RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Western Water and Power Solution Bulletin

Bulletin No. 44
Research and Development Office — Denver, Colorado
February 2011

Using Stream Water Temperature Measurements for Habitat Rehabilitation

Fiber optic cable system measures water temperatures through the length of a stream to understand stream interactions.

What Is The Problem?

Water temperature data provide information about the general health of a stream and aquatic species that require certain temperature ranges to survive and thrive. Documenting the ground water and surface water exchange throughout the length of the channel, including the location for cold water sources, is crucial to channel restoration or habitat enhancement work. Locating cold ground water upwelling in rivers is difficult because point temperature sensors are generally spaced large distances apart. Knowing the cold water source locations could help in designing channel reconstruction and habitat features (e.g., woody debris, boulders, or other materials). These habitat features provide cover for fish, increase food production, and provide resting areas while fish move along the stream.

What Is The Solution?

Reclamation and Oregon State University (OSU) researchers have collaborated to develop and test a fiber optic Distributed Temperature Sensing (DTS) system to measure the interaction between ground water and surface water along the stream channel. The system measures temperature at one-meter intervals along the cable, resulting in a more complete temperature profile. The system's records this data at a user-specified frequency, from seconds to hours. Data on air temperature and solar radiation are also recorded. The data are analyzed using a numerical modeling tool to identify ground water and surface water interactions relative to effects of air temperature and solar radiation. Results are considered relative to the stream's physical, biological, and chemical makeup, thus increasing the chances for successfully siting rehabilitation or restoration projects.

Who Can Benefit?

Stream temperature is a key determinant of habitat for salmonids and other aquatic species throughout the Western United States. Restoration professionals can benefit from the DTS system to guide restoration of critical fish habitat and to pinpoint restoration strategies that will provide the greatest returns in habitat creation and enhancement.

Where Have We Applied This Solution?

Staff from Reclamation's Columbia Snake Recovery Office (CSRO) recently collaborated with OSU to use DTS information for the Big Boulder Creek Restoration Project in Oregon. This project involved relocating a stream to its historical location, including design and construction of numerous habitat enhancement features. The DTS system was installed to document the stream channel temperature characteristics and changes in the existing and new channels. The DTS system was installed in the existing channel to measure temperatures prior to and after stream reconstruction in 2008. The DTS system was installed in the new channel again in 2009. A final report documenting the successful application of the DTS system on the Big Boulder Creek Project will be published by the end of fiscal year 2011.

Determining the location of a ground water source after river restoration (Huff 2009, used with permission).

Future Development Plans

The DTS system could be used where water temperature data are required along a continuous path in nonstream settings such as bore holes or reservoirs. For example, the DTS could be used vertically in a reservoir to monitor temperature gradients to guide discharge temperature adjustments by a selective withdrawal intake structure.

Reclamation and OSU plan to continue to develop the DTS technology to further refine field techniques and improve data analysis and modeling for future rehabilitation projects.

More Information

Huff, J.A. 2009. John Day Project: Monitoring river restoration using fiber optic temperature measurements in a modeling framework. Oregon State University, MS thesis. <http://ir.library.oregonstate.edu/xmlui/handle/1957/13847>

Contact Information

Mark Croghan, CSRO, mcroghan@usbr.gov, 541-575-3033
Dr. John Selker, OSU, John.Selker@oregonstate.edu, 541-737-6304

Collaborators

Reclamation's Science and Technology Program and CSRO, as well as OSU Department of Biological and Ecological Engineering.