

Chrysemys a River! Comparisons of Freshwater Turtle Populations using Community Science

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PRELIMINARY STUDY

From June to July 2024, a riparian habitat assessment was conducted alongside a freshwater turtle survey at the Bronx Zoo.¹ This study was conducted along the Bronx Zoo's Twin Dams and Mitsubishi Riverwalk areas, and aimed to answer the question: how do turtle capture rates differ along sections of the Bronx River with varying degrees of erosion and Japanese knotweed (*Reynoutria japonica*) cover?

This study provided evidence for the invasive nature of red-eared sliders (*Trachemys scripta elegans*) in the Bronx River and their displacement of native painted turtles (*Chrysemys picta*) and common snapping turtles (*Chelydra serpentina*). Additionally, this study indicated that plant diversity positively impacts the observed species richness of turtles.

BACKGROUND

While riparian zones are ecologically important, they are also economically important.^{2,3,4} Human development along rivers has resulted in the altering of rivers,³ the destruction of riparian zones,^{2,4} and the introduction of invasive species.^{2,3} The introduction of invasive species has altered the manner certain species interact with and exist within their environment—resulting in the displacement of native species by invasive species.⁴ Additionally, anthropogenic climate change, which has resulted in global temperatures rising 2°F since 1850,⁵ has the potential to alter wildlife behavior, biodiversity, and the range of species.

Ranges of reptiles, amphibians, birds, mammals, fish, and plants depend on riparian zones (the land adjacent to rivers) for food and shelter.^{2,3} Freshwater turtles, for example, depend on macroinvertebrates and aquatic plants for nutrients; as well as submerged rocks and branches and river substrate for shelter and hunting grounds.

Livin' It Up in the City: Turtle Distribution across Major Northeastern and Midwestern Cities | Anisa Nurani, C.J. Vargas

Research Question: How have populations of *T. s. elegans*; an introduced, naturalized species; and *C. picta*, a native species, changed over the past 10 years across eight major US Midwestern and Northeastern cities (Chicago, Detroit, Boston, New York City, Philadelphia, Minneapolis, St. Paul, Washington DC)?

Hypothesis: The number of *C. picta* observations will vary significantly across major US cities and will show a general declining trend over time, with some cities experiencing more rapid declines than others due to urbanization and habitat loss.

Findings: *C. picta* are growing faster than *T. s. elegans* in most cities. Notably, native and introduced turtle species shown adaptability to urban conditions, dispelling the assumption of invasive species outcompeting native species.

Nurani and Vargas attempt to reveal relationships and trends among observations of native and introduced turtle species across several urban areas, while Lin investigates possible relationships between surface temperature and observations of disturbed turtle brumation in New York State. Both projects investigate how freshwater turtles have been responding to a changing habitat utilizing public access databases—such as the US Census and National Weather Service— and community science databases, which engages the public in scientific research through data collection and interpretation through platforms like iNaturalist.

Slumped Sleeper: A Study on *Chelydra serpentina* | Justin Lin

Research Question: How does surface temperature correlate with observations of common snapping turtles during the early to late winter season (September to March) from 2018 to 2024 in New York State?

Hypothesis: Observations of snapping turtles will increase as mean air temperature increase

Findings: There seems to be no consistent relationship between turtle observations and temperature. However, whenever there was a major increase in temperature, there was a major increase in the number of observations recorded.



Credit: Zein Mera

Image 1: *C. picta*, the painted turtle, is a species native to much of the United States.



Credit: WCS © Julie Larsen Maher

Image 2: *T. scripta elegans*, the red eared slider, is a species native to the southern United States.



Credit: Zein Mera

Image 3: Two *C. serpentina*, the common snapping turtle, is a species native to much of the United States.

ACKNOWLEDGMENTS

We would like to thank Max Falkenberg and Lowell Iporac for their indispensable guidance and support throughout this study. We would like to thank the Wildlife Conservation Society for providing the opportunity to continue our research at the Bronx Zoo. Finally, we would like to thank the Pinkerton Foundation for their support made this research possible.

