### 6.2.21 Cascade Creek

The Cascade Creek watershed (Figure 6-13) is the next drainage to the north from Strawberry Creek. Major tributaries include McDonald Creek and Barney Creek. Fisheries information is limited for streams in this watershed. A fish survey in McDonald Creek, conducted in 1984, yielded an estimated 92 brown trout per 1,000 feet of stream. Other species presumed present include mottled sculpin, mountain whitefish, rainbow trout, and Yellowstone cutthroat trout (Table 6-23). As with other streams lacking current fish surveys, a conservation objective for the Cascade Creek watershed is determining species composition, distribution, and genetic status of any Yellowstone cutthroat trout present.

**Table 6-23: Distribution and abundance of fishes in Cascade Creek (MFISH database).**

| Begin Mile | End Mile | Species | Abundance | Use Type | Life History | Genetic Status | Data Rating |
|---|---|---|---|---|---|---|---|
| 0 | 1 | Brown trout | Abundant | Both resident and fluvial/adfluvial populations | N/A | N/A | EBS |
| 0 | 1 | Mottled sculpin | Abundant | Year-round resident | N/A | N/A | EBS |
| 0 | 1 | Mountain Whitefish | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 1 | Rainbow trout | Common | Both resident and fluvial/adfluvial populations | N/A | N/A | EBS |
| 0 | 1 | Yellowstone cutthroat trout | Common | Unknown | Resident | Potentially hybridized | EBS |

Although Cascade Creek and its tributaries are not listed as dewatered streams, the amount of neighboring irrigated agriculture evident in aerial photos suggests irrigation withdrawals are substantial. FWP will seek opportunities to work with irrigators on voluntary measures to increase water use efficiency, and maintain in-stream flow.

### 6.2.22 Trail Creek

Trail Creek (Figure 6-13) originates in the Gallatin Range, and flows through private lands for most of its 30-mile length. Pine Creek is a major tributary of Trail Creek, and a considerable portion of its length flows through the GNF. An irrigation system intercepts Trail Creek as it flows into Paradise Valley, and the stream no longer has connectivity to the Yellowstone River.

A number of disturbances have had pronounced influence on stream morphology and habitat quality in the upper portions of the Trail Creek watershed. Timber harvest in the 1980s included several large clear cuts, which likely increased water yield and sediment loading over the short term. In 2000, the Fridley fire burned the entire Pine Creek drainage, which has resulted in increased water yield, sediment loading, and flooding. In addition, failure of a large earthen dam in 1997 had pronounced effect on Trail Creek. The dam impounded a 12-acre pond, and the resulting flood exerted tremendous erosive force on the channel downstream of the dam. The

landowners have restored this section of stream; otherwise, disturbance of this magnitude would have taken decades to recovery naturally.

Limited fisheries data are available for the Trail Creek watershed. MFISH lists Yellowstone cutthroat trout, mottled sculpin, brown trout, and rainbow trout as likely being present (Table 6-24). In 2008, FWP sampled Trail Creek in the area of the failed dam and found Yellowstone cutthroat trout, brown trout, and apparent hybrids. In the 1990s, surveys in Pine Creek found nonhybridized Yellowstone cutthroat trout above a culvert and hybrids downstream of the culvert (S.W. Shuler, GNF, personal communication). Fish surveys following the Fridley fire revealed a complete fish kill on the National Forest, and by 2007, fish had not yet refounded upper reaches of Pine Creek. This event underscores the vulnerability of small isolated populations of Yellowstone cutthroat trout to natural disturbance. The culvert that had protected the now extirpated population of Yellowstone cutthroat trout was removed and replaced with a larger culvert that allows for fish passage.

