Table 6-2: Distribution and abundance of fishes in the Yellowstone River within the Yellowstone Headwaters HUC (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Genetic Status*	*Data Rating*
554	559	Mottled sculpin	Unknown	Not applicable (N/A)	EBS[16]
519	559	Rainbow trout	Common	Tested conservation	EBS
548	559	Yellowstone cutthroat trout	Common	Nonhybridized	EBS
379	559	Mountain whitefish	Abundant	N/A	EBS
375	559	Brown trout	Common	N/A	EBS
454	559	Brook trout	Rare	N/A	EBS

Knowles Falls (Figure 6-3) restricts the distribution of several fish species within the Montana portion of the Yellowstone River. Mountain whitefish do not extend past these falls. Brown trout occur up to the falls, and have been reported, but not documented in the Yellowstone River upstream of Knowles Falls. Rainbow trout are present in the Lamar River, and have potential to disperse into the Yellowstone River and its adjacent tributaries.

Collection of current information on species presence, distribution, abundance, and genetic status of Yellowstone cutthroat trout is a conservation need for the portion of the Yellowstone River within Yellowstone National Park. As riverine Yellowstone cutthroat trout tend to spawn in tributaries, identifying spawning areas and ensuring access to these would also be beneficial. Brown trout and rainbow trout in the Yellowstone River upstream of Knowles Falls are threats to Yellowstone cutthroat trout throughout a large portion of the Yellowstone River basin within the national park. Determining their distribution and abundance would inform development of specific strategies to protect and secure Yellowstone cutthroat trout populations.

6.2 Upper Yellowstone River Subbasin (HUC 10070002)

The Upper Yellowstone River Subbasin (Figure 6-4) lies entirely within Montana, originating at the confluence of the Yellowstone River downstream of Gardiner, Montana, and extending to the confluence of Bridger Creek. The watershed contributing to Paradise Valley comprises a substantial portion of the hydrologic unit. Major subdrainages downstream of Paradise Valley include the Boulder River, Big Timber Creek, Sweet Grass Creek, and Otter Creek.

[6] EBS = extrapolated, based on surveys

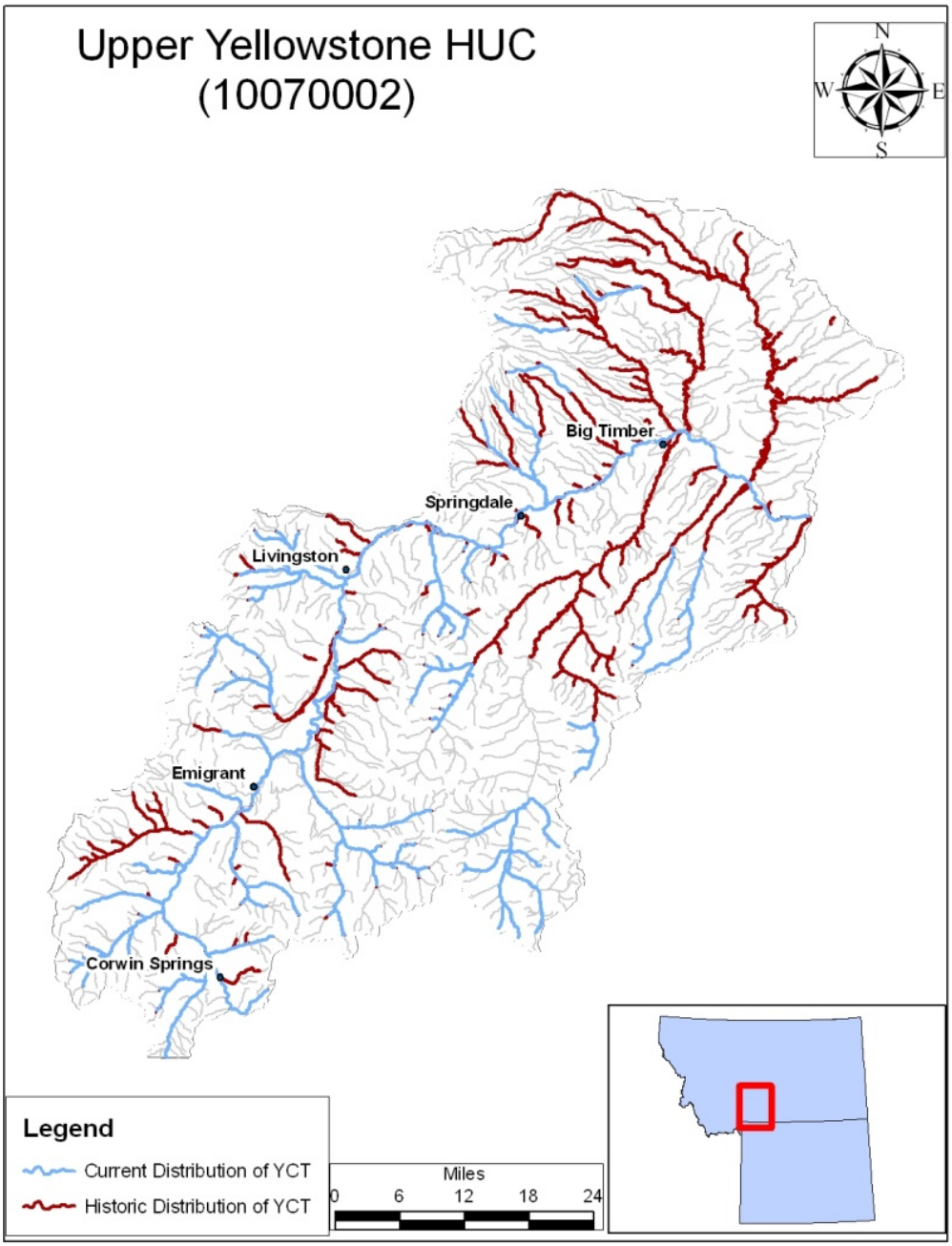

Figure 6-4: Current and historic distribution of Yellowstone cutthroat trout in the Upper Yellowstone River Subbasin (FWP GIS database).

This subbasin provides substantial habitat to core and conservation populations of Yellowstone cutthroat trout, and according to the 2006 status review (May et al. 2007), 50% of its historically occupied stream miles still support conservation populations. Streams draining to Paradise Valley have relatively intact distribution; however, Yellowstone cutthroat trout populations

become increasingly fragmented in streams in the eastern portion of the subbasin. A similar pattern exists for the fluvial population of Yellowstone cutthroat trout in the Yellowstone River. Highest densities occur in the upstream portions of the river, near Corwin Springs. Yellowstone cutthroat trout become progressively rare proceeding downstream. Scarcity of Yellowstone cutthroat trout near Springdale is a relatively recent phenomenon, with dramatic reductions in abundance in the 2000s compared to the 1980s and 1990s (Opitz 2004).

Fisheries investigations have occurred on a substantial number of the subbasin's streams, although significant gaps in genetic testing and fish distribution exist. Moreover, some of the surveys may be outdated, and may no longer reflect current conditions. For example, fisheries investigations on East Fork Duck Creek in the 1980s found Yellowstone cutthroat trout substantially outnumbered brown trout (White 1984). In 2007, the reverse scenario was present, with brown trout dominating the fishery by a considerable margin (FWP, unpublished data). Fisheries biologists from FWP and the USFS have been working to fill these data gaps through a prioritized approach to survey and genetic testing.

Nonnative salmonids have wide distribution in the upper Yellowstone HUC, and pose a continuing threat to remaining populations of Yellowstone cutthroat trout. Rainbow trout are abundant in the Yellowstone River and many of its tributaries. Although temporal asynchrony in the spawning times has prevented wholesale hybridization and resulting loss of the nonhybridized fluvial Yellowstone cutthroat trout population (DeRito 2004), climate change may bring moderation in the physical cues that maintain this separation. Similarly, brown trout and brook trout occur sympatrically with Yellowstone cutthroat trout in numerous streams, or have displaced Yellowstone cutthroat trout altogether.

Dewatering during the irrigation season presents another constraint to fluvial and resident populations. FWP has identified several streams as being chronically or periodically dewatered (Table 6-3). Most of these are the lower ends of Yellowstone River tributaries, which limits the potential of these streams to support recruitment of Yellowstone cutthroat trout fry to the Yellowstone River. Water leases protect in-stream flows in several of these streams, including Cedar Creek, Mulherin Creek, Big Creek, and Locke Creek.

