North Carolina

Alligator Management Plan

With July 12, 2018 Addendum

North Carolina Wildlife Resources Commission

October 5, 2017

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North Carolina Alligator Management Plan

I. INTRODUCTION

The North Carolina Wildlife Resources Commission (NCWRC), during its February 2016 meeting, tasked the Executive Director with establishing an Alligator Task Force (Alligator TF) to write an American alligator (*Alligator mississippiensis*) management plan (see NCWRC resolution, Appendix A). Executive Director Myers established the Alligator TF (see Appendix B) in June 2016 and charged the group with writing a management plan by July 2017. He also instructed the Alligator TF to examine options under existing law to use North Carolina sportsmen and women to aid in removal of alligators under nuisance or depredation circumstances.

The Alligator TF first met in late August 2016. In November 2016, NCWRC staff hosted three public input forums in Leland (Brunswick County), Swansboro (Carteret County), and Manteo (Dare County). NCWRC staff also held a public forum on alligator management at Lake Waccamaw in July 2016. These meetings served as scoping meetings that helped the Alligator TF create the Draft North Carolina Alligator Management Plan. The Alligator TF held its second meeting in December 2016, its third meeting in March 2017, and its final meeting in June 2017. The June 2017 meeting followed six public forums held in coastal counties to present and listen to public opinions on the Draft North Carolina Alligator Management Plan. These forums were in Hampstead (Pender County), Dublin (Columbus County), Bolivia (Brunswick County), Jacksonville (Onslow County), New Bern (Craven County), and Washington (Beaufort County). Two documents produced during the Alligator TF's work are available on NCWRC's website:

Summary of Public Input from 2016 NCWRC Alligator Management Forums
Summary of Public Input on the Draft Alligator Management Plan

The Alligator TF prepared this North Carolina Alligator Management Plan using input from multiple stakeholders interested in alligator management in North Carolina. This plan proposes five management goals and 22 objectives to strengthen American alligator management in the state. Narratives about management strategies and objectives are also included. The final sections of the plan estimate the costs of achieving each objective and discusses the potential economic impacts of alligators and alligator management in North Carolina.

Several scientific research objectives proposed herein address uncertainties about the biological characteristics of North Carolina's alligator populations. New research may reveal information that requires amendment of management strategies and objectives described in this plan. Thus, NCWRC implementation of the North Carolina Alligator Management Plan will take an adaptive management approach. It is a dynamic plan that will use systematic learning from project outcomes to improve alligator management. The Alligator TF presented its final proposal for a North Carolina Alligator Management Plan to NCWRC on October 5th, 2017. The NCWRC Commission adopted their proposal following an amendment to add Hyde County to Alligator Management Unit (AMU) 1. This approved North Carolina Alligator Management Plan reflects the Commissioners' amendment.

II. BIOLOGICAL INFORMATION

A. General Description

The American alligator resembles a large lizard, but reaches a much larger size, has a thicker body and tail, and is strongly associated with wetlands. Adults range in color from black or dark gray to dark olive. Juveniles are born with bright yellow bands that encircle their bodies. These bands gradually fade over time.

Alligators can live 50 or more years in the wild (Wilkinson et al. 2016), and captive animals have been documented to live more than 70 years (Weigl 2014). Upper size limits for males, which grow larger than females, are typically 13-14 feet (396 - 427 cm) in length, while females reach 9-10 feet (274 – 305 cm) (Woodward et al. 1995; Brunell et al. 2013; Brunell et al. 2015). Adult males can reach weights of more than 500 pounds (227 kg), while females do not usually exceed 200 pounds (91 kg). Per Palmer and Braswell (1995), the largest male alligator ever examined in North Carolina was 12.5 feet long (382 cm total length) and weighed 475 pounds (215.5 kg), while the largest female was just over 8 feet (246 cm total length, weight unknown). External sexual characters are minimal for the alligator.

B. Taxonomy

There are currently 24 described species of crocodilians in the world (IUCNCSG 2017). The genus Alligator includes the only two extant species that can endure temperate climates, the American alligator (*Alligator mississippiensis*) and the Chinese Alligator (*Alligator sinensis*). American alligator (see Table 1) has existed in North America for at least 7 million years (Whiting 2016). Fossils of prehistoric crocodilians and their ancestors dating back to 231 million years ago (MYA) have been discovered in North Carolina (see Appendix D).

Table 1. Taxonomy of the American alligator.

Kingdom	Animalia
Phylum	Chordata
Class	Reptilia
Order	Crocodylia
Family	Alligatoridae
Genus	Alligator
Species	mississippiensis

C. Life History and Ecology

Reproduction

Sexual maturity in alligators is directly related to body size. Both genders tend to be capable of reproduction at 6 feet (183 cm) in length. Males in North Carolina are thought to take 14-16 years to reach sexual maturity, while females require 18-19 years; this is longer than the amount of time required for alligators from more southern locales (Doerr et al. 1983). For example, in South Carolina, researchers have estimated that male alligators reach sexual maturity at about 11.6 years of age, while females require approximately 15.8 years (Wilkinson et al. 2016; see Table 2). Due to slower growth rates, juvenile alligators in North Carolina require more time to outgrow a vulnerability to predation (Doerr et al. 1983). Immature alligators are much less susceptible to predators upon reaching 3 feet (91 cm) in length. Alligators typically mate from mid-May to early-July in North Carolina (Klause 1984), after which females construct mound nests of vegetation and soil on the shore. They lay an average of 35 eggs, then cover them with additional vegetation to incubate for 9-12 weeks until hatching.

The sex of young alligators is not determined at conception; rather, it is determined by nest temperatures during the thermosensitive period (TSP) of incubation. Lang and Andrews (1994) reported that the TSP occurs from stages 21 to 24 of embryonic development (in the middle third of the incubation period), during which nests with high or low temperatures produce females, while males are predominantly produced at intermediate temperatures (approximately 32-34°C or 90-93°F). Findings from a more recent study have expanded our understanding of this mechanism and demonstrated that the TSP begins by stage 15, and potentially earlier (McCoy et al. 2015).

After 60-80 days of incubation, the young hatch at about 9 inches (23 cm) long. While hatching they instinctively call to attract the female, who scratches open the nest mound and carries the hatchlings in her mouth to the edge of the water (Hunt 1987). Females have also been observed gently picking up eggs and rolling them in their mouth to aid in the hatching process (Kushlan and Simon 1981). Unlike most reptiles, female alligators protect their offspring from predators throughout incubation and into their early years of life. Juveniles generally congregate together in pods for the first few years, during which the female will respond to distress calls made by the young when threatened (Hunt and Watanabe 1982, Kushlan 1973).

Table 2. Reported length of time (years) required for American alligators to reach sexual maturity.

State	Males	Females	# of Alligators Studied	Source
Louisiana	6 - 10	8 - 13	745	Rootes et al. (1991)
Florida	8.9 – 12.4		N/A	Fujisaki et al. (2007)
Texas	10		48	Saalfeld et al. (2008)
South Carolina	11.6	15.8	185	Wilkinson et al. (2016)
North Carolina	14 - 16	18 - 19	87	Doerr et al. (1983)

Ecology

During their first years of life, alligators eat primarily snails, frogs, crayfish, insects, and other small invertebrates. Larger alligators may eat smaller alligators, turtles, snakes, fish, waterbirds, beavers, raccoons, and otters. Given the opportunity, alligators can prey upon dogs, cats, and other small domestic animals, such as goats and pigs. Alligators in North Carolina grow more slowly than alligators to the south because our water temperatures do not stimulate feeding for as long a period each year.

Alligators create small wetlands using their snouts, feet, and tail to excavate "gator holes" the size of small backyard pools. Because these holes provide critical pockets of aquatic habitat to many other species during periods of drought, the alligator is considered a keystone species within the coastal communities they inhabit (Palmer and Mazzotti 2004).

A mutualistic relationship between alligators and long-legged wading birds has been documented (Nell et al. 2016; Burtner and Frederick 2017). Large colonies of these birds choose to nest high up in trees near alligators because the presence of alligators is a strong deterrent for mammalian nest predators, such as raccoons and opossums. The resident alligators have an opportunity to scavenge nestlings that fall from the nests, which can be a substantial food source for alligators. Because the birds forage in other locations, this relationship also facilitates the transfer of nutrients from other ecosystems to these wetlands (Nell and Frederick 2015).

As an apex predator, alligators play an important role in ecosystems by regulating mesopredator populations. In salt marsh food webs, for example, predation on blue crabs by alligators results in the increased survival of a keystone marsh grazer (the Periwinkle snail, *Littoraria irrorata*) and a *Spartina* cordgrass-facilitating mutualist (the Atlantic ribbed mussel, *Geukensia demissa*) (Nifong and Silliman 2013).

Behavior

Alligators usually remain in the same area where they were hatched for two to three years before establishing their own territories. Hagan (1982) reported that annual home ranges of alligators at Lake Ellis Simon (Craven County, NC) ranged from 7.4 acres (3.0 ha) to 3,555 acres (1,439 ha) and that male home ranges were significantly larger than those of females.

Although adult alligators are usually solitary, they are known to congregate during the breeding season. Both males and females vocalize. The male calls with a loud, throaty bellow and may hiss and inflate to impress a mate. Females bellow and grunt, too, but less loudly.

Genetics

Genetic studies of alligators in Louisiana, Alabama, South Carolina, and Florida have revealed geographic patterns of genetic variation and population differentiation (Glenn et al., 1998; Davis et al., 2000). The results of a study in Texas indicated limited levels of gene flow among both coastal and inland populations of alligators (Ryberg et al. 2002). These findings suggest that alligators in North Carolina could exhibit genetic differentiation between isolated populations.

D. Distribution and Population Status

American Alligator Distribution

The range of the alligator in the United States includes areas from the southern tip of Texas through the northern coastal areas of North Carolina (Fig. 1).

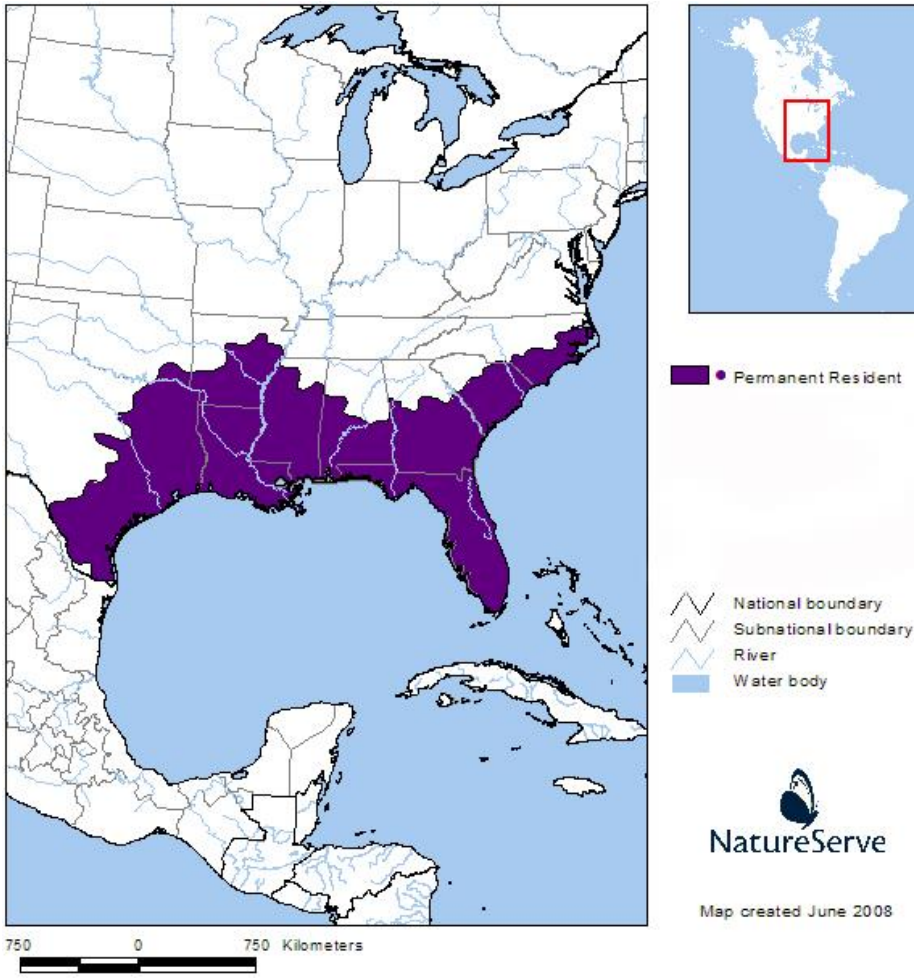


Figure 1. Range of the American alligator in the United States.