**Table 6-24: Distribution and abundance of fishes in Trail Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 13 | 29 | Brown trout | Rare | Year-round resident | N/A | N/A | EBS |
| 12 | 21 | Cutthroat trout | Unknown | Unknown | Unknown | Unknown | EBS |
| 0 | 13 | Mottled sculpin | Rare | Year-round resident | N/A | N/A | NSPJ |
| 13 | 18 | Mottled sculpin | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 13 | Rainbow trout | Rare | Year-round resident | N/A | N/A | NSPJ |
| 14 | 28 | Yellowstone cutthroat trout | Common | Unknown | Resident | Potentially hybridized | EBS |

The limited amount of data available on fish distribution in the Trail Creek watershed indicates further inventory is a conservation need. Determining species distribution and genetic status of any remaining Yellowstone cutthroat trout would allow development of a specific conservation strategy. If nonhybridized or slightly hybridized Yellowstone cutthroat trout remain in the basin, protecting these fish would be the highest priority. If conservation populations of Yellowstone cutthroat trout are no longer present in the Trail Creek drainage, this watershed may be a candidate for reestablishment of native fish.

The extent of habitat alteration from dam failure and wildfire was considerable, and several private landowners have completed habitat restoration projects. These projects include restoring reaches of channel altered by dam failure and replacing culverts on tributaries affected by the Fridley fire. Additional efforts may be beneficial, especially if conservation populations of Yellowstone cutthroat trout are involved. Likewise, review of aerial photographs indicates areas exist with apparently reduced riparian health and function. Opportunities to work with

landowners on restoring these reaches may exist, and these would benefit fisheries and water quality.

### 6.2.23 Pine Creek

Pine Creek (Figure 6-13) arises in the Absaroka Range on the east side of the Paradise Valley. It flows through the GNF, with a substantial proportion of the watershed occurring within the Absaroka-Beartooth Wilderness. South Fork Pine Creek is a major tributary, and contributes a substantial amount of habitat for fish within the GNF. Pine Creek enters private lands about three river miles from its confluence with the Yellowstone River. Much of this watershed burned in a severe wildfire in 2012. Increased sediment loading, water yield, and woody debris recruitment are likely consequences of this event.

Natural and human-made barriers are significant features on Pine Creek that influence distribution of fishes. Two diversion structures within private lands are likely barriers that prevent invasion by brown trout and rainbow trout into the upper watershed (Endicott 2008c). A large waterfall presents a total barrier to upstream movement. Historically, this portion of Pine Creek, and the lakes in its headwaters, were likely fishless; however, FWP regularly stocks Pine Creek Lake with Yellowstone cutthroat trout to provide a recreational fishery. These stocked fish likely occupy Pine Creek upstream of the waterfall, and may occasionally disperse downstream.

Brook trout are likely the most abundant and widely distributed fish species in Pine Creek, and a fish survey in 1983 found only brook trout in a sampling reach near the USFS boundary (MFISH database). Other species presumed present in the lower reach, downstream of barriers, include mottled sculpin and rainbow trout (Table 6-25). Occupancy of fish in the lowest 1 to 2 miles of channel is seasonal, as irrigation withdrawals divert most to all flows in most years.

**Table 6-25: Fish distribution in Pine Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 0 | 4.5 | Brook trout | Abundant | Year-round resident | N/A | N/A | EBS |
| 0 | 4.5 | Mottled sculpin | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 4.5 | Rainbow trout | Rare | Fluvial/adfluvial population, spawning elsewhere | N/A | N/A | EBS |
| 0 | 3.7 | Yellowstone cutthroat trout | Unknown | Unknown | Resident | Potentially hybridized | NSPJ |

The Pine Creek watershed is a potential candidate for reestablishment of a nonhybridized Yellowstone cutthroat trout population, following removal of nonnative brook trout. The existing irrigation diversions may prevent reinvasion by nonnatives and eliminate the need to construct a fish barrier. More evaluation of these barriers is needed to determine if they are passable. The amount of habitat upstream of the upper diversion structure, approximately 10 miles, is sufficient to support a population over the long-term (Hilderbrand and Kershner 2000)

Chronic dewatering limits Pine Creek's ability to support a fluvial run of Yellowstone cutthroat trout in the lower 2 miles of stream. Nonetheless, opportunities to promote water use efficiency and maintain in-stream flow through voluntary measures may exist. FWP will explore these options with willing landowners and irrigators.

