FINAL PERFORMANCE REPORT

Federal Aid Grant No. F19AF00843 (T-114-R-1)

Life History of Western Chicken Turtles in Southeastern Oklahoma: Nesting Ecology and Longevity

Oklahoma Department of Wildlife Conservation

January 1, 2020 through June 30, 2022

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Grant Program: State Wildlife Grants

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Grant Period: January 1, 2020 – June 30, 2022

Principal Investigator: Day Ligon, Department of Biology, Missouri State University

Project Participants: Dylan Wichman, Hannah Dallas, Ethan Hollender

ABSTRACT:

Western Chicken Turtles (*Deirochelys reticularia miaria*) are found in Louisiana, Texas, Arkansas, Missouri, and Oklahoma. Anecdotal evidence suggests that populations are declining, and the conservation status of the subspecies is under review. We sought to investigate two important aspects of the species' biology that have important consequences for individual fitness as well as the relative resilience of populations: 1) nesting behavior and reproductive output, and 2) aging, longevity, and mortality. We determined that nesting may occur at nearly any time during daylight hours and that nests are likely created in upland woodland habitats that are similar to where we documented estivation sites; however, we did not identify the location of any nests and cannot comment further on the microhabitat characteristics of *D. r. miaria* nest sites. We determined the ages of individual turtles using a combination of scute annulus counts and long-term monitoring. We also documented 5 mortality events and determined that the oldest known male *D. r. miaria* in our population likely died at an age of 15–18 years. Finally, we looked for but did not find evidence of physiological aging and senescence by measuring changes in lengths of telomeres using time series of tissue samples that were collected over a span of 10 years.

OBJECTIVES:

<u>Objective 1</u> (TRACS Strategy – Research, Survey, Data Collection and Analysis)
Conduct 1 investigation by June 30, 2022.

- Activity Tag 1: Fish and wildlife species data acquisition and analysis
    - Activity Tag 2: Western Chicken Turtle

<u>Specific Sub-Objectives:</u>

<u>Objective 1</u>: To characterize the diel and seasonal timing of nesting activity of Western Chicken Turtles. Clutch statistics and timing of nesting will be provided in each Performance Report.

<u>Objective 2</u>: To describe nest site characteristics and nest predation rates of Western Chicken Turtles. Nest locations and habitat descriptions will be provided in each Performance Report.

<u>Objective 3</u>: To quantify longevity and describe causes of mortality that contribute to the presumably short life span of Western Chicken Turtles. Each mortality event, as well as the estimated age of individual turtles at time of death, will be provided in each Performance Report.

BACKGROUND:

Chicken Turtles (*Deirochelys reticularia*) are native to the southeastern United States. Three sub-species are currently recognized: the Eastern Chicken Turtle (*D. r. reticularia*) occurs east of the Mississippi River to the Atlantic coast and south into northern Florida; the Florida Chicken Turtle (*D. r. chrysea*) occurs in Peninsular Florida; and the Western Chicken Turtle (*D. r. miaria*) occurs west of the Mississippi River in Louisiana, Arkansas, Missouri, Texas, and

Oklahoma (Ernst and Lovich 2009). While most natural history studies of the species have focused on the eastern and Florida subspecies, until recently the western subspecies remained relatively unknown. However, recent research has revealed ecologically important traits that differentiate *D. r. miaria* from other conspecifics. For example, *D. r. reticularia* and *D. r. chrysea* are carnivorous at all life stages, whereas the western subspecies exhibits a more omnivorous diet and likely undergoes a dietary transition from carnivory as juveniles to consuming more plants as adults (McKnight et al. 2015a). Additionally, the nesting and estivation patterns of *D. r. miaria* differ in significant ways from that of their eastern and Florida conspecifics (McKnight et al. 2015b, 2020).

Based upon the documented variation in some traits among subspecies, assumptions about other aspects of the ecology of Western Chicken Turtles that previously could only be inferred by extrapolation from studies of Eastern and Florida subspecies should be treated cautiously. A robust understanding of the natural history of *D. r. miaria* is needed for generating an accurate life history table, which in turn can be used to generate population viability models and make sound conservation decisions on behalf of the taxon. There is a pressing need for these data because the U.S. Fish and Wildlife Service has been petitioned to consider listing it under the Endangered Species Act (Federal Register 2011). Additionally, in Oklahoma *D. r. miaria* is classified as a Tier II Species of Greatest Conservation Need (SGCN; Oklahoma Comprehensive Wildlife Conservation Strategy).

A population of the Western Chicken Turtle was first detected in Atoka County in 2007 (Patton and Wood 2009). Since 2012, a series of studies have been conducted at Boehler Seeps and Sandhills Preserve (BSSP), a property in Atoka County, Oklahoma, that is owned and managed by The Nature Conservancy. Over time, this work has extended out to other privately owned properties elsewhere in the Muddy Boggy and Clear Boggy River drainages. Because of our early success at detecting this rare and enigmatic species, and because much remains to be learned about the biology of the western subspecies anywhere in its geographic range, we sought to investigate aspects of the species' biology related to reproduction and longevity, two variables that have important implications for individual fitness and population stability. To address these objectives, we employed trapping surveys, radio telemetry, bio-logging, and X-ray and ultrasound imaging to closely monitor adult females throughout two reproductive seasons in 2020–2021. We also carefully monitored a subset of the population consisting of older individuals for which we had morphometric data from previous years to assess age and aging using scute annulus counts to estimate age and changes in telomere lengths over time to infer senescence.

APPROACH:

Study Site Selection

Our study area is composed of three beaver-formed wetlands where *D. r. miaria* were detected during previous survey efforts (McKnight et al. 2015a). Beaver Pond 5 (BP5) was selected to be the chief focus of our work because it has hosted the highest known density of *D. r. miaria* of any of the ponds in the metapopulation. It is located on private property in Atoka County, Oklahoma (**Figure 1**). There, we used a range of traps to capture *D. r. miaria* and other species of aquatic turtles. The other two wetlands on which we focused, Boehler Lake (BL) and Hassell Lake (HL), are located at Boehler Seeps and Sandhills Preserve (owned and managed by The Nature Conservancy) and are less than 4 km west from BP5. BL and HL were trapped as well in the 2020 and 2021 seasons in conjunction with researchers from the University of Arkansas. Boehler Lake was also monitored at least twice monthly following the return of a transmittered adult male Western Chicken Turtle (CHT1) that had recently been inhabiting BP5.

Beaver Pond 5 (BP5) — The largest of the three wetlands, BP5 supports the densest and most abundant subpopulation of Western Chicken Turtles known to occur in Oklahoma. It is shallow (mean depth = 0.4 m), includes areas of densely vegetated mats separated by sections of open

Figure 1. Map showing the relative locations of Boehler Lake ( ), Hasell Lake ( ), and Beaver Pond 5 ( ). Three potential nursery wetlands that gravid females entered or approached are to the north of BP5 ( ). The Muddy Boggy River can be seen running along the easternmost edge of the map.

water, and is surrounded by hardwood forest (**Figure 2**). The terrestrial habitat around BP5 is frequently disturbed by cattle and feral hogs and the wetland itself is used for hunting waterfowl. The terrestrial environment is significantly higher elevation on the southwestern and western portions with a lower gradient sloping northwest. The eastern and northeastern portions are predominantly floodplains with intermittent shallow pools.

BP5 is also fed by a significant stream from a beaver pond located to the northwest dubbed BP9, as well as some adjacent wetlands to the northeast that are located on properties to which we have not been granted access. Additionally, a stream runs south past the dam and loops back north 200 meters east of the pond separated by a small floodplain. These water bodies, in combination with the terrestrial topography, result in significant flooding in BP5 following large storm events. These floods often expand the wetland to the stream to the east as well as across much of the floodplain lying between BP5 and the northern inaccessible wetlands.

Boehler Lake (BL) — Boehler Lake is smaller than BP5 but shares similar characteristics including the general structure of vegetated mats, the presence of beaver dams, and sections of open water. BL initially had a significant population of *D. r. miaria* when studies began in 2012;

however, major flooding in 2015 damaged the dam and drained significant portions of the pond. Since then, chicken turtles have been detected but in lower numbers. The site, along with Hassell remains one of the most herpetologically biodiverse locations in Oklahoma.

