WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: Clarks Fork River Instream Flow Report

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Studies were conducted during the 1981 field season to obtain instream flow information from a portion of the Clarks Fork River near the town of Clark. The studies were designed to provide results which could be used to determine instream flow needs for Yellowstone cutthroat trout as well as to evaluate potential flow-related impacts of future water development activities.

METHODS

All of the field data used in this study were collected from a 2580 foot long study site located on BLM property in the northeast corner of Section 22, Township 56 North, Range 103 West. This site contained a combination of pool and riffle habitat for trout that was representative of trout habitat features found throughout this portion of the stream. Results and recommendations were applied to a portion of the stream extending from the mouth of Sunlight Creek in the NE1/4, SW1/4 of S33, T56N, R104W downstream to the north boundary of the NW1/4, NE1/4 of Section 13, T56N, R104W. This is a distance of approximately 5.85 stream miles.

A physical habitat simulation (PHABSIM) model 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 or weighted usable area (WUA) for adult Yellowstone cutthroat trout with changes in flow. Data were collected at seven transects which were placed across each habitat type within the study segment. Velocities and depths were measured at 5 to 10 foot intervals across each transect during 3 different flow events (Table 1). These data permitted simulation of physical habitat over a range of flows between 70 and 1675 cfs.

Table 1. Dates and discharges when instream flow data were collected.

Date	Discharge (cfs)
08-03-81	670
08-21-81	380
10-03-81	170

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1978) was used to estimate potential changes in trout standing crops over a range of late summer flow conditions. This model incorporates seven attributes that address chemical, physical as well as biological components of trout habitat. Results are expressed in habitat units (HU) per acre. Analyses obtained from this method apply only to the time of year that governs trout production. On the Clarks Fork River this time period is between July 1 and September 30.

By measuring habitat attributes at various flow events as if those habitat features are typical of late summer flow conditions, HU estimates can be made for a range of theoretical summer flows. These data can be used to determine the impact on trout production that would occur if a dam or other stream flow regulating device were placed upstream and resulted in higher (or lower) average flow conditions between July and the end of September. Habitat attributes on the Clarks Fork were measured on the same dates and at the flow levels that data were collected for the PHABSIM model (Table 1.)

To better define the potential impact of other average late summer flow conditions on the existing stream fishery, some attributes were derived mathematically or obtained from existing gage data for flows other than those which were measured. Gage data, adjusted proportionately to reflect flow conditions at the instream flow site, were obtained from a U. S. Geological Survey gage located near Belfry, Montana. Derived HQI analyses were done for flows of 100, 150, 190, 210, and 230 cfs.

Results from the HQI were used to identify the flow needed to maintain existing levels of trout production between July 1 and September 30. Results from the PHABSIM model were used to identify a flow from October 1 to March 31 which would maintain or improve trout survival during the winter and provide adequate physical habitat for adult trout during the spring (April 1 to June 30) as well.

RESULTS

The PHABSIM model identifies changes in the suitability of hydraulic conditions for various life stages of the target species. These data indicate relative trade-offs in usable area in the stream at different flows and cannot be used to quantify changes in trout production. While these data are used for determining the flows which provide the maximum usable area at any time during the year, they are most useful for determining the relative impacts of different flows on trout survival during the winter and spring.

Data for the Clarks Fork indicate that the maximum WUA occurs between 225 and 250 cfs (Figure 1). Usable area decreases at an increasingly rapid rate at higher flows. At flows less than 225 cfs, usable area also decreases, though at a more rapid rate than at higher flows.

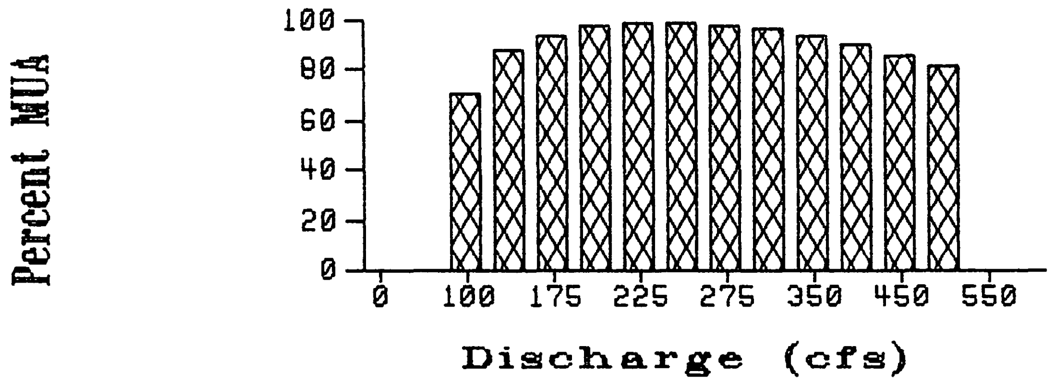

Figure 1. Percent of maximum usable area (MUA) for adult Yellowstone cutthroat trout in the Clarks Fork River.

