

# Comparison of ecosystem services provided by *Phragmites australis* vs native plant species via meta-analysis.

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## Introduction

*Phragmites australis*, is commonly considered an invasive species in North America, but there are at least two lineages of the reed, an invasive lineage common to Europe and Asia (*Phragmites australis* subsp. *australis*) and a non-invasive native lineage in North America (*Phragmites australis* subsp. *americanus*). Our meta-analysis focuses on the invasive lineage that is often eradicated through herbicides, burning, and other methods. It is commonly found in brackish wetlands, but is known to thrive in saltwater and freshwater wetlands as well. The main concern with *P. australis* is that it hordes nutrients and space, taking away from other plants and wildlife. Many people dislike *P. australis* because it blocks access to water for recreational activities or simply because they find it ugly to look at. Acknowledging “negative” attributes, we must also understand that *P. australis* can also have positive ecosystems services, e.g. it may be better at keeping pace with sea level rise and heavy metal runoff from industrial waste. Our meta-analysis compared the ecosystem services between invasive *P. australis* and the native reed to the area of study in order to determine if there are in fact instances where invasive *Phragmites australis* is beneficial in combating industrialization and climate change.

## Methods

This project was begun by establishing the protocol that would be used to search for papers in Web of Science and screen the papers located in the search. This was a collaborative effort by the authors, and two other biologists; Judith Weis and Erik Kiviat. This protocol determined the 66 search term combinations that were used in Web of Science to find the 798 initial papers. The search terms included the combination of either *Phragmites*, *Spartina*, X or *Phragmites*, Native, X. X being one of the following:

- “Nutrient uptake”
- “Metal sequestration”
- Bird
- avian
- Fish
- nekton
- Invertebrates
- Animal
- Habitat
- GPP
- “Gross Primary Production”
- “Ecosystem service”
- Wildlife
- “Carbon storage”
- Soil
- “Blue Carbon”
- “Surface elevation”
- Accretion
- SET
- “Wave attenuation”
- Erosion
- “Aboveground biomass”
- “Belowground biomass”

The abstracts of these 798 papers were then subjected to an initial screening. Of the 798, 462 adhered to the criteria that the study must be conducted in North America and included *Phragmites*. We recorded if and why papers failed the screening, to eliminate bias. In the second screening, we accessed and read the papers resulting in 269 papers that adhered to the criteria that the study must be done in North America, include *Phragmites*, include a native reference, and be conducted in a tidal system. Currently screening 3 and data extraction is being done on those 269 papers. Thus far about half have been eliminated based on the fact that there was not enough data to extract. In our final steps, we will use the R programming language with specifically designed models to analyze the extracted data.

## Abstract

This project explored the ecosystem services of the invasive common reed, *Phragmites australis*, in comparison with native plant communities in tidal wetlands. This involved a thorough literature review using specific search criteria, screening papers using tracktable methodology, and extracting data from papers or corresponding authors. Currently we have begun extracting data from the 269 papers that passed final screening. Our next step this fall will be analyzing the data in R.

## Results

### Screening 1

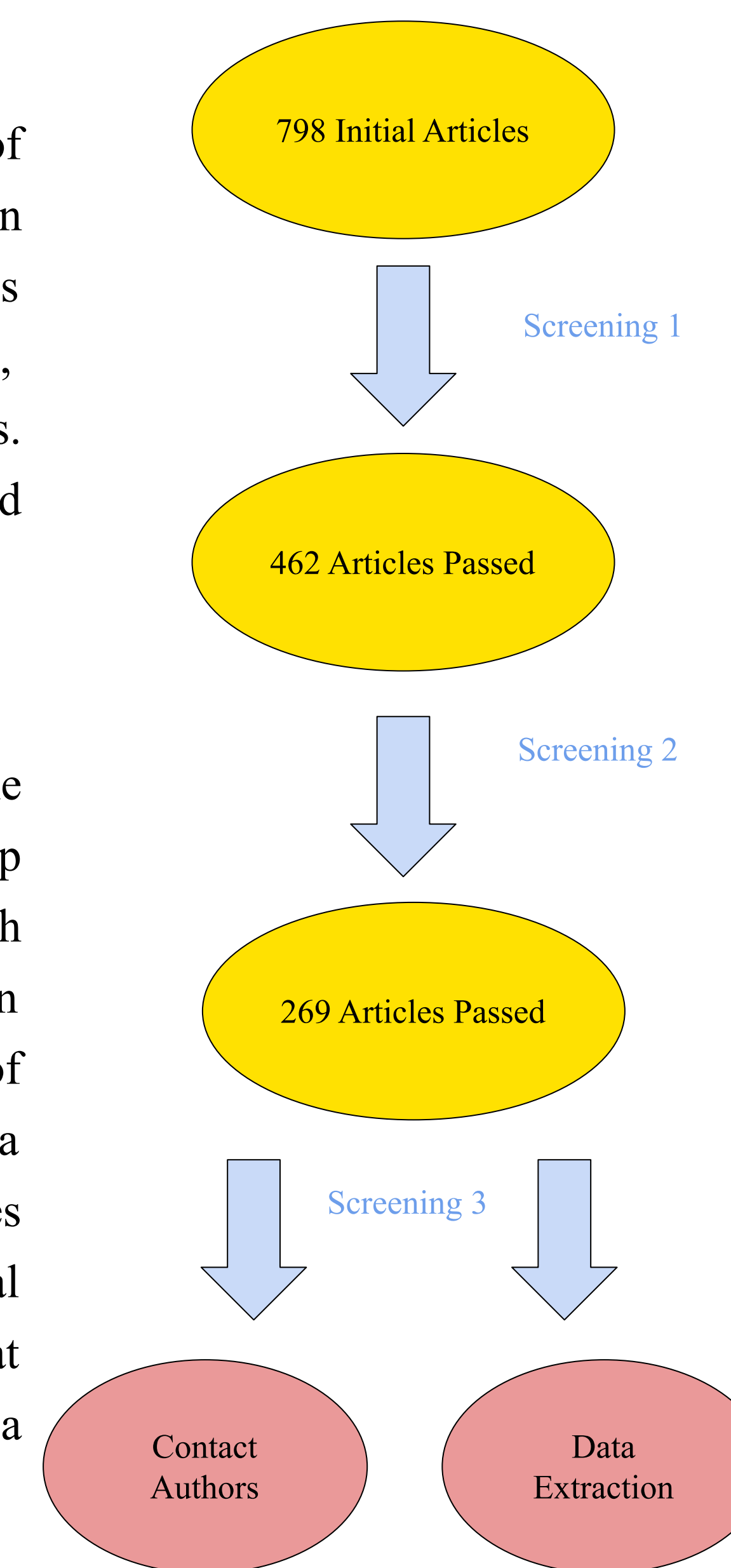
Our first screening included reading titles and abstracts of every paper that showed up using our search words (798 in total) to see if it included North America and *Phragmites australis*. This left 462 at the end of the screening, including papers that did not specify location or species. Most papers were excluded because they were conducted in Europe or Asia.

### Screening 2

The second screening of the 462 reiterated the requirements for screening one, as some studies ended up being conducted in multiple places or using the North American strand but in a different country. Studies in different languages or conducted in countries outside of North America were excluded. Screening 2 also required a native reference that was compared to the *Phragmites australis*. The study also needed to be conducted in a tidal marsh system. After screening 2 there were 269 papers that passed. Most papers were excluded for not containing a native reference.

### Screening 3

Screening 3 was done at the same time as data extraction, and most papers were excluded for not having data for ecosystem services, not having consistent study sites, or not having comparable data for their native reference. Many papers did not report their data in numerical form, and corresponding authors were contacted for this data. In some instances the authors no longer had the data (when studies were over 15 years old), and then the study was excluded, despite it being a viable paper otherwise. Screening 3 is still underway along with data extraction.



## References

- Kiviat, E. (2013). Ecosystem services of *Phragmites* in North America with emphasis on habitat functions. *AoB Plants*, 5(0). doi:10.1093/aobpla/plt008
- Mary Bohling, M. (2018, September 25). Invasive *Phragmites australis*: What is it and why is it a problem? Retrieved August 30, 2020, from [https://www.canr.msu.edu/news/invasive\\_phragmites\\_australis\\_what\\_is\\_it\\_and\\_why\\_is\\_it\\_a\\_problem](https://www.canr.msu.edu/news/invasive_phragmites_australis_what_is_it_and_why_is_it_a_problem)

## Acknowledgments

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## Discussion and Future Work

Collaboration with other biologists and authors has been immensely important on this project. They have been critical for data extraction, developing the protocol, and other important steps that have led the project to the point where it is now. The preliminary two screenings that were done of the initial 798 papers were broader than the third and final screening for data extraction in order to prevent papers from being eliminated that could be useful, but had vague abstracts or methods, as these were the main sections read in screening one and two. Of the 269 papers that have passed two of the three screenings, it is expected that about half (135) will pass screening three and have their data extracted. This is a large amount of papers for a meta-analysis, which is significant because there will be a lot of data to extract. Currently, screening three is taking place along with data extraction of the papers that have passed thus far. Authors are being contacted on an ongoing basis in order to retrieve data that is contained in papers, but cannot be extracted because it is in the form of a figure. Moving forward, the data that is currently being extracted and stored in excel will be fed into R and analyzed using unique models that are fitted to the data. Once this analysis is complete, the hypothesis of if there are ecosystem services that *Phragmites australis* provide that are comparable to the native species will be confirmed or denied.

## Summary

There has been little work done on the benefits that invasive *Phragmites* may provide. This meta-analysis seeks to answer some of the unknowns about invasive *Phragmites* in comparison to the native plants that this species tends to overtake in North America. We gathered 798 initial papers using Web of Science and search words determined in the protocol.

Two screenings of these 798 initial studies resulted in 269 peer-reviewed papers with data that can contribute to the meta-analysis. When data was not extractable, authors were contacted to provide data. The project is nearing the point where this semester, extracted data will be analyzed in R.

This study will provide critically important information – does invasive *Phragmites* provide similar, or maybe even superior ecosystem services than native plant communities. This project has the potential to turn what most people believe about *Phragmites* being a nuisance on its head, which is very exciting.