Mapping of Submerged Shorelines at Junius Ponds, NY

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1) Abstract:

Wetland hydrology can be complex with changes in water budgets and routing, which can influence sensitive ecosystems containing rare plant and animal species that rely on stable or slowly changing water levels. Junius Ponds, Unique Area, NY consists of four interconnected ponds which were formed in kame deposits associated with the last glaciation. Water flows from south to north from Phillips Pond to Lowery Pond and into East and West Newton Ponds. In some locations along the margins of the ponds, there are fens containing rare endemic species. Water levels in these ponds are pivotal because they control the amount of rare fen habitat available. Rising water levels submerge and remove habitat. Over the last ~100 years, pond water levels have generally risen and today are near their highest in historical time. Water levels and water routing are governed by culverts associated with I-90 and SR 318, changes in land use, and are also influenced by factors like beavers and climate. Here, we use a combination of historical aerial imagery, bathymetric mapping, and side scan sonar to investigate the modern high stand shoreline and prior submerged shorelines. This information provides constraints on past wetland extents and associated water level changes. The sonar data was collected with a Humminbird SOLIX 12 CHIRP MEGA SI + G2 with frequencies of 50/83/200/455/800 kHz & 1.2 MHHz in the summer of 2018. Reefmaster, SonarTRX, ArcGIS, and Google Earth were utilized in the analysis of sonar data and generating detailed bathymetry. Comparing depth and speed corrected side scan sonar data with aerial imagery indicates that, past shoreline features in Lowery Pond are approximately 1-1.5 meters below the pond surface level. There are also several generations of shoreline features indicating multiple lake level stages. These data are foundational for examining the evolution of wetland systems through time and for site management.

2) Objectives:

Map past shorelines to determine past pond extents to understand water level fluctuations.

3) Study Area:

Lowery Pond is one of four interconnected ponds in the Junius Ponds system, located 10 km north of Seneca Lake (Fig. 1a) and is nested in kame deposits associated with the last ice sheet (Fig. 1b). Rising water levels have drowned shoreline marshlands (Fig. 1c).

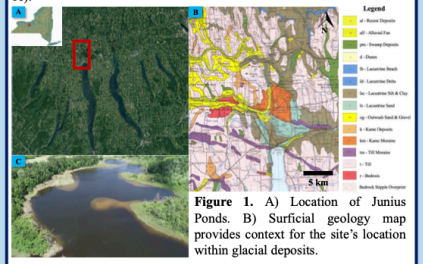


Figure 1. A) Location of Junius Ponds. B) Surficial geology map provides context for the site's location within glacial deposits. C) Site overview and drone images of Lowery Pond. North view, I-90 visible along the top edge of the photo. Submerged shelves can be seen. They once contained bog mats which are now absent.

4) Methods:

We used prior imagery, field observation, drone images, and sonar to identify pond and wetland changes:

Prior imagery: We used 19 aerial images from 1938 to 2019 to map pond and marsh extents.

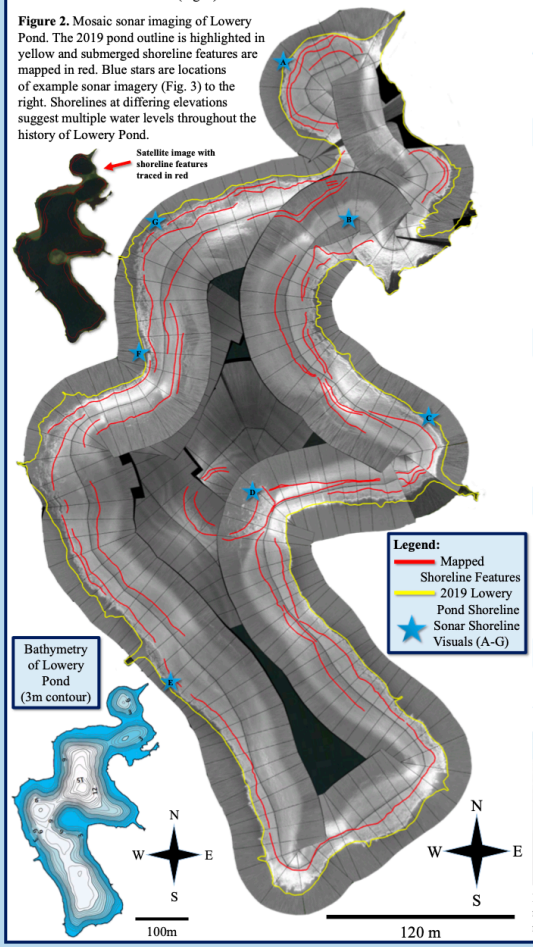
Field Observations and Drone Imagery: We checked our mapping with a mixture of field and drone observations.

Bathymetry and Sonar Mapping: We used a SOLIX 12 CHIRP MEGA SI+ G2 50/83/200/455/800 kHz & 1.2 MHz to establish pond bathymetry and gather sonar images of the pond perimeter shoreline. Reefmaster 2.0 and SonarTRX were utilized for high resolution bathymetric mapping and visualization of the sonar data, respectively.