The HQI is most useful for identifying the late summer flow that will maintain the existing fishery at its present level. This fishery supports 45 habitat units per acre at the existing late summer flow of 230 cfs (Figure 2). An instream flow of 225 cfs would not significantly reduce the number of habitat units presently found in the stream; however, further reductions in flow would result in increasingly greater losses of trout habitat units. An average late summer flow of 210 cfs would support only 39 HU's per acare which is a reduction of more than 13 percent. These reductions would largely be the result of lower critical period flow, higher annual flow variation and slower average channel velocities. Higher late summer flows (up to about 400 cfs) would increase the number of trout habitat units that the river could support. At considerably higher average late summer flows, the number of HU's supported by the river would decline, largely due to increased velocities.

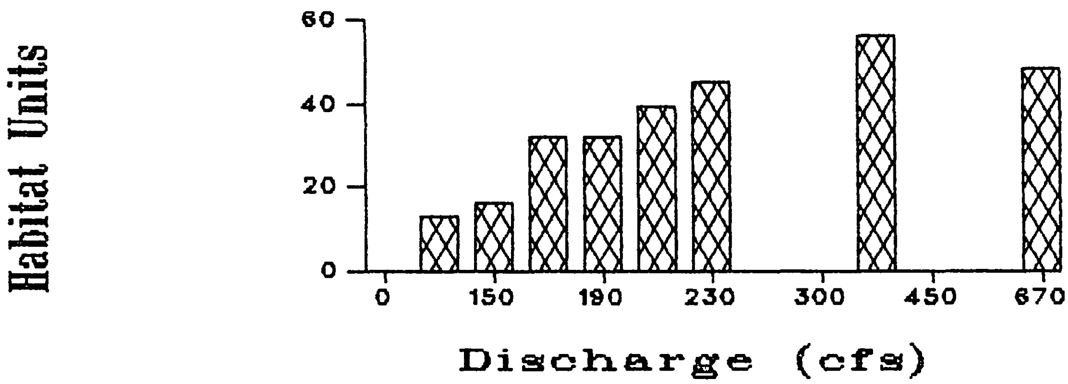

Figure 2. Number of potential trout habitat units at several late summer flow levels in the Clarks Fork River.

Based on the results of these models, an instream flow of 225 cfs is recommended to maintain existing levels of trout production and physical habitat between July 1 and September 30.

It is a well documented fact that wild trout populations suffer substantial mortality rates in the winter, particularly in relatively high elevation streams like the Clarks Fork River. 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 Green River in Wyoming. Needham et al. (1945) documented overwinter losses of brown trout ranging up to 85 percent and averaging over 60 percent 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 to be the primary causes of trout winter mortality. These studies were all conducted on unregulated streams and illustrate the severe conditions that trout are exposed to naturally during the winter.

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.

The previously identified flow that will provide suitable hydraulic conditions during the summer (225 cfs), will maximize trout survival during the period between October 1 and March 31. Although flows less than 225 cfs will cause increased mortality of trout for the reasons mentioned above, the existing trout population has adapted to this natural flow regime. As a consequence, natural, undepleted flows that are less than 225 cfs would not cause a significant change in the survival of trout during the winter. A permanent reduction in the natural flow regime such as might result from storage or diversion of winter flows would cause an increase in winter mortality of trout.

Similarly, natural flows that are greater than 225 cfs during the winter will not significantly affect survival or production of trout in the Clarks Fork. However, considerably higher flows on a long term basis could be expected to reduce the number of trout in this stream segment. This reduction would be caused by emigration of trout from the instream flow segment to areas with more desirable habitat further downstream.

Preliminary analyses indicate that the recommended winter instream flow is not available naturally on occasion in the portion of the Clarks Fork addressed by this study. This does not indicate a need for storage to provide the recommended flow but instead shows that the entire available natural flow (up to 225 cfs) is needed through the winter to maintain trout survival at its present level.

Most of the trout found in this portion of the Clarks Fork are spawned and reared in smaller tributaries upstream in the drainage and reach the study site by drifting downstream as they mature. As a consequence, an instream flow specifically for spawning, incubation, fry and juvenile life stages is not appropriate. Maintenance of adequate physical habitat for adult cutthroat trout is necessary at all times of year; however, and as a result, an instream flow of 225 cfs is recommended during portions of the year not addressed by the recommendations listed previously (April 1 to June 30).

CONCLUSIONS

Based on the analyses and results contained in this report, the instream flow recommendations in Table 3 apply to a 5.85 mile segment of the Clarks Fork River extending downstream from the mouth of Sunlight Creek to the east section line of Section 10, T56N, R87W.

Table 3. Summary of instream flow recommendations for the Clarks Fork River.

Time Period	Instream Flow Recommendation (cfs)
July 1 to September 30	225*
October 1 to March 31	225**
April 1 to June 30	225**

* - Feasibility determined by availability at least 50 percent of this time period

** - To maintain existing natural flows up to the specified amount

LITERATURE CITED

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