Contents

BACKGROUND

This handbook was developed by Trout Unlimited scientists in collaboration with TU's Western Native Trout Workgroup. Our intent is to encourage chapter-based stream monitoring programs around the country. Stream temperature data are relatively easy to collect and can be very informative for developing sound trout and salmon management programs. Chapter-based stream monitoring projects achieve multiple goals for Trout Unlimited. First, data on stream temperature provides relevant scientific information that can help determine stream temperature trends, stream and riparian condition, and project effectiveness. Second, as chapters gather temperature data from their streams, they form a closer connection to the streams themselves as they gain a better appreciation for how these systems work. This handbook provides the nuts and bolts of where, when, and how to accomplish the goal of temperature monitoring in your local area. We hope you will agree that temperature monitoring is relatively easy, fun and informative.

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INTRODUCTION

Why Monitor?

We all know that trout and salmon need cold water, but what is the best method for figuring out if your favorite fishery has suitable temperatures in the face of climate change or other stressors? Or that your climate adaptation project is keeping stream temperatures cool? The answer: **monitor stream temperature**. Monitoring stream temperature is relatively cheap and easy to do, and it can

> **WHAT IS MONITORING?** Monitoring is the observation of something over time, usually at a regularly defined interval, on an on-going basis for the purpose of evaluating:
>
> - **Baseline conditions**: Assessing patterns of condition across time at single or multiple sites.
> - **Long-term trends**: Tracking trends across watersheds using year-round, long-term observations over multiple years and across a large network of sites.
> - **Project impacts**: Collecting observations before and after actions such as restoration.
> - **Legal compliance**: Ensuring conditions comply with state and federal regulations.

provide valuable insights into restoration effectiveness, environmental compliance, and fishery potential among other things (see Box above). Now that you know why you should be monitoring, two important considerations are *when* and *where* to monitor.

When to Monitor?

Stream temperature fluctuates throughout the day and from day to day, both of which are important to consider when deciding when and where to monitor. Because water warms and cools less quickly than air, stream temperature only loosely corresponds to air temperature. Fluctuation in stream temperature can be more than 10°F in summer, change by season, and depend on groundwater influences.

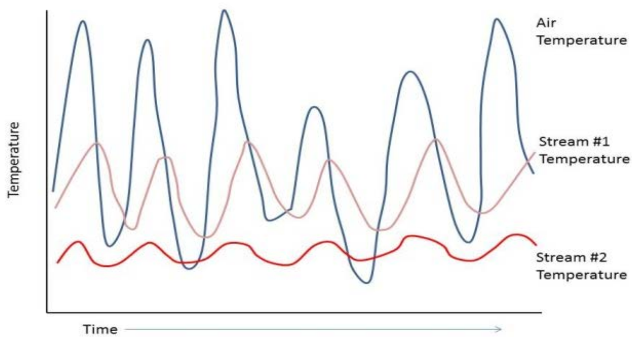

FIGURE 1. RELATIONSHIP BETWEEN AIR TEMPERATURE, A SURFACE-FLOW STREAM (#1), AND A SPRING-FED STREAM (#2).

The simplest means for monitoring stream temperature is to take a single measurement with a thermometer, capturing a “snapshot” of the stream’s ambient thermal condition. Keep a thermometer with you for any trip to the water and take a stream’s temperature – you’ll soon be able to calibrate what you feel while fishing with a real measure of water temperature. During critical periods – especially when warm air temperatures coincide with low flow – these spot checks can be a useful means determining when fish might be stressed.

A more robust method of stream temperature monitoring requires capturing information across days, seasons, or years to provide a long-term perspective on water temperature variability and trends. This continuous monitoring method ensures that daily fluctuations and peak temperatures are captured and allows for calculation of other metrics that may be critical to trout and salmon (e.g., monthly average temperature, maximum weekly average temperature within a year, winter average temperatures). Many state and federal agencies maintain networks of sensors for continuously monitoring stream temperature. Sources include some

WHAT TROUT PREFER: Trout prefer cold water, often less than 65°F (18°C), and restoration projects often target improving temperatures for trout by limiting solar radiation through riparian restoration and by restoring streamflows.

