Environmental quality in the Fenholloway River, characterized by historic cellulose mill pollution and remediation

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Nematode/Copepod Abundance

Overall Project Methods

- In August 2022, sediments from the river mouth and coastal area of the Fenholloway and Econfina rivers were sampled for meiofauna analysis.
- Eleven stations were sampled in each area, and environmental data (dissolved oxygen, temperature, salinity) were measured using a YSI.
- Sediment samples were fixed in buffered formalin (10%) and carefully washed over 63 and 500-micrometer meshes to separate the meiofauna size fraction.
- This fraction was subjected to density flotation using Ludox HS40 to separate the organisms from the sediment grains.

Meiofauna Abundance Methods

- Nematodes and copepods were then counted and picked out, gradually transferred to glycerol process, and mounted on glass slides to conduct size measurements (length and width).
- These measurements were then used to calculate biomass.

Figure 1: Nematodes

Figure 2: Copepods

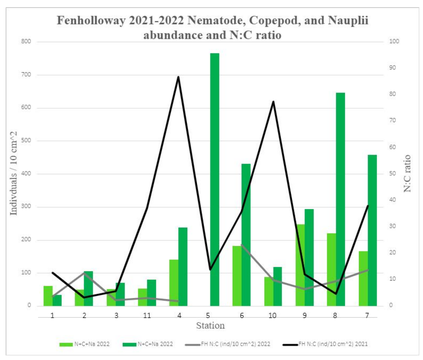

Figure 3: Fenholloway nematodes, copepods, and nauplii individuals per 10 square centimeters. N:C ratio, in black for 2021 samples, and grey for 2022.

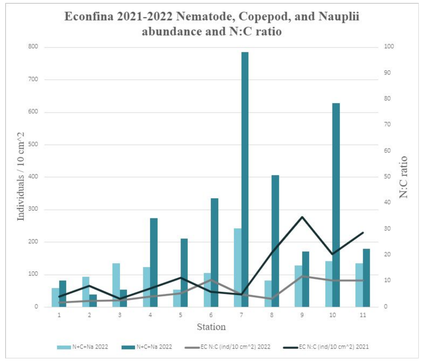

Figure 4: Econfina nematodes, copepods, and nauplii individuals per 10 square centimeters. N:C ratio, in black for 2021 samples, and grey for 2022.

Discussion

- The 2022 samples for the biomass of nematodes and copepods have not been completed yet, but there is data from previous years that is expected to be consistent with those of the 2022 samples.
- Data gathered from samples taken in 2021 illustrated that because copepod abundance increases further away from the river, the conditions improved with that distance.
- In some of the Econfina samples, the nematode : copepod ratio was lower than in the Fenholloway for comparable sampling sites, indicating better environmental conditions.
- Copepod abundance seems to be more sensitive than nematode abundance to environmental change.

Background

- The Fenholloway River, located in North Florida, has received cellulose mill effluent since the 1950s.
- Following remediation measures that improved the wastewater, the effluent discharge point was moved from over 30 miles upriver to the mouth of the river near the Gulf of Mexico coastline, potentially influencing the coastal system.
- The Econfina river is very similar to the Fenholloway in that it is also a black-water river and is located about 12 miles North of the Fenholloway river, however, it does not have a point source of effluent.
- Meiofauna (nematodes and copepods, for example) are microscopic animals (32-500 micrometers) that live in the spaces between sediment grains. The quality of sedimentary environments can be determined by investigating meiofauna; many studies have demonstrated their use as ecological indicators (Alves et al. 2013).
- Sediment samples from 11 different stations along a river-mouth and coastal environmental gradient were collected to analyze their respective meiofauna communities.
- The abundance and biomass of the dominant meiofauna, i.e. nematodes and copepods were analyzed, specifically to obtain nematode:copepod ratio metrics, a well-documented ecological indicator metric
- Environmental data (dissolved oxygen, temperature, salinity) was extracted from the National Water Quality Monitoring Council for stations along both the Fenholloway and Econfina Rivers

Fenholloway Stations

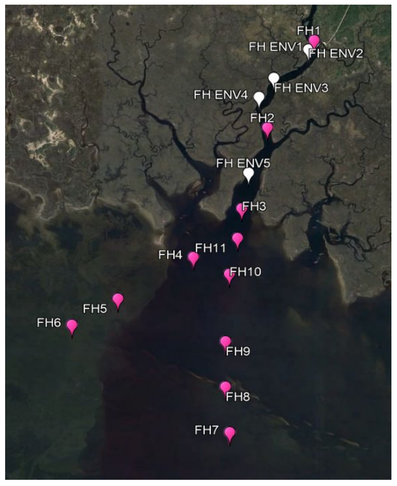

Figure 5: FH sample sites. Station 1 is nearest to the relocated wastewater pipeline. The river and river mouth includes station 1, 2, 3, and 11, the southwest transect is stations 4, 5, and 6, and the southeast transect is stations 10, 9, 8, and 7. Also shown are the sampling locations for the environmental data.