5) Results:

Below are the results of our sonar mapping in Lowery Pond. Multiple shoreline features are evident. (Fig. 2).

Figure 2. Mosaic sonar imaging of Lowery Pond. The 2019 pond outline is highlighted in yellow and submerged shoreline features are mapped in red. Blue stars are locations of example sonar imagery (Fig. 3) to the right. Shorelines at differing elevations suggest multiple water levels throughout the history of Lowery Pond.



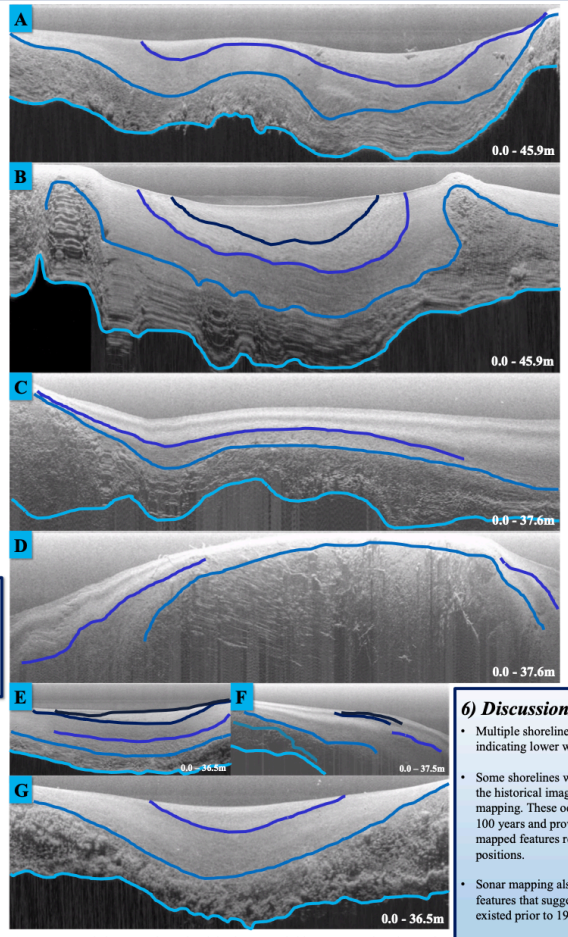
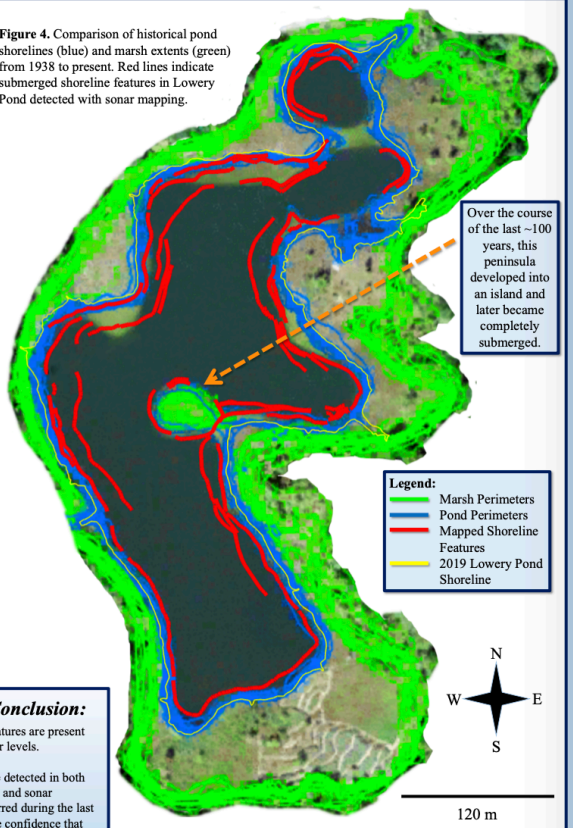


Figure 3. Example imagery of speed and depth corrected side scan sonar data showcasing multiple generations of shorelines within Lowery Pond. Light blue lines correlate with modern shorelines, darker blue lines correspond with deeper, submerged shorelines.

Figure 4. Comparison of historical pond shorelines (blue) and marsh extents (green) from 1938 to present. Red lines indicate submerged shoreline features in Lowery Pond detected with sonar mapping.



6) Discussion/Conclusion:

- Multiple shoreline features are present indicating lower water levels.
- Some shorelines were detected in both the historical imagery and sonar mapping. These occurred during the last 100 years and provide confidence that mapped features represent past shoreline positions.
- Sonar mapping also detected multiple features that suggest lower water levels existed prior to 1938.
- In some locations raising water levels must have eroded shoreline materials, removing bog mat habitat.

7) Acknowledgements:

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Citations: Dr. Andrew Kozlowski. New York State Finger Lake Surficial Geology Map, Cornell University Geospatial Informational Library, the USDA and. USGS National Geospatial Program for imagery.