8-3-1979

Motion of the Spokane Tribe of Indians to Amend Findings in Court's Memorandum Opinion

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A Hach chemical kit, Model AL-36-P, was used for water analysis and samples were analyzed in the field immediately upon collection. Aquatic invertebrates were sampled using a one-square foot Surber stream sampler and the organisms were stored in 80% isopropyl alcohol for later analysis. The aquatic invertebrates were enumerated and the total volume was determined by liquid displacement. Fish populations were sampled on August 8, 1973 by electro-fishing techniques using a variable voltage fish shocking unit to determine the species of trout present. Stream length sampled at each of Stations 1, 2, and 3 were 350, 300 and 300 feet respectively.

Air temperature data are from records obtained from the National Oceanic and Atmospheric Administration, National Weather Service Office located at the Spokane International Airport.

Stream flow data were provided by Mr. Walter L. Woodward, Consulting Engineer, Spokane, Washington and from U.S. Geological Survey records. The data were obtained at a water gauging station located approximately 0.1 mile below Chamokane Creek falls (Figure 2).

Results and Discussion

Physical Characteristics

Water temperature is one of the most important physical factors affecting fish in streams, both directly and, for cold water fish such as trout, indirectly through its influence on oxygen consumption.

Chamokane Creek is particularly vulnerable to increased water temperatures in the summer from solar radiation because its valley is oriented in a northeast to southwesterly direction and as such is shaded by the surrounding hills only in the morning and late evening. Streamside vegetation of mixed conifers and deciduous trees provides some shade and reduces solar radiation. Cool water from spring sources moderates water temperature fluctuations in the stream.

Galbraith Springs and the springs at the Ford fish hatchery are the principal sources of spring water flowing into Chamokane Creek. That portion of the stream flow contributed by the hatchery springs varied from 4.5 cfs to 6.0 cfs during the study period.[1/] The water temperature of the hatchery springs is a nearly constant 47°F.[2/] The volume of water from Galbraith Springs appeared somewhat greater than the hatchery springs and water temperatures were nearly the same.

Because Chamokane Creek is spring-fed, daily variation in water temperatures (caused primarily by radiation into and out of the water) declines towards the spring source. The daily temperature variations recorded at two locations during the warmest air temperature period, July 17 to August 1, 1973 are graphically presented (Figure 3). Daily water temperature variations during this period ranged between 3°F. and 7°F. at the recording station nearest the springs, and between 7°F. and 15°F. at the downstream location.

The range of flows in Chamokane Creek during the critical summer period under study was very narrow. Stream flows, as well as water and air temperatures, undergo diurnal fluctuations (Figure 3). The diurnal fluctuations in flow appear to be the result of evapo-transpiration. Erratic fluctuations, as depicted by the stream flow chart, resulted from water surges from release of water at the hatchery and from pumping of water from the stream. There was an inverse relationship between water flow and maximum water temperatures recorded in Chamokane Creek during the study, with higher water temperatures occurring during lower average daily stream flows and lower maximum water temperatures occurring during higher average daily stream flows (Figure 6).

Maximum water temperatures (Table 1) recorded at Station 3 exceeded maximum temperatures recommended for the well-being of salmonids (trout - 68°F., Table 2) on

2/ Bob Johns, Hatchery Manager, Washington Department of Game, personal communication, October 18, 1973

Table 1. Water Temperature Data from Chamokane Creek and Air Temperature Data from Spokane Airport in Degrees Fahrenheit.

