

Introduction

Nahant Marsh is home to three frequently observed species of freshwater turtles: Painted turtles (*Chrysemys picta*), which are by far the most common, red-eared sliders (*Trachemys scripta elegans*), and common snapping turtles (*Chelydra serpentina*). During winter brumation, turtles usually experience lower rates of mortality; however, in the winter of 2025, Nahant Marsh staff discovered 453 dead painted turtles and red-eared sliders in and around Carp Lake (a 14-acre former quarry owned by Nahant Marsh) over a course of several weeks. Many of the shells collected were gnawed on or eviscerated, and staff saw river otters handling turtle shells near Carp Lake. Thus, it is hypothesized that predation by local river otters is the cause of this die-off.



Common snapping turtle



Painted turtle



Red-eared slider

Aims of Study

A mortality event of this scope was unprecedented in the region, so the immediate and long term consequences were unknown. The goal of this study is to answer the following questions regarding a population's reaction to this level of loss:

- What percentage of the population was decimated by the mortality event?
- How has species assemblage and population demographics within species changed?
- What are the likely ecological consequences of this mortality event in the coming years?

Methodology

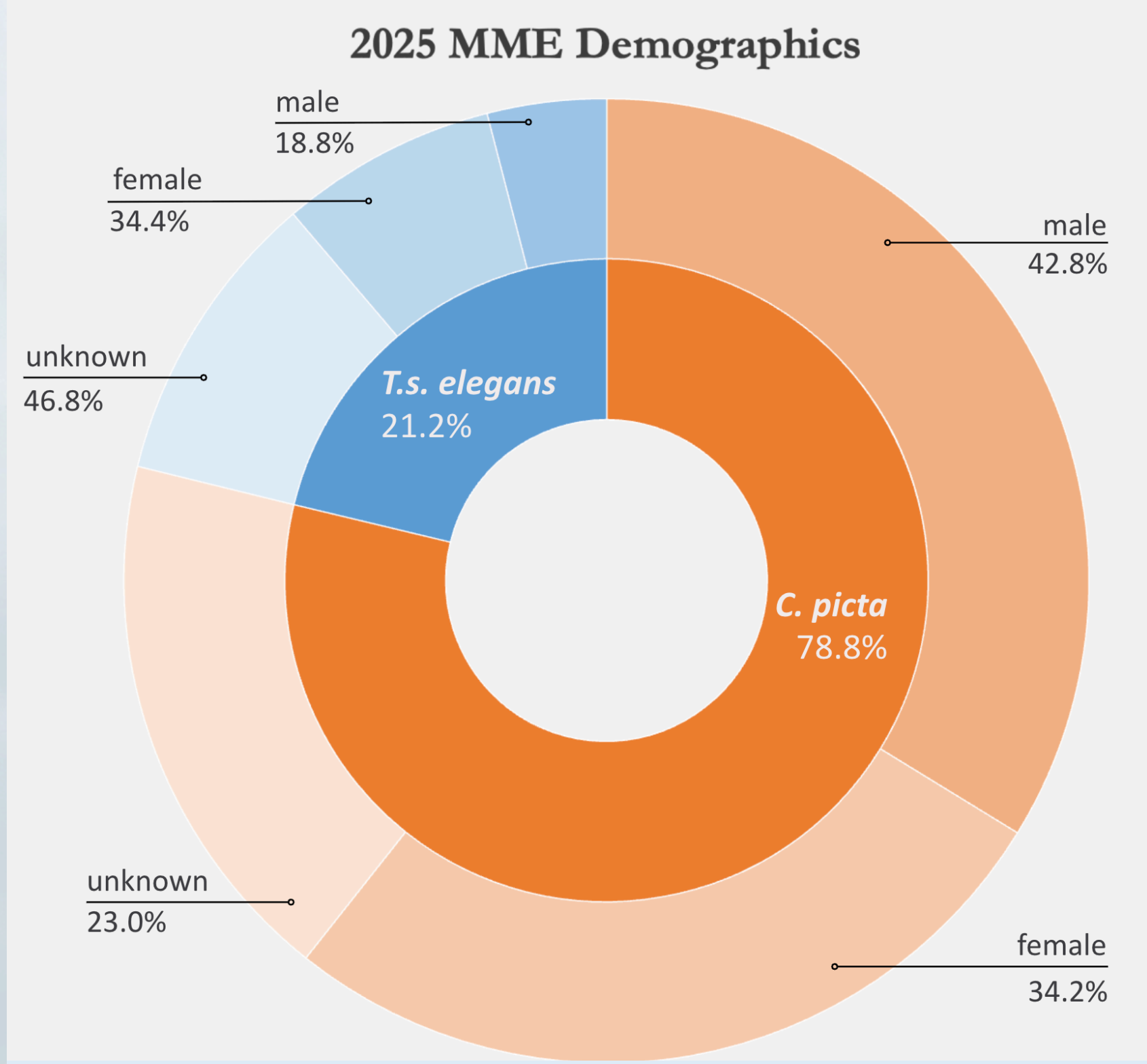
Six hoop net traps were connected in pairs with 50 feet of netting and baited with sardines. For five weeks, traps were deployed in various parts of Carp Lake every Monday and checked every 24-48 hours to ensure turtle safety. The data collected on captured turtles included species identification, carapace and plastron measurements, sex, and recapture status. Turtles that were captured for the first time were marked with a unique hole combination in their marginal scutes for future identification. Turtles were then released to mix back in with the general Carp Lake population. A trapping effort was defined as the six traps being deployed over two nights, and a total of 11 trapping efforts were made over the course of five weeks.



