



Department of Defense Legacy Resource Management Program

Recommended Best Management Practices for the Alligator Snapping Turtle on Department of Defense Installations

Department of Defense Partners in Amphibian and Reptile Conservation



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Introduction

The Alligator Snapping Turtle (*Macrochelys temminckii* [inclusion also of *Macrochelys apalachicola*]) is considered an at-risk species and was petitioned for listing under the Endangered Species Act (ESA) in 2012. The U.S. Fish and Wildlife Service (USFWS), after a review of the best available scientific and commercial information, found that listing the species is warranted. Accordingly, they propose to list the Alligator Snapping Turtle as a threatened species with a rule issued under section 4(d) of the Act (86 Fed. Reg. 62434 [November 9, 2021]). The Service will make a determination on their proposal within one year. The Department of Defense Partners in Amphibian and Reptile Conservation (DoD PARC) network, and the USFWS have developed Best Management Practices (BMPs) for the Alligator Snapping Turtle. The management practices described in this document were developed specifically for DoD installations but are also suitable for implementation throughout the range of the species.

The management practices described in this report are intended to serve as guidelines that DoD resource managers can use to help plan, prioritize, and implement conservation and management actions that provide a conservation benefit to the Alligator Snapping Turtle, while also providing information to comply with regulatory processes such as Environmental Protection Agency's National Environmental Policy Act (NEPA) and associated components (i.e., Environmental Assessments and Environmental Impact Statements). Implementation of these BMP guidelines should 1) support military readiness activities 2); be documented in installation Integrated Natural Resource Management Plans (INRMPs) and 3) align with existing efforts among the DoD, federal/state agencies, and non-governmental organizations (NGOs) to prevent this species further decline.

Species Profile

Description: The Alligator Snapping Turtle is the largest freshwater turtle in North America with a maximum recorded carapace length of 31.5 inches (80 cm) and mass of 249 lbs. (113 kg). The carapace (upper shell) has three strongly keeled ridges and is distinguished from the Snapping Turtle (*Chelydra serpentina*) with 2 to 5 supramarginal scutes (Figure 1, Figure 2). Shell coloration is a grayish-brown to brown as are the head, legs, and tail. The plastron (lower shell) is reduced in size and cruciform in shape (Figure 3). The head and jaws are large with the upper jaw strongly hooked. A worm-like lure, that may be pinkish, light gray to white or dark purple, is in the lower jaw. Eyes are located on the side of the head; eye placement in Snapping Turtles is toward the top of the head. The head has a series of fleshy tubercles and the eyes are ringed with small fleshy tubercles. The tail is quite long. Adult males attain a larger size than females, with female maximum mass reaching about 75 lbs. (31.8 kg) (Trauth et al. 2004; Jensen et al. 2008; Ernst and Lovich 2009; Guyer et al. 2015; Krysko et al. 2019). Females attain maturity between 13-21 years of age and 32.7-37 cm straight carapace length (SCL) and males between 11-21 years of age and 37.8-41.0 cm SCL (Tucker and Sloan 1997).



Figure 1. A juvenile Alligator Snapping Turtle.

Diagnostic characters include three prominent ridges along the carapace, the presence of supramarginal scutes between the pleural and marginal scutes, strongly hooked mandible, and lateral placement of eyes.

Figure 2. Alligator Snapping Turtles are unique in having a row of extra scutes located between the pleural and marginal scutes. The number of surpamarginal scutes ranges between 2 to 5, in this example the individual possesses 4 supramarginal scutes.

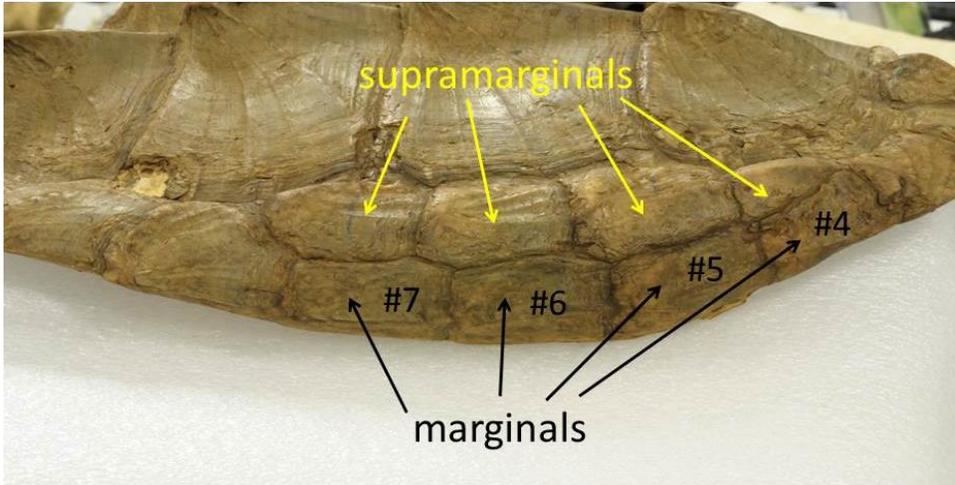
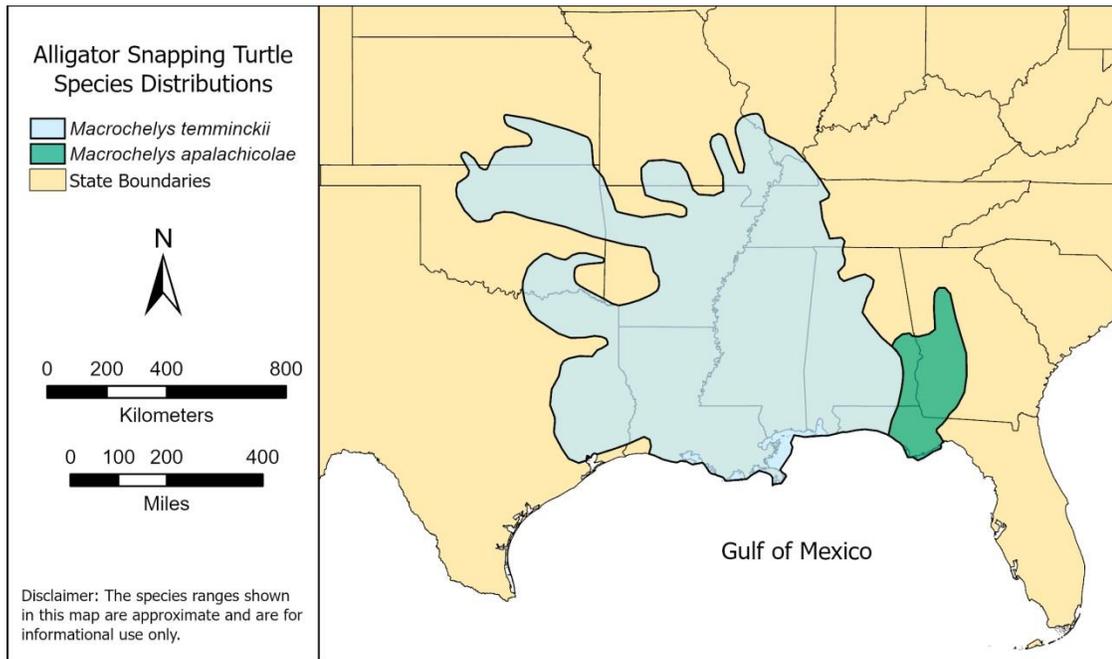


