Document ID #P110084

The Integrated Status and Effectiveness Monitoring Program

Variation (Status and Trend) of Fine Sediment in Spawning Gravel within the Entiat River Subbasin

July 2008- October 2008

Prepared by

Pierre Dawson
USDA Forest Service
Okanogan-Wenatchee National Forest

Funded by

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Portland, OR. 97208-3621

Project No. 2003-017-00
Contract No. 37149

January 29, 2009

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

Sediment monitoring was initiated for the Entiat River in 1993 and Mad River in 1994 using an established methodology for Forest-wide consistency. This monitoring project addresses long-term trends in watershed condition as expressed by changes in water quality and fish habitat capability and is being conducted to determine if present sediment conditions in the Entiat and Mad Rivers meet Wenatchee National Forest standards ($\leq$20 % fines $\leq$1.00 mm). Sediment monitoring results will also be used to describe the range of variability of fine sediment in the Entiat and Mad Rivers and guide

future watershed restoration activities aimed at reducing sources of accelerated fine sediment.

Study Area

See Table 1, last column titled "location".

Methods

The purpose, procedures, and limitations of the methodology are well-documented in the Northwest Indian Fisheries Commission Salmonid Spawning Gravel Composition Module (Schuett-Hames et al. 1993) and are not entirely repeated here. Samples were collected from four reaches in the Entiat River and one reach in the Mad River, according to the sampling methodology described in Schuett-Hames et al. (1993). For statistical validity, this methodology specifies a minimum sample size of three reaches per stream, three riffles per reach, and four samples per riffle.

Reaches 1, 2, and 3 were chosen to coincide with the reach delineation of the 1991 WNF Stream Survey of the Entiat River. Sampling sites were selected based on their suitability for, or known occurrence of, spawning by Chinook salmon, steelhead or bull trout. Sampling sites in Reaches 1 and 2 overlap the WDFW/USFWS Chinook spawning index reach on the Entiat River. Reach 3 contains known bull trout spawning habitat. Reach 4 on the lower river was sampled where late-run Chinook, steelhead, and coho spawning is known to occur (Mullan et al. 1992, Steele pers comm 1994, Carie 1996-2001, Hamstreet 2005, pers obs 1994-2007). Reach 4 sampling sites were in suitable spawning gravel just above the upper limit of fluctuation of the Rocky Reach Dam pool (Lake Entiat). The lower reach of Mad River, from mouth to Pine Flat Campground (RM 4.0), is known spawning habitat for steelhead and spring Chinook.

A McNeil core sampler was used to collect the samples. Entiat River samples were collected by a WCC crew consisting of 4 crew members, one crew boss, and one Forest Service supervisor from 10/6-10/8/2008. Mad River Samples were collected by WSU Cooperative Extension sponsored 4H crews consisting of 4 crew members with supervisor and one Forest Service supervisor from 7/24 – 7/31/2008.

The core-collection procedure conformed to that described in Schuett-Hames et al. (1993). Bucketed samples were tightly covered and transferred to the Steliko Work Center for processing where they were wet-sieved through the following sequential series of 8-inch diameter, stainless steel, soil sieves: 75.0, 25.0, 19.0, 9.5, 6.3, 4.0, 2.36, 1.7, 1.0, 0.85, and 0.5 mm.

Silts (<0.5 mm) collected in a bucket beneath the sieves were poured into Imhoff cones where they settled out and were measured. In 1997, 0.85 mm was added to the sieve series and 0.25 mm deleted from the sieve series. The reasons for this change were to provide data on percent fines less than 0.85 mm, the value used by Washington State,

the US Fish and Wildlife Service (1998), and the National Marine Fisheries Service (NMFS 1996). The data produced by the 0.25 mm sieve had no apparent application and fines less than 0.25 mm are now being collected with and reported as "silts". The sieving procedure conformed to that described in Schuett-Hames et al. (1993).

Data entry and summary statistic calculation were accomplished using an Excel spreadsheet program furnished by WNF Fisheries specialist P. Dawson. Excel-generated summary statistics include: mean percent fines ≤1.0mm per sample, riffle, and reach; mean percent fines ≤0.85mm per sample, riffle, and reach; standard deviation per riffle and reach; and Fredle Index and geometric mean particle size per sample. Confidence intervals (95% CI and 80% CI) were calculated for each reach using the formula in Schuett-Hames et al. (1993) with the appropriate sample size (n=12) and t-values for reach statistics (Zar 1984):

$$t_{0.05(2),11} = 2.201 \text{ and } t_{0.20(2),11} = 1.363$$

Results

2008 Entiat Subbasin fine sediment sampling data were uploaded to NOAA on January 30, 2009. A summary of 2008 sediment sampling statistical data is presented in Table 1.