http://explorer.natureserve.org/servlet/NatureServe?searchName=Alligator+mississippiensis

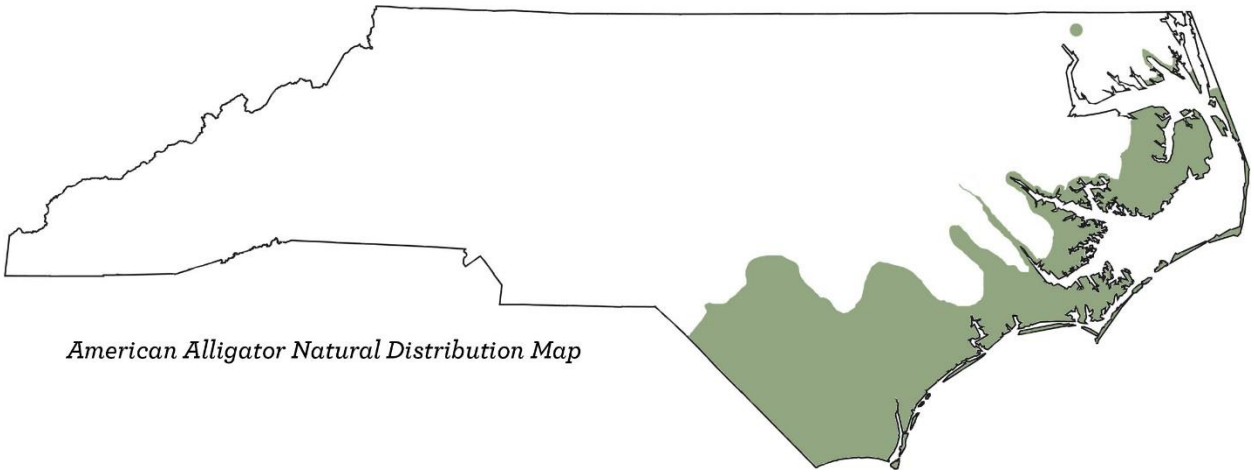


Figure 2. Approximate range of American alligator in North Carolina.

Alligator Distribution and Abundance in North Carolina

In North Carolina, the alligators occur just north of Albemarle Sound, south along the eastern Coastal Plain, and west as far as Robeson County (Palmer and Braswell 1995; Gardner et al. 2016) (Fig. 2). The aquatic habitats that alligators occupy vary widely across their range in North Carolina and from season to season. Alligators tend to prefer fresh to brackish waters, although they can tolerate higher levels of salinity for short periods of time. They inhabit swamps, creeks, rivers, tidal marshes, canals, ponds, lakes, and reservoirs.

Recent study of alligators in North Carolina by Gardner et al. (2016) showed that alligator populations are likely stable or slightly increasing and their current distribution appears to be relatively consistent with the results of a study conducted 30 years ago (O'Brien and Doerr 1986). Although these results did not indicate a population decline, the researchers noted that alligators occur in patchy distributions and very low densities across much of their North Carolina range. Alligators were more abundant closer to the coastline, further south, and in locations that limit access by people and provide more protection for alligators.

E. Historic and Ongoing Conservation Efforts

Chiefly driven by the commercial market for alligator skin products, alligator populations were greatly diminished by the mid-twentieth century because of unregulated harvest throughout their range. Under the 1966 Endangered Species Preservation Act, the very first list of endangered species compiled in 1967 (32 FR 4001) included the American alligator. This act authorized the use of federal funds for the acquisition of lands inhabited by listed species, but take ("to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct") of these species was not prohibited by federal law until Congress passed the Endangered Species Act of 1973. In 1969, Congress amended The Lacey Act (16 USC 3371-3378, 18 USC 42-43) to include reptiles, perhaps the most important legislation related to the recovery of American alligator. The Lacey Act prohibits interstate commerce of illegally obtained wildlife. In 1973, governments of 80 countries signed a treaty—the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The international export of

alligator skins was banned by CITES in 1975. Owing to these and state-level protections, alligator populations rebounded in many parts of their range. This recovery prompted the U.S. Fish and Wildlife Service to reclassify alligators range-wide in 1987 (52 FR 21059) as Threatened Due to Similarity of Appearance to other crocodilians worldwide, including the American crocodile (*Crocodylus acutus*), which was federally listed as Endangered in 1979 (44 FR 75074) and down-listed to Threatened in 2007 (72 FR 13027). Under this classification, the U.S. Fish and Wildlife Service continues to regulate interstate trade of alligators today. Illegal trade of alligators or alligator parts is generally thought to seldom occur.

With the rare exception of individuals taken by WRC employees or permitted Nuisance Alligator Agents (e.g., if an alligator poses a threat to public safety or personal property), there has been no legal take of alligators in North Carolina since 1973. While also relatively uncommon, relocation of alligators occurs far more often than euthanization when "problem" alligators are found in locations that could be a safety hazard to humans or their pets (see Public Safety Strategies in this document). In many cases, private citizens are provided with information about alligators and encouraged to allow the alligator to move on its own, which typically occurs within a few hours to a couple of weeks.

Alligators are usually shy and secretive in nature. If fed, they can lose their natural fear of humans and learn to associate people with an easy meal. In 2007, the North Carolina General Assembly passed a law, NCGS § 113 291.11, that prohibits the feeding of alligators. NCWRC has published a document titled Coexist with Alligators that highlights how important it is for people to refrain from feeding alligators.

III. PLAN GOALS

Five broad goals will guide the state's management of alligators. Proposed strategies (Section IV) and objectives (Section V) will guide activities to achieve these goals. Objectives that address each goal are referred to by objective number (see Table 3) following the goal narrative.

A. Maintain viable populations of alligators in North Carolina

NCWRC will maintain viable populations of alligators in suitable areas within the state. A viable population (see glossary) can survive or live successfully over the long-term, especially under current environmental conditions. Alligators are a socially valued and biologically important native wildlife species inhabiting North Carolina. NCWRC is charged with managing wildlife resources for the benefit of the people. The General Assembly has directed the agency to conserve native species. This goal is addressed by objectives 1, 6, 7, 8, 10, 14, 15, 17, 18, 20, 21, 22.

B. Conduct research to support science-based management of alligators

Long-term surveys, monitoring, and research of alligator populations will best inform management decisions affecting the conservation of alligators in the state. Science-based management of wildlife resources is a strategic goal for NCWRC. Sufficient, long-term information on the ecology and population status of alligators in the state, needed for successful management, is lacking. The best possible decisions for alligator conservation and management will always require up-to-date scientific information. This goal is addressed by objectives 1, 2, 6, 7, 8, 10, 14, 15, 16, 17, 18, 22.

C. Promote public safety through management of alligator populations

NCWRC must address public safety needs to retain support for alligator conservation in the state. The agency has received many requests from people for advice and help with managing alligators. These requests have increased as the state's human population has grown and rural areas have been developed. NCWRC places a high priority on reducing human-alligator interactions that compromise public safety or result in property damage. This goal is addressed by objectives 1, 2, 4, 5, 6, 9, 10, 11, 13, 18, 22.

D. Provide comprehensive information about alligators and alligator management

Expansion of the agency's outreach efforts will help reduce negative human interactions with alligators and promote public support for alligator conservation and management. Working closely with local governments will help communities achieve their alligator management goals and promote inter-agency communication. High public interest in alligators and alligator management offers opportunities to improve public knowledge about alligator behavior and therefore public safety. This goal is addressed by objectives 1, 2, 3, 4, 5, 9, 12, 13, 14, 15, 19, 20.

E. Provide opportunities for public enjoyment of alligators through hunting and wildlife viewing

The alligator is a valuable wildlife resource of great interest to people. NCWRC has received requests from those interested in using this resource. Creating and managing opportunities for public enjoyment of alligators will promote public support of alligator conservation. This goal is addressed by objectives 1, 2, 6, 10, 11, 12, 19, 21, 22.

IV. STRATEGIES

A. Education and Outreach Strategies [Goals C, D]

Public education, outreach, and non-lethal management options will be the first line of response in nuisance situations, and lethal removal will be the last option to resolve conflicts. Providing information, education, and outreach to the public related to alligators has been a long-term challenge for NCWRC. The perception many individuals have that every alligator is a dangerous nuisance, misconceptions about alligator behavior and biology, public unawareness that alligators exist in North Carolina, and the transient nature of human populations in some areas (e.g., military bases, vacation destinations, recreational areas) all contribute to the need for a strong and continual education and outreach program to keep the public informed. Historic education and outreach activities have involved periodic news releases in the spring to inform the public of increasing alligator activity and ways to reduce conflicts with alligators. Other current activities include responding to media inquiries (e.g., local paper and electronic media), informal and formal meetings with presentations to citizen groups and community leaders, and public information forums.

A major component of NCWRC's past and future public education and outreach efforts involves technical guidance to landholders and other citizens who have real or perceived conflicts with alligators. NCWRC responds to reports of such conflicts by providing information on alligator biology, regulatory considerations, public safety strategies, habitat management recommendations, alligator exclusion techniques, and other ways to reduce conflicts with alligators. These information exchanges occur in

informal or formal settings with individual citizens, groups of citizens at public meetings, and with community leaders. When necessary, site visits are conducted to investigate site-specific circumstances and to communicate with the involved persons. In some instances, actions are taken to resolve conflicts by removing problem alligators. In all instances, public education and outreach efforts are critical aspects of informing the public and managing expectations related to alligator management. As human populations and associated landscape development continue to expand, the frequency of these education and outreach opportunities continues to increase. NCWRC must continue to address these public education and outreach challenges to reduce future conflicts with alligators and to ensure long-term public support for conservation of this valuable resource.

With increasing contacts and demands from the public related to alligator issues, and uncertainties related to some aspects of alligator biology and population dynamics, clearly NCWRC should develop a formal alligator education and outreach program. NCWRC will strive to define and target appropriate audiences using multiple outlets to reach the right people effectively. Important audiences are residential communities, sportsmen and women, conservation groups, tourists, boaters, and governmental organizations. Effective education and outreach outlets could include paper media, televised media, online social and other online shared media (e.g., emails, blogs), news releases, agency video productions, agency webpages, public information meetings, and citizen science opportunities. NCWRC staff will work together to build a comprehensive public education and outreach program to better inform its constituents and address the various challenges associated with the management of the state's alligator resource.

B. Population Management Strategies [Goals A, B, C, E]

Management Units

The development of Alligator Management Units (AMUs) involves identifying geographic areas where alligator population management and human sociological objectives align. These delineated areas will then represent unique AMUs where different applications of NCWRC alligator management tools and strategies can best be applied. In some situations or locations within individual AMUs, there may be varying population management and sociological goals due to differences in land uses, varying levels of urbanization, and local differences in alligator population dynamics.

Alligator population dynamics, human population and associated sociological factors, and landscape features are the most useful parameters for delineating AMUs. In most areas of the Coastal Plain, alligators persist at relatively low densities and conflicts with humans are rare. In other areas, alligator populations are more robust or conflicts with humans are more common. The primary landscape feature most useful for delineating AMUs are riverine systems or watersheds. North Carolina Coastal Plain rivers and watersheds serve as somewhat of an east-to-west gradient that complement differences in alligator population dynamics from southern to northern areas of North Carolina's Coastal Plain.

When considering alligator population dynamics and sociological factors, the Alligator TF feels that two AMUs will be ideal. However, the Alligator TF understands that multiple approaches could be used to delineate AMUs. The proposed approach to delineating AMUs combines alligator resource, human sociological, and landscape factors. AMU 1 will consist of the following counties where alligator populations are generally considered to be more robust, human-alligator conflicts most commonly occur, and water bodies representing quality alligator habitat are more common and well distributed: Hyde, Pamlico, Craven, Carteret, Jones, Onslow, Pender, New Hanover, Brunswick, and Columbus. AMU 2 will consist of other counties where alligators currently exist to the west and north of AMU 1 (Fig. 3).