Figure 3. Plastron of the Alligator Snapping Turtle is greatly reduced and cruciform in shape.



Range: The Alligator Snapping Turtle is found in southeastern river systems that flow into the Gulf of Mexico from the Chattahoochee-Flint-Apalachicola river system of Georgia and Florida west to the San Antonio River in Texas (Figure 4). The turtle ranges from Alabama, Mississippi, western Tennessee and Kentucky, Arkansas and Louisiana, eastern Texas and Oklahoma, southern Missouri and Illinois, and historically ranging north along the Mississippi River to southeastern Iowa (Ernst and Lovich 2009).

Figure 4. Distribution of both the Alligator Snapping Turtle taxa, although the taxonomy of the Apalachicola Alligator Snapping Turtle (*Macrochelys apalachicola*) is unresolved. BMP recommendations in this document apply equally to both taxa.



Distribution on Military Sites: The Alligator Snapping Turtle is confirmed present on the following 17 military sites:

- Air Force: Eglin AFB (Florida); Little Rock Air Force Base (AFB; Arkansas); Tyndall AFB (Florida); Moody AFB (Georgia); Barksdale AFB (Louisiana)
- Army: Fort Benning (Alabama/Georgia); Fort Polk (Louisiana); Camp Shelby (Mississippi); Red River Army Depot (Texas)
- Army National Guard: Robinson Maneuver Training Center (Arkansas); Fort Chaffee (Arkansas)
- Navy: Naval Air Station (NAS) Pensacola - Main Base (Florida); NAS Pensacola - NOLF Bronson Field (Florida); NAS Pensacola - Saufley Field NETPDTC (Florida); NAS Whiting Field (Florida); NAS JRB NOLA (Louisiana); NCBC Gulfport (Mississippi)

The Alligator Snapping Turtle is considered unconfirmed and potentially present on the following military sites; specimens have been found in the same county as a particular military site, but not within the boundaries of the installation:

- Air Force: Maxwell AFB (Alabama); Hurlburt Field (Florida)
- Army: Pine Bluff Arsenal (Arkansas); McAlester AAP (Oklahoma)

- Army National Guard: Camp Beauregard Training Site (Louisiana); Camp Minden Training Center (Louisiana); Camp Villere (Louisiana); Camp McCain (Mississippi); Camp Gruber Maneuver Training Center (Oklahoma)
- Navy: NAS Whiting Field (Alabama); NAS Meridian, Main Base (Mississippi); NAS Meridian, Joe Williams Field (Mississippi); NAS Meridian, Searay Target Range (Mississippi)

Habitat: Alligator Snapping Turtles inhabit a range of freshwater lotic and lentic habitats from small streams to large rivers, oxbows, swamps, bayous, lakes, and canals with water clarity that ranges from clear to murky and turbid (Ernst and Lovich 2009). During high water events turtles will move out of deeper waters and channels into adjacent inundated flood plains (Godwin pers. obs). Tidally influenced, brackish water habitats are also utilized. Shaded stream banks with intact riparian tree cover, an abundance of submerged logs, trees, and other in-stream structure appear to be favored. In bayou and swamp habitat vegetated microhabitats, with plants such as cypress, buttonbush, and floating aquatic vegetation, are occupied (Harrel et al. 1996; Riedle et al. 2006; Shipman and Riedle 2008; Howey and Dinkelacker 2009). Substrate of habitats include soft mud, clay, sand, gravel, and rocks. Juvenile turtles use submerged root masses, log jams, and entangled branches.

Behavior: The Alligator Snapping Turtle is a highly aquatic species that has rarely been observed moving overland. Basking has been documented for juvenile individuals (Ewert 1976; Carr et al. 2011). Nesting by females is the main terrestrial activity of the species. The annual activity cycle of the Alligator Snapping Turtle has not been studied (Ernst and Lovich 2009). Individuals have been captured in baited nets in Alabama, Georgia, and Mississippi between March and October (Godwin and L. Pearson, pers. obs.). Bogosian (2010) suggests turtles in Louisiana may be inactive from October to February, although Boundy and Kennedy (2006) trapped significant numbers in October and November.

Age and straight carapace length (SCL) of maturity for females has been estimated at 13-21 years and 32.7-37.0 cm, males from 11-21 years and 37.8-41.9 cm (Dobie 1971; Tucker and Stone 1997). Nesting in Georgia and Florida is known to occur in April to May and may extend to June in other parts of the range (Ernst and Lovich 2009). Females lay between 9 and 61 eggs in a nest generally within 20 m of the water and about 3 m above the waterline in sand or sandy soil mixed with silt and organic material; open sandbars and low forested ground with matted roots are avoided (Ewert 1976).

