

Background

- Long-term monitoring datasets can reveal trends that may be used to evaluate how marine turtle populations respond to increasing environmental & anthropogenic pressures
- These trends can also provide metrics to assess the success of conservation efforts
- The nesting beaches of Sanibel Island, Florida, USA have been monitored since 1959 to protect the local loggerhead (*Caretta caretta*) nesting population, as well as a growing population of nesting green (*Chelonia mydas*) turtles in more recent years

Study Site

Gulf of Mexico



Objectives

- Nest-monitoring and night-tagging datasets from Sanibel were analyzed to identify trends in reproductive metrics
- These included nest counts and dates of first and last nesting emergences from 1980 to 2023, incubation duration and hatch success from 1998 to 2023, and average size of encountered loggerhead nesting females from 1972 to 1976 to those from 2016 to 2023

Methods

- Trained staff and volunteers collected data on nesting sea turtles along 21 km of nesting habitat on Sanibel FL, USA from 1972 to 2023
- The differences in years represented in the analyses are due to discrepancies in data collection during early years of nest-monitoring, and the first documented green nest on Sanibel was not until 1998
- Dates of first and last nesting emergence were converted to Julian dates
- Incubation duration was defined as the number of days between when the nest was laid and when the nest hatched
- Hatch success was calculated as the # of hatched eggs / total clutch count
- Calipers were used to take straight carapace length (SCL) measurements from nesting female loggerheads during permitted nighttime tagging activities
- R 4.1.3 (R Core Team 2023) was used to perform statistical tests and analyses
- All data were tested for normality (Shapiro-Wilk), and quadratic models, general linear models, t-tests, Spearman's r tests, and Pearson's r tests were used to assess relationships over time

