Water Level, Dissolved Oxygen, and Light Loggers to Assess Hydrological Conditions in
Great Lakes Coastal Wetlands
Standard Operating Procedures

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Proposal: We are interested in testing the hypothesis that fish catch is related to temporal variation in dissolved-oxygen (DO), and that such DO variation is partly driven by seiche activity causing horizontal movement of high-DO water into and out of wetlands in the short term. We suggest that this variation in DO is most important in the densely vegetated, inshore wetland zones (usually wet meadow, under high-water conditions), so our protocol is intended for use only at the most-inshore fyke-net locations.

The following provides information on best practices for using water level loggers (as well as DO, and light loggers), to ensure consistency among field crews. The goal is to collect a data set that can be used in future analyses of fish-catch response to water level fluctuations. We hope that all crews will deploy water-level loggers. Other loggers can provide important supplemental information, but their use is optional, depending on logger availability to each crew.

Logger Site Selection

Loggers should be deployed at one of the fyke nets installed in the inshore zone (usually wet meadow, *Phragmites*, or cattail), if that zone consists of such dense vegetation that a DO gradient is likely to occur (i.e., DO is high at the zone edge, and decreases as one progresses into the zone toward shore). Typically, in such a dense zone, the fyke net is installed at the zone edge, and the lead and wings are placed in the dense vegetation, itself, according to SOPs.

The water-level loggers are actually pressure loggers, and must be deployed in pairs, with one installed below the water surface, and one above the surface, to compensate for air-pressure changes. Water-level, light, and DO/temperature loggers should all be placed at the same fyke net. If additional DO loggers are deployed, we suggest placing one logger at each of three fyke nets installed in the inshore zone.

DO-logger placement is especially important: loggers should be attached to a stake anchoring one of the fyke-net wings. This is important because fishes must move at least this far into the dense vegetation in order to be caught in the net. Thus, fishes must be able to tolerate the DO conditions at this location, if only briefly.

Logger Operation

In the field, download data from the loggers as soon and as often as possible. In most cases, loggers will be deployed at one site, and then moved to another site the following day. On days when the loggers are not deployed overnight, the data can be downloaded to a computer that evening.

Download data using HOBOware software by attaching the logger/coupler/shuttle to a field computer and following steps found in the "**Downloading Data from Water Level Loggers**" OR "**Downloading Data from DO Loggers**" in the Appendix. If more clarity on downloading data is needed, https://www.youtube.com/watch?v=4g9hcmtz-28 is a great YouTube video that shows how to use water depth loggers.

Also, make note of the weather occurring overnight, most importantly wind or rain as it can help corroborate the seiche and DO.

Ideally loggers should be installed on the morning of day 1 and removed mid-day on day 2, in order to record trends of overnight, afternoon and morning. Although this may not be possible, as sampling schedules are often time limited, please try to collect the longest data record possible.

Water Depth Loggers

It is VERY IMPORTANT to tie a length (at least 4') of brightly-coloured, buoyant cord to each pressure logger. This helps you find it if you drop it in the water or it becomes dislodged from its stake. Be sure that it is tied to its stake by somebody who knows how to tie secure knots (e.g., bowline). These loggers are expensive to replace.

One logger will be submerged to measure water pressure, and the other will be mounted above the water surface to record variation in atmospheric pressure. To minimize error, label the outside of each logger with 'Water' or 'Air' using a permanent marker and consistently use a logger for either water or air (you should also label each box in which each logger is stored). Periodically check loggers, because markings can be rubbed off of the smooth metal over time.

The "Water" logger should be placed at least 30 cm below the water surface in the case a seiche could cause the logger to be out of water (seiche amplitudes of 30 cm or more can occur under some conditions).

The "Air" logger should be placed as high on the stake as possible, in case rising water from a seiche causes the logger to be submerged in water. Attach both loggers to the same stake with cable (zip) ties for greater security (there are two end-cap holes though which cables can be connected). Ties can be unzipped with a knife tip, but should be replaced after a few uses. If you use smooth stakes, you may need to add a clamp to the stake to hold the cord in position. The stake with both loggers attached should be placed near the cage of the fyke net.