### 6.2.24 Deep Creek

Deep Creek (Figure 6-13) is the next major drainage to the north from Pine Creek. Its north and south forks originate in the Absaroka-Beartooth Wilderness before entering private lands in Paradise Valley. The confluence of these forks marks the upstream extent of Deep Creek, about 2.5 miles from its mouth. The Deep Creek drainage burned in a major wildfire in 2012 and will experience increased water yield, sediment loading, and debris recruitment until the watershed recovers.

Little fisheries information is available for the Deep Creek watershed. In 2011, a fish survey in South Fork Deep Creek yielded no fish, presumably, because its high gradient may not be suitable to support fish. Otherwise, no formal survey data are available to verify species composition and distribution; although, brook trout and Yellowstone cutthroat trout are presumed to be present (Table 6-26). As the lower two miles of channel are chronically dewatered during summer months, Deep Creek is unlikely to support much of a fluvial spawning run, and no fluvial Yellowstone cutthroat trout have been documented in Deep Creek in spawning investigations (Berg 1975, DeRito 2004)

**Table 6-26: Distribution and abundance of fishes in Deep Creek (MFISH database).**

| Begin Mile | End Mile | Species | Abundance | Use Type | Life History | Genetic Status | Data Rating |
|---|---|---|---|---|---|---|---|
| 0 | 2.4 | Brook trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 2.4 | Yellowstone cutthroat trout | Unknown | Unknown | Resident | Potentially hybridized | NSPJ |

The first priority for the Deep Creek watershed is to conduct fisheries investigations to determine species composition in the main stem and its north fork. The resulting information would guide development of a conservation strategy. For example, if Yellowstone cutthroat trout still occur in the upper watershed, protection of remaining fish would be the course of action. Alternatively, the south and north forks of Deep Creek may be candidates for reclamation and reestablishment of Yellowstone cutthroat trout. Should appropriate barrier sites be present, these streams have sufficient stream miles to support Yellowstone cutthroat trout over the long-term.

Similar to other dewatered streams, opportunities may exist to increase in-stream flow during summer months. FWP will work to identify irrigators willing to increase water use efficiency, and lease water savings for in-stream flow. These efforts may result in reestablishment of a spawning run of fluvial Yellowstone cutthroat trout in Deep Creek.

### 6.2.25 Nelson Spring Creek

Nelson Spring Creek is among several spring creeks arising in the floodplain of the Yellowstone River at the north end of the Paradise Valley. As with the next few spring creeks, their locations and names are not clear in the available GIS streams layer. This stream flows entirely through private land. Like many spring creeks, this stream is highly productive, and its summer cool/winter warm water temperatures attract large numbers of fish. Species composition reflects its proximity to the Yellowstone River, with introduced and native species being present (Table 6-27). This spring creek is an important contributor to the main stem populations of the Yellowstone River, and is among streams supporting a run of fluvial Yellowstone cutthroat trout (Berg 1975; Clancy 1984; DeRito 2004; Roberts 1988).

**Table 6-27: Distribution and abundance of fishes in Nelson Spring Creek (MFISH database).**

| Begin Mile | End Mile | Species | Abundance | Use Type | Life History | Genetic Status | Data Rating |
|---|---|---|---|---|---|---|---|
| 0 | 2.5 | Brown trout | Abundant | Both resident and fluvial/adfluvial populations | N/A | N/A | EBS |
| 0.7 | 2.5 | Mottled sculpin | Common | Year-round resident | N/A | N/A | EBS |
| 0.7 | 2.5 | Mountain whitefish | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 2.5 | Rainbow trout | Abundant | Both resident and fluvial/adfluvial populations | N/A | N/A | EBS |
| 0 | 0.70 | Yellowstone cutthroat trout | Common | Unknown | Resident | Potentially hybridized | EBS |
| 0.7 | 2.5 | Yellowstone cutthroat trout | Common | Unknown | Resident | Potentially hybridized | EBS |

Whirling disease is a potential constraint on the ability of spring creeks to produce trout fry. Spring creeks have high susceptibility to be a source of whirling disease as the summer-cool and winter-warm water temperatures, and moderate flows, provide habitat favorable to *Tubifex tubifex*, the intermediate worm host to the whirling disease organism (*Myxobolus cerebralis*). The commercial hatchery fed by this spring is tested regularly, and remains free from infection. Future investigations into the role of whirling disease in shaping fluvial Yellowstone cutthroat trout populations are possible.

