

# Impacts of Hydrologic Change and Flooding of the Mississippi River on Riverine Turtle Nesting and Population

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## Background

We are seeing hydrologic alteration in the form of increased flow magnitude, duration, and frequency of the Upper Mississippi River from increased precipitation due to climate change (Lenhart et. Al, 2013). These changes can have negative affects on our aquatic ecosystem, specifically for riverine turtles. There are several species of turtle that are found in the Upper Mississippi River. The most common found at 9-Mile are: *Graptemys geographica*, *Graptemys ouachitensis*, *Graptemys pseudogeographica*, *Apalone mutica*, and *Chelydra serpentina* species. Successful nesting requires river levels to drop during the summer, as most eggs cannot survive more than two days of submergence (Lenhart et. Al, 2013). Riverine turtles are aquatic reptiles that come onto land to create nests to lay their eggs, where the female turtle decides to nest will affect several factors, but mostly the survival of her young. Riverine turtles have specific requirements they look for in a nesting site, and constant disturbance of suitable sites by flooding can impact that spatiotemporal availability.

## Methods

Research was conducted along the 9-Mile Island in Pool 12 of the Upper Mississippi River Wildlife and Fish Refuge. There were several different habitats around 9-mile include backwaters, small channels, and larger Mississippi River Channel.

Potential nesting sites were evaluated through recent satellite imagery and GIS mapping by using these criteria:

- Soil type
- Elevation
- Proximity to water
- Sun exposure

Once sites had been selected, they were then surveyed for:

- turtle tracks
- nest signs
- turtle eggs or shells
- other indicators such as human or animal activity.

GIS data was accessed from the USGS for this project. Topobathy data was used to construct a map of 9-Mile detailing areas covered at each river level by foot, using the gauge values at the Dubuque station. Surveys of randomly selected sites were used to create a classification system that is detailed on the map.

## Abstract

Expected changes being observed on the Upper Mississippi River due to climate changes include hydrologic changes due to increased flow magnitude, duration, and frequency. Among other ramifications, these changes could impact the ability of riverine turtles to nest. The purpose of this study was to model potential impacts of climate change on turtle nesting sites. Field surveys were conducted along the 9-Mile Island in Pool 12 of the Upper Mississippi River Wildlife and Fish Refuge. Sites were categorized based on turtle nesting quality, using several criteria. We used GIS to model the impacts of hydrology changes on the potential nesting sites. Our results found that the primary nesting sites are becoming increasingly vulnerable to increased water flow and hydrologic changes. These changes could lead to detrimental effects for the riverine turtle population on the Upper Mississippi.

## Results

### Classifications

- 1: Unlikely nesting would take place here. If eggs were to be deposited, they would have a low chance of survival.
- 2: Nests could be found here but have a low survival rate.
- 3: Nests found here but the conditions are not ideal.
- 4: Nesting takes place in these areas but there are still 1-2 factors that are not ideal.
- 5: Conditions ideal for nesting, high survival rate.

\*Classification/rating based on proximity to water, type & drainage of soil, vegetation cover, human & animal presence. Presence of nests are also taken into account.



Figure 1. Picture of turtle nest remains.

