitor alligator populations, showing an evolving and sustainable approach to wild alligator harvesting.

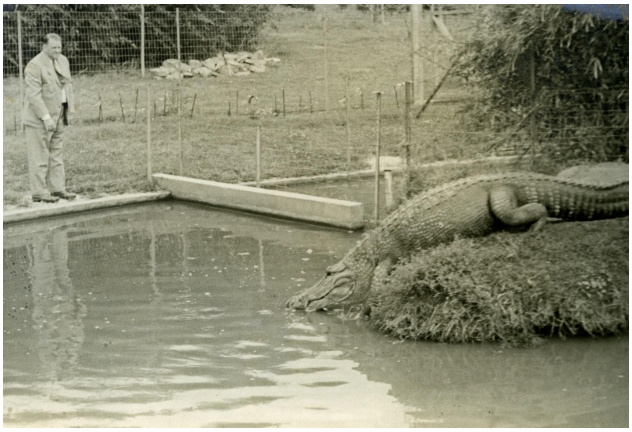
There is full integration with alligator farmers and landowners to ensure that alligator-related revenue from skins, eggs, and leases is returned to maintaining the marshlands. The management of alligators around Avery Island also ties together both consumptive alligator hunting and non-consumptive tourism. As Ross (2020) argued, Avery Island has been an "ark" or safe refuge, supporting the multi-generational stewardship of the area by individuals such as E.A. McIlhenny, Mr. Heath Romero, Mr. Mark Shirley and Mr. Stephen Sagrera for nearly 200 years. As Sagrera said "my great-grandfather settled on the Cheniere au Tigre around the same time McIlhenny was doing his conservation work." When I asked Romero why he has done this job for nearly his whole career, he said "I enjoy it. There haven't been many studies on alligator management, so it's a lot of trial and error, but I think I have it figured out!" Romero therefore continues to maintain McIlhenny's "meaningful spirit of conservation in the Gulf" (Davis, 2017, p213).

This study shows how the Avery Island area serves as a model for sustainable alligator conservation in both Louisiana and beyond. It reflects a personal understanding of management – the ecology and population dynamics of the alligator, integrating with captive breeding protocols, protection of nesting sites, adhering to hunting quotas, investment in protected area management, law enforcement, and conserving alligator habitat. It is a prime example of how wildlife management can be successful when it is curated over generations by people who work in this area and have championed the sustainable conservation of the species. E.A. McIlhenny was truly ahead of his time as he used his larger perspective on the importance of conserving this delicate species for future generations, dedicating his life to this work.

Personal Statement



E.A. McIlhenny, 1897



E. A. with "Frank" in his breeding pond on Avery Island c1932

A combination of pursuing my passion for environmental research, learning more about Louisiana's ecosystem, and understanding my Southern heritage, has drawn me to this alligator study, recreating E.A.'s McIlhenny's 1935 monograph as my high school independent study nearly a century later. This study serves as a microcosm of the hard work and dedication of scientists and management experts on Avery Island over the past 150 years. It also highlights McIlhenny's legacy – planting the seeds of conservation for future generations of the Island's custodians. I hope that my great, great-grandchildren will be able to sit around and hear the story about how I continued his legacy and made it relevant for my descendants. Around the island in the marsh where both E.A. and I spent time growing up, this study was also my own very personal journey, one in which the bayou connects my inner and outer worlds, connects me to my family, and to this unique landscape where I originate from.

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Appendix 1: Research Questions

Heath Romero February 8th, 2025

1. The data shows that harvest numbers declined before the break (2012-2016). Why was this?
2. The 2023 season resumed with only 30 alligators harvested, matching the lowest pre-break year. Why was this?
3. The 2024 harvest increased to 63 alligators .Why was this?
4. The post-break alligators appear larger than pre-break, with a record-high average length of 7.69 ft in 2024. Why is this
5. Does the increase in average size suggest that fewer young alligators were harvested, or were hunters targeting larger alligators?
6. The percentage of males harvested increased to 74-75% post-break. Does this align with what you've observed?
7. Could this be due to intentional selective hunting, or were female alligators less available?
8. Have there been any regulatory or environmental changes that explain this shift in the male-to-female harvest ratio?
9. Before the break, the total length of harvested alligators declined. Did hunters report difficulties finding large alligators, or was this due to economic constraints?
10. After the break, the total length increased despite lower harvest numbers. Were there more larger alligators, or were hunters targeting bigger individuals?
11. The largest alligator recorded in the dataset (11.33 ft) was harvested in 2024. Have you noticed an increase in the number of very large alligators since hunting resumed?
12. Do you think the five-year break allowed alligators to reach larger sizes, or could other factors have contributed to their growth?
13. How do you think hunting pressure in 2023-24 might affect alligator size trends in the coming years?
14. With the increase in harvest numbers in 2024, was there a rise in market demand or prices for alligator products?
15. Have hunters reported it's more difficult to find large alligators compared to pre-break years?
16. Do you think the current trend of larger harvested alligators will continue, or do you expect sizes to decrease as hunting continues?

Mark Shirley, February 16th, 2025

1. How do you census alligators?
2. Are female alligator nests always in the same spot or do they change over the years
3. Are there any alligator nests correlated with vegetation maps?
4. Do you know why there was a break in harvesting between 2016 and 2023?
5. Did this happen all over Louisiana or just in our area
6. Why are hunters incentivized to harvest smaller alligators
7. The data shows that harvest numbers declined before the break (2012-2016). Why do you think this was?
8. The post-break alligators appear larger than pre-break, with a record-high average length in 2024. Why is this?
9. The percentage of males harvested increased to 75% post-break. Why is this?
10. The largest alligator recorded in the dataset (11.33 ft) was harvested in 2024. Has there been an increase in very large alligators?
11. With the increase in harvest numbers in 2024, has there been a rise in market demand or prices for alligator products?
12. What is the ratio of farmed v wild-harvested alligators?
13. What are some of the biggest threats that alligators in Louisiana face today?

Stephen Sagrera, March 12, 2025

1. Can you tell me a little bit about yourself? I read the article you wrote in the 2020 article in *Vermillion Today* about your father. He was really the pioneer of the alligator farming business in Louisiana. Can you talk a little bit more about him and the key decisions that he made that made the business a success?
2. What were the turning points in alligator population management that led to their recovery in Louisiana?
3. How has alligator farming impacted wild alligator populations and conservation efforts?
4. What are the main challenges faced by alligator farmers in balancing the demands of the luxury goods market with sustainable conservation practices?
5. Could you talk about the economic impact of alligator farming on local communities, particularly in regions like this where it is a significant industry?
6. What are some of the biggest threats that alligators in Louisiana face today?
7. What lessons can other conservation programs learn from the success of alligator management in Louisiana?
8. One question for clarification: I've looked at the egg harvesting maps. Do you know why no eggs are harvested around Avery Island?

Professor Hastings, February 27th, 2025

1. Can you tell me a little bit about yourself and what led you to write your book? what experiences have shaped your interest in alligator conservation?
2. How do you think Louisiana's relationship with alligators has changed over time?
3. Can you explain the role of alligators as a keystone species and their ecological impact on Louisiana's wetlands?
4. What were the turning points in alligator population management that led to their recovery in Louisiana?
5. How has alligator farming impacted wild populations and conservation efforts?
6. What are the biggest threats alligators in Louisiana face today?
7. What lessons can other conservation programs learn from the success of alligator management in Louisiana?
8. What makes Louisiana's alligator population different from those in other states?
9. What are some of the biggest threats that alligators in Louisiana face today?
10. What future policies or protections do you think are necessary to ensure the continued survival of alligators in Louisiana?