USGS stream flow gages or your state agency responsible for monitoring compliance with the US Clean Water Act's "fishable" waters clauses and temperature standards. Most of these monitoring stations, however, are not located in important native trout streams, which typically are higher elevation headwater streams.

If you have a specific objective that is driving your interest in monitoring stream temperature, you should establish your own network of continuously monitored temperature using underwater temperature data loggers deployed at times and locations designed to meet your monitoring objectives (see Defining Monitoring Objectives). Temperature loggers are compact gadgets that are widely available, affordable, reliable, and are essentially a waterproof thermometer and memory chip. Data loggers are typically deployed in secure locations using rebar, aircraft cable, underwater epoxy or other means that can withstand floods and active stream channels. As a compliment to water temperature data, it can be a good idea to place an additional logger on a tree or other well-shaded locations to collect air temperature. These data allow you to draw conclusions about the relationship between air and water temperatures.

Where to Monitor?

Now that you've considered *when* to monitor stream temperature, the next important question is deciding *where* to monitor. Small streams are often well-mixed, but stream temperature can still vary across short stretches of stream depending on influences of groundwater, tributary junctions, turbulence, slack-water areas, and shading. These influences are amplified as you look from a single stretch of stream to the pattern of stream temperature within or across watersheds (see Defining Monitoring Objectives and Site Selection sections below).

To gain an understanding of your local fishery's existing temperature conditions, it may be sufficient to monitor temperature at a few key locations. These key locations could include spawning areas, tributary confluence areas, or deep pools that persist during low flow periods. At any chosen location it is important to consider how representative your point of sampling is

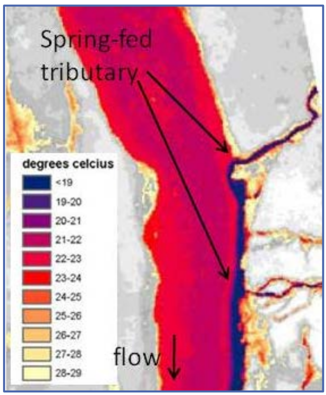

FIGURE 2. TEMPERATURE INFLUENCE OF A SPRING-FED TRIBUTARY.

relative to the larger system, and how local features will influence the information you capture there. For example, solely monitoring shortly below a spring-fed tributary may give an inaccurate portrayal of the temperature in most of the stream whereas monitoring above *and* below the tributary will provide a more accurate picture of the tributary's influence on stream temperature.

A similar network of temperature monitoring may be sufficient for evaluating the effectiveness of a restoration project designed to lower stream temperature or mitigate climate change stresses. By measuring the trend of key metrics such as temperature before and after a restoration project – or even better, measuring before-after trends both above *and* below the project site – you will gain a sense of the magnitude of impact your project has had on stream temperature.

TU CHAPTER MONITORING

Now that you have a basic understanding of the *why*, *when*, and *where* of a temperature monitoring program the next steps focus on the details of explicitly defining your monitoring objectives and understanding the specifics of implementation.

Defining Monitoring Objectives

Using the general guidelines previously discussed, each chapter should determine reasons for monitoring. Is there a trout stream that is particularly important to the chapter? Is temperature an issue now, or will it become an issue in the future? If so, where? If the chapter recently completed a project to restore a native trout population, is this a reason to monitor? Just having knowledge of stream temperature in local streams might be a good reason. Answering these types of questions will help define your objective for monitoring, which is important to explicitly state and write down so that it can be periodically revisited. Some example objectives are:

<u>Objective 1</u>: Determine if Logan River temperature is near the thermal tolerance for Bonneville cutthroat trout.

<u>Objective 2</u>: Collect baseline temperature in the Gunnison River to assess potential climate change trends.

<u>Objective 3</u>: Determine whether decreasing stream width:depth ratio during stream restoration of Trout Run decreased maximum August stream temperature.

<u>Recommendation</u>: Clearly define your objective(s) for monitoring and write them down

some background information before the meeting, such as existing temperature monitoring locations and accessibility of those data.

