WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: New Fork River Instream Flow Report

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INTRODUCTION

Studies were conducted to obtain instream flow information from the New Fork River near Boulder from May through October of 1987. The studies were designed to provide the basis for determining instream flows which would maintain or improve the existing fishery in the section of the New Fork River that passes through the state school section (S36, R109W, T33N) adjacent to the Pinedale airport. Public access is available throughout this stream segment which is 1.5 miles long.

This section of the New Fork River is designated by the Wyoming Game and Fish Department (WGF) as a Class 2 trout stream which is managed for wild brown trout. Less than 6% of the flowing water in Wyoming is classified as Class 2. Other species present include rainbow and brook trout and mountain whitefish. The New Fork River provides fishing opportunities for a diverse group of anglers. Some of the highest angling effort on the New Fork River occurs within the state school section (Kurtz 1987). For these reasons this stream segment is considered a critical reach.

The objectives of this study were to determine instream flows necessary to 1) maintain or improve physical habitat for brown trout spawning and incubation and for fry, 2) maintain hydraulic characteristics during the winter that are important for winter survival of trout, fish passage and aquatic insect production and 3) maintain or improve adult trout production during the late summer months.

METHODS

The data for these studies were collected from a site located approximately in the middle of the south half of Section 36, Range 109 West, Township 33 North, near the Pinedale airport. The trout habitat found within the study sites is typical of that found throughout the candidate section of the New Fork River.

The Habitat Retention method (Nehring 1979, Annear and Conder 1983) was used to identify a maintenance flow. A maintenance flow is defined as a continuous flow that is needed to maintain minimum hydraulic criteria at riffle areas in a stream segment. Meeting these criteria provides passage for all life stages of trout between different habitat types and maintains survival of trout and aquatic macroinvertebrates. The maintenance flow is identified as the discharge at which two of the three criteria in Table 1 are met for all candidate riffles in the study site. Instream flow recommendations derived from this method are applicable to all times of year except when higher instream flows are required to meet other fishery management purposes. Data were collected from transects placed across three riffles within the study area and analyzed using the IFG-1 computer program (Milhous 1979). Data were collected on the dates shown in Table 2.

Table 1. Hydraulic criteria used to obtain an instream flow recommendation using the Habitat Retention method.

Category	Criteria
Average Depth (ft)	Top width[1] x 0.01
Average Velocity (ft per sec)	1.00
Wetted Perimeter (percent)[2]	60

1 - At average daily flow
2 - Compared to wetted perimeter at bank full conditions

Table 2. Dates and discharge rates when data were collected for PHABSIM, HQI and IFG-1 modeling on the New Fork River near the Pinedale airport.

Date	Discharge (cfs)
05-20-87	740
07-01-87	395
09-12-87	132
10-23-87	85

A physical habitat simulation model (PHABSIM) developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (Bovee and Milhous 1978) was used to examine incremental changes in the amount of physical habitat available for brown trout spawning, incubation and fry at various discharge rates. The amount of physical habitat available at a given discharge is expressed in terms of weighted usable area (WUA) and reflects the composite suitability of depth, velocity and substrate at a given flow. Depth, velocity and substrate data were collected after peak runoff from eight transects in accordance with guidelines given by Bovee and Milhous (1978). Dates and discharge rates when data were collected are given in Table 2. Using calibration and modeling techniques outlined in Milhous (1984) and Milhous et al. (1984), the WUA for the three brown trout life stages was calculated for flows ranging from 35 to 500 cubic feet per second (cfs).

The Habitat Quality Index (HQI) model developed by Binns and Eiserman (1979) was used to assess late summer habitat conditions for adult trout. Results of the HQI model are expressed as habitat units (HU), with one habitat unit defined as the amount of habitat quality capable of supporting one pound of trout. The results of the HQI model apply to the time of year that determines trout production. For Wyoming trout streams, this period is from July 1 to September 30. The data required for the HQI model were collected concurrently with PHABSIM data (Table 2).

By measuring habitat attributes at various flow events as if associated habitat features were typical of late summer flow conditions, HU estimates were made for a range of theoretical summer flows from 50 to 500 cfs. To better define the potential impact of other late summer flow levels on trout production some attributes were derived mathematically for flows lower or higher than those which were measured. Results from the HQI model were used to identify the flow needed to maintain existing levels of trout production between July 1 and September 30.

RESULTS AND DISCUSSION

The Habitat Retention method was developed to identify a flow that would maintain survival rates of aquatic insects in riffle areas, maintain existing survival rates of trout and provide passage for trout between different habitat types in streams during the winter. Maintenance of these features is important year round except when higher flows are needed at specific times to meet other requirements.