The Alligator Snapping Turtle consumes a wide variety of food with fish as a primary prey item. Other items ingested such as crustaceans, mollusks, snakes, turtles, birds, mammals, and vegetation indicate that feeding is also opportunistic and scavenging (Else 2006; Ernst and Lovich 2009). The Alligator Snapping Turtle is unique in possessing a lingual appendage that resembles a worm and functions as a lure to attract prey.

Threats: Threats to the Alligator Snapping Turtle include pollution of streams and wetlands, hydrologic changes caused by channelization, draining of wetlands, collection for foreign and domestic sale, removal of logs and trees within stream channels, loss of riparian vegetation leading to streambank destabilization, nest depredation by mammals and birds, human consumption, drowning in commercial fish nets, and drowning due to snagging on trot-lines or bush hooks (Jensen et al. 2008; Ernst and Lovich 2009; Guyer et al. 2015; Krysko et al. 2019).

Conservation Status

Alligator Snapping Turtles have experienced decline and extirpations due to commercial harvest, watershed alteration, nesting habitat alteration and destruction, and incidental fishing mortality. The Alligator Snapping Turtle was petitioned to be federally listed by the USFWS in 2012. In 2015 the USFWS (USFWS 2015) stated

“the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted.” On November 9, 2021, the USFWS found that listing the species is warranted. Accordingly, they propose to list the Alligator Snapping Turtle as a threatened species with a rule issued under section 4(d) of the Act. The IUCN lists the Alligator Snapping Turtle as Vulnerable. The range of the Alligator Snapping Turtle historically included 14 states, in two states it is considered “presumed extirpated,” or “possibly extirpated.” The species is considered a “species of greatest conservation need” (SGCN designation) in 12 states.

Recommended Conservation Implementation Strategies and Best Management Practices for Alligator Snapping Turtles on Military Sites

In general, implementation of the specific BMPs listed below should not be performed at the expense of an existing Alligator Snapping Turtle population. Implementation of habitat management practices can be performed when the turtles are not active to reduce potential negative impacts. Make sure to document performance of any of the following BMPs, whether current or future, in your installation’s INRMP.

- 1. Identify and protect Alligator Snapping Turtle stream habitats and adjacent intact riparian zones on military properties.** Review aerial photography and installation Geographical Information System (GIS) data to identify potentially suitable streams and intact vegetated riparian zones. The Alligator Snapping Turtle is a highly aquatic species seldom leaving streams with the exception of nesting females. To best manage for Alligator Snapping Turtle on military sites, the stream habitat must be identified and delineated, along with riparian zones that may be used by nesting females. Ground-truthing of habitat and preliminary trapping may be necessary to refine the habitats identified through GIS analysis. Signage at stream access points (i.e., bridge crossing, boat ramp, fishing pier) to inform personnel of actual or potential presence of Alligator Snapping Turtles and their vulnerability to military operations and other human activity should be posted as necessary. Include a contact number on signage to report observations of illegal and/or unauthorized operations and activities such as poaching.
- 2. Prohibit collection of Alligator Snapping Turtles on your installation.** Alligator Snapping Turtles have been popular in the pet trade, captured as food, and collected for scientific purposes. Pet trade and commercial harvest is illegal in all states where they occur, and personnel limited capture is prohibited in most states. Due to their longevity, delayed sexual maturity, and normally high mortality of nests and young turtles, any removal from populations may have a negative impact. We recommend that military natural resource managers prohibit collection of Alligator Snapping Turtles on military sites, even in the few states where limited personnel take is not prohibited.
- 3. Develop fact sheets and outreach tools.** Educational fact sheets and pamphlets can be shared with military and civilian personnel to inform them about this at-risk species. The more wide-spread and abundant common Snapping Turtle may be confused for the Alligator Snapping Turtle. A fact sheet for the common Snapping Turtle is available (https://www.denix.osd.mil/dodparc/parc-resources/education-and-outreach/snapping-turtle-fact-sheet/Snapping_Turtle-final.pdf). A similar fact sheet for the Alligator Snapping Turtle should be developed.
- 4. Control subsidized predator populations.** Highest mortality of Alligator Snapping Turtle occurs during the egg stage when predators such as raccoons, foxes, coyotes, opossums, and crows depredate and decimate entire nests. Often populations of these predators are subsidized indirectly or directly through enhancement of food and habitat due to human activity. Installation residents should limit access to garbage and shelter for subsidized predators. In addition, pets such as cats and dogs can also be predators upon nests of Alligator Snapping Turtles. Installation residents should limit pet

access to Alligator Snapping Turtle habitat, where they may depredate nests, and keep pets leashed near nesting habitat.

- 5. Survey existing Alligator Snapping Turtle populations on military sites.** Monitoring existing Alligator Snapping Turtle populations is critical to understanding if a population is increasing or decreasing. Survey methods (see *Inventory and Monitoring Techniques for Alligator Snapping Turtles* below) and levels of effort are variable and can be tailored to available time and funding constraints. Consider conducting surveys for this species on your military installation.
- 6. Maintain stream riparian zones.** The most important terrestrial activity of the Alligator Snapping Turtle is nesting by females. Ensure that vegetated riparian zones, minimum of 50 m, are maintained as natural as possible to promote favorable nesting habitat and stream channel integrity. Silviculture practices and forest management activities that use State approved best management practices to protect water and sediment quality and stream and riparian habitat are exempt from prohibitions of incidental take.
- 7. Avoid the use of all vehicles in stream riparian zones and in-stream habitats.** If possible, avoid use of military vehicles (including all-terrain vehicles) in riparian zones and stream channels and establish a vehicle-free buffer zone of at least 100 m along stream channels known to be occupied by Alligator Snapping Turtles. Install barriers where unauthorized stream crossings occur to minimize stream damage. Authorized stream crossings should be perpendicular to stream channel to minimize in-stream impact. Construction, operation, and maintenance activities that occur near and in a stream, such as installation of stream crossings, replacement of existing instream structures (e.g., bridges, culverts, water control structures, boat launches, etc.), operation and maintenance of existing flood control features (or other existing structures), and directional boring, when implemented with industry and/or State-approved best management practices for construction are exempt from prohibitions for incidental take.
- 8. Control or remove invasive and non-native species.** Invasive species may include various plants that grow at unnaturally high densities (particularly in the absence of fire in streams, associated wetlands, and riparian zones) thereby changing physical habitat structure and altering wetland hydroperiod, both of which adversely impact the turtles. Non-native aquatic plants such as water hyacinth, Alligator weed, hydrilla, *Phragmites*, purple loosestrife and reed canary grass can have negative impacts to wetlands by outcompeting native wetland plants. Invasive species may also include animals such as fire ants, armadillos, coyotes, and feral hogs that depredate turtle nests. The best procedures for controlling invasive species are those that effectively limit their proliferation, as well as minimize potentially harmful impacts to turtles, and will vary according to the invasive species in need of control, and numerous criteria specific to each installation. Therefore, consult your natural resources staff for invasive species control guidelines for your installation. Pesticide and herbicide application that follows the chemical label and appropriate application rates are exempt from prohibitions for incidental take.
- 9. Retain snags, logs, rocks and other natural in-stream structures.** Adult turtles use submerged logs, rocks, and undercut banks as refugia and smaller individuals use underwater root masses, and tangles of limbs and branches for protection from predators and as sites for foraging. These natural structures should remain within the stream channels; however, unnatural debris (e.g. tires, trash, etc.) should be removed.

