The Integrated Status and Effectiveness Monitoring Program

Variation (Status and Trend) of Stream Water Temperature within the Entiat River Subbasin

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Introduction

The Integrated Status and Effectiveness Monitoring Program (ISEMP – BPA project #2003-017-00) has been created as a cost effective means of developing protocols and new technologies, novel indicators, sample designs, analytical, data management and communication tools and skills, and restoration experiments that support the development of a region-wide Research, Monitoring and Evaluation (RME) program to assess the status of anadromous salmonid populations, their tributary habitat and restoration and management actions.

The most straightforward approach to developing a regional-scale monitoring and evaluation program would be to increase standardization among status and trend monitoring programs. However, the diversity of species and their habitat, as well as the overwhelming uncertainty surrounding indicators, metrics, and data interpretation methods, requires the testing of multiple approaches. Thus, the approach ISEMP has adopted is to develop a broad template that may differ in the details among subbasins, but one that will ultimately lead to the formation of a unified RME process for the management of anadromous salmonid populations and habitat across the Columbia River Basin.

ISEMP has been initiated in three pilot subbasins, the Wenatchee/Entiat, John Day, and Salmon. To balance replicating experimental approaches with the goal of developing monitoring and evaluation tools that apply as broadly as possible across the Pacific Northwest, these subbasins were chosen as representative of a wide range of potential challenges and conditions, e.g., differing fish species composition and life histories, ecoregions, institutional settings, and existing data.

ISEMP has constructed a framework that builds on current status and trend monitoring infrastructures in these pilot subbasins, but challenges current programs by testing alternative monitoring approaches. In addition, the ISEMP is:

- Collecting information over a hierarchy of spatial scales, allowing for a greater flexibility of data aggregation for multi-scale recovery planning assessments, and
- Designing methods that:
 - Identify factors limiting fish production in watersheds;
 - Determine restoration actions to address these problems;
 - Implement actions as a large-scale experiment (e.g. Before After Control Impact, or BACI design), and
 - Implement intensive monitoring and research to evaluate the action's success.

The intent of the ISEMP project is to design monitoring programs that can efficiently collect information to address multiple management objectives over a broad range of scales. This includes:

- Evaluating the status of anadromous salmonids and their habitat;
- Identifying opportunities to restore habitat function and fish performance, and

- Evaluating the benefits of the actions to the fish populations across the Columbia River Basin.

The multi-scale nature of this goal requires the standardization of protocols and sampling designs that are statistically valid and powerful, properties that are currently inconsistent across the multiple monitoring programs in the region. Other aspects of the program will aid in the ability to extrapolate information beyond the study area, such as research to elucidate causal mechanisms, and a classification of watersheds throughout the Columbia River Basin. Obviously, the scale of the problem is immense and the ISEMP does not claim to be the only program working towards this goal. As such, ISEMP relies heavily on the basin's current monitoring infrastructure to test and develop monitoring strategies, while acting as a coordinating body and providing support for key elements such as data management and technical analyses. The ISEMP also ensures that monitoring programs can address large-scale management objectives (resulting largely from the ESA) through these local efforts. While the ISEMP maintains a regional focus it also returns the necessary information to aid in management at the smaller spatial scales (individual projects) where manipulations (e.g., habitat restoration actions) actually occur.

The work captured in this report is a component of the overall Integrated Status and Effectiveness Monitoring Program, and while it stands alone as an important contribution to the management of anadromous salmonids and their habitat, it also plays a key role within ISEMP. Each component of work within ISEMP is reported on individually, as is done so here, and in annual and triennial summary reports that present all of the overall project components in their programmatic context and shows how the data and tools developed can be applied to the development of regionally consistent, efficient and effective Research, Monitoring and Evaluation.