<u>Recommendation</u>: Identify locations where temperature loggers will best address the monitoring objectives for your chapter's favorite trout fishery

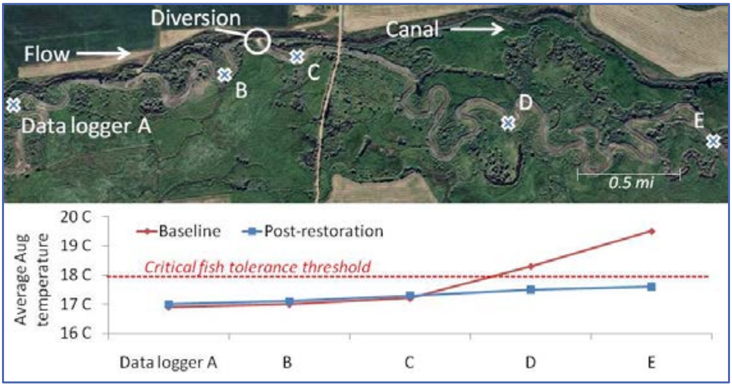

FIGURE 3. MONITORING SITES USED TO EVALUATE THE EFFECT OF STREAMFLOW RESTORATION.

Purchasing Loggers and Other Equipment

One reason for compiling this manual is to create consistency in monitoring programs across TU chapters. There are a number of different temperature loggers available to purchase. Previous versions of this manual recommended the Onset Computer Corporation TidbiT v2 (model: UTBI-001), which collects accurate temperature data for up to 6 years, but has an internal, non-replaceable battery and requires a special shuttle for “launching”, or activating the logger. Onset recently introduced a new series of temperature loggers we are now recommending – the MX series. The MX series has three advantages over the TidbiT v2 – they have a replaceable battery, they can be launched and their data downloaded using a Bluetooth connection and the free Onset HOBOmobile app, and they have a ‘water detect’ feature that can be used for monitoring stream drying and intermittency. Using the TidbiT MX series will be the focus of this manual. Chapters interested in previous versions of this manual which describe use of the Tidbit v2 can find that manual archived on tu.org at https://bit.ly/2vzsRUW

As the MX series loggers have a number of possible configurations available, we recommend consulting Onset documentation carefully to understand the resulting effects on battery life and field procedures for retrieving data before you deploy them. See the logger documentation at www.onsetcomp.com.

Table 1 on the next page shows specifications of the TidbiT MX, Pendant MX, and TidbiT v2 loggers. The primary trade-off between TidbiT MX and Pendant MX loggers is accuracy and resolution of temperature measurements, battery life, and the ‘water detect’ function. Because of the

loggers for $110 each. This is about $220 for a 2-logger system, or $660 for a 6-logger system. The discount is also available for TidbiT v2 UTBI-001 loggers.

Ordering: Go to www.onsetcomp.com/ to order. Reference discount code **TU-15**. For phone orders, call 800-564-4377, and ask for Customer Service. Becky Fish is TU's contact at Onset.

If you need help assembling the necessary equipment, Trout Unlimited staff can help. Contact: Matt Barney, 208-345-9800, mbarney@tu.org.

Onset has 3 software products available for exploring and summarizing monitoring data collected using their data loggers: HOBOmobile (free mobile app), HOBOware (free desktop software) and HOBOware Pro ($99 desktop software). HOBOmobile is required to launch and download data from the MX series loggers and supports simple charting and data export. The desktop HOBOware software provides additional charting features and the free version of HOBOware will likely meet the needs of most chapters - the primary difference between the HOBOware products is the ability to "crop" the data to specific time frames and additional plotting tools. If you find that the free version of HOBOware doesn't meet your needs, it is easy to upgrade to Pro at a later date. Data in the .DTF format is readily exchangeable between versions of HOBOware.

TidbiT MX loggers come with a rubberized boot to protect loggers during deployment. Depending on the conditions of your local site, we recommend some form of additional protection, especially if your monitoring site could experience high flow events. Schedule 40 PVC 1½-inch bushings and caps can be used as a strong housing for the logger if it is taken out of its rubberized boot. Drill ¼ inch holes in the top of the cap to let water circulate through the unit. Drill two $^{11}/_{32}$ inch holes near the base of the bushing for attachment to rebar using ties straps (zip ties). Note that the rubberized boot contains a magnet which must be pressed to the logger to activate the Bluetooth for logger configuration and data transmission, depending on the logger settings. If the loggers are not deployed as "Bluetooth Off Water Detect", then the rubberized boot or another magnet must be used in the field when retrieving data.