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Livin' It up in the City: Turtle Distribution Across Major Northeastern and Midwestern Cities

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Abstract

Freshwater turtles live in riparian zones – the buffer zone between land and river – where they depend upon macroinvertebrate and plant populations. Riparian zones, popular sites for urban development due to their coastal locations, make turtles especially vulnerable to urbanization, which can change or even destroy their habitats. Urbanization also leads to the introduction of nonnative species, which can become invasive and harm local populations. This work focuses on population trends of the introduced red-eared slider (*Trachemys scripta elegans*) and the native painted turtle (*Chrysemys picta*) from 2013 to 2023 in 8 major metropolitan areas of the Midwestern and Northeastern United States. We analyzed information derived from citizen science records, standardized surveys, and available historical data to explore the trends of abundance, distribution, and demography of turtles. Our results show an increasing trend in sightings for both species, but *C. picta* are growing faster than *T. s. elegans* in most cities. Notably, native and introduced turtle species showed adaptability to urban conditions, dispelling the assumption of invasive species outcompeting native species.

Introduction

Freshwater turtles have key roles in riparian ecosystems through the regulation of macroinvertebrates and plant populations¹. However, this makes them especially vulnerable to habitat destruction and the introduction of invasive species through urbanization along riparian zones². Unexpectedly, *C. picta* and *T. s. elegans* both have responded positively to urbanization; studies indicate that the presence of mature females of painted turtles is positively correlated with urbanization, as are relative abundances for both species in human-dominated landscapes³. A recent study used the iNaturalist citizen science platform to make estimates of abundance, distribution, and demographic parameters from *C. picta* and *T. s. elegans* across eight major metropolitan areas in the Midwestern and Northeastern United States between 2014 and 2023⁴. This research examines interactions within turtle populations and urban density to further understand the challenges for freshwater turtles in increasingly urbanized landscapes.