Results from the Habitat Retention model showed that flows of 65, 81 and 95 cfs are necessary to maintain aquatic insect production and fish passage at riffles 1, 2 and 3 respectively (Table 3). The maintenance flow derived from this method is defined as the flow at which two of the three hydraulic criteria are met for all riffles in the study site. For this segment of the New Fork River, this stream flow is 95 cfs.

Table 3. Results from IFG-1 modeling at the New Fork River study site during 1987.

Discharge (cfs)	Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter
		Riffle 1	
13	0.32	1.50[1]	26.6
28	0.33	1.83	47.0
51	0.44	1.95	59.8
65[2]	0.49	1.99	66.8[1]
90	0.61	2.10	69.7
125	0.77	2.27	72.3
171	0.90[1]	2.46	76.8
253	1.11	2.76	83.1
		Riffle 2	
72	2.60[1]	0.49	103.8
81[2]	2.52	0.57	106.3[1]
107	2.43	0.68	113.2
127	2.35	0.77	118.4
149	2.29	0.87	123.6
183	2.20	1.00[1]	131.8
202	2.15	1.07	136.7
275	2.20	1.28	145.2
		Riffle 3	
7	0.32	1.00[1]	26.6
33	0.52	1.69	38.2
69	0.62	2.08	53.5
95[2]	0.69	2.21	61.8[1]
132	0.80[1]	2.38	69.8
189	0.97	2.58	76.0
246	1.11	2.77	80.0
275	1.19	2.85	81.0

1 - Hydraulic criteria from Table 2 met.
2 - Flow meets two of three criteria for individual transect.

The natural mortality that occurs during the winter can often be a significant factor limiting a trout population. Kurtz (1980) found that the loss of winter habitat due to low flow conditions was an important factor affecting mortality rates of trout in the upper Green River, with mortality approaching 90% during some years. Needham et al. (1945) documented average overwinter brown trout mortality of 60% and extremes as high as 80% in a California stream. Butler (1979) reported significant trout and aquatic insect losses caused by anchor ice formation. Reimers (1957) considered anchor ice, collapsing snow banks and fluctuating flows resulting from the periodic formation and breakup of ice dams as the primary causes of winter trout mortality.

The causes of winter mortality discussed above are all greatly influenced by the quantity of winter flow in terms of its ability to minimize anchor ice formation (increased velocity and temperature loading) and dilute and prevent snow bank collapses and ice dam formation respectively. Any reduction of natural winter stream flows would increase trout mortality and effectively reduce the number of fish that the stream could support. The fishery management objective for the time period from October 1 to March 31 is subsequently to protect all available natural stream flows in the instream flow segment up to the maintenance flow. The maintenance flow for this stream segment is 95 cfs.

Gage records are unavailable for this section of the New Fork River, and it is possible that the discharge of 95 cfs identified by the Habitat Retention method may not be present at times during the winter. This does not imply the need for storage to supply winter flows, but illustrates the need to maintain all natural winter streamflows, up to 95 cfs, in order to maintain existing survival rates of trout populations.

The state school section is within a segment of the New Fork River managed for wild brown trout, and as such, is dependent on spawning and egg survival for perpetuation of the trout fishery. Brown trout generally spawn in October and November, their eggs incubate from December through March, and the fry are present from March through June. Results from the PHABSIM model for spawning, incubation and fry life stages were used to determine flows necessary to maintain or improve brown trout reproductive success and fry recruitment during these time periods.

The brown trout spawning and incubation period coincides with the time of year when the management objective is to preserve all natural stream flows. Results from the PHABSIM analysis show that meeting this objective with the discharge identified by the Habitat Retention method (95 cfs) will maintain 95% of the available physical habitat for brown trout spawning and 100% of the incubation habitat (Figure 1). Additionally, meeting the discharge identified by the Habitat Retention method during the time when fry are present (March through June) will maintain 99% of the physical habitat for fry (Figure 2).

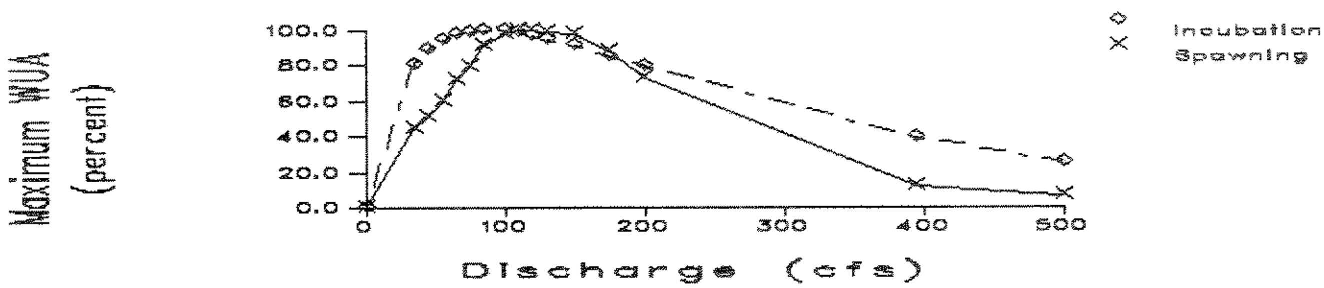

Figure 1. Percent of maximum weighted usable area (WUA) for brown trout spawning and incubation at the state school section study site as a function of discharge.

