

Continuous Monitoring Approaches to Quantify Water Quality Fluctuations from Rainbow Trout Cage Aquaculture

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Most aquaculture production in the Great Lakes comes from rainbow trout (*Oncorhynchus mykiss*) cage-culture in Lake Huron waters. Present environmental regulations require grab samples and spot measurements of total phosphorus (*TP*) and dissolved oxygen (*DO*) in the 'near-field' (within 30m) water column. Such proximate measurements often exhibit extensive temporal and spatial variations, and therefore may not reflect actual perturbations in water quality due to the farming activity. Monitoring is further hindered by the inability to differentiate between phosphorus originating from the fish farm, from that which is naturally occurring or introduced by other anthropogenic sources. To help understand this variation in monitoring data and to determine the contribution of fish cages to 'near-field' *TP* concentrations, water quality response was compared with feed use and water current dynamics at a commercial cage farm in Lake Huron. At the cage mid-depth (6m), *DO*, *pH*, temperature and current dynamics were measured continuously in conjunction with grab samples of *TP*. Initial analysis indicates that the trends in 'near-field' *TP* concentrations appear to be related to feed use and current dynamics. Increased flushing reduces *TP* and increases *DO* concentrations, ultimately to background concentrations if current magnitude is large enough. An inverse *DO* -*TP* relationship seems to be present in water immediately influenced by fish within the cages. 'New' incoming water has no *DO* -*TP* correlation; the strongest relationship existed within the site center and a weaker relationship existed 30m down-current from the cages. The inverse *DO* -*TP* relationship can be useful for identifying *TP* samples taken within the 'site plume', and may also enable real-time identification of phosphorus trends based on continuous monitoring of oxygen at cages. This research should improve understanding of the instantaneous, as well as longer-term effects of cage aquaculture on water quality, and should assist in the refinement of fish cage monitoring protocols.