Tracking Changes in the Historical Ecology of Florida's Freshwater Springs and Rivers Using Recent and Fossil Mollusks

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Background

Florida's spring and river systems play an important environmental, economic, cultural, and societal role for the state.

However, they are being heavily threatened by:

- **Urban development**
- **Human recreation**
- **Storm water runoff**
- **Decreased water flow**
- **Increased algal growth**
- **Invasive species**

While these impacts have been ongoing for more than 200 years, restoration and conservation efforts often must rely on only decades of recorded historical data. However, where written records are lacking, fossil and death assemblages record evidence of previous, historical molluscan communities. These can provide a baseline for better targeted restoration efforts.

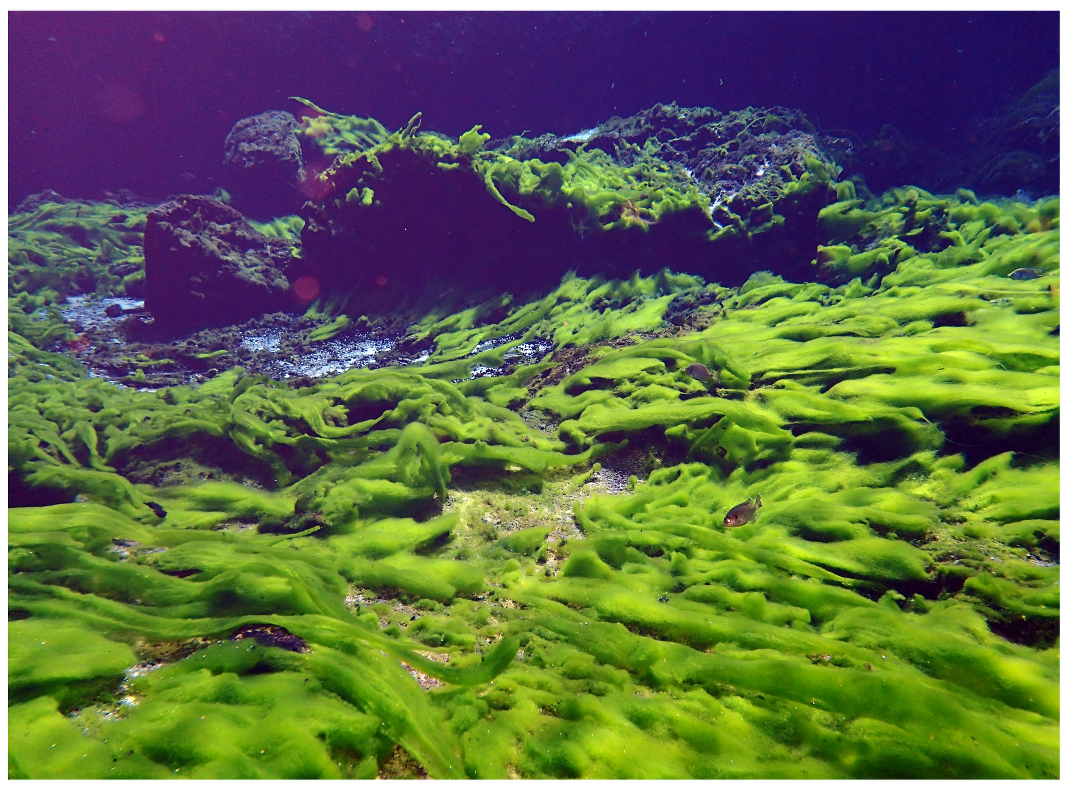

Figure 1: Algal mat at Mammoth Spring in the Silver Springs system. Increased growth of algae and algal mats can have detrimental effects on water quality and biotic communities.

Research Objectives

1. Comparative analysis of three assemblage types:
- **Live mollusks (living assemblage)**
- **Surficial shell buildup (death assemblage)**
- **River bank sediments (Pleistocene-Holocene fossil assemblage)**

2. Compare temporal and spatial patterns within and between spring and river systems

3. Identify possible causes driving any changes in community composition over time

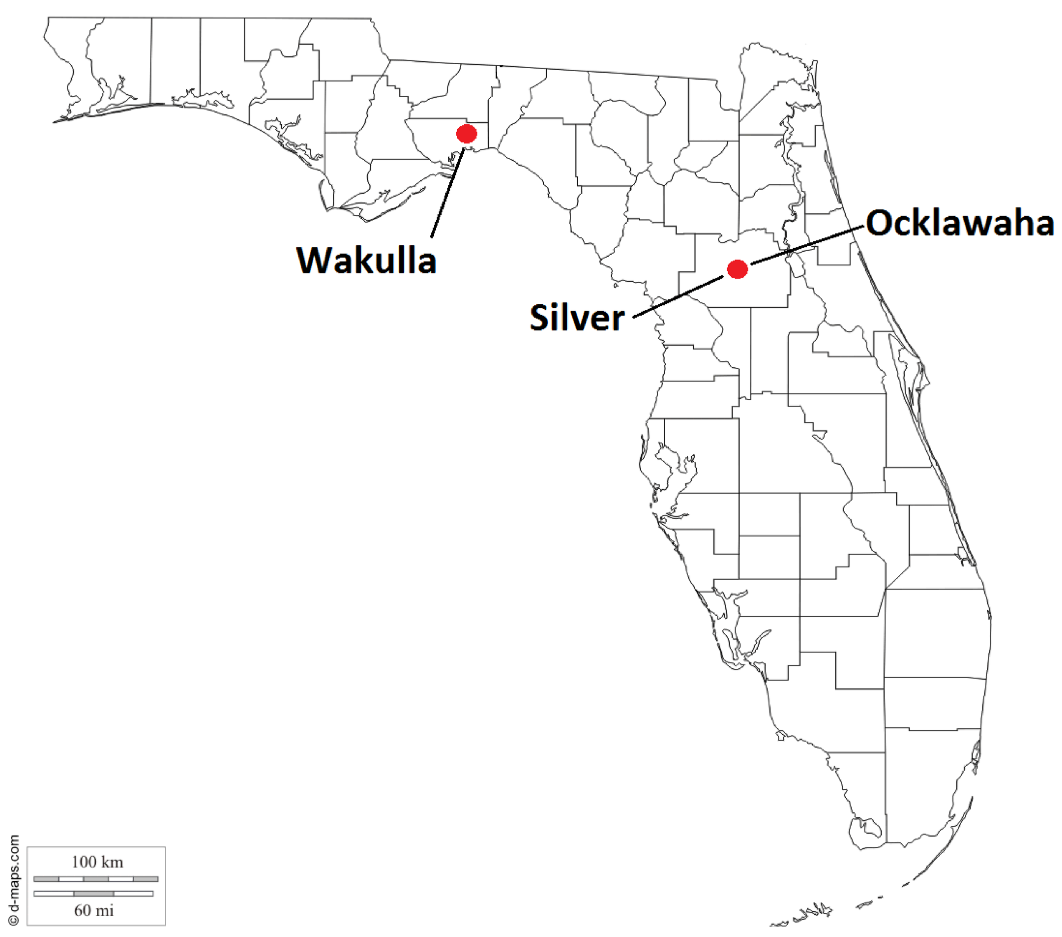

Figure 2: Sampled spring and river systems in Florida. Note that the Silver River is a tributary of the Ocklawaha River.

Methodology

- **Collection of samples from three systems (Wakulla, Silver, and Ocklawaha Springs/Rivers) using SCUBA**
- **Total of 181 samples (63 live, 52 death, and 66 fossil assemblages) collected from 25 sites**
- **Bulk sampling (~ one gallon of sediment) for death and fossil assemblages**
- **Timed (5 minute) collection for living assemblages**
- **Bulk samples sieved to 1 mm**
- **Diversity and community associations evaluated using nonmetric multidimensional scaling (nMDS) and various diversity measurements**

Figure 3: Collection of *in situ* fossil sediments from Wakulla River using SCUBA.

Results

- **Modern living assemblages reduced in diversity compared to death or fossil assemblages**
- **Death assemblages composed of a mixture of recent dead and fossil material eroding into the system**
- **Living assemblages dominated by different species than fossil assemblages**
- **Abundant presence of invasive taxa in death & living, absent in fossil assemblages**
- **Ordination reveals separation of living assemblages of each system as well as from their respective fossil assemblages**
- **Fossil assemblages from multiple systems plot similar to one another in ordination space**

TAXA	FOSSIL	DEATH	LIVE
Amnicola dalli johnsoni	159	310	0
Ancylidae indet.	3	3	0
Argopecten sp.	0	2	0
Corbicula fluminea	0	1979	326
Crassostrea sp.	0	2	0
Daedalochila auriculata	5	2	0
Elimia floridensis	3784	6002	2227
Lioplax pilsbryi	514	326	2
Melanoides tuberculata	0	330	249
Micromentus sp.	0	1	0
Physa hendersoni	914	1188	0
Physella sp.	2	0	0
Pisidium sp.	76	31	0
Planorbella duryi	3000	5553	1
Planorbella trivolvis	408	450	3
Polygyra septemvolva	116	49	0
Pomacea paludosa	305	230	5
Tarebia granifera	0	337	1
Tryonia aequicostata	338	688	0
Unionidae	6	241	630
Vitta usnea	0	45	166
Viviparus georgianus	784	1317	7
Mercenaria?	0	1	0
TOTAL	10,414	19,087	3,617
NUMBER OF TAXA	15	22	11

Table 1: Taxa abundance counts within the three assemblage types. Nonnative/invasive taxa marked in red.