Hassell Lake (HL) — The smallest of the three beaver ponds, Hassell historically hosted a large and diverse turtle population. As recently as 2014 it supported numerous Western Chicken Turtles,

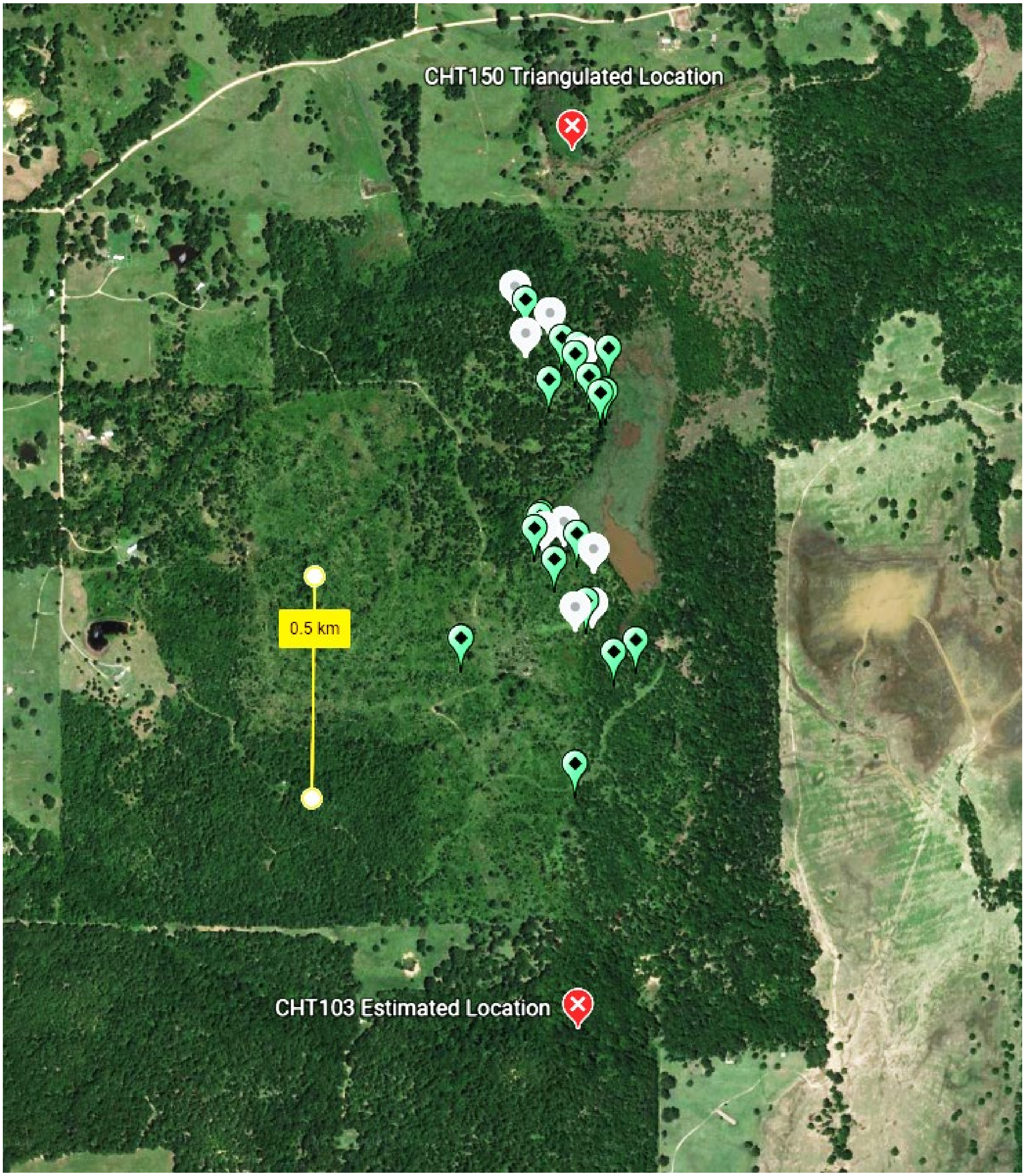

Figure 2. Map of BP5 showing known estivation sites of transmittered Western Chicken Turtles (*Deirochelys reticularia miaria*) in 2020 and 2021. Green pins indicate the locations of estivation sites of a subset of transmittered *D. r. miaria* in 2020. Gray pins indicate the locations of estivation sites of a subset of transmittered *D. r. miaria* in 2021. Red pins indicate locations estimated or triangulated for transmittered turtles on properties we have been denied access to. Triangulation was possible from adjacent properties for the northern turtle.

accumulated and greatly reduced the depth of the pond. Beaver have subsequently abandoned the site and resulting deterioration of the dam has further reduced the ponds' capacity. Presently, the wetland holds so little water that it has become untrappable for much of the year. This deterioration of the pond was first noted in 2018 and made trapping impossible by 2020.

Trapping and Telemetry

We surveyed turtles from April–July 2020 and 2021. To ensure thorough sampling of the turtle community, trap arrays incorporated a range of types of traps suitable for use in water of different depths (McKnight et al. 2015b). During our first trapping effort, traps were arranged in arrays and placed at locations within wetlands with suitable habitat (McKnight et al. 2015c). Each array consisted of 15 hoop nets of various diameters (0.90, 0.76, 0.61 m). Of the 15 traps, 6 were attached to the ends of three 1×6-m leads and the remaining 9 were set unpaired and without leads. Each array also included 5 wire-mesh minnow traps with openings modified to increase capture and retention rates of small turtles. Finally, 30 plastic snake traps were deployed in each array. These traps were targeting snakes for a companion project but also captured turtles that were included in our study. Trap arrays remained stationary for at least five nights and initially were placed in the northern- and southernmost portions of BP5. Arrays were also placed in the centers of Boehler Lake and Hassell Lake. All traps were checked and rebaited daily.

The second round of trapping was less standardized and was implemented to specifically target *D. r. miaria* without regard for equally detecting other species of turtle. Specifically, variable numbers of hoop traps (0.90-m and 0.76-m diameter) with 6-m leads were deployed throughout BP5 in areas believed to attract *D. r. miaria* to maximize capture rates (e.g., beaver runs, patches of open water along edges of aquatic vegetation). Traps were left in place only if they continued to capture our target species; if no *D. r. miaria* were detected after 3 days, traps were moved to a different location within the wetland to increase effectiveness (Hollender et al. 2022). As in the first round of surveys, traps were checked and rebaited daily with canned sardines. All captured turtles were measured, weighed, sexed, and marked prior to release at their point of capture.

Upon initial capture, *D. r. miaria* received a unique notch code, PIT tag, and a blood sample was taken and stored in lysis buffer for use in another study. When possible, scute annuli were counted, and photographs were taken of unusual markings, injuries, and scarring. A radio transmitter (RI-2B, 15g; Holohil Systems Ltd., Carp, Ontario, Canada) and temperature data logger (iButton model DS1922L or DS1925L, Maxim Integrated, Sunnyvale, CA) set to record air temperature at 15-minute intervals during the nesting season and 60-minute intervals during estivation were attached to the carapace of 5 male and 15 female *D. r. miaria*.

Timing of Nesting and Clutch Characteristics (**Objective 1**)

Transmittered female *D. r. miaria* were palpated for eggs during every recapture event in 2020 and 2021. If eggs or follicles were detected manually, we then used a portable ultrasound to inspect their reproductive tracts and assess reproductive condition. Both follicles and shelled eggs were readily identifiable and differentiable using ultrasound; follicles and unshelled eggs appeared as bright spheres, and shelled eggs could be identified by the bright white ring reflecting off of the calcified shell. If ultrasound scans showed presence of shelled eggs, females were taken to a veterinary clinic in Atoka, Oklahoma, where film X-rays were taken. The X-rays were used to determine the number of eggs females produce per clutch and to measure the short-axis diameter of each egg (as for most emydids, the eggs of *D. r. miaria* are distinctly ovoid; however, because each egg varies in its orientation, accurate long-axis measurements cannot be derived from a 2-

dimensional image). We endeavored to relocate females with shelled eggs daily until we determined they were no longer gravid via palpation. However, this strategy was frequently disrupted during the 2021 nesting season by flood-producing rain events that made recapturing turtles impossible, often for several consecutive days. Therefore, monitoring of gravid *D. r. miaria* was less consistent in the second year of our study.

We combined intensive tracking efforts with bio-logging to aid in identifying timing of nesting. Temperature data loggers that were affixed to each transmittered turtle generated temperature profiles that typically show inflections during turtles' movements from water to land and vice versa (Thompson and Ligon *in press*). When we failed to find a nest but could determine when nesting occurred within 48 hours, we examined these temperature profiles for evidence of terrestrial movements and, when possible, determined a window within which nesting occurred.

Males were tracked to monitor habitat use within the wetland and adjacent terrestrial habitat. After each nesting season ended, males and females were relocated on a regular basis to determine when they exited the wetland and where they went for estivation. The location of estivating turtles was confirmed by gently digging through the soil until the transmitter antenna or turtle's shell was visible. Depth of soil to turtle carapace (cm), soil characteristics, vegetated ground cover (%), and distance from water's edge (m) were recorded for each estivating turtle. Photographs were taken of the site before and after turtle presence was confirmed. Trail cameras that were set to be triggered by movement and to take a time-lapse image hourly were used to detect predation attempts and movements of turtles from their estivation sites.