Results – Nest Counts

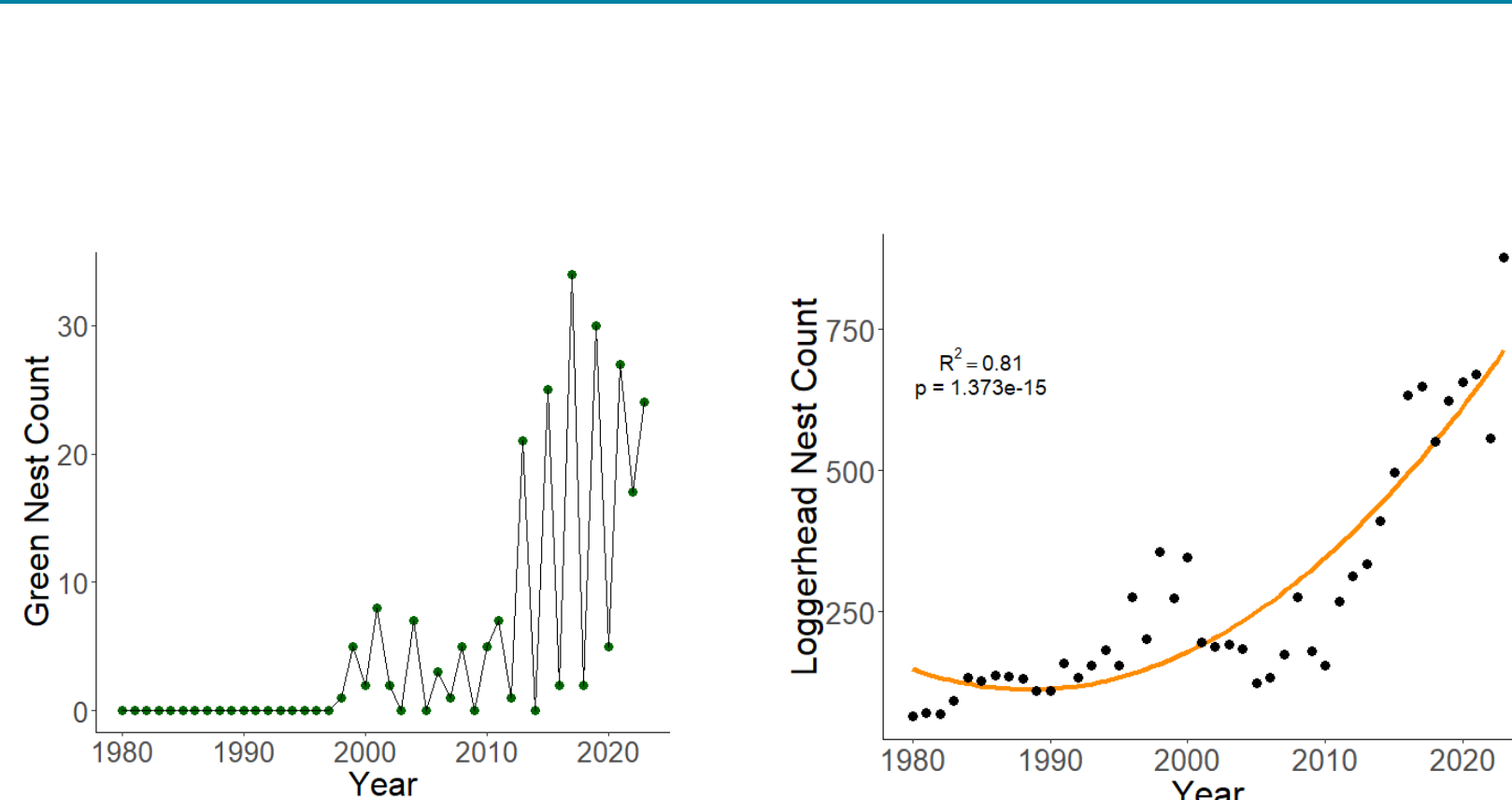


Figure 1. Nest counts for green and loggerhead turtles from 1980 to 2023.

Results – Nest Metrics

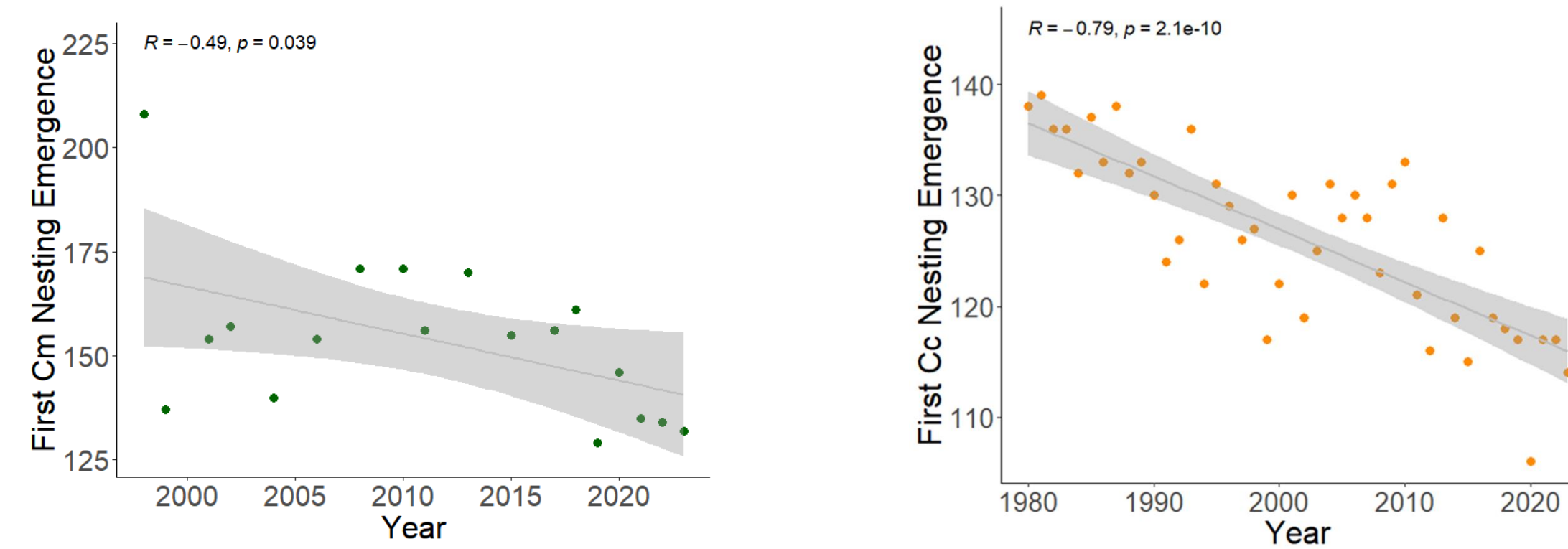


Figure 2. Julian date of first nesting emergence for green (Cm) turtles from 1998 to 2023 and loggerhead (Cc) turtles from 1980 to 2023. The range of Julian dates is 5/9 to 7/27 for green turtles, and 4/19 to 5/19 for loggerhead turtles. Note – there were 4 years where no green nests were laid (2003, 2005, 2009, 2014).

