POPULATION ESTIMATES OF THE URBAN TURTLE COMMUNITY IN FRENCH LAKE

by

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ABSTRACT

POPULATION ESTIMATES OF THE URBAN TURTLE

COMMUNITY IN FRENCH LAKE

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An infectious turtle disease called bunyavirus that can lead to hemorrhagic fevers was emerging so the Texas Parks and Wildlife Department monitored turtle populations through the use of capture recapture studies in various lakes to determine if the turtle population increase, decreased, or remained stable, which is a good indicator of population demographics throughout the years to see if the turtles were being harmed by the virus, various parasites, hunting, etc. This focused on the population of four turtle species, including *Apalone spinifera* (spiny softshell), *Chelydra serpentina* (common snapping turtle), *Psudemys spp.* (river cooter), and *Trachemys scripta* (pond slider) in French Lake, at Fort Worth, Texas, USA. The turtles were captured, tagged, and recorded over a course of ten trapping periods in three years. The population data for each species was analyzed through the statistical program MARK. For *Apalone spinifera*, *Chelydra serpentina*, and

Psudemys spp., the population estimate was 20.000, 11.000, and 5.000 respectively with no upper and lower bounds due to low capture rates. For *Trachemys scripta*, the populationestimate was 278.375, with upper and lower bounds of 321.452 and 249.099, respectively. The population estimates are essential in evaluating the overall lake health and keeping the ecological food web in check. Because *T. scripta* made up the majority of the turtle population and was the primary indicator of turtle population health in French Lake with a large amount of recaptures over the years, this demonstrates that the turtle population is stable and is not heavily impacted by the presence of the bunyavirus in regards to this ecosystem at French Lake.

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CHAPTER 1

INTRODUCTION

1.1 Importance of Animal Census in Nature

Similar to the reason that the United States conducts the U.S. census every ten years, recording animal populations throughout different habitats by species is beneficial because it gathers important information such as population growth, sex ratio, life expectancy of a species, survival probability, population density, etc. If one of these aspects is out of balance, the entire ecosystem can become displaced. For example, with an unbalanced sex ratio, there would be an increase in intraspecific competition to find a mating partner and the population growth would then also be affected. Another possibility is that for endangered species, if they are in groups where population density is high and spread out in a habitat, then the likelihood that they could be eliminated through a natural disaster that targets a certain range of geographical locations would be increased. Although gathering population data from various animal species is not a requirement, the need for a balanced ecosystem is important. This requires having a controlled population that is kept accountable for its growth/decline over the years to determine if there is an ecological threat present in the habitat or for that particular species (Moore, 2022). A proper animal census for a given location can help to prevent the overcrowding or insufficiency of the population for a given species, both of may lead to underlying issues such as the depletion of resources within a habitat, ultimately leading to the destruction of that particular ecosystem, with effects reaching towards the surrounding biome.

<u>1.2 Ecological Significance of Turtles</u>

There are a multitude of species of turtles around the world, from aquatic, semi-aquatic, to those that are terrestrial. Turtles are a vital part to the ecosystem that they inhabit for a range of reasons: they are responsible for a large percentage of the biomass of an ecosystem, they are able to reach high population densities due to their long-life span and reproductive rates, and even as prey to few predators. Sea turtles are a prime example of this, as they are prey to many animals in the ocean, but the eggs that they lay are also a source of food (Olive Ridley Project, 2020). If the population of sea turtles were to decline, the number of beaches would also be expected to decrease, as the nutrients released from the eggshells are absorbed into the surrounding plants to maintain erosion required for beaches (Bouchard & Bjorndal, 2000). Semi-aquatic turtle species, such as the alligator snapping turtle, serve as prime predators in the habitat they reside in, eating prey from fish to insects. Terrestrial turtles, such as the Galapagos giant tortoise, serve as one of the main herbivores in their environment, meaning that they are also responsible for the consumption and distribution of seeds (Rogers, 2019).