Characterizing Nest Characteristics (**Objective 2**)

Following confirmation that a female *D. r. miaria* was gravid with shelled eggs, we attempted to relocate her daily using radio telemetry with the expectation that close monitoring would reveal when and where females leave a water body to nest. Upon finding a female on a nesting excursion, we would then track her to her nest site, carefully observe nesting, and then measure a suite of habitat and nest characteristics after the female completed the nesting process and departed. However, we were unsuccessful in locating nests and therefore were unable to describe microhabitat conditions.

Assessing Age, Senescence, and Predation (**Objective 3**)

Estimating ages from scute annuli — Scute annuli are faint ridges that form during periods of arrested growth, typically during periods of dormancy during winter or droughts. When periods of arrested growth occur at predictable intervals (e.g., annually with the onset of winter in temperate climates) annuli can be a useful predictor of age. Chicken Turtles have thin scutes that are shed frequently relative to other emydids and because of this, annuli are often indiscernible on the shells of adults. Nonetheless, scute annuli are a useful method for estimating age among younger *D. reticularia*.

A complimentary method of estimating the ages of individuals is that of conducting capture-mark-recapture efforts over a sufficiently long span of time relative to the longevity of the species in question. By this means, young individuals with discernible scute annuli that are captured early in a longitudinal study can then be monitored over subsequent years, and their age will remain known despite the eventual loss of discernible annuli. To date, combining age estimates of young individuals with long-term monitoring remains the only reliable path to knowing the ages of older turtles.

Measuring telomeres — To measure molecular senescence, we measured telomeres of turtles using tissue samples collected over 10 years from 2012 to present. DNA was extracted from either toenail clippings or blood samples. Claw were stored in glacial ethanol at -80°C and blood samples were stored in lysis buffer and stored at 5°C.

Turtles for which we had at least 3 samples collected from different years were included in this aspect of our study. Using DNeasy Blood and Tissue Kits (Qiagen), we extracted DNA from 10 µL of red blood cells or 3 claws. The relative telomere length was then measured using quantitative Polymerase Chain Reaction (qPCR) by comparing the amplification of the telomere region to a reference gene (T-to-C ratio; Cawthon 2002; Criscuolo et al. 2009).

We performed qPCR assays using QuantStudio 6 Pro with 96 well plates and 100nM isodilutions of primers. Telomere primers were Tel1b (5′-CGGTTTGTTTGGGTTTGGGTTT-GGGTTTGGGTTTGGGTT-3′) and Tel2b (5′-GGCTTGCCTTACCCTTACCCTTACCCTTA-CCCTTACCCT-3′). Our control gene, 18S, has been used successfully in the past on sea turtles (Plot et al. 2012) with primers 18S-F (5′-GAGGTGAAATTCTTGGACCGG-3′) and 18S-R (5′-CGAACCTCCGACTTTCGTTCT-3′). PCR conditions in the QuantStudio 6 Pro were 10 min 15 s at 95°C for the whole plate, by 40 cycles of 40 s at 62°C for the 18S portion of the plate and 67°C for the Tel portion of the plate, 40 s at 72°C for the whole plate, 15 s at 95°C for the whole plate, and 60 s at 60°C for the whole plate. Standard Dilution Curves were generated using a golden sample of CHT 75 (Amp Score = 1.35 ± 0.05).

Predation — Predation events could not be anticipated and were documented opportunistically throughout our study. Upon finding a depredated *D. r. miaria*, the location and habitat characteristics were recorded. The condition of the carcass was inspected to deduce whether predation had occurred recently, and when possible, circumstances were used to develop a gestalt estimation of the cause of death.

RESULTS AND DISCUSSION:

Trapping

In 34 days of trapping in 2020, we conducted 729 trap-nights of survey effort in BP5. We captured 544 turtles representing 7 species 1,106 times (**Table 1**). In 52 days of trapping in 2021, we conducted 968 trap-nights of survey effort in BP5. We captured 352 turtles representing 6 species 515 times (**Table 1**). In both years, the community was dominated by three species: Red-eared Slider Turtles (*Trachemys scripta*), Mississippi Mud Turtles (*Kinosternon subrubrum hippocrepis*), and Common Musk Turtles (*Sternotherus odoratus*). Due to the dominance of these species, diversity and evenness in the community was relatively low across both years (Shannon's diversity index = 1.34; Evenness = 0.69). Summaries of demographics data for all species are reported in **Appendix 3**.

We captured 43 and 37 *D. r. miaria* in 2020 and 2021, respectively. Many captures in 2021 were of individuals also captured in 2020; in total, 48 individuals were detected in the span of our study.

Timing of Nesting and Clutch Characteristics (Objective 1)

Over the two-year period, 18 clutches were recorded for Western Chicken Turtles. Among the transmittered females, 12 were found to be gravid at least once; additionally, at least 4 produced multiple clutches within a season. Eleven of the 15 clutches were sufficiently developed to count and measure eggs from X-rays (**Table 2; Appendix 1**) with an average of 7.6 eggs per clutch and an average egg diameter of 19.6 ± 1.7 mm).

One female (CHT172) laid two eggs while being processed in 2021 following her X-radiograph. Her eggs were quickly retrieved, measured, photographed, and placed into a cavity dug by researchers near BP5. Measurements included mass, short diameter, and long diameter (**Table 3**). Measurements appear to match those previously recorded for Western Chicken Turtles (Dinkelacker and Hilzinger 2014; McKnight et al. 2018).

Despite significant effort radio tracking gravid females, we failed to locate any nests during our study. However, we detected 4 gravid females as they left BP5, and all moved into upland habitat north of BP5 during significant flooding events, with 3 returning after laying eggs. The type of habitat to which they moved is consistent with the type of upland habitat where estivation often occurred; therefore, protection of these habitats surrounding wetlands are likely to have multiple positive impacts for *D. r. miaria*.

Although locations of nests remained elusive, in 5 instances we used temperature profiles generated from animal-borne data loggers to infer the timing of nesting (**Appendix 2**). All nest events that we documented appeared to have been created during daylight hours, with females leaving water to nest from 07:00–18:20 and returning at times ranging from 13:30 to 21:10. The duration of time out of water during nesting varied widely from 1.30 to 6.50 hours (**Table 4**). However, we cannot establish how this time was used or what fraction was spent engaging in different aspects of nesting such as site searching, excavation, oviposition, and nest covering.

Estivation Site Selection

In 2020, estivation sites were determined for 18 of the 20 transmittered turtles (**Figure 2**); inability to access adjacent private properties as well as road construction prevented even remote triangulation of the last two turtles during the winter. GPS locations of all estivation sites and trail cameras were recorded using a hand-held GPS.

In 2021, estivation sites were determined for 11 of the 16 transmittered turtles; two that could not be precisely located had moved onto an adjacent property to which we have been repeatedly denied access (**Figure 2)**. One of these turtles, CHT 150, was determined by triangulation to be residing in or near wetlands across the floodplain to the north-northeast of BP5. Two other turtles could not be detected over the winter via radio telemetry but were captured in BP5 by Ethan Hollender in spring 2022.

Of note, one female (CHT 75) was documented still in the water in September of 2021. This is the latest active period documented for a Western Chicken Turtle and may represent a response to the extreme cold and late start to the season of typical activity. CHT 75 was found one month later estivating successfully and recaptured alive in spring 2022.

Nest Site Characteristics (Objective 2)

No nests were located during the execution of our study. Therefore, although we determined that females entered upland habitats that were similar to areas where estivation was documented, we cannot comment on microhabitat characteristics of *D. r. miaria* nests.

Assessing Age, Senescence, and Mortality (Objective 3)

<u>Estimating ages from scute annuli</u> — Among the *D. r. miaria* that we captured, 8 of 15 males and 12 of 20 females did not have discernable annuli. However, among individuals with distinct annuli, counts ranged from 3 to 9. Additionally, we captured 3 adult males and 4 adult

females that had previously been captured and marked as juveniles with discernible annuli, thereby providing a permanent record of their age (**Tables 5 and 6**). Males and females differ in size, and whether they mature at similar ages is unknown; therefore, analyses of annuli were conducted separately for each sex. Both males and females with countable annuli exhibited a significant positive relationship between annulus count and straight carapace length (males: $F_{1,5} = 12.79$, $P = 0.016$, $r^2 = 0.72$; females: $F_{1,8} = 49.87$, $P \leq 0.001$, $r^2 = 0.86$). Unsurprisingly, the pool of turtles of both sexes without annuli was dominated by larger individuals (**Figure 3**). Therefore, while annuli are useful in our study population up to 6–8 years of age, they are of little value on their own for assessing the age of older individuals.

