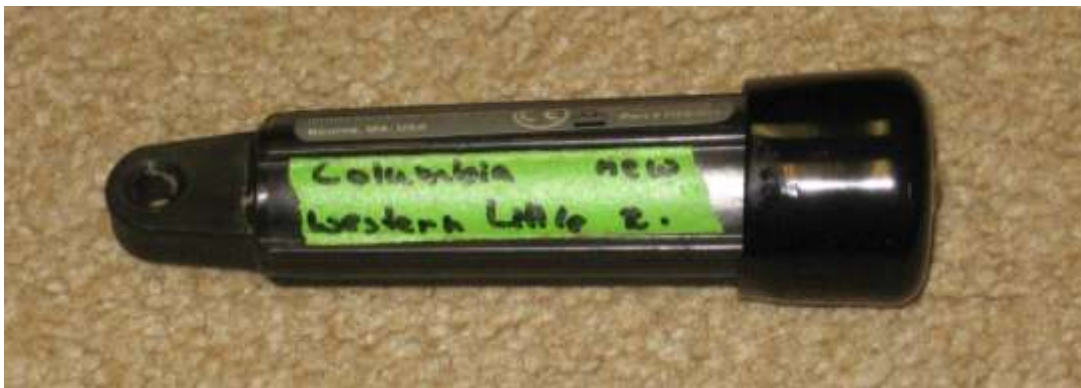




Protocols for Measuring Continuous Water Temperature Using an Onset Data Logger



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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. When all data have been processed, these forms will be printed out and included in the Biomonitoring unit's QAPP folder.



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.
 - (2) Cable ties, nylon (not cotton) rope, steel cable, brick, 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) Color-coded flagging tape to mark logger 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).
NOTE: Temperatures in the fume hood are not stable...expect to see an increase of approximately 1 degree Celsius over a 2-hour testing period (noticed during 2008 test, also found in 2007 data).
 - (2) Pre-deployment logger launch
 - i. Connect the HOBO Optic USB base station to a host computer with HOBOWare Pro v 2.3.0 or v 3.0.0 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: 109xxxx", where "xxxx" is the 4-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"). In the "Select Device" window, which has a radio button selected for "HOBO U22-001 Water Temp, S/N: 109xxxx", click "OK".
 - v. In the "Launch Logger" window, check the Battery State (it should read "Good"), Description ("test" if you're doing the pre-season precision test; water body name, station number, and town if launching for field deployment - use this format:



- ‘SheepscotR_S74_Whitefield’ and ‘Str’ for Stream, ‘Bk’ for Brook, ‘Ck’ for Creek), Logging Interval (it should be 10 minutes), and Launch Options (choose “Delayed” and enter the date and start time for launching). When finished, click on “Launch”.
- vi. Unplug the sensor from the coupler once the “Launch successful” message appears in the lower left-hand corner of the HOBOWare Pro window. 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 the logger tracking file <H:\Biomonitoring\SOPs-Instructions\BIOMON TRACKING LISTS\Tracking temp loggers.xls> (App. B). 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



- color-coded 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
- i. Connect HOBO Optic USB base station to a host computer that has the HOBOWare Pro v 2.3.0 or v 3.0.0 software installed.
 - ii. 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.
 - 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: 109xxxx), where "xxxx" is the 4-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. Start the readout procedure using either the pull down menu (Device > Readout) or the icon ("Readout device"). In the "Select Device" window, which has a radio button selected for "HOBO U22-001 Water Temp, S/N: 109xxxx", click "OK".
 - v. A warning window will pop up, confirming whether you want to stop logging in order to read out the data; click "Stop".
 - vi. Select location to save data and rename file as appropriate
 - (a) For river and stream data save the file here: Augusta
H:L&W\WATERSHED\Monitoring & Assessment\Program\Biomonitoring\STREAM DATA\H2OTEMPS\ (appropriate year)\Stream Data\dtf and hobo files\, and use this naming formula:
'Pretty_Brook_S####_PrettyTown.dtf'; if station (S) number has not yet been assigned, say 'Snew' and add descriptor, e.g., 'upstream' or 'below_POTW' if necessary.
 - (b) For wetland data save the file here: Augusta
H:L&W\WATERSHED\Monitoring & Assessment\Waterbody



- Type\Wetlands\DATA\HOBO data\ (appropriate year)\csv and hobo files\, and use this naming formula: 'waterbody name_site number'.
- vii. 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.
 - viii. Click on File > Export Points as Excel Text (or Export Table Data in v 3.3.3). A window will pop up with a radio button selected for "Export to a single file"; click on "Export".
 - ix. In the "Save" window, navigate to the appropriate folder (if necessary), see 5. D. (5) vi., above, and give the .csv file the same name as the .hobo file; click on "Save".
 - x. 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. Calculate the maximum temperature, which can be done by selecting an empty cell, typing in =MAX(then selecting all of the temperatures and pressing enter. Add this value to column S in the temperature logger tracking file.
 - v. Save as an excel worksheet (.xls) in the excel folder for the appropriate year, in the appropriate file location, see 5. D. (5) vi., above.



- (b) To upload temperature data into EGAD please see Protocols for Uploading Temperature Data into EGAD (App. C).
- (c) To use temperature data in the Biomonitoring portion of the annual SWAT report please see Protocols for Creating Temperature Graphs and Transferring them into a Word File for the SWAT Report (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
HOBOWater Temp Pro User's Manual, Onset Computer Corporation, Bourne, MA



Addendum - List of edits to existing SOP

SOP section	Old text	New text
<i>Edited in May 2012</i>		
Title Page	Tom Danielson Maine Department of Environmental Protection 17 State House Station Augusta, ME 04333 (207) 287-7728 Thomas.J.Danielson@maine.gov	Beth Connors, Maine Department of Environmental Protection 312 Canco Rd., Portland, ME 04103 (207) 441-6139 beth.connors@maine.gov
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 summer months (low flow period in rivers and streams).	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).