Date 1973	Station 1 Maximum	Station 1 Minimum	Station 1 Average	Station 3 Maximum	Station 3 Minimum	Station 3 Average	Spokane Airport Maximum	Spokane Airport Minimum	Spokane Airport Average
July									
18				70	55	62.5	93	58	75.5
19	62	55	58.5	70	58	64.0	94	59	76.5
20	59	56	57.5	66	59	62.5	80	61	70.5
21	59	54	56.5	66	57	61.5	78	55	66.5
22	61	55	58.0	66	55	60.5	74	48	61.0
23	58	55	56.5	64	55	59.5	77	49	63.0
24	59	54	56.5	64	54	59.0	83	50	66.5
25	61	55	58.0	67	55	61.0	89	56	72.5
26	62	58	60.0	70	59	64.5	91	64	77.5
27	64	59	61.5	70	59	64.5	94	60	77.0
28				70	59	64.5	92	65	78.5
29				69	59	64.0	96	65	80.5
30				69	60	64.5	94	65	79.5
31				69	58	63.5	92	61	76.5
August									
1				69	59	64.0	95	63	79.0
2							93	62	77.5
3							94	62	78.0
4							92	64	78.0
5							84	61	72.5
6							80	52	66.0
7							85	54	69.5
8							88	60	74.0
9				68	58	63.0	92	62	77.0
10	62	54	58.0	67	61	64.0	85	66	75.5
11	62	54	58.0	68	59	63.5	90	61	75.5
12	59	54	56.5	68	59	63.5	93	62	77.5
13	62	54	58.0	63	60	61.5	89	66	77.5
14	61	54	57.5	67	58	62.5	91	60	75.5
15	59	52	55.5	66	57	61.5	89	59	74.0
16	58	52	55.0	64	56	60.0	81	54	67.5
17	58	50	54.0	62	55	58.5	71	45	58.0
18	59	49	54.0	61	52	56.5	72	43	57.5
19	59	51	54.5	62	51	56.5	83	45	64.0
20	59	51	55.0	63	55	59.0	85	52	68.5
21	59	53	56.0	63	55	59.0	86	56	71.0

From Navarre Report, Exhibit 64

nine days during the period July 18 through August 1, 1973. Optimum water temperatures for trout (50°-60°F.) were exceeded every day during this same period. Stream flow in the upper reaches of the study area was sufficient to maintain suitable temperatures for trout; however, adequate flows of spring water did not exist to maintain optimum water temperatures in the lower reaches of the stream. Discharge at the water gauging station during this period varied from 19 cfs to 23 cfs (Table 3).

Water temperatures in excess of 68°F. were recorded on three occasions with a pocket thermometer at the Boardman Road crossing (Figure 4). The maximum water temperature recorded by this method at the water gauging station below the falls on lower Chamokane Creek was 73°F. on July 17, 1973. The maximum air temperature reached during the critical summer period was 96°F. At no time did the maximum daily air temperature reach or exceed the historical daily maximums recorded for the Spokane area (Figure 5).

The spring water which is warmer than ambient temperatures in the fall, winter and spring serves to extend the growing season for trout beyond that found in streams with only surface water supplies. The average water temperatures in the upper reaches of the study area, closer to the spring source, began to exceed those in the lower section of the stream in September (Table 1). Temperature benefits from spring water sources are finally negated when large volumes of cool water from snow melt descend the stream from above.

Chemical Characteristics

Chemical data collected on Chamokane Creek are shown in Table 4. Values obtained from all chemical tests were found to be favorable for trout habitat. Dissolved oxygen ranged from 10 ppm to 11 ppm at the sampling locations. Hydrogen-ion (pH)

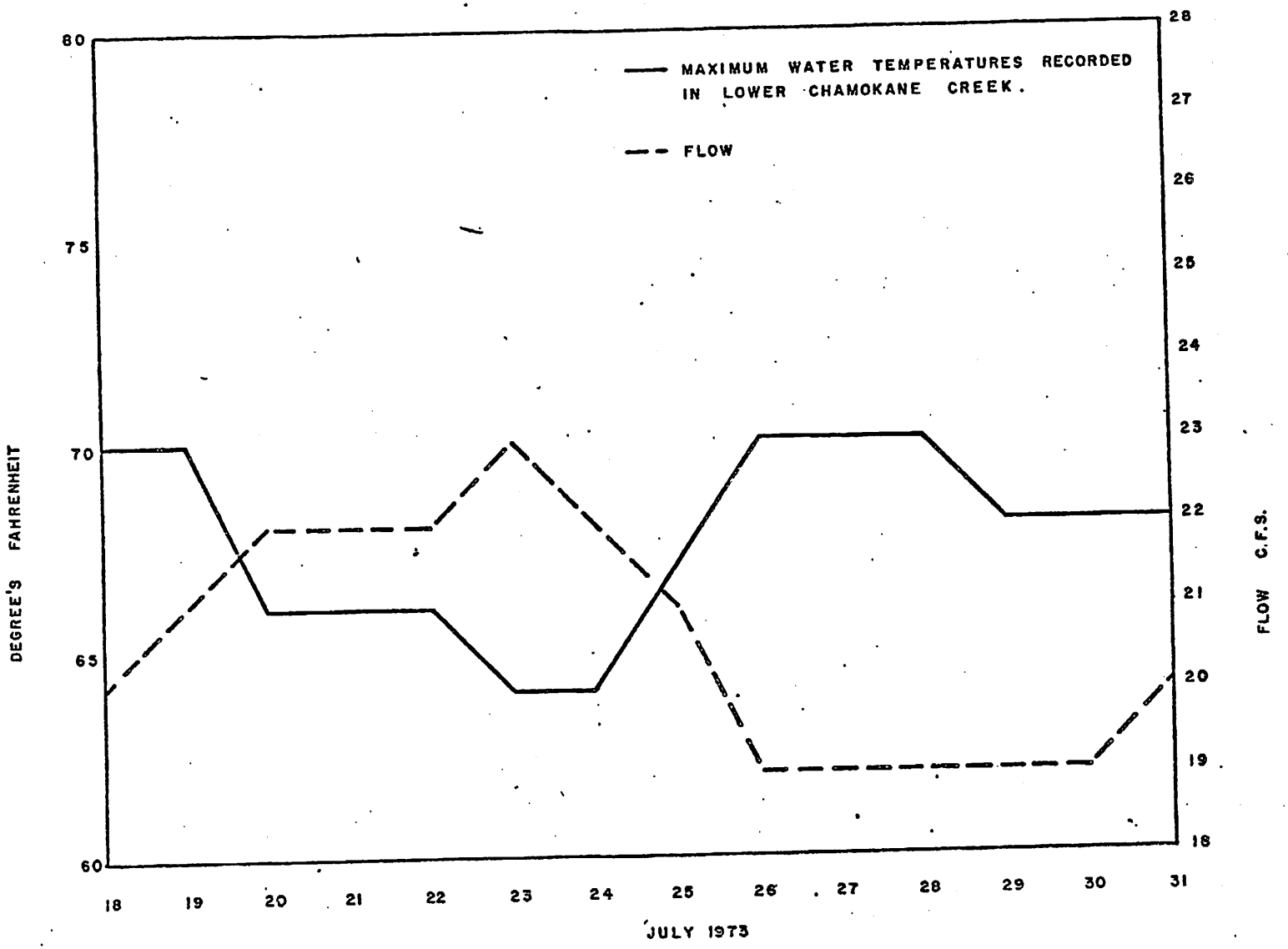

Figure 6. RELATIONSHIP OF WATER FLOW TO MAXIMUM WATER TEMPERATURE IN LOWER CHAMOKANE CREEK DURING PERIOD JULY 18-31, 1973.

were found above Chamokane Creek falls. Trout were scarce in the lower reaches of Chamokane Creek (Station 3). Excessively high water temperatures occurring in the summer in the lower reaches of the stream are believed to be the most limiting factor responsible for the low trout population.

Summary

Physical, chemical and biological factors affecting the status of the trout population in Chamokane Creek were examined during the period July 13, 1973 to November 30, 1973. Brown trout were found to be the dominant trout species present in the stream.

All factors examined affecting the quality of trout habitat in Chamokane Creek were favorable except for excessive water temperatures which occurred in the lower reaches of the stream. The volume of cool water emanating from springs along Chamokane Creek during the study period was not adequate in volume to maintain favorable temperatures for quality trout habitat.

Any reduction in the natural flow of water from the springs will have additional adverse effects on the ecology of the stream and the area available for trout will be reduced, upstream, towards the springs source.

Recommendations

Pumping of water which reduces stream flows should be curtailed. A minimum flow of 30 cfs should be maintained in the lower reaches of Chamokane Creek to provide favorable habitat for trout populations. The United States Fish and Wildlife Service should restock trout in Chamokane Creek when adequate stream flows are restored.

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