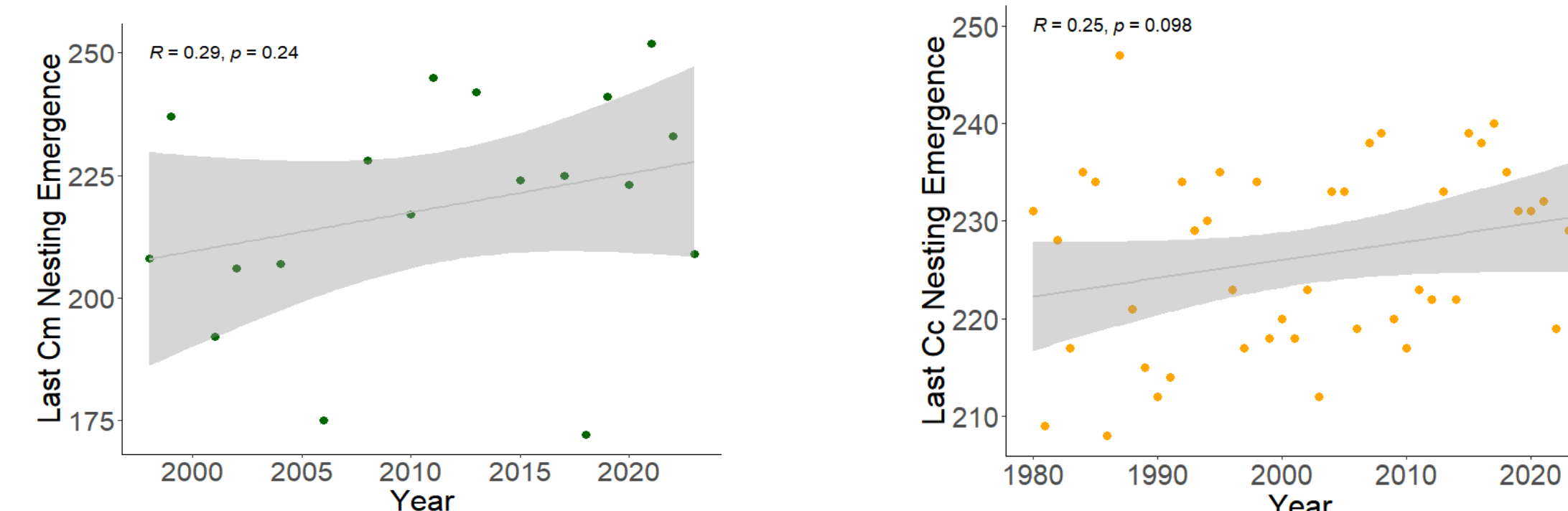


Figure 3. Julian date of last nesting emergence for green (Cm) turtles from 1998 to 2023 and loggerhead (Cc) turtles from 1980 to 2023. The range of Julian dates is 5/28 to 9/9 for green turtles, and 7/27 to 9/4 for loggerhead turtles. Note – there were 4 years where no green nests were laid (2003, 2005, 2009, 2014).

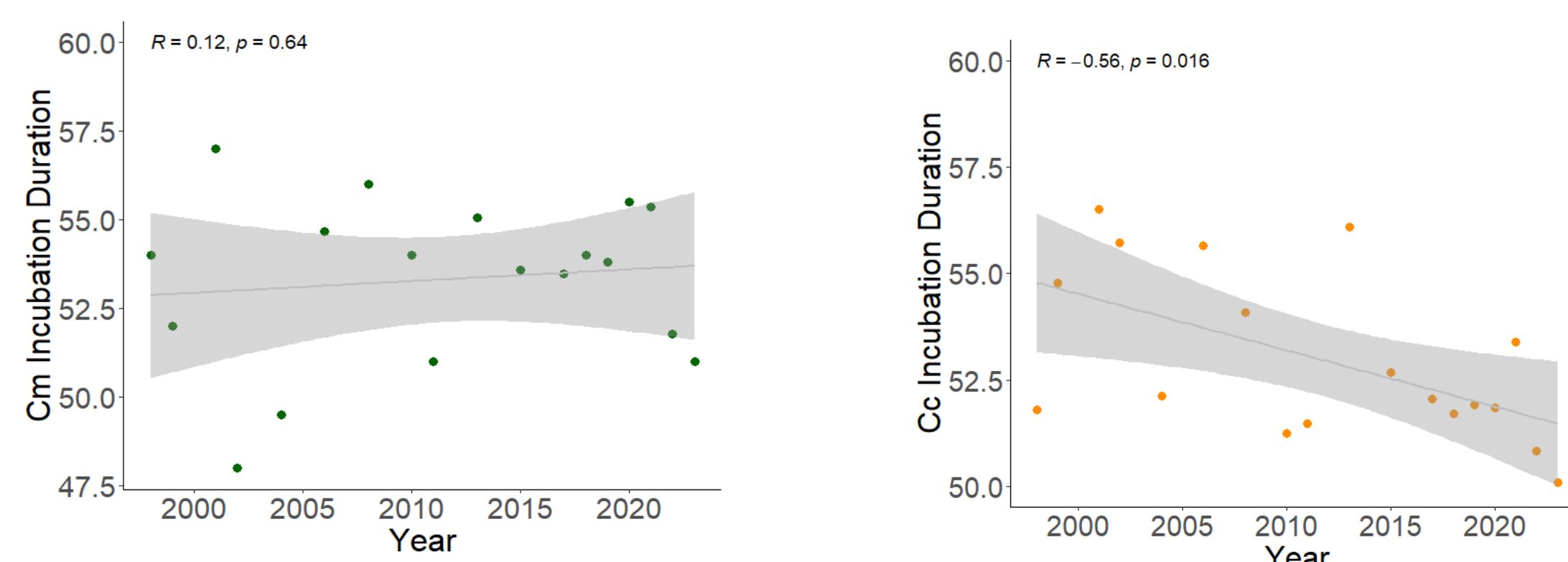


Figure 4. Average incubation duration for green (Cm) and loggerhead (Cc) turtle nests from 1998 to 2023. Note – there were 4 years where no green nests were laid (2003, 2005, 2009, 2014).

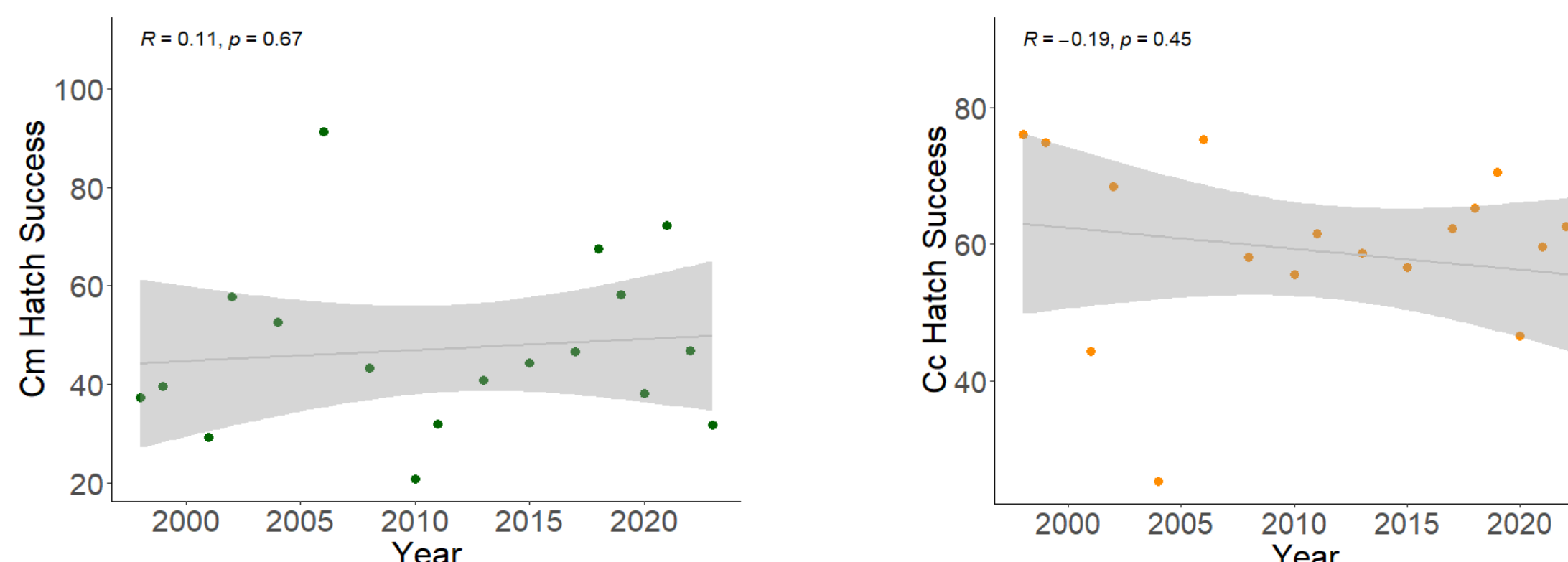


Figure 5. Average hatch success for all green (Cm) loggerhead (Cc) turtle nests from 1998 to 2023. This includes nests that experienced a total depredation or total washout, resulting in a hatch success of 0%. Note – there were 4 years where no green nests were laid (2003, 2005, 2009, 2014).

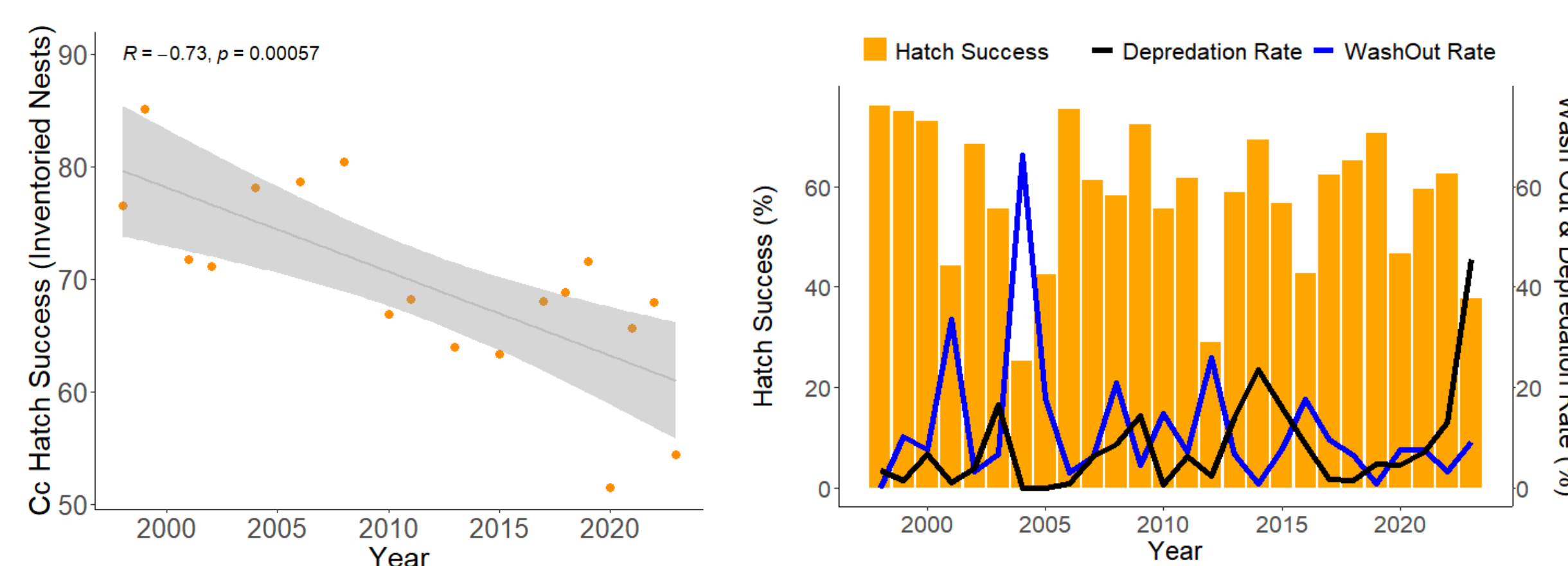


Figure 6. Average hatch success for inventoried loggerhead (Cc) turtle nests from 1998 to 2023. Nests that were completely depredated or washed out are not included.