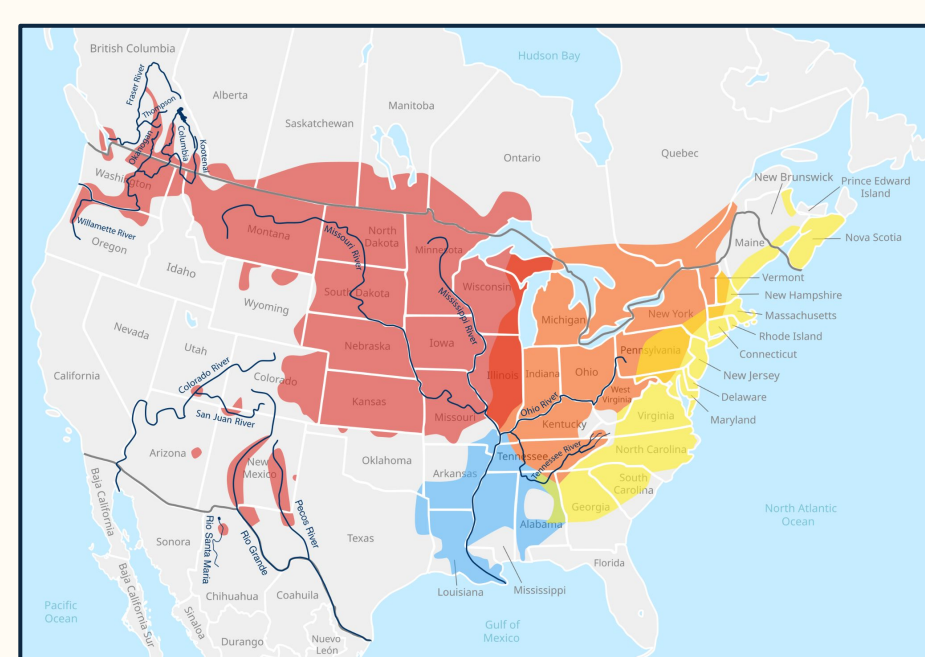


Fig. 1. The native range of *C. picta*¹¹

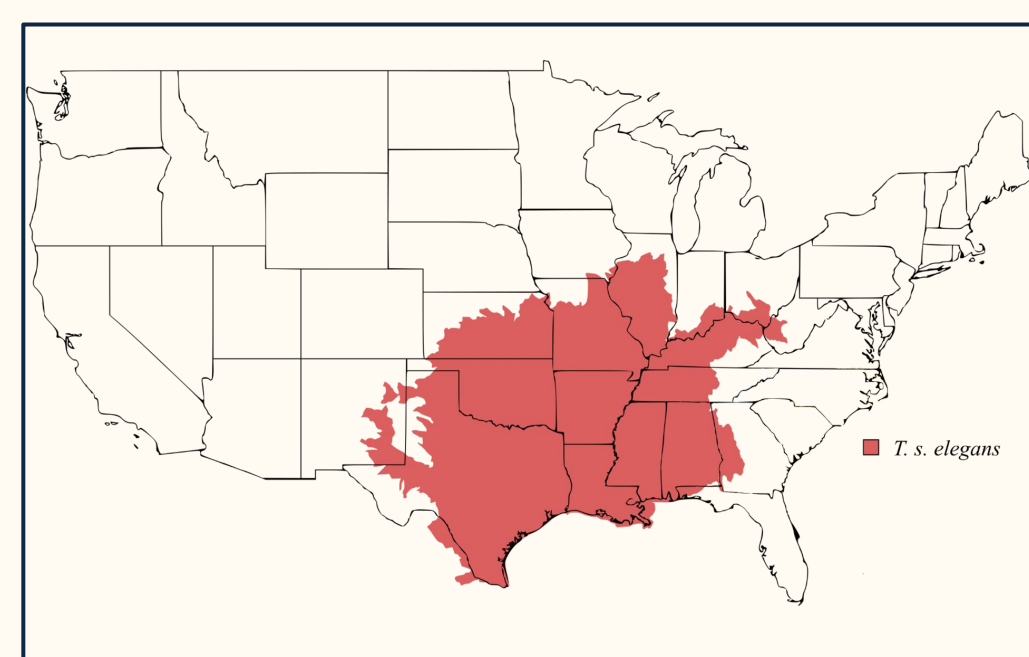


Fig. 2. The native range of *T. s. elegans*¹²

Research Questions & Hypotheses

Research Question: How have populations of *T. s. elegans*; an introduced, naturalized species; and *C. picta*, a native species, changed over the past 10 years across eight major US Midwestern and Northeastern cities (Chicago, Detroit, Boston, New York City, Philadelphia, Minneapolis, St. Paul, Washington DC)?

Hypothesis: The number of *C. picta* observations will vary significantly across major US cities and will show a general declining trend over time, with some cities experiencing more rapid declines than others due to urbanization and habitat loss.

Methodology

This study assessed population trends in freshwater turtles and related environmental factors across eight major Midwestern and Northeastern U.S. cities from 2014 to 2023: Chicago, IL; Detroit, MI; Boston, MA; New York City, NY; Philadelphia, PA; Minneapolis, MN; St. Paul, MN; and Washington D.C.. Open-source and online databases were used to gather all data. iNaturalist⁵, a citizen science platform, provided data regarding observations of *C. picta* and *T. scripta elegans* in each city per year. Only research grade observations – those confirmed by at least two identifiers – were included. The National Weather Service⁶, an online government database showing national weather records across time, also provided climate data – including average annual temperature and precipitation.

The iNaturalist observations, national weather data, US census data, and city area data were collated into spreadsheets. Pivot tables and graphs were created to reveal observation trends, possible correlations between weather patterns. Population density for each city was calculated by dividing the annual population by city area – enabling the analysis of the relations between the urban density and turtle populations.

Results & Figures



Fig. 3. The comparative distribution of *T. s. elegans* and *C. picta*'s population throughout a period of 10 years across eight Northeastern and Midwestern cities from 2014 – 2023.

Analysis/Conclusions

- Trend Overview (2014–2023): Rising observations for painted turtle (*C. picta*) and red-eared slider (*T. s. elegans*) in eight cities with higher growth rates for painted turtles in most cities.
- City-Specific Insights: NYC: Dramatic growth; red-eared sliders outnumber painted turtles. Philadelphia: Large population expansions for both species. Washington D.C.: Generally increasing, but variable. Chicago: Peak for painted turtles in 2018. Detroit, Boston, Minneapolis: Consistently higher painted turtle populations. St. Paul: Only one red-eared slider observation.
- Key Findings: Painted turtles outnumber red-eared sliders in seven out of eight cities. Adaptability of both native and introduced species challenges the notion of invasive species outcompeting natives.

Discussion

Our study revealed a surprising trend: both native *C. picta* and introduced *T. s. elegans* are thriving in urban environments⁷. This is particularly intriguing for the painted turtles, dispelling assumptions about urbanization negatively affecting native species. The red-eared sliders' success is less shocking, given their reputation as adaptable opportunists⁸.