We began marking *D. r. miaria* in this study system in 2012, and of the 46 individuals that we captured in 2021, 32 had been captured and marked in a previous year. Notably, we recaptured a *D. r. miaria* that was first captured as a young adult in 2012 (CHT1), as well as an additional *D. r. miaria* from 2012 that had migrated from Hassell Lake to BP5. Unlike CHT1, the second turtle (CHT12) was captured as juvenile with distinct annuli that identified him as a 3-year-old. CHT12 was initially captured and marked on 25 May 2012 and was 81 mm straight carapace length and 86 g; on 29 June 2021, he had increased to 136.5 mm and 390 g, changes of 69% and 354%, respectively. Growth was much greater than that of CHT1 over a comparable period (4%). A study of Eastern Chicken Turtles (*D. r. reticularia*) found that growth tends to slow abruptly at around 5 years, likely correlating with the onset of sexual maturity (Buhlmann et al. 2009). CHT1 grew just 4% over an 8–9-year span, suggesting that it was likely at least 5 years old and sexually mature at the time of first capture. Thus, we can infer that this turtle was ≥ 13–14 years old in 2021.

Measuring telomeres — Standard Curves for Telomere to Control gene ratios (T/C ratio) were generated using Pfaffel Analyses due to shifts in primer efficiency (Tel Primer Eff = 119.8%, $R^2 = 0.907$; 18S Primer Eff = 102.2%, $R^2 = 0.972$). Telomere lengths across time were compared using T/C ratios over given years between sampling events to generate a general slope of change of lengths. We then used a one-tailed T-test to determine if telomere lengths were decreasing across time. Through preliminary analyses, we failed to reject the null hypothesis ($t_{20} = 1.08$, $P = 0.290$) suggesting that telomeres do not shorten over the lifespan of *D. r. miaria* (mean = 0.20 ± 0.86; **Figure 4**). Further research on potential comparisons between sexes and reproductive output are ongoing.

Mortality — Five transmittered turtles died in 2021 (**Table 7**). In early spring, we found carcasses of two transmittered individuals (CHT179 and CHT 136) in the forests surrounding BP5 within 10 m of the water. The causes of death could not be determined due to the lack of known estivation sites for the individuals, as well as the lack of soft tissue on the remains, but because they were found very early in the season, we infer that they were either preyed upon during estivation or - less likely given the early date - during return from their estivation sites to water. Additionally, during the trapping season, two transmittered turtles were found deceased in wetlands with little evidence of the causes of mortality. Finally, a fifth turtle was discovered in September during a routine trip to monitor estivating turtles. The turtle's carcass was found in a wooded upland area, and we consider this instance to be the most convincing evidence of depredation occurring during estivation. However, we cannot rule out that one or more of these events may have been acts of scavenging rather than depredation.

In fall 2021, radio-transmittered turtle CHT1 was found dead and mostly decayed in upland habitat of Boehler Lake with no indication of cause of death. This individual was the first *D. r.*

miaria documented by our lab in 2012 and, and an estimated age 15–18 years, the oldest known male in the population. This individuals' age is similar to the maximum ages reported for male *D. r. reticularia* and *D. r. chrysea* (Gibbons 1969; Gibbons and Greene 1978). Additionally, we confirmed the continued survival of two turtles first captured in 2008 (CHT9 and CHT21; minimum ages 16 and 20 respectively) and another turtle first captured in 2012 (CHT12, known age = 12). Continued longitudinal studies will help to further clarify aging and mortality norms in our study population.

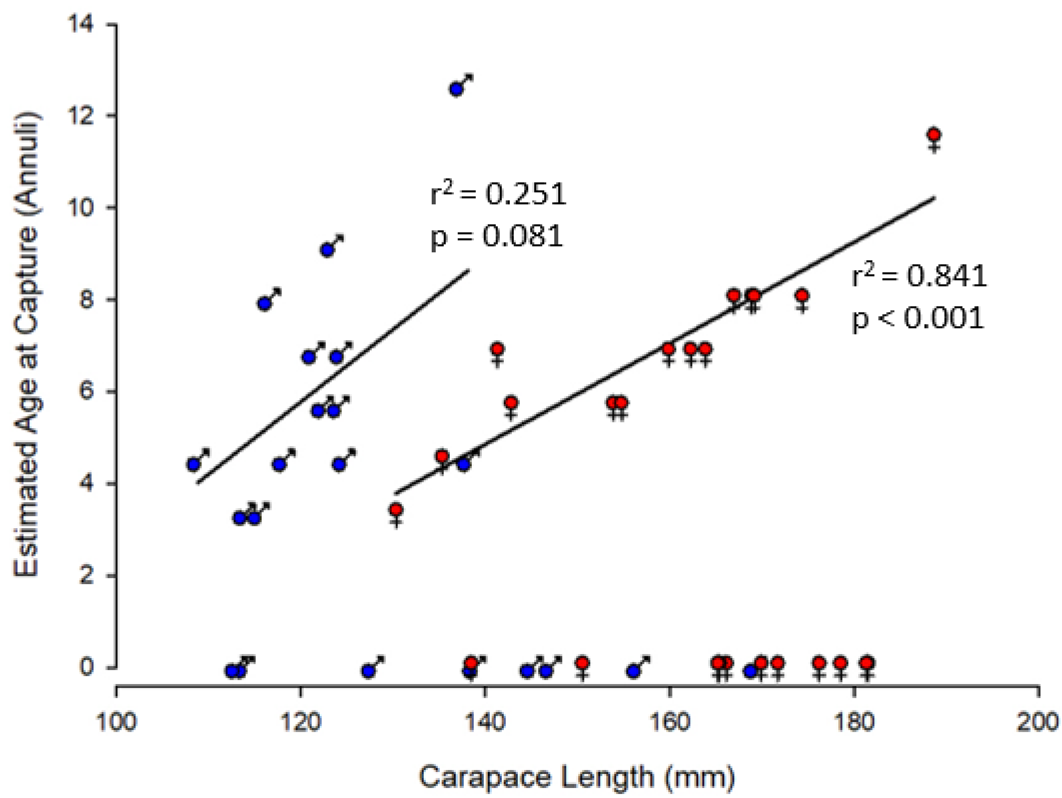

Figure 3. Correlation between midline carapace length and number of scute annuli. Most males and females retained no discernible annuli and are depicted along the x-axis with 0 annuli. Among males with visible rings, there was a positive correlation between size and number of annuli. Among females with discernible rings there was a strong, significant, and positive correlation. Individuals without countable rings were not included in regression calculations.

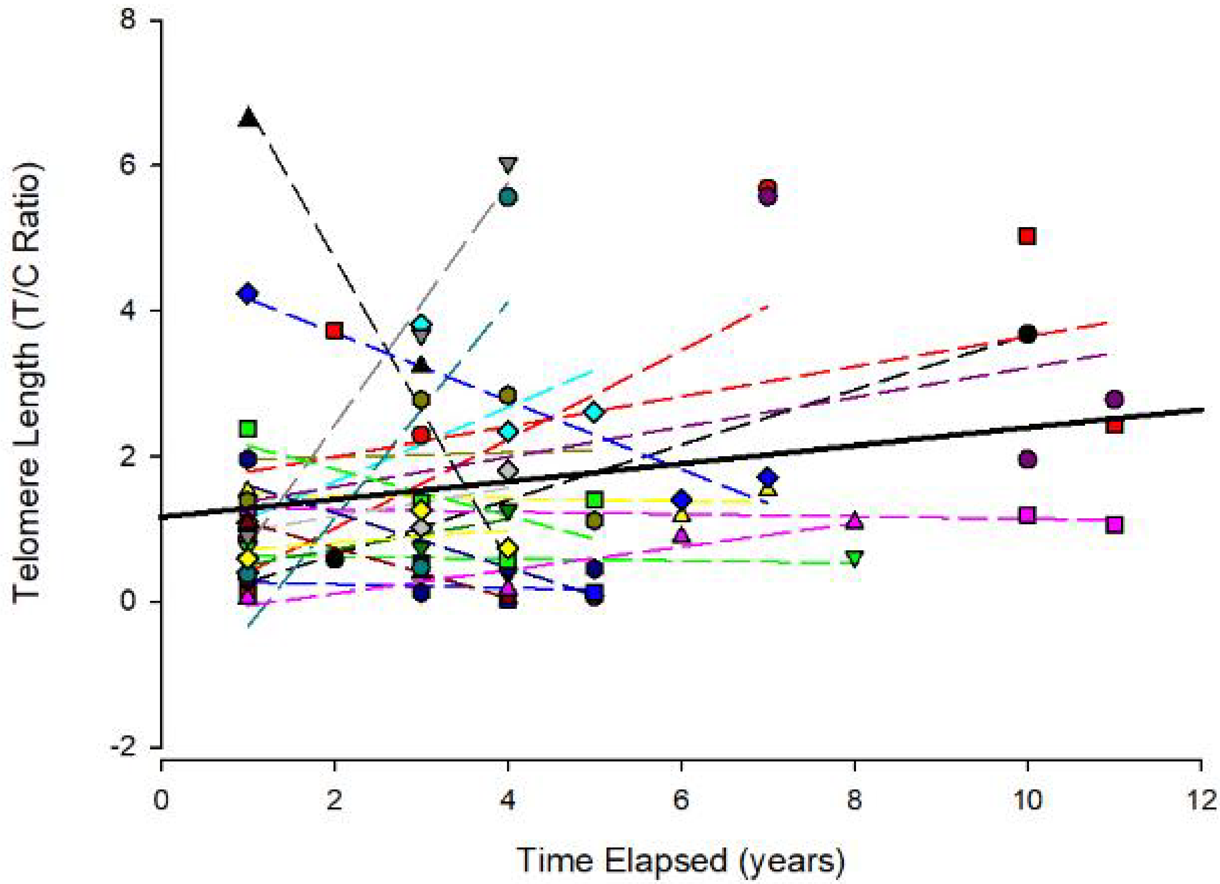

Figure 4. Changes over time in telomere length relative to a control gene for Western Chicken Turtles (*Deirochelys reticularia miaria*). At least three tissue samples were collected from each individual included in the study. Dashed lines are regressions calculated for individuals.