Acknowledgements

Thank you to all the Nahant staff for making research like this possible. A special thanks to Jimmy Wiebler, Mik Holgersson, Hanna Rusk, and Elizabeth VanCamp for all your guidance and work with the turtles!

Results



Between the 11 trapping efforts, we captured a total of 64 uniquely identified turtles, consisting of 4 red-eared sliders (*T.s. elegans*), 28 painted turtles (*C. picta*), and 32 snapping turtles (*C. serpentina*). 22% of the turtles captured were recaptured this summer.

Note: Carp Lake has not been heavily studied in recent years. 2020 and 2023 both had low trapping effort and 29-31 turtles captured in total. The data from 2011 and 2012 is much more robust and should be considered a more accurate estimate of the population demographics.

Fig 1. breaks down the proportion of red-eared sliders (*T.s. elegans*) to painted turtles (*C. picta*) killed in the mass mortality event, as well as their respective sex ratios. A total of 453 turtles (357 painted turtles, 96 red-eared sliders) died. Comparing these numbers to 2025 summer population estimates, we approximate that 94.6% of the red-eared slider population and 85.2% of the painted turtle population at Carp Lake was decimated. A disproportionate amount of red-eared sliders killed were female, which is concerning because their population in Carp Lake and throughout the marsh is relatively small, and a lack of breeding females can inhibit recruitment.

