Sediment-Profile Imaging (SPI) Technology Used to Quantitatively Evaluate Effects of Carp Removal on Surface Sediment Conditions in a Michigan Lake

Gene Revelas, Integral Consulting Inc.; Louise Venne, WSP; Stefan Wodzicki, Integral Consulting Inc.; Grace Chang, Integral Consulting Inc.; Phil Pauquette, WSP; Cynthia Draper, WSP

Background

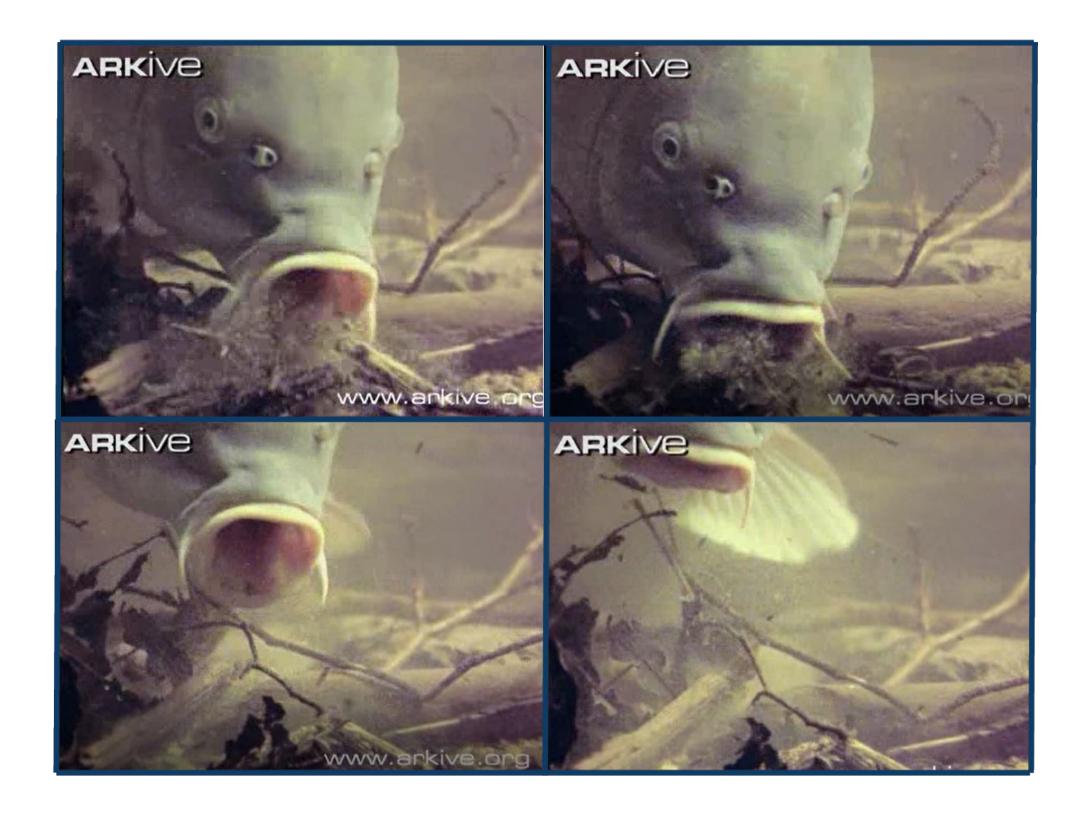
Bottom-feeding activities by fish such as carp can result in surface sediment disturbance, decreased water quality, and reductions in bed stability. These processes are counter to those necessary for natural recovery of contaminated sediments. Thus, reducing the abundance of carp from a lake has the potential to improve conditions for natural recovery.

Objectives

Enhance natural recovery of a lakebed with novel carp-removal strategy and apply SPI technology to measure success:

- SPI technology was used to establish baseline sediment conditions, especially sediment bed bearing strength before carp removal
- Post-carp removal SPI surveys will facilitate assessment and quantification of the effects of carp removal on surface sediment conditions