Purpose of this project

We continued to monitor water temperatures (a key component of fish habitat) in selected drainages to determine if streams met water quality standards in 2008 and to establish temporal trends in water temperatures for Eastside streams. Water temperature trend data will be utilized in District and Forest efforts to describe reference conditions and desired future conditions in Watershed Analyses and future Forest Plan revisions. These data are also important to further evaluate conditions in 303(d) listed waterbodies experiencing temperature standard excursions (e.g. mainstem Entiat River). These data are used by the Entiat 2514 Planning Unit and Cascadia Conservation District to support the water quality element of the Entiat Watershed Plan. Hendrick and Monahan (2003) used SNTemp to model water temperature in the Entiat River. Entiat Ranger District data supported SNTemp model calibration by providing observed water temperatures for the years 1995-2002. Finally, these data are frequently used by District specialists in project analyses for proposed actions on National Forest lands and in biological assessments for three ESA listed species (bull trout, spring Chinook salmon and steelhead trout).

Study Area

See Table 1, first column titled "location".

Methods

The procedures outlined in the TFW Stream Temperature Module, Level 1 methodology (Rashin et al. 1994) were utilized with some departures as noted. The monitoring period was chosen to encompass expected low flows and the highest air temperatures for this area. In most years that period has been early July to mid-Sept, but in 2008 flows remained high until the end of July. The monitoring period was extended at key sites to include the steelhead spawning period from March to May and the

declining period of stream temperatures that typically occurs during the fall spawning period for Chinook salmon and bull trout. Thus, several temperature monitoring devices were in place from January to November this year (see Table 1 for specific dates) in the Entiat and Mad Rivers.

Stream temperatures monitored by the Entiat Ranger District included the Entiat and Mad Rivers (23 stations) within the Entiat Watershed.

Measurement methods included Onset Hobo® Water Temp Pro V2 Data Loggers, which were deployed at 23 locations in the Mad River and Entiat River drainages (see Table 1). Data were continuously recorded at 30-minute intervals during the deployment period and devices were checked to ensure they were functioning properly during the monitoring period.

Temperature data loggers were encased in open-ended PVC plastic tubes that were anchored by one-pound weights and secured with galvanized steel 1.5 mm cables. This procedure was used to: (1) prevent “sand-blasting” of thermograph cases, (2) to prevent direct sunlight from striking the thermographs and warming them, and (3) to allow deployment into deeper water thereby decreasing occurrences of dewatered devices. Hand-held thermometers were used for quality control comparisons.

Pre-season calibration and quality control of thermometers and thermographs consisted of simultaneous immersion in a water bath for approximately 15 minutes to ensure that all devices were registering the same temperatures $\pm 0.36^{\circ}\text{F}/0.2^{\circ}\text{C}$ (manufacturer’s maximum total error standard). Two water baths were used, one warm ($24\text{--}37^{\circ}\text{C}$) and one cold ($15\text{--}18^{\circ}\text{C}$). Post-season calibrations were not performed. Prior to deployment, thermographs were set to record at 30-minute intervals. The 30-minute interval allowed a maximum deployment of over 500 days before these data loggers needed to be downloaded.

Results

2008 Entiat Subbasin water temperature data are available to be uploaded to NOAA. A summary of 2008 temperature monitoring results is presented in the following table.

Table 1. 2008 Water Temperature Monitoring Summary.

Location	Monitor dates	# Days	# Days $>64.4^{\circ}\text{F}$	# Days Avg 7-Day Max $>58^{\circ}\text{F}$
<i>Entiat River</i>				
RM 1.4	1/1-11/13	318	46	81
RM 3.2	7/29-10/30	94	30	52
RM 5.8	7/29-10/30	94	21	51
RM 7.1				
RM 8.5	7/29-10/30	94	20	51
RM 10.2	8/7-10/30	85	15	43
RM 10.8	8/7-10/30	85	16	44
RM 12.5	8/7-10/30	85	11	43
RM 15.0	8/7-10/30	85	9	41
RM 18	1/1-11/1	316	9	70
Total		1256	177	476
		# Days	# Days $> 61^{\circ}\text{F}$	# Days Avg 7-Day Max $>58^{\circ}\text{F}$
RM 21.1				
RM 24	8/7-10/23	78	11	24