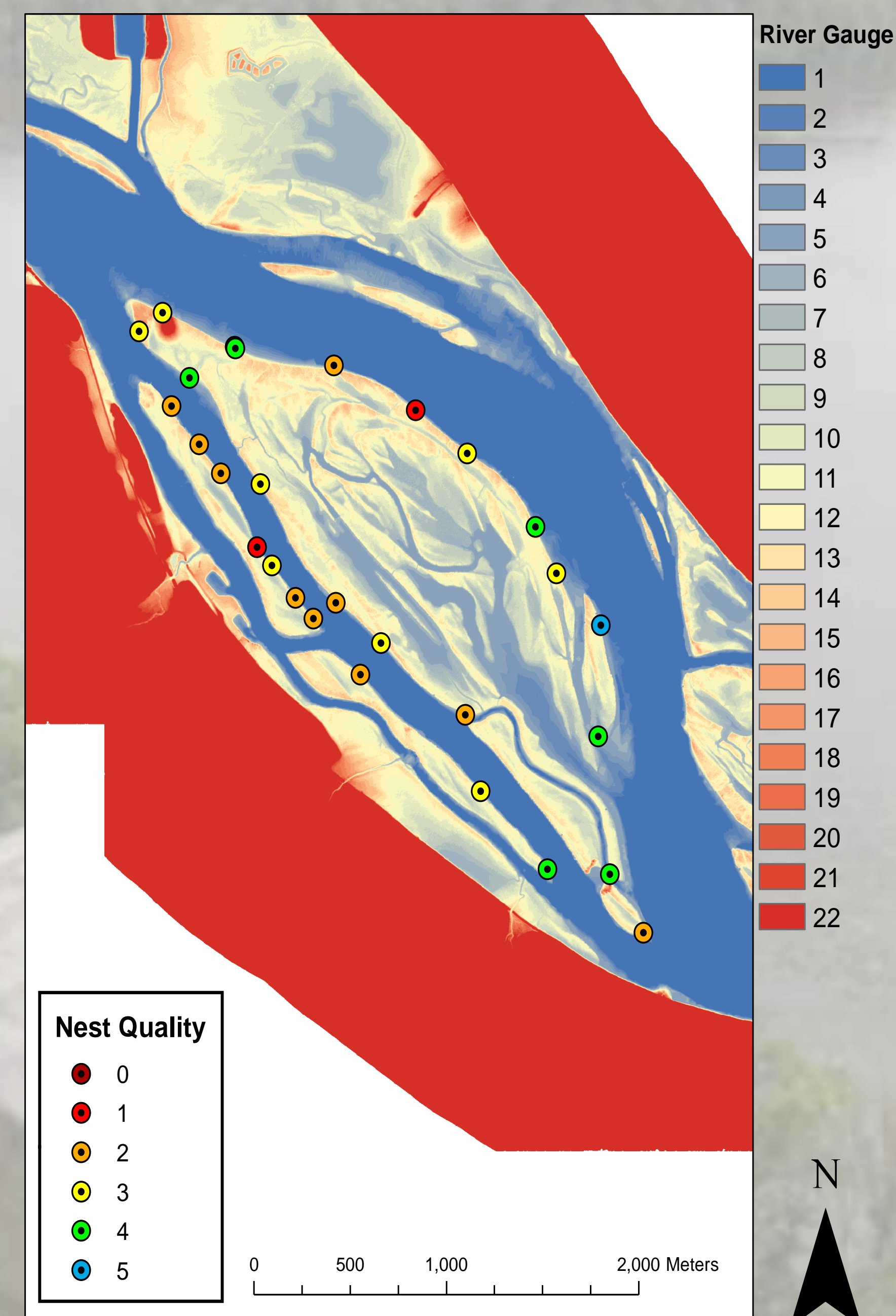


Figure 2. Map of site topography and sample sites. Note that topography here is feet from the Dubuque river gauge and that 17' is flood stage.