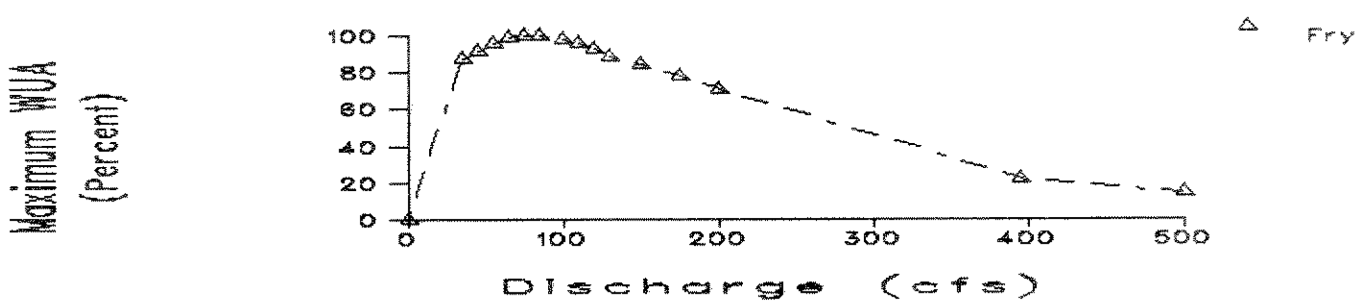

Figure 2. Percent of maximum weighted usable area (WUA) for brown trout fry at the state school section study site as a function of discharge.

It should be noted that the PHABSIM model does not account for maintaining fish passage and aquatic insect survival, nor does it address impacts which might occur during the winter due to low temperatures and increased ice formation. Although the PHABSIM model indicates that physical habitat (WUA) for spawning, incubation and fry remain high at flows less than 95 cfs, the lower flows cause undesirable reductions in hydraulic criteria necessary for maintenance of fish passage, trout survival and aquatic insect production. The recommendation derived from the Habitat Retention method (95 cfs) more accurately accounts for these limiting factors. A discharge of 95 cfs is recommended for the period from April 1 through June 30 as the minimum flow necessary to maintain or improve recruitment.

Under existing average late summer conditions, this segment of the New Fork River supports approximately 95 Habitat Units. Results from the HQI analysis (Figure 3) indicate that 135 cfs is the minimum flow that will maintain this existing level of HU's, and that trout habitat units would be reduced at lower flows. The current fishery management objective is to maintain the existing number of habitat units, and at the same time, to protect the habitat features addressed by the Habitat Retention method. In order to accomplish this objective, a flow of 135 cfs is recommended for the period from July 1 through September 30.

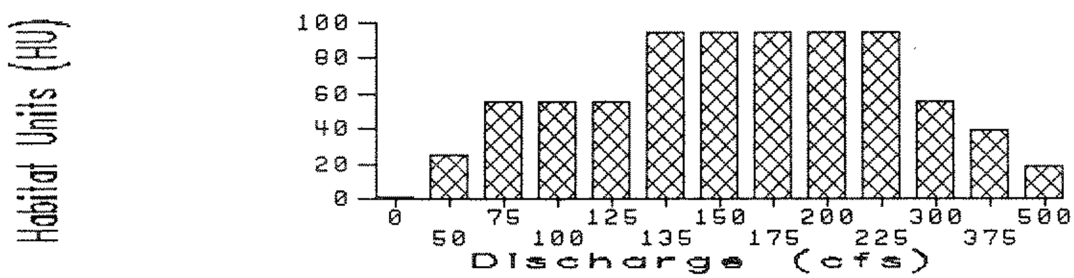

Figure 3. Adult trout habitat units (HU) as a function of discharge at the state school study site during 1987.

SUMMARY

Based on results from the Habitat Retention method and PHABSIM and HQI modeling, the following instream flow regime is recommended for maintaining or improving existing trout production levels in the New Fork River within the state school section (S36, R109W, T33N). These recommendations are applicable to 1.5 miles of the New Fork River.

Table 4. Summary of instream flow recommendations for the New Fork River near the Pinedale airport.

Time Period	Instream Flow Recommendation (cfs)
July 1 to September 30	135
October 1 to March 31	95
April 1 to June 30	95

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