One possible explanation for this trend is that iNaturalist and other citizen science platforms make it easier for people to report the presence of turtles. Perhaps, urban landscapes provide certain benefits to turtles, such as artificial ponds and fewer predators⁹. Climate changes may be working in their favor, making historically cold environments more suitable for habitability¹⁰. Parallel successes of both native and introduced species question the widely accepted perception that invasive species will invariably outcompete natives in urban areas.

This research underlines the need for continued monitoring and deeper investigation into urban turtle populations. As our cities grow and change, understanding how these resilient reptiles adapt is crucial for urban ecology and conservation efforts. It's an optimistic yet complex picture of wildlife adaptation in our ever-expanding urban jungles.



Acknowledgements

We would like to thank our supervisors Max Falkenberg and Dr. Lowell Iporac, and our mentor, Zein Mera, for their guidance, instruction, and support throughout the entire research process. We would like to thank the Wildlife Conservation Society (WCS) for providing the opportunity to use the Bronx Zoo to conduct our research. Finally, we would like to thank the Pinkerton Foundation for funding and providing resources.

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Slumped Sleeper: A Study on *Chelydra serpentina*

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Abstract

Freshwater turtles such as *Chelydra serpentina* (common snapping turtles) are indicators of riparian and river health. *C. serpentina* usually enters brumation around September when temperatures drop below 5 degrees Celsius and emerge around March and April when temperatures once again exceed 5 degrees Celsius. This study quantified the *C. serpentina* observations on iNaturalist in the New York state area from 2018 through 2024 during the species' expected brumation period (September through March). The study predicts that due to human induced climate change, turtle brumation will vary a lot along with temperature. However, the results showed no noticeable trend between the two studied variables.

Introduction

C. serpentina face a variety of environmental challenges due to urbanization and anthropogenic climate change— rapid habitat loss and a change in their overall behavior.¹ *C. serpentina* is known for its ability to survive in a wide variety of environments.² *C. serpentina* has been shown to be useful biomonitors since they are able to absorbing environmental contaminants like lead³ and mercury.⁴ *C. serpentina* also transport contaminants from ingested material onto their offspring via the lipid stores, which when examined, reflecting lipophilic compounds from their local environment.⁵ *C. serpentina* undergo brumation—a state of dormancy that reptiles enter during the winter or when temperatures drop, similar to hibernation in mammals— which usually starts in September and ends in late March/early April.⁶ *C. serpentina* population is typically lower in numbers in the north and even declining in northern areas due to their tendency to conserve energy in colder climates due to brumation.⁷ Which is important because this study will focus on the *C. serpentina* that exhibit perceived disturbed brumation.

As *C. serpentina* populations show declining trends across the north and northeast, this study was interested in understanding how this species may further be affected by climate change. Many species are experiencing changes in migration patterns and behaviors like brumation as a result of seasonal shift.¹ We sought to understand whether these patterns were evident in snapping turtles. Focusing mainly on New York state due to its geography and historically large *C. serpentina* population. iNaturalist was used to collect this data. iNaturalist is a data collection site where community scientists and users from around the world can submit observations of different living things found in their local community. This data can be used by researchers to understand populations and ranges of various species. The purpose of this study is to find how air temperatures correlate with observations of perceived disturbed hibernation *C. serpentina* during the winter over the course of 5+ years in New York state. By assessing these two variables, we are able to find whether or not temperature correlates with *C. serpentina* observations. Which in turn can further emphasize the effects of climate change.

Methodology

Observations of *C. serpentina* during the brumation period were collected from iNaturalist, and used as a proxy measurement of non-brumating turtles. These observations include all research grade observations ranging from September 2018 to October 2024 in New York state.¹⁰ Data was then analyzed using pivot tables and graphs in Google Sheets and Microsoft Excel. The National Weather Service⁹ was used to gather temperatures of the 5 counties (Onondaga, Tompkins, Westchester, Suffolk, Monroe) with the most observations to create graphs of observations vs temperature. Data was plotted to display trends of turtle observations and mean temperature per month for the 5 years. A separate chart was created for each county.