- 10. Avoid ditching of streams and rip-rapping banks.** Ditching of streams would remove the natural habitat structure required by Alligator Snapping Turtles thus negatively impacting the turtles. Ditching and channelization would negatively alter the geomorphology and hydrology of the stream affecting the Alligator Snapping Turtle and its aquatic prey. Maintenance dredging activities that remain in the previously disturbed portion of a maintained channel are exempt from prohibitions for incidental take. Where natural vegetation along stream banks has been removed large rock (rip-rap) is often employed to stabilize sloughing banks. This method should be avoided as the rip-rap would be in impediment to hatchling turtles moving between a nest and the stream.
- 11. Remove barriers to aquatic movement.** Man-made barriers such as dams, weirs, culverts and similar structures within the normal channel of a waterway are known to impede the movement of aquatic species, including the Alligator Snapping Turtle. These barriers serve to artificially separate existing populations, and in some cases can lead to otherwise suitable habitat becoming inaccessible. Removing non-functional or non-essential dams or weirs and replacing improperly sized or designed culverts with single-span bridges or larger, bottomless culverts, will restore normal flow regimes and remove physical barriers to movement of Alligator Snapping Turtle.
- 12. Maintain or improve water quality.** Prevent erosion of, and input of sediment, and chemicals (fertilizers) into wetlands and streams to maintain or improve water quality. Where feasible, minimize soil disturbance when using heavy equipment around wetlands and streams. Use native wood chips or hay bales to slow or prevent intrusion of fertilizers, herbicides and pesticides necessary to achieve management objectives especially on lawns and golf courses.
- 13. Consider Alligator Snapping Turtles when conducting wetland mitigation.** Alligator Snapping Turtles may move into artificially constructed wetland ponds if connected by stream channel to occupied habitat. Wetland mitigation sites are typically sited in areas less prone to human interference and military training and can be constructed in areas adjacent to known Alligator Snapping Turtle populations.
- 14. Protection and maintenance of nesting habitats.** Nesting typically occurs from late April to early June with hatching completed by end of August. Nest sites are typically within 20 m or less of water in sandy soils and generally elevated two to three meters above the water line. The nest site may be in the open or under forest cover. It is recommended that mowing does not take place in known nesting sites during this period. Mowing is encouraged during the dormant season when possible, to maintain open conditions, as needed.
- 15. Education of fisherman.** Fisherman should be educated on identification of Alligator Snapping Turtles, techniques for releasing hooked Alligator Snapping Turtles, and the need to report sightings to natural resource managers. Alligator Snapping Turtles are attracted to odiferous bait and are occasionally hooked by fisherman, or captured on baited bush hooks, set lines, and trot-lines. Lines should be checked every 6 to 8 hours to minimize bycatch mortality of Alligator Snapping Turtles (or other freshwater turtle species). It is recommended that fishermen use non-stainless steel circle hooks, which are already required by many state and federal regulations. Lines on military installations should be tagged with fisherman's name, phone number, and license number, with lines removed once fishing is completed. Consider prohibiting fishermen from using hoop nets and other traps on installations or at least require the same types of safeguards prescribed in the survey techniques listed below (e.g., parts of traps must always be above the water to avoid drowning turtles).

Benefits of Alligator Snapping Turtle Best Management Practices to Military Training Operations

1. Identification of inhabited streams enables military planners to consider these sensitive habitats when developing and/or scheduling training and maneuvering activities.
2. Management of invasive species lessens the damage they may cause to training and maneuver area conditions and provide natural, realistic training environments.
3. Stream crossings in Alligator Snapping Turtle habitat may be difficult to cross and hard on military equipment.
4. Minimum setbacks ensure long-term stability of military training areas.
5. Intact riparian zones provide excellent sediment control structure to reduce downstream effects of soil compaction and erosion from surface training.

DoD PARC Points of Contact

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Military Service Points of Contact

Contact your Military Service headquarters natural resources personnel with questions regarding Alligator Snapping Turtle and conservation actions:

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Inventory and Monitoring Techniques for Alligator Snapping Turtle

Alligator Snapping Turtle Assessment Protocol

No Alligator Snapping Turtle Assessment Protocol has been prepared but trapping and sampling in surveys across southeastern US states have followed standard methodologies (see Attachment A). Often the presence of the Alligator Snapping Turtle at a site goes unnoticed because, while a large and impressive turtle, it is cryptic in its biology. Individuals seldom bask and females are seldom observed while nesting, therefore visual assessments without traps are ineffective. Trap-based assessment is the preferred methodology for inventory or monitoring of the Alligator Snapping Turtle.

