WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: Sand Creek Instream Flow Report

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Studies were conducted during the 1986 field season to obtain data suitable for analyzing instream flow needs for a defined instream flow reach on Sand Creek. Studies were designed to provide an analysis of the effects of various discharge rates on several life stages of brown trout at different times during the year. The defined instream flow reach extends from the point where the stream crosses the boundary of the state land on the SW1/4, NE1/4, of section 7, T52N, R60W downstream to the NE1/4 SE1/4, SE1/4, of section 31, T53N, R60W. This is a distance of approximately 4.4 stream miles.

METHODS

A physical habitat simulation model (PHABSIM) developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (USFWS) (Bovee and Milhous 1978) was used to identify incremental changes in the amount of physical habitat for brown trout with changes in flow. Data were collected from a 239 foot long study site located on Wyoming Game and Fish Department property at R60W, T52N, S8, NW1/4, NE1/4. Six transects were established throughout this reach to sample all habitat types. The habitat within the study reach contained a combination of pool and riffle habitat that was representative of trout habitat features throughout the defined instream flow reach.

Although stream flows were measured on two different occasions (Table 1), a significant change in flow was not observed at the study site. As a result, the PHABSIM model was calibrated using only the data from June 12. The model was calibrated by using the WSP program to generate water surface elevations and using these values in the PHABSIM model with one set of measured cell velocities (Bob Milhous, USFWS, unpublished reports). This method permitted simulation of physical habitat (useable area) over a range of flows between 8 and 50 cfs. The results of the PHABSIM model were used to quantify changes in useable area only for brown trout spawning and incubation life stages. This model was not used for motile life stages of brown trout since factors

other than the physical factors included in the model were judged to have a larger influence on potential trout standing crops at low flows.

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1978) was used to estimate the number of habitat units (HU) per acre that the stream can support given existing late summer flow conditions. This model incorporates seven attributes that address chemical, physical as well as biological components of trout habitat. The estimates derived from this model are based on late summer flow conditions and apply to the time of year that governs productivity of adult trout. On Sand Creek this time period is between May 1 and October 31. By measuring habitat attributes at various flow events as if associated habitat features were typical of late summer flow conditions, HU estimates can be made for a range of theoretical summer flows. Since the flow conditions in Sand Creek are very constant, habitat conditions for a range of flows could not be measured. As a result, some attributes were derived mathematically or from existing gage data in order to assess potential HU changes at flows lower than the measured base flow. Gage data were obtained from a U. S. Geological Survey gage located at the downstream end of the instream flow segment from 1977 to 1983.

Stream flow data were also measured at I-90, the downstream boundary of Ranch A and at the Ranch A pump house to evaluate longitudinal accretion or loss of stream flows (Table 1).

Table 1. Dates, locations and discharge rates when stream flow data were collected on Sand Creek.

Location	Date	Discharge (cfs)
I-90	6-11-86	37.0
	7-10-86	23.9
Study Site	6-12-86	21.1
	7-11-86	20.2
Ranch A Boundary	6-11-86	25.5
	7-10-86	20.2
Ranch A Pump House	6-11-86	7.7
	7-10-86	11.5

RESULTS

Results from the HQI analysis showed that, at a summer flow of 20 cfs, this portion of Sand Creek provides 495 habitat units per acre (Figure 1). Reductions in flow from this base flow would significantly reduce the quality of this fishery. Results from the model show that the stream is capable of supporting as many habitat units at 18 cfs as at 20 cfs; however, a reduction in flow to 16 cfs would result in a loss of approximately 50 percent of the habitat units presently found in the stream. Further reductions in flow would result in additional fishery losses. On this basis, the instream flow recommendation to maintain existing levels of trout production is 18 cfs from May 1 to October 31.

The feasibility of this recommendation, in terms of its ability to maintain this number of habitat units, should be judged on the frequency that this amount of water is available between May 1 and October 31. According to Burton and Wesche (1974), this flow should be available at least 50 percent of the time during the summer "production" period (with adequate, continuous flows at other times of year) in order to accomplish this objective.

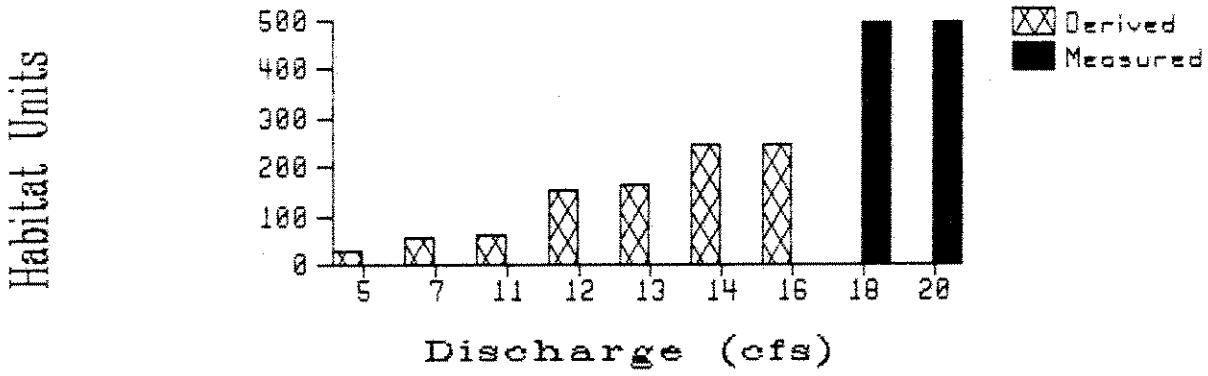

Figure 1. Number of habitat units in Sand Creek at various flows.

This fishery is supported entirely by natural reproduction and as a consequence spawning and incubation flows are extremely important in order to maintain the fishery at its present level. Results from the PHABSIM analysis showed that spawning habitat is maximized at 21 cfs and incubation habitat is maximized at 16 cfs (Figures 2 and 3 respectively). Since the brown trout in Sand Creek spawn in November and December and their eggs hatch in late winter (March and April), flows of 21 cfs and 16 cfs are recommended for November 1 to December 31 and January 1 to April 30 for spawning and incubation respectively.

Figure 2. Percent of maximum useable area (MUA) for brown trout spawning.

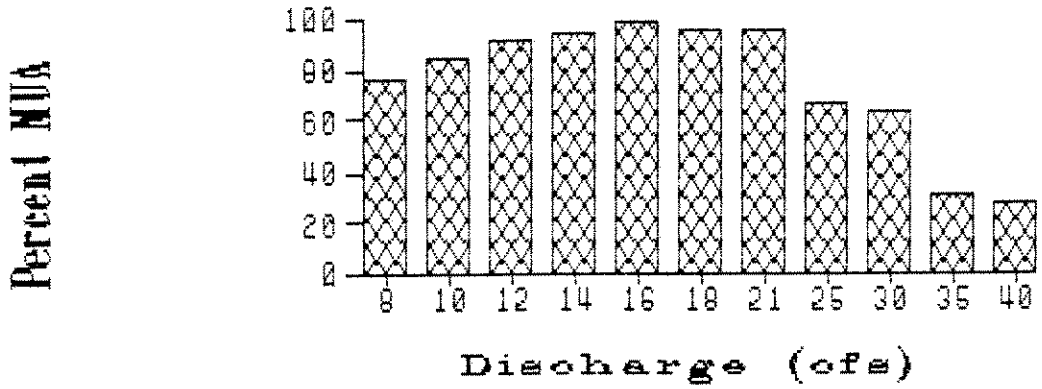

Figure 3. Percent of maximum useable area (MUA) for brown trout incubation.

Several studies have been conducted which revealed that winter flow conditions commonly place a very high stress on adult trout populations in streams (Butler 1979, Kurtz 1980, Needham et al. 1945). These studies show that most fish mortality, including angling mortality, occurs during the winter months. Without exception, these studies concluded that any reduction in natural winter flows would negatively impact existing stream fisheries. In this regard, the fishery management objective for the winter time period (November to May) is to protect all available natural stream flows in the instream flow segment.

The instream flows identified for spawning and incubation appear to approximate existing natural flows during the winter and would help

accomplish the above-defined management objective. Although stream flows may on occasion naturally fall below these recommendations, these recommendations are feasible to the extent that they maintain existing natural flows up to the specified amount.

CONCLUSIONS

Sand Creek is one of the most productive and valuable trout fisheries in Wyoming. Any reduction in the quality of this fishery would therefore be a serious loss. Instream flows are an important part of maintaining this fishery in its present form. Based on the analyses and results contained in this report, the instream flow recommendations presented in Table 3 would maintain the existing fishery in a 4.4 mile segment of the stream upstream from a control point at R60W, T53N, S31, SE1/4, SE1/4, NE1/4.

Table 3. Summary of instream flow recommendations for a portion of Sand Creek.

Time Period	Instream Flow Recommendation (cfs)
November 1 to December 31	21*
January 1 to April 30	16*
May 1 to October 31	18**

* - To maintain existing natural flows up to the specified amount
** - Feasibility determined by availability at least 50 percent of this time period

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