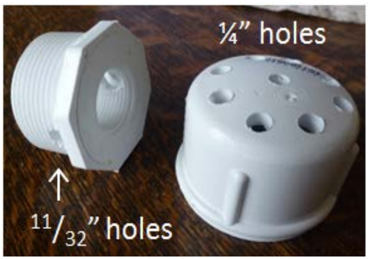

FIGURE 4. HOLES DRILLED IN PVC BUSHING (LEFT) AND CAP (RIGHT).

In addition to the data loggers, other equipment needs include rebar, a sledge hammer (or t-post driver) to pound the rebar into the stream bottom, and tie straps (zip ties). Rebar 3 to 4 feet in length, which should be cut to length at a hardware store or lumberyard, will most often work. Alternatively, cold rolled steel may be beneficial to use because you can bend it below the water surface. A sledge hammer (or t-post driver) will be used to pound the rebar into the streambed. If you use nylon tie straps, make sure they are of good quality and in good condition; use two or more for each data logger and make sure you always have extras on hand. The PVC bushing can also be bolted to the rebar using a U-bolt. Don't forget to ask for a donation of the items to support the local TU chapter!

***Recommendation*: Purchase your Onset TidbiT MX loggers and the other relevant materials listed above. Ask the hardware store for a donation to TU!**

TABLE 2. EQUIPMENT LIST FOR STREAM TEMPERATURE MONITORING.

Manufacturer	Product	Qty	Cost (per unit)
Onset	TidbiT MX logger	1 or more	$110
	HOBOmobile app	1	Free
Hardware store	1-$^1/_2$" PVC Cap	1 per TidbiT	$3
	1-$^1/_2$" x $^3/_4$" PVC Bushing	1 per TidbiT	$3
	Rebar (~3 to 4')	1 per TidbiT	$5
	Industrial tie straps	1 package	$7
	Sledge hammer (5-10 lb) or t-post driver	1	$20
	Toolbox (storage)	1	$15
	Notebook	1	$5

Logger Calibration

Once the loggers arrive from Onset, it is important to calibrate your logger(s) in an ice water bath prior to getting it ready for deployment. Calibration essentially means understanding how much your logger deviates from a known temperature. An ice bath allows for a good comparison because the temperature of an ice bath should be at or near freezing (32°F or 0°C).

The following steps can be followed to use an ice bath for calibration of a temperature logger:

1. Add cold water and ice to a container and wait about an hour. If the ice melts completely after one hour, add more.

2. Launch the logger using Onset HOBOmobile app.

3. Place the logger in the ice bath, and make sure the water remains mixed to ensure temperature is the same throughout the container.

4. Remove the logger after 15 minutes.

5. Download the data from the logger.

6. Write down the temperature of the ice bath as measured by the logger.

The water temperature of the ice bath, as recorded by your logger, should read near 0°C or 32°F because the water should be close to freezing. Even if your measured temperature is off by 0.5°F, this should be written down since it is good to know how much your logger is off when interpreting your data. Most loggers have a manufacturer-stated accuracy of ~0.5°F. If the logger is off substantially (≥2°F), consider re-doing your calibration test to ensure it is consistently off by that much. If it is consistently inaccurate, consider returning it to Onset. Calibration is also a good time to familiarize yourself with retrieving data from the logger (see Data Retrieval) and using the software to show the temperature of the water bath (see Data Checking).

<u>Recommendation</u>: Calibrate your loggers using an ice bath to determine they are accurately measuring temperature.

Logger Initialization

Before going to the field you need to initialize your logger by setting the logger's start time, recording unit (°F or °C), and recording interval (how often a temperature is recorded). A more frequent recording interval will use up the data storage more quickly, so balance your data needs with the period of sampling. For example, if your objective is to try and record the maximum (or minimum) daily data temperature then a more frequent recording interval will be required to measure a value close to that maximum. Even with a 1 hour recording interval you have a good chance of capturing the daily maximum temperature (specifically, a 1-hour interval results in less than a 1% chance of missing the maximum daily temperature by more than 2°F). If your goal is to measure average daily temperature, then you can use