Trap-based assessment involves the use of baited traps to capture Alligator Snapping Turtles in their natural habitat. This method may be conducted in a rapid manner (two to three nights of trapping) or over a long-term period (re-trapping the same site on a weekly or bi-weekly schedule following the two to three nights of continuous trap set). Rapid surveys are intended to serve as a method for quickly collecting baseline occurrence and abundance information whereas long-term trap assessments are intended to facilitate the collection of population information that will allow for more precise estimates of population size, age structure, sex ratios,

and additional population information via mark recapture. If an Alligator Snapping Turtle is found dead in any trap during military survey efforts, all trapping should be suspended until it can be determined why the turtle died and if there is a remedy to the trapping methodology.

Mark-recapture

Mark-recapture is still the most widely-used method to census turtle populations. This technique uses permanent marks in the shells, such as notching or drilling the lateral scutes that provide long-term visual indicators of distinct individuals. Use of Passive Integrated Transponders (PIT) can also be used to identify individuals. Researchers can perform these surveys annually or as time and funding allows.

Radio-telemetry

Radio-telemetry is a method in which a radio transmitter is attached to an animal with the unique radio frequency being detected by a receiver. Use of radio-telemetry allows researchers to follow the movements and behavior of study animals. Alligator Snapping Turtles, from juvenile stage to adult, are large enough that a radio transmitter with multi-year battery life can easily be attached to the shell. With regular tracking (minimum weekly) of individual Alligator Snapping Turtles, data may be collected on movements, habitats used, and seasonal activity patterns.

Environmental DNA (eDNA)

Environmental DNA is organismal DNA that can be found in the environment. Environmental DNA originates from cellular material shed by organisms (via skin, excrement, etc.) into aquatic or terrestrial environments that can be sampled and monitored using new molecular methods. It is easily repeatable, relatively inexpensive, and could help target other surveying efforts. Such methodology is important for the early detection of invasive species as well as the detection of rare and cryptic species such as the Alligator Snapping Turtle. Fort Polk in Louisiana has successfully sampled for this species using this technique.

High Priority Research Questions

Confirmation of Alligator Snapping Turtles at Unconfirmed Military Sites

Many DoD installations (see Distribution on Military Sites above) throughout the range of the Alligator Snapping Turtle have the potential to have populations of this species, however, their presence is unconfirmed. It is recommended that surveys be conducted to confirm the presence or likely absence of the species on those military lands.

Gene Flow Between Populations and Long-term Implications

Little is known regarding the gene flow between Alligator Snapping Turtle populations and how this impacts their survival in the long-term. Studies/surveys that focus on how populations of turtles interact among each other and the degree of gene flow among populations are needed.

Population Size and Trends

Most turtle species are long lived and do not reproduce until an advanced age. These characteristics make turtle populations extremely vulnerable to even low levels of adult mortality (Congdon et al. 1993). Therefore, the stability of a population on a military installation is influenced by population size (number of turtles present), demography (sex and age ratios), and population trajectory (rate of increase or decrease). Surveys that focus on population size and trends are needed on DoD sites.

Habitat Connectivity and Dispersal

Stream ecosystems are often hydrologically variable, resulting in the need for Alligator Snapping Turtles to use different stream sections and habitats annually and across years. Alligator Snapping Turtles may use a variety of

stream sites for mating, foraging, and overwintering purposes. Understanding when, how, and why Alligator Snapping Turtles move between the stream habitats is vital for understanding the mechanisms underlying their population stability. It is also critical to understand how stream features such as habitat variability influence movement within streams.

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Appendix A

Alligator Snapping Turtle Assessment Protocol

This document provides guidelines for a standardized and flexible methodology for sampling Alligator Snapping Turtle (*Macrochelys temminckii*) populations.

The basic methodology outlined is trap-based assessment with descriptions of two levels of trap-based assessments: **Rapid** and **Demographic**. The protocol for Rapid Assessments is simply a reduced-effort version of the Demographic Assessment protocol. To summarize the protocol: (1) delineate potential Alligator Snapping Turtle habitat using a geographic information system (e.g., Google Earth or ArcGIS) and recent aerial imagery; (2) conduct a Trap-based Rapid Assessment (TRA) or Demographic Assessment (DA; trap-based). For TRAs, set 10 traps ≥ 100 m apart along the stream stretch using one or both banks of the stream channel. Same type trap and bait should be used throughout the time period of the demographic assessment to ensure data compatibility. Check and rebait all traps every 24 hours for five consecutive days. For DAs, conduct the TRA protocol three to five times with a non-trapping minimum one-week interval between trapping periods. If an Alligator Snapping Turtle is found dead in any trap during military survey efforts, all trapping should be suspended until it can be determined why the turtle died and if there is a remedy to the trapping methodology.

The methodology outlined in this document is designed to be relatively simple, flexible, fit within existing research programs, and accommodate regional differences in seasonal activity, habitat structure, and research priorities. Broad regional participation is encouraged to increase the size of the representative sample.

Planning Phase

Step 1: Select a stream section

Identify a stream section that is suitable for study. It may either be (A) a stream known to be occupied by Alligator Snapping Turtles; (B) a data-deficient site with potentially suitable Alligator Snapping Turtle habitat; (C) randomly-selected stream of potential habitat and occurrence. When selecting a stream for surveys, remember that Alligator Snapping Turtles are associated with streams and tributaries of a wide range of size, cypress swamps seasonally connected to streams, coastal marshes, and beaver impoundments. As an approximate guide the focus area should be 5 to 20 stream km in length.

Step 2: Develop reference stream sites

Within the focus area, identify reference trap sites separated by a 200 to 500 m using Google Earth or a similar GIS program. Reference trap sites should be within stream sections of highly suitable Alligator Snapping Turtle habitat. Reference trap sites may be along one or both banks of a stream.

Step 3: Conduct an optional reconnaissance site visit

If you have not visited the stream already, consider conducting a reconnaissance visit to make sure that stream access is feasible and that reference trap sites do not need to be re-situated. Use this visit to identify potentially ideal trap locations. Traps may be set either from a boat, canoe, or foot access along the stream bank. If a boat is to be used, then an important goal with a reconnaissance site visit is to assess boat ramp condition and proximity to selected stream sections. If traps are to be carried from a land vehicle to the stream bank for setting, then accessibility from nearest road and ease of trap transport needs to be assessed.