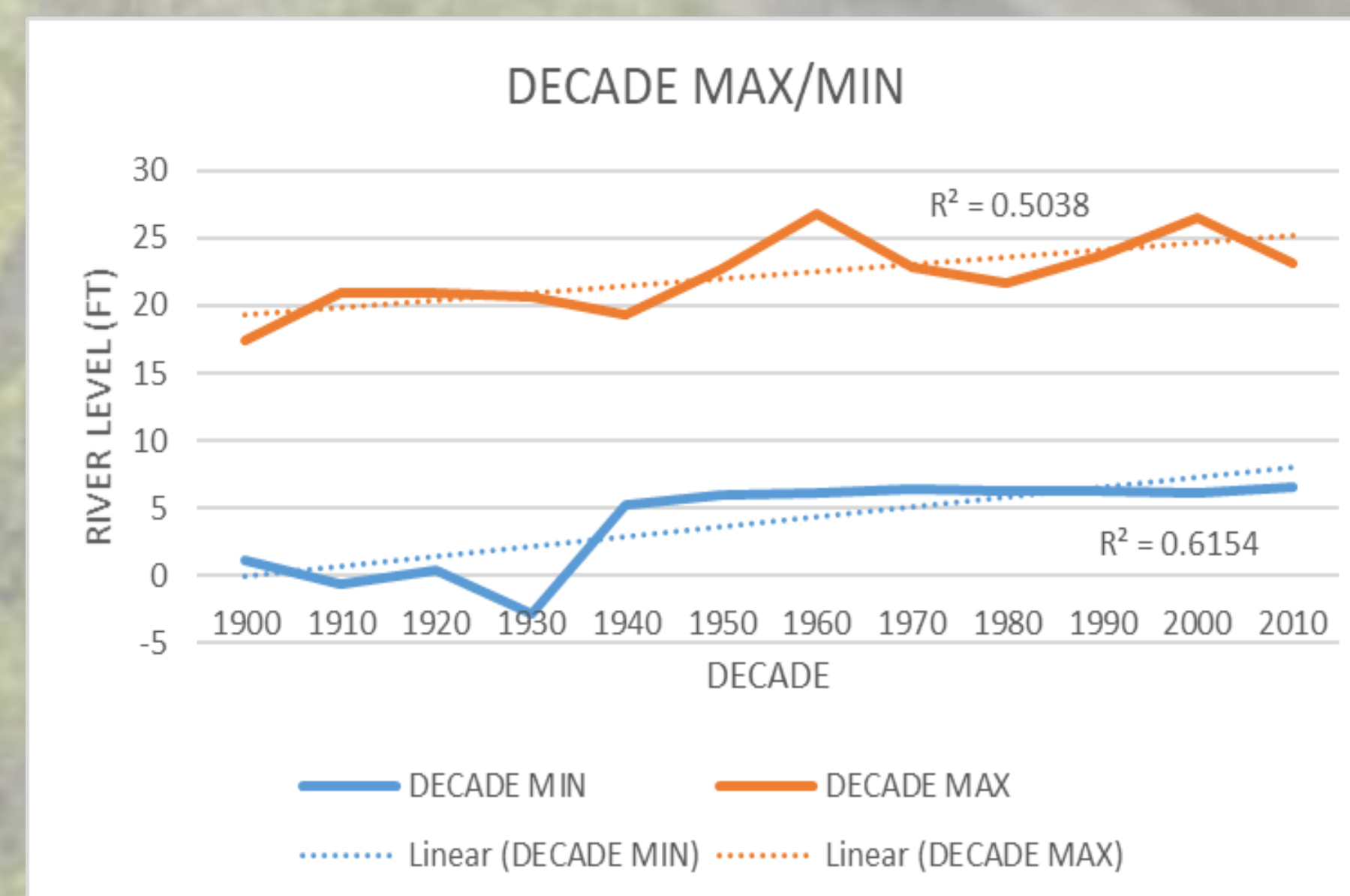


Figure 3. Decadal max and min levels for the river at the Dubuque river gauge.