Table 1. Number of unique individuals of each species of turtle captured in BP5 in 2020 and 2021.

Species	2020	2021
Apalone spinifera	3	0
Chelydra serpentina	6*	5*
Deirochelys reticularia miaria	42	37
Kinosternon subrubrum hippocrepis	111	86
Pseudemys concinna concinna	3	1
Sternotherus odoratus	183	105
Trachemys scripta elegans	196	118

*Given common notch (L9); therefore, the number of unique individuals captured was determined based on the condition of scute marks. Those made within a field season were readily differentiable from marks made in previous seasons.

Table 2. Statistics for seven Western Chicken Turtle (*Deirochelys reticularia miaria*) clutches that were detected when eggs were shelled and could be visualized using X-radiography. Mean egg diameters were measured across the short axis of eggs; values are reported as mean ± 1 s.d.

Date	Turtle ID	Eggs (n)	Mean egg diameter (mm)
5/26/2020	172	8	19.7 ± 0.7
6/4/2020	75	9	19.8 ± 1.0
6/9/2020	110	8	19.4 ± 0.4
6/9/2020	150	8	19.2 ± 0.9
6/9/2020	125	6	18.2 ± 0.8
6/9/2020	151	8	19.1 ± 0.9
6/15/2020	136	7	17.1 ± 0.7
5/25/2021	157	7	21.6 ± 0.7
5/25/2021	174	5	21.4 ± 1.6
6/18/2021	172	9	22.9 ± 1.4
6/24/2021	103	8	21.1 ± 0.9
mean		**7.6**	**19.6 ± 1.7**

Table 3. Measurements of eggs deposited by Western Chicken Turtle (*Deirochelys reticularia miaria*) female 172 during processing. Diameters for both length and width are reported due to oblong nature of eggs.

Length Diameter (mm)	Short Diameter (mm)	Egg Mass (g)
33.5	21	9.75
34	20.5	9.25

Table 4. Dates of nesting inferred from a regimen of intensive radio tracking and palpation of female Western Chicken Turtles (*Deirochelys reticularia miaria*) to test for presence of shelled eggs, as well as estimates of timing of nesting events inferred by comparing temperature profiles from loggers affixed to turtles' shells to air temperatures.

Turtle ID	**Date**	**Est. Time Leaving Water**	**Est. Time Returning to Water**	**Duration of Nesting Foray (hrs)**
CHT172	5/30/2020	07:00	13:30	6.50
CHT157	6/6/2020	07:00	11:05	4.08
CHT75	6/8/2020	18:20	21:10	2.83
CHT136	6/16/2020	12:55	15:30	2.58
CHT 150	6/19/2020	15:58	17:40	1.30 (est.)

Table 5. Biometric and capture history data for 43 Western Chicken Turtles which were captured or tracked in 2020. Note that many individuals are represented in both Tables 5 and 6.

Sex	ID	Carapace length (mm)	Plastron length (mm)	Mass (g)	Recapture from previous years (Y/N)	Transmittered (Y/N)	Counted Annuli	Estimated Birth Year
M	1	169.8	146	655	Y	Y	NA	NA
M	120	127.8	113.6	290	Y	Y	NA	NA
M	134	157.8	135.9	610	Y	Y	NA	NA
M	140	123.6	108.8	280	Y	Y	NA	NA
M	148	138.8	122.2	410	Y	Y	NA	NA
F	75	187.2	164.5	1100	Y	Y	8	2012
F	172	181.7	158.1	940	Y	Y	NA	NA
F	157	166.6	150	750	Y	Y	NA	NA
F	149	168.3	146.7	730	Y	Y	NA	NA
F	103	174.3	156	875	Y	Y	7	2014
F	151	170.3	150.3	810	Y	Y	NA	NA
F	110	179.1	156.2	880	Y	Y	NA	NA
F	150	170.9	153.4	780	Y	Y	NA	NA
F	125	176.2	156.7	890	Y	Y	NA	NA
F	174	152.9	133.2	575	N	Y	NA	NA
F	136	166.1	148	730	Y	Y	NA	NA
F	179	165.4	146.5	700	N	Y	NA	NA
F	88	161.1	148.2	680	Y	Y	NA	NA
M	77	115.7	101.8	250	Y	N	NA	NA
M	78	118.2	105.8	265	Y	N	6	2014
M	95	114.6	103.6	240	Y	N	4	2016
M	132	117	103	250	Y	N	5	2015
M	137	113	98.5	220	Y	N	NA	NA
M	144	123.8	109.4	280	Y	N	5	2015
M	146	116.9	102.4	225	Y	N	NA	NA
M	153	123.2	107.4	275	Y	N		
M	158	117.5	103.2	240	Y	N	NA	NA
M	159	117.3	104.8	250	Y	N	5	2015
M	168	110.6	99.5	220	Y	N	NA	NA
M	173	137.3	122.1	365	N	N	5	2015
F	98	165.2	149.4	660	Y	N	NA	NA
F	117	151.5	137.8	530	Y	N	NA	NA
F	165	132.1	119.9	360	Y	N	NA	NA
F	169	123.2	112.3	290	Y	N	NA	NA
F	170	129.6	115.8	360	N	N	5	2015
F	171	146.9	136.1	520	N	N	7	2013
F	172	181.7	158.1	940	N	N	NA	NA
F	174	152.9	133.2	575	N	N	6	2014
F	175	131.4	113.3	350	N	N	4	2016
F	176	125.8	115.6	310	N	N	4	2016
F	178	134.4	124.1	390	N	N	3	2017
F	179	165.4	146.5	700	N	N	NA	NA
F	181	123.2	113	285	N	N	5	2015

Table 6. Biometric and capture history data for 37 Western Chicken Turtles (*Deirochelys reticularia miaria*) that were captured or tracked in 2021. Note that many individuals are represented in both Tables 5 and 6.

Sex	ID	Carapace length (mm)	Plastron length (mm)	Mass (g)	Recapture from previous years (Y/N)	Transmittered (Y/N)	Counted Annuli	Estimated Hatch Year
M	1	169.2	145.6	640	Y	Y	NA	NA
M	134	156.5	135	605	Y	Y	NA	NA
M	140	123.6	108.9	270	Y	Y	7	2014
M	148	138.8	122.5	355	Y	Y	NA	NA
M	120	NA	NA	NA	Not Recaptured*	Y	NA	NA
F	75	187.8	164.7	985	Y	Y	9	2012
F	103	181.7	161	880	Y	Y	NA	NA
F	88	161.4	148.8	610	Y	Y	NA	NA
F	110	178.5	157	800	Y	Y	NA	NA
F	117	159	142	625	Y	Y	7	2014
F	125	175	157	770	Y	Y	NA	NA
F	149	167.4	148.1	640	Y	Y	8	2013
F	150	169.9	153.3	670	Y	Y	NA	NA
F	151	171.7	152.7	730	Y	Y	NA	NA
F	155	166.1	149.5	620	Y	Y	NA	NA
F	157	169.4	151.8	700	Y	Y	8	2013
F	172	181.3	157.9	870	Y	Y	NA	NA
F	174	152.6	134	540	Y	Y	6	2015
F	192	163	148	680	N	Y	7	2014
F	102	NA	NA	NA	Not Recaptured*	Y	NA	NA
F	136	NA	NA	NA	Deceased**	Y	NA	NA
F	176	NA	NA	NA	Deceased**	Y	NA	NA
M	12	136	119	390	Y	N	12	2009
M	78	122.5	110	280	Y	N	NA	NA
M	132	120.5	105	265	Y	N	7	2014
M	146	118	103.5	235	Y	N	4	2017
M	158	121.5	107.5	250	Y	N	6	2015
M	168	113.8	101	220	Y	N	NA	NA
F	169	138.5	124	370	Y	N	NA	NA
F	170	142	127	490	Y	N	6	2015
F	175	150.5	133.5	500	Y	N	NA	NA
F	176	134.5	121.5	375	Y	N	5	2016
F	178	140.5	130	460	Y	N	7	2014
F	181	129.5	112	320	Y	N	4	2017
M	184	108	95.5	190	N	N	5	2016
M	187	145	126	435	N	N	NA	NA
M	188	147	130	470	N	N	NA	NA

*Individuals were identified at estivation site in winter of 2020 or early spring 2021. Turtles could not be located during the regular field season due to transmitter malfunctions, or migration beyond our range of detection.