Approach / Methods

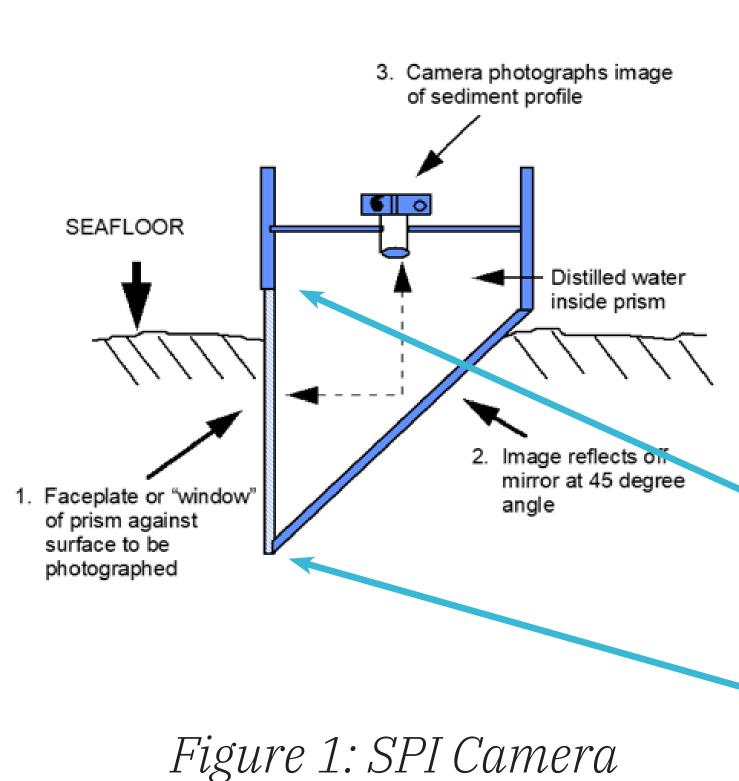
Before carp removal, the consolidation and stability of Lake Allegan's lakebed were mapped using a modified SPI camera.

July 2019 SPI Survey of Lake Allegan, Michigan

Key Measurements:

- Grain size
- SPI prism penetration depth (bed bearing strength)
- Apparent Redox Potential Discontinuity Depth (biogenic mixing intensity)
- Methane abundance (bed stability)