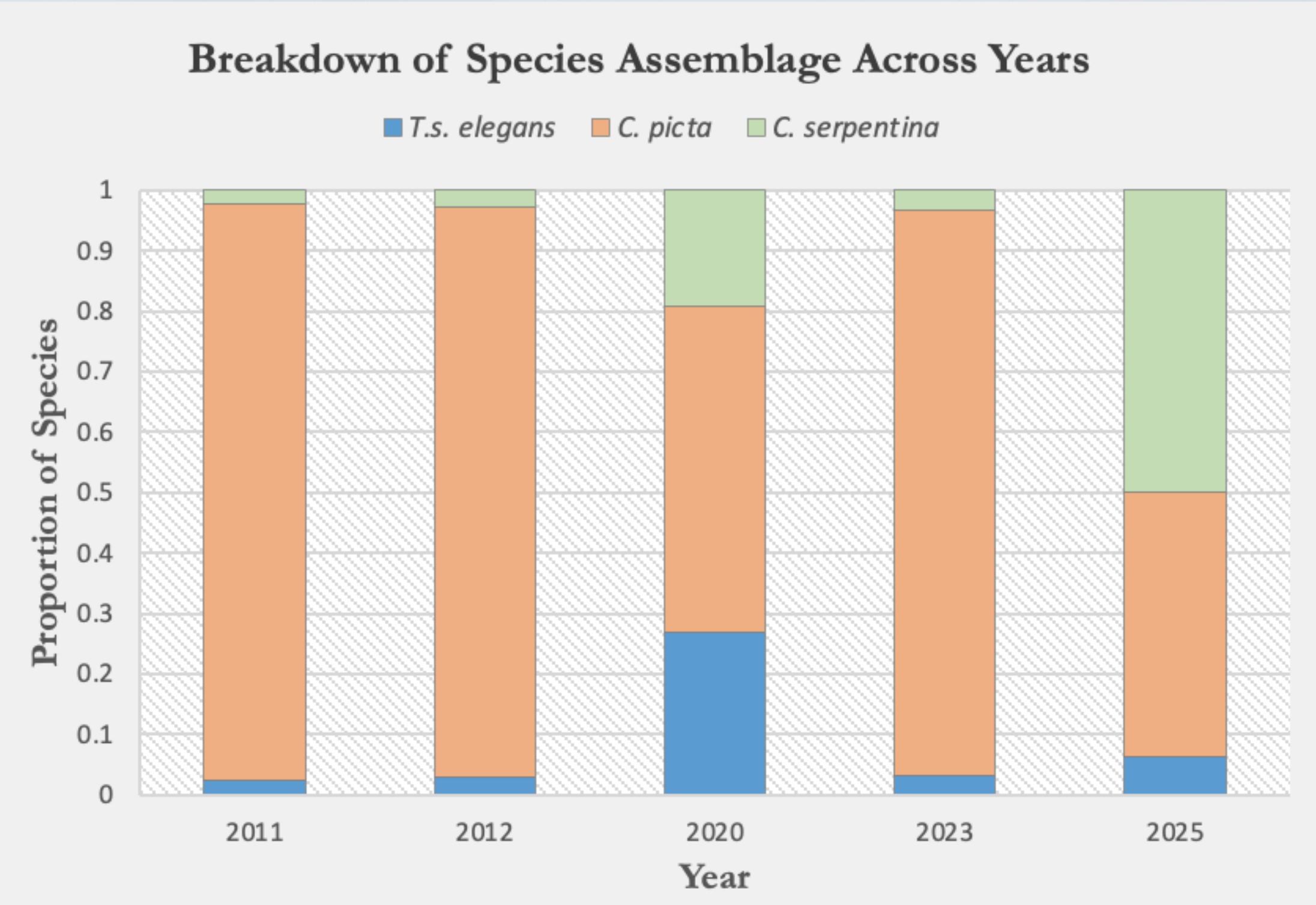


Fig 3. demonstrates how the relative abundance of each species compared with one another across years where traps were set at Carp Lake. Painted turtles represented the overwhelming majority up until 2025, when snapping turtles jumped up to represent 50% of all turtles captured at Carp Lake. This was expected because snapping turtles were unaffected by the mortality event. A chi-square test for the change in species abundance calculated the p-value<0.0001, indicating that the results are statistically significant.

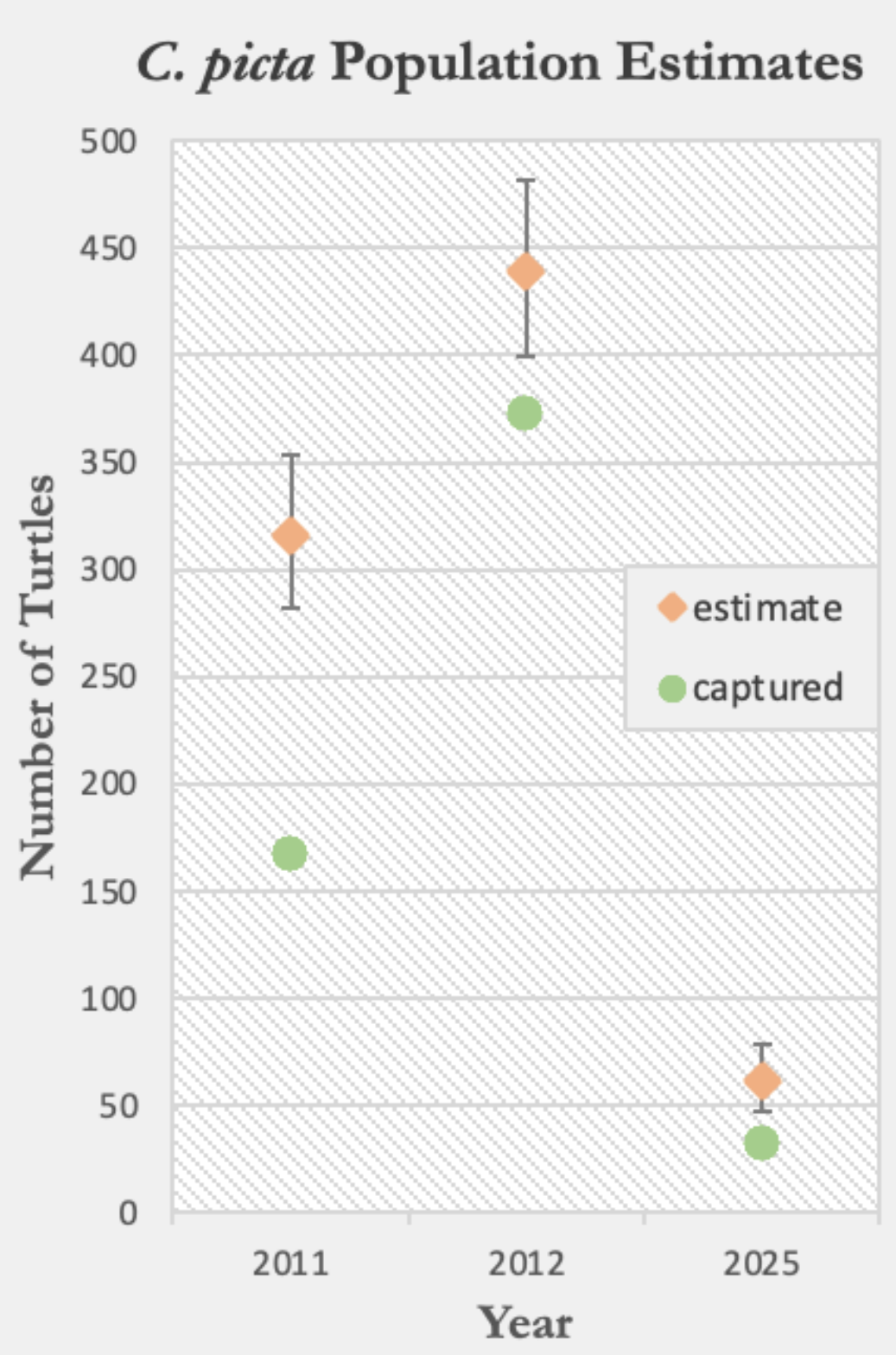


Fig 2. estimates the total population size for painted turtles at Carp Lake with 95% confidence limits and compares that to the actual number of unique turtles captured in a given year. Estimates were calculated using the Schnabel Index, which sums up the new to recapture proportions across all the trapping efforts within a season. Carp Lake previously supported nearly 500 painted turtles, but the current population is probably below 80. This sharp reduction has likely caused a significant loss in genetic diversity, meaning that the remaining population is more susceptible to diseases and environmental changes. Additionally, the chance of inbreeding and resulting birth defects are higher.

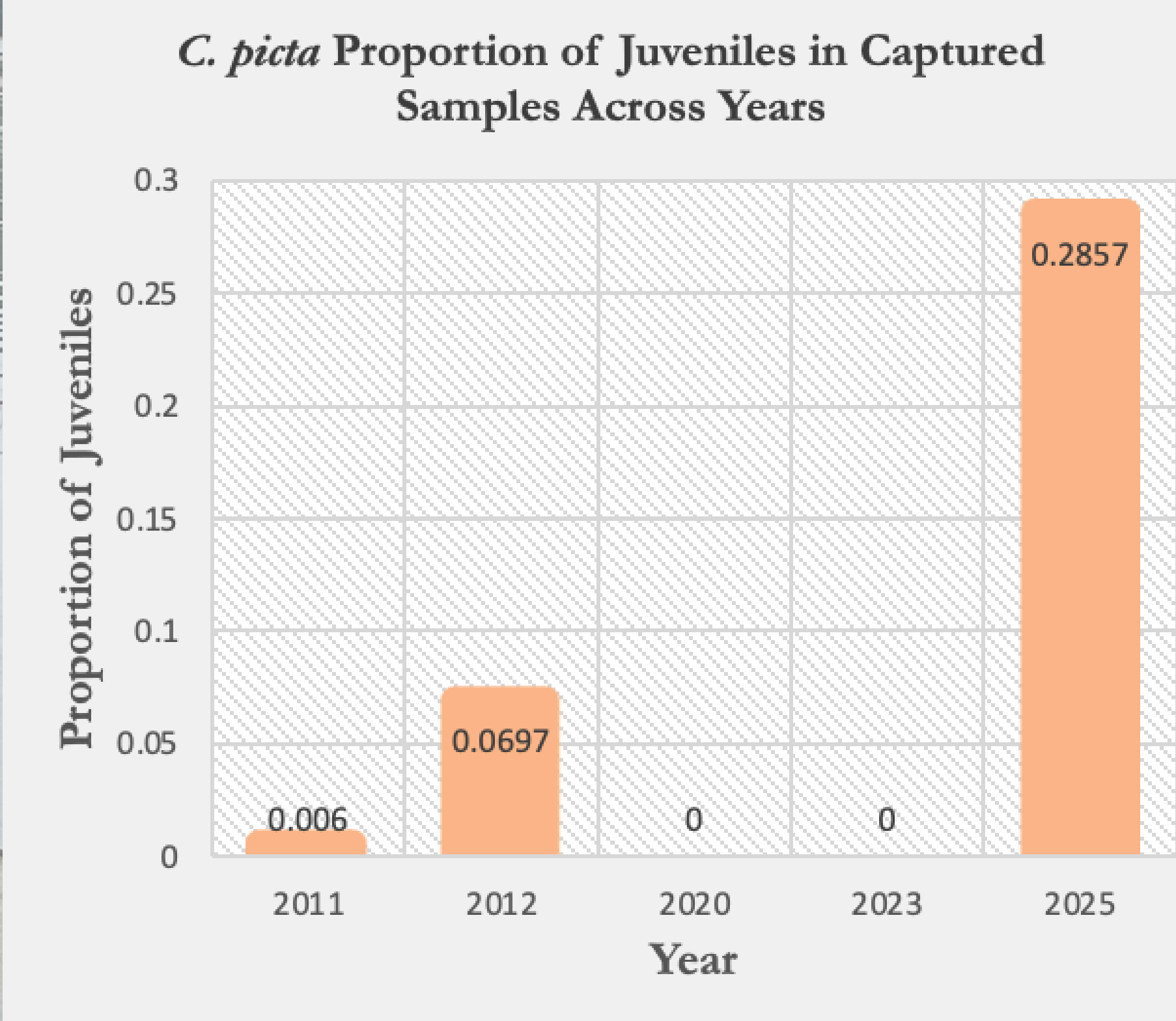


Fig 4. demonstrates the relative proportion of juveniles in the samples of painted turtles captured at Carp Lake. Juveniles were defined as turtles with a carapace length less than 97 mm. The proportion consistently remained between 0-7% across several years before notably increasing to 28.57% in 2025. This can hinder birth rates over the next few years because juveniles cannot yet reproduce. A chi-square test for the change in age structure calculated the p-value<0.0001, indicating that the results are statistically significant.

Conclusion

Future research is needed to reveal the ecological consequences of this die-off in the coming years. I hypothesize two likely outcomes:

- The niche left by painted turtles and red-eared sliders will be filled by snapping turtles, and we will see a steadily increasing proportion of them in Carp Lake over the next several years. Painted turtle recovery will be slowed due to a high proportion of sexually immature individuals. It is unlikely in this case that painted turtles will ever recover to their full numbers at Carp Lake as the population that remains is overall younger, less genetically diverse, and thus more vulnerable to threats. Red-eared slider presence at Carp Lake will likely die out entirely or migrate due to the lack of mating opportunities.
- The niche will be filled by adequate migration of painted turtles from the main marsh. Carp Lake is not a closed system, and two painted turtles have already been documented migrating from the main marsh to Carp Lake this summer. Turtles that migrate may stay at higher rates due to lack of competition and an abundance of resources that previously supported upwards of 500 turtles. Migration would negate the issues of a limited gene pool and a high proportion of sexual immaturity. However, quickly restored numbers could result in repeated mass predation by river otters this coming winter, depleting the population again.

This data can be used to inform the direction of various studies in the future. Researchers could accurately quantify river otter populations to see how the predator and prey fluctuate in relation to one another. It could also be beneficial to protect painted turtle and red-eared slider nests at Carp Lake next season to improve survival rates. It will be important to keep close track of migration rates and any increase in birth defects as a result of inbreeding.