**Individuals were tracked in 2020 but discovered in early 2021 to have been predated, likely during estivation.

Table 7. Mortality events of Western Chicken Turtles (*Deirochelys reticularia miaria*) throughout 2021 season. Coordinates reference the WGS84 datum.

ID	Date Discovered	Coordinates	Condition
CHT179	6 March 2021	34.16673, -95.85325	Scattered bones, long dead
CHT136	7 March 2021	34.16677, -95.85313	Scattered bones, long dead
CHT88	18 June 2021	34.16481, -95.85317	Decayed but intact, dead several days. Found in water.
CHT 1	22 July 2021	34.16688, -95.89098	Shell intact, most other bones missing. Dead for several weeks.
CHT 155	September 2021	NA	Decayed but intact, likely dead for a week or more. Signs of potential depredation on soft tissues.

RECOMMENDATIONS:

1. Presently, just two populations of *D. r. reticularia* are known to persist in Oklahoma, though the population that we studied in Atoka and Choctaw counties is thought to be larger and likely more resilient than that known from Red Slough Wildlife Management Area in McCurtain County. The species persistence in the state relies on the persistence of these populations; therefore, <u>we recommend continuing a regimen of monitoring both populations</u>.
2. The beaver-formed wetland dubbed BP5 has consistently supported a much larger population of *D. r. miaria* than any other wetland in Oklahoma and appears to serve as a central hub in the metapopulation in the Muddy Boggy River drainage. We believe that the loss of this wetland would likely devastate the population as a whole; therefore, <u>we recommend acquiring the wetland and as much surrounding woodland habitat as possible and securing their conservation status</u>.
3. Although we failed to find nests despite investing considerable effort in searching, we were able to infer that nesting chiefly occurs some distance from water in similar wooded upland habitats that estivation typically does. This gives added weight to the need for protecting extensive tracts of upland habitat, in addition to wetlands, if *D. r. miaria* populations are to persist long term. <u>If efforts to locate nests are renewed, we recommend attempting this in a more open habitat than our heavily wooded site, such as at Red Slough Wildlife Management Area in McCurtain County to examine how available habitat may affect nesting and estivation behavior.</u>
4. Although the mechanism of early death remains ambiguous, all available evidence supports *D. r. miaria* being comparably short-lived to the other Chicken Turtle subspecies. This life history character is unusual among turtles and, particularly because they deviate from other turtle species, <u>we recommend conducting a population viability analysis for the species to better understand population resiliency</u>.

SIGNIFICANT DEVIATIONS:

Despite daily efforts during the nesting season in 2020 and more sporadic efforts in 2021 that were greatly complicated by several significant flooding events, we failed to find any natural *D. r. miaria* nests during the course of our study. Therefore, we cannot comment about nest microhabitat characteristics as indicated in Objective 2.

EQUIPMENT:

No equipment was purchased.

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LITERATURE CITED:

Buhlmann, K.A., J.D. Congdon, J.W. Gibbons, and J.L Greene. 2009. Ecology of Chicken Turtles (*Deirochelys reticularia*) in a seasonal wetland ecosystem: exploiting resource and refuge environments. Herpetologica 65:39–53.

Cawthon, R.M. 2002. Telomere measurement by quantitative PCR. Nucleic Acids Research 30(10):e47.

Criscuolo, F., P. Bize, L. Nasir, N.B. Metcalfe, C.G. Foote, K. Griffiths, E.A. Gault, and P. Monaghan. 2009. Real-time quantitative PCR assay for measurement of avian telomeres. Journal of Avian Biology 40:342-347.

Dinkelacker, S.A., and Hilzinger, N.L. 2014. Demographic and reproductive traits of Western Chicken Turtles, *Deirochelys reticularia miaria*, in Central Arkansas. Journal of Herpetology 48:439–444.

Gibbons, J. W. 1969. Ecology and population dynamics of the Chicken Turtle, *Deirochelys reticularia*. Copeia 1969:676.

Gibbons, J. W., and J. L. Greene. 1978. Selected aspects of the ecology of the Chicken Turtle, *Deirochelys reticularia* (Latreille) (Reptilia, Testudines, Emydidae). Journal of Herpetology 12:237–241.

Hollender, E.C., D.T. McKnight, and D.B. Ligon. 2022. Learned trap avoidance in freshwater turtles and its effects on capture rates, abundance estimates, and inferences about community structure. Wildlife Research (*in press*).

McKnight, D.T., J.R. Harmon, J.L. McKnight, and D.B. Ligon. 2015a. The spring–summer nesting and activity patterns of the western chicken turtle (*Deirochelys reticularia miaria*). Copeia 103:1043–1047.

McKnight, D. T., Harmon, J. H., McKnight, J. L., and D. B. Ligon. 2015b. Taxonomic biases of seven methods used to survey a diverse herpetofaunal community. Herpetological Conservation and Biology. 10:666–678.

McKnight, D.T., A.C. Jones, and D.B. Ligon. 2015c. The omnivorous diet of the Western Chicken Turtle (*Deirochelys reticularia miaria*). Copeia 103:322–328.

McKnight, D.T., E.C. Hollender, H.J. Howell, J.L. Carr, K.A. Buhlmann, and D.B. Ligon. 2018. Egg and clutch sizes of Western Chicken Turtles (*Deirochelys reticularia miaria*). Acta Herpetologica 13:191–194.

McKnight, D.T. and D.B. Ligon. 2018. Western Chicken Turtle metapopulations and wetland connectivity. Report to the American Turtle Observatory. 6 pp.

Plot, V., F. Criscuolo, S. Zahn, and J.Y. Georges. 2012. Telomeres, age, and reproduction in a long-lived reptile. PLoS ONE 40855 7(7).

Thompson, D.M. and D.B. Ligon. Nesting behavior and ecology in a captive population of Alligator Snapping Turtles (*Macrochelys temminckii*). The Southeastern Naturalist (*in press*).

APPENDIX 1

Appendix 1A. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 172. Image was taken on 18 June 2021 and reveals the outlines of 9 shelled eggs (see Table 2 for a summary of egg morphometrics). The white circle in the upper-left corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

Appendix 1B. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 172. Image was taken on 5 July 2021 and reveals the outlines of just 1 shelled egg, possibly indicating that one egg was retained following nesting (see Table 2 for a summary of egg morphometrics). Note that this image is of the same turtle as represented in the preceding figure.

Appendix 1C. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 103. Image was taken on 25 June 2021 and reveals the presence of 9 shelled eggs (see Table 2 for a summary of egg morphometrics). The white circle in the upper-right corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

Appendix 1D. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 174. Image was taken on 25 May 2021 and reveals the faint outlines of 3 partially shelled eggs (see Table 2 for a summary of egg morphometrics). The white circle in the upper-left corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

Appendix 1E. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 157. Image was taken on 25 May 2021 and reveals the outlines of 7 shelled eggs (see Table 2 for a summary of egg morphometrics). The white circle in the upper-right corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

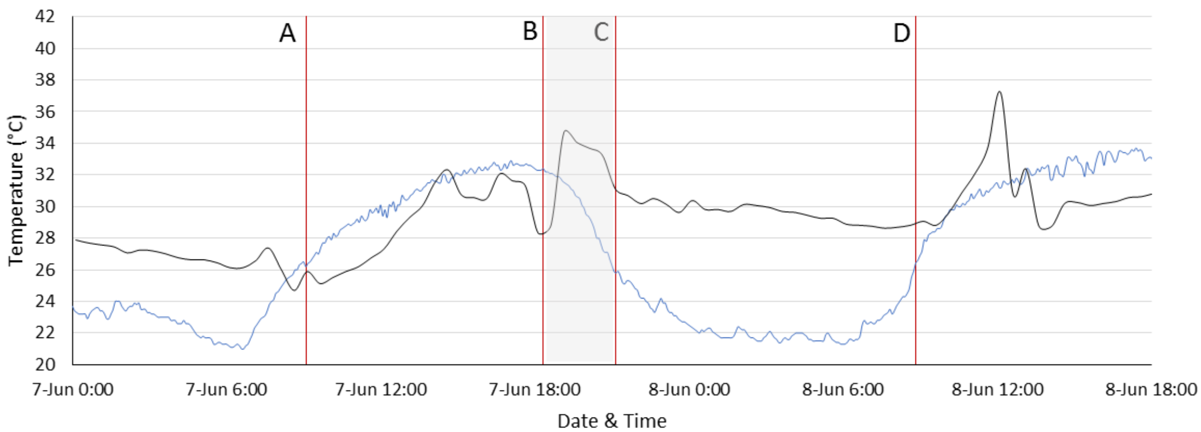
Appendix 1F. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 155. Image was taken on 25 May 2021 after eggs were detected by manual palpation. However, no eggs were visible, suggesting that the eggs shells were not yet sufficiently calcified. The white circle in the upper-left corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