The landowners have a continued commitment to improving fish habitat, with an emphasis on providing high quality spawning habitat and holding habitat for adult fish. The goals for these landowner driven projects were to reduce width-to-depth ratios in overly wide and shallow portions of the stream, provide depth and cover for fish, and provide clean gravel substrate for spawning. Other actions have included riparian fencing to exclude livestock from the stream, and native plantings to restore the health and function of the riparian zone.

### 6.2.26 DePuy's Spring Creek

DePuy's Spring Creek is a 3.5-mile long spring creek that parallels and eventually joins the Yellowstone River near the northern end of the Paradise Valley. Like many spring creeks, this stream is highly productive, and its cool water attracts large numbers of fish. Similar to Nelson Spring Creek, public access is limited to reduce damage to cutthroat trout embryos and fry from wading. Yellowstone cutthroat trout occupy DePuy's Spring Creek during the spawning period (DeRito 2004).

Little fisheries information is available for DePuy's Spring Creek. A fish survey in 1988 found exceptionally high densities of fish, and rainbow trout were the most abundant of the trout species (Decker-Hess 1989). Habitat improvements in the 1980s were predicted to improve habitat for resident fish and increase recruitment of trout to the Yellowstone River (Decker-Hess 1989). Genetic analyses of trout captured in DePuy's Spring Creek found nonhybridized Yellowstone cutthroat trout in sympatry with rainbow trout (Leary 1997).

As is true of many spring creeks, whirling disease is a potential constraint on the stream's ability to produce Yellowstone cutthroat trout fry. In general, more research is needed to evaluate the relative susceptibility of Yellowstone cutthroat trout to whirling disease, and its potential to have population level effects. Until more is known, educating anglers on the importance of cleaning gear is among the options to conserving Yellowstone cutthroat trout in these streams.

### 6.2.27 Armstrong Spring Creek

Armstrong Spring Creek flows for over a mile in the north end of the Paradise Valley before entering the Yellowstone River south of Livingston. This spring creek supports a renowned fee fishery for brown trout, rainbow trout, and Yellowstone cutthroat trout. Fish surveys in the 1970s found high densities of game species in Armstrong Spring Creek with species composition reflecting proximity to the Yellowstone River (Berg 1975; Stevenson 1980).

This spring creek is an important contributor to main stem populations of Yellowstone River fish. Moreover, it is one of the few tributaries in the area available to fluvial fish and provides ideal spawning and rearing habitat. Similar to DePuy's Spring Creek, the cool water and productivity attracts large numbers of fish. As a spring creek, it has potential to be a source of whirling disease underscoring the need to educate anglers on cleaning fishing gear before moving to a different stream to fish.

### 6.2.28 Yellowstone Cutthroat Trout Conservation Potential in Upper Yellowstone River Subbasin Spring Creeks

The spring creeks at the mouth of the Paradise Valley provide important, high-quality habitat that supports main stem fish populations and high-quality resident fisheries. The conservation opportunities beyond the existing recruitment of Yellowstone cutthroat trout are limited. Rainbow trout and brown trout will continue to be important components of the fisheries of these

streams. Landowners have invested considerably in habitat protection and quality. This stewardship will likely continue so to maintain the health and abundance of fish in these streams.

### 6.2.29 Suce Creek

Suce Creek (Figure 6-13) is the next drainage to the north of Deep Creek, originating in the GNF on the east side of Paradise Valley. Limited fisheries information is available for this stream. Species presumed present include brown trout, mottled sculpin, and rainbow trout (Table 6-28). In 1987, a sample of 16 Yellowstone cutthroat trout collected in the headwaters tested as nonhybridized (Leary 1987). A sampling effort in 2011 yielded no fish (MFISH database). Chronic dewatering limits Suce Creek's ability to support a fluvial spawning run.

**Table 6-28: Distribution and abundance of fishes in Suce Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 0 | 7.4 | Brown trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 7.4 | Mottled sculpin | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 7.4 | rainbow trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 7.4 | Yellowstone cutthroat trout | Rare | Unknown | Resident | Nonhybridized | EBS |

Conservation priorities for Suce Creek include conducting fisheries investigations to update information on species composition and distribution, and genetic status of Yellowstone cutthroat trout. The results would guide development of a specific conservation approach. Likewise, reestablishment of a fluvial Yellowstone cutthroat trout population may be possible, if irrigators agree to voluntary water conservation measures and leasing water rights for in-stream flow. FWP will work towards identifying interested landowners.

### 6.2.30 Billman Creek

The Billman Creek (Figure 6-14) watershed originates in the north slope of the Wineglass Mountains, which form the northern boundary of Paradise Valley. Nearly the entire watershed lies on private lands. Major tributaries include Miner and Area creeks. (Locals refer to Area Creek as O'Rea Creek.)

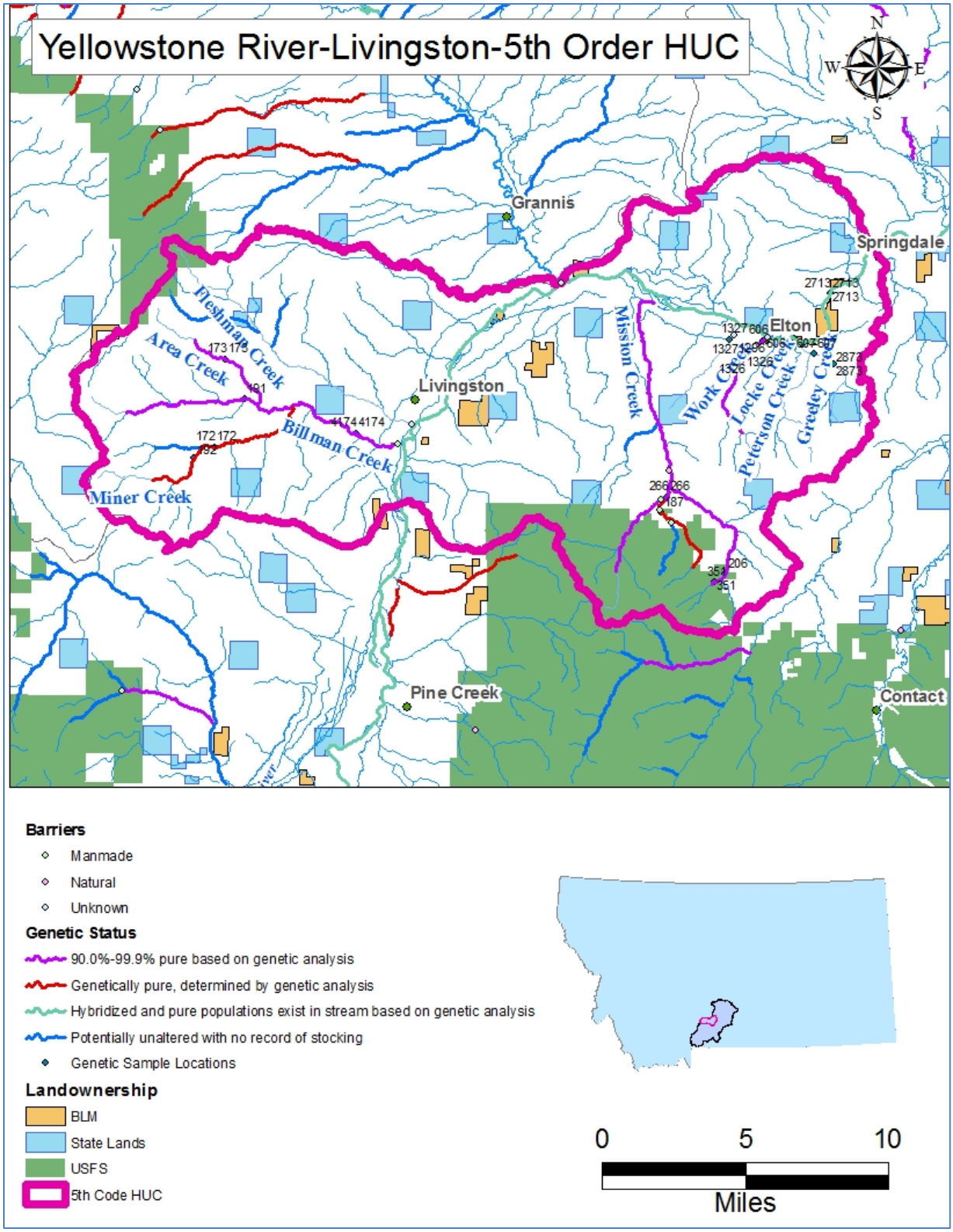


**Figure 6-14: Distribution of Yellowstone cutthroat trout in the Yellowstone River-Livingston Watershed (FWP GIS database)**

Fisheries information is limited for the Billman Creek watershed, and age of the available data restricts the ability to make inference on current conditions. Species presumed to be present include Yellowstone cutthroat trout, brook trout, brown trout, rainbow trout, mountain whitefish, and several nongame species (Table 6-29). In the mid-1980s, genetic analyses of Yellowstone cutthroat trout found nonhybridized and slightly hybridized fish in Billman Creek and its tributaries (Table 6-30).

**Table 6-29: Distribution and abundance of fishes in Billman Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 0 | 12 | Brook trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 12 | Brown trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 12 | Longnose sucker | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 12 | Mottled sculpin | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 12 | Mountain whitefish | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 12 | Rainbow trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0.1 | 12 | Yellowstone cutthroat trout | Common | Unknown | Resident | Nonhybridized | EBS |

**Table 6-30: Summary of genetic analyses conducted in the Billman Creek watershed (MFISH database).**

| *Stream* | *Sample No.* | *Sample Size* | *Target Species* | *Percent of Genes* | *Collection Date* |
|---|---|---|---|---|---|
| Billman | 191 | 19 | YCT | 100 | 10/09/1986 |
| Miner | 192 | 28 | YCT | 100 | 10/09/1986 |
| | 172 | 25 | YCT | 94 | 07/31/1986 |
| Area | 173 | 25 | YCT | 99.6 | 08/01/1986 |
| | 173 | 25 | RBT | 0.04 | 08/01/1986 |

Fisheries investigations in 2009 confirmed the presence of Yellowstone cutthroat trout in Miner and Area creeks, both are relatively large tributaries (C.L. Endicott, FWP, personal communication). Captured fish showed no obvious signs of hybridization; however, genetic analysis of tissue samples is pending. Additional sampling in Billman Creek tributaries is warranted to determine species composition and update genetic status of Yellowstone cutthroat trout.

In 2010, FWP sampled Billman Creek near the west interchange of Interstate 90. Yellowstone cutthroat trout, brown trout, and brook trout were present (MFISH database). Genetic analyses found that the 19 fish evaluated contained a hybrid swarm with predominantly Yellowstone cutthroat trout and a small component of hybrids with a greater degree of admixture (Leary 2011).

The presence of private ponds has the potential to be a source of rainbow genes in the Billman Creek watershed. These ponds lie in the headwaters and were likely stocked with rainbow trout. Stocking no longer occurs, but species composition has not been confirmed.

A potential barrier at the mouth of Billman Creek may limit this stream's accessibility to fluvial Yellowstone cutthroat trout. A culvert approximately 600 feet long conveys water to its confluence with the Yellowstone River. Given its length, the pipe may not be passable. This pipe is an ideal candidate to apply the Fish Xing model.

Land use activities adjacent to Billman Creek and its tributaries include livestock grazing, forage crop production, and urbanization. These uses have potential to negatively affect stream habitat and water quality, if not managed in a compatible manner. The Montana Department of Environmental Quality lists Billman Creek as a water quality impaired stream, with nutrients and sediment being probable causes of impairment, and agriculture and habitat modification being probable sources of impairment. Associated water quality planning efforts will be useful in identifying potential habitat restoration projects, and opportunities to work with private landowners on implementing fisheries-compatible streamside management.

Conservation priorities for Billman Creek include collecting updated information of species composition, distribution, and genetic status. In addition, the culvert at the lumberyard should be evaluated for its potential to block upstream movement of fish. These data will guide development of more specific plans to secure or reestablish resident Yellowstone cutthroat. Reestablishment of connectivity with the Yellowstone River would likely be incompatible with securing or reestablishing the resident fishery.

### 6.2.31 Fleshman Creek

Fleshman Creek (Figure 6-14) is the next drainage to the north of Billman Creek, and its watershed is nearly entirely in private ownership. Rangeland and irrigated crop production dominate the upper reaches. The lower two miles flow through Livingston. The Sacajawea Park Lagoon is an on-stream impoundment.

Fisheries investigations have focused mostly on the portion of stream flowing through Livingston, and species composition reflects the neighboring Yellowstone River (Table 6-31). In the 1970s, FWP sampled Fleshman Creek just upstream of the City of Livingston, and found brook trout were the most abundant species, with a few Yellowstone cutthroat trout present (FWP, unpublished data). Investigations following a fish kill in 2007 indicated the presence of brown trout, rainbow trout, and Yellowstone cutthroat trout (FWP data files).

**Table 6-31: Distribution and abundance of fishes in Fleshman Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 0 | 12 | Brook trout | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 6 | Brown trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 6 | Lake chub | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 12 | Mottled sculpin | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 6.44 | Rainbow trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0.1 | 7.1 | Yellowstone cutthroat trout | Common | Unknown | Resident | Potentially hybridized | EBS |

In 2009, FWP sampled fish at two locations on Fleshman Creek (C.L. Endicott, FWP, personal communication). The lower reach was just above town, and the upper reach was close to the headwaters. Fishes captured in the lower reach included lake chub, longnose dace, white sucker, rainbow trout, and brown trout. One apparent Yellowstone cutthroat trout × rainbow trout hybrid was also present. Yellowstone cutthroat trout was the only species found at the upper sampling reach. These fish showed no apparent signs of hybridization. Genetic analysis of this population is a conservation need.

The apparent absence of nonnative fishes from the upper reach of Fleshman Creek suggests a passage barrier exists somewhere along the stream. Potential barriers include several large beaver dams or road crossings. Identifying and securing any existing barrier protecting the upper reaches from invasion is a conservation priority for Fleshman Creek.

Fleshman Creek is the subject of a series of conservation actions that target fish habitat and flood and sediment conveyance through Livingston. The first phase, which was constructed in 2010, restored habitat on a ranch upstream of Livingston. This effort involved channel restoration and installation of suite of ranch infrastructure improvements such as riparian fencing and development of off-channel water for livestock. The next phase will involve restoration of a two-mile reach flowing through Livingston. Partners in this phase include Park County, the Army Corps of Engineers, the Federal Emergency Management Agency (FEMA), FWP, the Joe Brooks Chapter of Trout Unlimited, and private landowners along the creek. The goals of this project include mitigation of flood risks, restoration of in-stream and riparian habitat, water quality improvement, and improved recreation and aesthetics.

### 6.2.32 Mission Creek

Mission Creek (Figure 6-14) originates on the north slope of the Absaroka Range, and flows for over 13 miles, mostly through private lands, before its confluence with the Yellowstone River. Major tributaries include Little Mission Creek and Mill Fork. Fishes present in Mission Creek include Yellowstone cutthroat trout, mountain whitefish, and two suckers (Table 6-32).