Record (on the datasheet) the times and dates that the loggers were put in place at the start of the survey and when they were taken out of the water. Take GPS readings of all loggers' locations. We have modified our own CWM invertebrate/WQ data sheets to provide space for these records.

Dissolved Oxygen Loggers

It is VERY IMPORTANT to tie a length (at least 4') of brightly-coloured, buoyant cord to each DO logger. This helps you find it if you drop it in the water, and it can be used to lower and tie the logger in place. Be sure somebody who knows secure knots (e.g. bowline) is the one to tie these correctly. These loggers are expensive to replace. **Don't forget to take off the Calibration Boot before installation.**

To put the logger in place, place your foot on the sediment and gently lower the logger until it rests on the top of your foot, then use your foot to lift the logger so it is situated between 10-15 cm from the bottom (this approach keeps you dry). Once the logger is at the correct depth, tie its rope to the stake. If you use smooth stakes, you may need to add a clamp to the stake to hold the cord in position.

Make a note (on the datasheet) of the time the loggers were placed in and taken out of the water. Also, make a note about features of the vegetation zone in which the loggers were placed (as per the pressure loggers above).

Light Loggers

Using a zip tie, attach the logger to top of the fyke net frame, ensuring that the logger is submersed approximately 10 cm below the water surface. The light readings will allow us to

determine when dawn and dusk occurs, which will be useful in helping to interpret temperature and DO changes.

Make a note (on the datasheet) of the time the logger was placed and removed. Also, make a note of the dominant vegetation zone the loggers were placed in.

Sending Data

The steps to offload the data from the different loggers can be found in the appendix. Data should be sent as the .hobo file with the file name with all the site codes contained in the file, and what the logger was recording.
Ex. 5709_5585_Water

In addition, please send a scanned or photographed copy of your field data sheets so that we have the weather, vegetation, and fish information, logger deployment and retrieval times, and GPS coordinates.

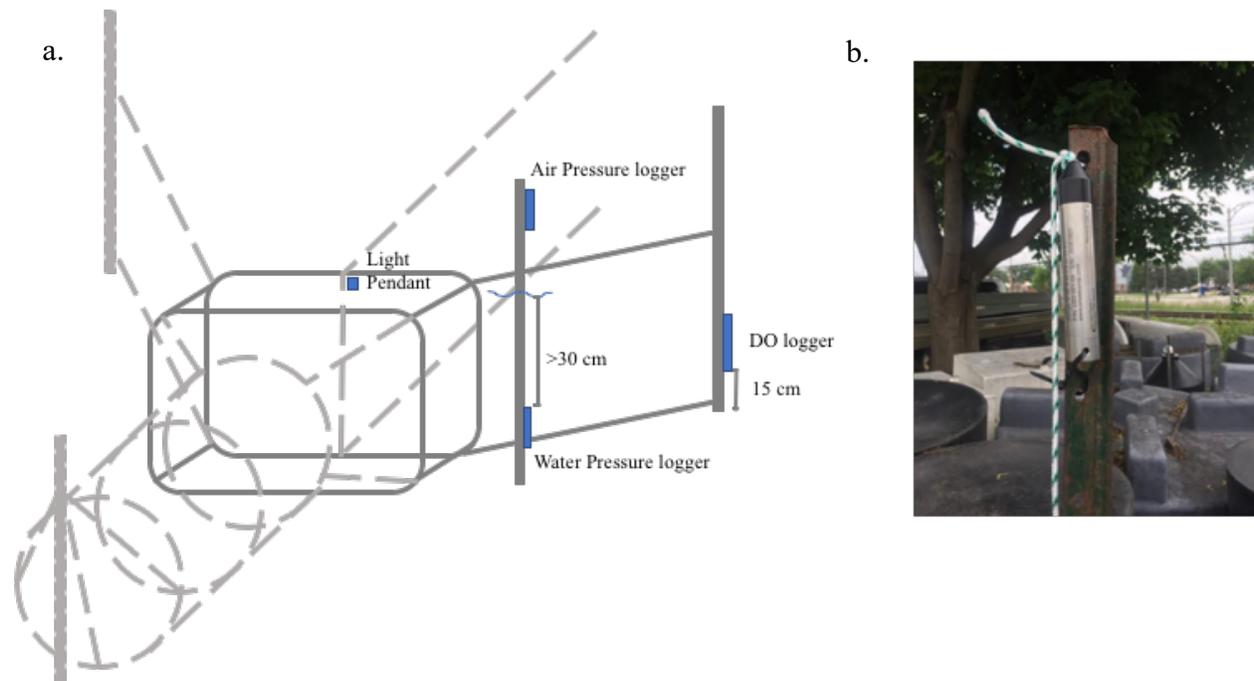Files should be sent to cshrimpt@uwindsor.ca at the earliest convenience.