Appendix 1G. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 125. Image was taken on 25 May 2021 after eggs were detected by manual palpation. However, no eggs were visible, suggesting that the eggs shells were not yet sufficiently calcified. The white circle in the upper-left corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

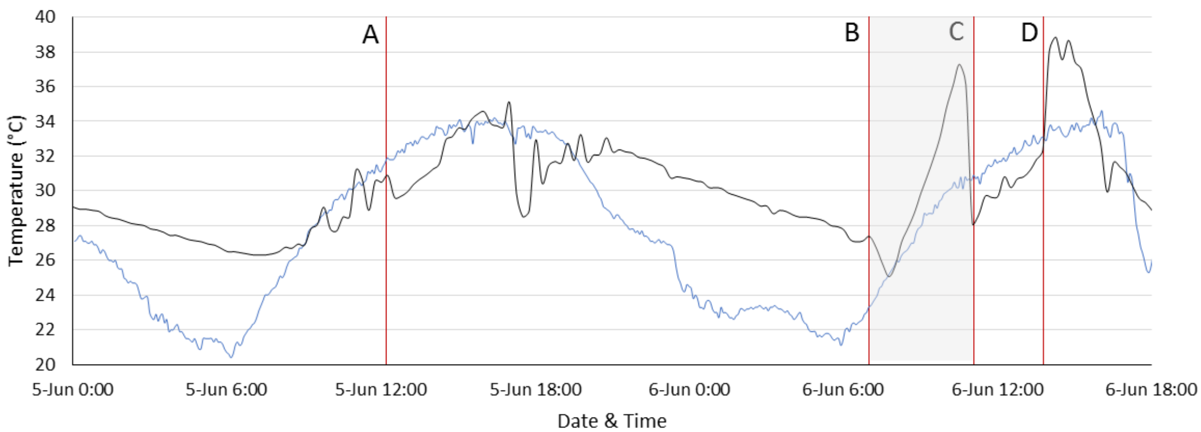
Appendix 1H. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 88. Image was taken on 12 June 2021 after eggs were detected by manual palpation. The outlines of at least four poorly calcified eggs are faintly visible but were insufficiently defined to confidently count or measure. The white circle in the upper-right corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

Appendix 1I. X-radiograph of Western Chicken Turtle (*Deirochelys reticularia miaria*), ID number 75. Image was taken on 21 July 2021 after eggs were detected by manual palpation. However, no eggs were visible, suggesting that the eggs shells were not yet sufficiently calcified. The white circle in the upper-left corner is a U.S. quarter, measuring 19.05 mm in diameter that was included as a size standard in the scan.

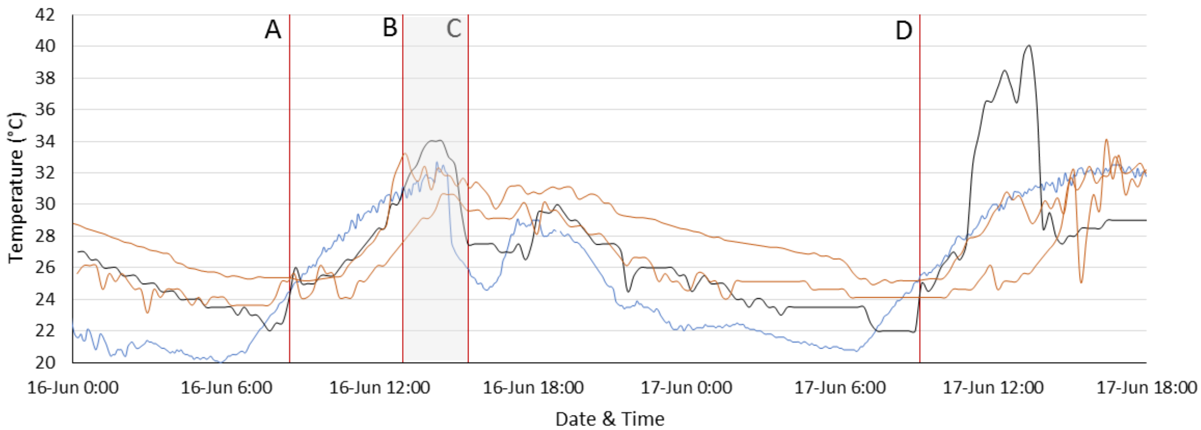
APPENDIX 2



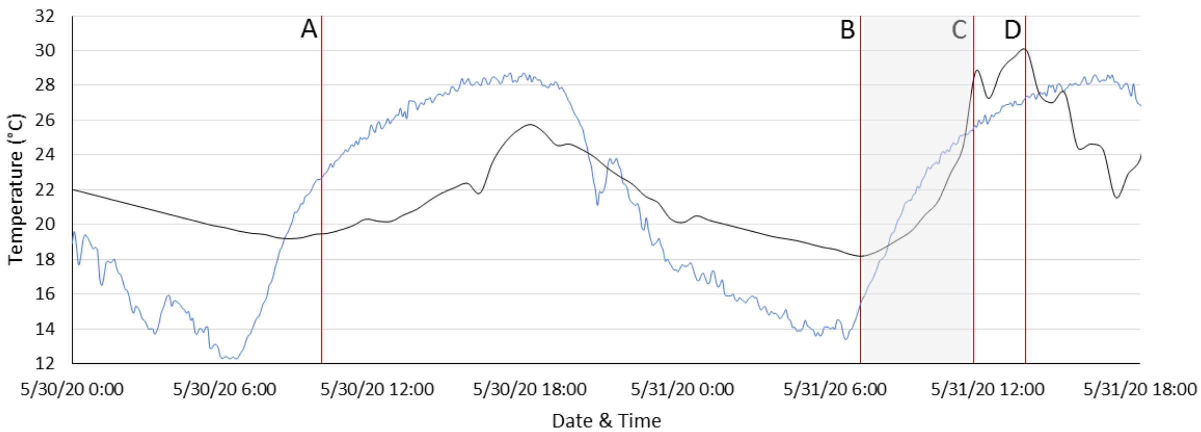
Appendix 2A. Temperature profiles comparing the air temperature (blue trace, created from Oklahoma Mesonet station no. 56, located 1 mile WNW of Lane, Oklahoma, and 23 km NW of the study site) to the external carapace temperature of Western Chicken Turtle CHT75 (black trace). At point A (7 June, 09:07), this gravid turtle was tracked to a Button Bush (*Cephalanthus occidentalis*) clump in the water. At point D (8 June, 08:50), this turtle was captured in a trap, manually palpated for eggs, and assessed to no longer be gravid. Beginning 45 minutes after point D, CHT75 was in a bucket with a few cm of water. The period between points B (8 June, 18:20) and C (8 June, 21:10), resembles the temperature profile when the turtle was out of water in our possession, and likely represents a terrestrial nesting foray.



