Environment Agency – Wessex Area (South)

Temperature Data Logger Deployment Protocol for the Hampshire Avon Temperature Project 2009

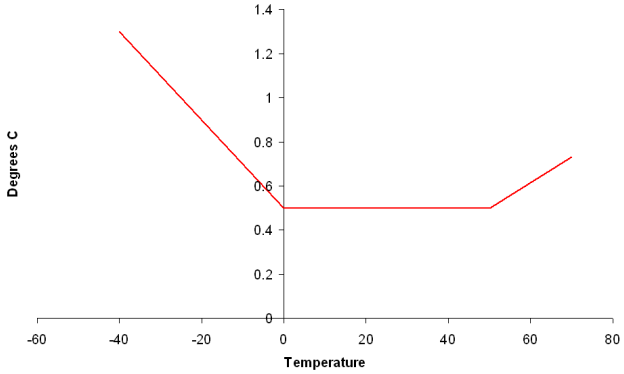
Introduction

The following information outlines the protocol used by the Environmental Monitoring Department for the deployment of temperature data loggers for the Hampshire Avon temperature study 2009. The protocol is intended to provide guidance on the installation, calibration, and maintenance of Tinytag loggers (TG-4100 and TG-2100). The aim of the protocol is to ensure the data collected is representative, accurate and reliable.

Equipment specification

The TG-4100 and TG-2100 data logger specifications are detailed below.

- IP Rating: IP68 water proof (rating is valid only when the unit's lid is securely fitted
  and is valid to a depth of 500m)
- Reading Range (Operational Range*):
  TG-4100 = -40°C to +70°C(-40°C to +158°C).
  TG-2100 = -40°C to +85°C (-40°C to +185°C)
  *The Operational Range indicates the physical limits to which the unit can be exposed, not the reading range over which it will record.
- Case Dimensions:
  TG-4100 = Diameter 51mm, Height 50mm, Weight 90g
  TG-2100 = Diameter 58mm, Height 48mm, Weight 120g
- Battery Type: Renata CR2450N
- Battery replacement Interval: Annually
- Sensor Type: 10K NTC Thermistor (Internally mounted)
- Response Time: <20mins to 90% FSD in moving water
- Reading Resolution: 0.01°C or better
- Reading Accuracy: Approximately 0.5°C with temperatures between 0°C and 50°C (see graph below).
- Total Reading error = 0.51°C



Calibration and Checks

The Tinytag Data Loggers should be calibrated (UKAS traceable) annually whilst they are in operation. The Tinytag manufacturers (Gemini Data Loggers) provide a calibration service in-house which includes a UKAS traceable certificate of calibration.

In addition to this calibration checks upon deployment and retrieval are used to check and document logger bias and performance to assure the quality of the data. See Appendix A for the temperature check record sheet.

The pre-deployment bias checks are completed in advance of logger deployment and the post-deployment checks are done shortly after the sampling results have been downloaded and backed up.

Calibration check method

Temperature loggers undergoing a bias check in a water bath should be programmed for a *delayed start* and set to record *point measurements* every minute. The checks subject the temperature loggers to at least two water temperature ranges that bracket the expected sampling range (between 25-30℃ and 0-5℃).

A calibrated (NIST traceable) thermometer should be used to record the water temperature. Temperature logger readings should be within acceptable limits at each of the two temperature ranges. The temperature loggers should be given about 120 minutes of acclimatisation time after they have been transferred into a water bath.

The accuracy of the temperature loggers should be equal to or less than 0.2℃. If a temperature logger fails a post-sampling calibration check, then another calibration check must be performed. If it fails a second calibration check, then the raw data should be adjusted accordingly.

Deployment Procedure

Temperature profiling

In order to ensure that the temperature data collected is representative of the cross-section it is necessary to determine and record the temperature profile of the deployment site.

First make a cross-section temperature profile to determine if there is any significant temperature variability across the river section using a hand-held YSI 556 meter. Take measurements at as many points across the river cross-section as is necessary, using at least three points, including one in the main flow. At each point record the water temperature 15-30cm from the river bed, and approximately 30cm the surface. This process will be repeated at each logger retrieval and re-deployment, and under different flow regimes 1-2 times over the deployment period.