Figure 1a: Diagram of a fyke net with logger locations shown. 1b: An example of a secured logger. A pressure logger secured to a stake with zipties and with bright buoyant cord attached.

Appendix

<u>Water-Level Logger</u>

Logger Setup

Before going into the field, you need to download the HOBOware software. Initializing, calibrating, launching, and uploading data from the loggers can be done with the free version, available for download to PC and Mac at: https://www.onsetcomp.com/hoboware-free-download. This site also contains a link to the HOBOware User's Guide for more information.

Connecting Water-Level Logger to Computer

In order to connect the loggers to the computer so you can start logging, check status, etc. follow these steps.

Step 1: Open HOBOware Software

Step 2: Attach the HOBO shuttle USB to the shuttle and your computer (you have to unscrew the white shuttle top in order to plug the USB in). The program should show that the shuttle is connected

Step 3: Attach the HOBO U20 Logger to the HOBO U20 Coupler (there is a small flat side on the logger that fits specifically in the coupler)

Step 4: Attach the HOBO U20 Coupler/Logger to the shuttle (some extra force may be needed to slide the coupler on tight to the shuttle)

Step 5: Press (lightly) on the black lever on the side of the coupler to determine the status (Red light = failed connection, Yellow = connecting, Green = connected)

Step 6: Once the light is green you should see the logger ID at the bottom of the HOBOware program.

Step 7: At this point the logger is connected and you can begin the launching/offloading process.

Checking Water-Level Logger Status

In order to check the battery life of your logger, memory storage, last launched, logging interval or the unit, and current status of the logger, follow these steps. Follow 'Connecting Water-Level Logger to Computer' if you have not done so then proceed with the further steps.

Step 1: Click on 'Device' in the menu bar

Step 2: Click on 'Status'

Step 3: This opens a new tab with all the information about your logger.

Launching Water-Level Loggers for Sampling

Prior to a sampling it is possible to pre-program the loggers to begin recording on a certain date and time. The next steps show how to do so. Follow 'Connecting Water-Level Logger to Computer' if you have not done so then proceed with the further steps.

Step 1: Click on 'Device' in the menu bar

Step 2: Click on 'Launch'

Step 3: In the 'Name:' section, type if the logger is going in the 'Water' or 'Air'

Step 4: Under 'Sensors', check both the 'Absolute Pressure' and 'Temperature' boxes

Step 5: Under 'Logging Interval' select '15 minutes' in the drop-down menu

Step 6: Beside 'Start Logging' click 'On Date/Time' and using the drop-down menus that appear beside it, choose the date and time when you will be sampling. To make all data universal the start time should be 5:00am the day you are expected to sample.

Step 7: Click on 'Delayed Start' at the bottom to launch.

Step 8: After Step 7, leave the logger plugged in until the programming has completed. Then you are able to remove the logger from the coupler. Repeat this with the same date, time, and time interval for the other logger. It is imperative that both devices are logging at the same intervals and start times to make organization and manipulation of data easier.

Uploading Data from Water-Level Loggers

After loggers have been taken from a site, make sure there is no debris on the devices before attaching it to the coupler. Follow 'Connecting Water-Level Logger to Computer' if you have not done so then proceed with the further steps.