Table 6-3: FWP's dewatered stream list for the Upper Yellowstone River Subbasin (MFISH database).

Stream Name	*Tributary To*	*Begin River Mile*	*End River Mile*	*Dewatering Class*
Big Creek	Yellowstone River	0	2	Chronic
Big Timber Creek	Yellowstone River	0	5	Chronic
Boulder River	Yellowstone River	0	5	Chronic
Bridger Creek	Yellowstone River	0	3	Chronic
Cedar Creek	Yellowstone River	0	1	Periodic
Deep Creek	Yellowstone River	0	3	Chronic
East Fork Boulder River	Boulder River	0	7	Chronic
Eightmile Creek	Yellowstone River	0	2	Chronic
Elbow Creek	Yellowstone River	1	2	Chronic
Elk Creek	East Boulder River	0	2	Chronic
Emigrant Creek	Yellowstone River	0	2	Chronic
Fleshman Creek	Yellowstone River	0	10	Periodic
Fridley Creek	Yellowstone River	0	0.1	Chronic
Locke Creek	Yellowstone River	0	0.1	Periodic
Lower Deer Creek	Yellowstone River	0	4	Chronic
Mill Creek	Yellowstone River	0	1	Chronic
Mill Creek	Yellowstone River	1	5	Periodic
Mission Creek	Yellowstone River	0	1	Chronic
Mulherin Creek	Yellowstone River	0	1	Periodic
Pine Creek	Yellowstone River	0	2	Chronic
Sixmile Creek	Yellowstone River	0	3	Chronic
Strawberry Creek	Yellowstone River	0	1	Chronic
Suce Creek	Yellowstone River	0	2	Chronic
Suce Creek	Yellowstone River	2	3	Periodic
Sweet Grass Creek	Yellowstone River	0	2	Periodic
Trail Creek	Yellowstone River	8	13	Chronic
Trail Creek	Yellowstone River	18	31	Periodic
Upper Deer Creek	Yellowstone River	10	13	Chronic
Yellowstone River	Out-of-State	294	474	Periodic

Whirling disease presents a potential threat to the fluvial Yellowstone cutthroat trout population in the upper Yellowstone River HUC. Several tributaries tested positive for *Myxobolus cerebralis* and Yellowstone cutthroat trout are especially susceptible to infection (R. Vincent, FWP retired, personal communication). Educating anglers on the importance of cleaning gear between stream visits is among the tools available to prevent further spread of this disease. Managing streamside activities to reduce loading of fine sediment and nutrients is an important conservation objective. These pollutants favor a high abundance of the aquatic worm *Tubifex tubifex*, *Myxobolus cerebralis*'s intermediate host. Additional study on the influence of whirling disease on Yellowstone cutthroat trout is a research need. The findings will foster an adaptive approach to conserving Yellowstone cutthroat trout with respect to this growing concern.

Streams in the Upper Yellowstone River Subbasin have been the focus of substantial conservation efforts involving collaboration among FWP, private landowners, and the USFS. Specific conservation measures have included water leases, which have mostly been successful in maintaining in-stream flows and increasing reproductive success of fluvial Yellowstone cutthroat trout. The Upper Yellowstone River Subbasin presents several opportunities to secure genetically unaltered populations of Yellowstone cutthroat trout. The Yellowstone River is the largest stream supporting nonhybridized Yellowstone cutthroat trout, although hybridized fish also exist. The primary approach to securing this population will be to promote in-stream flows in the lower reaches of tributaries, combined with improving habitat, to promote recruitment of Yellowstone cutthroat trout fry.

As cues maintaining segregation of the rainbow trout and Yellowstone cutthroat trout may be moderating with climate change, continued monitoring of the genetic status is required to inform future management options. For example, if the spawning runs begin to show a greater degree of overlap, fisheries managers might resort to structures that facilitate selective passage of Yellowstone cutthroat trout, while preventing entrance of rainbow trout to tributaries.

Securing other core and conservation populations within the subbasin will require a combination of barrier installation and removal of nonnative species. Likely candidates for these activities include the Upper Deer Creek watersheds, Little Timber Creek, and streams in the Duck Creek watersheds. A massive Yellowstone cutthroat trout conservation project has been ongoing in streams in the upper Boulder River watershed, above Hell's Canyon. Opportunities to restore Yellowstone cutthroat trout into streams where they have been extirpated also exist. Most of the potential sites are likely to occur in upper reaches of watersheds, which are mostly under USFS management. FWP and the USFS will identify streams with suitable characteristics, such as sufficient habitat and presence of a feasible barrier site.

In summary, the upper Yellowstone HUC supports relatively intact populations of Yellowstone cutthroat trout; however, an aggressive approach to securing existing and restoring extirpated populations is required to ensure persistence over the long-term. Protecting nonhybridized fluvial and resident populations is the highest priority, requiring an integrative approach that addresses dewatering, hybridization, competition, and disease. Continued survey of the basin's streams, combined with genetic testing, is another critical component of the conservation approach, and will inform future actions. Finally, reintroduction of Yellowstone cutthroat trout into reclaimed streams will increase the fish's distribution in its historic range.

6.2.1 Yellowstone River

The Yellowstone River (Figure 6-4) flows for about 120 miles through the Upper Yellowstone River Subbasin. Most of the land in the valley bottom is in private ownership, although some publically owned land is present along the river's course. FWP has several long-term monitoring sections on the Yellowstone River, and annual fisheries investigations provide information on relative abundance of Yellowstone cutthroat trout and other fishes. In addition, an investigation

of movements and spawning of Yellowstone cutthroat trout, rainbow trout, and hybrids provides substantial information on the river's cutthroat trout population (DeRito 2004).

Several factors limit the river's Yellowstone cutthroat trout population. As Yellowstone cutthroat trout tend to be tributary spawners, flow in tributary streams and access to spawning areas are perhaps the greatest influences on the riverine population (Berg 1975; Clancy 1984). Harvest was a constraint until the implementation of catch-and- release regulations for Yellowstone cutthroat began in the 1980s (Clancy 1987). In recent years, whirling disease has emerged as a potential threat, with Yellowstone cutthroat trout showing infection, primarily in the form of cranial deformities.

Corwin Springs Monitoring Section

The Corwin Springs monitoring section begins upstream of the Corwin Springs bridge and extends downstream for just over 5 miles. Trout present in this section include Yellowstone cutthroat trout, rainbow trout, and brown trout. Comparisons of population estimates indicate rainbow trout are often the most abundant species, although Yellowstone cutthroat trout were the most abundant in several years (Figure 6-5). Brown trout and Yellowstone cutthroat trout tend to be present in similar numbers. This upper sampling reach generally has the greatest number of Yellowstone cutthroat trout compared to downstream reaches. Although no confidence intervals or other measures of variance were reported with these data, these results indicate Yellowstone cutthroat trout are relatively abundant in this part of the Yellowstone River compared to brown trout and rainbow trout.

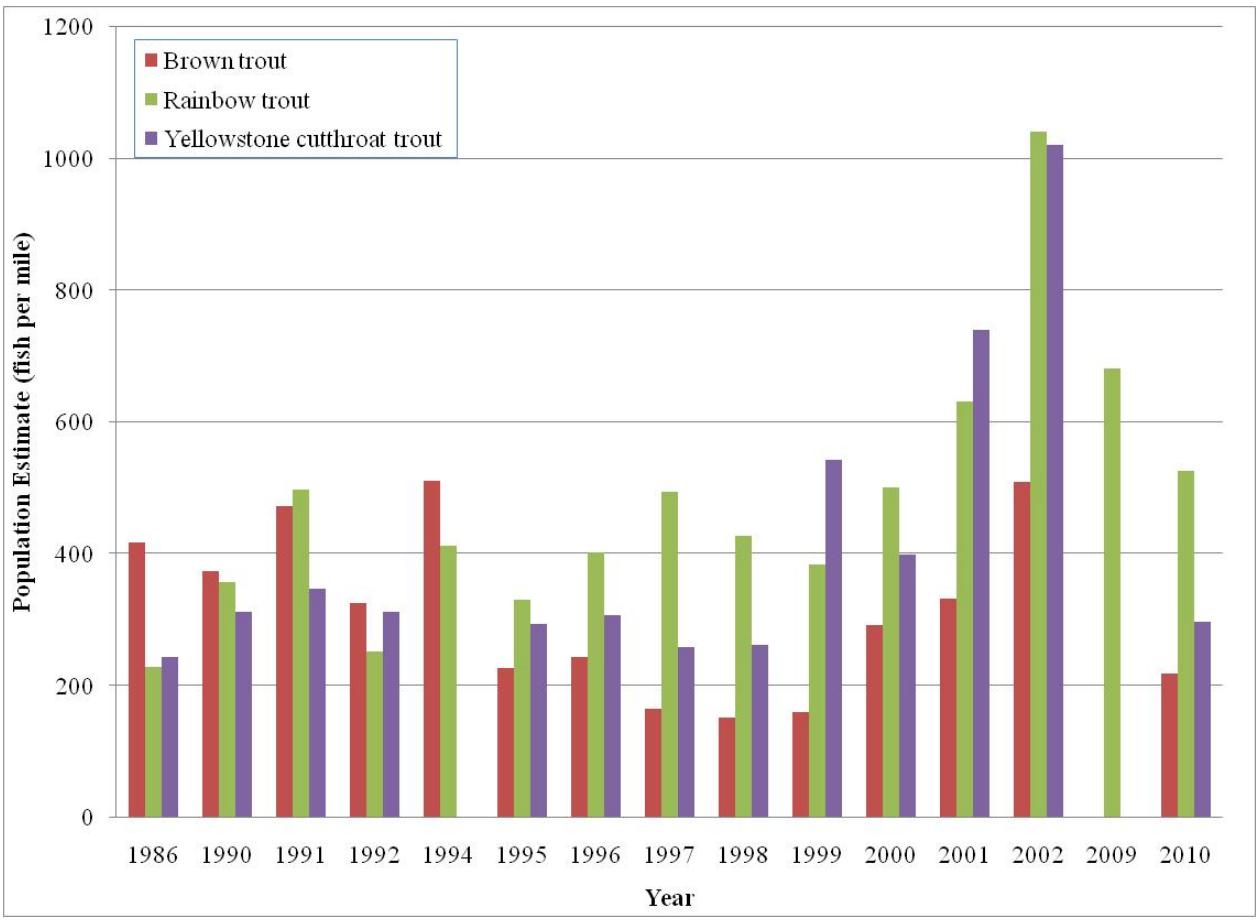

Figure 6-5: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Corwin Springs section (MFISH database).

The increases in Yellowstone cutthroat trout abundance in the late 1990s through the early 2000s follow water leases in neighboring streams including Cedar Creek, Mulherin Creek, and Big Creek, which began in the late 1990s. Such positive responses following implementation of water leases underscore the value of conservation.

Nonhybridized and hybridized individuals are present in this part of the river. A sample of 30 fish captured in 1998 tested as being a mixture of nonhybridized Yellowstone cutthroat trout and hybridized individuals (Thelen 1999). The average contribution of Yellowstone cutthroat trout alleles for this sample was 96.7%, and rainbow trout alleles comprised 3.3%. DeRito (2004) reported radio-tagging 27 nonhybridized Yellowstone cutthroat trout from this section during 2001 and 2002, along with 7 hybrids. More recently, analyses of 43 putative Yellowstone cutthroat trout collected from this section yielded a mixture of nonhybridized and hybridized fish (S.T. Opitz, FWP, personal communication).

The presence of substantial numbers of Yellowstone cutthroat trout in this portion of the river relates largely to the proximity of several high quality tributaries including Cedar Creek, Mulherin Creek, Big Creek, and Tom Miner Creek. Maintaining habitat, water quality, and

stream flows within these tributaries are important conservation objectives for the river's Yellowstone cutthroat trout population. Likewise, identifying potential projects to increase the number of suitable spawning tributaries would be beneficial.

Whirling disease is among the threats to Yellowstone cutthroat trout in this portion of the Yellowstone River. Cranial deformities typical of whirling disease are present in Yellowstone cutthroat trout and rainbow trout captured in this portion of the river (S.T. Opitz, FWP, personal communication). Identifying spawning streams testing positive for the *Myxobolus cerebralis* would be useful in devising strategies to reduce or mitigate infection.

This portion of the Yellowstone River has outstanding conservation value for Yellowstone cutthroat trout. This value relates in part to the relatively high abundance of Yellowstone cutthroat trout remaining in this part of the river. Moreover, this population retains the fluvial life-history strategy that has been eliminated in a large extent of the Yellowstone cutthroat trout's historic range. Preserving the diversity of life-history strategies is a priority under the cutthroat trout conservation agreement (MCTSC 2007). Threats to this population include reduced recruitment relating to dewatering in tributary streams, and continued hybridization with sympatric rainbow trout. Conservation actions will include promoting in-stream flows in spawning tributaries and installation of screens on irrigation diversions to reduce loss. Continued monitoring will evaluate the population level risks from hybridization with rainbow trout.

Mill Creek Bridge Monitoring Section

Proceeding downstream, the next long-term monitoring section is the Mill Creek bridge monitoring reach. This section begins at the bridge, and extends 4.4 miles downstream. This section supports Yellowstone cutthroat trout, rainbow trout, and brown trout. Mountain whitefish are also abundant in this portion of the river. Data from several years indicate nonhybridized and hybridized Yellowstone cutthroat trout have been captured in this monitoring section (MFISH database).

Relative abundance of the three species of trout has varied over the years (Figure 6-6). Throughout the 1990s, brown trout were the most abundant species; however, in the 2000s, rainbow trout became numerically dominant. Yellowstone cutthroat trout were typically less abundant than the nonnative trout, but still comprised a substantial proportion of the assemblage. Yellowstone cutthroat trout were the most abundant trout species in 1999. This strong showing was potentially related to a strong year class produced in Mill Creek in 1997. The combination of a water lease to maintain in-stream flows and a good water year resulted in the greatest number of fry produced in Mill Creek during six years of monitoring (Roulson 2002).

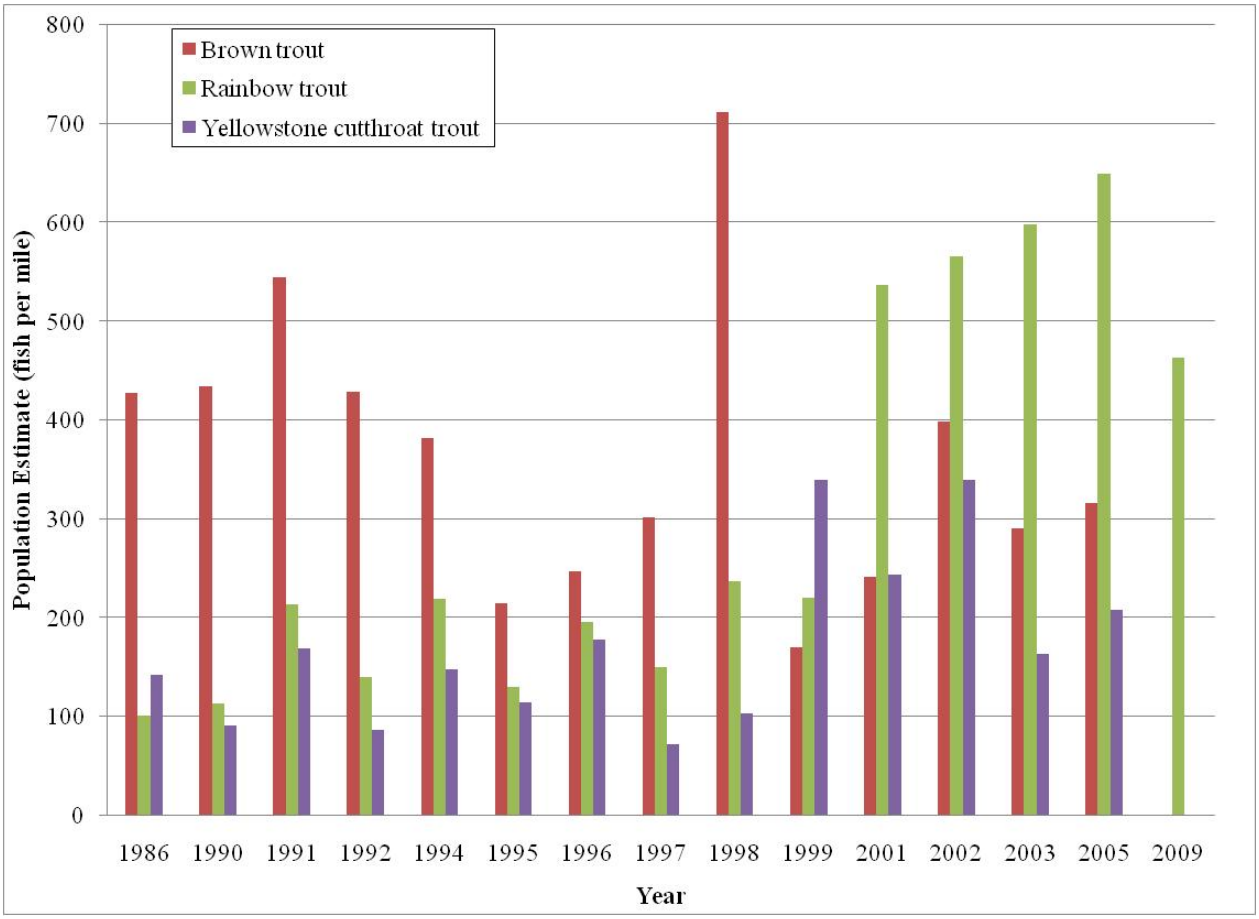

Figure 6-6: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Mill Creek bridge section (MFISH database).

Whirling disease presents a threat to Yellowstone cutthroat trout in this portion of the Yellowstone River. The characteristic cranial deformities are present in Yellowstone cutthroat trout and rainbow trout captured in the Mill Creek bridge monitoring reach (S.T. Opitz, FWP, personal communication). Additional investigation is needed to evaluate hotspots for whirling disease infection.

Increasing recruitment from tributaries would benefit the Yellowstone cutthroat trout in this portion of the Yellowstone River. Potential actions include finding solutions to maintain in-stream flow, and ensuring access to potential spawning habitat. In 2008, installation of a fish ladder on an irrigation diversion on South Fork Fridley Creek opened up several miles of potential spawning habitat. Apparent Yellowstone cutthroat trout were observed spawning upstream of this structure in 2009 (C.L. Endicott, FWP, personal communication).

Other conservation actions for this portion of the river relate to continued monitoring. Evaluations of abundance of Yellowstone cutthroat trout, evidence of whirling disease, and genetic status are the primary monitoring objectives.

Ninth Street Bridge Monitoring Section

The upstream extent of this monitoring section has changed over the years, originally starting at the Ninth Street Bridge, but then moving downstream to Mayor's Landing. The downstream end is at the Highway 89 bridge. Trout species include rainbow trout, brown trout, and Yellowstone cutthroat trout, with rainbow trout outnumbering the others by a substantial margin (Figure 6-7). Yellowstone cutthroat trout are typically the least abundant trout in this reach of the Yellowstone River.

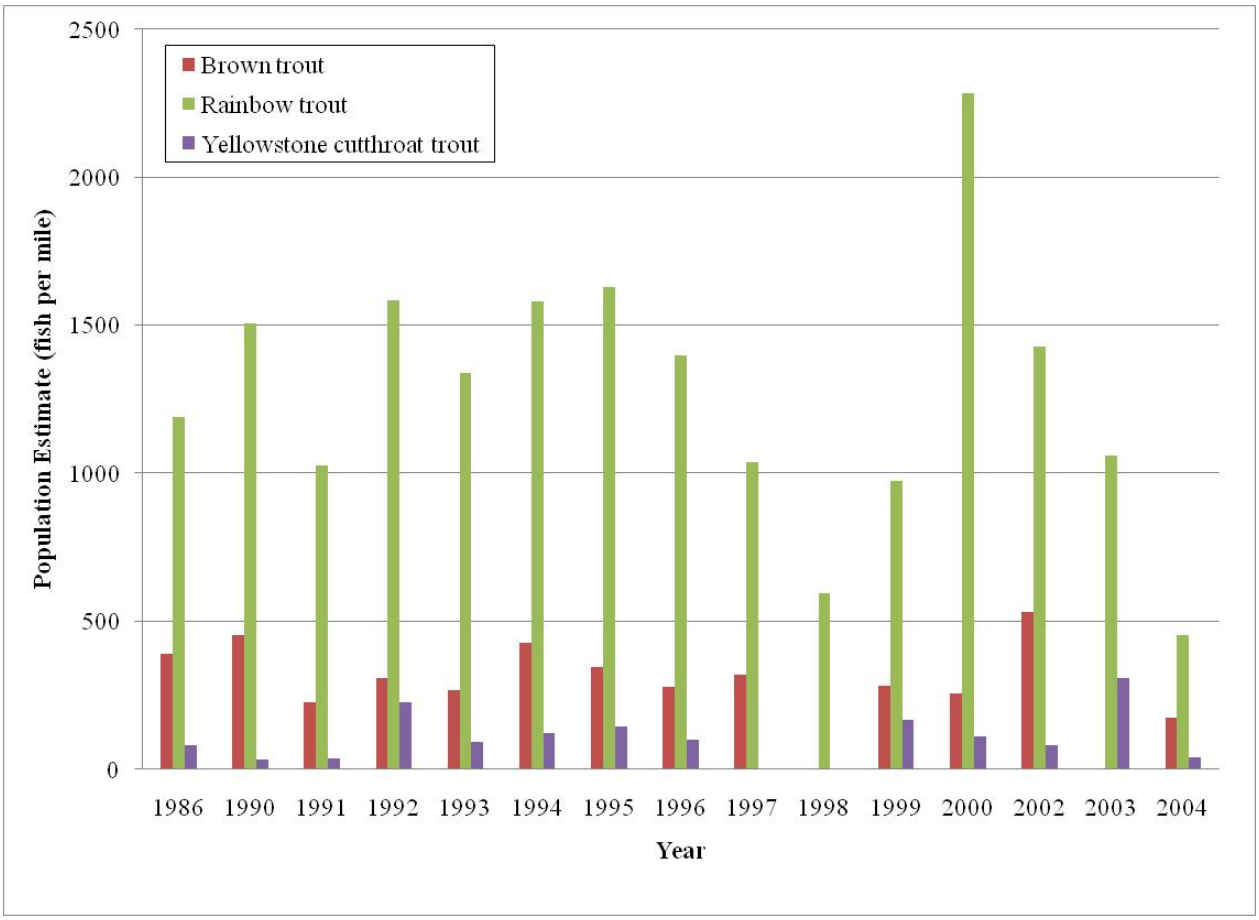

Figure 6-7: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Ninth Street bridge section of the Yellowstone River (MFISH database).

A lack of tributary spawning habitat is among the constraints on the Yellowstone cutthroat trout population in this portion of the river. Completed and proposed habitat improvements in Fleshman Creek may be beneficial to Yellowstone cutthroat trout. Currently, brown trout and rainbow trout spawn in Fleshman Creek; however, high levels of fine sediment likely limit survival to emergence of embryos (C.L. Endicott, FWP, personal communication). An effort in the 1990s to imprint Yellowstone cutthroat trout fry on Fleshman Creek resulted in production of about 14,500 Yellowstone cutthroat trout fry (Tohtz 1996); however, this did not result in the establishment of a fluvial run into Fleshman Creek. Yellowstone cutthroat trout were

documented among lost in a fish kill in 2007, but at low numbers. Following restoration of Fleshman Creek, a potential option would be to try again with imprinting using fertilized eggs collected from known fluvial fish.

Springdale Monitoring Section

The Springdale monitoring section encompasses about five river miles, extending upstream from the fishing access site at Springdale. Rainbow trout tend to be the numerically dominant trout in this part of the river, followed by brown trout (Figure 6-8). Until recently, the Springdale monitoring section had some of the higher concentrations of Yellowstone cutthroat trout, and these were often similar to, or greater than, brown trout. The past decade has seen a substantial decline in Yellowstone cutthroat trout numbers, with too few fish captured to calculate a population estimate.

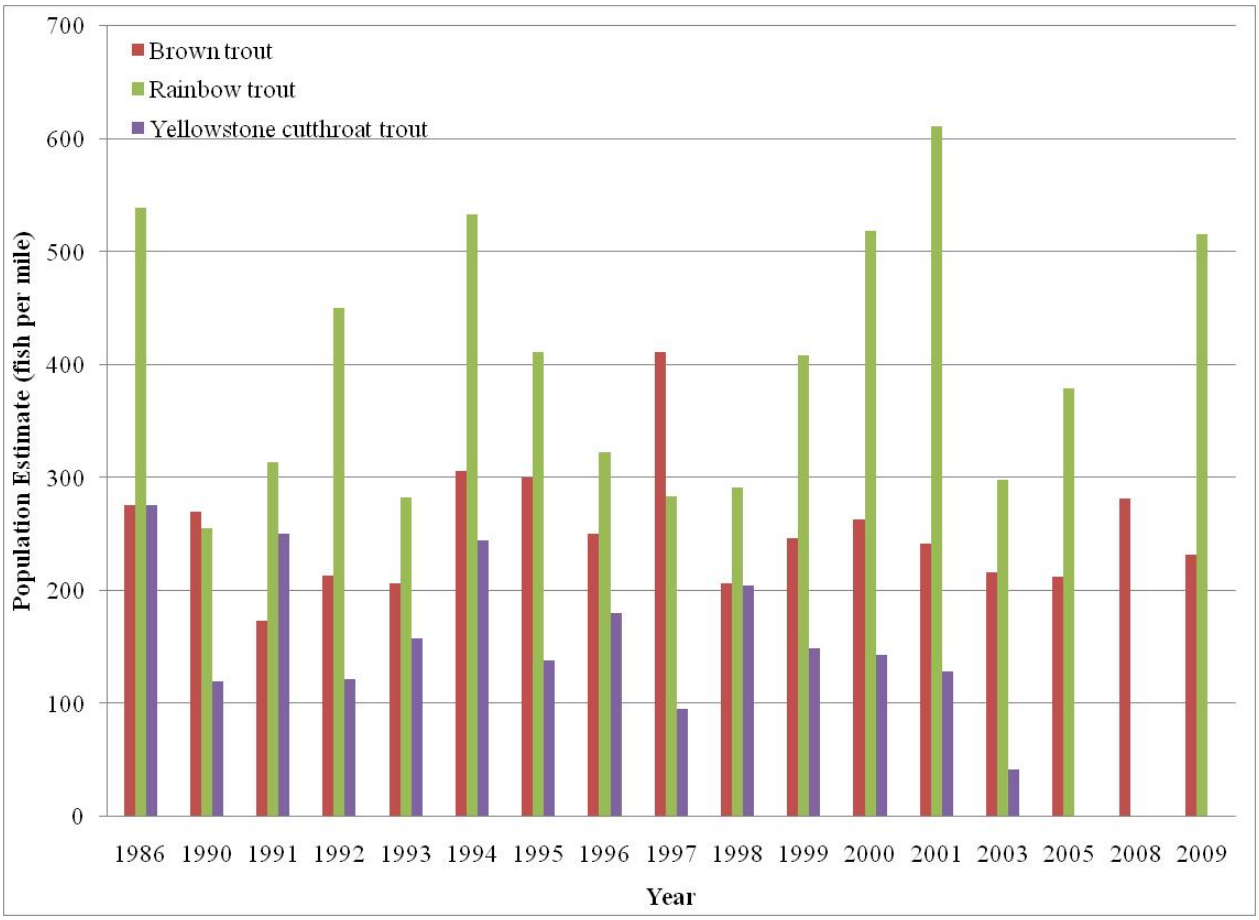

Figure 6-8: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Springdale section of the Yellowstone River (MFISH database).

The causes of decline likely relate in part to extended drought that put greater demands on available water in tributaries and side channels, and increased water temperatures in tributaries and the main stem. The loss of a spawning run in Locke Creek is another potential factor. Locke Creek was once among the high quality spawning streams for Yellowstone cutthroat trout

(Clancy 1988). With changes in the course of the Yellowstone River following the 1997 flood, a perched railroad culvert became more of a barrier to spawning Yellowstone cutthroat trout. Trapping over the past few years has not documented any Yellowstone cutthroat trout accessing this formerly productive spawning area (S.T. Opitz, FWP, personal communication). Whirling disease is another potential factor, as cranial deformities in rainbow trout and Yellowstone cutthroat trout are present in this part of the river (S.T. Opitz, FWP, personal communication) and these streams tested positive for whirling disease in 2007 (R. Vincent, FWP retired, personal communication).

A substantial conservation need for this part of the river is to increase recruitment in tributaries. Restoring access through the culvert in Locke Creek was a potential project; however, liability associated with modifications near a railroad culvert is considerable. Likewise, restoring access may be detrimental to the nonhybridized Yellowstone cutthroat trout higher in the Locke Creek watershed. In other neighboring tributaries, irrigation withdrawals and habitat degradation may be factors in limiting the potential of these streams to support a fluvial spawning run. Finding opportunities to work with private landowners on conservation projects to improve flow and habitat quality would be beneficial to fluvial Yellowstone cutthroat trout.

Big Timber Monitoring Section

The Big Timber monitoring section begins at the Otter Creek fishing access site downstream of Big Timber, and extends upstream for six miles. Monitoring in this reach has occurred sporadically beginning in the 1980s. Among year comparisons of fish numbers are difficult given the variability in how results were reported. In several years, a population estimate yielded numbers of fish per mile. In other years, results were reported as catch per unit effort or total number of fish captured. Because of the disparity in methodologies, Figure 6-9 displays the percentage of the total number of trout comprised by the three species.

Similar to the Springdale and Ninth Street Bridge monitoring sections, rainbow trout are the most abundant species of trout in the Big Timber monitoring section. Brown trout are the next most abundant species. Yellowstone cutthroat trout are relatively rare, and comprise considerably less than 10% of trout in most years.

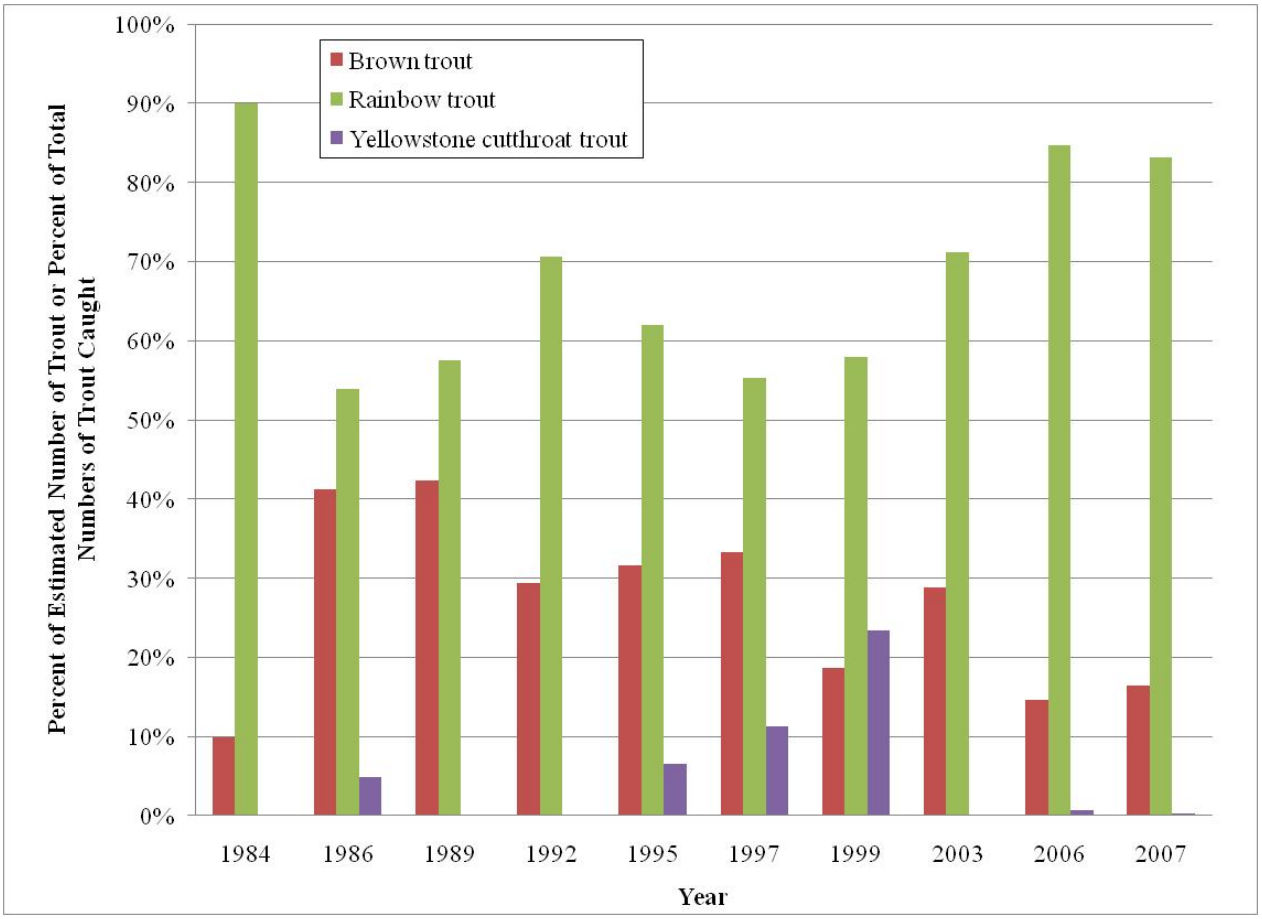

Figure 6-9: Comparisons of percentages of total estimated trout numbers or total trout caught comprised by brown trout, rainbow trout, and Yellowstone cutthroat trout in the Big Timber monitoring section (MFISH database).