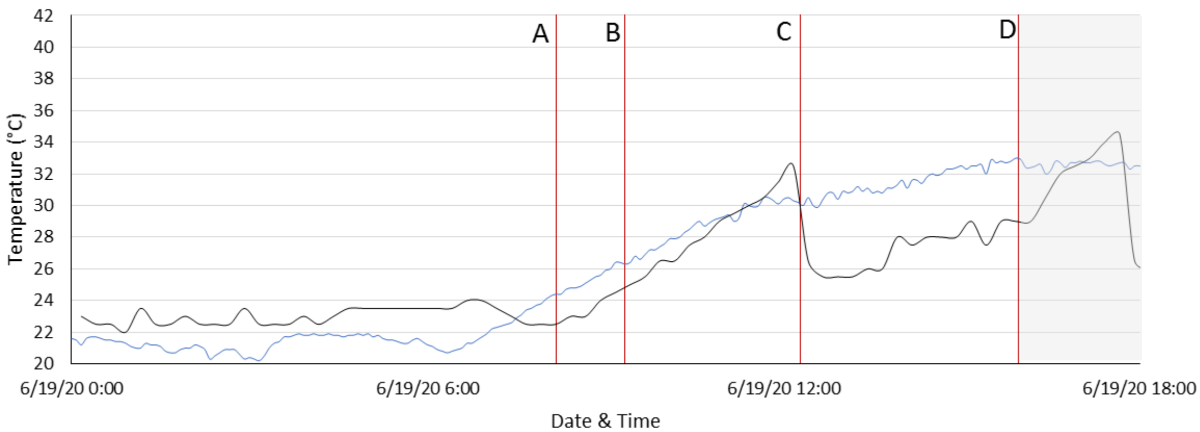
Appendix 2B. Temperature profiles comparing the air temperature (blue trace, created from Oklahoma Mesonet station no. 56, located 1 mile WNW of Lane, Oklahoma, and 23 km NW of the study site) to the external carapace temperature of Western Chicken Turtle CHT157 (black trace). At point A (5 June, 12:12), this turtle caught in a trap and manually assessed to be gravid with partially shelled eggs. At point D (6 June, 13:48), this turtle was tracked to a clump of rushes in the water, manually palpated, and determined to be non-gravid (later confirmed via ultrasound). After point D, CHT157 was in a bucket with a few cm of water. The period between points B (6 June, 07:00) and C (6 June, 11:05), resembles the temperature profile when the turtle was out of water in our possession, and likely represents a terrestrial nesting foray.



Appendix 2C. Temperature profiles comparing the air temperature (blue trace, created from Oklahoma Mesonet station no. 56, located 1 mile WNW of Lane, Oklahoma, and 23 km NW of the study site) to the external carapace temperature of Western Chicken Turtle CHT136 (black trace). For comparison, orange traces represent a female that was confirmed to have nested 10 days earlier and therefore was known to be non-gravid, and a male, also known to be non-gravid. At point A (16 June, 08:30), this turtle was known to be gravid and was released. At point D (17 June, 09:09), this turtle was tracked to cutgrass in the water, manually palpated, and determined to be non-gravid. After point D, CHT157 was in a bucket with a few cm of water. During the period between points B (16 June, 12:55) and C (6 June, 15:30), CHT 136's temperature profile tracked closely with air temperature, including during a storm-related temperature drop, whereas profiles from the two non-gravid turtles appear to be dampened by the thermal inertia of water. Therefore, we inferred that nesting occurred during this interval.



Appendix 2D. Temperature profiles comparing the air temperature (blue trace, created from Oklahoma Mesonet station no. 56, located 1 mile WNW of Lane, Oklahoma, and 23 km NW of the study site) to the external carapace temperature of Western Chicken Turtle CHT172 (black trace). At point A (30 May, 08:30), this turtle was tracked to a patch of rushes in the water and determined to be gravid with shelled eggs via manual palpation. At point D (31 May, 13:30), this turtle was tracked to a terrestrial location where she was partially buried in mud. Upon inspection she was determined to no longer be gravid and was left in place. the period between points B (31 May 2020, 7:00) & C (31 May 2020, 11:29), resembles a typical temperature profile generated when a turtle is out of water in our possession and bookend a point when the turtle was observed on land, presumably to nest. This suggests that the turtle nested in the first 20 minutes of her terrestrial excursion and remained on land for approximately two hours after nesting.



Appendix 2E. Temperature profiles comparing the air temperature (blue trace, created from Oklahoma Mesonet station no. 56, located 1 mile WNW of Lane, Oklahoma, and 23 km NW of the study site) to the external carapace temperature of Western Chicken Turtle CHT150 (black trace). At point B (19 June, 09:20), turtle was observed on land, apparently nesting, likely having left the water around point A (19 June, 08:10). After several attempts at constructing nest cavities, the turtle (still gravid) was observed re-entering the water at point C (19 June, 12:17). At point D (19 June, 15:58), attempts to track the turtle were unsuccessful, but the subsequent temperature peak suggests she may have made another foray onto land. The turtle was not captured again until 24 June, at which time she was no longer gravid.

APPENDIX 3

Appendix 3A. Summary biometrics for all turtles captured in BP5 in 2020. Values are mean ± s.d. (NA = no data to report).

Species	Male	Female	Juvenile
Apalone spinifera	*n = 1*	*n = 2*	*n = 0*
Carapace Length (mm)	102.8 ± NA	200.4 ± 86.2	NA
Plastron Length (mm)	147.0 ± NA	175.2 ± 103.4	NA
Mass (g)	250.0 ± NA	2460.0 ± 3715.4	NA
Chelydra serpentina	*n = 3*	*n = 0*	*n = 4*
Carapace Length (mm)	234.9 ± 33.1	NA	116.0 ± 32.6
Plastron Length (mm)	176.1 ± 20.6	NA	90.2 ± 27.5
Mass (g)	3416.7 ± 1607.3	NA	521.7 ± 503.1
Deirochelys reticularia miaria	*n = 18*	*n = 26*	*n = 0*
Carapace Length (mm)	126.7 ± 16.0	160.3 ± 18.3	NA
Plastron Length (mm)	111.8 ± 12.9	143.0 ±15.2	NA
Mass (g)	310.7 ± 137.9	667.6 ± 211.0	NA
Kinosternon subrubrum hippocrepis	*n = 46*	*n = 57*	*n = 9*
Carapace Length (mm)	80.1 ± 9.5	81.8 ± 14.5	50.2 ± 2.4
Plastron Length (mm)	67.4 ± 7.7	78.1 ± 12.2	43.4 ± 2.2
Mass (g)	88.6 ± 32.0	122.1 ± 51.6	22.6 ± 4.9
Pseudemys concinna concinna	*n = 1*	*n = 0*	*n =2*
Carapace Length (mm)	179.2 ± NA	NA	72.9 ± 22.9
Plastron Length (mm)	159.2 ± NA	NA	67.1 ± 20.7
Mass (g)	720.0 ± NA	NA	75.5 ± 55.9
Sternotherus odoratus	*n = 91*	*n = 92*	*n = 2*
Carapace Length (mm)	76.0 ± 17.2	78.5 ± 15.7	50.9 ± 2.0
Plastron Length (mm)	51.3 ± 9.4	58.7 ± 9.8	36.0 ± 2.0
Mass (g)	69.5 ± 37.9	86.5 ± 36.9	20.0 ± 0.0
Trachemys scripta elegans	*n = 116*	*n = 70*	*n =27*
Carapace Length (mm)	150.5 ± 32.1	176.6 ± 168.2	64.5 ± 19.3
Plastron Length (mm)	151.2 ± 143.2	168.0 ± 26.6	50.2 ± 13.1
Mass (g)	548.6 ± 310.9	948.5 ± 338.9	39.1 ± 35.1

Appendix 3B. Summary biometrics for all turtles captured in BP5 in 2021. Values are mean ± s.d. (NA = no data to report).

Species	Male	Female	Juvenile
Chelydra serpentina	*n = 3*	*n = 1*	*n = 1*
Carapace Length (mm)	236.0 ± 6.5	241	80
Plastron Length (mm)	179.3 ± 7.1	180.5	62
Mass (g)	3383.3 ± 528.2	3150	140
Deirochelys reticularia miaria	*n = 13*	*n = 20*	*n = 0*
Carapace Length (mm)	132.3 ± 18.1	160.3 ± 18.3	NA
Plastron Length (mm)	116.1 ± 14.9	143.0 ±15.2	NA
Mass (g)	354.2 ± 146.2	667.6 ± 211.0	NA
Kinosternon subrubrum hippocrepis	*n = 31*	*n = 40*	*n = 15*
Carapace Length (mm)	78.6 ± 9.8	87.0 ± 13.3	55.6 ± 8.6
Plastron Length (mm)	66.7 ± 7.2	80.5 ± 12.5	49.6 ± 7.6
Mass (g)	87.4 ± 27.4	135.8 ± 55.0	37.0 ± 13.3
Pseudemys concinna concinna	*n = 0*	*n = 0*	*n =1*
Carapace Length (mm)	NA	NA	86.8
Plastron Length (mm)	NA	NA	78.4
Mass (g)	NA	NA	110
Sternotherus odoratus	*n = 60*	*n = 36*	*n = 9*
Carapace Length (mm)	76.5 ± 10.0	80.0 ± 9.9	53.6 ± 4.9
Plastron Length (mm)	53.4 ± 7.7	60.8 ± 7.8	39.1 ± 4.9
Mass (g)	73.4 ± 30.9	90.2 ± 32.9	29.1 ± 6.7
Trachemys scripta elegans	*n = 59*	*n = 32*	*n =25*
Carapace Length (mm)	157.0 ± 26.0	175.1 ± 22.2	89.4 ± 9.6
Plastron Length (mm)	142.6 ± 23.9	162.0 ± 20.2	80.8 ± 9.4
Mass (g)	599.4 ± 287.5	827.2 ± 315.1	127.6 ± 41.0