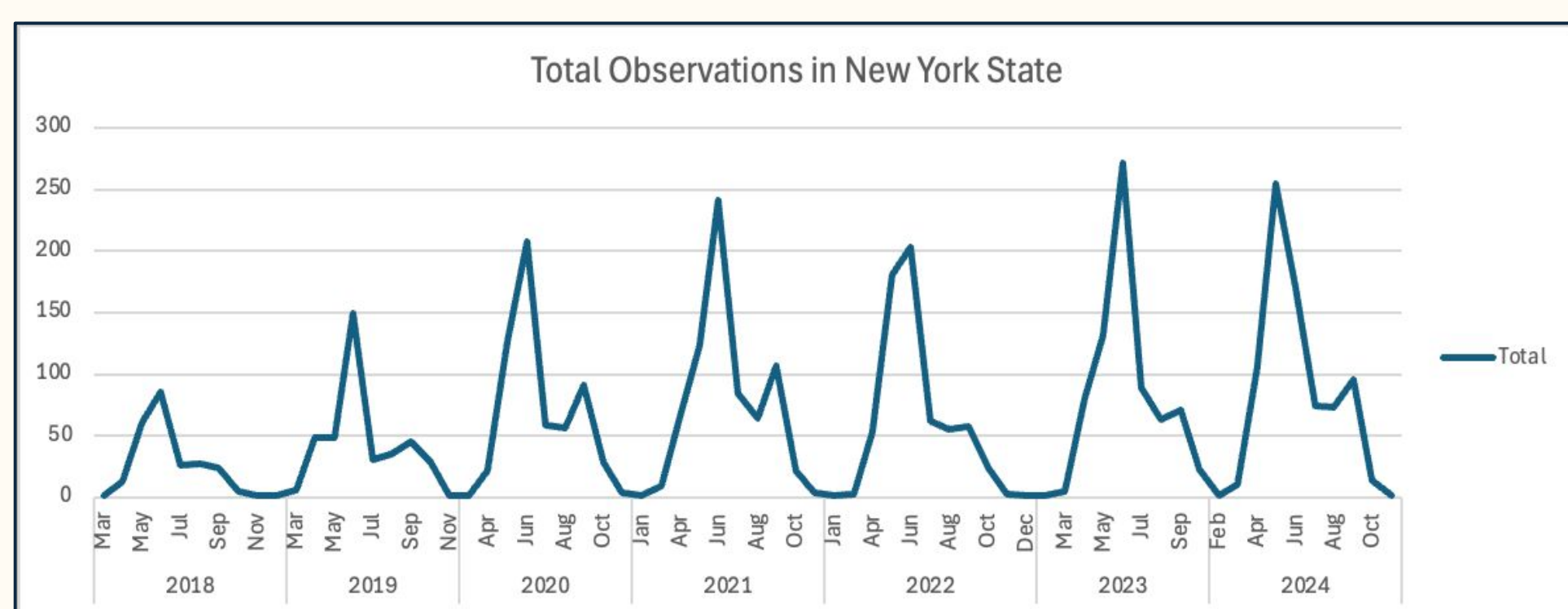


Fig. 1. Graph of the total observations made over 2018-2024

Research Questions & Hypotheses

Research question: How does surface temperature correlate with observations of common snapping turtles during the early to late winter season (September to March) from 2018 to 2024 in New York State?

Hypothesis: Observations of snapping turtles will increase as mean air temperature increase.

