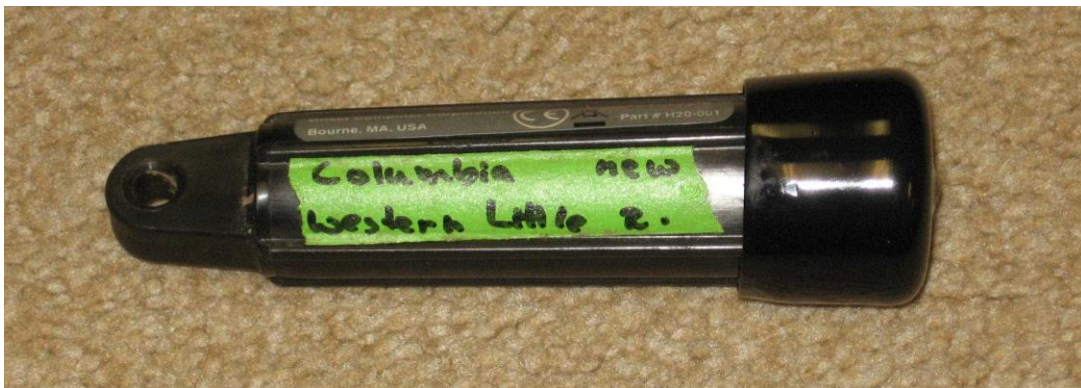


Protocols for Measuring Continuous Water Temperature Using an Onset Data Logger



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Standard Operating Procedure
Protocols for Measuring Continuous Water Temperature
Using an Onset Data Logger

1. **Applicability.** This standard operating procedure (SOP) applies to the collection and analysis of continuous water temperature data from wadeable rivers and streams and freshwater wetlands in Maine using HOBO temperature loggers from Onset Computer Corporation.
2. **Purpose.** The purpose of this SOP is to provide standardized methods for collecting and processing continuous water temperature data from wadeable rivers and streams and freshwater wetlands in Maine.
3. **Definition.** Continuous water temperature data are those that are collected at certain time intervals (e.g., every 10 or 30 minutes) for an extended period of time (e.g., 4-6 weeks) using an electronic temperature logger deployed in a waterbody.
4. **Responsibilities**
 - A. **Training.** It is the responsibility of the task manager for whose project temperature data are collected to ensure that the individual(s) using the loggers are familiar with this SOP.
 - B. **Tracking of temperature logger usage.** It is the responsibility of the individual launching, deploying, or retrieving a logger to note these activities on the relevant tracking forms and/or field sheet; this is especially important if a logger is to be deployed and retrieved by different groups (i.e., algae *versus* macroinvertebrate staff). It is the responsibility of the task manager to place completed tracking forms and/or field sheet in the appropriate folder located in the Biomonitoring staff area.
 - C. **Data retrieval and processing.** It is the responsibility of the task manager or the staff member retrieving/processing the data to note these activities on the relevant tracking forms (see 5. D. (2) viii., below).



5. Guidelines and Procedures

- A. Measurement period. In the majority of cases, temperature data will be collected concurrently with the sampling of algae and/or macroinvertebrates during the late spring and/or summer months (low flow period in rivers and streams).
- B. Materials
- (1) Launched temperature logger, labeled with deployment location (if known).
 - (2) Cable ties, nylon (not cotton) rope, steel cable, brick (preferably with holes), and rebar where appropriate, to anchor logger in deployment location.
 - (3) Lengths of PVC pipe (~6 inches) to shade and protect logger. PVC pipe has 2 holes drilled at one end to allow it to be secured to the logger with cable ties.
 - (4) Appropriate field sheet to note deployment/retrieval of logger.
 - (5) Colored flagging tape to mark logger and its location.
- C. Precautions and limitations. The HOBO Water Temp Pro is only suitable for measurements in the range of 32°F to 122°F (0°C to 50°C).
- D. Procedures
- (1) Pre-deployment logger precision test. Prior to each sampling season, all temperature loggers must be tested for precision according to the procedures outlined in the Protocols for Testing Temperature Logger Precision (App. A).
 - (2) Pre-deployment logger launch
 - i. Connect the HOBO Optic USB base station to a host computer with HOBOWare Pro software installed on it.
 - ii. Plug a logger into base station's coupler, being careful to align the white arrow on the logger with the white arrow on the base station.
 - iii. Open HOBOWare Pro software program. Check the lower left corner of the window to ensure the program is recognizing the sensor (it should read "Dev: HOBO U22-001 Water Temp, S/N: xxxxxxxx), where "xxxxxxx" is the 7-digit number specific to the sensor's ID. In the lower right corner of the window, there should be a message saying "1 device connected".
 - iv. Launch the device using either the pull down menu (Device > Launch) or the icon ("Launch device").
 - v. In the "Launch Logger" window, check:
 - (a) the Battery State (it should read "Good"),
 - (b) Description ("test" if you're doing the pre-season precision test; water body name, station number, and town if launching for field deployment, if known; use a unique numeric identifier if planned launch location is not known),
 - (c) Logging Interval (it should be 10 minutes),
 - (d) Set 'Start Logging:' to the desired date and start time for launching).



- (e) When finished, click on “Delayed Start”.
 - vi. Unplug the sensor from the coupler once the “Launching Logger” message window disappears. To ensure the sensor launched, look for a small, red LED light in the sensor’s window to flash every five seconds or so.
 - vii. Repeat steps i-vi with the remaining sensors.
 - viii. Enter logger type, number and launch info (start date and time, initials of MDEP staff who launched logger, measurement interval, planned deployment location) in Appendix B, the logger tracking file (Augusta H...\Biomonitoring\SOPs-Instructions\BIOMON TRACKING LISTS\Tracking temp loggers.xls). Using tape, label temperature logger with planned deployment location, i.e. waterbody name, town, station number or ‘new (station)’, and a descriptor such as ‘above’ or ‘below’ if necessary.
- (3) Logger deployment
- (a) Determine a suitable site for deployment in line with the program’s objectives. In general, the logger should be deployed near the sample location in an area that is likely to stay inundated throughout the sampling period.
 - (b) Attach logger (with the sensor end down) with a cable tie, nylon (not cotton) rope, or steel cable to a suitable deployment point, for example:
 - i. a sturdy structure such as a large tree root;
 - ii. a rebar stake driven into the substrate;
 - iii. one of the sampling devices (e.g., rock bag). This is the preferred method if the site is being sampled for river and stream macroinvertebrates.
 - iv. a brick placed on the substrate. Attach flagging to the brick and run a length from the brick to the water surface and attach to sturdy nearby vegetation.
 - v. If options (i) – (iv) are not available, the task manager should use his/her best judgment to find a suitable attachment point.
 - (c) If the deployment location is in a sunny area, the logger should be secured within a length of PVC pipe or shaded in some other way.
 - (d) The Hobo Water Temp Pro loggers tend to float and steps must be taken to ensure the logger remains completely submerged throughout the sampling period. For example, the logger could be placed under a boulder or within a length of PVC pipe with both ends secured so one end does not float.
 - (e) To aid in logger retrieval, make a drawing on the field sheet indicating logger location and note location (e.g., attached to rock bag). If deemed necessary, the area of deployment can also be flagged or marked with colored flagging tape, or the GPS coordinates of the location, if available, can be recorded.



- (f) Note logger number and indicate that the probe was deployed on the applicable field sheet. Make sure to note if the logger was deployed in a different location than planned.
 - (g) Back at the MDEP office, enter deployment information in the temperature logger tracking file (App. B).
- (4) Logger retrieval
- (a) Locate the logger utilizing drawing, notes, flagging, marking, or GPS coordinates as available/necessary. Retrieve logger and note that it was retrieved on the applicable field sheet.
 - (b) Keep logger in a safe location and return it to the MDEP office for data retrieval and processing.
 - (c) Back at the MDEP office, enter retrieval information in the logger tracking file (App. B).
- (5) Data retrieval
- (a) Set up the folders that will be needed to save the various file formats. In each location below create the following folders: 'csv files', 'excel files', 'HOBO files', and 'Grapher graphs'
 - i. For river and stream data create the folders here: Augusta
H:L&W\WATERSHED\Monitoring & Assessment\Program\Biomonitoring\STREAM DATA\H2OTEMPS\
(appropriate year) data\Stream Data\
ii. For wetland data save the file here: Augusta
H:L&W\WATERSHED\Monitoring & Assessment\Waterbody Type\Wetlands\DATA\HOBO data\ (appropriate year)\
 - (b) Connect HOBO Optic USB base station to a host computer that has the HOBOWare Pro software installed.
 - (c) Plug a logger into the base station's coupler, being careful to align the white arrow on the logger with the white arrow on the base station.
 - (d) Open HOBOWare Pro software program. Check the lower left corner of the window to ensure the program is recognizing the sensor (it should read "Dev: HOBO U22-001 Water Temp, S/N: xxxxxxxx), where "xxxxxxx" is the 7-digit number specific to the sensor's ID. In the lower right corner of the window, there should be a message saying "1 device connected".
 - (e) Start the readout procedure using either the pull down menu (Device > Readout) or the icon ("Readout device").
 - (f) A warning window will pop up, confirming whether you want to stop logging in order to read out the data; click "Stop".
 - (g) Save the file in the HOBO files folder, see 5. D. (5) (a) above, and use this naming formula: "waterbody name_site number_town.hobo; if a site number has not yet been assigned, say 'Snew' and add descriptor, e.g., 'upstream' or 'below_POTW' if necessary.
 - (h) In the "Plot Setup" window, select degrees C in the "Units" pull down menu. Next to the window titled "Select Internal Logger Events to Plot"



- click “None”, then click the “Plot” button. This will create a graph of all data records collected.
- (i) Click on File > “Export Points as Excel Text” or “Export Table Data”, depending on the software version. A window may pop up with a radio button selected for “Export to a single file”; click on “Export”.
 - (j) In the “Save” window, navigate to the ‘csv files’ folder, see 5. D. (5) a, above, and give the .csv file the same name as the .hobo file; click on “Save”.
 - (k) Repeat steps (b) – (j) with the remaining sensors.
 - (l) Enter the data retrieval date and your initials into the temperature logger tracking file (App. B).
- (6) Data processing
- (a) Converting data in an Excel file:
 - i. With desired csv file open in Excel, delete row 1 (Plot Title:...), and column A (#, 1, 2, 3....)
 - ii. To determine the correct subset of all temperature data collected to be uploaded into EGAD, find the date when the logger was deployed and when it was retrieved by looking at either
 - (a) the field sheet,
 - (b) the logger tracking file (Augusta H:..\\Biomonitoring\\SOPs-Instructions\\BIOMON TRACKING LISTS\\Tracking temp loggers.xls) – the easiest option
 - (c) or MESA 2.
 - iii. Trim data in the Excel file to include data from midnight (12:00 AM) the day after the logger was deployed to the midnight (12:00 AM) of the day logger was retrieved. For example, if a logger was deployed on July 15 and retrieved on August 15, the data will include some records from before and after the logger was in the water. Select and delete the data from the first record to midnight July 16. Select and delete the data from midnight August 15 to the last record.
 - iv. Save as an excel worksheet (.xlsx) in the appropriate folder see 5. D. (5) a, above.
 - (b) To upload temperature data into EGAD please see Protocols for Uploading Temperature Data into EGAD (App. C).
 - (c) To get the temperature data out of EGAD, create a graph of the data and use the graphs in the Biomonitoring portion of the annual SWAT report please see Protocols for Exporting Temperature Data and creating Graphs and Image Files (App. D).

6. Care and Maintenance



- A. After use, clean the loggers using non-abrasive, mild, antibacterial soap and warm water with a non-scratching sponge or cloth. Any scratches on a logger's communication window may impair downloading of data. If necessary a plastic polish may be used for tougher cleaning jobs.
 - B. Be sure to keep the logger free from dirt and dust when not in use.
7. **QA/QC Procedures.** At the start of each sampling season, all temperature loggers must be tested for precision using the procedure outlined in the Protocols for Testing Temperature Logger Precision (App. A).

8. References

HOBOWare Pro User's Manual, Onset Computer Corporation, Bourne, MA
HOBO Water Temp Pro User's Manual, Onset Computer Corporation, Bourne, MA