1.2.1. Turtle Imports and Exports in Texas

The freshwater turtle population in the United States is not safe from human interactions, as one of the major issues regarding turtles stems from the unchecked commercial reaping of turtles due to the demand of Asian markets (Mali et al., 2014). A significant amount of turtles were being exported from the United States of America each year, a number of southeastern states have begun to enforce restrictions on the export of the freshwater turtles (Mali et al., 2014). The majority of turtle exports recorded were of the species *Trachemys*, *Pseudemys*, *Chelydra*, and *Apalone, with Trachemys* being one of the largest exported species in the United States, with approximately 2.2 million *Trachemys* being exported from Louisiana and 26 million exported from California annually (Mali et al., 2014). Texas is considered to be the 3rd highest exporting state for turtles, following behind Louisiana and California (Mali et al., 2014). In Texas, freshwater turtles in particular are being sold and marketed for a multitude of purposes, including but not limited to consumption and sales of turtle meat, reptile expositions, pet shops, zoos, aquariums, local Texas herpetological societies, and the international trade of turtles. Eighty percent of the international sales of such turtles are being marketed to the Republic of Korea, Japan, Holland, and France (Ceballos & Fitzgerald, 2004).

CHAPTER 2

LITERATURE REVIEW

2.1 Population Estimates and Capture Rates by Varying Trap Type

A study conducted by Tesche and Hodges (2015) focused on mark-recapture trapping, with the intention to determine a bias, if any, in the sex and ages of the turtles sampled and the impacts that these present towards population estimates. A variety of traps were utilized, including hoop-net traps, dip-nets, and basking traps. This study focused on 11 populations of one species of turtle, *Chrysemys picta brllii*, otherwise known as the Western painted turtle. Hoop net traps had the lowest capture rate for adult turtles, while dip-nets captured the most hatching and juvenile turtles. As for recapture rates, turtles that were caught more than once were caught in the same trap type, which discourages deploying more traps of the same type to catch more turtles. When analyzing the population data through various statistical tests such as the ANOVA, a Tukey-Kramer HSD post hoc test for each trap type, it was discovered that the population estimates and sex to age ratios varied greatly when compared to population data that combined all the trap types together. This demonstrates that utilizing only one type of trap will lead to inaccurate estimates, as there are bias for each trap type depending on the age of the turtle. Tesche and Hodges (2015) were able to conclude that using a variety of traps would increase the overall capture rate and population estimate, but there is no current way to determine if utilizing a variety of traps would decrease the true bias in turtle trapping.

2.2 Mark-Recapture Study Without Trapping Techniques

A mark-recapture study by Scheider et al. (2018) was conducted in Michigan from 1998-2015 and with a goal of creating a detailed demographic analysis of a single population of wood turtles (*Glyptemys insculpta*) that reside in a 37.5 m segment of a river in Michigan. To collect data in this study, turtles were searched for using canoes and kayaks while moving along the river, hiking, and telemetry, which were all later denoted as inconsistent and low sampling effort. The turtles were initially tracked with telemetry and radio markings, but approximately 12 years into the study new and recaptured turtles instead were tracked with passive integrated transponder (PIT) tags, while also keeping track of age, sex, and mass of the turtles. The capture data was analyzed through the program MARK by the Cormack-Jolly-Seber model to determine survival and population estimates. This study had a few limitations due to the capture methods, which led to a low capture rate of juvenile turtles who were under the age of eight years old. Because this study lacked trapping techniques, the capture rates were diminished and capturing turtles based only on sight and telemetry created bias for turtles that reside directly in the river and closer to the surface.

2.3 Hoop Net Trap Bait Influence on Freshwater Turtle Capture Success

A study conducted by Mali et al. (2012) attempted to increase the capture and recapture rates of turtles in Texas by changing the bait used in the hoop net traps, as it was hypothesized that the low recapture rates were due to a trap shy response because of the scent of the bait. The traps were set in the Lower Rio Grande Valley and Bastrop Lost Pines area and was conducted since 2008-2009. Bait types were alternated, as fish bait (canned sardines) were used during the first couple years of the study, and then red meat was used for the last year of the study. When testing each type of bait, it was used exclusively to prevent bias between the differing baits. The study showed that alternating bait is associated with a higher rate of capture for long-term studies with hoop net traps, despite there not being enough evidence to demonstrate significant species preferences regarding the different types of bait. The study did not prove that using a variety of bait would lead to increased capture rates, as this would require additional research and methods that are time consuming and unrealistic, such as draining an entire body of water to control the diet of the turtles.

2.4 Hoop Net Trap Diameter on Capture Success

The use of hoop net traps with varying diameter size was tested by Gulette et al. (2019), where traps were deployed over 32 different ponds with five hoops of 0.91m and 0.76m diameters, for a total of ten traps per pond. The study caught two species of freshwater turtles, *Chelydra serpentina* (snapping turtle) and *Chrysemys picta* (painted turtle). The study showed that the use of varying diameters can impact the size distribution of the turtles captured, for both the larger and smaller species; however, the range of the species did not change between species, as both the large and small diameter traps captured the same turtle sizes. This study is applicable to future studies with regard to freshwater turtle capturing, as it shows that different trap sizes can affect the distribution of samples, so one-sized trap would be best to compare results across studies. In addition to this, it is important to take into account that the size of the trap that it is not too large that smaller turtles are able to escape through the mesh of the larger traps.

CHAPTER 3

METHODOLOGY

For this study, the turtles were captured by using trapping methods at French Lake over the course of three years. Data such as gender, shell circumference, mass, and date captured were recorded during the sampling.

3.1 Study Site at French Lake

The turtle population data for each of the turtle species was collected at French Lake, an urban lake located in South Fort Worth near Hulen Street and Sycamore School Road. This lake was chosen to be representative of Texas lakes due to its size and proximity to reduce travel time. The area of the lake is approximately three acres and drains 462 acres in the surrounding watershed (City of Fort Worth, Texas, 2020). The lake is located within a park that contains a small area of flat grassland surrounding it; the entire park is surrounded by neighborhoods. The water from the lake drains into the watershed which then runs through Sycamore Creek on its way to the Trinity River. With reference to this lake, turtle population data has only been collected since 2019, and the data collected will be used in addition to previous years.

3.1.1 Trapping and Sampling Periods

The turtles were caught over the course of three weekly trapping periods from September - October in the years 2019 to 2021, for a total of ten trapping periods over the course of three years. These months were chosen due to the optimal weather before the winter months, where the turtles would begin to hibernate, which would decrease the overall capture rates. During the sampling periods, the weather was fair, with temperatures ranging from approximately 16 - 27°C on average.

3.1.2 Preparing the Traps

Hoop net traps were used ($n=4$) and baited the traps with canned sardines, as it is one of the most common baits for freshwater turtles and is relatively easy to obtain (Mali et. al, 2014). To prepare the traps, the canned sardines were punctured to have holes and fastened it with rope to the middle of the trap. Approximately 1.8m of rope was tied to both the open and closed side of the trap and was held down by a stake at the bottom of the lake with a cinderblock to keep the traps stable and prevent accidental immersion, making sure that there was enough air in the top of the trap for the captured turtles to breathe, but with enough water that the turtles can swim inside to become trapped. The four traps were spaced out in the lake with approximately 7m in between each other. The traps were deployed the traps at approximately 3:30 PM on Tuesdays.

3.1.3 Data Collection and PIT Tagging

The deployed traps were collected 48 hours later, at 3:30 PM, on the Thursday of the same week. After the turtles were extracted from the traps, they were detained for a maximum of 2 h, as measurements of the weight in pounds, gender (if possible), and shell's circumference (cm) measured by the carapace width, at the most outspread part of the carapace (Bolten, 1999) were recorded in addition to the species. In addition to this, passive integrated transponder (PIT) tags were injected into the higher level of the leg close to the shell rather than the foot of the turtles that were captured to identify them if they did not already have an identification tag (Buhlmann et. al, 1998). Turtles with existing PIT tags had their recapture date recorded.

3.2 Program MARK POPAN Data Analysis

Once all of the data has been collected, the capture/recapture dates and the PIT identification tags were sorted by species and ran through the program MARK in the population analysis (POPAN) model. The resulting values that were computed were the probability of survival (φ), probability of recapture (p), and the population estimates including upper and lower bound estimates for each of the species (Schwarz et. al, 1996).

CHAPTER 4

RESULTS

A total of four different freshwater turtle species were captured, including *Apalone spinifera*, *Chelydra serpentina*, *Pseudemys spp.*, and *Trachemys scripta*. The results showed that the majority of the turtles captured were *T. scripta* after combining the population data from the previous years.

4.1 *Apalone spinifera* Population Data

During the trapping periods from 2019-2021, a total of 21 *A. spinifera* were captured, with one recapture. The proportion of recapture was 0.048. The capturing of *A. spinifera* was sporadic, as it was not captured at every trapping date but was still captured throughout the years (Figure 4.1). The population estimate for *A. spinifera* was 20.000, with no differing upper or lower bounds due to the low capture rate (Table 4.1).