200+ locations sampled in 1 week



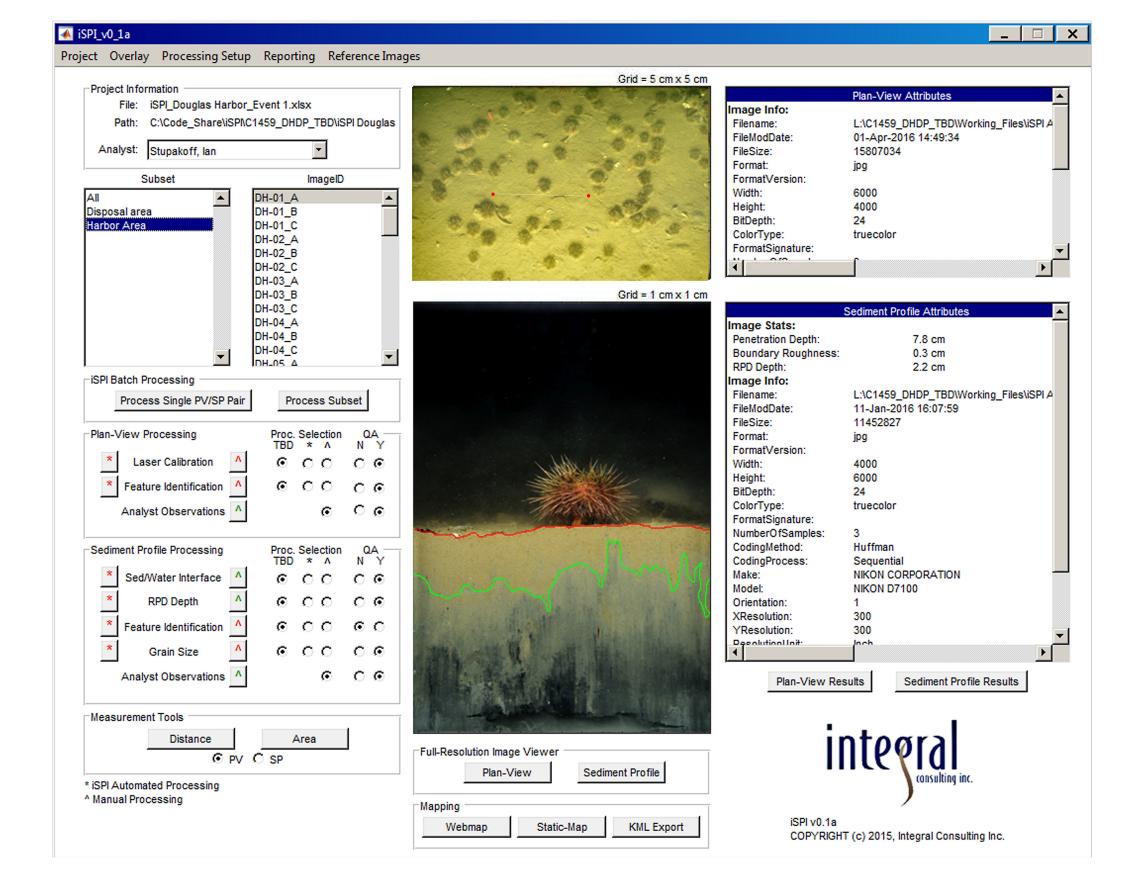


Figure 2: iSPI semi-automated image analysis system

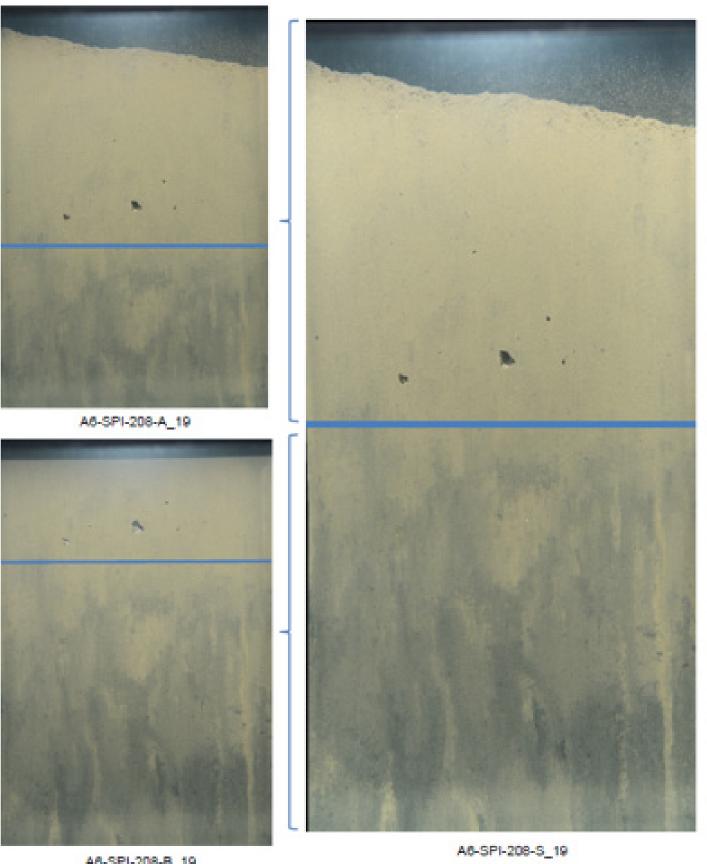
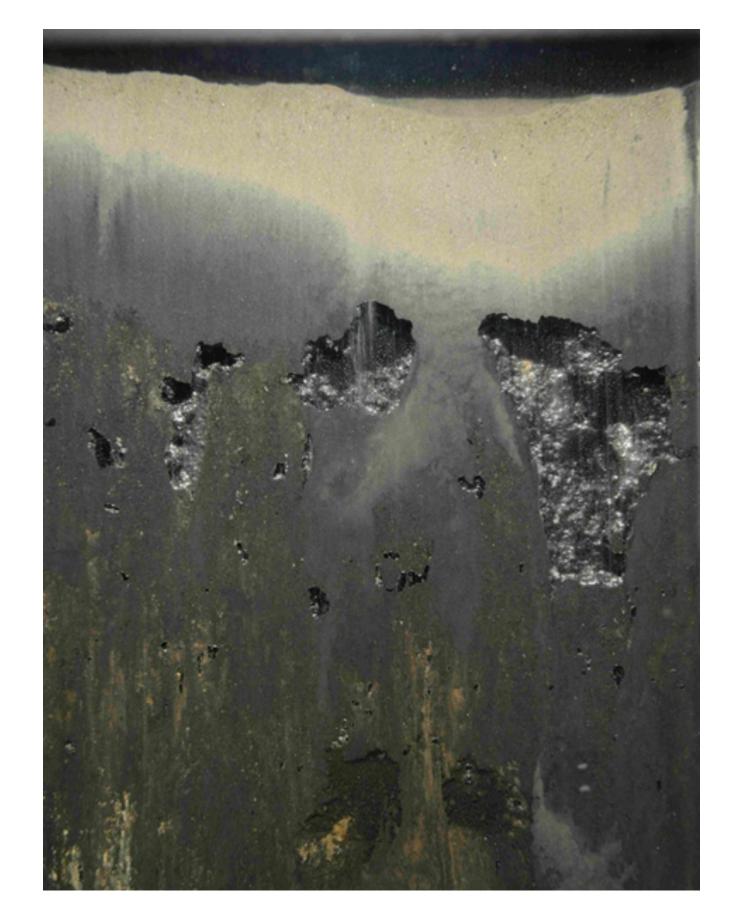


Figure 3: Penetration depths to 32 cm – Figure 4: Methane abundance (cm²) stitched two profile images





Results

SPI DATA MAPS

- Spatially detailed maps of lakebed physical, geochemical, and biological features were generated
- Relative camera prism penetration depth (Figure 5) is a function of bed bearing strength/consolidation
- Relative abundance of sedimentary methane (Figure 6) is a partial function of bed stability
- Repeat of this pre-carp removal SPI survey following carp removal should allow changes in lakebed conditions to be quantified, and so determine if the decrease in carp population has improved conditions for natural recovery

Conclusion

This innovative use of SPI technology provided cost-efficient documentation of physical, geochemical, and biological conditions in lakebed sediments (upper 30 cm of sediment column) at a density that will allow effective evaluation of a novel site management approach.

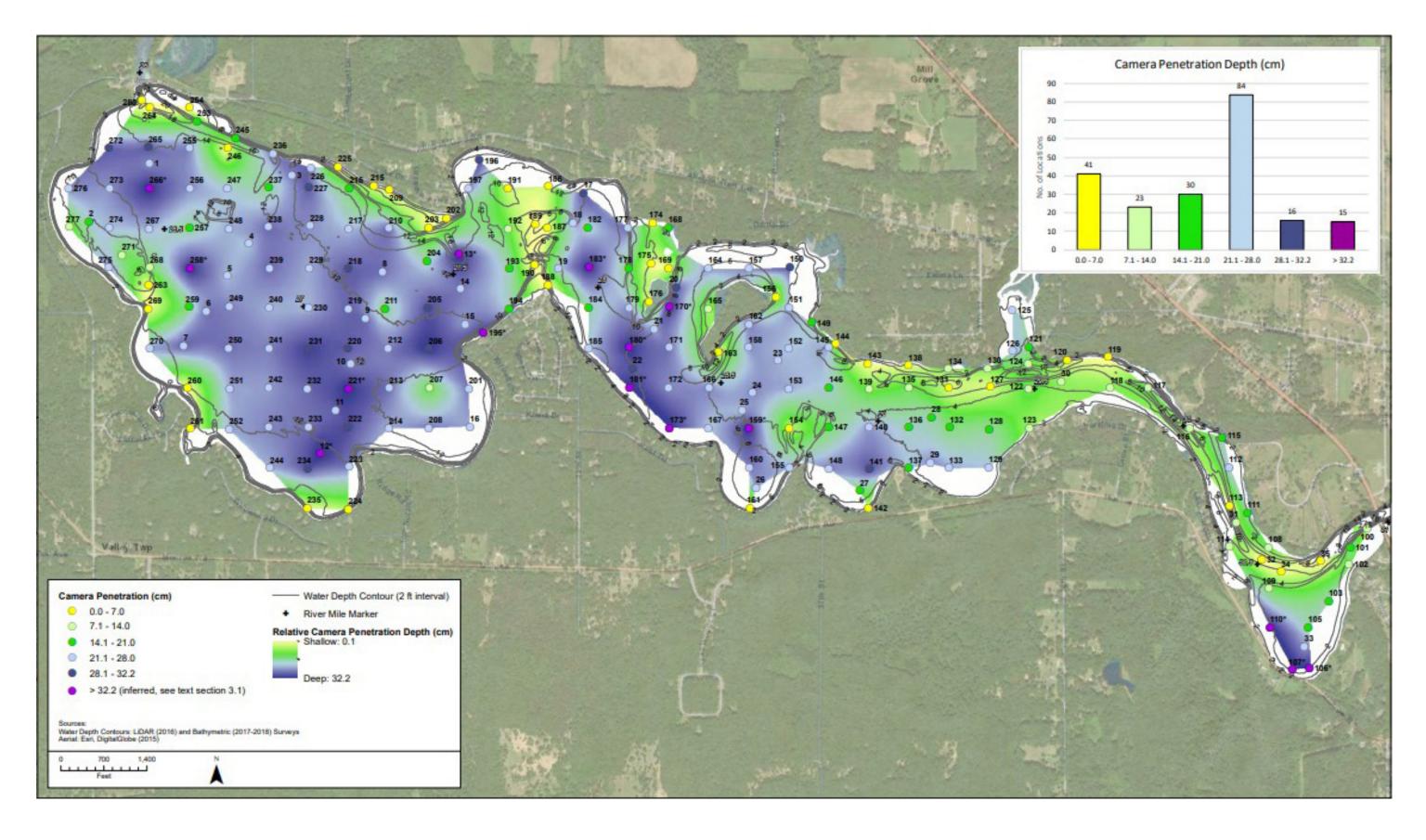


Figure 5: Penetration depth map in July 2019

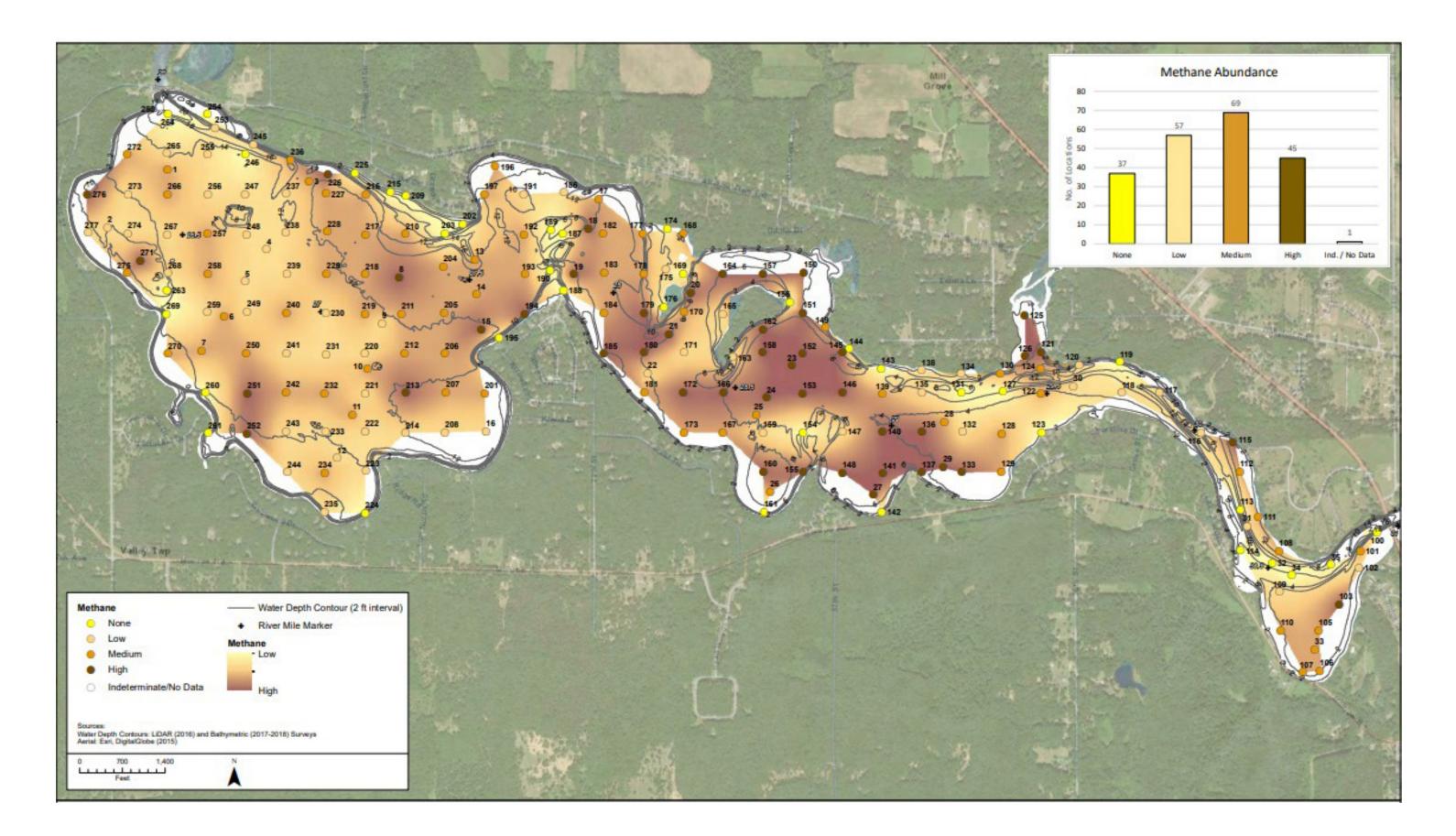


Figure 6: Methane abundance map in July 2019

Gene Revelas Integral Consulting Inc. 360) 939-9618 grevelas@integral-corp.





Group 1 Session A1