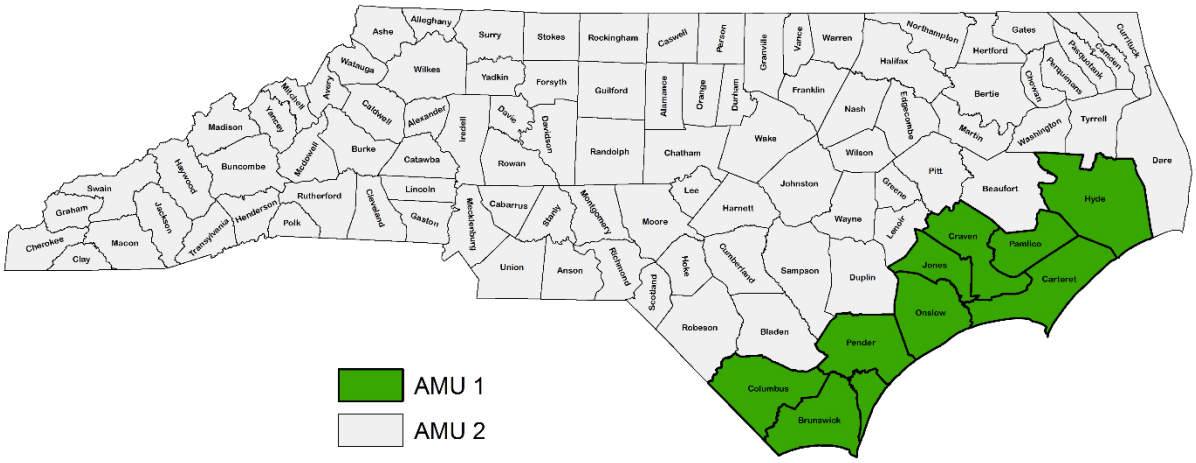


Figure 3. Proposed Alligator Management Units (AMU) in North Carolina.

Population Goals

The goal for both AMUs is to maintain viable alligator populations throughout their current range. A viable population is a population likely to persist over the long-term, in this plan defined as a population where the population growth rate (λ) is estimated as equal to or greater than 1.

Previous research suggests that the state's alligators may exist in metapopulations. A metapopulation is comprised of spatially separated populations of alligators which interact at some level. Alligators in separate metapopulations do not interact. While the degree of interchange between alligator populations in North Carolina is not well known, no management strategy will be implemented within either AMU with the objective of eliminating a population. Following are more specific population goals for each AMU.

AMU 1: Alligators may be more actively managed on some properties in this management unit than in AMU 2. The overall population objective is to maintain alligator natural distributions, densities, and associated trends, and allow the limited take of alligators in two circumstances. First, limited take could occur to reduce alligator numbers in municipalities where reports of human-alligator conflicts frequently occur. Second, take of alligators could occur where research demonstrates a population growth rate that can maintain long-term population viability despite hunter harvest.

AMU 2: The overall population objective is to manage alligator populations to maintain their natural distributions, densities, and associated trends with no lawful forms of regulated take other than take by depredation permit. This approach corresponds to current management. Exceptions for management or take of alligators may be made in situations involving alligator threats to public safety or damage to property.

Population Management

While problem evaluation and technical guidance are the initial response to conflict situations, relocation or lethal removal of alligators may become necessary in some localities. Should a municipality desire a reduction of alligator numbers for public safety or protection of property, the only current option is for

alligator relocation or, in extenuating circumstances, lethal removal. NCWRC staff and a few Nuisance Alligator Agents have conducted population management for many years by removing a small number of alligators in accordance with depredation laws.

Current management practices are efficient to address situations where an alligator is causing a problem, such as a food-conditioned alligator or an alligator blocking traffic. However, resolution of some incidents requires considerable effort. Targeted take of alligators to reduce numbers in areas with frequent alligator conflicts may be more economically accomplished by licensed sportsmen and women. These alligator removals may be completed at a reduced cost to communities because individual sportsmen and women are willing to pay a portion of the management costs out-of-pocket. The participants are willing to bear these costs because they realize a personal benefit from taking the alligator.

The Alligator TF recommended that NCWRC establish a process by which a city (as defined by NCGS § 160A-1(2) and hereinafter referred to as municipality) can formally request agency support to manage an alligator population. NCWRC will then work cooperatively with the municipality to assess alligator numbers, define areas of public safety concern, and identify those areas where alligator take could be safely conducted by hunters. If advisable to promote public safety, the Director may then issue an appropriate number of permits to accomplish the desired take of alligators. NCWRC must retain decision-making authority on the number of take permits issued. Local officials and NCWRC staff will jointly plan and implement any alligator removals authorized.

Public involvement is critical to gain support for alligator conservation and management, whether increasing, maintaining, or decreasing alligator abundance. Public support is gained by maintaining the distinction between removing alligators for personal gain and removing alligators to protect the public or property. Hunting provides a legal means for a person to take a public trust wildlife resource into lawful possession for personal benefit. Hunting removes a surplus of animals and does not violate the public trust by diminishing wildlife populations below sustainable levels over the long-term.

Removal of wildlife for a public safety or property protection purpose is a benefit to the public and not primarily to the person removing the alligator. Some people would, and have tried to, take public trust wildlife resources by hunting under the guise of protecting property or public safety.

NCWRC will maintain a distinction between hunting and removal of animals to protect the public or property by working closely with communities when setting goals for numbers of alligators. A public participatory process offers local and state government the best opportunity to communicate with all stakeholders in alligator management. A public decision-making process to set alligator population levels best protects public trust wildlife resources and meets the need for public safety and person property protection.

Some populations of alligators in AMU 1 may support a limited removal of alligators over a larger area than municipalities typically include. Because hunting throughout the entire area inhabited by an alligator population could result in the removal of too many alligators, NCWRC must acquire demographic, vital rate, and other biological information before allowing hunting in a substantial portion of a population's inhabited area. Factors informing the decision to permit hunting of a population include: area inhabited, alligator abundance by life stage, sex ratio, fecundity, and survival rates.

The Alligator TF recommended that NCWRC not issue permits authorizing hunting throughout a population's range when the population growth rate (λ) is less than 1.0, although exceptions may be made in populations where the management objective is to decrease alligator numbers. If NCWRC decides to allow the limited take of alligators by hunters outside of municipalities, then close monitoring must ensure that take does not exceed harvest quotas set by NCWRC biologists. Based upon research already conducted in North Carolina, a prudent approach to regulated hunting will maintain sub-adult and adult

alligators in populations, particularly females. NCWRC will issue hunting permits based upon the best available take per permit rates, including those from other states that allow alligator hunting. Recent data from alligator hunts in South Carolina indicate that 4 alligators are harvested for every 10 hunting permits issued.

C. Habitat Management Strategies [Goals A, B, E]

Habitat Conservation

Federal, state and private conservation organizations own significant lands in eastern North Carolina. NCWRC alone owns 225,000-acres of land within the range of alligators. About 60% of this habitat is wetlands where alligators can reside. Game lands, national wildlife refuges, national forests, state parks and national estuarine research reserves have management plans that seek to conserve freshwater wetland habitats. A review of current alligator distribution relative to available habitat and conservation ownerships may point out opportunities for habitat conservation.

Some conservation lands are appropriate for management to stabilize or increase alligator populations. Maintenance of healthy populations of prey species such as turtles, fish, snakes, waterbirds, rodents and other mammals allows alligator populations to thrive. Because alligators do not tolerate high salinity for long periods (Birkhead and Bennett 1981, Fujisaki et al., 2016, Parlin et al., 2015), management techniques and methods to ameliorate or minimize the effects of sea level rise will be important for maintaining alligators near the coast. Maintenance of dikes and plugging ditches to restore wetlands and inhibit salt intrusion will help to maintain or improve habitats. Control of exotic invasive species such as imported fire ants and feral hogs may minimize losses of alligator eggs to predators. Elsey et al. (2012) found that alligator nest losses from feral swine were on the rise in Louisiana.

Permit Review

State and federal biologists will review permit applications for projects that might impact wetlands inhabited by alligators. This promotes adherence to wetland laws, regulations, rules and best management practices. Alligators use a variety of wetland habitat types and depend on uplands for dispersal or movement between wetlands (Subalusky et al., 2009). Federal wetland laws, including the Clean Water Act, protect much of the habitat that alligators use. However, important habitat for juvenile alligators in isolated or seasonal wetlands receive less protection. Storm water management rules, along with the Division of Coastal Management's rules for Areas of Environmental Concern, dredge and fill laws, and forestry Best Management Practices all protect water quality and habitat for alligators.

Alligator Management Assistance Program

The Alligator TF recommended that NCWRC develop an Alligator Management Assistance Program (AMAP) to promote alligator habitat conservation and management. NCWRC will provide support to landowners to set and achieve their alligator conservation and management goals through a cooperative agreement. The landowner must agree to provide and manage habitat for alligators and to provide access to NCWRC for alligator population monitoring and research. Where a hunting season is established, landowners may be eligible to receive alligator tags for use on their property during an established hunting season when consistent with the overall population goal for the metapopulation. Landowners will agree to provide biological information from any alligators harvested.

D. Public Safety Strategies [Goals C, D]

Alligator Removal

Although the legal harvest of alligators may lessen some need for relocation, NCWRC will retain the ability to relocate or euthanize alligators where they pose safety issues or cause damage to property. In the interest of public safety and property protection, alligators may be trapped and relocated from public or private properties under the following circumstances: damage to property, injuries or threats to pets or livestock, proximity to human habitation, threats to human safety, alligator injury or welfare, emergency situations (e.g., roadway blockage, presence in structure or dwelling), or other appropriate circumstances at the discretion of NCWRC. Alligators will only be euthanized if they have been shown to be aggressive towards humans, there is an imminent public safety threat, or the alligator has suffered a severe injury and survival is unlikely. Properly trained personnel will be authorized to conduct alligator site visits and to make and carry out relocation and euthanization decisions. NCWRC will pre-approve release sites for alligators that are relocated by staff or permittees.

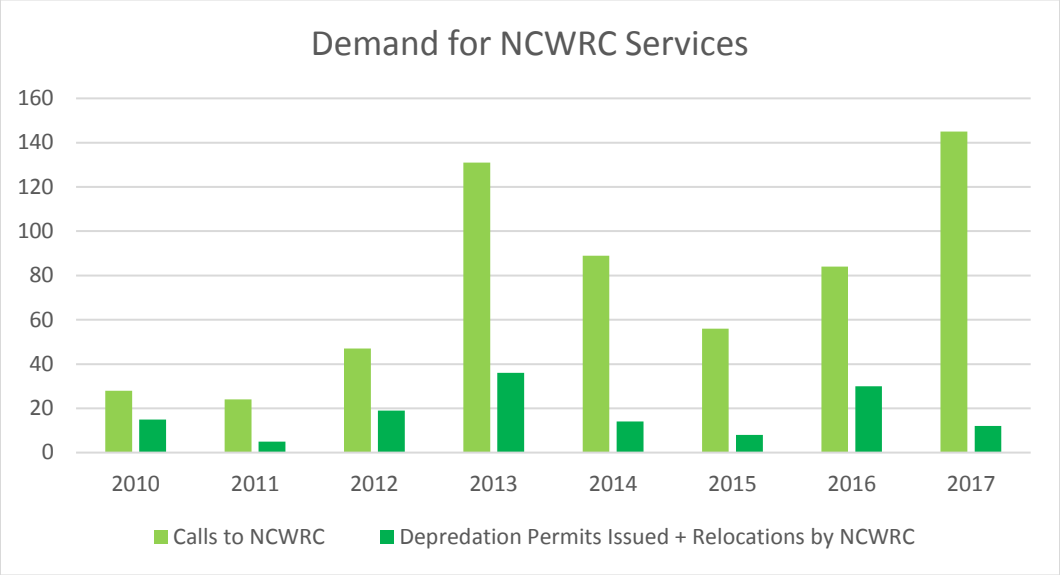
Due to agency staff and other resource constraints, NCWRC established a Nuisance Alligator Agent program. This program permits individuals to trap and relocate alligators under the above-listed circumstances. Nuisance Alligator Agents may charge a fee for alligator trapping and relocation services. Historically, NCWRC has had very few Nuisance Alligator Agents and currently has three, two of which are with governmental organizations working only within their jurisdictions.

With the recent development of a more formal Nuisance Alligator Agent program, the agency will recruit more agents to help resolve alligator nuisance issues. Doing so will lessen demands on agency personnel, while also providing better service to the public. Other than NCWRC staff and Nuisance Alligator Agents, no other individuals are authorized to trap and relocate alligators in the state.

NCWRC will adopt the revised guidelines in Appendix C for the Nuisance Alligator Agent program. Program participants must obtain an annual Endangered Species permit that authorizes them to take alligators, and they must follow certain equipment, capture, and alligator handling guidelines. Trapping and relocation of alligators to pre-approved release sites by program participants must occur after issuance of a depredation permit from NCWRC personnel, except in instances involving emergency situations where NCWRC staff can provide verbal permission to handle the situation. Program participants may not euthanize an alligator unless prior approval has been granted by NCWRC personnel, and authorization for euthanasia will only be granted if the alligator is suffering from severe injury and survival is unlikely.

