Texas Coastal Nutrient Input Repository - Task 3 Report

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# Introduction

A substantial proportion of coastal estuaries in the United States face excessive nutrient loading and exhibit symptoms of eutrophication (Bricker et al. 2008). Eutrophication leads to depletion of dissolved oxygen, degradation of habitat (Darby and Turner 2008) and increased risks of harmful algal blooms (Heisler et al. 2008).

There have been limited attempts at assessments of estuarine eutrophication along the Texas coastline. Notably, Bugica et al. (2020) provided evidence of regional eutrophication hot spots attributed to increases in coastal population, urbanization, and alterations of freshwater inflows along the Texas coast and is an important starting point for targeted regional studies. Bugica et al. (2020) assessed three sites in the Lavaca Bay and identified small but significant increases in Total Phosphorus (TP) and Orthophosphate (PO4-3) at two sites, Total Kjeldahl Nitrogen (TKN) at two sites, and chlorophyll-*a* at one site. Importantly, decreases in dissolved oxygen were not detected in the study. While there are indications that potential drivers of eutrophication are increasing in Lavaca Bay, the immediate symptoms of degraded dissolved oxygen are not evident. Significant decreases in pH at all sites assessed by Bugica et al. (2020) in Lavaca Bay also point to long-term decreases in freshwater inflow and a resulting increase in salinity. Long-term declines in the abundance of sensitive benthic fauna in Lavaca Bay have been linked to increases in salinity and reductions in freshwater inflows (Beseres Pollack et al. 2011; Palmer and Montagna 2015; Montagna et al. 2020).

The potential for negative impacts induced by eutrophication is a especially concerning given the significant declines already observed in benthic fauna abundance, biomass, and diversity within Lavaca Bay (Beseres Pollack et al. 2011). Underscoring this concern is the need for data that is adequate for evaluating changes over time in watershed nutrient loading. There is also a need to understand the effects of land management decisions on nutrient loading, relative to environmental drivers such as precipitation and discharge, and how it may contribute to or improve conditions related to eutrophication in Lavaca Bay. This work (1) quantifies Nitrate-Nitrogen (NO3-N) and TP loadings in the Lavaca Bay watershed and (2) assesses the relationship of eutrophication indicators in Lavaca Bay to changes in watershed discharge and loads.

Regression based approaches are commonly used to estimate constituent concentration and fluxes based on continuously measured streamflow and sparsely measured constituent concentrations.  
Most regression-based approaches estimate daily concentration based on modeled relationships between concentration and discharge, season, and time (Cohn et al. 1992; Hirsch et al. 2010).

# Headings

## Second Level Heading

### Third Level Heading

First, second, and third level headings are defined by #, ##, and ### respectively.

# Tables

This is an example of an unformatted table and how we cross-reference that table ([Table](#tab:mtcars) ).

Table . this is the builtin mtcars data.

| mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21.0 | 6 | 160.0 | 110 | 3.90 | 2.620 | 16.46 | 0 | 1 | 4 | 4 |
| 21.0 | 6 | 160.0 | 110 | 3.90 | 2.875 | 17.02 | 0 | 1 | 4 | 4 |
| 22.8 | 4 | 108.0 | 93 | 3.85 | 2.320 | 18.61 | 1 | 1 | 4 | 1 |
| 21.4 | 6 | 258.0 | 110 | 3.08 | 3.215 | 19.44 | 1 | 0 | 3 | 1 |
| 18.7 | 8 | 360.0 | 175 | 3.15 | 3.440 | 17.02 | 0 | 0 | 3 | 2 |
| 18.1 | 6 | 225.0 | 105 | 2.76 | 3.460 | 20.22 | 1 | 0 | 3 | 1 |
| 14.3 | 8 | 360.0 | 245 | 3.21 | 3.570 | 15.84 | 0 | 0 | 3 | 4 |
| 24.4 | 4 | 146.7 | 62 | 3.69 | 3.190 | 20.00 | 1 | 0 | 4 | 2 |
| 22.8 | 4 | 140.8 | 95 | 3.92 | 3.150 | 22.90 | 1 | 0 | 4 | 2 |
| 19.2 | 6 | 167.6 | 123 | 3.92 | 3.440 | 18.30 | 1 | 0 | 4 | 4 |

The [flextable](https://davidgohel.github.io/flextable/) package provides additional formatting flexibility when exporting to Word (Table ).