Similar to the Springdale and Ninth Street Bridge monitoring sections, rainbow trout are the most abundant species of trout in the Big Timber monitoring section (Figure 6-9). Brown trout are the next most abundant species. Yellowstone cutthroat trout are relatively rare, and comprise considerably less than 10% of trout in most years.

A lack of spawning habitat is among the factors likely to be constraining Yellowstone cutthroat trout in this part of the river. Several projects have attempted to provide spawning habitat in unmapped spring creeks, but none have been successful as of yet (see 6.2.45 Unmapped Spring Creeks). Future attempts should consider using gametes collected from fluvial strains of Yellowstone cutthroat trout.

6.2.2 Beattie Gulch

Beattie Gulch (Figure 6-10) is a small stream located near the upstream boundary of the upper Yellowstone River HUC. This stream flows mostly within the GNF, with less than two-tenths of its 2.6 miles crossing private land near its mouth. No fisheries data are available for this stream.

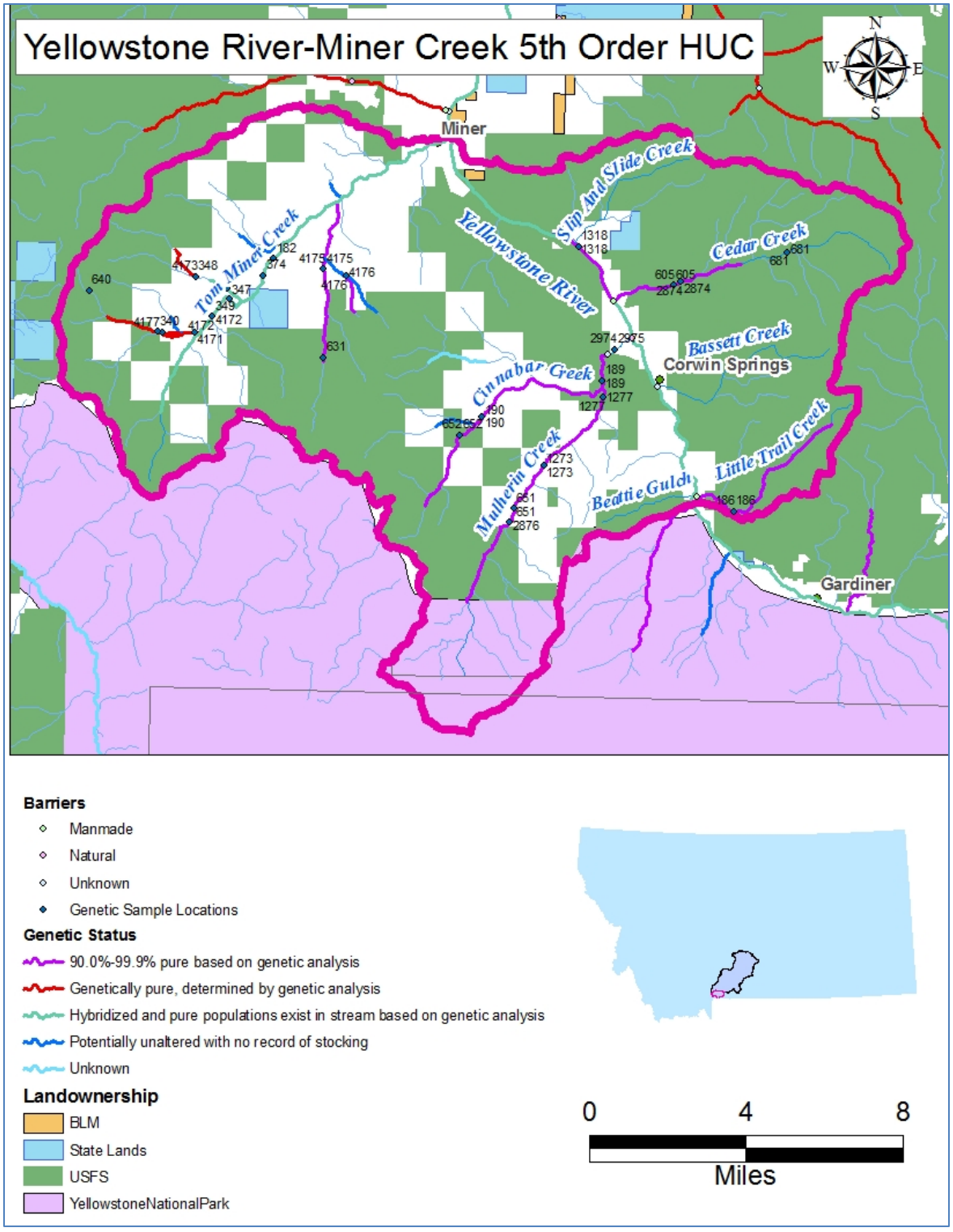

Figure 6-10: Distribution of Yellowstone cutthroat trout in the Yellowstone-Miner Creek Watershed (FWP GIS database).

Aerial imagery suggests Beattie Gulch currently has low potential to support a spawning run of fluvial Yellowstone cutthroat trout; however, its upper reaches may contain a resident population. Factors apparently limiting the ability of this stream to provide spawning habitat to fluvial cutthroat include low water supply and marginal habitat. A lack of water in this stream is inferable from aerial photos, which show an irrigation ditch intercepting the stream about 0.5 miles from its mouth. In addition to potential flow alterations from the irrigation canal, this small watershed may not supply enough water to ensure reliable flows through incubation and emergence periods. Downstream of the irrigation canal, the stream appears to lose channel definition, which may be related to a lack of stream power due to low water supply, combined with its occupancy of an alluvial fan. Alluvial fans tend to be highly permeable, and flows may naturally go subsurface through this reach. A combination of the limited natural potential to provide sufficient water and suitable habitat, and apparent flow alterations for irrigation, make Beattie Gulch a marginal to poor candidate for establishing or enhancing a fluvial spawning run.

A conservation priority for Beattie Gulch is assessment of fish populations to determine if this stream supports a nonhybridized or conservation population of Yellowstone cutthroat trout. The apparently dewatered reach, combined with the lack of channel definition and an intercepting irrigation ditch, may present a barrier to nonnatives, which would protect Yellowstone cutthroat trout in the forested portions of the stream. Should a nonhybridized or conservation population exist in upper Beattie Gulch, the small amount of habitat available would put the population at risk of extirpation because of small population size and the resulting risks of inbreeding, and vulnerability to disturbance. Intervention may include supplementing the existing population to increase genetic diversity. Should Beattie Gulch not support a nonhybridized or conservation population of Yellowstone cutthroat trout, this stream would be a low priority for reestablishment of a nonhybridized population given the low probability that a population would be able to self-maintain over the long-term in the small amount of available habitat.

6.2.3 Little Trail Creek

Little Trail Creek is (Figure 6-10) on the east side of the Yellowstone River, and flows mostly through the GNF. Of its nearly 6-mile length, only about one-third of a mile flows across private lands. Fisheries information for Little Trail Creek includes genetic samples from the 1980s (Leary et al. 1989), and documentation that a culvert close to the mouth of Little Trail Creek presents a barrier to upstream movement. Species assumed present include Yellowstone cutthroat trout and mottled sculpin (Table 6-4). Electrofishing surveys in the early 1990s found no other species to be present (S.W. Shuler, GNF, personal communication.). Recent survey data are not available to rule out the presence of competing species.

Table 6-4: Distribution and species composition for Little Trail Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	6	Mottled sculpin	Rare	Year-round resident	N/A	N/A	NSPJ[7]
0	5	Yellowstone cutthroat trout	Common	Unknown	Unknown	Tested conservation	EBS

In 1986, Little Trail Creek supported a conservation population of Yellowstone cutthroat trout; however, the small sample size (N=4) limits the certainty of these results (Leary et al. 1989). Additional sampling using a minimum sample size of 25 fish is warranted to evaluate the status of the Yellowstone cutthroat trout population in Little Trail Creek.