Step 1: Click on 'Device'

Step 2: Click on 'Readout'

Step 3: A tab will open asking to 'Stop Logging', Click 'Ok'

Step 4: A new tab will open that will allow you to save the data

Step 5: Save the file with all the site codes contained in the file, and if the logger was recording Water or Air.

Ex. 5709_5585_Water

Step 6: Choose the location of the file on your computer with the drop-down menu beside 'Where' (I recommend having a single folder with all other depth data to minimize the risk of misplacing data)

Step 7: Click 'Save'

Step 8: To be safe, it is a good idea to find the file and open it to make sure the data is there.

Step 9: Once you have saved the file, a new tab will open to allow you to view the data in the HOBOware program.

Step 10: In the 'Select Series to Plot' section, select which units you want to see the data in (variety of pressures and Celsius or Fahrenheit)

Step 11: Under 'Select Internal Logger Events to Plot' click on 'All' icon

Step 12: At the bottom of the tab, select 'Plot'

Step 13: This will instantly plot the data on a graph for you and show the table data above it. This will allow you to make sure the data is there, started at the correct time and ended at the correct time. It also allows you to visually see the pressure changes over the time of sampling.

Dissolved-Oxygen Logger

Logger Setup

Before going into the field, you need to download the HOBOware software. Initializing, calibrating, launching, and uploading data from the loggers can be done with the free version, available for download to PC and Mac at: https://www.onsetcomp.com/hoboware-free-download. This site also contains a link to the HOBOware User's Guide for more information.

Initialization instructions come with new loggers and sensor caps.

Connecting DO-Logger to Computer

In order to connect the loggers to the computer so you can start logging, check status, etc. follow these steps.

Step 1: Open HOBOware Software

Step 2: Attach the HOBO shuttle USB to the shuttle and your computer (you have to unscrew the white shuttle top in order to plug the USB in). The program should show that the shuttle is connected

Step 3: Attach the HOBO U26 Logger (unscrew end that comes to a point, not the sensor end) to the HOBO U26 Coupler. There is a small indent with an arrow and the word 'align'. Make sure this lines up with the 'align' arrow on the coupler.

Step 4: Attach the HOBO U26 Coupler/Logger to the shuttle (some extra force may be needed to slide the coupler on tight to the shuttle)

Step 5: Press (lightly) on the black lever on the side of the coupler to determine the status (Red light = failed connection, Yellow = connecting, Green = connected)

Step 6: Once the light is green you should see the logger ID at the bottom of the HOBOware program.

Step 7: At this point the logger is connected and you can begin the launching/offloading process.

Checking DO-Logger Status

In order to check the battery life of your logger, memory storage, last launched, logging interval or the unit, and current status of the logger, follow these steps. Follow 'Connecting DO-Logger to Computer' if you have not done so then proceed with the further steps. The first time the logger is connected to the computer, when you check the status you will have to initialize the cap (It will pop up and ask to initialize).

Step 1: Click on 'Device' in the menu bar

Step 2: Click on 'Status'

Step 3: This opens a new tab with all the information about your logger.

Calibrating DO-Loggers for 100% Water-Saturated Air

Loggers should be calibrated before the first deployment or after a sensor cap has been replaced.

Step 1: Click on 'Device' in the menu bar

Step 2: Click on 'Lab Calibration'

Step 3: Enter 760.00 mmHg for the value of barometric pressure, check the 'if using sea level barometric pressure' and enter your elevation. This can be found on Google Earth or Google.

Step 4: Wet the small sponge with water, squeeze out excess, and place in calibration boot. Place the boot on the logger with 1cm overlap between the boot and the body of the logger

Step 5: Wait approximately 15 minutes for the logger to reach equilibrium. Click the 'Get DO value from the logger' button occasionally to check for fluctuation. When the value remains the same, the logger is at temperature equilibrium.

Step 6: When equilibrium is reached, click 'Next'

Step 7: Click 'Skip this Step' for the 0% Saturation

Step 8: Click 'Send Calibration to Logger.' Now that the logger is calibrated, you can close the window.