Table . flextable formatted table.

| mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21.0 | 6 | 160.0 | 110 | 3.90 | 2.620 | 16.46 | 0 | 1 | 4 | 4 |
| 21.0 | 6 | 160.0 | 110 | 3.90 | 2.875 | 17.02 | 0 | 1 | 4 | 4 |
| 22.8 | 4 | 108.0 | 93 | 3.85 | 2.320 | 18.61 | 1 | 1 | 4 | 1 |
| 21.4 | 6 | 258.0 | 110 | 3.08 | 3.215 | 19.44 | 1 | 0 | 3 | 1 |
| 18.7 | 8 | 360.0 | 175 | 3.15 | 3.440 | 17.02 | 0 | 0 | 3 | 2 |
| 18.1 | 6 | 225.0 | 105 | 2.76 | 3.460 | 20.22 | 1 | 0 | 3 | 1 |
| 14.3 | 8 | 360.0 | 245 | 3.21 | 3.570 | 15.84 | 0 | 0 | 3 | 4 |
| 24.4 | 4 | 146.7 | 62 | 3.69 | 3.190 | 20.00 | 1 | 0 | 4 | 2 |
| 22.8 | 4 | 140.8 | 95 | 3.92 | 3.150 | 22.90 | 1 | 0 | 4 | 2 |
| 19.2 | 6 | 167.6 | 123 | 3.92 | 3.440 | 18.30 | 1 | 0 | 4 | 4 |

# Figures

We can embed and cross-reference plots (Figure ).