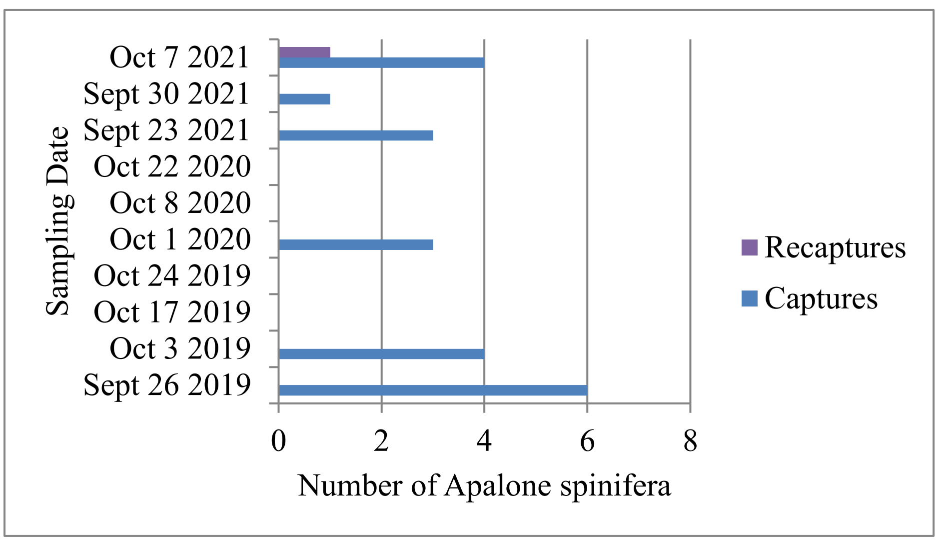

Figure 4.1: The number of captures and recaptures of *Apalone spinifera* over ten sampling periods in French Lake in Fort Worth, Texas, USA

4.2 *Chelydra serpentina* Population Data

Throughout the study, a total of 11 *C. serpentine* were captured, with no recaptures. Most of the *C. serpentine* that were captured was during the 2019 trapping periods with no captures in 2020, and a couple of captures in 2021 (Figure 4.2). The population estimate for *C. serpentina* was 11.00, with no differing upper or lower population estimates due to a low capture rate (Table 4.1).

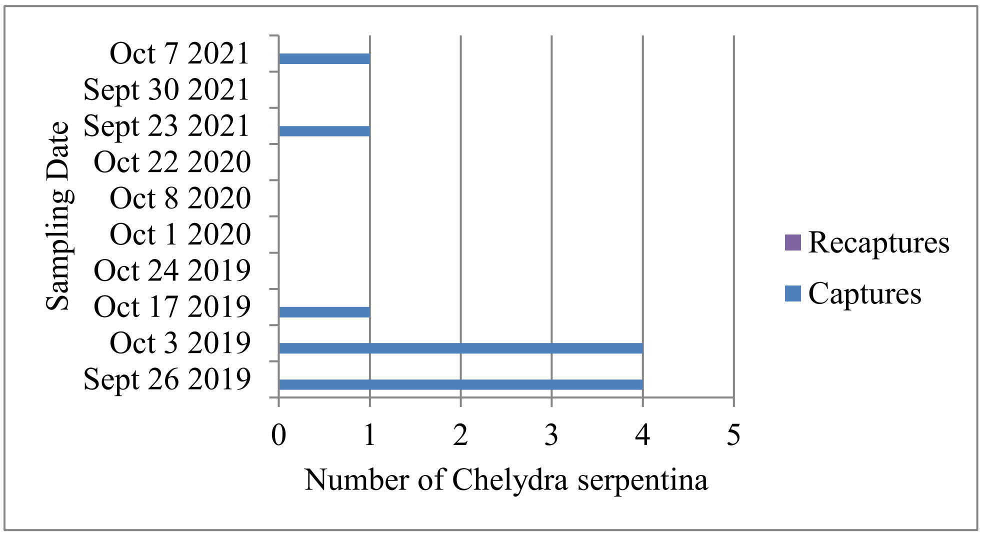

Figure 4.2: The number of captures and recaptures of *Chelydra serpentina* over ten sampling periods in French Lake in Fort Worth, Texas, USA

4.3 *Pseudemys spp.* Population Data

For *P. spp.*, there were a total of 11 captures, with five recaptures over the course of the trapping periods. The proportion of recapture was 0.455. The capture distribution was highest during 2019, and the capture rate slowly decreased over time, with only one capture and recapture in 2021 (Figure 4.3). The population estimate for *P. spp.* was 5.000, with no differing upper or lower population bounds due to a low capture rate and high recapture rate (Table 4.1).