Prior to or during the deployment process, all field data including site name, logger ID numbers, and water temperature measurements obtained during profiling with a YSI 556 need to be noted on a deployment/retrieval record sheet (Appendix B).

Installation

The next step is to find a deployment location in the watercourse where representative stream temperature data may be obtained but that is safe to get to under all reasonable flow conditions

Loggers should not be in direct contact with a large thermal mass i.e. bridge. Loggers are housed within a black plastic tubing punctured with holes to create shading and avoid any heating effects from direct sunlight, whilst allowing water flow through.

In all rivers especially small streams, loggers should be installed as close to the main flow as possible and between 15 and 30cm off the bottom depending on the water depth, to avoid any direct contact with the bed. In large streams, areas of potential temperature stratification (resulting from eddies, groundwater, and tributaries) need to be avoided. Loggers should be situated where they will remain submerged during low flows, but also accessible during high flows, and at least 30cm below the surface where possible.

The preferred method of deployment is to attach the logger to a suitable existing structure. Alternatively a metal stake, a concrete block or weight can be used as an anchor point on the river bed.

Retrieval Procedure

First make a cross-sectional temperature profile of the river section using a hand-held YSI 556 meter. The water temperature measurements, the depth of the water temperature logger, and any other observations need to be noted on the deployment/retrieval record form (see Appendix B).

Downloading Procedure

The temperature loggers should first be gently cleaned to remove any biofouling or sediment that may affect its ability to communicate optically during the downloading process. The preferred way is to use a little water and a soft cloth or soft bristled brush.

The loggers should then be connected and downloaded following the manufacturers' procedures.

Maintenance

If deployed for long periods, the logger's battery should be replaced annually to prevent the loss of data during a recording run. If the logger is being used frequently, the battery should be changed when prompted by a low battery warning from theTinytag Explorer software. Please refer to the manufacturer's service kit instruction sheet for battery replacement instructions. Gemini Data Loggers also provide servicing of data loggers in-house including battery change.

Quality Control Procedures

Each data logger must have a current valid UKAS calibration certificate.

The accuracy of the temperature loggers should be verified by evaluating the results of pre- and post-deployment calibration checks. If the results indicate a consistent bias of more than 0.2º C, then the raw data should be flagged with the appropriate data qualifier. The data may also be adjusted by the mean difference of the pre and post calibration check results to correct for the instrument bias.

Water temperature data, recorded prior to deployment and after retrieval, must be identified and deleted from each raw data set based on the information noted on the deployment record form (deployment/retrieval times and temperatures).

Anomalous data may then be identified by reviewing a plot of the water temperature results. Identified data anomalies then may be deleted from the record provided the reason has been noted on the deployment record form for the site and also noted in the electronic version of the data record.

References

Further information can be found from the USGS website regarding deployment protocol (http://www.ecy.wa.gov/biblio/0303052.html). In addition Forest Research (Forestry Commission) have produced a standard operating procedure for the use of Tinytag Plus loggers, document ref:SOP0314.

Appendix A - Temperature checks

Pre-deployment:

Date: _____ Officer:_____

Ambient (25-30 degC)

Time	YSI 556 No.	Calibration Thermometer	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.

Cool (0-5 degC)

Time	YSI 556 No.	Calibration Thermometer	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.

Post Deployment:

Date: _____ Officer:_____

Ambient (25-30 degC)

Time	YSI 556 No.	Calibration Thermometer	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.

Cool (0-5 degC)

Time	YSI 556 No.	Calibration Thermometer	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.	TT Serial No.

Appendix B – Deployment / Retrieval* record (* delete as appropriate)

Site name: _____ **Date:**_____ **Officer:**_____

Data logger serial no:_____ **Logger depth (m):**_____ **YSI 556 serial no:**_____

	Point 1	point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8
Position: NGR/post no./ distance from L/R bank								
Near bed measurement (degrees C)								
Near surface Measurement (degrees C)								

Other observations: