WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

Title: Instream Flow Studies on Pine Creek, Sublette County, Wyoming

Project: IF-PE-7NT-511

Author: Thomas C. Annear and Paul D. Dey

Date: December 2001

Introduction

Pine Creek is a small, third order stream that originates on the west slope of the Wind River Mountains near Pinedale, Wyoming. The stream flows westerly passing from high elevation conifer-dominated forest to lowlands dominated by pasture and hay meadows before joining with the New Fork River. Along its course, the stream flows through Fremont Lake, which is a 5,000 surface acre natural lake that has been enlarged to provide supplemental water for irrigation, municipal and domestic purposes.

Pine Creek and Fremont Lake are important natural resources on both local and statewide bases. Residents from across the state and the Western U.S. frequent Fremont Lake for scenic and angling purposes. The sport fishery in the lake is composed largely of rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), kokanee salmon (*Oncorhynchus nerka*) and lake trout (*Salvelinus namaycush*). The lake also harbors native fishes that include roundtail chubs (*Gila robusta*), and mountain suckers (*Catostomus platyrhynchus*). Pine Creek supports populations of brook trout (*Salvelinus fontinalis)* at high elevations. At lower elevations, the fishery consists of rainbow and brown trout (*Salmo trutta)*. Rainbow trout are stocked within the city limits of Pinedale to supplement angling opportunities for tourists and local anglers. Native stream fishes in Pine Creek include mountain whitefish (*Prosopium williamsoni*), mountain suckers and mottled sculpins (*Cottus bairdi*)

The value of healthy fisheries throughout Pine Creek is very high to local residents. They greatly value the opportunities afforded not only for angling by adults and youth of the community, but also draw esthetic pleasure from the stream and lake. The economy of the Pinedale community depends heavily on tourism and local leaders know well that a healthy, flowing stream is an essential part of maintaining a healthy economy by enticing passersby to spend extra time in their community in pursuit of aquatic-based recreation and enjoyment (Rose Skinner, Mayor, Pinedale, personal communication). Waters originating in the Pine Creek watershed are critically important for helping support a viable ranching industry as well. The combination of these demands on the limited water supplies in Pine Creek create a challenge for its many users to equitably apportion those resources according to the state's legal and institutional framework for water administration.

The Town of Pinedale (Town) recently recognized that the fishery in Pine Creek downstream from Fremont Lake was limited in large degree because of existing water management practices. They also acknowledged that the Town had storage water resources in Fremont Lake that could be used to

improve that condition. In the summer of 2000, they presented these concerns and facts to the Wyoming Game and Fish Department (WGFD) and requested assistance to help identify strategies for improving instream flows in the stream while maintaining the quality of fishery resources in Fremont Lake.

The purpose of this report is to 1) identify the relationship between instream flow and the amount of habitat for rainbow trout over a range of flows, 2) provide information that can assist the Pinedale community with decisions for using portions of their storage water in Fremont Lake to maintain a healthy fishery in Pine Creek, and 3) provide the basis for a temporary water use agreement to provide legal protection of instream flow releases from existing, adjudicated water storage accounts in Fremont Lake. Results from these studies apply to the segment of Pine Creek from the base of Fremont Lake in T34N, R109W, S23, NW 1/4 downstream to its confluence with the New Fork River in T33N, R109W, S33, NW ¼ (Figure 1). This segment is approximately 7.5 stream miles long.

Methods

This study focuses on identifying stream flows that will provide base flow habitat conditions for rainbow trout adult and spawning. We did not conduct analyses to evaluate the adequacy of flow recommendations for non-target fishes like mountain whitefish or mottled sculpins. We assumed, based on professional judgment, that stream flows that provided for the needs of rainbow trout would generally meet the needs of these species as well for the times of year in question. Additional site-specific studies would be needed to affirm this assumption.

Study Site

After visually surveying a segment of the stream between the base of Fremont Dam and a short distance downstream from the city limits of Pinedale, a study area was established within the city limits of Pinedale at T34N, R109W, S33, SE 1/4. Habitat at this site consisted mostly of riffle and pool habitat in the main channel and lateral scour pools along the stream banks. This site contained habitat for all motile life stages of rainbow trout as well as spawning habitat. This site was in near-natural condition and did not exhibit any sign of channel alteration or modification, making it a good candidate to reflect the natural relationship between physical habitat and stream flow throughout the lower sections of the segment.

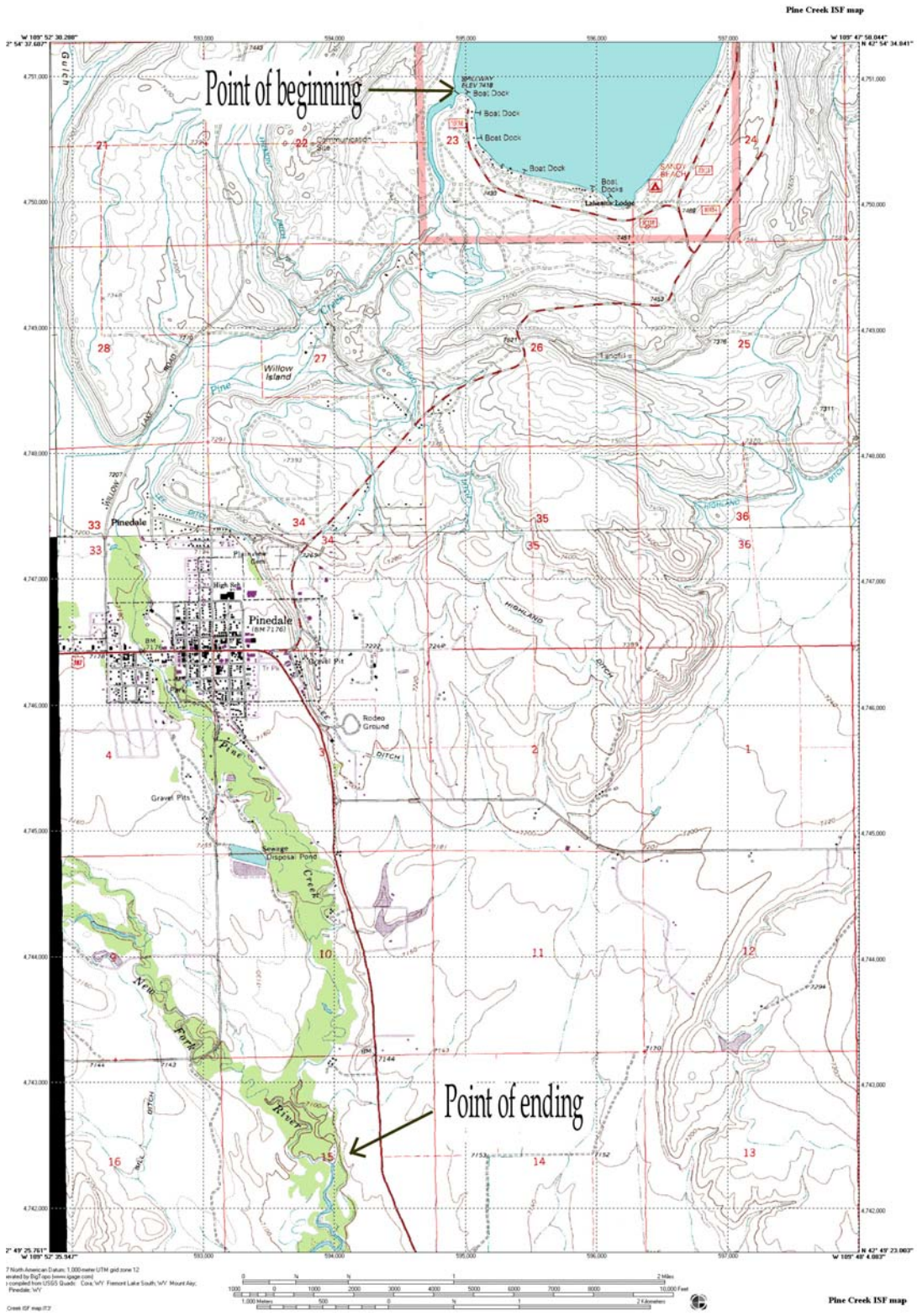

Figure 1. Location of the Pine Creek instream flow segment.

Physical Habitat Simulation

Physical Habitat Simulation (PHABSIM) methodology was used to quantify physical habitat (in terms of depth, velocity and substrate) availability for adult and spawning life stages of rainbow trout over a range of discharges. This methodology was developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (Bovee and Milhous 1978) and is widely used for assessing instream flow relationships between fish and existing physical habitat (Reiser et al. 1989).

The PHABSIM method uses empirical relationships between physical variables (depth, velocity, and substrate) and suitability for fish to derive weighted usable area (WUA; suitable ft^2 per 1000 ft of stream length) at various flows. Depth, velocity, and substrate were measured along transects (*sensu* Bovee and Milhous 1978) on the dates in Table 1. Hydraulic calibration techniques and modeling options in Milhous et al. (1984) and Milhous et al. (1989) were employed to incrementally simulate physical habitat between 5 and 200 cfs.

Table 1. Dates and discharges when data were collected on Pine Creek in 2001.

Date	Discharge (cfs)
June 19	157
June 21	87
August 9	29
August 10	16

Curves describing depth, velocity and substrate suitability for trout life stages are a necessary component of the PHABSIM modeling process. Suitability curves for rainbow trout were obtained from the U.S. Geological Survey, Biological Research Division (Raleigh, et al. 1986).

Rainbow trout in Pine Creek typically spawn between April 1 and May 31 depending on runoff and stream water temperature patterns. The eggs remain buried in the gravels until hatching within 40 to 60 days (depending on water temperature). Recommendations for spawning were therefore developed for the period of April 1 to June 30. Adult trout are present in the stream at all times of year. An instream flow recommendation based on this method for this life stage is provided for this entire period.

Results

Adult Rainbow Trout

Based on the results of physical habitat simulation modeling, usable area for adult rainbow trout is maximized at about 60 cfs (Figure 2). Physical habitat remains relatively high at flows between 40 and 100 cfs. At flows less than 40 cfs, physical habitat decreases significantly with small decreases in flow. Flows below 30 cfs result in rapid degradation of both rainbow trout habitat and aquatic insect-producing riffle areas (Figures 3 to 6).

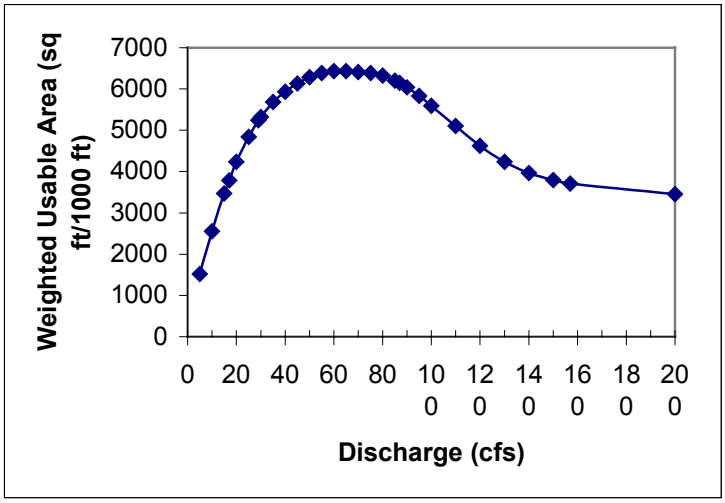

Figure 2. Relationship between stream flow and physical habitat (weighted usable area) for Pine Creek.

Figure 3. Pine Creek riffle at 30 cfs.

Figure 4. Pine Creek pool at 30 cfs.

Figure 5. Pine Creek riffle at 16 cfs.

Figure 6. Pine Creek pool at 16 cfs.

Rainbow Trout Spawning

Spawning is triggered by a combination of physical cues that include temperature, photoperiod length and stream flow. These conditions typically initiate spawning behavior in Pine Creek between early April and late May. The PHABSIM analysis showed that physical habitat for rainbow trout spawning was maximized at flows of 40 cfs and above about 150 cfs (Figure 7) although the relative amount of physical habitat for spawning remains relatively similar at slightly lower flows and much higher flows. This dynamic does not reflect the suitability of habitat at the same locations over the range of flows modeled. In fact, suitability at any one "cell" or spot within the study site does change considerably over the range of flows, but the location of suitable locations changes with change in flow. Thus, the model indicates that regardless of the flow greater than 40 cfs, trout should be able to find about the same amount of habitat for spawning somewhere within the study site between April 1 and May 30. Maintenance of flow at this level or higher from June 1 to June 30 is also needed to ensure that eggs deposited in gravels remain wet and survive as they hatch throughout the months of May and June. Importantly, flows less than 40 cfs result in significant declines in physical habitat that can limit the ability of trout to reproduce and maintain a viable population (Figures 3 and 5).

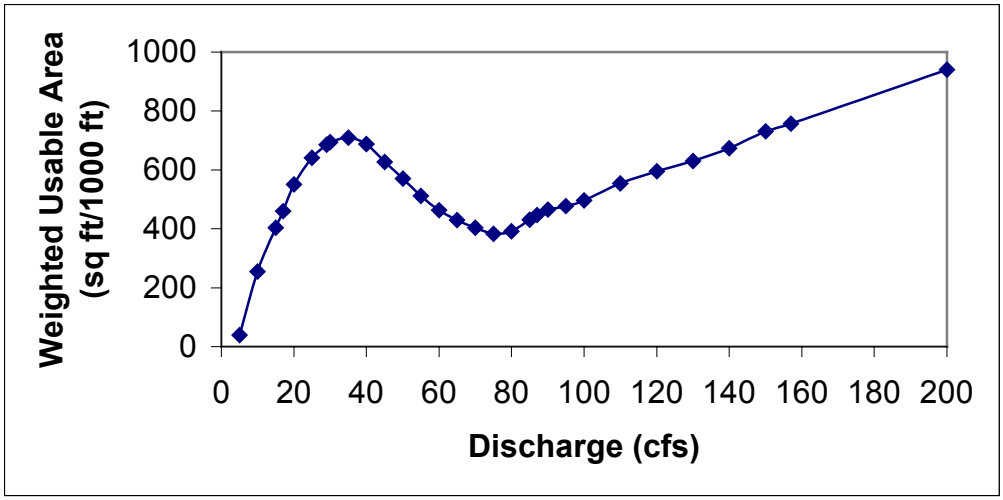

Figure 7. Relationship between stream flow and physical habitat for rainbow trout spawning (weighted usable area) in Pine Creek.

Conclusions

A preferred base flow for maximizing the productive potential of the fishery in Pine Creek would consist of a year round flow of about 40 cfs. However, the focus of this study was to help the Town of Pinedale get the greatest beneficial use possible of their existing storage account – with the realization that available supplies may not be enough to attain the maximum fishery potential of the stream. In consideration of this goal, we conclude that a base flow of 30 cfs will provide almost as many benefits as the maximum fishery production base flow of 40 cfs and extend the period of time over which the Town can use their water to protect the fishery in Pine Creek and benefit their citizens and visitors. It is important to note that this recommendation relates only to flows needed for fish production and survival and spawning. It does not address flow needs for flushing sediments from gravels (flushing flows) or higher flows to redistribute gravels and maintain channel features (channel maintenance flows). In nearly all years, these flow functions are provided by natural runoff patterns. Complete protection of this fishery would require filing instream flow water rights that quantify and reserve these flow levels too and is beyond the scope of this report.

The information and recommendations contained in this report for maintaining base fish flows apply to all times of year when flow in Pine Creek falls below the target level of 30 cfs. However, because of normal delivery patterns, existing reservoir operation agreements and other water use characteristics, the time of year when storage water in Fremont Lake may have greatest benefit for instream flow purposes is late summer (August to October). It is during this period that natural direct flow begins to fall below demands placed on the river by traditional consumptive users. This recommendation applies to the approximately 7.5 mile-long stream segment extending from the base of Fremont Lake Dam in T34N, R109W, S23, NW ¼ downstream to Pine Creek's confluence with the New Fork River in T33N, R109W, S33, NW ¼.

References

Bovee, K. and R. Milhous. 1978. Hydraulic simulation in instream flow studies: theory and technique. Instream Flow Information Paper 5, FWS/OBS-78/33, Cooperative Instream Flow Service Group, U.S. Fish and Wildlife Service. Fort Collins, Colorado.

Milhous, R.T., D.L. Wegner, and T. Waddle. 1984. User's guide to the physical habitat simulation system. Instream Flow Paper 11, FWS/OBS-81/43, U.S. Fish and Wildlife Service, Fort Collins, Colorado.

Milhous, R.T., M.A. Updike, and D.M. Schneider. 1989. Physical habitat simulation system reference manual - version II. Instream Flow Information Paper No. 26. U.S. Fish and Wildlife Service, Biol. Rep. 89(16).

Raleigh, R., L. Zuckerman and P. Nelson. 1986. Habitat suitability index models and instream flow suitability curves: Brown trout, revised. U.S. Fish and Wildlife Service. Biol. Rep. 82(10.124) 65pp.

Reiser, D.W., T.A. Wesche, and C. Estes. 1989. Status of instream flow legislation and practices in North America. Fisheries 14(2):22-28.