Survey Phase

Option 1: Conduct a Trap Assessment (Rapid or Demographic Assessment)

Trap Assessment Types

Trap-based sampling may take the form of either rapid or demographic assessments. These assessment types differ in intensity (i.e. number of trap nights), but utilize the same trapping methodology and are therefore directly comparable.

Rapid.-Trap-based Rapid Assessments (TRA) are intended to serve as a method for quickly collecting baseline occurrence and abundance information. TRAs require five consecutive nights of trapping at a site during the Alligator Snapping Turtle active period.

Demographic.-Long-Term Trap Assessments (DA) are a more intensive method intended to facilitate the collection of population information that will allow for more precise estimates of population size, age structure, sex ratios, and additional population information via mark recapture. DA sites should be trapped for three, five-night trap runs (3 TRAs) for a total of at least 15 nights during the Alligator Snapping Turtle active season.

Trap Configuration

Large hoop nets are the preferred trap type for Alligator Snapping Turtles with the basic configuration a hoop net of four fiberglass hoops 1.2 m in diameter covered with #36 twine nylon netting with a square mesh size of 4.45 cm, with body length of the trap 2.4 m and total length 3 m. Funnel length should be 0.75 m with an inner throat diameter of 35 cm if using fingered throat design. An alternative throat design is the Arkansas style with a flat throat; this design prevents entanglement of captured animals in the throat threads. A modification of this trap type has seven hoops, a second funnel, and 4.3 m total length. The advantage to using the longer double-throated trap is the ability to set the opening in deeper water while having the tail exposed to air and likely better retention of trapped turtles. Fiberglass hoops are used because fiberglass will not rust when exposed to saline waters and are less likely to be damaged by Alligators. A minimum of 10 traps should be set during each sampling period and spaced a minimum 100 m apart.

Single hoop net traps (Fig. 1) are used in streams with directional flow, in coastal tidally-influenced waters or cypress swamps and beaver ponds that lack directional flow, a third trap configuration may be used; paired hoop nets with lead lines (trammels) (Fig. 2) . Lead nets are 1.2 m in height and 13.7 m in length with the end of the lead net tied into the throat of a hoop net. The intervening lead net functions as a drift fence to intercept and direct turtles into the hoop nets.



Figure 1. A single hoop net set alongside a submerged log. Note that the tail is tied above water line with the opening facing downstream.



Figure 2. Paired hoop nets with interconnecting lead net (trammel). Funnel openings of the hoop nets face one another with the lead net acting as an aquatic drift fence directing active turtles into one of the hoop nets. No bait is needed with this trap configuration but may be used if desired.

Trap Placement

Microhabitat. Traps should be set within high potential use areas as follow:

- In streams with steady flow and parallel to bank
- Upstream of structural features (i.e., logs, trees, large limbs, undercut banks, large rock) that may be used by Alligator Snapping Turtles
- Intact riparian zones with trees overshadowing the stream
- Non-stream settings parallel to shore in shallow (ca. 1 m) water
- Non-stream setting near structural features of downed trees if available

Placement. Trap placement will depend upon the aquatic setting with stream placement differing from non-stream placement.

In streams, tie the tail of the trap to a stout anchor, such as a tree trunk or thick limb, with the opening (funnel) of the net facing downstream. Tail of the trap should be above water to allow trapped turtles access to atmospheric air with the funnel (open end) of the trap facing downstream. To minimize the chances of turtles drowning due to unexpected increases in water levels, buoys should be placed at the tail end of the trap. Trap set should be parallel or near parallel to the bank and upstream of suitable microhabitat features. Preferable flow conditions were those in which some flow was present but not strong enough to float the net from off the stream bottom. Bait (fresh chopped fish is preferred; frozen Tilapia, invasive carp, or catfish nuggets may be substituted) is placed in a 0.5 to 1 liter bottle with holes cut in it, alternatively a 3 inch diameter PVC pipe with two grated caps on either end and holes drilled into the pipe may be used and is more durable than a plastic bottle. Bait volume in bottle should approximate $\frac{1}{2}$ of the bottle volume; this allows water to freely enter and flow through the bottle to carry the bait scent downstream. The bottle is tied and hung in the rear of the trap and must be submerged when the trap is set.

Non-stream habitat generally has substrates of soft mud. Paired funnel traps with intervening lead lines are anchored with PVC tubing (3.8 cm diameter, 3.1 m length) driven into the soft mud substrate. Four poles are used for one trap configuration that includes two hoopnets plus the lead net. One pole anchors the hoop opening with a second pole anchoring the tail of the net, with this arrangement repeated at the other hoop net. In tidally influenced waters a single 11.3 L jug is placed in the rear of the hoop net to maintain an air space for trapped turtles. In cypress swamps trees and cypress knees may be suitably spaced to anchor nets. In swampy and marshy settings where Alligators are abundant the dual hoopnet configuration with intervening lead net is used, and traps are not baited to avoid attracting Alligators. Trap data should be recorded on field form (example included). Minimum trap data is state, county, locality (military installation), latitude, longitude, trap number, and time set. Traps should be labelled according to state wildlife regulations. Surveyors must watch forecast weather conditions and stream flow parameters, if available (<https://waterdata.usgs.gov/nwis/rt>) and pull or monitor traps if heavy precipitation or flooding is expected. During subsequent DA trap placements, traps should generally be placed in same location as during the previous run, unless this is impossible due to changing water levels.

Trap Checks.-Traps should be checked and rebaited every 24 hours. On each trap-check day, the trap-check field form should be completed, and the turtle individual field form (example included) should be completed for each Alligator Snapping Turtle captured in the trap (see protocol for processing individual turtles). Other species of trapped turtles may be processed at the surveyor's discretion but at minimum, each individual turtle trapped should be recorded.