In 2017, the agency established the North Carolina Wildlife Helpline to aid people with questions or concerns about wildlife interactions and conflicts. All calls received are answered; some responses require more effort than others. Agency records regarding calls (Figure 4) for help have improved recently, therefore the data indicate a greater increase in calls than occurred. The number of calls received in 2016 and 2017 are the most accurate data. The number of depredation permits issued for either relocation or lethal take of alligators has not increased at the same rate as calls for help. The data are not complete for 2017.

Figure 4. Calls to NCWRC requesting help with alligator management (2017 data is to date).



E. Science Strategies [Goals A, B, D]

Surveys and Monitoring

Various protocols are available for conducting surveys and monitoring of alligators. The prevalent tool used in North Carolina to date to assess the distribution and relative abundance of alligators is eye-shine counts. The technique can be used from a boat or car in motion or while stationary. Summaries of studies conducted in North Carolina using this technique follow.

Study 1: The first study was conducted during 1979-1980 by North Carolina State University (NCSU) in coastal North Carolina (Doerr et al. 1983). This study looked at distribution and relative abundance of alligators and considered three different methodologies for counting alligators: 1) night-time eye-shine counts, 2) day-time visual surveys, and 3) aerial visual surveys. They found that densities reported from night-count surveys in the coastal counties were very low (from 0 to 0.8 per km), that observations declined from south to north, that populations were clumped in areas where alligators are given some degree of protection, that no alligators were observed north of the Albemarle Sound, and that densities in 4 of 8 watersheds were too low to be effectively measured. They estimated a total population size of 1,772 alligators based on night-count survey results and calculations that included the probability values for observing alligators.

Results of the study included a finding that moon phase was the only correlated environmental variable that predicted alligator detection (increased observations with fuller moon). Also, careful standardization of night survey methodology improved results, and randomization was necessary. Comparing surface night counts, surface day counts, and aerial day counts as methods for surveying alligators, the authors made several observations: 1) season, time of day, and weather are critical to success of day counts, therefore these surveys should be conducted only on clear days, in the early mornings of early spring; 2) for aerial surveys, researchers can cover a large area in a short period of time, but the methodology is expensive and is most effective in open marsh and lake habitats in early spring; 3) night surveys were considered the best option by the author if alligator activity, ease of observation, and non-zero counts are

considered, and in these surveys eye-shine was visible up to 0.5 km. Based on the results, the authors recommended that when designing surveys, the number of survey routes should be maximized, and that each should be surveyed only once (between route variance was much higher than within route variance). They also found high spatial heterogeneity in the alligator observations within a route.

Study 2: To duplicate some of the work completed in the '80s, another study was conducted by NCSU in 2012-2013 in conjunction with NCWRC (Garner 2017; Gardner et al. 2016). This work employed night-time eye-shine counts to explore occupancy and relative abundance of alligators in North Carolina. Latitude (further north), longitude (further west), and salinity (increasing) all had negative effects on occupancy, while a positive response was seen with date of survey (later in the season). Additionally, higher temperatures resulted in greater detection probabilities, while presence in estuaries (as opposed to lakes and rivers) had significantly lower detection probability. The authors also suggested that habitat type, wind speed, and weather all likely play a role in detection, but none of these rose to statistical significance. The overall distribution of alligators in North Carolina appears to be clumped, with large unoccupied areas in eastern North Carolina.

Abundance analysis showed similar patterns to occupancy with latitude, longitude, and salinity. Two additional habitat parameters also had effects on abundance. Rivers appeared to have lower abundance estimates than lakes. Vegetation was important in the abundance model, suggesting that alligator abundance is greater in water bodies with vegetated shorelines. Abundance estimates among sites ranged from 0 to 105.4 alligators. In the area sampled by the 156 surveyed sites, abundance was estimated to be 672.13 (95% confidence interval 315-1507) alligators. This abundance estimate was only for the area sampled and is not an estimate of the total number of alligators in North Carolina.

Research

The conservation of the American alligator in North Carolina depends on understanding fully the demography of each metapopulation. This includes all the vital rates, such as fecundity, nest and egg survival, recruitment rates, growth rates, and size at maturity of adults. An understanding of alligator movements between populations within a metapopulation would also clarify population dynamics. These data are sorely lacking for North Carolina, although some relevant information may be available from other states.

Some modeling has been conducted to attempt to understand alligator population dynamics in North Carolina, but these models have relied on vital rates acquired from other states or from data collected in North Carolina at 2 sites during a short period in the early 1980s. Two recent published studies applicable to North Carolina were by Gardner et al. (2016) and Dunham et al. (2014). Both studies explored models including a harvest element, and both appeared to show declines with any significant level of harvest. In fact, the Dunham et al. (2014) model found that the overall population of northern alligators (which would include North Carolina) is in decline currently. The Gardner et al. (2016) model reported a similar negative population trajectory, but anecdotal reports from trappers and biologists and comparison of raw counts between the 1980s and 2010s indicated a slowly increasing population. Hence, Gardner et al. (2016) explored harvest models with the vital rates of a slowly increasing population. Model results reported that only a very small harvest of the adult female component of the population (i.e., 0.13 adult females per year given a population of 100 females) was sustainable. As indicated, both studies examining North Carolina alligators have relied heavily on vital rates from other states. To properly understand population dynamics in North Carolina, it is critical to have robust estimates of all vital rates from North Carolina populations.

Recommended Surveys, Monitoring, and Research

Alligators in North Carolina are at the northern extent of their range. They are not able to colonize colder areas northward because alligator births do not exceed deaths. Accurate, up-to-date information on alligator populations in any part of North Carolina on vital rates and the public's acceptance of alligators is required for wildlife professionals to maintain viable alligator populations and meet the needs of people.

New studies are required to provide the scientific basis for management of alligators in North Carolina. Collection of data on alligator populations in North Carolina will require considerable field work and resources. Some vital rates can be estimated in two field seasons, while others (e.g. growth rate, maturity, movements) may require years to accomplish.

Six studies are proposed to provide important information on which to base alligator management decisions.

Investigate spatial ecology of alligators

Knowledge about the movements of alligators is important for two reasons. First, alligator populations in North Carolina may occur in one or more metapopulations. Study of populations throughout the alligator's range in North Carolina may answer this question. Metapopulations may be comprised of populations with differing demographic, genetic, or other characteristics. These characteristics are important factors in management decisions. Second, alligator relocation is expensive and experience has shown that alligators often attempt to return to the general area where they were captured. Knowledge of return rates in North Carolina will help NCWRC evaluate the effectiveness of relocation as a population management technique. Due to the time required to learn about alligator movements in North Carolina, this study will begin immediately.

Improve estimates of demographic characteristics of populations

Accurate estimates of natality rates, survival rates, population age class distributions, sex ratios, age of first breeding, and fecundity are needed to reliably predict the ability of the alligator population to sustain itself. This research could provide initial data to estimate population growth rate (λ) for some populations within 4-years. Once acquired, NCWRC will evaluate the reliability of λ estimates for populations considered for limited take of alligators by hunters. Estimates judged unreliable will result in continued monitoring of populations to improve those estimates. Due to the time required to learn about demographic characteristics of alligator populations in North Carolina, this study will begin immediately.

Assess the level of acceptance of alligators in each AMU 1 county

Periodically assessing the attitudes, values, and beliefs of the state's residents and visitors will provide important information to state and local governments to set and periodically revise alligator population goals. Like biological carrying capacity, cultural carrying capacity can change over time. Due to the need to understand the human dimensions of alligator management in North Carolina, this study will begin immediately.

Evaluate usefulness of alligator survey techniques

Periodic surveys of the number of alligators in a variety of habitats is required to evaluate the effectiveness of alligator conservation and management actions. These surveys are costly and NCWRC is interested in conducting these surveys in the most efficient and economical way possible. This study will begin immediately to minimize agency monitoring costs over the long-term.

Identify and map important alligator habitat and target areas for conservation attention

In a rapidly changing environment, it is prudent to periodically assess habitat availability for American alligator. Alligator habitat availability is an important factor in conservation decisions, as well as helpful for establishing research and monitoring projects. This study will begin immediately.

Determine the economic values of alligators

NCWRC manages wildlife resources to benefit the people of the state. Periodically assessing the tangible and intangible values of alligators will provide important information to state and local government to set and periodically revise alligator population goals. This work will begin once more information is available on the distribution and abundance of alligators in the state.

F. Legal Strategies [Goals A, C, E]

Current Laws (General Statutes and North Carolina Administrative Code)

The American alligator is listed as Threatened by the U.S. Fish and Wildlife Service (FWS) due to its similarity of appearance to other protected crocodilians. The FWS regulates the take of alligator by the Code of Federal Regulations (CFR) under 50 CFR 17.42. Per 50 CFR 17.42 (a)(ii), a person may take alligators in accordance with the laws and regulations of the State. Per 50 CFR 17.42 (a)(ii)(B), a person may sell or transfer a specimen domestically in accordance with the laws and regulations of the source and receiving States.

The FWS regulates the trade of alligators by 50 CFR 23.70. States must require tagging of any alligator skins for sale or transfer. Tags must be FWS-approved in accordance with 50 CFR 23.70. The State must set up a management program using FWS guidelines for approval by the FWS. Once the program is approved, international trade under the Convention in International Trade of Endangered Species (CITES) may be allowed.

North Carolina statutes (NCGS) concerning alligators include NCGS S 113 Article 25, requiring NCWRC to list the alligator as a Threatened species to match its federal listing. NCGS § 113-129 (15) includes the American alligator in the definition of "Wild Animal" due to its federal listing as Threatened Due to Similarity of Appearance. NCGS § 113-291.11 prohibits the feeding of alligators outside of captivity. NCGS § 106-763.1 regulates the commercial propagation and production of captive alligators. NCGS § 14-417.2 regulates the ownership or use of crocodilians exclusive of alligator. Collection for scientific purposes is governed by NCGS § 113-272.4, which prohibits the taking and collection of endangered, threatened and special concern species except under a special permit issued by the Executive Director for research purposes.

Alligators are managed as a Threatened species per North Carolina Administrative Code, and currently there is no open season for taking alligators. The only currently legal take of alligator is via a depredation permit issued by the Executive Director per 15A NCAC 10I .0102 (b)(4), except in instances of defense of human life per 15A NCAC 10I .0102 (c)(1).

NCWRC may establish rules allowing the hunting of alligators within the state. The Commission is authorized to establish season, bag limits and some manners of taking for any wild animal and may require persons taking wild animals to possess a hunting license. Definition of the alligator as a "Wild Animal" invokes this authority. Note that federal delisting of the alligator would remove it from the definition of "Wild Animal".

Recommended Changes to Law

NCWRC will evaluate a proposal during its 2017-2018 rulemaking cycle allowing the limited take of alligators by hunters. These rules will provide the legal framework to enable hunters to take alligators in cities, towns, and villages as authorized by permit. These rules will also provide the legal framework for hunting in those areas of AMU 1 where research has demonstrated that the recruitment rate is sufficient to offset adult mortality and sustain a viable population over the long-term ($\lambda \geq 1.0$).

G. Other Conservation Strategies [Goals A, B, D, E]

Conservation Incentives

Several conservation incentive programs focus on restoring water quality by preventing runoff and siltation. Each of these programs helps to provide better alligator habitat. Each of the following incentive programs, except for the North Carolina Wildlife Conservation Land Program, come from the Farm Bill.

The Conservation Reserve Program is administered by the Farm Services agency and pays a yearly rental payment in exchange for farmers removing environmentally sensitive lands from agriculture and planting species that will improve environmental quality. The Conservation Reserve Enhancement Program provides rental payments to landowners with high priority conservation issues in exchange for removal of these lands from farm production.

The Farmable Wetlands Program is designed to restore wetlands and wetland buffer zones that are farmed. It also provides annual rental payments to farmers willing to restore wetlands and establish planted buffers.

The Grassland Reserve Program works to prevent grazing and pasture land from being converted into cropland or used for development. In return, landowners receive an annual rental payment.

The Environmental Quality Incentives Program (EQIP) is a Farm Bill program that provides financial and technical assistance to farmers who plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and non-industrial private forestland. The Wildlife Habitat Incentive Program was another Farm Bill program that focused more specifically on wildlife habitat, but was repealed in 2014. Some parts of that program have been rolled into EQIP.

The North Carolina Wildlife Conservation Land Program provides tax incentives to landowners willing to manage priority habitats such as wetlands, or protected state listed species such as the alligator. This program is administered by NCWRC, and allows landowners a reduced assessment for taxation purposes. Although this program has not been used much in eastern North Carolina, it has significant potential to improve habitat for alligators.

Collaboration with Other Organizations

NCWRC has developed strong collaborations with a variety of organizations involved in wildlife conservation work. Many of these collaborations are long-standing and offer opportunities to strengthen habitat management and public relation projects that would benefit alligators. The following is not a complete list of all partners, but constitutes primary collaborators and potential opportunities for joint conservation work.

Non-government Organizations

Cape Fear Arch: This regional collaboration covers an area from Cape Lookout, North Carolina to Cape Romain, South Carolina, and extends inland beyond Fayetteville to the Sandhills Region of the Carolinas. It was created in 2006, and consists of 28 partner organizations, agencies and municipalities. Its mission is to develop and implement a community conservation vision to build awareness, protection and stewardship of the region's important natural resources. An opportunity exists for NCWRC to work with the Cape Fear Arch to protect additional lands for the conservation of alligators.

Onslow Bight Conservation Forum: This is another regional collaboration. It was established in 2002, and is the first of its kind. It extends from the lower Northeast Cape Fear River to the Pamlico River and from offshore waters to approximately 30 miles inland. Twelve governmental agencies and private conservation groups with land holdings in the landscape, as well as other interested agencies and groups, established this forum to enhance cooperation and communication regarding regional conservation issues within the Onslow Bight landscape. The mission of the North Carolina Onslow Bight Conservation Forum is: *To provide for open discussion among the participants concerning the long-term conservation and enhancement of biological diversity and ecosystem sustainability throughout the Onslow Bight landscape compatible with the land use, conservation and management objectives of the participating organizations and agencies.*

North Carolina Coastal Land Trust and *The Nature Conservancy*: These land conservation organizations work independently or with partners to conserve ecologically significant lands. Many acres of land acquired by these organizations have been transferred to NCWRC, and continued partnerships like these provide opportunities to conserve additional alligator habitat.

North Carolina Coastal Federation: This advocacy organization works to protect and restore coastal water quality and habitats throughout the North Carolina coast by collaborating with and engaging people committed to preserving the coast. NCWRC works with the North Carolina Coastal Federation to restore wetlands and create marsh habitat to provide alligators more places to live.

Federal Agencies

Department of Defense: Marine Corps Air Stations at Cherry Point and New River, the Marine Corps Base at Camp Lejeune, and the Navy Base at Military Ocean Terminal Sunny Point all partner with NCWRC on various projects. The military is very involved in both the Cape Fear Arch and Onslow Bight Conservation Forums. Land acquisition, wildlife research, and wildlife surveys and monitoring are all consistent activities between our agencies. Camp Lejeune has provided NCWRC with alligator survey data from that base, and continued cooperation will provide research, monitoring and habitat conservation opportunities.

United States Forest Service: The Croatan National Forest lies within Craven, Jones and Carteret Counties. A cooperative agreement between NCWRC and the U.S. Forest Service provides that NCWRC will conduct wildlife management activities on the forest. The forest is in the Game Lands Program, and is a valued location for hunting. Alligator population numbers are not known on the property, but are thought to be at least average given the northern latitude. Few complaints about alligators on the Croatan National Forest have been received. There seems to be good potential for the Croatan National Forest to be a large reservoir of alligators, although there may be a need to take some alligators in isolated locations where the forest interfaces with urban settings.

United States Fish and Wildlife Service: The FWS has purview over federally listed species, so our partnership with them is paramount. The American alligator was declared recovered in 1987, and was the first success story for the Endangered Species Act. The USFWS still regulates the legal trade in alligators and their products to protect the federally-listed Threatened American crocodile because of their

similarity in appearance. The recovery of the alligator could not have been achieved without the partnership between the USFWS and state wildlife agencies. In addition, the National Wildlife refuges of Swan Quarter, Cedar Island, Roanoke River, Alligator River, Pea Island, Pocosin Lakes and Lake Mattamuskeet all provide valuable habitat for alligators at the northern end of their range.

Department of Environmental Quality

National Estuarine Research Reserve: The North Carolina Coastal Reserve and National Estuarine Research Reserve (NERR) is within the North Carolina Department of Environmental Quality, Division of Coastal Management. Most of the reserves are within estuaries, and thus have less importance to alligators as habitat. However, the largest reserve (Emily Richardson Preyer Buckridge Reserve) is over 27,000 acres strategically located in Tyrrell County between Pocosin Lakes and Alligator River National Wildlife Refuges. This property is almost entirely forested wetlands and freshwater marsh. NCWRC has an opportunity to Partner with NERR to help manage alligator populations on their lands.

North Carolina Division of Marine Fisheries: The Division of Marine Fisheries manages and makes rules for fisheries in estuarine environments, so they have minimal impact on alligator habitat. However, they do have a significant enforcement division (Marine Patrol) that works with NCWRC wildlife officers. The Marine Patrol is sometimes called upon to help enforce wildlife laws when violations occur in marine environments.

Department of Agriculture and Consumer Services

North Carolina Division of Forest Resources: The N.C. Forest Service owns several state forests. Bladen Lakes State Forest has the largest potential for alligators. At almost 33,000 acres, this inland forest in Bladen County is mostly uplands, but contains ditches, canals, ponds, lakes and streams that provide potential alligator habitat. It is also located next to or near several state parks, state natural areas or NCWRC Game Lands. This geologically significant area contains numerous Carolina bays that provide additional alligator habitat. Some human and alligator interactions occur here. Additional opportunities exist for land managers to collaborate in the management of this area for the alligator population.

North Carolina Cooperative Extension: The Cooperative Extension Service offers an educational partnership with numerous programs implemented by county field faculty and supported by university-based specialists. This large-scale outreach system could be valuable in reaching landowners and homeowners who have alligator technical guidance issues.

Department of Natural and Cultural Resources

North Carolina Division of Parks and Recreation: There are numerous state parks in coastal North Carolina that provide habitat for alligators, and NCWRC has an excellent relationship with state parks. They also do significant monitoring and survey work, and would be an exceptional partner for additional survey efforts. No hunting is permitted in state parks, so these lands provide refugia for alligators.

North Carolina Museum of Natural Sciences: The state museum provides valuable data with respect to alligators. They also occasionally conduct surveys or research on wildlife species. Additional partner activities should provide better data collection and storage opportunities.

North Carolina Aquariums and *North Carolina Zoo*: Both these agencies are part of the N.C. Department of Natural and Cultural Resources. They both provide opportunities on occasion for rearing wildlife to release into the wild. In addition, the aquariums and zoo provide a tremendous education and outreach service. Each of the three coastal aquariums have displays involving alligators.

V. Implementation Plan: Schedule of Objectives and Actions by Year

Table 3. Objectives and implementation schedule.

Objective	Completion Date	Description	Related Goal(s)	Estimated Cost (4-yrs)
1	1-Nov-17	Adopt, publish online, and implement Alligator Management Plan for North Carolina	A, B, C, D, E	$ 100,000
2	1-Feb-18	Identify communities with frequent human-alligator interactions	B, C, D, E	$ 500
3	1-Feb-18	Implement public education program emphasizing public safety, prohibitions on illegal take and feeding, and alligator ecology and management	D	$ 10,000
4	1-Feb-18	Refine and adopt response guidelines, including third party involvement, to alligators causing public safety or property damage problems	C, D	$ 500
5	1-May-18	Assess local government interest in targeted removal of alligators by hunters	C, D	$ 1,000
6	1-Oct-18	Complete targeted removal of alligators by hunters where appropriate per requests of municipalities	A, B, C, E	$ 24,000
7	1-Feb-19	Identify and map important alligator habitat and target areas for conservation attention	A, B	$ 75,000
8	1-Mar-19	Develop first approximation of the number and extent of populations of alligators	A, B	$ 2,500
9	1-May-19	Assess interest of municipalities in the targeted removal of alligators by hunters	C, D	$ 1,000
10	1-Oct-19	Complete targeted removal of alligators by hunters where appropriate per requests of municipalities	A, B, C, E	$ 24,000
11	1-Dec-19	Design an Alligator Management Assistance Program (AMAP)	C, E	$ 2,500
12	1-Feb-20	Complete development of a watchable wildlife alligator viewing location on a game land	D, E	$ 20,000
13	1-May-20	Assess interest of municipalities in the targeted removal of alligators by hunters	C, D	$ 1,000
14	1-May-20	Complete an assessment of cultural carrying capacity by county in AMU 1	A, B, D	$ 150,000
15	1-May-20	Complete study to determine economic values of alligators in North Carolina	A, B, D	$ 150,000
16	1-May-20	Complete study to evaluate usefulness of alligator survey techniques in North Carolina	B	$ 150,000
17	1-May-20	Complete study to improve estimates of vital rates and age-class distributions for metapopulations in AMU 1	A, B	$ 200,000
18	1-May-20	Complete study to investigate spatial ecology of alligators with emphasis on interchange between metapopulations and fate of relocated alligators	A, B, C	$ 200,000
19	1-Jun-20	Complete development of technical materials to help public land managers develop watchable wildlife viewing areas for alligators	D, E	$ 5,000
20	1-Jun-20	Review and adjust as needed the alligator population goals (increase, maintain, decrease) for each Alligator Management Unit (AMU)	A, D	$ 1,000
21	1-Jun-20	Review and revise as needed metrics for number of recreational hunt permits to hunt alligators where biologically sustainable and socially acceptable	A, E	$ 1,000
22	1-Oct-20	Complete targeted removal of alligators by hunters where appropriate per requests of municipalities	A, B, C, E	$ 24,000
				$ 1,143,000

The initiatives proposed in this Alligator Management Plan are achievable within four years given sufficient attention, staffing, and funding (Table 3). The highest priority objectives with the earliest completion dates are those important to improving public safety. Objectives relating to public enjoyment of alligators, while important, have completion dates ending the four-year period. This is due to the need to conduct research to provide the scientific basis for management of alligator populations.

VI. ECONOMIC IMPACTS

A. Alligator Management Revenues and Costs

Agency Revenues

The implementation of the North Carolina Alligator Management Plan will require upfront and long-term costs for NCWRC. NCWRC does not expect to receive any substantial revenues from the management of alligators, although some funds could be collected from hunters selected by lottery to receive alligator permits. Most funding to support more intensive management of alligators in North Carolina will come from other sources. Two primary sources are the Nongame and Endangered Wildlife Fund and a federal grant, State and Tribal Wildlife Grants. Nongame and Endangered Wildlife funds are given by North Carolina taxpayers for conservation of nongame and at-risk wildlife, donations which in 2017 totaled about $230,000. Nongame and Endangered Wildlife Funds are used to match State and Tribal Wildlife Grants, funds appropriated by Congress to conserve at-risk species. The amount of State and Tribal Wildlife Grant funding allocated by the federal government to North Carolina in 2017 was about $1,275,000. These funds are used to support conservation work for aquatic organisms, reptiles and amphibians. Another funding source that could support alligator management is the Wildlife Endowment Fund.

Agency Costs

The current estimated cost of the proposed initiatives in this Alligator Management Plan is $1,143,000 over a 4-year period (Table 3). This estimate does not include the cost of redirecting current staff to alligator management work. Using existing agency staff to perform new or additional tasks incurs opportunity costs (i.e., an existing or different task will be forgone). Some staff time savings will be realized by shifting responsibility for alligator relocations or lethal removals to the private sector.

The estimated cost to produce and implement the Alligator Management Plan is about $100,000. These costs were incurred by permanent and temporary staff to support the Alligator TF, and travel to attend task force meetings and public forums.

The Alligator Management Plan calls for an expanded education and outreach program. NCWRC will incur the production cost for materials, though no increased staff will be necessary. Estimated cost to produce materials and pay for travel for outreach activities is $10,000.

NCWRC may need a temporary staff position to support targeted removal of alligators by hunters in municipalities, depending on demand for technical guidance services. Current cost for a 6-month position is $17,700. This work will also require effort by District Biologists, but likely add minimal additional costs beyond travel to meet with local officials and production of hunting permits. Total cost by the agency over a four-year period is estimated at $75,000.

NCWRC will pay for improving or constructing wildlife viewing facilities on game lands to enable easier access to safer alligator viewing. These improvements could include viewing platforms and parking areas.

Estimated cost is $20,000 per facility, but the actual cost is expected to vary considerably depending upon site characteristics.

Completion of the six studies outlined in Section D could cost about $925,000. The research is required to provide the scientific basis for management of alligator populations. Contractors will be hired to conduct the research needed, although staff may have substantial involvement in some of this work.

Costs to Private Sector

Landowners will incur costs should they require the services of Nuisance Alligator Agent, which will be at the discretion of the agent. The cost to remove an alligator is expected to be in the range of $300 - $500, depending on the services rendered.