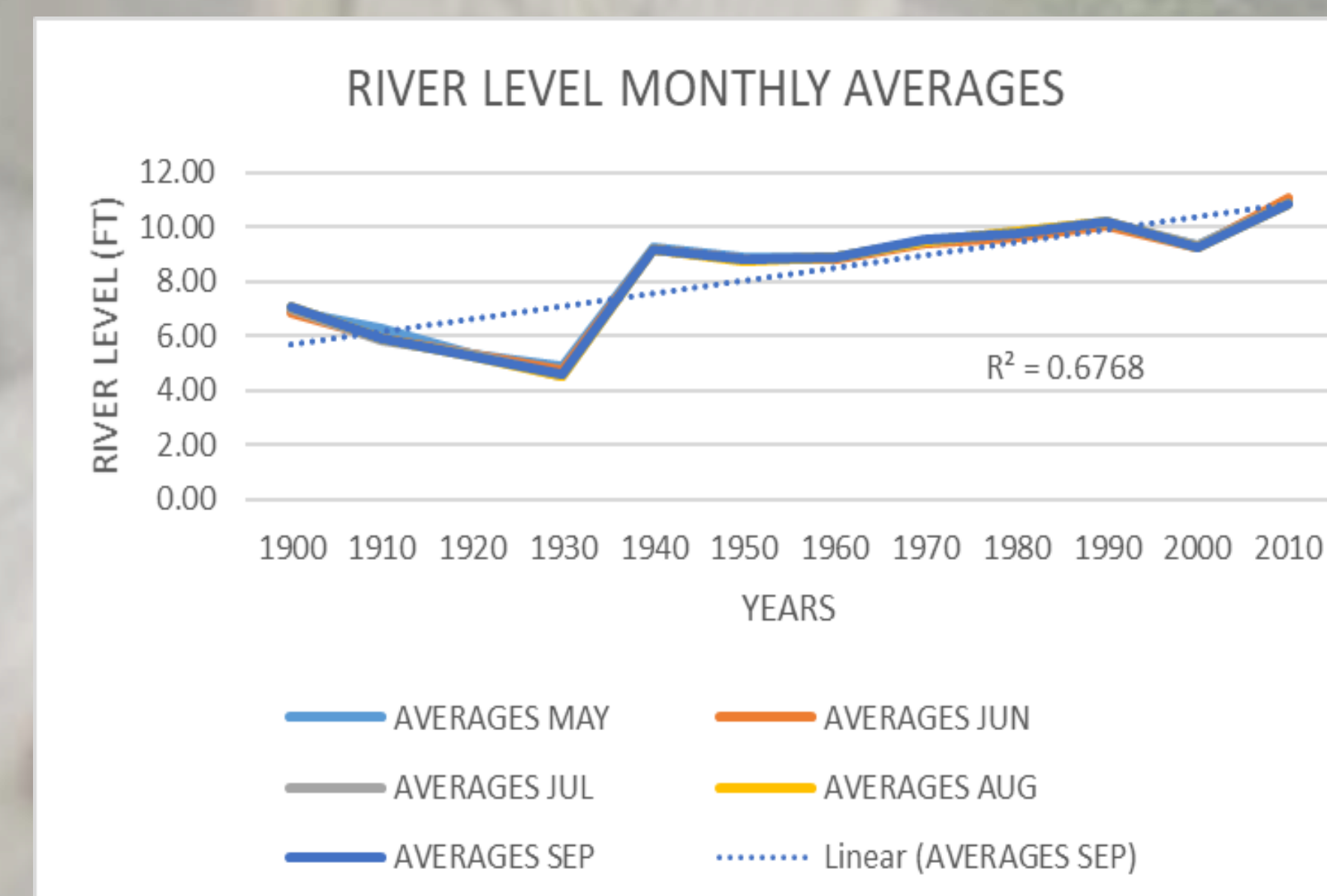


Figure 4. Decadal monthly average river levels for the river at the Dubuque river gauge. May through September are the critical months for turtle nesting.

## Discussion

The result of this research was a GIS map of 9-mile Island that includes both topobathy data, using 17 feet as the flood stage, and surveyed nesting sites. Creating a classification from three months of observations of nesting sites found shows the most suitable areas are. The river levels then show what areas are being covered by water. This map revealed that the primary nesting sites are becoming increasingly vulnerable to increased water flow and hydrologic changes. These changes could lead to detrimental effects for the riverine turtle population on the Upper Mississippi. This disproves our null hypothesis that there is no observed effect on nesting sites due to hydrologic change.

Unfortunately, we were not able to receive a trapping permit for this project due to COVID-19 restrictions. Because of this we were unable to continue long term data collection on riverine turtle populations or identify any changes in populations. Despite this, the GIS map created paints a clear picture of what could happen to turtle populations in the face of anthropogenic climate change.

The river level data was gathered from the USGS. What this shows is the increasing in river levels, specifically during summer nesting months, over the past decades. There has been another increase in just the 2000s. The maximum and minimum river levels have also been rising during the past decades. With river levels steadily rising and increased potential for flood events, this could make nesting even more difficult. Further study needs to be done to evaluate the effect this is having on riverine turtle populations and population dynamics. Not only that, but an evaluation on how this is changing nesting sites along riverbanks in the Upper Mississippi. Climate change, and corresponding increased hydrologic flow, is having a negative effect on riverine turtle nesting which could lead to further effects on the populations. An upset of one species population can affect the entire aquatic ecosystem.

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## References

Lenhart, C. F., Naber, J. R., & Nieber, J. L. (2013). Impacts of hydrologic change on sandbar nesting availability for riverine turtles in eastern minnesota, USA. *Water (Switzerland)*, 5(3), 1243-1261. <https://doi.org/10.3390/w5031243>

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