Results & Figures

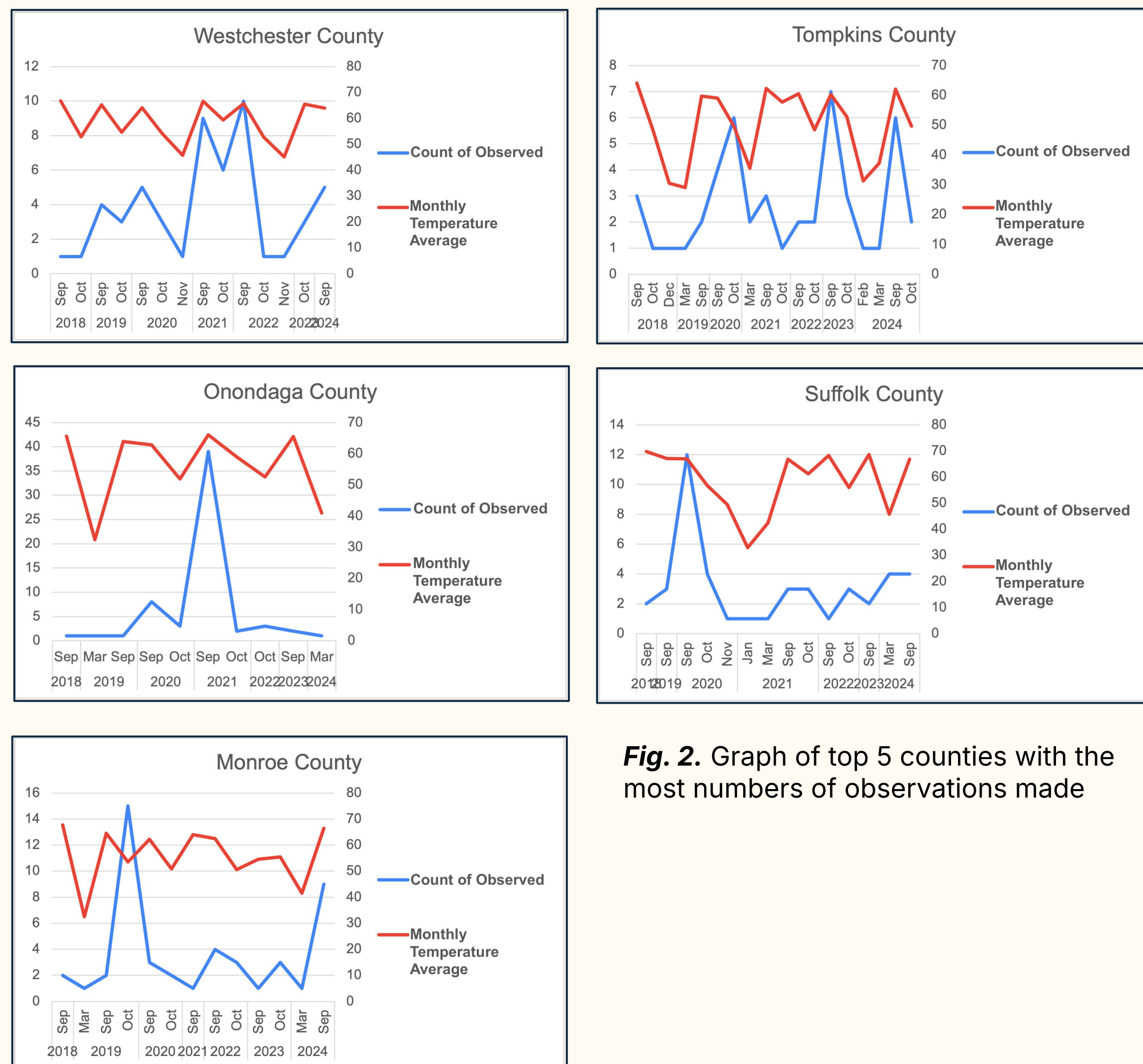


Fig. 2. Graph of top 5 counties with the most numbers of observations made

Results

In this study, a total of 695 observations of *C. serpentina* were analyzed. Observations of turtles were highest during September, where observations are typically 50 - 500% more any other month recorded. Onondaga (61 entries), Westchester (53 entries), Tompkins (48 entries), Monroe (47 entries) and Suffolk (44 entries) Counties had the most snapping turtle observations.

Analysis/Conclusions

The data shows that while temperature did not directly correlate with turtle observations very much, whenever there was a major increase in temperature, there was a major increase in the number of observations recorded. The study showed little correlation thus negating the original hypothesis, observation of *C. serpentina* will positively correlate with surface temperature in the winter in the New York state area.

Discussion

This study attempted to establish a potential correlation between *C. serpentina* observation to temperature throughout the traditionally colder months. Here, it can be said that the study had some flaws that could affect our result/conclusion, possible errors include: the amount of data available was not very abundant and the ones available could have been affected by other factors like people simply not using the application and effects of quarantine in early 2020-2021. Furthermore, iNaturalist and National Weather Service do not cover all data available and can potentially hinder results. Aside from this, due to *C. Serpentina's* role as a bioindicator, finding a relationship between temperature and *C. serpentina* can help create a clearer picture of the effects of climate change and further research is required.

Acknowledgements

I would like to thank Max Falkenberg, Lowell Iporac, and our mentor, Zein Mera, for their guidance, instruction and support throughout the entire research process. I would also like to thank the Wildlife Conservation Society (WCS) for the opportunity to use the Bronx Zoo. Finally, we would like to thank the Pinkerton Foundation for funding and providing resources.

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