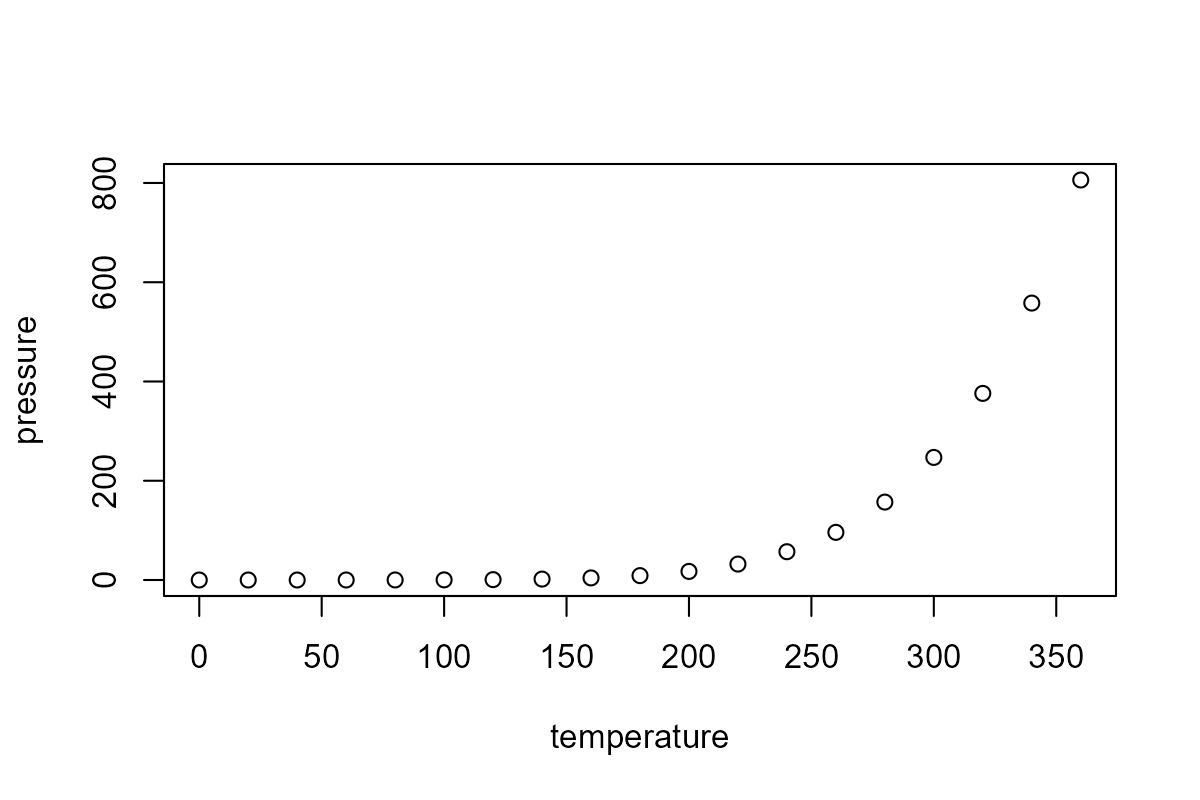


Figure . pressure dataset

# Landscape Section

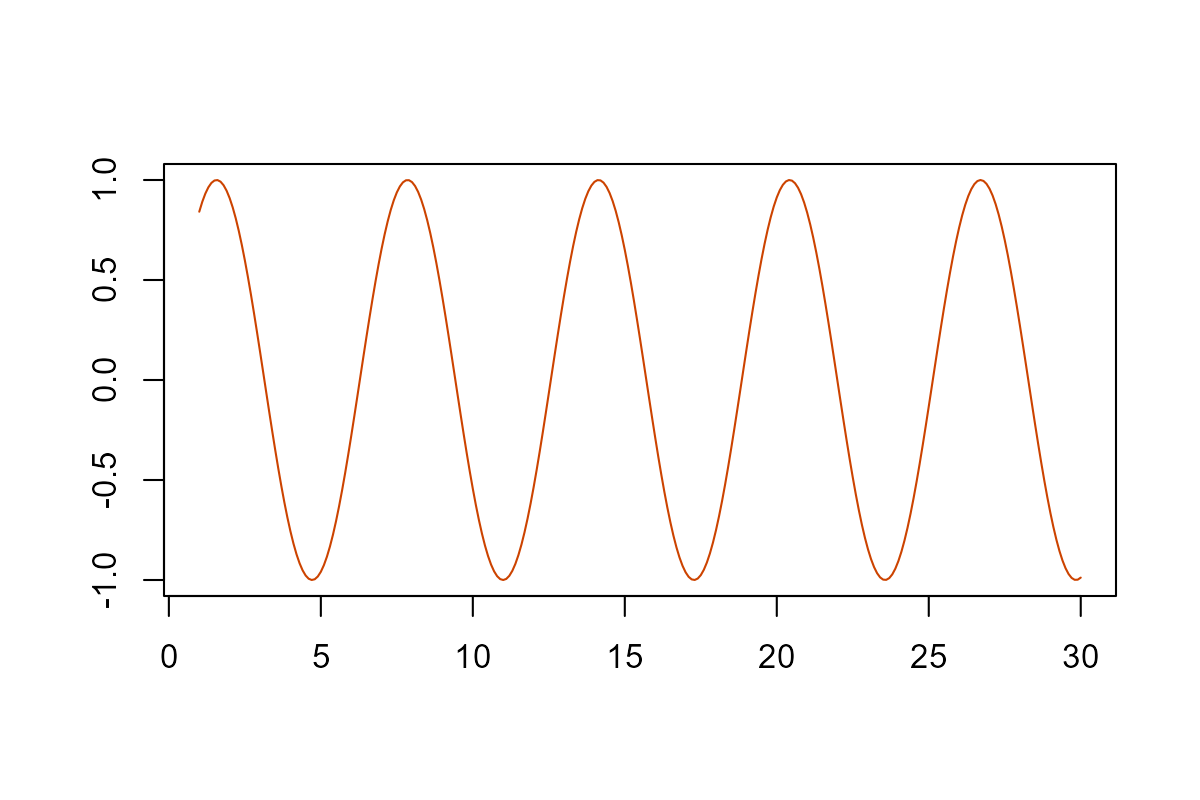


Figure . sin function

# Math

Wrap variables or math in a single $ to show math inline. For example, . Standalone equations are wrapped with $$.

If the equations need to be numbered and cross-referenced the format as:

\begin{equation}  
\left(\prod\_{i=1}^{n}y\_i\right)^{\frac{1}{n}} = \exp\left[\frac{1}{n}\sum\_{i=1}^n\log{y\_i}\right], \quad \textrm{when} \quad y\_1, y\_2, ..., y\_n > 0  
(\#eq:gmean)  
\end{equation}

Which renders as (Equation @ref(eq:gmean):

# References

In-text references and bibliography generation are handled automatically. It relies on creating a bibtex .bib file with your references. Software such as Zotero, Mendely, and even Google Scholar can generate the bibtex entries for you. The entries are stored in the bibliography.bib file inside the same directory as this .Rmd file. To make a in text citation, use the following syntax, [@helsel\_statistical\_2002] to generate the reference at the end of this sentence (**helsel\_statistical\_2002?**). Use a semicolon to include multiple references [@helsel\_statistical\_2002; @hirsch2010weighted] (**helsel\_statistical\_2002?**; **hirsch2010weighted?**). Or we might use @helsel\_statistical\_2002 without brackets to indicate (**helsel\_statistical\_2002?**) provide a fundamental overview of water quality statistics. The bibliography will populate automatically.

# Styling and fonts

This template uses Minion Pro for body fonts and Open Sans for headings following TWRI brand guidance and AgriLife brand guidance. I can’t bundle Minion Pro in this package because of licensing, but you can download and install both fonts from AgriLife (<https://agrilife.tamu.edu/wp-content/uploads/2021/03/AgriFonts.zip>). I recommend downloading and installing the fonts before knitting your documents. Note that Minion Pro won’t “embed” in Word documents because it is an OTF style font and currently Word only embeds TTF fonts. That means collaborators without the font installed on their system will see a different serif font on their system in Word. Once exported to pdf, both OTF and TTF fonts should be embedded correctly.

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# Appendix A

You can add more info, tables, and figures here.