Private citizens (licensed hunters) will pay for the opportunity to harvest an alligator either through hunts in municipalities or permitted hunts in AMU 1. Permit fees and any associated cost (guide service fees, etc.) fall to the hunter. Should a landowner wish to enroll in the AMAP program, they could incur some costs from providing access to NCWRC, collecting data on alligators, or implementing habitat management recommendations. However, there may be revenue received from providing hunting access to alligator permit holders.

Costs to Business/Commercial Sector

Businesses will need to pay for Nuisance Alligator Agent services, like private landowners. Real estate businesses may benefit from improved management of alligators in residential areas.

Costs to Municipalities

Municipalities will also need to pay for Nuisance Alligator Agent services as well as whatever costs they would incur if choosing to remove some alligators with the help of hunters. The relative cost of alligator management by these two options will depend on the number of alligators that must be handled each year. Municipalities may also choose to display informational (educational) signage about how to safely coexist with alligators.

Costs to Other State Agencies

Other state agencies may incur costs associated with managing alligators on their lands. Agencies may wish to participate in outreach programs or alligator research and incur costs from those activities.

Costs to Federal Agencies

Federal agencies may incur costs associated with managing alligators on their lands. Agencies may wish to participate in outreach programs or alligator research and incur costs from those activities.

B. Efforts to Minimize Costs and Adverse Economic Impacts

Costs to NCWRC have been reduced in that no additional permanent employees are required to enact any of the management objectives outlined in the Alligator Management Plan. The agency could redirect staff time and other resources to other alligator management objectives (e.g., outreach, research) when an expanded cadre of Nuisance Alligator Agents become available. Where appropriate, the use of licensed hunters to manage alligator numbers could reduce costs to both private and public sector land managers. Additionally, the high cost of research to support the proposed management approach will be reduced by awarding research contracts through a competitive request for proposals process.

C. Potentially Affected Parties

The North Carolina Alligator Management Plan contains topics and initiatives that could affect a wide variety of individuals and organizations (Table 4).

Table 4. Individuals and organizations potentially influenced by this plan.

Type	Local	State	National
Governments	• Municipalities • Counties	• WRC • DOT • DACS • DEQ • State Parks • State Forest Service • NWAC	• DOD (military bases) • USFWS • USDA (Croatan NF) • USDA (APHIS) • USGS
Businesses	• Golf courses • WDCAs • Nuisance Alligator Agents • Rental housing providers • Realty companies • Chambers of Commerce	• Tourist associations	• Rental housing providers
Groups	• Homeowners (HOAs) • Wildlife clubs • Conservation groups	• NC Herp Society • NC PARC • Alligator Alliance • NC Wildlife Federation • The Nature Conservancy • NC Coastal Federation • NC Coastal Land Trust • Cape Fear Arch	• ASIH • Crocodile Specialist Group • Herpetologists League • PARC • SEAFWA • SSAR • TWS
Individuals	• Academics (teachers and students) • Homeowners • Hunters, hunting guides • Owners of rental property • Paddlers • Swimmers • Tourists • Wildlife watchers	• Academics (teachers and students) • Tourists	• Academics (teachers and students) • Tourists

VII. LITERATURE CITED

Birkhead, William S. and Charles R. Bennett. 1981. Observations of a small population of estuarine-inhabiting alligators near Southport, North Carolina. Brimleyana 6 (Dec.): 111-117.

Brunell, Arnold M., J. Patrick Delaney, Richard G. Spratt, Dwayne A. Carbonneau, and Jason E. Waller. 2013. Record total lengths of the American alligator in Florida. Notes of the Southeastern Naturalist 12(4): N9-N17.

Brunell, Arnold M., Thomas R. Rainwater, Michael Sievering, and Steven G. Platt. 2015. A new record for the maximum length of the American alligator. Notes of the Southeastern Naturalist 14(3): N38-N43.

Burtner, Brittany F. and Peter C. Frederick. 2017. Attraction of nesting wading birds to alligators (*Alligator mississippiensis*). Testing the 'nest protector' hypothesis. Wetlands: 1-8.

Davis, L.M., T.C. Glenn, R.M. Elsey, I.L. Brisbin, Jr., W.E. Rhodes, H.C. Dessauer, and R.H. Sawyer. 2000. Genetic structure of six populations of American alligators: a microsatellite analysis. Crocodilian Biology and Evolution: 38-50.

Doerr, P. D., J. D. Hair, P. C. Smithson, M. K. Fuller, J. M. Hagan III, T. G. O'Brien, and S. E. Klause. 1983. Status of the American alligator in North Carolina. Report issued to the North Carolina Wildlife Resources Commission by North Carolina State University, Raleigh, NC. 599 pages.

Dunham, K., S. Dinkelacker, and J. Miller. 2014. A stage-based population model for American alligators in northern latitudes. Journal of Wildlife Management, 78:440-447.

Elsey, Ruth M., Edmond C. Mouton, Jr., and Noel Kinler. 2012. Effects of feral swine (*Sus scrofa*) on American alligator (*Alligator mississippiensis*) nests in Louisiana. Southeastern Naturalist 11(2): 205-218.

Fujisaki, Ikuko, Kristen M. Hart, Michael S. Cherkiss, Frank J. Mazzotti, Jeff S. Beauchamp, Brian M. Jeffery, and Laura A. Brandt. 2016. Spatial and temporal variability in estuary habitat use by American alligators. Estuaries and Coasts 39: 1561-1569.

Fujisaki, Ikuko, Kenneth G. Rice, Allan R. Woodward, and H. Franklin Percival. 2007. Possible generational effects of habitat degradation on alligator reproduction. The Journal of Wildlife Management 71(7): 2284-2289.

Gardner, Beth, Lindsey A. Garner, David T. Cobb, and Christopher E. Moorman. 2016. Factors affecting occupancy and abundance of American alligators at the northern extent of their range. Journal of Herpetology, 50(4):541-547.

Garner, Lindsey A. 2017. Population status of American Alligator (*Alligator mississippiensis*) in North Carolina. Thesis, NCSU, Raleigh, USA.

Glenn, Travis C., Herbert C. Dessauer, and Michael J. Braun. 1998. Characterization of Microsatellite DNA Loci in American Alligators. Copeia 3: 591-601.

Hagan, John M., III. 1982. Movement habits of the American alligator (*Alligator mississippiensis*) in North Carolina. Thesis, NCSU, Raleigh, USA.

Hunt, R. Howard and Myrna E. Watanabe. 1982. Observations on maternal behavior of the American alligator, *Alligator mississippiensis*. Journal of Herpetology 16(3): 235-239.

Hunt, R. Howard. 1987. Nest excavation and neonate transport in wild *Alligator mississippiensis*. Journal of Herpetology 21(4): 348-350.

International Union for the Conservation of Nature Crocodile Specialist Group [IUCNCSG]. 2017. IUCNCSG Crocodilian Species page. <http://www.iucncsg.org/pages/Crocodilian-Species.html>. Accessed 24 Mar 2017.

Klause, Stephen E. 1984. Reproductive characteristics of the American alligator (*Alligator mississippiensis*) in North Carolina. Thesis, NCSU, Raleigh, USA.

Kushlan, James A. 1973. Observations on maternal behavior in the American alligator, *Alligator mississippiensis*. Herpetologica 29(3): 256-257.

Kushlan, James A., and Jeffrey C. Simon. 1981. Egg manipulation by the American alligator. Journal of Herpetology 15(4): 451-454.

Lang, Jeffrey W. and Harry V. Andrews. 1994. Temperature-dependent sex determination in crocodilians. Journal of Experimental Zoology 270: 28-44.

McCoy, Jessica A., Benjamin B. Parrott, Thomas R. Rainwater, Phillip M. Wilkinson, and Louis J. Guillette, Jr. 2015. Incubation history prior to the canonical thermosensitive period determines sex in the American alligator. Reproduction 150(4): 279-287.

Nell, Lucas A. and Peter C. Frederick. 2015. Fallen nestlings and regurgitant as mechanisms of nutrient transfer from nesting wading birds to crocodilians. Wetlands 35: 723-732.

Nell, Lucas A., Peter C. Frederick, Frank J. Mazzotti, Kent A. Vliet, and Laura A. Brandt. 2016. Presence of breeding birds improves body condition for a crocodilian nest protector. PLoS ONE 11(3): e0149572.

North Carolina Wildlife Resources Commission. 2015. North Carolina Wildlife Action Plan. Raleigh, NC.

Nifong, James C. and Brian R. Silliman. 2013. Impacts of a large-bodied, apex predator (*Alligator mississippiensis* Daudin 1801) on salt marsh food webs. Journal of Experimental Marine Biology and Ecology 440: 185-191.

O'Brien, Timothy G. and Phillip D. Doerr. 1986. Night count surveys for alligators in coastal counties of North Carolina. Journal of Herpetology 20: 444-448.

Palmer, William M., and Alvin L. Braswell. 1995. The Reptiles of North Carolina. Chapel Hill: University of North Carolina Press.

Palmer, Michelle L. and Frank J. Mazzotti. 2004. Structure of Everglades alligator holes. Wetlands 24(1): 115-122.

Parlin, Adam, Steve Dinkelacker, and Aaron McCall. 2015. Do habitat characteristics influence American alligator occupancy of barrier islands in NC? Southeastern Naturalist 14(1): 33-40.

Rootes, William L., Robert H. Chabreck, Vernon L. Wright, Bobby W. Brown, and Thomas J. Hess. 1991. Growth rates of American alligators in estuarine and palustrine wetlands in Louisiana. Estuaries 14(4): 489-494.

Ryberg, Wade A., Lee A. Fitzgerald, Rodney L. Honeycutt, and James C. Cathey. 2002. Genetic Relationships of American Alligator Populations Distributed Across Different Ecological and Geographic Scales. Journal of Experimental Zoology 294(4): 325-33.

Saalfeld, David T., Kevin K. Webb, Warren C. Conway, Gary E. Calkins, and Jeffrey P. Duguay. 2008. Growth and condition of American alligators (*Alligator mississippiensis*) in an inland wetland of east Texas. Southeastern Naturalist 7(3): 541-550.

Subalusky, Amanda L., Lee A. Fitzgerald, and Lora L. Smith. 2009. Ontogenetic niche shifts in the American alligator establish functional connectivity between aquatic systems. Biological Conservation 142: 1507-1514.

Weigl, Richard. 2014. Longevity of crocodilians in captivity. International Zoo News 61(5): 363-373.

Whiting, Evan T., David W. Steadman, and Kent A. Vliet. 2016. Cranial polymorphism and systematics of Miocene and living *Alligator* in North America. Journal of Herpetology 50(2): 306-315.

Wilkinson, Philip M., Thomas R. Rainwater, Allan R. Woodward, Erin H. Leone, and Cameron Carter. 2016. Determinate growth and reproductive lifespan in the American alligator (*Alligator mississippiensis*): Evidence from long-term recaptures. Copeia 104(4): 843-852.

Woodward, Allan R., John H. White, and Stephen B. Linda. 1995. Maximum size of the alligator (*Alligator mississippiensis*). Journal of Herpetology 29(4): 507-513.

VIII. GLOSSARY

A. Definitions of Terms

Adaptive Management:	Adaptive management is a systematic approach for improving resource management by learning from the outcomes of management actions.
Alligator Management Unit:	Geographic areas within the Coastal Plain where both alligator population management and human sociological goals align.
Apex Predator:	A predator that exists at the top of the food chain within an ecosystem that is not preyed upon [as a healthy adult in the wild] by other species in that system.
Biological Carrying Capacity:	The maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water, and other necessities available in the environment.
City as defined by § 160A-1(2):	"City" means a municipal corporation organized under the laws of this State for the better government of the people within its jurisdiction and having the powers, duties, privileges, and immunities conferred by law on cities, towns, and villages. The term "city" does not include counties or municipal corporations organized for a special purpose. "City" is interchangeable with the terms "town" and "village," is used throughout this Chapter in preference to those terms, and shall mean any city as defined in this subdivision without regard to the terminology employed in charters, local acts, other portions of the General Statutes, or local customary usage.
Conservation:	Usage, improvement, and protection of natural resources in a wise manner, ensuring derivation of their highest economic and social benefits on a continuing or long-term basis.
Cultural Carrying Capacity:	The maximum number of individuals of a species that the human population will accept.
Fecundity:	The number of young produced per year for each reproductive-age female in the population.
Gene Migration:	The alteration of the frequencies of alleles of genes in a population, resulting from interbreeding with organisms from another population; the movement of individuals and their genetic material from one population to another.
Genetic Differentiation:	The accumulation of differences in allelic frequencies between completely or partially isolated populations due to evolutionary forces such as selection or genetic drift. In population genetics, allele frequencies show the genetic diversity/variation of a species population or the richness of its gene pool.
Genetic Variation:	Differences in genes between individual members of a population, or the frequency in which the various gene types are expressed. Genetic

	variation is important for the survival and adaptation of a species, as it helps in terms of natural selection and evolution.
Keystone Species:	A species on which other species in an ecosystem largely depend, such that if it were removed the ecosystem would change drastically; a keystone species has a disproportionately large effect on its environment relative to its abundance.
Mesopredator:	Any midranking predator in a food web, regardless of its size or taxonomy; a non-apex predator which often increases in abundance when a higher-ranking predator that preys on it is reduced or eliminated from the ecosystem.
Metapopulation:	A group of spatially separated populations of the same species which interact at some level; a regional group of connected populations of a species.
Mutualist:	One of the two species in a relationship from which both species benefits.
Population:	A group of alligators that interbreed and live in the same place at the same time.
Population Growth Rate:	Lambda (λ) describes the population growth over a single time unit where λ is called the finite growth rate (a per-capita rate). The alligator population grows when $\lambda > 1$, stays constant when $\lambda = 1$, and declines when λ is between 0 and 1.
Recruitment Rate:	Number of young produced that survive to breeding age per adult alligator.
Relocation:	The removal of an alligator from one place to another, often because of a concern for public safety or property damage.
Stakeholder:	A person, group, or organization with an interest in alligators and alligator management.
Viable population:	A population likely to persist over the long-term, in this plan defined as a population where the population growth rate (λ) is estimated as equal to or greater than 1.

Wild Animal:	Game animals; fur-bearing animals; feral swine; and all other wild mammals except marine mammals found in coastal fishing waters. In addition, this definition includes members of the following groups which are on the federal list of endangered or threatened species: wild amphibians, wild reptiles except sea turtles inhabiting and depending upon coastal fishing waters, and wild invertebrates except invertebrates declared to be pests under the Structural Pest Control Act of North Carolina of 1955 or the North Carolina Pesticide Law of 1971. Nothing in this definition is intended to abrogate G.S. 113-132(c), confer jurisdiction upon the Wildlife Resources Commission as to any subject exclusively regulated by any other agency, or to authorize the Wildlife Resources Commission by its regulations to supersede valid provision of law or regulation administered by any other agency.

B. Acronyms

AMAP:	Alligator Management Assistance Program
AMU:	Alligator Management Unit
APHIS	Animal and Plant Health Inspection Service
ASIH	American Society of Ichthyologists and Herpetologists
CFR:	Code of Federal Regulations
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DACS	North Carolina Department of Agricultural Services
DEQ:	North Carolina Department of Environmental Quality
DOD	United States Department of Defense
DOT	North Carolina Department of Transportation
MYA:	Million years ago
NCAC	North Carolina Administrative Code
NCGS:	North Carolina General Statutes
NWAC	North Carolina Nongame Wildlife Advisory Committee
PARC	Partners in Amphibian and Reptile Conservation
SEAFWA	Southeastern Association of Fish and Wildlife Agencies
SSAR	Society for the Study of Amphibians and Reptiles
TSP:	Thermosensitive period
TWS	The Wildlife Society
USDA	United States Department of Agriculture
USFWS:	United States Fish and Wildlife Service
USGS	United States Geological Service
WDCA:	Wildlife Damage Control Agent
WRC:	North Carolina Wildlife Resources Commission

IX. APPENDIX A – NCWRC RESOLUTION ESTABLISHING ALLIGATOR TASK FORCE

Resolution Regarding Proposed Establishment of an Alligator Hunting Season in North Carolina

Whereas, the American alligator (*Alligator mississippiensis*) occurs along the southeast Coastal Plain, into coastal North Carolina, where it reaches the current northern limit of its geographic range, and

Whereas, cooler environmental conditions in North Carolina result in differences in some life history traits from alligators in more southern states, and

Whereas, alligators in North Carolina have slower rates of growth and achieve sexual maturity later than alligators in more southern states, and

Whereas, these variable life history traits make alligators in North Carolina more vulnerable to over-harvest, and

Whereas, alligators have a patchy and variable distribution in coastal North Carolina, and

Whereas, there are indications that the distribution and relative abundance of alligators in some locales has increased over the last thirty years, and

Whereas, there is public interest in allowing take of alligators through hunting in areas and situations where harvest and the alligator populations are sustainable, and

Whereas, sustaining the alligator population in North Carolina requires unique conditions for allowing take through hunting or other means, and

Whereas, in response to public interest and some situations of over-abundance, the Commission took a proposal (H4) to public hearings in January 2016 to conditionally establish an alligator hunting season in which take would only be allowed by Commission issued permits, and

Whereas, 328 comments were received from these public hearings and through an on-line portal on Proposal H4, 133 (41%) of which were in opposition, and

Whereas, eight organizations including the Society for the Study of Amphibians and Reptiles, the North Carolina Partners in Amphibian and Reptile Conservation, the Carteret County Wildlife Club, the Coastal Plain Conservation Group, the North Carolina Wildlife Federation, the North Carolina Chapter of the Nature Conservancy, The Alligator Alliance, and the North Carolina Nongame Wildlife Advisory Committee have all submitted letters or resolutions in opposition to opening an alligator hunting season at this time, and

Whereas, Commission staff received 648 standardized emails in opposition to alligator hunting.

Now, therefore be it resolved, that while the Commission believes the take of alligators in some situations is reasonable and appropriate, based on public comments and the need to further refine conditions under which alligator hunting should be allowed, the Commission does not approve proposal H4 taken to public hearings in January 2016, and

Now, therefore be it further resolved that the Commission directs the Executive Director to:

Examine options under existing statutory authorities to utilize the skills and expertise of North Carolina sportsmen and women to provide assistance in removal of alligators under nuisance or depredation circumstances,, and to establish a North Carolina Alligator Task Force to develop a North Carolina Alligator Management Plan that includes:

- Evaluation of all available biological information on alligators in North Carolina,
- Identification of knowledge gaps and additional research needed on alligator population demography, historical changes in alligator habitats, and public attitudes and opinions on alligator conservation,
- Identification of areas where alligators may be over-populated and recommend biological and social strategies to address alligator management issues in these areas,
- Recommendations of geographical management zones,
- Recommendations for metrics to establish the number of permits per year that could be issued for opportunities to harvest alligators by hunting where sustainable and consistent with local alligator population, habitat, and social conditions, and
- Recommendations on a framework for gathering public input on the North Carolina Alligator Management Plan.

Approved this the 11th day of February, 2016, in an official meeting by the North Carolina Wildlife Resources Commission.

John Litton Clark, Chairman

Gordon Myers, Executive Director

X. APPENDIX B – ALLIGATOR TASK FORCE MEMBERS

Allen Boynton, NCWRC - (Chair)

Alvin Braswell, NC Museum of Natural Sciences (retired)

Dillon Epp, Orton Plantation

Dr. Chris Moorman, North Carolina State University

Dr. Courtney Mitchell IV, Camp Bryan Farms

Dr. Thomas Rainwater, Clemson University

Ed Corey, NC State Parks

Evin Stanford, NCWRC

J.T. Windham, Brunswick County resident

Jay Wheless, Wheless Law Firm

Jeff Hall, NCWRC

Jeff Messinger, Camp Bryan Farms

Keith Rogers (retired) NCWRC

Sgt. Brandon Dean, NCWRC

Thomas Padgett (retired), NCWRC

Wanda Diefes, Lake Waccamaw resident

XI. APPENDIX C – GUIDELINES FOR THE NUISANCE ALLIGATOR AGENT PROGRAM

A. Nuisance Alligator Agent Qualifications

1) Program applicants must be able to demonstrate to NCWRC that they have the experience and/or ability to capture and relocate alligators. Preference will be given to individuals who have prior experience trapping and handling wild, feral, and/or livestock animals.

2) Program applicants must show NCWRC that they have the necessary equipment to capture and relocate alligators, including at a minimum the following: ropes, cables, snares, and poles.

3) Program applicants must demonstrate to NCWRC that they are knowledgeable in the use of alligator capture and relocation equipment.

4) Program applicants that are not currently a Wildlife Damage Control Agent must agree to a criminal history check. Applicants will not be approved if they have a conviction within the past 5 years for charges related to animal abuse or fish or wildlife violations. Convictions for other offenses will be assessed on a case-by-case basis.

5) Nuisance Alligator Agents must apply annually to receive an Endangered Species permit that allows them to have alligators in their possession while conducting alligator capture and relocation activities. Nuisance Alligator Agent activities cannot take place unless the individual has obtained a current Endangered Species permit, and the permit must be in their possession when conducting alligator capture and relocation activities. Nuisance Alligator Agents are not required to also be a Wildlife Damage Control Agent, unless they are involved in nuisance/damage control work for wildlife species other than alligators.

B. Approved Alligator Capture Equipment

For Capture

1) Handheld, hand-thrown, or pole-mounted cable snares affixed to enough rope or cable to secure, control, and take possession of the alligator.

2) Heavy-duty fishing rod (e.g., surf or offshore rod) and reel and a snagging hook. The snagging hook shall not be made of stainless steel or other noncorrosive material that will not corrode with time in the event the alligator escapes with an imbedded hook.

3) Murphy traps, other trip-snare style traps, or cage traps are allowed if the trap design can safely capture the alligator without causing injury to the animal and minimizes the potential to capture nontarget species. All traps must be marked with the Endangered Species permit number assigned to the Nuisance Alligator Agent.

4) Other equipment may be approved for use by NCWRC on a case-by-case basis. Equipment that may not be used for capturing alligators include firearms, archery equipment, set hooks (baited or un-baited), or conibear or other body-gripping traps that cause injury or death to the alligator.

For Transport

1) Captured alligators must be transported in a device consisting of a secure tube, cage, or other type of enclosure that provides for the security and safety of the alligator and humans. Transport device must accommodate the size of the alligator being transported. Alligators must not be transported in the

back of open bed trucks, open trailers, or other vehicles that do not allow for security of the alligator and safety to humans.

C. Protocols and Guidelines for Responding to a Nuisance Alligator Situation

1) Nuisance alligator reports will be investigated by NCWRC personnel. If agency personnel determine issuance of a depredation permit is warranted, a permit will be issued to the landholder with the Nuisance Alligator Agent of their choice being listed as a 2nd party.

2) Local NCWRC Division of Law Enforcement personnel will be notified that the depredation permit has been issued and that alligator capture and relocation activities will be taking place.

3) Any traps that are set must be checked at least once daily by the Nuisance Alligator Agent or his/her designee. Note that unless they are also a permitted Nuisance Alligator Agent, the only action related to alligator trapping the designee can participate in is visibly checking the trap. The trap check designee cannot participate in setting traps, baiting traps, maintaining traps, or removing alligators from traps unless they are also a permitted Nuisance Alligator Agent. Traps in urban areas, or other areas with high human activity, must be checked at least twice daily with each check occurring at least 10 hours apart.

4) Live bait will not be used to bait traps.

5) Under normal circumstances, alligators will be handled and manipulated with the Nuisance Alligator Agent having no or minimal physical contact with the animal. If determined to be necessary, captured alligators may be restrained using rope or tape. Wire or metal of any kind shall not be used to restrain alligators after capture. The legs of restrained alligators may be bound by tape or rope alongside the alligator, but the legs shall not be tied behind the alligator's back as to cause permanent injuries.

6) Care will be taken to avoid exposing captured alligators to excessive heat throughout the capture, transportation, and release process.

7) Alligators that are to be released offsite must be transported in a transport device as described in the above section titled Approved Alligator Capture Equipment.

8) Captured alligators must be scanned for a PIT tag with equipment provided by NCWRC, and unmarked alligators must be PIT tagged and/or marked following NCWRC guidelines. The following data must also be obtained and submitted from each captured alligator: total length, snout-to-vent length, tissue sample, and PIT tag or other marker identification. Other data collection requirements may be implemented by NCWRC as needed to address alligator management and research needs.

9) Captured alligators must be released as soon after capture as possible and cannot be held in captivity longer than 24 hours.

10) Relocated alligators must be discretely released at locations preapproved by NCWRC. Alligators may not be released on private lands without the permission of the landholder.

11) Nuisance Alligator Agents must notify NCWRC of any alligator captures by the end of the next business day via telephone or electronic means.

12) Nuisance Alligator Agents may not euthanize an alligator unless prior approval has been granted by NCWRC personnel. Authorization for euthanasia will only be provided if the alligator is suffering from severe injury, survival is highly unlikely, and agency personnel cannot respond in a timely fashion.