Investigations of streams used by fluvial Yellowstone cutthroat trout (Berg 1975; Clancy 1988) did not examine Little Trail Creek, and DeRito (2004) did not document any of the 44 radio-tagged Yellowstone cutthroat trout entering this stream during the spawning period. Steep gradients, such as Maiden Falls, in the lowest reach of Little Trail Creek may be natural impediments to a spawning run, as fluvial spawners may not be able to ascend the stream. Field verification of accessibility would determine the potential for fish to access Little Trail Creek.

Although Little Trail Creek is not on the list of dewatered streams, no information is available to evaluate the sufficiency of flows through the irrigation season to support a spawning run of fluvial Yellowstone cutthroat trout. Aerial imagery shows an apparent diversion about 0.4 miles from the mouth, indicating some decrease in stream flow likely occurs. Future conservation planning for Little Trail Creek should include evaluation of the stream flow through critical periods, and the potential for developing voluntary measures to promote sufficient flows during summer months.

Restoring or enhancing a fluvial spawning run is one category of conservation action possible for Little Trail Creek, although additional investigation is necessary to determine limiting factors, feasibility, relative benefits, and to develop a specific approach if warranted. A primary factor affecting feasibility is the steepness of the channel immediately upstream of the confluence with the Yellowstone River. In the event that gradient does not present a barrier, potential opportunities include restoring passage under the Highway 89 crossing and improving in-stream flow through voluntary increases in water use efficiency, water leases, or both, if water supply is limited. Installation of fish screens would be a potential future action, with establishment of a spawning run and evidence that entrainment limits recruitment or captures adult fish. Factors that may relegate these actions to a lower priority include costs associated with these actions, and the potential benefit based on the amount and quality of spawning habitat made available.

[7] NSPJ = no survey, professional judgment

Securing or restoring Little Trail Creek's resident Yellowstone cutthroat trout is the second potential category of conservation action for Little Trail Creek. Given the age of the available data, and the small sample size of genetic samples (N=4), field sampling is the first need in developing a specific conservation approach. Specific actions to conserve the resident population would follow the findings of the field surveys.

Determination of the specific actions to conserve Yellowstone cutthroat trout in Little Trail Creek must acknowledge the potential conflicts in promoting access for fluvial spawners and maintaining the genetics and lack of competing species for the resident population. Reopening access for fluvial spawners may also allow invasion of nonnative brown trout and rainbow trout, which would place the resident population at risk. As securing the remaining conservation populations is the highest priority, restoring or enhancing the fluvial run would occur only if it would not jeopardize the resident Yellowstone cutthroat trout.

6.2.4 Bassett Creek

Bassett Creek (Figure 6-10) originates in the Absaroka Mountains and flows to the west until its confluence with the Yellowstone River near Corwin Springs. Most of Bassett Creek's five-mile length is on the GNF, with only its lowest ¼ mile flowing through private lands. Bassett Creek is among streams considered to support a Yellowstone cutthroat trout population historically (May et al. 2007).

In the early 1990s, mottled sculpin and brook trout were the only species found within the Absaroka-Beartooth Wilderness (S .W. Shuler, GNF, personal communication). Habitat in the headwaters is suitable for supporting a resident fishery, making Bassett Creek a potential candidate for reintroduction of Yellowstone cutthroat trout following removal of brook trout. A perched culvert located upstream of Highway 89 is a definite fish barrier, which would protect a restored population from reinvasion by nonnative species, although construction of a barrier may be advisable to ensure protection of a reestablished population.

Bassett Creek has potential to support a spawning run of fluvial Yellowstone cutthroat trout from the Yellowstone River in some years. Bassett Creek's confluence with the Yellowstone River is perched above river elevation during most flows, and spawning Yellowstone cutthroat trout do not always have access to the stream. Nonetheless, in higher water years, river flows are sufficiently high to allow fish passage into Bassett Creek, and GNF personnel have documented spawning in the lower reaches during these events.

The extent of available spawning habitat for fluvial Yellowstone cutthroat trout is likely limited, as the Highway 89 culvert is a possible barrier to upstream movement, leaving about 1/10 mile of stream reliably available to spawning Yellowstone cutthroat trout. Moreover, a perched culvert located approximately 300 yards upstream of the Highway 89 crossing is impassible. Upstream of this culvert, Bassett Creek flows through a steep, confined canyon reach, with gradients approaching 15%. This section is unlikely to provide a significant amount of potential

spawning habitat, so opening access to passage for fluvial spawners through the perched culvert would not bring substantial conservation benefit.

In 2006, a proposal to develop a hydroelectric facility would have used an existing water right claim of 12.5 cfs. This amount typically exceeds the available water in Bassett Creek and diversion of flow for power generation could dewater the channel. The special use permit process allows the USFS to retain sufficient water in Bassett Creek to protect water dependent resources. Initial review suggested about 1 cfs is the minimum flow needed below the pipeline diversion to submerge the active channel and maintain aquatic habitat and riparian vegetation. Should this project proceed, monitoring may be a conservation action needed to ensure sufficient flow.

Conservation opportunities in Bassett Creek include reestablishment of a resident population of Yellowstone cutthroat trout, and increasing the amount of habitat available to fluvial spawners. Habitat upstream of the canyon reach is of suitable quality to support Yellowstone cutthroat trout (S.W. Shuler, GNF, personal communication). In addition, the amount of available habitat in Bassett Creek and in lower reaches of its tributaries is approximately 5 miles, which is the minimum recommended length of stream to maintain a viable fishery over the long-term (Hilderbrand and Kershner 2000). Although streams providing a greater extent of available habitat would be higher priorities for reestablishment of a Yellowstone cutthroat trout population, Bassett Creek is a suitable candidate for this activity.

Increasing the available spawning habitat for fluvial spawners is an option for Bassett Creek; however, more investigation is required to determine the potential benefits and landowner interest. Specifically, determination of the river flow required to make Bassett Creek accessible to fluvial Yellowstone cutthroat trout would aid in decision-making. If the recurrence interval for the necessary flow is long, other projects may be higher priorities.

6.2.5 Mulherin Creek

Mulherin Creek, known locally as Mol Heron Creek, (Figure 6-10) arises in Yellowstone National Park, and flows through a patchwork of private and public lands until its confluence with the Yellowstone River. A number of tributary streams feed Mulherin Creek, with Cinnabar Creek being the largest. Mulherin Creek has been the subject of considerable study to evaluate its use by fluvial Yellowstone cutthroat trout. These studies have resulted in implementation of conservation actions aimed at increasing reproductive success in this important stream, and provided documentation of the effects on Yellowstone cutthroat trout production. The resident fishery has received less study. Nonnative salmonids presumed present in Mulherin Creek and its tributaries include brook trout and rainbow trout (Table 6-5).

Table 6-5: Distribution and abundance of fishes in Mulherin Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	1	Brown trout	Rare	Year-round resident	N/A	N/A	EBS[8]
0	1	Longnose sucker	Rare	Year-round resident	N/A	N/A	EBS
0	1	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
5	9	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
0	1	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
1	2	Mountain whitefish	Rare	Year-round resident	Adfluvial	N/A	EBS
0	1	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
2	5	Rainbow trout	Common	Year-round resident	N/A	N/A	EBS
5	9	Rainbow trout	Common	Year-round resident	N/A	Tested conservation	EBES
0	1	Westslope cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
0	1	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially hybridized	EBS
1	9	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Tested conservation	EBES[9]

The importance of Mulherin Creek as a spawning tributary has been recognized since the early 1970s (Berg 1975), and subsequent investigations found Mulherin Creek to be among the most heavily used tributaries in the upper Yellowstone River hydrologic unit (Clancy 1988, DeRito 2004). In addition, Mulherin Creek is one of the major contributors of Yellowstone cutthroat trout fry to the Yellowstone River (Roulson 2002). These factors make Mulherin Creek a highly valuable stream in Yellowstone cutthroat trout conservation.

