



An evaluation of Yellowstone cutthroat trout fry recruitment related to water leases on four tributaries of the Yellowstone River  
by Leanne Elizabeth Hennessey

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management  
Montana State University  
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**Abstract:**

In 1989 the Montana Legislature passed House Bill 707, allowing Montana Fish, Wildlife and Parks to lease water rights to benefit fisheries. The first water leases on tributaries of the upper Yellowstone River were finalized in 1992 on Mill Creek, and in 1993 on Cedar Creek. The leases provide instream flows from May to October in an attempt to reestablish Yellowstone cutthroat trout (*Oncorhynchus clarki bouveri*) spawning runs. This study evaluated the existing leases' effect on fry recruitment. Recruitment to the Yellowstone River was measured in 1996 and 1997 on four tributaries: Locke, Mill, Cedar, and Mol Heron creeks. Since Yellowstone cutthroat trout fry move out of their natal tributaries soon after emergence, outmigration was monitored using traps located near the mouth of each stream. More fry were captured in 1997 than in 1996 in all but Mol Heron Creek. Mill Creek had the greatest percent increase in fry captured (4000%), followed by Locke Creek (300%), and Cedar Creek (200%). The lease on Cedar Creek prevented extended pre-emergence dewatering in 1996. The instream flow lease in Mill Creek was critical during fry outmigration in 1996, but not in 1997 because of unusually high discharge. For sampling protocol development, fry outmigration was broken into three stages based on observed patterns; the ascending limb, peak region and descending limb. Three pattern-based, and three systematic sampling protocols were evaluated in terms of their ability to provide a reliable estimate of fry outmigration with a minimum number of sample days. Mean estimates from four replications of each of the three pattern-based protocols were less variable and sampled fewer days than those from the three systematic protocols. Pattern-based protocol A, which concentrated sampling during the peak region of fry outmigration, and minimally sampled the descending limb, was chosen as the best protocol for all four streams because of the consistently narrow 95% confidence interval for its estimates, and was recommended to Montana Fish, Wildlife and Parks for adoption. Based on my results, other water leases should be pursued on creeks where dewatering is affecting fry recruitment, and fry outmigration should be monitored periodically to evaluate each lease's effectiveness.

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APPROVAL

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Leanne Elizabeth Hennessey

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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## VITA

Leanne Elizabeth Hennessey was born in Hattiesburg, Mississippi on April 3, 1965. She is the daughter of James Edward Hennessey and Susan Peters Hennessey. She attended Saint Martin's Episcopal School in Metairie, Louisiana and graduated Cum Laude in 1983. Leanne earned her Bachelor of Science in Biology at the University of Oregon-Eugene in 1988.

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## ABSTRACT

In 1989 the Montana Legislature passed House Bill 707, allowing Montana Fish, Wildlife and Parks to lease water rights to benefit fisheries. The first water leases on tributaries of the upper Yellowstone River were finalized in 1992 on Mill Creek, and in 1993 on Cedar Creek. The leases provide instream flows from May to October in an attempt to reestablish Yellowstone cutthroat trout (*Oncorhynchus clarki bouveri*) spawning runs. This study evaluated the existing leases' effect on fry recruitment. Recruitment to the Yellowstone River was measured in 1996 and 1997 on four tributaries: Locke, Mill, Cedar, and Mol Heron creeks. Since Yellowstone cutthroat trout fry move out of their natal tributaries soon after emergence, outmigration was monitored using traps located near the mouth of each stream. More fry were captured in 1997 than in 1996 in all but Mol Heron Creek. Mill Creek had the greatest percent increase in fry captured (4000%), followed by Locke Creek (300%), and Cedar Creek (200%). The lease on Cedar Creek prevented extended pre-emergence dewatering in 1996. The instream flow lease in Mill Creek was critical during fry outmigration in 1996, but not in 1997 because of unusually high discharge. For sampling protocol development, fry outmigration was broken into three stages based on observed patterns; the ascending limb, peak region and descending limb. Three pattern-based, and three systematic sampling protocols were evaluated in terms of their ability to provide a reliable estimate of fry outmigration with a minimum number of sample days. Mean estimates from four replications of each of the three pattern-based protocols were less variable and sampled fewer days than those from the three systematic protocols. Pattern-based protocol A, which concentrated sampling during the peak region of fry outmigration, and minimally sampled the descending limb, was chosen as the best protocol for all four streams because of the consistently narrow 95% confidence interval for its estimates, and was recommended to Montana Fish, Wildlife and Parks for adoption. Based on my results, other water leases should be pursued on creeks where dewatering is affecting fry recruitment, and fry outmigration should be monitored periodically to evaluate each lease's effectiveness.

## INTRODUCTION

Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) were indigenous to the Snake River above Shoshone Falls, Idaho and the Yellowstone River above its confluence with the Tongue River in Montana (Behnke 1992). Hadley (1984) showed that their current range is centered near Yellowstone National Park and comprises only 8% of their historic range. Genetic contamination, stream dewatering, exploitation, competition and habitat perturbations have contributed to the decline of the species (Varley and Gresswell 1988). In response to decreasing populations, angling regulations for the Yellowstone River from Yellowstone National Park to Springdale, Montana were changed to catch and release for Yellowstone cutthroat trout in 1984 (Clancy 1987).

Yellowstone cutthroat trout are tributary spawners; however, due to severe dewatering for irrigation, only 7 of the 18 Yellowstone River tributaries within their native range support spawning populations (Clancy 1988). Spawning occurs in early June or July, and fry remain in the gravel for up to 2 weeks after hatching. Emergence and outmigration begin approximately 40 to 60 d after fertilization, depending on water temperature (Byorth 1990; Kelly 1993). This results in embryo development, fry emergence and outmigration to the Yellowstone River coinciding with the greatest water demand for irrigation. In 1989, the Montana legislature passed House Bill 707, allowing Montana Department of Fish, Wildlife and Parks (MDFWP) to lease existing water rights



to enhance or maintain streamflow for the benefit of fisheries. The first water leases were on Mill and Cedar creeks, tributaries to the Yellowstone River. The goal of the leasing program is to reduce incubation and outmigration losses in streams that have been chronically dewatered, such as Mill Creek. My study estimated the extent to which the leasing program has met its goal.

Water rights in Montana are based on the appropriative system which can be summarized as "first in time is first in right" (Getches 1990). The senior water right holder has the right to use all of the water claimed and used when the water right was filed. If a drought reduces the flow in a creek to  $2.0 \text{ m}^3/\text{s}$ , and the senior water right is for  $2.0 \text{ m}^3/\text{s}$ , the full flow of the creek may be diverted, regardless of any junior water right holders' claims. A drought in the late 1980's dewatered many Montana streams because the claimed water rights exceeded discharge. Part of the strategy in leasing water rights from landowners under House Bill 707 is to acquire the oldest or senior rights to ensure that leased water stays in the stream.

House Bill 707 tested the feasibility of encouraging more efficient water use by providing financial incentives in watersheds at high risk for stream dewatering. Before the Mill Creek Water and Sewer District constructed a pipeline and enclosed irrigation delivery system in 1992, an average of 90% of the creek flow was diverted during August (Soil Conservation Service 1986). Historically, this dewatered the lower reach of Mill Creek during a critical incubation period for Yellowstone cutthroat trout in 6 of 10 years (Soil Conservation Service 1986). After pipeline installation, a large amount of water was conserved and considered "salvage water". Salvage water belongs to the

original water right holder and may be used for additional irrigation or sold to another after completion of a change of use permit (Getches 1990).

Montana's water lease program was pioneered on Mill Creek (Figure 1), a large tributary with over 100 claimed water rights. The first of three leases provides for a flow of up to  $1.8 \text{ m}^3/\text{s}$  (65 cfs) for a 48 h period to flush fry into the Yellowstone River in August (Table 1). This "flushing flow" lease involves 95 water rights owned among 48 individuals (Spence 1995). The other two leases on Mill Creek, totalling  $0.25 \text{ m}^3/\text{s}$  (8.77 cfs) and including the most senior right, maintain flows in the lowest reach from spawning to outmigration (Table 1). Protecting the critical flows during incubation and outmigration and implementing the annual flushing flow, should improve recruitment of Yellowstone cutthroat trout from Mill Creek.

A lease on Cedar Creek was finalized in 1993 after the United States Forest Service (USFS) purchased the OTO ranch and its water rights (Environmental Quality Council 1996). This lease provides water from May through October, which encompasses the Yellowstone cutthroat trout spawning and outmigration periods. The OTO ranch's water lease varies from  $0.18 \text{ m}^3/\text{s}$  to  $0.27 \text{ m}^3/\text{s}$  (6.39 cfs to 9.64 cfs) throughout the summer (Spence 1995). In drought years, the available flow in Cedar Creek may fall below the amount leased. The Cedar Creek lease is in a change of use permit process to address the differences among the lease amount, the water available and the minimum needed to meet the intent of the lease ( F. Nelson 1998, MDFWP, personal communication). The change would require a minimum of  $0.04 \text{ m}^3/\text{s}$  (1.3 cfs), as measured at the gauge downstream of the East River Road bridge, to remain in Cedar

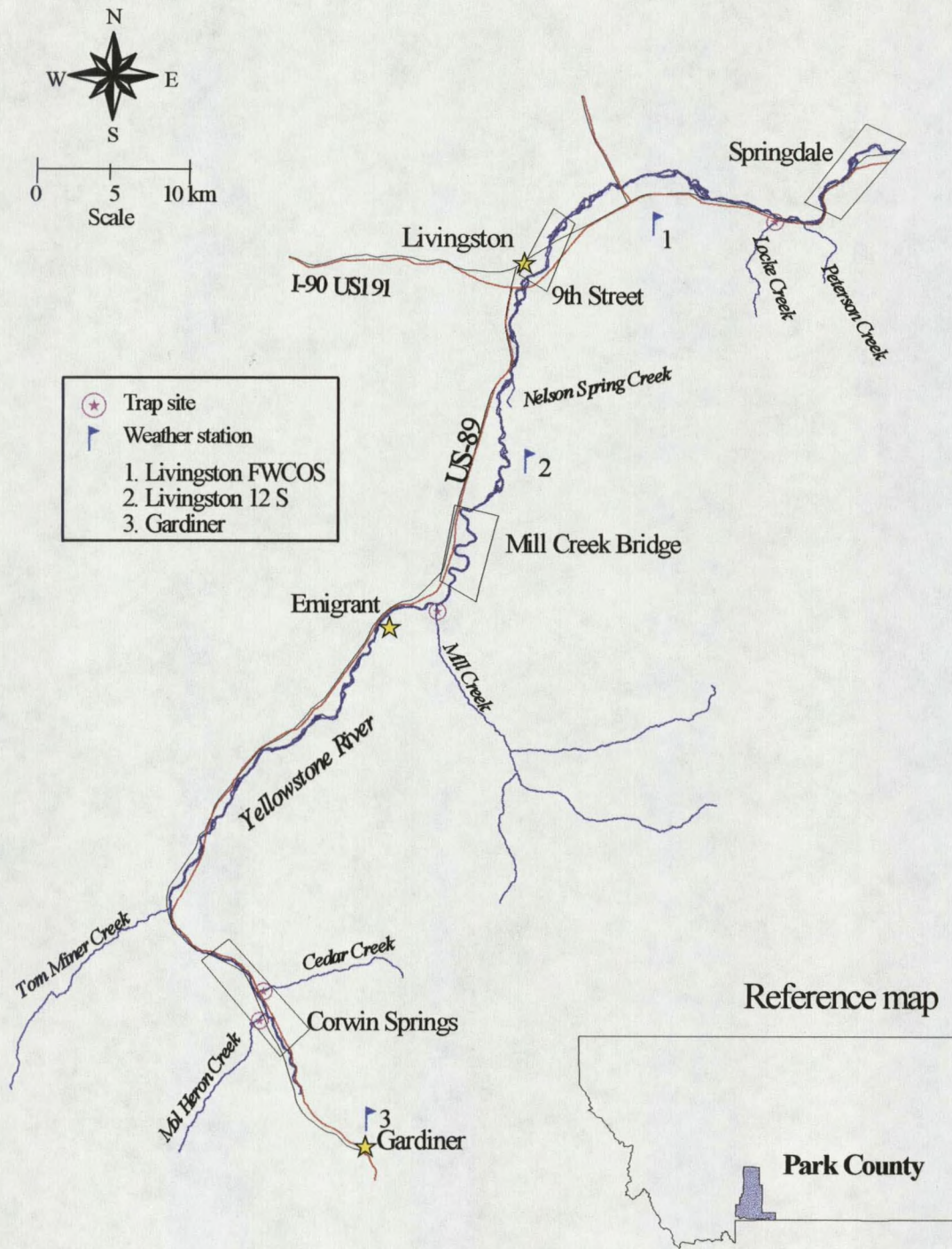


Figure 1. Map of the study area showing the four study streams (Locke, Mill, Cedar and Mol Heron creeks), trapsites, additional high quality spawning tributaries and electrofishing sections (enclosures) on the Yellowstone River.

Table 1. Summary of water leases on the four study streams (Spence 1995).

Location	Lessor	Priority of right	Total quantity	Period of use	Date
Mill Creek	Mill Creek Water & Sewer District	95 rights with various priorities	up to 65 cfs	48 hours in August	August, 1992
	individual	1880 and 1903	6.13 cfs	May 1 to October 4	October, 1992
	individual	1891	2.64 cfs	May 1 to October 19	August, 1995
Cedar Creek	USFS	1890, 1893, 1898, 1904, 1972	a minimum of 1.3 cfs <sup>a</sup>	May 1 to October 15	December, 1993
Mol Heron Creek	Church Universal and Triumphant	1884 <sup>b</sup>	a minimum of 5 cfs		pending
Locke Creek	individual	1880 <sup>c</sup>	not yet defined		pending <sup>d</sup>

<sup>a</sup> As stated in the application for change of appropriation water right for the Cedar Creek lease.

<sup>b</sup> Sole water right held on Mol Heron Creek

<sup>c</sup> Sole water right held on Locke Creek

<sup>d</sup> Agreement will be with a chapter of Montana Trout Unlimited

Creek from May to October (Table 1). The revised lease level is based on Byorth's estimation that a discharge of  $0.035 \text{ m}^3/\text{s}$  is adequate to prevent redd dewatering in Cedar Creek (1990). By changing the lease to protect the instream flow required to keep incubating redds watered, MDFWP has shown that the leasing process is flexible and responsive to the needs of water users.

Increasing or maintaining flows via a water lease on Cedar Creek will enhance an already established spawning population (Clancy 1988; Byorth 1990; Shepard 1992).

Trout response to the Mill Creek lease may be dependent upon straying adult

Yellowstone cutthroat trout to found or revive the currently depleted population.

Electrofishing surveys from 1990 to 1997 showed that numbers of Yellowstone cutthroat trout 17.5 cm (7 in) and larger per mile in the Mill Creek section of the Yellowstone

River were much lower than in the Corwin Springs section (Figure 2) (Tohtz 1997). Two

spawning surveys conducted in 1983 and 1993 indicated almost no use of Mill Creek by

Yellowstone cutthroat trout (Clancy 1984; Wiltshire 1994). Two Yellowstone cutthroat

trout egg plants were made in 1994 and one in 1995, but were unsuccessful (J. Tohtz

1996, MDFWP, personal communication). High flow during spring runoff precluded

locating artificial redds in the main channel, and embryos were dewatered before

emergence. A larval plant of 45,000 McBride Lake Yellowstone cutthroat trout fry was

made on July 5, 1994. The estimated success of this plant was 10 to 15% (Wiltshire

1994).

Since resident Yellowstone cutthroat trout generally spawn in their natal tributaries or in those upstream of and near their home territories, the number of cutthroat