Sample mean percent fines ≤1.0 mm were 16.0 percent, 13.1 percent, 15.2 percent, and 20.2 percent in Entiat Reaches 1, 2, 3, and 4, respectively. Mad River Reach 1 sample mean percent fines ≤1.0 mm were 19.8 percent. Figure 1 shows 1993 through 2007 results for comparison.

Zar (1984) cautions that although the sample mean is the best estimate of the population mean (μ), it is still only an estimate, and the calculation of the confidence interval for the population mean allows us to express the precision of the estimate. Therefore, we report the 95% and 80% confidence intervals for each reach.

Table 1. Entiat River and Mad River sediment sampling statistical data, 2008.

Sample Sites	n	Mean % Fines < 1mm	95 % C.I. Lower	95% C.I. Upper	80% C.I. Lower	80% C.I. Upper	Mean % Fines < 0.85mm	Location
Entiat Reach 1								
site 1	4	15.8					14.2	RM 18.3 @ Stormy Cr.
site 2	4	19.9					17.5	RM 21.5 @ Dill Creek
site 3	4	15.4					9.7	RM 23.3 @ Brief
Reach 1 Average	**12**	**16.0**	**13.2**	**18.8**	**14.2**	**17.8**	**13.8**	**RM 18 to RM 25**
Entiat Reach 2								
site 1	4	15.4					12.5	RM 26 @ WNF Boundary
site 2	4	12.3					10.9	RM 26.5 @ Snow-Park
site 3	4	11.6					10.0	RM 27.5 @ Fox Cr spn chan
Reach 2 Average	**12**	**13.1**	**9.2**	**17.0**	**10.7**	**15.5**	**11.1**	**RM 25 to RM 29**
Entiat Reach 3								
site 1	4	16.0					13.7	RM 30.5 @ Interp trail
site 2	4	16.1					15.1	RM 31.0 @ Silver Falls CG
site 3	4	13.5					11.1	RM 33.5 @ Entiat Falls gage
Reach 3 Average	**12**	**15.2**	**12.9**	**17.5**	**13.8**	**16.6**	**13.7**	**RM 29 to RM 34**
Entiat Reach 4								
site 1	4	14.9					13.5	RM 0.6 near mouth
site 2	4	26.7					26.2	RM 0.7 near mouth
site 3	4	18.8					17.1	RM 1.3 @ Keystone bridge
Reach 4 Average	**12**	**20.2**	**15.5**	**24.8**	**17.3**	**23.0**	**18.9**	**RM 0.6 TO RM 1.3**
Mad River								
site 1	4	17.4					15.4	RM 1.3
site 2	4	18.6					16.2	RM 1.4
site 3	4	23.4					20.7	RM 3.3
Reach 1 Average	**12**	**19.8**	**16.0**	**23.6**	**17.4**	**22.1**	**17.4**	**RM 1.0 to RM 3.3**

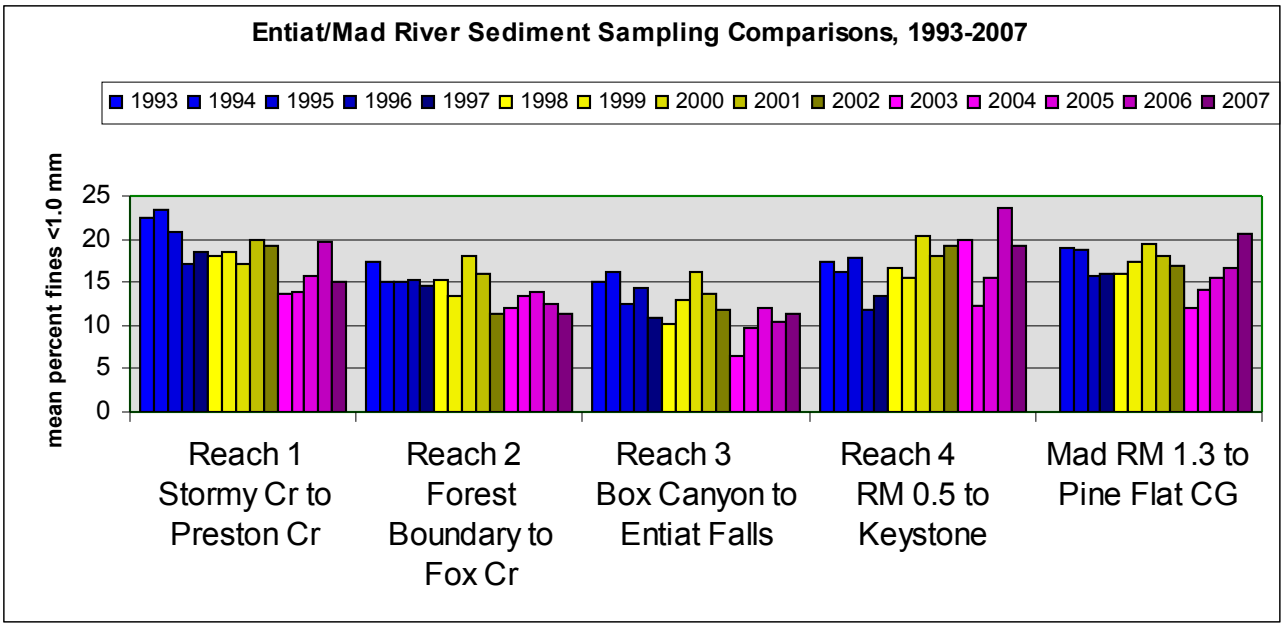


Figure 1. Entiat Subbasin fine sediment sampling reach comparisons, 1993-2007.

Discussion

Although variability exists in the mean percent fines ≤1.0 mm within reaches, between reaches, and from year to year, a certain amount of inherent natural variability is expected. Also, consistent precise methods need to be applied over a large sample size to reduce sampling error. In 2008, as in the previous 13 years, sampling was performed by a WCC crew who were trained and supervised by a Forest Service project supervisor. We believe this consistent application of the sampling method and quality control has kept sampling errors at minimal levels. In 2008, Mad River sampling was conducted by crews of 4-H high school students supervised by a WSU team leader and Forest Service project supervisor.

This year 3 out of 5 reaches were at their 2nd or 3rd highest value on record. All Entiat sampled reaches showed increases from last year. The farther upstream a reach was the greater its increase with reach 3 increasing by 3.8 percentage points from 11.4 % fines in 2007 to 15.2% in 2008. Mad River showed a negligible decrease of .8 percentage point. The long-term decrease in reach 3 has ended this year with this year's value being the second highest on record. The 16-year trend for Reaches 1 and 2 appears to be an overall long-term decrease. The 16-year trend for Reach 4 appears to be a long-term increase. This year's value for reach 4 is the 3rd highest on record. The 15-year trend for Mad River appears to be increasing, especially since 2003. This year's value is the 2nd highest on record.

References

Carie, D. G. 1996-2001. Spring and summer chinook salmon spawning ground surveys on the Entiat River. USFWS Mid-Columbia River Fishery Resource Office, 12790 Fish Hatchery Road, Leavenworth, WA 98826.

Hamstreet, C.O. 2005. Spring and summer chinook salmon spawning ground surveys on the Entiat River, 2004. USFWS Mid-Columbia River Fishery Resource Office, 7501 Icicle Road, Leavenworth, WA 98826.

Mullan, J.W., K.R. Williams, G. Rhodus, T.W. Hillman, and J.D. McIntyre. 1992. Production and Habitat of Salmonids in mid-Columbia River Tributary Streams. USFWS Monograph I. Leavenworth, WA.

National Marine Fisheries Service (NMFS). 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale.

Schuett-Hames, D., B. Conrad, M. McHenry, P. Peterson, and A. Pleus. 1993. Salmonid Spawning Gravel Composition Module. NWIFC Ambient Monitoring Program Manual, TFW AM9-93-001.

Steele, B. 1994. WDFW Regional Habitat Manager report of spawning late-run chinook in the Entiat River near Keystone Bridge. Personal communication.

USDA Wenatchee National Forest. 1990. Land and Resource Management Plan.

USFWS. 1998. A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale.

Zar, J. H. 1984. Biostatistical analysis, pp 103-104. Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632.