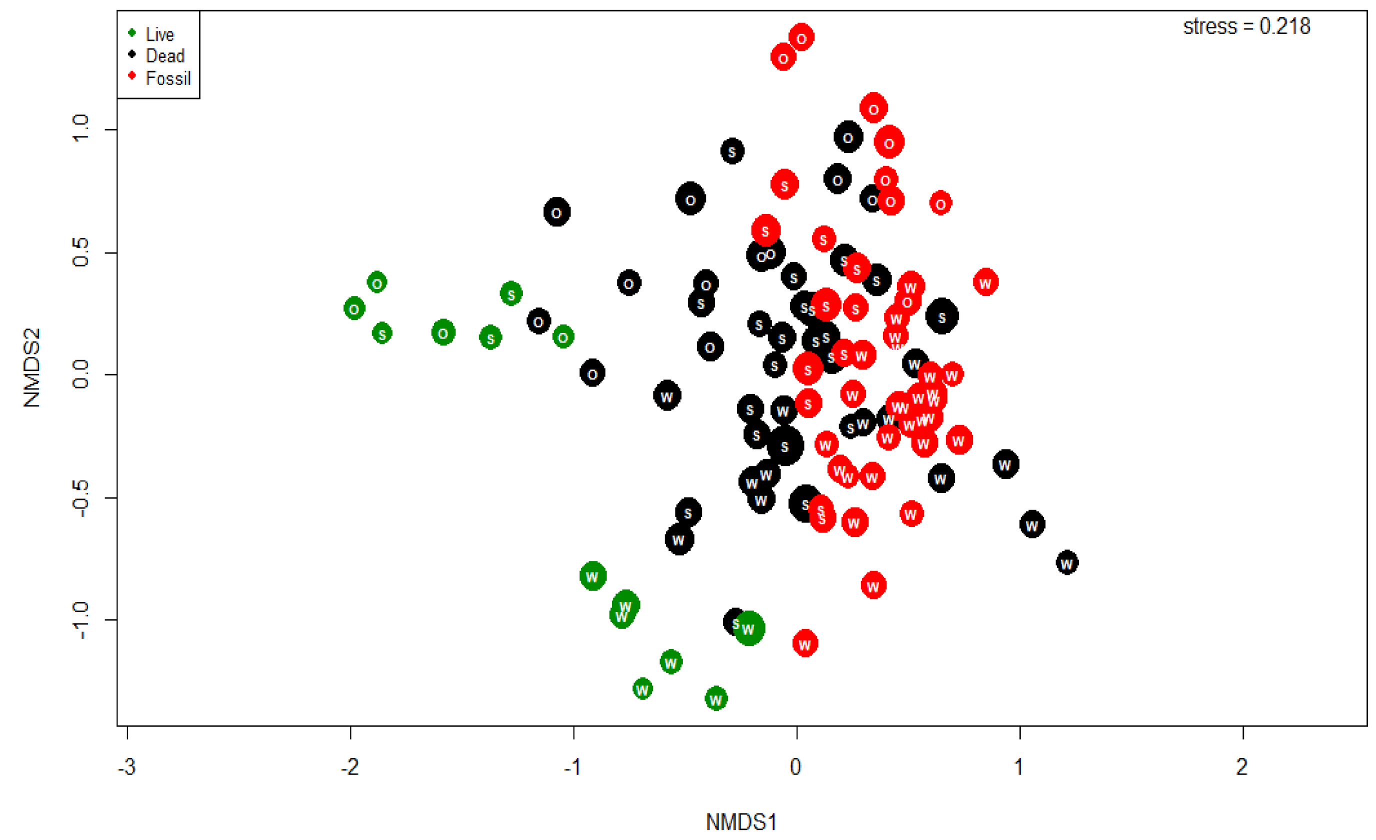

Figure 4: nMDS of samples from all assemblage types. Note heavily overlapping clusters of fossil (red) and death (black) assemblages. Clusters of live assemblages (green) are distinct from one another and also from their respective death and fossil assemblages.

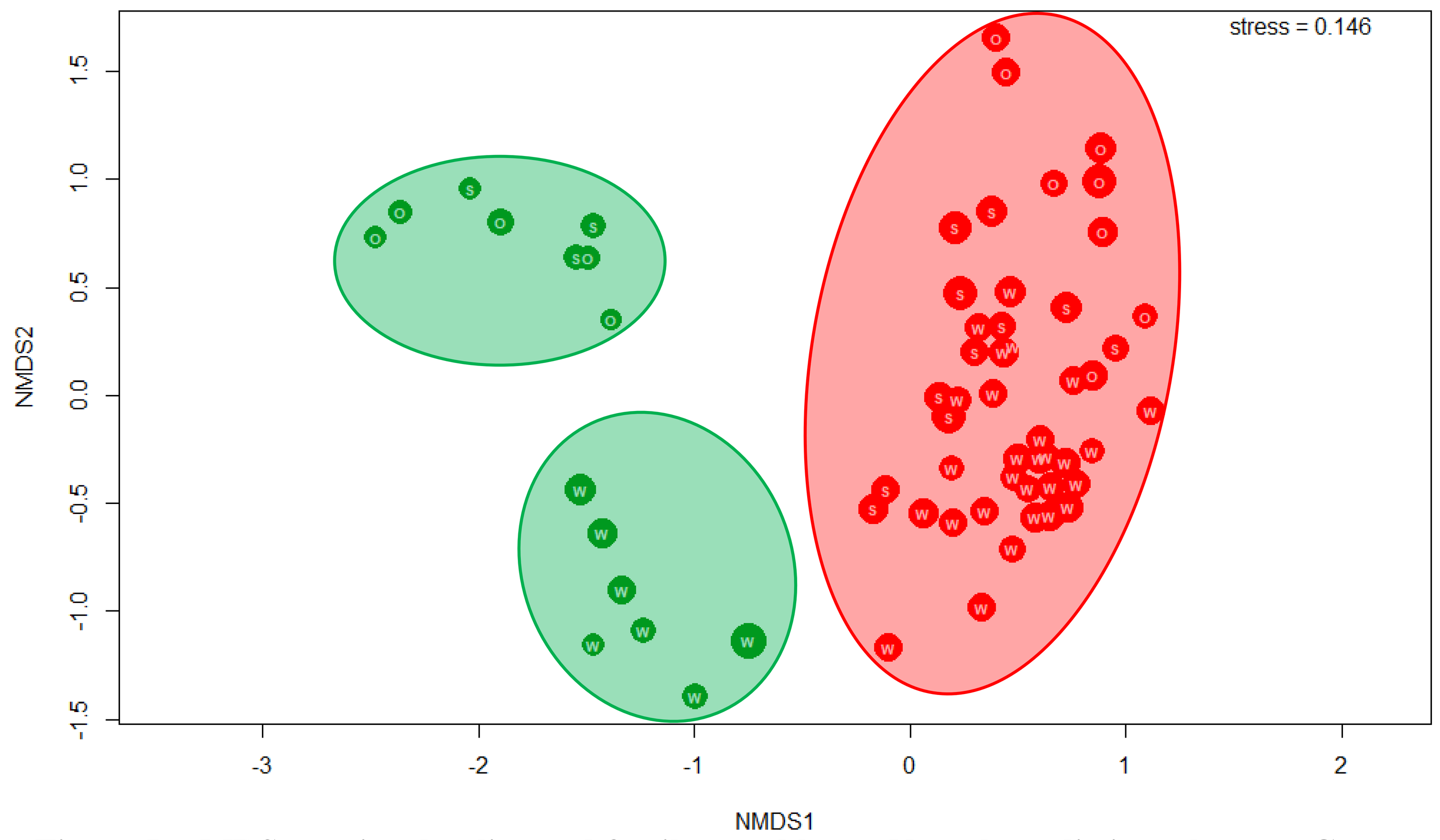

Figure 5: nMDS restricted to live and fossil assemblages. Note three distinct clusters: Green Ws– Wakulla live, Green S & Os– Silver/Ocklawaha live, and Red W, S, & Os– fossil from all three systems. Colored ellipses added to further emphasize clustering.

Conclusions

- **Modern, living molluscan communities are lower in diversity compared to fossil or death assemblage communities**
- **Death assemblages are heavily time averaged due to fossil material eroding into the river systems**
- **Shifts in composition from regionally homogeneous Pleistocene-Holocene communities to more heterogeneous modern communities are a recent development**
- **Presence and success of recent invasive/nonnative taxa may drive more recent shifts in community composition**
- **Restoration/conservation efforts in these threatened systems should consider addressing a spectrum of issues including invasive taxa**

Figure 6: Subaqueously exposed fossil marl exposure in the Wakulla River.

Acknowledgements

- **We thank the Felburn Foundation, Florida Museum of Natural History, Southwest Florida Fossil Society, Florida Paleontological Society, and the Florida Park Service for funding or logistical support**
- **Additional thanks to Sahale Casebolt, Ryan Means, Charmaine Pedrozo, and Mariah Monroe**