13) Any dead or injured alligators must be reported to NCWRC by the end of the next business day. Alligators that are found dead, die during the capture and relocation process, or that are euthanized must

be disposed of via burial or at a landfill. No parts of a dead alligator may be retained by a Nuisance Alligator Agent or any other individual for any reason, except:

a. Tissue samples (i.e. femur bone, liver, and scutes) will be collected from dead alligators to be submitted to NCWRC staff.
b. Educational or research facilities may receive alligator carcasses or carcass parts with prior approval from NCWRC.

14) Any fees charged by Nuisance Alligator Agents are set by the agent or otherwise negotiated between the agent and their client. NCWRC does not set or establish fees for Nuisance Alligator Agent activities.

D. Emergency Situations & Incidents on Public Waterway and Roads

Emergency Situations

An emergency is one involving an alligator that must be moved immediately due to current or imminent threat to human safety, pet or livestock safety, safety of the alligator, property damage, or obstruction of traffic. Nuisance Alligator Agents must obtain verbal approval from NCWRC staff prior to acting in emergency situations. If the Nuisance Alligator Agent cannot reach a local agency representative, they can obtain verbal permission from NCWRC's communications center in Raleigh (800-662-7137). A depredation permit is not required when taking actions in emergency situations, and Nuisance Alligator Agents may collect payment for services rendered under such circumstances. If NCWRC becomes aware of an emergency that agency staff cannot respond to, agency personnel will attempt to locate a Nuisance Alligator Agent to capture and relocate the alligator. In these circumstance the Nuisance Alligator Agent closest to the incident will be the initial point of contact. If necessary, contacts with other Nuisance Alligator Agents will be based on proximity to the incident.

Incidents on Public Waterways and Roads

When an alligator presents a demonstrable nuisance or public safety issue in a public waterway or on a public road, NCWRC in some situations may request that a Nuisance Alligator Agent capture and relocate the animal. When NCWRC contacts a Nuisance Alligator Agent to capture and relocate alligators in public waterways or roadways, the agent closest to the incident location will be the initial point of contact. If necessary, contacts with other Nuisance Alligator Agents will be based on proximity to the incident.

Reporting Requirements

Nuisance Alligator Agents are required to notify NCWRC of any alligator captures, mortalities, or injuries by the end of the next business day. This notification will contain the GPS location of the capture site, GPS location of the release site, PIT tag and/or other marker identification, total length, snout-to-vent length, date(s) of capture and release, and general circumstances regarding the incident. By December 31 of the year the Nuisance Alligator Agent's Endangered Species permit was issued, each agent will submit a completed NCWRC-provided report form for each alligator that was relocated during the permitted period. The report form can be submitted via paper or electronic means and will include the following information on each alligator relocated: capture and release date(s), GPS location of the capture and release sites, method of capture, injuries and condition, total length, snout-to-vent length, PIT tag and/or other marker identification, and circumstances justifying relocation. If an alligator is found to be dead, or authorization is given to euthanize the animal, information on the cause of death and disposition of the carcass will also be included on the report form.

XII. Appendix D – Prehistoric Presence of Crocodilians and Their Ancestors in North Carolina

Following the Permian-Triassic extinction event that took place approximately 252 million years ago (MYA), a newly evolved group of animals referred to as archosaurs (see Glossary) became the dominant land vertebrates (Fig. 4). Modern crocodilians and their extinct relatives belong to a group of archosaurs known as crocodylomorphs. *Carnufex carolinensis*, one of the oldest and earliest diverging crocodylomorphs described to date, was discovered in 2003 from the Carnian Pekin Formation (~231 MYA) in Chatham County, North Carolina.[1] While small-bodied crocodylomorphs had previously been unearthed by paleontologists from late Triassic excavations[2,3], *Carnufex* was much more formidable at 3 meters long and boasting a skull length of 50 cm. This find reveals that crocodylomorphs filled top predator roles in the equatorial regions of Pangea prior to the global dominance of dinosaurs in the early Jurassic period.

Descendants of the crocodylomorphs that had survived the Triassic-Jurassic extinction event, alligatoroids were the first group of crocodilians to evolve by the Campanian period of the late Cretaceous epoch (~72-83 MYA). Fossils of *Deinosuchus rugosus*, one of the earliest-known alligatoroids, were uncovered at Phoebus Landing and the Black Creek Formation site in Bladen and Sampson counties of North Carolina around the time of the Civil War.[4] Considerably larger than any living crocodilians, *D. rugosus* would have typically measured 8 meters long and weighed in at approximately 2.3 tons.

There are currently 24 described species of crocodilians in the world.[5] The genus *Alligator* includes the only two extant species that can endure temperate climates, the American alligator (*Alligator mississippiensis*) and the Chinese Alligator (*Alligator sinensis*). *A. mississippiensis* has existed in North America for at least 7 million years.[6] North Carolina contains the northernmost portion of the American alligator's present-day range.

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[1] Zanno, Lindsay E., Susan Drymala, Sterling J. Nesbitt, and Vincent P. Schneider. 2015. Early crocodylomorph increases top-tier predator diversity during rise of dinosaurs. Scientific Reports 5(9276). DOI: 10.1038/srep09276.

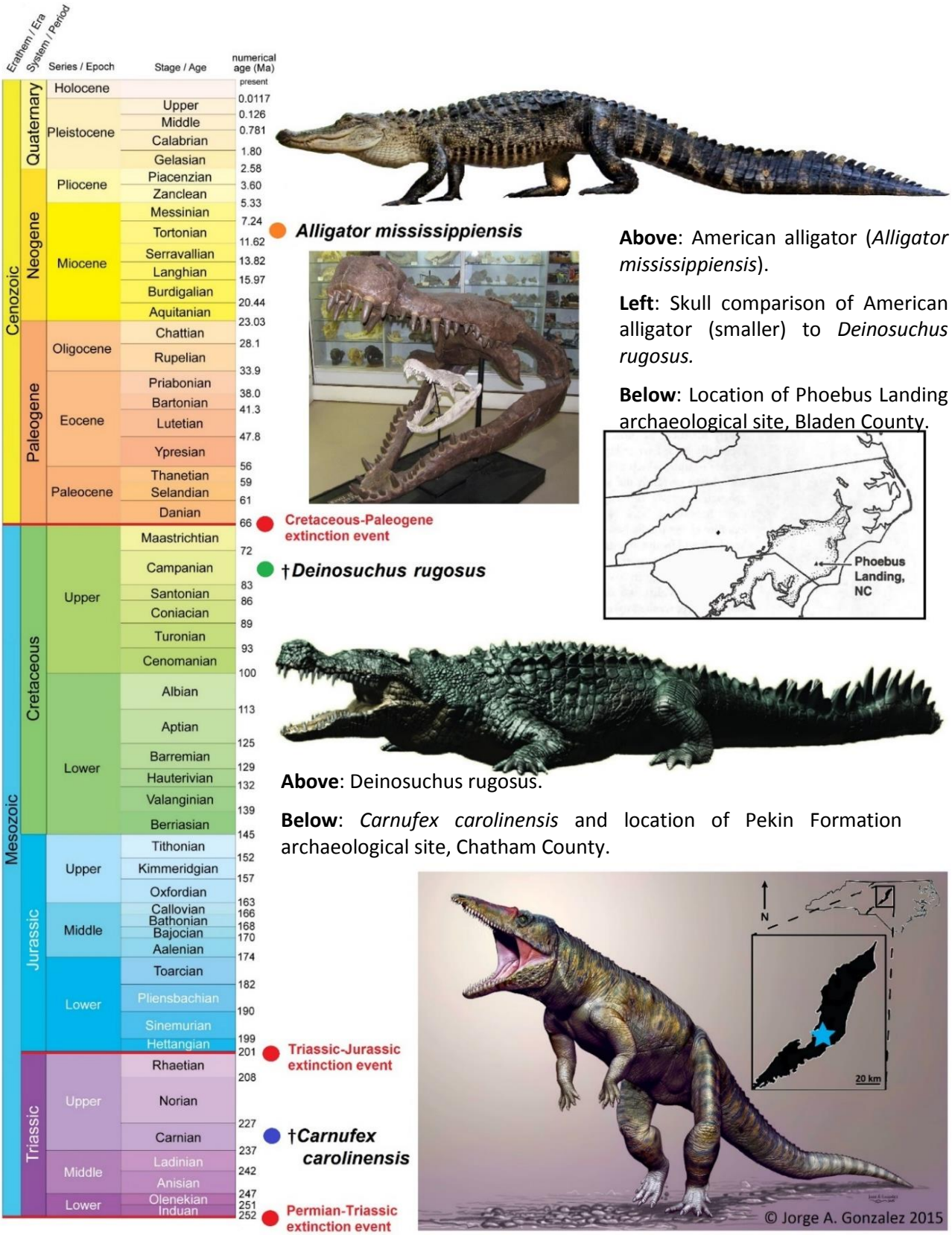
[2] Drymala, Susan M. and Lindsay E. Zanno. 2016. Osteology of *Carnufex carolinensis* (Archosauria: Psuedosuchia) from the Pekin Formation of North Carolina and Its Implications for Early Crocodylomorph Evolution. PLoS One 11(6): e0157528. doi:10.1371/journal.pone.0157528.

[3] Sues, Hans-Dieter, Paul E. Olsen, Joseph G. Carter, and Diane M. Scott. 2003. A new crocodylomorph archosaur from the Upper Triassic of North Carolina. Journal of Vertebrate Paleontology 23(2): 329-343.

[4] Schwimmer, David R. 2002. King of the Crocodylians: The Paleobiology of Deinosuchus. Indiana University Press, USA.

[5] International Union for the Conservation of Nature Crocodile Specialist Group [IUCNCSG]. 2017. IUCNCSG Crocodilian Species page. <http://www.iucncsg.org/pages/Crocodilian-Species.html>. Accessed 24 Mar 2017.

[6] Whiting, Evan T., David W. Steadman, and Kent A. Vliet. 2016. Cranial polymorphism and systematics of Miocene and living Alligator in North America. Journal of Herpetology 50(2): 306-315.



Above: American alligator (*Alligator mississippiensis*).

Left: Skull comparison of American alligator (smaller) to *Deinosuchus rugosus.*

Below: Location of Phoebus Landing archaeological site, Bladen County.

Above: Deinosuchus rugosus.

Below: *Carnufex carolinensis* and location of Pekin Formation archaeological site, Chatham County.

Figure 5. Geologic timeline for evolution of American alligator.

Alligator Management Plan Addendum 1

Hyde County officials reviewed information on the agency website about the Alligator Management Plan (AMP) and expressed interest by email to the Commission in the "targeted take to reduce numbers in areas with frequent alligator conflicts." However, no municipalities (i.e., areas that fit the definition of "cities" according to NCGS § 160A-1(2)) exist in Hyde County and so allowing such a hunt would not be consistent with the AMP. Based on this request, the Commission, at their May 18, 2018 telephonic meeting, charged the Executive Director to work with Hyde County to determine what, if any, changes should be made to the Plan and bring that information back to the Habitat, Nongame and Endangered Species (HNGES) Committee.

Staff met with the Acting County Manager of Hyde County on June 1, 2018 to discuss Hyde County's request, concerns and potential options. Based on that meeting, staff evaluated options to expand the application of population reduction hunts in counties in Alligator Management Unit 1 (AMU 1) to include unincorporated populated areas, where human-alligator conflicts may occur, and brought that evaluation back to the HNGES Committee on June 20, 2018.

Unincorporated areas do not have boundaries, which are beneficial for effective administration of managed hunts. Hunt boundaries must be recognizable to hunters and enforcement officers on the ground. As population reduction hunts are designed to promote public safety by reducing the number of alligators in human-populated areas, alligator home range information can guide the setting of boundaries within which alligator removals would be most effective. This can be accomplished by drawing a circle with a center point in the center of the highest density of human development, as evidenced by aerial imagery, with a radius that is based on the estimated maximum home range of an alligator. Commission and local government staff and others with knowledge of alligator activity in the region can then use this circle as general guidance to help identify appropriate landmarks (e.g., roads, canals, etc.) to utilize as a population reduction hunt boundary. This same methodology may also be utilized for defining population reduction hunt boundaries for municipalities.

This addendum modifies the existing language in the AMP and allows county governments in AMU 1 to apply for population reduction hunts in unincorporated, populated, areas within their boundaries to promote public safety and specifies a methodology for general guidance on establishing a population reduction hunt boundary. Any decision regarding requests for population reduction hunts will be made by the Commission on a case-by-case basis.