

Water Temperature Monitoring of the Klamath River Mainstem

Progress Report #3

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5-1-95
May 1995

PROGRESS REPORT #3

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BACKGROUND

This is the third progress report to the United States Fish and Wildlife Service (USFWS) concerning activities conducted under the terms of Cooperative Agreement Number 14-48-0001-92663, and covers the period of October 1, 1993 to September 30, 1994. This report describes the activities that have been initiated and/or completed on the Water Temperature Monitoring of the Klamath River Mainstem Project.

As described in our original proposal, seven water temperature monitoring sites were established in the Klamath River mainstem from Link River Dam in Oregon to the mouth of the Klamath River near the Pacific Ocean. During preparation for water temperature gage deployment in spring of 1993, Pacific Power and Light (PP&L) and the California Department of Fish and Game offered to share water temperature data from Ryan temperature gages located at two of this project's proposed locations (below Link River Dam and below Iron Gate Dam). PP&L also agreed to retrieve the data below Keno Dam along with the Link River site and two other gages they had located below Boyle and Copco Dams. At the same time, additional water temperature monitoring sites were established approximately three to five miles below the Shasta, Scott and Salmon Rivers to allow for water temperature mixing. The installation of these water temperature instruments was made possible with the help of the Oak Knoll and Salmon River Ranger Districts, Klamath National Forest. Each water temperature gage was deployed in a protective metal cage approximately one foot above the Klamath River bottom. Since the project was initiated in 1993, a total of thirteen water temperature monitoring locations were established at no additional cost.

Two of the thirteen water temperature gages deployed in 1993 were tampered with prior to data retrieval. The temperature gages above the Shasta and Trinity rivers were removed from their underwater locations and left near the surface of the River. Therefore, the water temperature data generated by these temperature gages could not be regarded as reliable for progress report #2. To avoid these problems in 1994 a brief description of the temperature monitoring instruments and the Karuk Tribe's phone number were painted on the outside of each protective cage. A new site above the Trinity River was also established.

To avoid loss or damage of the water temperature instruments during winter 1994, only the water temperature gages below Link River Dam, below Iron Gate Dam, above the Scott River, above the Salmon River and the mouth of the Klamath River were deployed during the winter months. To help guarantee that the computerized data memory would survive the winter, the water temperature gages in the river below Iron Gate Dam were set to record data at two hour intervals.

The increased number of data collection sites and the opportunity to coordinate the water temperature monitoring project with other entities in the basin added an unexpected work load on project staff and postponed submission of progress report #2. In recognition that the increased work load prevented the Tribe from fulfilling the quarterly report process agreed to in the original proposal, the U.S. Fish and Wildlife Service agreed to our request for a reporting process of two progress reports per year.

The following planned activities were identified in progress report # 2 and have been included in this report.

Planned Activities

Over the winter months, the Principal Investigator will evaluate the water temperature data collected in 1993 and begin to isolate any changes in mainstem water temperatures that may exist by stream reach (Program Objective B). The Happy Camp Ranger District hydrologist has provided the Karuk Tribe with a spreadsheet program that converts Ryan TempMentor data into Lotus 123 and U.S. Geological Survey (USGS) water temperature reporting format. The Principal Investigator will be evaluating the potential of displaying the water temperature data in the U.S. Geological Survey water temperature reporting format along with accessing USGS stream flow data. USGS flow data may be useful in determining if water temperatures are affected by streamflows from Lost River, Keno and Iron Gate Dams (Program Objective C). Other information such as pH, dissolved oxygen and other possible data will be evaluated for incorporation into the 1994 report (Program Objective D).

RESULTS and DISCUSSION

The inclusion of six additional sites in 1993 has provided opportunities for data comparison below every major dam and above and below every major tributary, except the Trinity River. Rainfall in the 1993 water year was considered to be near normal. In contrast, rainfall in the 1994 water year was one of the the worst drought

years on record and water management upstream of Keno Dam contributed to unusually low streamflows.

Data Format

In an effort to maintain consistency with other water temperature reports in the Klamath River Basin (Olson, et. al., 1993) the U.S. Geological Survey (USGS) mean daily water temperature reporting procedure has been adopted as the standard reporting format in this report. A Lotus 123 computer program was obtained from the Klamath National Forest, Happy Camp Ranger District, and used to convert all Ryan TempMentor data into USGS spreadsheet format. The water temperature data collected during the 1993 and 1994 water year in one and two hour intervals are displayed in daily mean USGS format and graph form. In addition, the Federal Energy Regulatory Commission (FERC) minimum requirements for Iron Gate Dam and the 1994 Iron Gate, Seiad, Orleans and Klamath, California, streamflow record data is provided for comparison with stream temperatures in USGS standard mean daily average flow format (Appendix A).

Data Analysis

The data from 1993 and 1994 shows the variations in spring, summer, fall and winter temperatures. Since gage deployment did not begin until spring of 1993, full water year comparisons were not possible. However, both daily temperatures on an hourly and mean daily basis are available for interpretation during critical spring, summer and fall Salmonid migration periods for both years. Data gaps throughout the 1993 and 1994 water year reflect the difficulties that are faced by cooperators in maintaining temperature gages in the river channel year-round.

In 1993, the peak warm water temperatures of 74 and lows of 64 degrees Fahrenheit below Link River Dam in late July and early August even out between 68 and 65 degrees Fahrenheit below Copco Dam. A California Department of Fish and Game Ryan TempMentor was lost below Iron Gate Dam and data was not available for this time period. The highs and low temperatures above the Shasta and Scott Rivers fluctuate more sharply but mirror the shape of the Copco water temperature graph. These daily mean trends continue downstream to the mouth at the Pacific Ocean. Warm water temperatures peak throughout the Klamath River mainstem at 75 degrees Fahrenheit in early August below the Scott River.

In 1994, water temperatures below Boyle Dam remained consistently below 65 degrees Fahrenheit. The temperatures below Boyle were unusually low throughout

the spring, summer and fall while water temperatures both upstream and downstream were considerably higher. A comparison of water temperatures below Link River, Boyle and Iron Gate Dams, graphed over the water year, illustrates how the peaks and valleys of Link River and the lows of Boyle are evened out by the time water is discharged from Iron Gate Dam (Appendix B). Once the water leaves Iron Gate Dam, water temperatures downstream fluctuate in a similar pattern but the peaks and valleys are more noticeable.

Warm water temperatures in the Klamath River Basin peaked at 81 degrees Fahrenheit on July 21, 1994 below the Scott River. Water temperatures above the Scott River (77 degrees Fahrenheit) and above the Salmon River (78 degrees Fahrenheit) were also high for this time period.

Streamflow from Iron Gate Dam contributes about 80% of the mainstem water measured at the Seiad USGS gage from August until October (Table 1). In late July 1994, streamflow from Iron Gate Dam amounted to approximately 90% of the mainstem flow at the USGS Seiad gage, below the Scott River water temperature instrument.

Table 1. Mean Monthly Discharge for the Klamath River, 1972-1981.
Discharge in cubic feet per second (cfs).

<u>Month</u>	<u>Below Iron Gate Dam</u>	<u>Near Seiad Valley</u>	<u>% of Iron Gate Flows at Seiad USGS Gage</u>
OCT	1,712	2,129	80%
NOV	2,274	3,363	65%
DEC	2,856	4,673	60%
JAN	2,957	6,530	45%
FEB	2,808	5,051	55%
MAR	3,799	7,072	50%
APR	2,703	5,143	50%
MAY	1,829	4,342	40%
JUN	820	2,325	35%
JUL	732	1,223	60%
AUG	977	1,212	80%
SEPT	1,264	1,506	80%

Source: Adapted from CH2MHILL 1985.

Throughout the Klamath River mainstem, daily water measurements approximate their lowest temperatures in the early morning around 9:00 AM and rise to their highest temperatures in the evening around 6:00 PM. These daily high and low changes from morning to evening cannot be viewed in the mean daily USGS water temperature format. During spring, summer and early fall months when juvenile outmigration and adult immigration occurs these daily highs and lows may become more critical to fish survival. Two examples of these daily high and low water temperature fluctuations during spring and summer water flow management changes are provided for review in Appendix C.

Salmonids are sensitive to temperatures above 60 degrees Fahrenheit. Water temperatures have the tendency to rise beyond this 60 degree threshold from June until October.

Other Forms of Information

Additional stream data were collected utilizing sophisticated Hydrolab instruments between spring and fall 1994 at the water temperature gaging stations below Iron Gate Dam, above the Scott River and above the Salmon River. Hydrolabs are instruments that can measure a variety of water quality variables. These instruments were provided by the Bureau of Reclamation to begin baseline measurement of dissolved oxygen, pH, conductivity and temperature. The instruments were deployed and retrieved on two week intervals from June until November 1994 by the Karuk Tribe and Oak Knoll Ranger District, Klamath National Forest. The information from these instruments has been forwarded to the Northcoast California Regional Water Quality Control Board in Santa Rosa, California for data analysis.

Other water quality studies are being conducted above and below the dams. This information is currently being evaluated to determine if it can be clearly integrated into future progress reports.

UNEXPECTED PROBLEMS

Unexpected changes in personnel within cooperating entities and a 27,000 acre fire in the Karuk Tribe's Ancestral Territory during summer of 1994 prevented our office from providing two project reports in 1994 and extended the time period for preparing this report for the full 1994 water season.

A shift in equipment and data format below Link River Dam by PP&L has resulted in a delay in reporting water temperatures from mid-July to September 1994.

The water temperature gages below Iron Gate Dam are secured to metal cables to prevent vandalism or theft. However, no convenient method of securing the water temperature gages to their underwater locations has been devised to prevent public water users from moving the gages closer to the river surface and corrupting the water temperature data. Rapid changes in stream flow in the spring, fall and winter months, and our concerns for worker safety, have discouraged us from securing the gages to their underwater locations.

Unusually low 1994 Klamath River flows below Ishi Pishi Falls and the curiosity of river recreational users resulted in the loss of late summer water temperature data below the Salmon River and above the Trinity River. Data in late June and early July were removed from each of these water temperature gages during these time periods to maintain data integrity throughout this report. Additional modifications of these sites were necessary in fall 1994 to assure that the data collected would be consistent with the other gaging stations.

Planned Activities

The next scheduled progress report is in the spring of 1995. Efforts are currently underway to connect the Karuk Tribe's computers to the California Data Exchange Center (CDEC) which collects, stores, disseminates and exchanges hydrometeorological data for various locations throughout the Klamath/Trinity system. Coordination with other entities within the Klamath River Basin is currently underway to access air temperature and other pertinent forms of information for integration in future progress reports.

REFERENCES

- CH2MHILL 1985. Klamath River Basin Fisheries Resource Plan, USDI Bureau of Indian Affairs, CH2MHILL, Redding, CA., page 5-35.
- Olson, A. and Reichert, M. 1993. Stream Temperature Data Compilation, Klamath River Basin, Number One, R-5 Fish Habitat Relationship Technical Report, USDA Forest Service, Happy Camp Ranger District, P.O. Box 377, Happy Camp, California 96039.