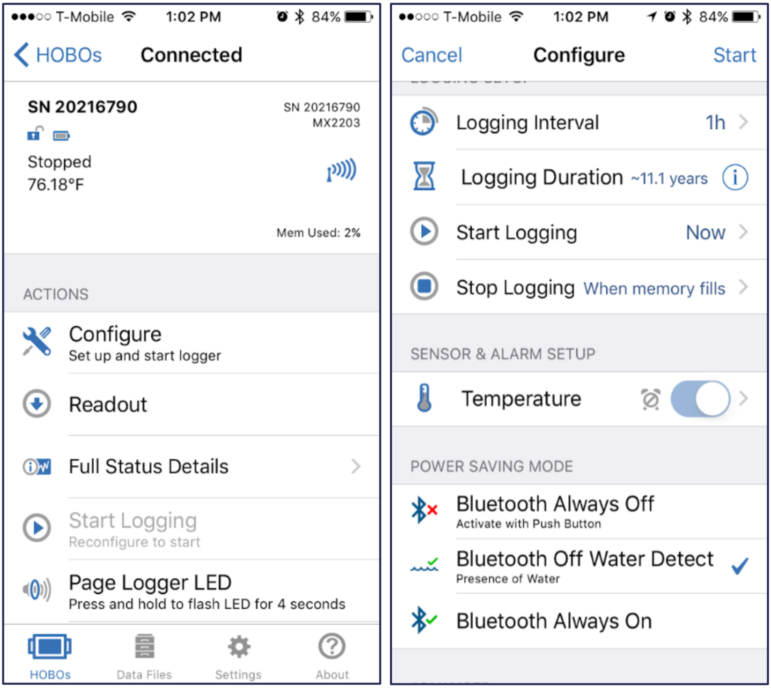

FIGURE 5. THE CONNECTION AND CONFIGURATION WINDOWS IN THE HOBOMOBILE APP.

a less frequent interval. We recommend setting the logger to record every 1 hour which will provide up to 5 years of storage. If you are deploying more than one logger they should all be set up the same way (start time for after deployment, measurement units, and recording interval), which will simplify data management. Instructions for use of the software are included with the package, but it is always good to have a chapter member that is very computer savvy to help out. Local biologists that have used the system before also will help out tremendously.

When connecting a logger to the HOBOMobile app for the first time, check that the battery is installed correctly, press the magnet in the rubberized housing to the center of the TidbiT, turn on Bluetooth on your mobile device, and check HOBOMobile to configure the logger.

***Recommendation*: Initialize your logger by setting the start time, the recording unit to Fahrenheit, and the recording frequency to 1 hour. If you are interested in patterns of stream drying or intermittency, or plan on deploying a logger in a PVC canister without the rubberized boot, use the Bluetooth Off Water Detect feature.**

Deploy the Logger(s)

Now it's time to deploy the logger(s). Select a day with good weather when the streams you want to monitor are at a low flow and make this a chapter project. Spring runoff is not a good time to deploy temperature loggers, due to both safety of the individuals involved and difficulty in knowing when the stream will be at low flow. Place the loggers in locations that will not be easily seen. People are curious and want to figure out what is going on, so they will often tamper with the loggers or remove them.

Methods of deploying the loggers are many, but using rebar, epoxy, or wire cable are the most common. Rebar is simple to use and will work in many situations but can have drawbacks if your stream floods, has a lot of ice or bedrock, or the rebar is visible and people disturb it. If it will work, drive the rebar into the stream bottom angled downstream and as close to the stream bottom as possible. Cold rolled steel bar can be used in lieu of rebar; it is more expensive but can be bent below the water surface once in the ground. Strap the PVC bushing to the rebar using nylon tie straps placed through the small $^{11}/_{32}$ inch holes. A U-bolt can also be used instead of nylon straps as a more permanent attachment. Make sure the PVC housing will point downstream, and ensure the straps are tight around the rebar so the housing can't move up the rebar during high flows and be lost but can still move around the rebar if rocks or heavy current move it.

When you are ready to deploy the logger, place the logger in the cap and screw the cap onto the bushing that is already fastened to the rebar. If the PVC housing is highly visable, cover it with rocks to hide it, but make sure the logger is submersed in water and water can flow though the PVC housing. Alternatively, you could paint the PVC housing a dark color prior to deployment so it is camouflaged, but remember you need to find it later too.