RM 26	7/3-11/1	247	8	16
RM 31	8/7-10/23	78	2	5
RM 34.1				
RM 38.2	8/7-10/23	78	0	0
Total		481	21	45
Mad River		# Days	# Days > 61°F	# Days Avg 7-Day Max >58°F
Mouth of Mad River	1/1-10/30	291	35	60
Mad ^ Tillicum	7/3-10/21	111	39	51
Mad ^ Pine Flats C.G.				
Mad ^ Hornet Cr	7/3-10/21	111	30	51
Mad ^ Windy Cr	7/3-10/21	111	14	45
Mad ^ Young	7/15-10/24	102	0	4
Mad ^ Cougar Cr	7/8-10/8	93	0	0
Mad ^ Berg Cr	7/8-10/8	92	0	0
Mad ^ Jimmy Cr	7/18-10/31	106	0	1
Mad ^ Blue Cr	8/9-8/27	19	0	1
Mouth of Mad Lake	8/9-10/19	72	31	41
Total		1108	149	254
Total Stream-Days		2845	347	775

Exceedences and the Thermal Regime in the Entiat River

Daily maximum temperatures exceeded the 61°F Forest Standard on Class AA waters of the Entiat River at all thermograph locations downstream of RM 38.2. The 7-day average maximum stream temperature standard (< 58°F) was exceeded at the same stations. Exceedences increased downstream with the largest exceedences at the mouth.

Exceedences in the Mad River and Tributaries

Maximum water temperatures in excess of 61°F in the lower Mad River have occurred consistently since this stream has been monitored (1993-2008). Speculation has arisen about the Mad River zone of warming, its magnitude, extent, effects on fish, and natural temperature regime. To address these questions, an expanded network of continuous recording thermographs was deployed in the Mad River during the years 1997 to the present. Data from this expanded network have been used to construct the following longitudinal summer thermal profile of the Mad River:

- The river originates at Mad Lake where stream temperatures are substantially warmer at the outlet of this high elevation (5900 feet) shallow lake;
- stream temperatures gradually cool going downstream until reaching the Cougar Creek area (3400 feet);
- re-warming progressively occurs from Cougar Creek downstream to Tillicum Creek (1400 feet);
- Tillicum Creek then provides a cooling influence evidenced by lower stream temperatures at the confluence with the Entiat River than those observed just above the Tillicum confluence.

Discussion

Based on all water temperature data compiled for the Mad River drainage, we believe that the thermal regime described in this report is firmly established. Longitudinal profile data from the Entiat River indicate that the Entiat River has its own unique thermal regime. We also conclude, based on multiple years of stream temperature monitoring results (1994-2008), that present Wenatchee National Forest Plan Standards are simply not attainable in all Entiat/Mad waters in all years. Future iterations of Watershed Analyses and Forest Plan revisions should take into consideration deviations from current water temperature standards that appear to be related to natural conditions within watersheds.

In 2007 we replaced all our obsolete Onset Optic Stowaway® temperature data loggers with Onset Hobo® Water Temp Pro V2 Data Loggers as well as the necessary software and support hardware (data shuttle and cables) at a cost of \$2,268 (Forest Service appropriated funds). Loss of several data loggers each year continues to be a problem in spite of our best efforts to replace frayed/corroded cables at the beginning of each monitoring season and conceal monitoring devices so they will not be discovered by the public. We would like to request ISEMP technical assistance with designing and installing a more robust and tamperproof system for anchoring our data loggers at our monitoring sites.

References

- Hendrick, R. and J. Monahan. 2003. An Assessment of Water Temperature of the Entiat River, Washington, Using the Stream Network Temperature Model (SNTMP) for the Entiat WRIA 46 Planning Unit.
- Rashin, E., D. Schuett-Hames, J. Matthews, and A. Pleus. 1994. Stream Temperature Module, TFW Ambient Monitoring Program.