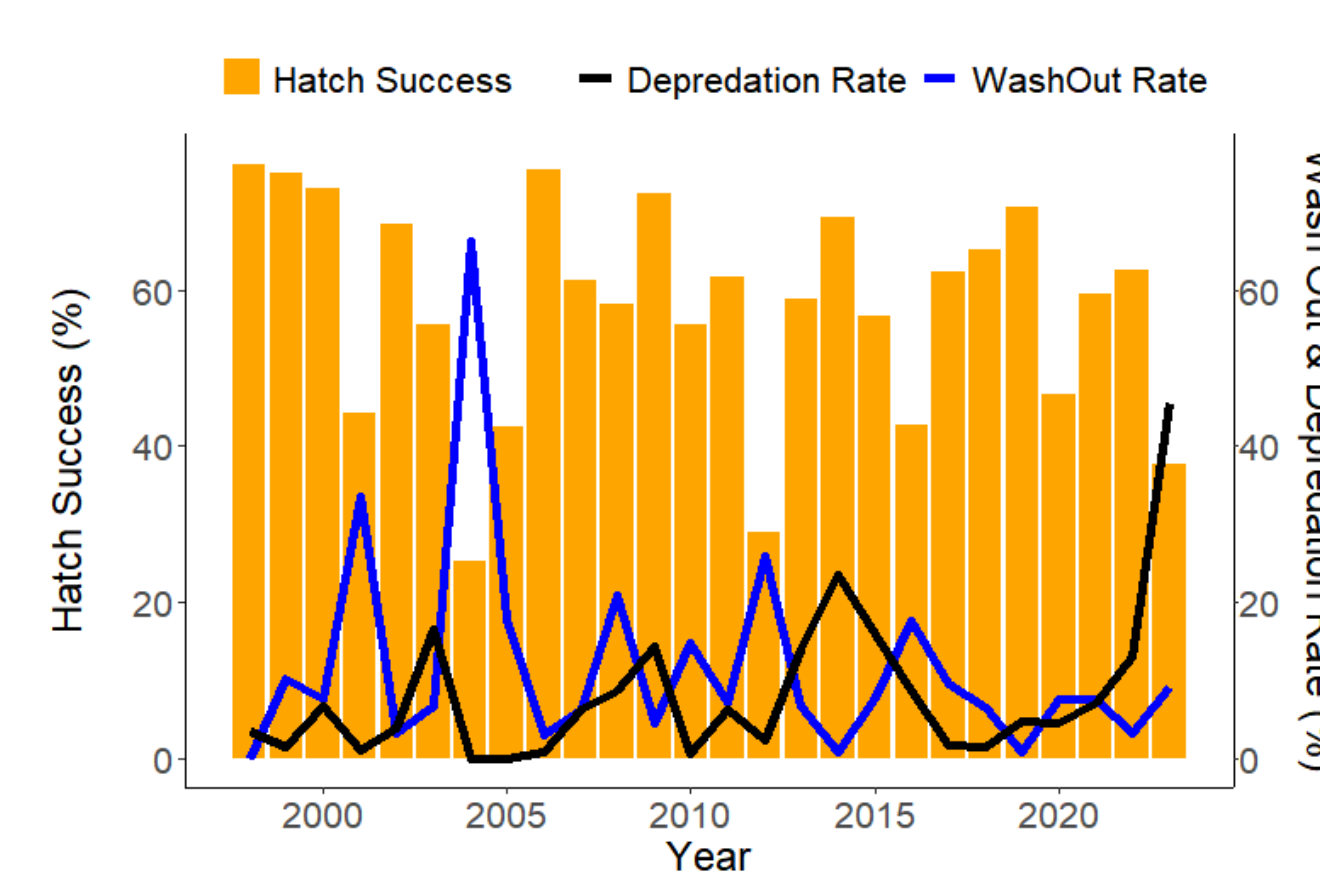


Figure 7. Average hatch success for all loggerhead (Cc) turtle nests from 1998 to 2023, overlaid with the depredation and washout rates (# of affected nests / # of total nests) for each year.

Results – Size of Nesting Loggerheads

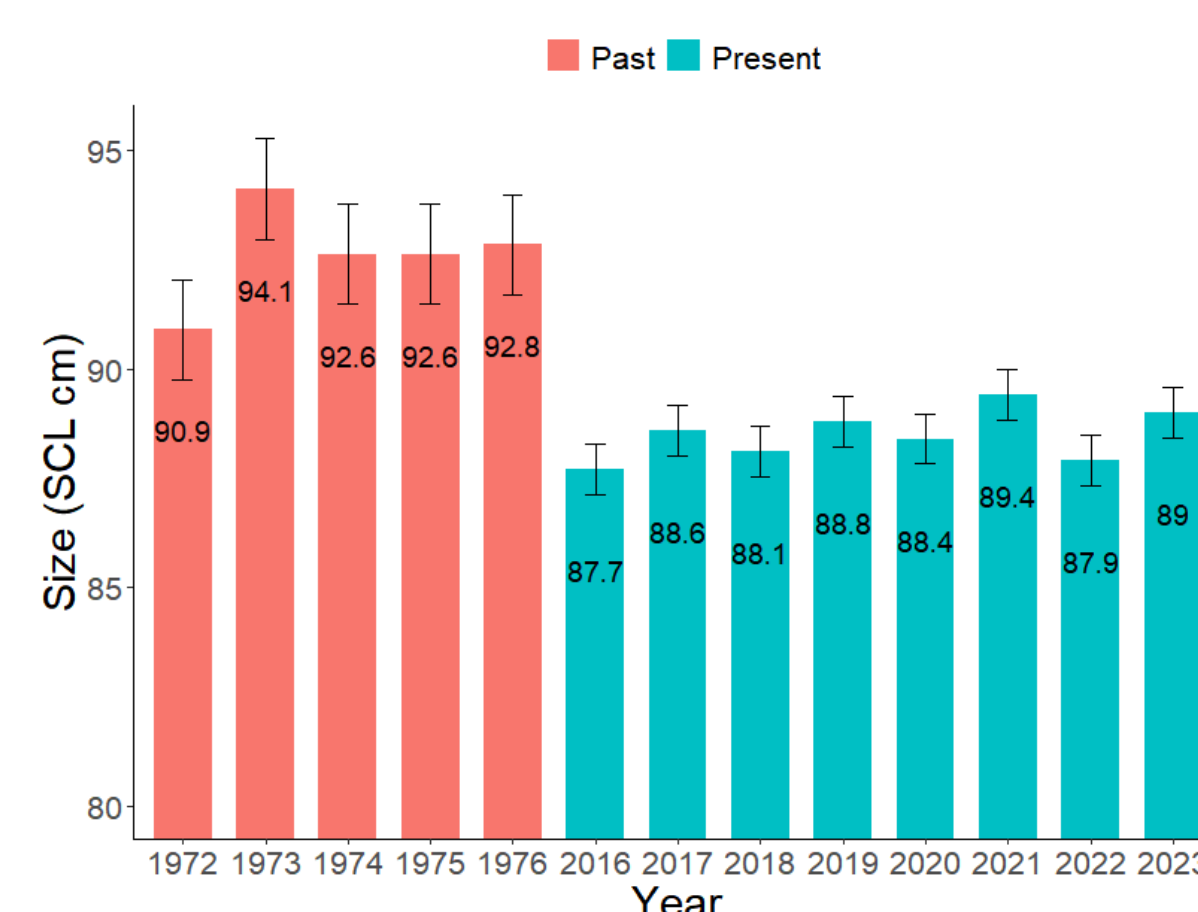


Figure 8. Average size (SCL cm) of loggerhead turtles tagged from 1972 to 1976 (n=116) and 2016 to 2023 (n=1272).

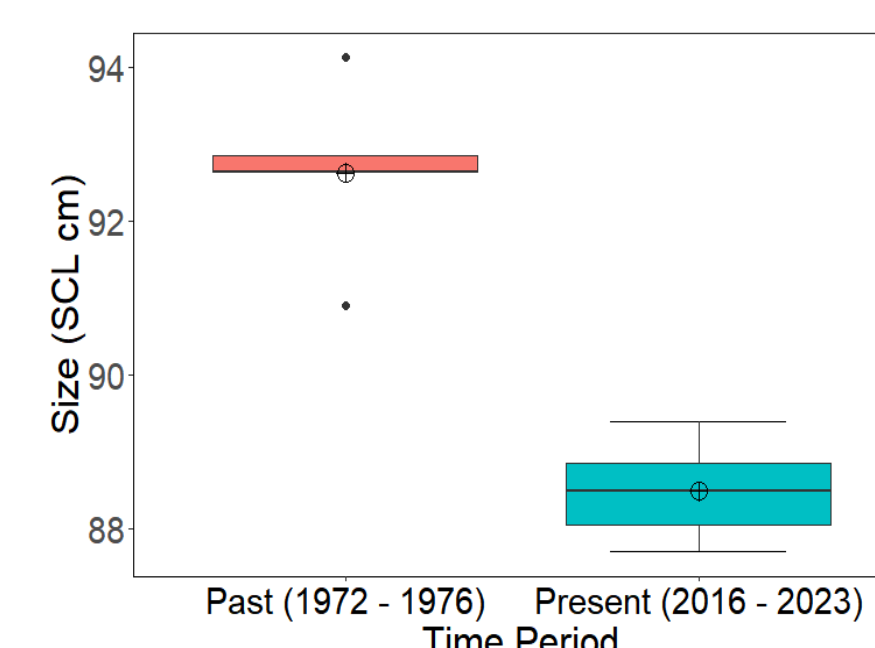


Figure 9. Boxplot to show the difference in average size (SCL cm) of loggerhead turtles tagged from 1972 to 1976 (n=116) and 2016 to 2023 (n=1272). The crossed circle represents the mean, and the black points represent the outliers. The boxes extend to the 25th and 75th percentile, while the lower and upper whiskers extend from the 10th to the 90th percentile.



Figure 10. Using calipers to measure straight carapace length (SCL) from a nesting loggerhead sea turtle

Summary

- Nest counts for loggerhead and greens significantly increased over time
 - Likely a reflection of the effectiveness of conservation efforts
- Date of first nesting emergence for loggerheads & greens shifted significantly earlier in the season
 - May be a result of warmer spring sea surface temperatures, which yield an earlier onset of nesting¹
 - Could also be due to the nesting population increasing and thus lengthening the nesting season
- Date of last nesting emergence for loggerheads and greens did not significantly change over time
 - Could be a result of the nesting population increasing and thus lengthening the nesting season
- Incubation duration for loggerheads decreased over time, no change for greens
 - For loggerheads, this trend could be a result of increased nest temperatures, resulting in shorter incubation periods²
 - For greens, the lack of trend is likely due to the comparatively smaller sample size of green nests
- Loggerhead and green hatch success from all nests did not significantly change over time, though hatch success was impacted by washouts (2001, 2004, 2012) and total depredations (2003, 2009, 2014)
- For inventoried nests (i.e., excluding washouts and total depredations), there was a significant decrease in loggerhead hatch success over time
 - May be a result of threats such as increasing temperatures, partial depredations, brevetoxin exposure, nest accretion, inundation, etc.
- There is a significant difference between the size of nesting loggerhead females from 1972-1976 and 2016-2023 (t=7.50, df=5.29, p<0.001)
 - Could indicate low quality foraging habitats → slower growth rates³
 - Could reflect an influx of new recruits to nesting population³

Conclusions

By bridging the gap between the past and present trends of demographics and reproductive activity, our investigation 1) provides insights into how these species may have been impacted by environmental changes and human-induced impacts, 2) highlights the importance of the continuation of long-term studies, as well as the need for consistent and standardized methodology, and 3) demonstrates evidence of the effectiveness of conservation efforts, which can help promote the protection of endangered species for future generations.

References

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- Philips, K., 2023. Are Sea Turtles Getting Smaller? [WWW Document]. *The State of the World's Sea Turtles | SWOT*.

Acknowledgements

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