

BRIEFING NOTE

(For Information Only)

Internal seiches as drivers of fish depth use in lakes

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Research Question What is the response of fish to chronic partial upwellings of hypoxic water in a stratified, eutrophic water body?

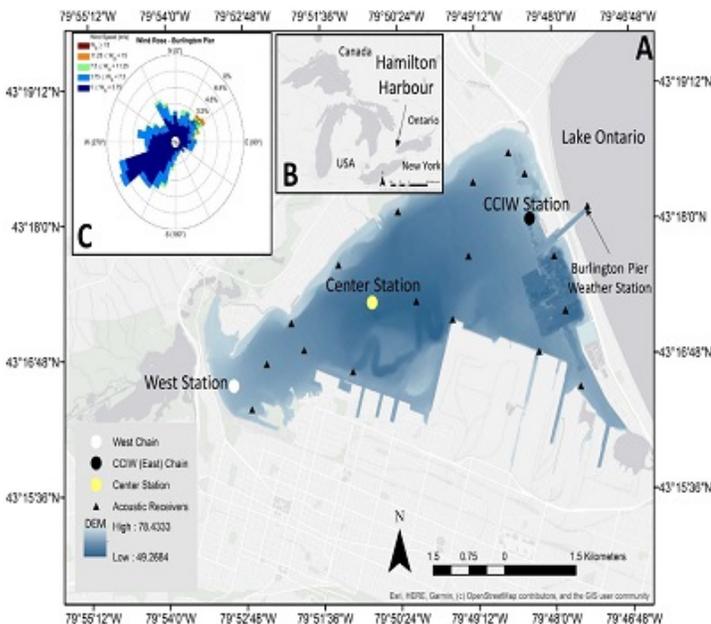


Photo taken by William Twardek.

Management Relevance Physical habitat restoration needs to consider areas of internal seiche flushing; Sampling in the fringes of low-oxygen zones (compression), could artificially inflate stock estimates, leading to higher catch allowances; Fish may appear to exhibit Diel Vertical Movement, but they are actually avoiding daily seiches.

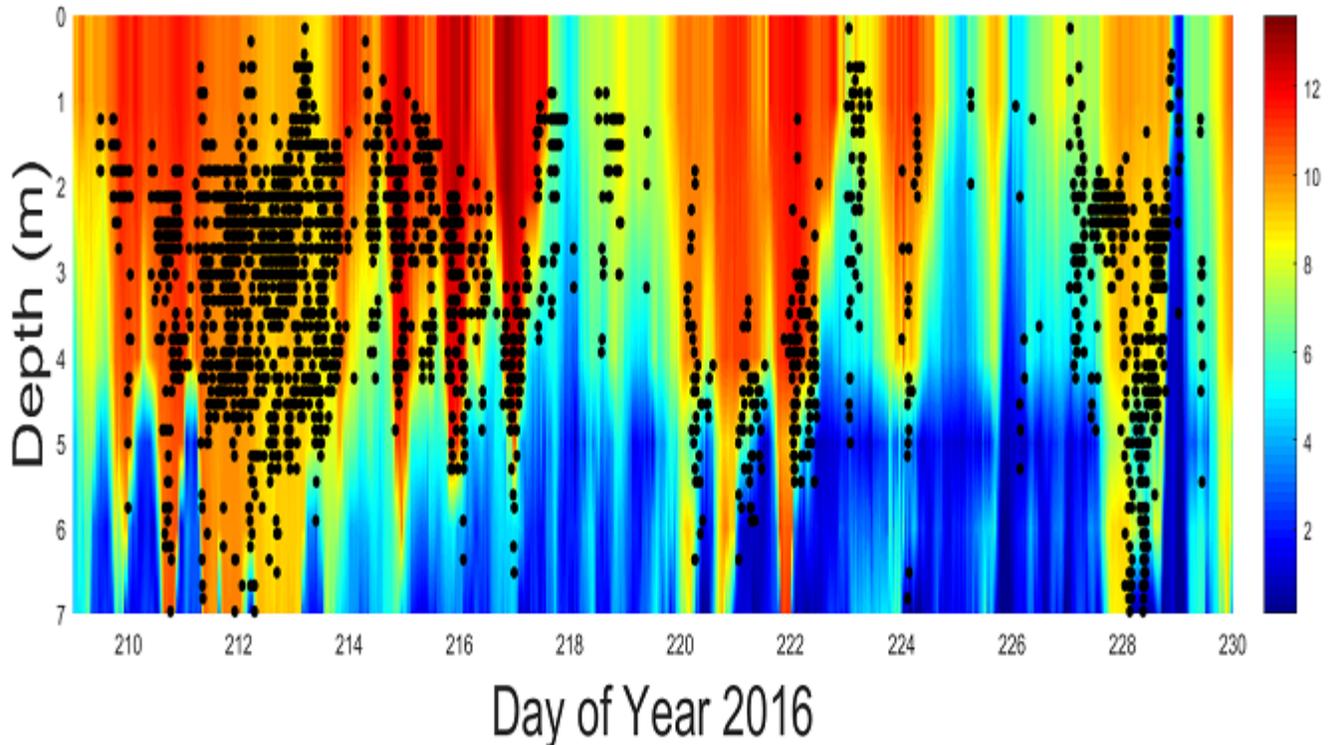
SUMMARY

- Walleye avoid daily upwellings of cool, hypoxic waters in a eutrophic, stratified waterbody.
- Wild walleye avoid dissolved oxygen values above their lab-obtained minimum thresholds.
- Internal seiches are 'invisible' at the surface, however should be considered in areas selected for physical habitat restoration, particularly in eutrophic, stratified systems.



Hamilton Harbour array, prevailing wind direction, and water quality monitoring stations.

Species:	Walleye
Waterbody:	Lake Ontario
Project date:	08/01/2015 - 08/01/2023
# fish tagged:	17
# receivers:	2
Analysis:	Quantile regression and GLMM.
Management Applications:	Walleye avoid 5 mg/L of dissolved oxygen in wild environments; Internal seiches allow cooler, hypoxic water into coastal regions- important for juvenile fish; Unknowingly sampling areas above upwellings can lead to higher CPUE; Habitat restoration should consider upwelling locations.



Interpolated dissolved oxygen values (mg /L) at depth (m) between DOY 208 and 230 of 2016 (26 July to 17 August 2016). Black points indicate individual walleye positions in the water column.

Limitations: This study only used two receives and seventeen walleye for one summer, however trends were also seen across multiple species, including pike, longnose gar, freshwater drum, and white sucker. It was assumed that the fish experienced the same environmental conditions as the loggers on the chain.

Next steps: A finer-scale Vemco Positioning Array was used to determine multi species fine-scale responses to the upwelling events.

Other details: A littoral area known to be well used by walleye experienced almost daily upwelling events during the 3-month stratified period, with hypoxic water conditions reaching the surface on several occasions. Walleye demonstrated a preference for oxygenated waters and positioned themselves above the dynamic, ever-changing depths of the 3, 4, and 5 mg/L oxyclines.

Publications: Brooks, J.L., Midwood, J.D., Smith, A., Cooke, S.J., Flood, B., Boston, C.M., Semecsen, P., Doka, S.E. and Wells, M.G., 2022. Internal seiches as drivers of fish depth use in lakes. *Limnology and Oceanography*. 67(5): 1040-1051.