After it is deployed, use a handheld GPS or the GPS on your smart-phone and write down the coordinates of the monitoring sites. Make a sketch map of the area for future reference as other chapter members may come to gather the data. Take pictures of the area. In short, take good field notes! It is amazing how much streams can change in a short time period, or how poorly our memories recall the exact location of the loggers. You may also want to place rebar, survey stakes, or some other fairly permanent marker, maybe spray-painted orange, on the bank and out

FIGURE 6. PVC HOUSING FIXED TO REBAR USING A NYLON STRAP (LEFT), OR ALTERNATIVELY FIXED TO A COLD ROLLED STEEL BAR USING A U-BOLT (RIGHT).

of the way to mark the location. Take photos of the markers too.

Alternative temperature logger attachment methods do exist. Although not recommended, you may choose to forgo use of PVC housing. In this case the logger can be strapped directly to the rebar. If this is done, much attention should be given to the location of deployment. The logger should be placed in an area that is continually shaded or some type of solar shield (a piece of neoprene, for example) should be used to protect the logger from direct sunlight. Research has shown that a logger exposed to sunlight (solar radiation) under water can result in measurement of temperatures that are 1 to 2 °F higher than the surrounding water temperature.

Use of waterproof epoxy is more complicated but used by many professionals. The idea is to epoxy the PVC housing to a boulder large enough that it will not move. Then, the PVC bushing will be fixed to the rock, but the cap (with the logger inside) can be removed during data download. If you are interested in this method, it is highly recommended that you contact someone that has used this

FIGURE 7. PVC HOUSING EPOXIED TO A ROCK.

method previously and have them help you with equipment and deployment. For any method, expect to occasionally lose a logger due to various reasons but that is part of the process, like losing a fish after it has been hooked!

<u>Recommendation</u>: Zip-tie your PVC housing containing the logger to rebar driven into the streambed. If you do not use PVC housing then use a solar shield. Take good field notes with a map, pictures, and GPS coordinates. Place a marker on the bank or a tree that is included in a picture.

Data Retrieval

Select a time interval for downloading your temperature data. We recommend downloading at least once every 6 months (e.g., pre-runoff in the spring and then before ice-up in the late fall). Selecting the download interval should be done at the initial chapter meeting on the temperature monitoring project so your members know when to plan on retrieving the data. Using the GPS locations, photos, and sketch maps locate the rebar or other attachment method and unscrew the cap with the logger. Be careful not to drop the logger when you remove the cap! Alternatively, you might have to detach the entire PVC housing and bring it to the stream bank. Clean the logger of dirt, insects, etc. that may have accumulated and dry it off.

Removing the logger from the water should initiate a Bluetooth signal if you are using the "Bluetooth Off Water Detect" setting. Otherwise, you will need to press a magnet to the lower center of the TidbitT using the rubberize boot that comes with the logger or a magnet you bring to the field. Once the Bluetooth is on, the logger should be visible in the HoboMobile app. Use the "Readout" action to download data from the logger. Data you have collected can be plotted in the HOBOMobile app or exported to HOBOware or another desktop software such as Excel.

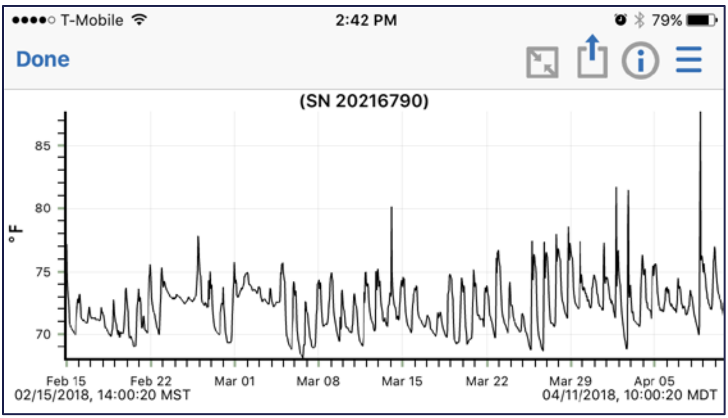

FIGURE 8. TEMPERATURE DATA FILE IN HOBOMOBILE

After the data have been transferred, double check that the logger has not been stopped, reattach the logger to the

PVC cap if it was removed, and screw the cap onto the bushing attached to the rebar. Once the PVC housing is securely attached to the rebar, the logger is ready for another cycle of monitoring. Be sure to take any relevant field notes, such as whether the logger was buried in sand or mud or showed evidence of being dry or tampered with.