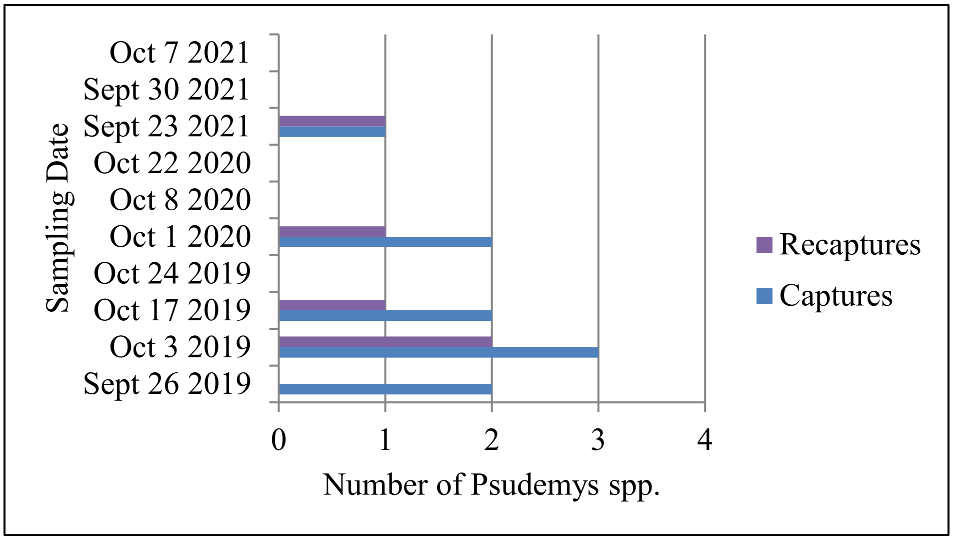

Figure 4.3: The number of captures and recaptures of *Psudemys spp.* Over ten sampling periods in French Lake in Fort Worth, Texas, USA

4.4 *Trachemys scripta* Population Data

T. scripta was the most abundant species that was captured in this study, with a total of 310 captures and 120 recaptures. The proportion of recapture was 0.387. From 2019 to 2021, the capture rates stayed fairly constant, slightly decreasing over the years, while the recapture rate was the opposite, showing a general increasing trend over the years (Figure 4.4). The population estimate for *T. scripta* was 278.375, with an upper population bound of 321.452 and a lower population bound of 249.099 (Table 4.1).

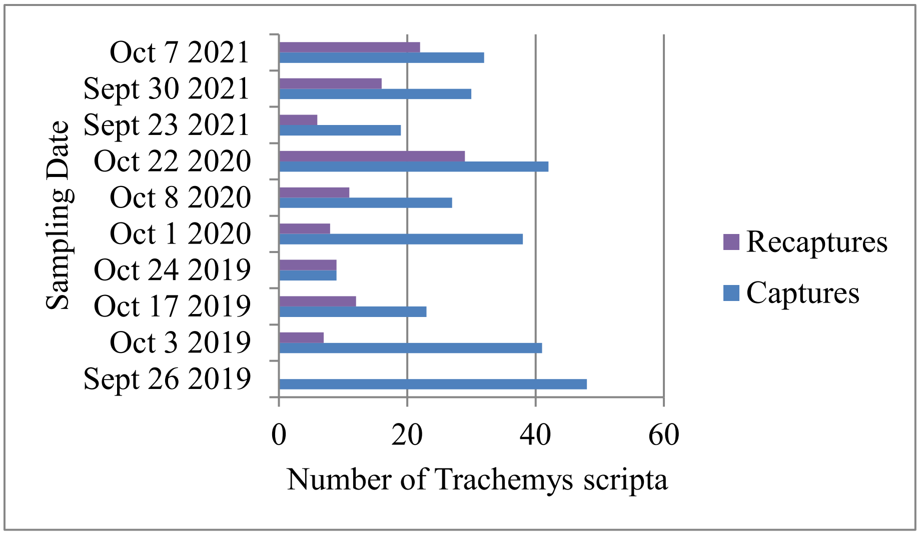

Figure 4.4: The number of captures and recaptures of *Trachemys scripta* over ten sampling periods in French Lake in Fort Worth, Texas, USA

4.5 Probability of Survivorship and Recapture

For *Apalone spinifera*, the φ (probability of survival) was 0.7692 and the p (probability of recapture) was 0.1068. For *Chelydra serpentina*, the φ was 0.4348 and p was 0.000. For *Pseudemys spp.*, the φ was 0.4394 and p was 0.0001. For *Trachemys scripta*, the φ was 0.8162 and the p was 0.2261 (Table 4.2).

The φ was highest for *T. scripta* and the lowest for *C. serpentina,* following the trend of capture rates. There is also a general positive association with the probability of survivorship and the probability of recapture.

Table 4.1: Population estimate bounds for *A. spinifera*, *C.serpentina*, *P. spp.*, and *T. scripta*

	Apalone spinifera	*Chelydra serpentina*	*Pseudemys spp.*	*Trachemys scripta*
$N_{estimate}$	20.000	11.000	5.000	278.375
N_{lower}	20.000	11.000	5.000	249.099
N_{upper}	20.000	11.000	5.000	321.452

Table 4.2: Survival and capture probability for *A. spinifera*, *C.serpentina*, *P. spp.*, and *T. scripta*

	Apalone spinifera	*Chelydra serpentina*	*Pseudemys spp.*	*Trachemys scripta*
φ	0.7692	0.4348	0.4394	0.8162
p	0.1068	0.0000	0.0001	0.2261

CHAPTER 5

DISCUSSION

5.1 Freshwater Turtle Population Demographics

The results demonstrate that a majority of turtles that reside in French Lake are *T. scripta*, with other turtle species making up the rest of the population, such as *A. spinafera*, *C. serpentine*, and *P. spp*. *T. scripta* greatly outnumbers the rest of the species due to its prevalence in this freshwater ecosystem over the years, allowing it to reproduce and continue to grow its population. A lower capture rate usually implies a lower population, and with a low capture rate of the other turtle species, it is difficult to attribute the reason to a lack of population, being trap shy, or another underlying reason. Due to the low recapture rates of the other species, it could be a possibility that they are being caught or perished due to natural/unnatural reasons; however, *T. scripta* remained the majority of the turtle population throughout the course of three years, indicating a sign of stability in the lake. This further indicates that the turtles are able to self-sustain their population and continue to prosper in this urban area. Since the halting of freshwater exports in Texas, it can be expected that the population to continue to grow over time and that the species proportions will stay approximately the same.

5.2 Errors in the Field and Corrections

During the first week of capture in 2021, there were two traps that did not capture any turtles. This may lead to an underrepresentation of the total population size and capture rate for that year. This may be due to the spacing of the traps or the bait quality within these traps.

If this study were to be conducted again, more traps could be set to gain a larger sample size, with more sampling dates throughout the year to detect changes in turtle activity to the seasonal and weather changes, if possible. In addition to this, traps would need to be monitored daily, as the collapse of a few traps during the 2021 sampling period resulted in the deaths of seven turtles. This can be prevented through surveillance or daily check-ins, if resources would create the opportunity to do so. This did not necessarily affect the population sampling for 2021, as the turtles were still captured and recorded, but if the study were to continue in future years, this could lead to bias in the results by underrepresenting the turtle population.

5.3 Implications of the Study

This study demonstrated that *T. scripta* was the most prevalent freshwater turtle species throughout the years that the study was conducted and maintained a stable population. This shows that the turtles in French Lake were not severely affected by the bunyavirus or other mechanisms of population decline such as excessive predation, hunting, capture, etc.

Although *T. scripta* is the most abundant turtle species within French Lake, this is not necessarily due to the fact that *T. scripta* is considered to be one of the most prevalent invasive species. Their population is also easily expanded, as this species is often mass produced for pets or exports (Burke, 2021). However, mature *T. scripta* do not make for long lasting pets, at which people tend to release them into local bodies of water, adding to the population of *T. scripta*. This addition may be beneficial for *T. scripta*, but it inhibits the growth of other species such as *C. serpentina*. The increasing population of *T. scripta* challenges the spatial demands of various species and other wildlife; as a result, competition for resources and space as well as an imposing ecological role are constant.

The significance of this study includes the incorporation of past studies and data, which can be referenced for future purposes. Comparison of data from subsequent decades can be utilized to monitor growth rates and observe any changes in *T. scripta* population. Without conglomerating data from past studies or analyses, the future studies that are conducted would be less credible, as they are lacking a foundation and previous evidence to support their results.

REFERENCES

Bolten AB. 1999. Techniques for Measuring Sea Turtles. Research and Management Techniques for the Conservation of Sea Turtles. 1999;4.

Bouchard SS, Bjorndal KA. Sea turtles as biological transporters of nutrients and energy from marine to terrestrial ecosystems. Ecology. 2000;81(8):2305–2313. doi:10.1890/0012-9658(2000)081[2305:stabto]2.0.co;2

Buhlmann, Kurt & Tuberville, Tracey. 1998. Use of Passive Integrated Transponder (PIT) Tags for Marking Small Freshwater Turtles. Chelonian Conservation and Biology. 3. 102-104.

Burke RL. 2021. Advances in the biology and conservation of Turtles. Diversity. 2021;13(1):17. doi:10.3390/d13010017

Ceballos CP, Fitzgerald LA. 2004. The trade in native and exotic turtles in Texas. Wildlife Society Bulletin. 2004;32(3):881–891. doi:10.2193/0091-7648(2004)032[0881:ttinae]2.0.co;2

City of Fort Worth, Texas. 2020. Urban Lakes. Available at https://www.fortworthtexas.gov/departments/code-compliance/environmental-quality/stormwater-quality/urban-lakes/french-lake

Gulette AL, Anderson JT, Brown DJ. Influence of hoop-net trap diameter on capture success and size distribution of comparatively large and small freshwater turtles. Northeastern Naturalist. 2019;26(1):129. doi:10.1656/045.026.0111

Mali I, Brown DJ, Jones MC, Forstner MRJ. Switching bait as a method to improve freshwater turtle capture and recapture success with hoop net traps. Southeastern Naturalist. 2012;11(2):311–318. doi:10.1656/058.011.0212

Mali, Ivana & Haynes, David & Forstner, M. 2014. Effects of Bait Type, Bait Age, and Trap Hours on Capture Success of Freshwater Turtles. Southeastern Naturalist. 13. 619-625. 10.1656/058.013.0317.

Mali I, Vandewege MW, Davis SK, Forstner MR. 2014. Magnitude of the freshwater turtle exports from the US: Long term trends and early effects of newly implemented harvest management regimes. PLoS ONE. 2014;9(1). doi:10.1371/journal.pone.0086478

Moore A. Transforming data into conservation. College of Natural Resources News. 2022 Jan 25 [accessed 2022 May 10]. https://cnr.ncsu.edu/news/2022/01/transforming-data-into-conservation/

Olive Ridley Project. Which animals eat sea turtles? Olive Ridley Project. 2020 Apr 19 https://oliveridleyproject.org/ufaqs/which-animals-eat-sea-turtles#:~:text=Racoons%2C%20foxes%2C%20coyotes%2C%20feral,they%20move%20from%20coastal%20waters

Rogers O. The Vital Importance Of Turtles. 2019 Apr 1. Available at https://faunalytics.org/the-vital-importance-of-turtles/#

Schneider AC, Arnold TW, Huber PW, Lewis TL. An 18-year mark–recapture study of wood turtles (Glyptemys Insculpta) in Michigan. Journal of Herpetology. 2018;52(2):193–200. doi:10.1670/17-063

Schwarz, C.J., Arnason, A.N. (1996): A general methodology for the analysis of open model capture recapture experiments. Biometrics 52: 860-873.

Tesche MR, Hodges KE. Unreliable population inferences from common trapping practices for freshwater turtles. Global Ecology and Conservation. 2015;3:802–813. doi:10.1016/j.gecco.2015.04.001

BIOGRAPHICAL INFORMATION

Jennifer Nguyen attended the University of Texas at Arlington from August 2019 – May 2021. She will have earned an Honors Bachelor of Science in Biology in May 2022. For this project, Nguyen had worked with supervisor and mentor, Dr. Corey E. Roelke, to observe turtle population estimates in French Lake. Research interests include topics ranging from bacterial growth, genetics, wildlife, the life sciences, and more; Nguyen is open to many topics within the field of research, as she would like to broaden her scope of knowledge and gain new experiences.

Awards and recognition include the Dean’s List for the Spring ’20, Spring ’21, and Fall ’21 semesters. Nguyen has been with the Honors College since Fall 2019 and has assisted in several minor research projects throughout her undergraduate career.

Nguyen intends to attend medical school in order to obtain a professional graduate degree as a Doctor of Medicine (M.D.), with plans to specialize in radiology where she will be able to explore diagnostic and interventional methods of care.