Econfina Stations

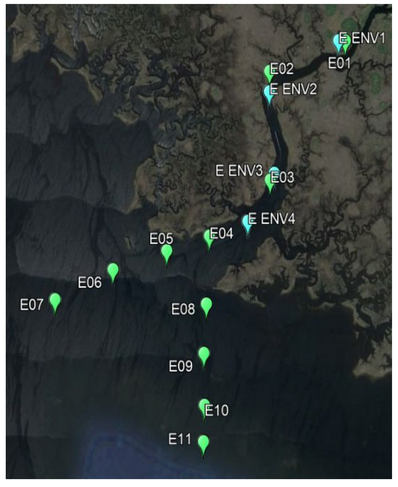

Figure 6: EC river sampling sites. The river and river mouth includes stations 1, 2, 3, and 4, the southwest transect is stations 5, 6, and 7, and the southeast transect is stations 8, 9, 10, and 11. Also shown are the sampling locations for the environmental data.

References

Alves, A. S., Adão, H., Ferrero, T. J., Marques, J. C., Costa, M. J., & Patrício, J. (2013). Benthic meiofauna as indicator of ecological changes in estuarine ecosystems: The use of nematodes in ecological quality assessment. *Ecological Indicators*, *24*, 462–475. https://doi.org/10.1016/j.ecolind.2012.07.013

Andrássy, I (1956). The Determination of Volume and Weight of Nematodes. 73-83.

Fenholloway River @ mouth (21FLTLHR_WQX-g1tlhr0042) site data in the Water Quality Portal. Fenholloway River @ Mouth (21FLTLHR_WQX-G1TLHR0042) site data in the . (n.d.). Retrieved February 28, 2023, from https://www.waterqualitydata.us/provider/STORET/21FLTLHR_WQX/21FLTLHR_WQX-G1TLHR0042/

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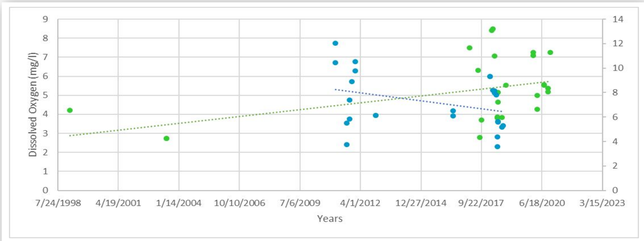
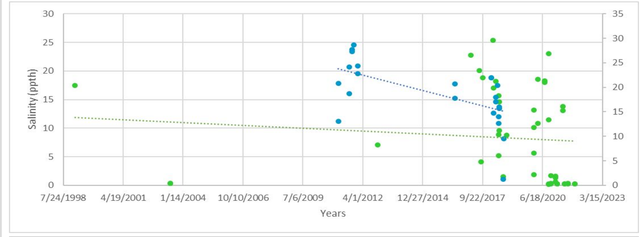
Environmental Data

Methods

- Environmental data consisting of temperature, salinity, and dissolved oxygen were gathered for the same general areas (the mouth of the river and coastal areas were available) from the National Water Quality Monitoring Council.
- This data was plotted to assess temporal patterns and investigate the potential influence of environmental parameters on our biological results.





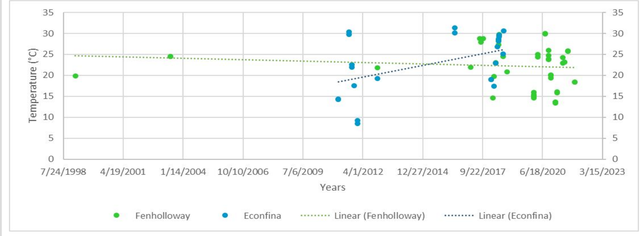


Figure 7 (top): Amount of dissolved oxygen (mg/l) over time (years) in the Fenholloway and Econfina River mouths.
Figure 8 (middle): Salinity (ppth) over time (years) in the Fenholloway and Econfina River mouths.
Figure 9 (bottom): Temperature (°C) over time (years) in the Fenholloway and Econfina River mouths.

Results

- The dissolved oxygen (DO) in the Fenholloway has been increasing over time while the DO has been decreasing in the Econfina. Salinity has decreased over time in both rivers. Temperature has decreased over time in the Fenholloway but increased in the Econfina.
- There is a lack of data before 2015 aside from a few scattered measurements. There is more recent data on the Fenholloway than the Econfina, potentially because of the recently constructed pipeline and monitoring obligations.
- While there was abundant abiotic data on the river system, there was a paucity of data for the mouth of the Fenholloway River (below 30 degrees North), highlighting the urgent need for environmental and biological monitoring of the river mouth and coastal systems now subject to industrial effluent.