***<u>Recommendation</u>*: Retrieve your logger and download data *<u>at least</u>* every six months, and take notes on whether the logger was out of water or buried**

Data Checking

After you download your data, you need to check it for errors. For example, the logger might have been set to begin recording data before it was placed into the stream, the water level may have dropped and exposed the logger to air, or the logger may have malfunctioned. The figure below shows a graph of temperature data from a creek in southwestern Idaho. Viewing these data suggest that there are two things wrong: 1) the logger began recording data before it was placed into the water, which is evident by the first few records being substantially higher than the subsequent records, and 2) that the stream went dry, which is evident by significant daily temperature fluctuations soon after deployment that include values below freezing.

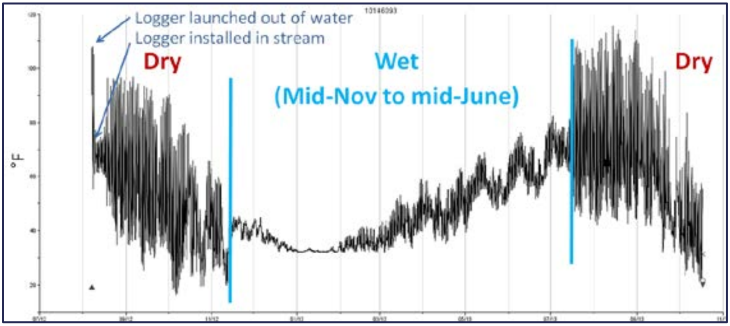

FIGURE 9. TEMPERATURE DATA SHOWING HIGH INITIAL TEMPERATURES PRIOR TO BEING INSTALLED AND PERIODS OF LOGGER EXPOSURE DURING STREAM DRYING IN SUMMER.

There are several things to identify anomalous data:

1) Simply look for abnormalities in temperature data
2) Compare data from multiple loggers from same stream
3) Graphically compare water temperature data to air temperature data if available
4) Graphically compare water temperature data from the same location across years
5) Graphically compare water temperature data to streamflow data (http://water.usgs.gov/nsip/)

<u>Recommendation</u>: Visually inspect your temperature data for dewatering events, extreme temperature maxima and minima, and wide daily fluctuations.

Data Summary and Interpretation

Once you retrieve your data and check for anomalies, the data should be summarized in a way that relates to your temperature monitoring objectives. If you're interested in how frequently your river's temperature is near the upper thermal maximum for a specific trout or salmon species, then you should summarize your data as the number of days above a critical temperature maximum. If you're interested in comparing your river to other rivers, often an average monthly temperature is used (e.g., mean August temperature). Common summaries can be done using the free HOBOware software. More advanced summaries may require other software programs (e.g., Microsoft Excel) or the Pro version of HOBOware.

After you've summarized your data appropriately you need to interpret your data. Compare your river's temperature to that of surrounding rivers or to upper thermal tolerances for different trout species determined from research studies. Summarize the number of days above a critical temperature threshold as defined by your state environmental agency.

Once you have your data adequately graphed and summarized, plan a Chapter meeting to discuss the results in the context of your monitoring objectives. Talk about

TABLE 3. GENERALIZED TEMPERATURE PREFERENCES AND TOLERANCES FOR TROUT AND SALMON.

Species	Preferred temperature (°F)	Upper Incipient Lethal Temperature (°F)*
Brook	58-64	77
Brown	62-68	80
Cutthroat	58-61	79
Rainbow	59-66	78
Chinook	54 (juv); 63 (adult)	77 (juv); 72 (adult)
Sockeye	57 (juv); 55 (adult)	76 (juv)
Coho	62 (adult)	77 (adult)
Pink	55 (juv)	75 (juv)

how your data relate to other temperature data from nearby monitoring sites or streams and how they relate to temperature tolerances of different trout species. Ideas such as other locations to place loggers, or perhaps even if loggers should be moved to a new location, may become apparent as the data are explored.

***Recommendation*: Summarize and interpret your data in the context of your temperature monitoring objectives.**

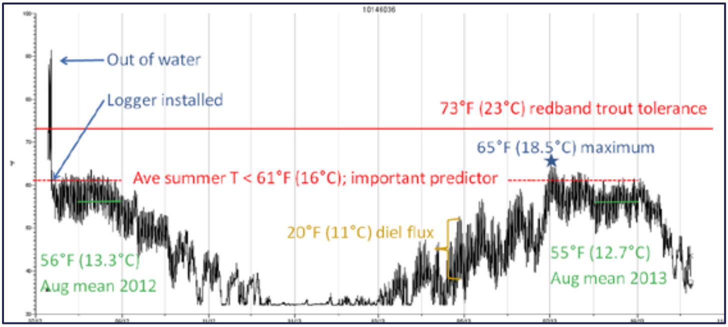

FIGURE 10. ERROR CHECKING AND INTERPRETATION OF STREAM TEMPERATURE DATA.

Data Storage

After you've summarized your data, you need to assign a data steward. The data steward will be responsible for organizing files. New files can be created every time data are downloaded. And, additional files may be created if data are summarized outside of the HOBOware software. A critical part of a long-term temperature monitoring program is efficient and organized data files.

In addition to storing your data locally, TU's Science Team (in Boise, Idaho) has developed a stream temperature database. Please send your data there as a backup. Once enough data are collected and incorporated into a database, the Science Team will use it to interpret broad patterns of temperature. They will also incorporate your data into national research where stream temperatures are being predicted for every stream in the country (currently being done by the US Forest Service). Contact:

Matt Barney, Trout Unlimited, Science
Email: mbarney@tu.org; P: 208-345-9800

<u>Recommendation</u>: Assign a data steward, develop a data organization strategy, and create redundancy by sending your data to TU Science staff.

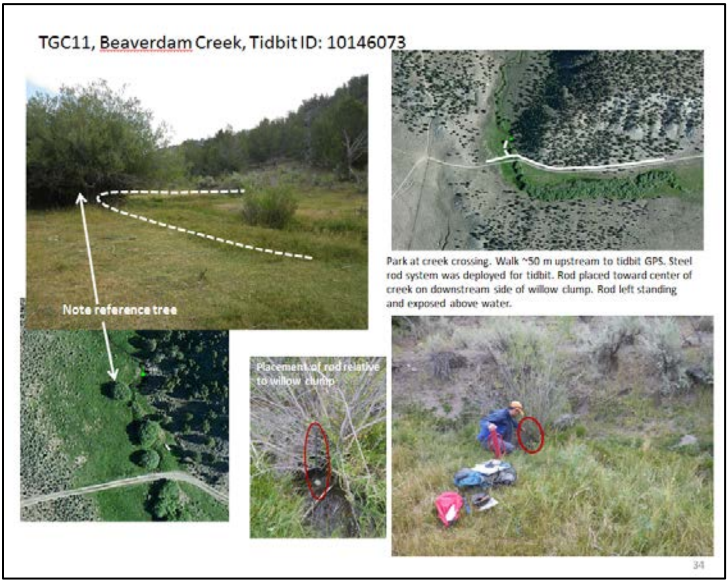

FIGURE 11. TEMPERATURE MONITORING SITE PHOTOS WITH NOTES.

ACKNOWLEDGMENTS

We'd like to thank the US Forest Service, Rocky Mountain Research Station (Boise, ID) and Forest Sciences Lab (Logan, UT) for leading the way on stream temperature monitoring and for guidance in developing this manual.

ADDITIONAL RESOURCES

Additional and up-to-date resources on stream temperature monitoring, including documents describing protocols and best practices for stream temperature from federal agencies and map-based tools providing reference information to help identify where to monitor, are available on TU's website at: www.tu.org/conservation/our-conservation-approach/science/stream-temp-resources

STREAM INFORMATION

Stream name:___________________ Site No.:___________________
Watershed:_____________________ River mile:_________________
Latitude:____________________ Longitude:____________________
Site description:____
____
____
____

LOGGER INFORMATION

Logger type:_________________ Serial No.:_____________________
Sampling interval:___________ Attachment method:___________
PVC Housing: Y N Date:____________ Time:________________

SITE INFORMATION

Habitat type (circle one): Riffle Run Pool Backwater
Shading: None Some Complete Logger Depth:______________
Notes: ____
____
____

SKETCH MAP:

NOTES: