WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: Fish Creek Instream Flow Investigation, Teton County

PROJECT: IF-1091-07-9004

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DATE: July 1992

INTRODUCTION

Studies were conducted to obtain instream flow information from a segment of Fish Creek near Wilson, Wyoming. These studies were designed to provide the basis for determining instream flows which would maintain or improve the existing fishery values in the candidate section of Fish Creek. Results of these studies could be applied to the stream segment extending upstream from the confluence of Fish Creek and the Snake River in the NW 1/4 of section 3, Range 117 West, Township 40 North; upstream to Lake Creek in the SE 1/4 of section 2, Range 117 West, Township 41 North (Figure 1).

This portion of Fish Creek is designated by the Wyoming Game and Fish Department (WGFD) as a Class 3 trout stream and is managed under the wild fish concept for Snake River cutthroat trout. Class 3 streams generally support regionally important fisheries, and the wild fish management designation ensures that perpetuation of the native cutthroat trout species is emphasized.

In addition to providing significant recreational fisheries opportunities for both resident and non-resident anglers, this section of Fish Creek contributes to the maintenance of cutthroat trout populations in the Snake River by providing recruitment of immature fish. Because adequate streamflows are necessary to maintain the adult fish populations that support recreational opportunities, and to ensure continued recruitment of immature cutthroat trout to the Snake River, this segment of Fish Creek is considered a critical segment.

The WGFD management goals for Fish Creek are to maintain or improve the existing fishery for adult trout, and to maintain the stream's current contribution of cutthroat trout recruitment to the Snake River. To address these goals, the specific objectives of this study were to determine instream flows necessary to, 1) maintain physical habitat for adult cutthroat trout and, 2) maintain streamflow conditions suitable for continued recruitment of immature cutthroat trout to the Snake River.

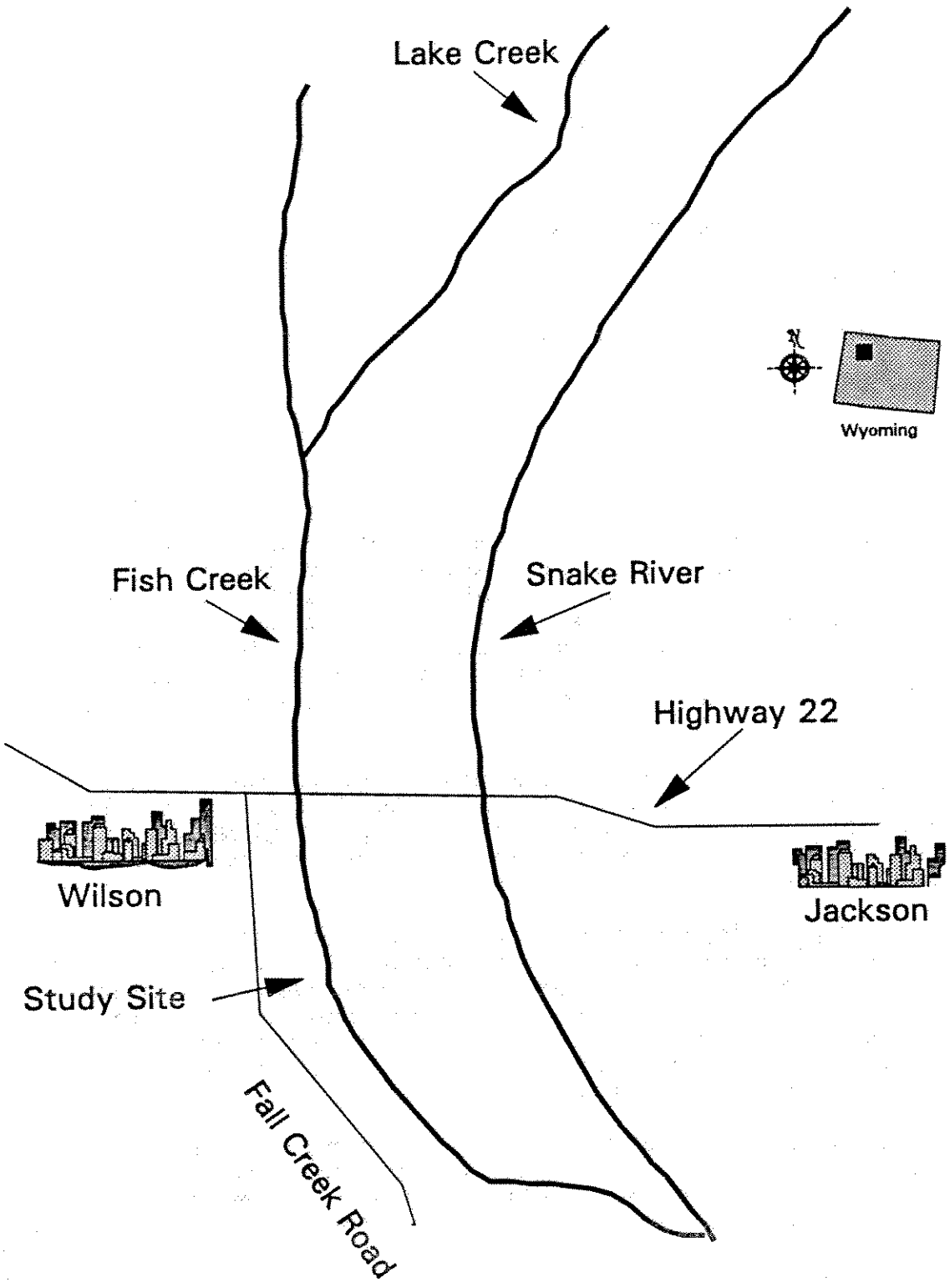

Figure 1. Instream flow study site location on Fish Creek near Jackson, Wyoming.

METHODS

Data for these studies were collected from a site located approximately 2.5 miles downstream from the town of Wilson, on property controlled by the Crescent H Ranch. The approximate location of the study site was Section 34, Range 117 West, Township 41 North (Figure 1). These studies were conducted during July and September of 1991 within a 375 foot long study site that contained trout habitat typical of that found throughout the candidate section of Fish Creek. Data for the two habitat models used in this study were collected after peak runoff (Table 1).

Table 1. Dates and discharge rates when instream flow data were collected from Fish Creek during 1991.

Date	Discharge Cubic Feet Per Second (cfs)
July 19	330
September 10	230

The PHABSIM model was developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (Bovee and Milhous 1978) to examine incremental changes in the amount of physical habitat available at various discharge rates. The amount of physical habitat available at a given discharge is expressed in terms of Weighted Usable Area (WUA). Weighted Usable Area values reflect the composite suitability of depth, velocity and substrate at a given flow, and are expressed as square feet of WUA per 1,000 linear feet of stream.

To standardize results relative to the maximum amount of physical habitat over the range of simulated flows, the WUA output for this study were converted to percent of Maximum Usable Area (MUA). This conversion expresses all WUA values as a percent of the maximum WUA value for each life stage where; $MUA = (WUA/WUA_{max}) * 100$.

Snake River cutthroat trout fry display a strong tendency to migrate downstream to the Snake River after emerging from spawning gravels in tributary streams (Kiefling 1978). Although most fish will migrate downstream, some will remain to mature in tributaries of the Snake River, and it is these remaining Snake River cutthroat trout that support the recreational fishery in Fish Creek. In order to determine the streamflows necessary to maintain physical habitat for adult trout, calibration and modeling techniques outlined in Milhous (1984) and Milhous et al. (1989) were combined with Habitat Suitability Curves developed by Hickman and Raleigh (1982), to simulate physical habitat for flows from 20 to 325 cfs.

The Habitat Quality Index (HQI) model developed by the Wyoming Game and Fish Department (Binns 1982, Binns and Eiserman 1979) was used to estimate potential changes in trout production over a range of flow conditions. The model incorporates nine attributes that address chemical, physical and biological components of trout habitat. Results are expressed in habitat units (HU), with one HU defined as the amount of habitat quality which will support about 1 pound of trout. Results of the HQI model apply to the time of year that determines trout production, which is from July 1 to September 30.

By measuring habitat attributes at various flow events as if associated habitat features were typical of late summer flow conditions (Conder and Annear 1987), HU estimates were made for hypothetical summer flows ranging from 20 to 325 cfs. To better define the potential impact of various late summer flow levels on trout production, some attributes were estimated by linear regression for flows other than those which were measured.

RESULTS AND DISCUSSION

The PHABSIM model indicated that physical habitat for adult cutthroat trout was maximized at a discharge of 150 cfs, and remained fairly high until streamflows dropped to about 120 cfs. As flows were reduced below 120 cfs, decreases in physical habitat were rapid. Streamflows in excess of 150 cfs also caused rapid decreases in physical habitat (Figure 2).

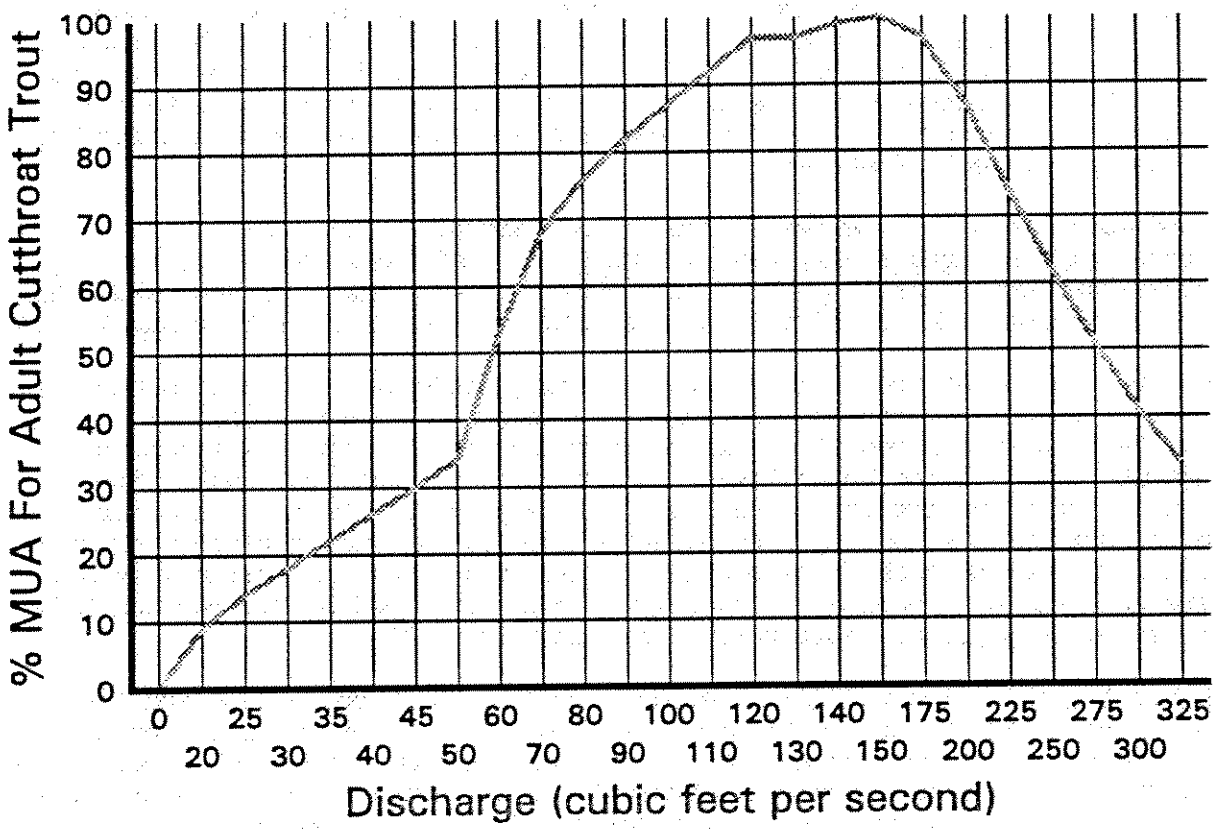

Figure 2. Relationship between physical habitat and discharge for adult cutthroat trout at the Fish Creek study site. Data are expressed in terms of percent of Maximum Usable Area (MUA).

Data were collected for these studies at discharges of 230 and 330 cfs, and these streamflows included substantial, but unknown, amounts of excess irrigation water. These excess irrigation flows which are introduced into Fish Creek via Lake Creek (Kiefling, personal communication) maintain relatively high flows in Fish Creek throughout the summer, which are in excess of flows that would occur naturally from only the Fish Creek drainage. An indication of streamflows contributed by Lake Creek was obtained from measurements made in July of 1992. When discharge at the study site was 207 cfs, streamflow was 83 cfs above Lake Creek. A dischargbe of 103 cfs was measured in Lake Creek near its confluence with Fish Creek.

Although there are no stream gauging records available for Fish Creek, and it is unknown how low streamflows would naturally fall during the late summer or winter, it appears that excess streamflows resulting from upstream irrigation returns are limiting the amount of physical habitat for adult Snake River cutthroat trout at least during the irrigation season.

Because maintenance of physical habitat for adults is important year round, an instream flow of 150 cfs is recommended for the entire year. However, it is recognized that streamflows may occasionally fall below 150 cfs, and at these times, maintenance of natural flows (up to 150 cfs) is important to ensure that impacts to fishery values are limited to the level that would have occurred naturally. The intent of adhering to this threshold even at times when that quantity of water may not be naturally available is to ensure that additional dewatering of the stream for other purposes does not occur, and to ensure that the fishery is afforded the ability to benefit from natural flows up to the defined 150 cfs threshold. Additional storage for the purposes of supplementing these natural shortfalls is not necessary to meet the WGFD objective of maintaining the existing trout fishery in Fish Creek.

Results from the HQI model indicate that under late summer conditions, this segment of Fish Creek supports about 55 trout Habitat Units per acre (Figure 3). A flow of 225 cfs is the minimum flow that will maintain this existing level of HU's. At higher streamflows, HU's are reduced, and at lower flows, HU's are increased until a discharge of 70 cfs is reached. As flows fall below 70 cfs, HU's will continuously decline with additional decreases in discharge.

Although a discharge of 70 cfs would provide the greatest increases in HU's relative to existing summer conditions, it is recommended that an instream flow of 150 cfs be maintained throughout this section of Fish Creek in order to address both the habitat quality and quantity requirements of adult trout. At a discharge of 150 cfs, HU's would be increased by about 40% over existing conditions, and at the same time, the need to maintain appropriate quantities of physical habitat for adults will be met throughout the year.

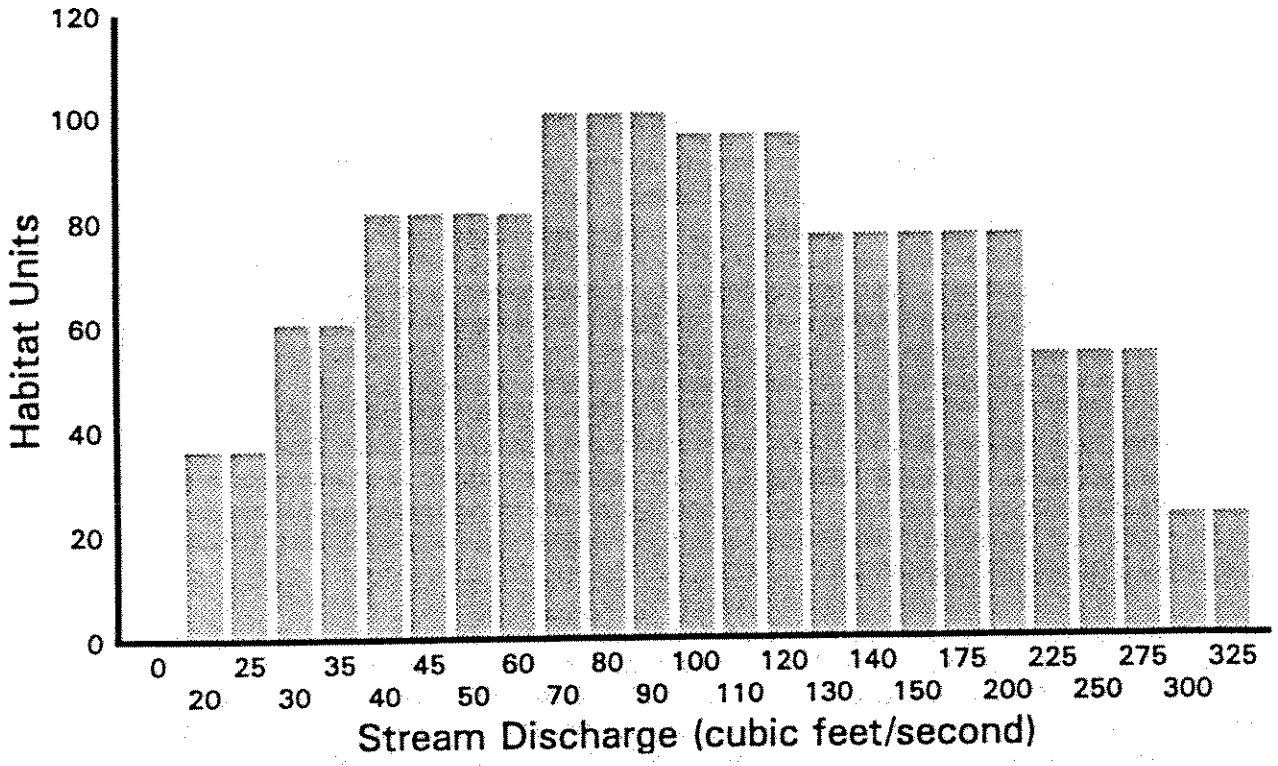

Figure 3. Relationship between stream discharge and Habitat Units for Fish Creek near Wilson, Wyoming. Data were collected in 1991.

In addition to meeting the habitat requirements of adult cutthroat trout, an instream flow through this section of Fish Creek must also be sufficient to permit downstream migration of immature fish. In terms of depth, velocity or wetted area limitations, riffles are often critical areas for fish passage, and maintaining adequate flows over this habitat type would also ensure adequate flows at other habitat types such as runs or pools. To gage the adequacy of an instream flow (150 cfs), hydraulic parameters derived from intermediate PHABSIM model output were tabulated for a range of streamflows at a riffle transect (Table 2).

Table 2. Changes in wetted perimeter, average velocity, and depth at a riffle, as a function of discharge in Fish Creek during 1991. Data are from intermediate output of the PHABSIM model.

Discharge (cfs)	Wetted Perimeter (ft)	Average Velocity (fps)	Average Depth (ft)
25	74.8	0.3	1.2
50	75.4	0.5	1.3
75	75.7	0.7	1.4
100	75.9	0.9	1.5
125	76.2	1.1	1.6
150	76.3	1.2	1.7
175	76.5	1.4	1.7
200	76.6	1.5	1.8
250	76.9	1.8	1.8
300	77.1	2.1	1.9

This analysis indicated that changes in hydraulic parameters at the riffle would be relatively small over the range of flows simulated. Most of the stream channel would remain wet even at very low streamflows, and average depth would always be in excess of 1 foot. The greatest change was noted for average velocity, which would become relatively low at discharges below about 100 cfs (Table 2). Since the size of downstream migrating trout would generally include trout smaller than 6 inches long, hydraulic conditions present over riffles at 150 cfs would be adequate for maintaining downstream passage.

Because hydraulic characteristics over riffles appear to be fairly stable, passage requirements for immature cutthroat trout would probably be met over a range of streamflows, including flows below 150 cfs. However, as indicated by the PHABSIM and HQI models, either the quantity or quality of adult trout habitat would be compromised at these lower flows. Consequently, an instream flow of 150 cfs is recommended to ensure uninhibited downstream passage for immature cutthroat trout.

SUMMARY

For the portion of Fish Creek considered in this report, it is important to maintain physical habitat for adult cutthroat trout throughout the year, while simultaneously, maintaining suitable conditions for downstream movements of immature trout. Based on the results of PHABSIM and HQI modeling, it has been determined that a streamflow of 150 cfs will meet these needs. The portion of Fish Creek for which this assessment applies extends upstream from the confluence of Fish Creek and the Snake River in the NW 1/4 of section 3, Range 117 West, Township 40 North; to Lake Creek in the SE 1/4 of section 2, Range 117 West, Township 41 North.

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