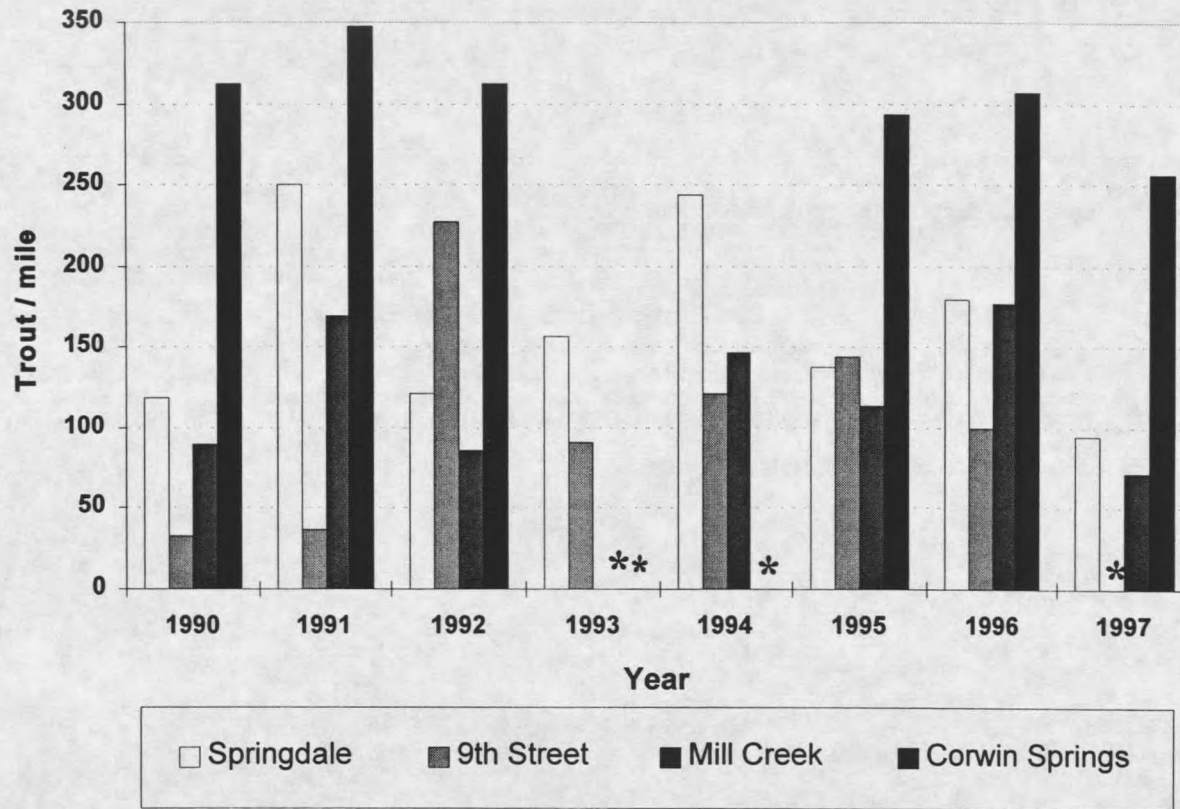


Figure 2. Density of Yellowstone cutthroat trout 17.5 cm (7 in) or longer for the four electrofishing sections in the upper Yellowstone River, 1990 to 1997 (Tohtz 1997). An “\*” indicates no data available for a section.

trout spawning in Mill Creek will likely be low for several generations (Clancy 1984). In contrast, Cedar and Mol Heron creeks are located in the section of the Yellowstone River most densely populated by Yellowstone cutthroat trout, Corwin Springs (Figure 1). Both of these creeks have well documented spawning populations (Clancy 1984, 1985; Byorth 1990; Shepard 1992) that seem to be self-sustaining; therefore, water leases may not seem as vital an investment. The concern for Cedar and Mol Heron creeks arises from the potential for dewatering and the desire to preserve the current Yellowstone cutthroat trout spawning runs. The MDFWP is negotiating a lease with the Church Universal and Triumphant (Church), which has exclusive water rights on Mol Heron Creek and is capable of dewatering its lower reaches (Environmental Quality Council 1996). Water leases established now will provide consistent flows in Mol Heron Creek during future summers. The two irrigation diversion headgates on Mol Heron Creek present potential migration obstacles for spawning adults and outmigrating fry. The Church has expressed interest in modifying these structures to improve passage of migrating spawners and reduce fry losses as part of the MDFWP lease.

The fourth creek in this study, Locke Creek, may become one of the first sites where more recent water lease legislation is implemented. House Bill 472, passed in 1995, allows any association, organization or individual to lease water rights to improve fisheries (Environmental Quality Council 1996). Locke Creek has the potential for low flows in the summer due to irrigation withdrawals and has a spawning population of Yellowstone cutthroat trout (Clancy 1985; Shepard 1992). Montana Trout Unlimited received a Future Fisheries Fund grant in March of 1996 to improve the existing



























































































































































