Protocol for Processing Individual Turtles

When an Alligator Snapping Turtle is captured, the individual turtle data form should be completed, and the following protocols are recommended. The individual turtle data form has been designed specifically for the Alligator Snapping Turtle but may also be used to collect data on other species of turtles. Collecting data on the turtle assemblage associated with Alligator Snapping Turtles is strongly advised. Placing large juvenile and adult turtles on the carapace with the head hanging free (edge of boat decks or seat work well) allows the researcher to easily collect ventral morphometric data and tissue sample (Fig. 3). This technique has been employed by Alligator Snapping Turtle researchers for over 25 years with >1,000 turtles having been handled and measured with no individuals exhibiting signs of harm afterward.

Morphometrics. Record shell dimensions in cm. At a minimum, record SCLmin (straight carapace length), CH (carapace height at the 2nd and 3rd vertebral suture line), CW (carapace width at 2nd and 3rd vertebral suture line), SM (supramarginal scutes) for each side, SPLmin (straight plastron length), TTL (total tail length from posterior edge of plastron to tail tip), and TPV (tail length from posterior edge of plastron to cloaca). Captured turtles may span a very broad size range from small juveniles to mature adults; maximum SCLmin of males approaches 80 cm. To properly measure turtles across this spectrum several caliper sizes are needed, dial calipers 150 mm (6”), Haglof tree calipers 40 cm (15.75”) and 80 cm (31.5”).

Weight. Record animal mass to nearest 0.1 kg. This will require a set of Pesola scales (e.g., 100g, 1,000 g, 5 kg, 10 kg, 50 kg, >50 kg). Most turtles will be less than 40 kg. If the goal is to collect accurate data on all specimens a scale capable of measuring in excess of 50 kg will be necessary. Constriction or ratchet straps are needed in weighing large turtles. The strap is tightened around the shell with the scale attached to the strap.

Individual marking. Turtles should be individually marked as directed by lead researcher. Secondary recognition is recommended using photographs, injuries, deformities, PIT tags. Alligator Snapping Turtle carapace for individuals > ca. 2 kg is thick enough to be marked with screws in the marginal. Select the unique number to be used between 1 and > 14,000 (see shell diagram for marking scheme). Use a portable drill with a 1/8” drill bit to begin a starter hole, screw a Phillips pan head stainless steel screw (#10 x 1/2”) into the hole until tight with screw head flush to shell surface (Fig. 4). This marking method uses easily obtained and inexpensive materials and provides an immediate visual cue that the turtle has been previously captured and marked. Supplemental PIT tags may be used, with recommended implantation occurring, laterally in the base of the tail.

Photographs. Photograph carapace and plastron with animal ID visible in photo (or sorted/ tagged post-capture). If possible, photograph lateral head shot and limbs/tail, as well as obvious injuries, deformities, and/or lure.

Injuries and general health. Note missing or injured limbs, tail, eyes, etc., as well as the presence of skin or upper respiratory tract infection or lethargic condition.

Scute morphology and other deformities. Note any major scute or other deformities, including less than or more than 12 marginals on either or both sides.

Tissue collection for genetic analysis. With approval, trained researchers may consider collecting blood or tissue samples for genetic sampling.

Figure 3. Inverting larger Alligator Snapping Turtle specimens at the edge of a platform with the head hanging free to temporarily immobilize the turtle is the accepted method to allow researcher to collect data and tissue samples.



Figure 4. This smaller individual Alligator Snapping Turtle has been marked on the #2 and #3 left marginal scutes with #10 stainless steel screws. The unique number this turtle is 12 (see marking scheme below). Marking with screws in the marginal provides a quick visual indication an individual has been previously captured, processed, and marked.

Required Equipment

The following equipment (Fig. 5) is required to complete the protocol: field forms (on waterproof paper, e.g. Rite in the Rain), writing implements, GPS for recording trap locations, calipers (150 mm to 480 cm), Pesola scales (100g to > 50 kg), straps or slings to support turtles, portable drill, drill bits (1/8”), stainless steel screws (#10 Philips head 1/2” length), screwdriver, camera or cell phone for photographing turtles, minimum 10 traps operated at a time, bait, and motorized boat with trailer or canoe. Additional equipment may also be necessary including waders, polarized sunglasses, disinfecting equipment, and or blood or tissue sampling equipment. Because researchers currently have a range of available equipment, specifications are flexible. Large hoop nets are the preferred trap type with the basic design of a hoop net with four fiberglass hoops 1.2 m in diameter covered with #36 twine nylon netting with a square mesh size of 4.45 cm, with body length of the trap 2.4 m and total length 3 m. A modification of this trap type has seven hoops, a second funnel, and 4.3 m total length. Single hoop net traps are used in streams with directional flow; in water bodies lacking a pair of hoop nets with lead lines (trammels) are substituted. Commercial net sources include Memphis Net and Twine, Memphis, TN (<https://www.memphisnet.net/>), Miller Net in Memphis (<https://millernets.com/>), and Nets and More (formerly The Fish Net Company, Jonesville, LA (<https://www.netsandmore.com/>)).

Trap identification: Assign unique ID to each trap and label trap on the corresponding field form.

Trap location/operation: Record trap ID, latitude/longitude (decimal degrees), and functional period (mm/dd-mm/dd), and complete appropriate field form upon trap placement.

Bait: Fresh (or frozen) fish.

Re-bait frequency: 24 hr. (Non-game, non-threatened fish captured in traps may also be used by tying into rear of trap and making several deep cuts into venter to release blood and scent).

Trap check frequency: 24 hr. with more frequent checks as required by agencies/partners or flood conditions.



Figure 5. Equipment used to collect weights, measurements, and marking of Alligator Snapping Turtles. Present in the photograph are small and large Haglof calipers, a 5 m metric tape graduated in cm, 10 and 50 kg Pesola scales, cinch strap to be used with Pesola scale, notebook with data sheet, screwdriver and screws for marking, and box of 2 ml vials with 95% ETOH for tissue samples.

General protocols to reduce likelihood of disease transfer

We suggest several precautionary measures to prevent the spread of disease. A 3% bleach solution may be used to disinfect traps, boats, and clothing between sites. After bathing or spraying tools and clothing in the bleach solution, items should be rinsed with clean water. Captured turtles from different sites and those displaying signs of illness should be held separately during processing, and equipment should be sterilized between turtles. Calipers and drill bits should be swabbed with alcohol, and drill holes dabbed with Betadyne. Latex gloves for handling turtles are an additional precautionary suggestion. The Northeast Partners for Amphibian and Reptile Conservation (NEPARC) Disinfection Protocol contains additional recommendations:

http://www.northeastparc.org/products/pdfs/NEPARC_Pub_2014-02_Disinfection_Protocol.pdf.