Launching DO-Loggers for Sampling

Prior to a sampling it is possible to pre-program the loggers to begin recording on a certain date and time. The next steps show how to do so. Follow 'Connecting DO-Logger to Computer' if you have not done so then proceed with the further steps.

Step 1: Click on 'Device' in the menu bar

Step 2: Click on 'Launch'

Step 3: In the 'Name:' section, type A1 since you will be placing the logger in the first net within the first dominant vegetation zone. If you have multiple loggers follow the same labelling system. For example, if you have a DO logger on the second net in the second vegetation zone it should be labelled B2. Therefore, labelling the vegetation zones A, B, C, etc. and the net number 1, 2, or 3.

Step 4: Under 'Sensors', check both the 'Dissolved Oxygen Concentration' and 'Temperature U26' boxes

Step 5: Under 'Logging Interval' select '15 minutes' in the drop-down menu

Step 6: Beside 'Start Logging' click 'On Date/Time' and using the drop-down menus that appear beside it, choose the date and time when you will be sampling. To make all data universal the start time should be 5:00am the day you are expected to sample.

Step 7: Click on 'Delayed Start' at the bottom to launch.

Step 8: After Step 7, leave the logger plugged in until the programming has completed. Then you are able to remove the logger from the coupler. Repeat this with the same date, time, and time interval for the other logger. It is imperative that all devices are logging at the same intervals and start times to make organization and manipulation of data easier.

Uploading Data from DO-Loggers

After loggers have been taken from a site, make sure there is no debris on the devices before attaching it to the coupler. Follow 'Connecting DO-Logger to Computer' if you have not done so then proceed with the further steps.

Step 1: Click on 'Device'

Step 2: Click on 'Readout'

Step 3: A tab may open asking to 'Stop Logging', Click 'Ok'

Step 4: A new tab will open that will allow you to save the data

Step 5: Save the file with all the site codes contained in the file, and the logger name
Ex. 5709_5585_A1

Step 6: Choose the location of the file on your computer with the drop-down menu beside 'Where' (I recommend having a single folder with all other DO data to minimize the risk of misplacing data)

Step 7: Click 'Save'

Step 8: To be safe, it is a good idea to find the file and open it to make sure the data is there.

Step 9: Once you have saved the file, a new tab will open to allow you to view the data in the HOBOware program.

Step 10: In the 'Select Series to Plot' section, select which units you want to see the data in (mg/L or ppm and Celsius or Fahrenheit)

Step 11: Under 'Select Internal Logger Events to Plot' click on 'All' icon

Step 12: At the bottom of the tab, select 'Plot'

Step 13: This will instantly plot the data on a graph for you and show the table data above it. This will allow you to make sure the data is there, started at the correct time and ended at the correct time. It also allows you to visually see the DO changes over the time of sampling.

Logger Checklist

Tool	Check
2 HOBO 13-Foot U20-001-04 Fresh Water Level Loggers	
HOBO Waterproof Shuttle	
HOBO Waterproof Shuttle USB	
HOBO Waterproof Shuttle Spare AA Batteries (device needs 2)	
Field computer with HOBOware software for offloading data	
HOBO U20 Coupler	
HOBO U20 Replacement Coupler (if needed)	
Bright coloured buoyant rope to place on both loggers	
2 cables (zip ties) at each end of both U20 Loggers (4 cables total)	
Spare cables (zip ties)	
Stake clamps if using a smooth stake (1 for each logger)	
Stake to attach U20 Loggers to	
Site Datasheet with Logger In/Out Times, Vegetation Zones, and Weather Conditions	
HOBO U26-001 Dissolved Oxygen Logger (if acquired)	
HOBO U26 Coupler (if acquired)	
HOBO U26 Replacement Sensor Cap (if acquired)	
HOBO UA-002-64 Pendant Temp/Light Logger (if acquired)	
HOBO Pendant Coupler (if acquired)	
HOBO Pendant Coupler Base Station (if acquired)	
Rubbermaid Bin (or other water proof container) to put all devices in	