Genetic investigations in the Mulherin Creek drainage have addressed fluvial and resident Yellowstone cutthroat trout (Table 6-6). Timing of sampling allows inference on life history strategy evaluated, with spring samples targeting fluvial spawners. Consistent with findings on temporal segregation of rainbow trout and Yellowstone cutthroat trout spawning runs (DeRito 2004), Wright (2005) reported two genetically different groups of trout ascending this stream to spawn. The earlier run consisted of hybridized fish possessing a dominance of rainbow trout genes, on average 77%, with Yellowstone cutthroat trout genes accounting for 11% of the loci examined. Slightly hybridized Yellowstone cutthroat trout comprised the second run. These fish were on average 98.4% Yellowstone cutthroat trout, with small proportions of rainbow trout and

[9] EBES = Extrapolated, based on extensive survey.

westslope cutthroat trout genes being present. DeRito (2004) documented three nonhybridized Yellowstone cutthroat trout occupying Mulherin Creek during the spawning period.

Table 6-6: Summary of genetic analyses conducted in the Mulherin Creek watershed (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Count*	*Collection Date*
Mulherin	2974	47	WCT×YCT×RBT	10		06/16/2004
Creek	2975	05	WCT×YCT×RBT	10		05/20/2004
	0189	29	RBT	31		10/03/1986
	0189	29	YCT	69		10/03/1986
	1277	6	YCT	78.2		04/01/1997
	1277	6	RBT	21.8		04/01/1997
	1273	16	YCT	96.7		05/21/1997
	1273	16	RBT	03.3		05/21/1997
	0651	20	YCT	70		07/28/1992
	0651	20	RBT	30		07/28/1992
	2876	20	YCT	100	19	07/15/2003
	2876	20	YCT × WCT		1	07/15/2003
Cinnabar	190	15	YCT	98.7		10/03/1986
Creek	190	15	RBT	1.3		10/03/1986
Mill	652	15	YCT	098.7		07/28/1992
Creek	652	15	RBT	1.3		07/28/1992

Variable degrees of hybridization occur in the Yellowstone cutthroat trout in Mulherin Creek, Cinnabar Creek, and Mill Creek, a tributary of Cinnabar Creek (Table 6-6). Fish sampled in fall of 1986 in Mulherin Creek, below the confluence Cinnabar Creek, were heavily hybridized, with an average of 69% Yellowstone cutthroat trout genes and 31% rainbow trout genes (Leary et al. 1987). Fish sampled above the confluence with Cinnabar Creek had a variable degree of hybridization among sampling efforts, with the proportion of Yellowstone cutthroat trout alleles comprising from 70 to 100%. Alleles typical of westslope cutthroat trout occurred in one fish collected in 2003.

Cinnabar and Mill creeks support conservation populations of Yellowstone cutthroat trout (Table 6-6). Samples from both streams indicated Yellowstone cutthroat trout were over 98% nonhybridized, with rainbow trout alleles accounting for 1.3% of the loci examined. Conserving the genetic integrity of these fish, and evaluating risks from introduced salmonids are significant needs for these streams.

Because of its importance as a natal stream for fluvial Yellowstone cutthroat trout, Mulherin Creek has been the subject of a variety of conservation efforts. A water lease has been in effect since 1998, with the objective of increasing recruitment of Yellowstone cutthroat trout from Mulherin Creek into the Yellowstone River. An early attempt to prevent entrainment of Yellowstone cutthroat trout into an irrigation ditch involved installation of an infiltration gallery. This approach failed, as deposition of fine sediment clogged the gallery, limiting water delivered

to irrigators. FWP is working towards installation of an alternative approach to reduce losses of fluvial adults and fry to irrigation ditches.

Identified barriers to fish movement in the Mulherin Creek watershed include a velocity barrier at its mouth, and an impassable culvert on Cinnabar Creek, near its confluence with Mulherin Creek. Spring runoff apparently obscures the velocity barrier at the mouth, as fluvial Yellowstone cutthroat trout regularly ascend Mulherin Creek. The impassable culvert is likely beneficial in preventing further hybridization to the conservation populations in Cinnabar Creek and its tributaries.

Significant data gaps for the Mulherin Creek watershed include a lack of information on species composition, distribution, and genetic status of Yellowstone cutthroat trout in headwater reaches in the basin. Aside from the impassible culvert on Cinnabar Creek, no other barriers are known to protect the headwaters of Mulherin Creek from invasion by nonnatives. Sportsman Lake in Yellowstone National Park supports nonhybridized Yellowstone cutthroat trout and likely contributes nonhybridized fish to headwater streams. Field surveys and genetic testing are priority actions for headwater reaches the Mulherin Creek watershed.

Aldridge Lake is a 24-acre lake that inundates portions of Aldridge Creek, which is a tributary of Mulherin Creek. Stocking of Yellowstone cutthroat trout into Aldridge Lake occurred 27 times, beginning in 1928 and ending in 1993. Limited public access provided the justification to cease stocking efforts. The ability of Aldridge Creek to continue to support a population of Yellowstone cutthroat trout is unknown. With a maximum depth of 20 feet, winterkill may limit the ability of the lake to sustain a self-sustaining population of Yellowstone cutthroat trout. Likewise, spawning habitat may be limited.

Given the limited information on the status of Aldridge Lake and Aldridge Creek, several surveys are warranted. Determination of fish species composition, distribution, genetic status, and abundance are primary data needs. Similarly, evaluation of the potential for winterkill and the availability of suitable spawning habitat would allow assessment of the lake's ability to support a wild fishery. Finally, the presence of a barrier may have kept some of Aldridge Creek and all of the lake free of nonnative species. Conducting a barrier search would be valuable and would guide a management approach for the lake and creek should one be present.

A lack of information on habitat condition and fish distribution also exists for privately owned portions of the watershed. Much of the lower Cinnabar Creek basin is under private ownership, with livestock grazing and forage production being primary land uses. Opportunities may exist for implementation of conservation actions to promote fish habitat and water quality, while maintaining the agricultural productivity of these lands.

Conservation of Yellowstone cutthroat trout in Mulherin Creek will involve actions to preserve the fluvial spawning run and protect the integrity of resident populations of Yellowstone cutthroat trout. FWP will continue to work with private landowners and irrigators in the basin to

maintain minimum in-stream flows, and reduce entrainment of adults and fry into irrigation systems. In addition, as a significant portion of the Cinnabar Creek sub-watershed flows through range and hay meadows, opportunities may exist to work with private landowners on implementing grazing and forage production practices to improve riparian function and habitat condition, while maintaining agricultural productivity. Fisheries investigations refining the understanding of distribution and status of nonnative salmonids will allow development of more specific strategies to conserve the headwaters population of Yellowstone cutthroat trout in the basin.

6.2.6 Cedar Creek

Cedar Creek (Figure 6-10) originates in the Absaroka-Beartooth Wilderness, and flows to the west until its confluence with the Yellowstone River downstream of Corwin Springs. Cedar Creek lies nearly entirely on the GNF, with less than 0.5 miles of its 8-mile length flowing through private lands. Fisheries investigations have focused primarily on its role as a spawning tributary for fluvial Yellowstone cutthroat trout, with considerably less emphasis addressing the resident fishery. A population survey in 1990 found an estimated 13 brook trout per 1000 feet, but did not report other species being present (FWP unpublished data). Fish surveys conducted by GNF personnel found brook trout to be the most abundant species downstream of the wilderness boundary (S.W. Shuler, GNF, personal communication)

Cedar Creek is an important spawning tributary for fluvial Yellowstone cutthroat trout and had the largest confirmed run of all streams evaluated (Berg 1975). Cedar Creek is among the “high quality” spawning tributaries (Clancy 1988) and has had substantially greater number of adults ascending the stream and correspondingly greater numbers of redds than neighboring Tom Miner or Big creeks (Byorth 1990). This heavy use by fluvial Yellowstone cutthroat trout has resulted in Cedar Creek being the greatest known contributor of fry to the Yellowstone River in the upper Yellowstone River HUC, with fry production substantially exceeding neighboring Mulherin, Big, and Mill creeks (Roulson 2002).

Genetic analyses have examined fluvial spawners, out-migrating fry, and resident fish (Table 6-7). In 1991, of the 13 fry tested, at least 2 individuals were of hybrid origin (Leary 1992). Analyses of tissue collected from 24 fluvial Yellowstone cutthroat trout in 2003 found 23 nonhybridized Yellowstone cutthroat trout, and one Yellowstone cutthroat trout × westslope cutthroat trout hybrid (Martin 2004). A radio-tag study also confirmed nonhybridized Yellowstone cutthroat trout use Cedar Creek, with one of the 44 tagged, nonhybridized Yellowstone cutthroat trout using Cedar Creek (DeRito 2004). In contrast, none of the radio-tagged rainbow trout nor hybrids used Cedar Creek during this study.