Data Entry

Upon returning to the office, or if possible, in the field at the end of each day, electronically enter data as soon as possible into a formatted Excel Worksheet.

List of species potential to co-occur with Alligator Snapping Turtle is below, across the range of the turtle the subset of species will vary by drainage and state. Species may be selected from this list to include in the “Species captured” column in order to capture data on the turtle assemblage associated with the Alligator Snapping Turtle.

<i>Chelydra serpentina</i>	<i>Graptemys pseudogeographica</i>
<i>Macrochelys temminckii</i>	<i>Graptemys pulchra</i>
<i>Macrochelys apalachicola</i>	
<i>Kinosternon baurii</i>	<i>Graptemys sabinensis</i>
<i>Kinosternon subrubrum</i>	<i>Pseudemys alabamensis</i>
<i>Sternotherus carinatus</i>	<i>Pseudemys concinna</i>
<i>Sternotherus intermedius</i>	<i>Pseudemys floridana</i>
<i>Sternotherus minor</i>	<i>Pseudemys nelsoni</i>
<i>Sternotherus odoratus</i>	<i>Trachemys scripta</i>
<i>Sternotherus peltifer</i>	
<i>Apalone ferox</i>	
<i>Apalone mutica</i>	
<i>Apalone spinifera</i>	
<i>Chrysemys dorsalis</i>	
<i>Chrysemys picta</i>	
<i>Deirochelys reticularia</i>	
<i>Graptemys barbouri</i>	
<i>Graptemys ernsti</i>	
<i>Graptemys flavimaculata</i>	
<i>Graptemys geographica</i>	
<i>Graptemys gibbonsi</i>	
<i>Graptemys nigrinoda</i>	
<i>Graptemys oculifera</i>	
<i>Graptemys ouachitensis</i>	
<i>Graptemys pearlensis</i>	

Alligator Snapping Turtle Trap Data

State/County: _____ Date (DD/MON/YYYY): _____

Collector(s): _____

Military Installation: _____ Drainage: _____

Latitude: _____; Longitude: _____ Waypoint No. _____ Trap No. _____

Trap Set RDB LDB Hoop Nets: No. _____

Trap Set Time (local standard time): _____

Vegetation/Habitat/Structure: _____

Flow: still slow medium fast

Water Turbidity clear slight moderate high clear but stained (*i.e.* tannic acids)

Channel (m): Width: _____ Depth @ trap site: _____

Substrate: _____

Riparian vegetation/habitat: _____

	Date			Date			Date		
	Trap check time			Trap check time			Trap check time		
Species captured	Male	Female	Juv	Male	Female	Juv	Male	Female	Juv
<i>Macrochelys temminckii</i>									
Empty (no turtles)									

Individual Turtle Data Form

Species _____ Turtle number (see diagram) _____

State/County: _____ Date: _____ Collector(s): _____

Latitude: _____; Longitude: _____ W Trap No. _____

Age Class/Sex: Adult Juvenile Male Female Recapture: yes

Blood sample yes no Blood sample label _____

Tissue sample: yes no Tissue sample label _____

Mass (to nearest 0.1 kg)	
CARAPACE	-----
SCLmin length @ midline (cm)	
SCLmax Maximum length (cm)	
CH Height @ 2 nd and 3 rd vertebral	
CW Width @ 2 nd and 3 rd vertebral	
No.SM (supramarginals) left/right	
PLASTRON	-----
SPLmin Length @ midline (cm)	
TAIL	-----
TTL Tail Length Total (cm)	
TPV Plastron to vent (anterior) (cm)	

Supplemental PIT tag number (if used):

Indicate marked marginals with X

Turtle ID photograph label

Wounds/Deformities:

Marginal marks tally sheet. Cross off number once used.

Species _____ Watershed _____

1	41	81	121	161	201	241	281	321	361
2	42	82	122	162	202	242	282	322	362
3	43	83	123	163	203	243	283	323	363
4	44	84	124	164	204	244	284	324	364
5	45	85	125	165	205	245	285	325	365
6	46	86	126	166	206	246	286	326	366
7	47	87	127	167	207	247	287	327	367
8	48	88	128	168	208	248	288	328	368
9	49	89	129	169	209	249	289	329	369
10	50	90	130	170	210	250	290	330	370
11	51	91	131	171	211	251	291	331	371
12	52	92	132	172	212	252	292	332	372
13	53	93	133	173	213	253	293	333	373
14	54	94	134	174	214	254	294	334	374
15	55	95	135	175	215	255	295	335	375
16	56	96	136	176	216	256	296	336	376
17	57	97	137	177	217	257	297	337	377
18	58	98	138	178	218	258	298	338	378
19	59	99	139	179	219	259	299	339	379
20	60	100	140	180	220	260	300	340	380
21	61	101	141	181	221	261	301	341	381
22	62	102	142	182	222	262	302	342	382
23	63	103	143	183	223	263	303	343	383
24	64	104	144	184	224	264	304	344	384
25	65	105	145	185	225	265	305	345	385
26	66	106	146	186	226	266	306	346	386
27	67	107	147	187	227	267	307	347	387
28	68	108	148	188	228	268	308	348	388
29	69	109	149	189	229	269	309	349	389
30	70	110	150	190	230	270	310	350	390
31	71	111	151	191	231	271	311	351	391
32	72	112	152	192	232	272	312	352	392
33	73	113	153	193	233	273	313	353	393
34	74	114	154	194	234	274	314	354	394
35	75	115	155	195	235	275	315	355	395
36	76	116	156	196	236	276	316	356	396
37	77	117	157	197	237	277	317	357	397
38	78	118	158	198	238	278	318	358	398
39	79	119	159	199	239	279	319	359	399
40	80	120	160	200	240	280	320	360	400