**Table 6-32: Distribution and abundance of fishes in Mission Creek (MFISH database).**

| Begin Mile | End Mile | Species | Abundance | Use Type | Life History | Genetic Status | Data Rating |
|---|---|---|---|---|---|---|---|
| 0 | 8 | Brown trout | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 8 | Longnose sucker | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 8 | Mottled sculpin | Common | Year-round resident | N/A | N/A | EBS |
| 0 | 8 | Mountain whitefish | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 8 | Rainbow trout | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 8 | White sucker | Rare | Year-round resident | N/A | N/A | EBS |
| 0 | 9 | Yellowstone cutthroat trout | Common | Unknown | Resident | Tested conservation | EBS |
| 8 | 14 | Yellowstone cutthroat trout | Abundant | Unknown | Resident | Tested conservation | EBS |
| 9 | 12 | Yellowstone cutthroat trout | Common | Unknown | Resident | Tested conservation | NSPJ |

Nonhybridized and slightly hybridized Yellowstone cutthroat trout reside in the basin's streams (Table 6-33). Chronic dewatering in the lowest portion of Mission Creek is a likely constraint to the potential for a fluvial Yellowstone cutthroat trout run, and DeRito (2004) did not document any radio-tagged fish ascending Mission Creek.

**Table 6-33: Summary of genetic analyses conducted in the Mission Creek watershed (MFISH database).**

| *Stream* | *Sample No.* | *Sample Size* | *Target Species* | *Percent of Genes* | *Collection Date* |
|---|---|---|---|---|---|
| Mission Creek | 452 | 12 | YCT | 98.3 | 09/29/1988 |
| | 452 | 12 | RBT | 1.7 | 09/29/1988 |
| Mill Fork Creek | 187 | 21 | YCT | 100 | 10/01/1986 |
| Little Mission Creek | 206 | 21 | YCT | 100 | 06/12/1987 |
| | 351 | 25 | YCT | 092.6 | 09/11/1989 |
| | 351 | 25 | RBT | 7.4 | 09/11/1989 |

Several culverts present potential passage barriers in Mission Creek (Figure 6-14). These culverts may be beneficial in preventing invasion of nonnative fishes. In 1993, the USFS retrofitted a culvert on Tie Creek, a tributary of Mission Creek to prevent upstream movement of rainbow trout and hybrids  Alternatively, impassable culverts may restrict movement, and gene flow, through the subbasin. Evaluating the costs and benefits of these features is a conservation priority for the Mission Creek watershed.

The age of the available data presents a concern in the management of Mission Creek's Yellowstone cutthroat trout. Reevaluation of species composition and genetic status are

considerable data needs. Updating information on Mission Creek would assist in developing a specific strategy doe conserving the watershed's Yellowstone cutthroat trout.

### 6.2.33 Work Creek

Work Creek (Figure 6-14) is a small stream originating in the foothills to the east of Mission Creek. Its headwaters originate in state-owned, school trust land. The rest flows through private property before its confluence with the Yellowstone River.

A combination of small drainage area and moderate elevation of its headwaters suggests Work Creek does not have sufficient water supply to support a strong, resident fishery. Investigations near the mouth in 1998 found several fluvial spawners in Work Creek. These included several nonhybridized Yellowstone cutthroat trout, and some hybrids (Kanda 1998). The sufficiency of flows to support a fluvial run in Work Creek is unknown. The conservation priority for the creek is to fill data gaps that will allow determination of the its potential and specific conservation opportunities.

### 6.2.34 Locke Creek

Locke Creek (Figure 6-14) is a small stream with substantial importance for Yellowstone cutthroat trout. Its headwaters originate in the foothills of the Absaroka Mountains, although most of its six miles flow through private lands. Locke Creek joins the Yellowstone River between Livingston and Springdale; it is one of the few documented spawning tributaries downstream of Paradise Valley.

Fisheries investigations on Locke Creek have focused on its role as a spawning stream for fluvial Yellowstone cutthroat trout. Locke Creek was among the high-quality spawning tributaries, owing to the number of Yellowstone cutthroat trout ascending this stream during the spawning period (Clancy 1985). Redd counts in 1991 found 13 redds from the stream's mouth to the culvert under Interstate 90 (Shepard 1992). Fry recruitment was considerable that year, with nearly 1,000 Yellowstone cutthroat trout fry captured in one fry trap during six nights of trapping (Shepard 1992). Fry trapping in 1996 and 1997 yielded fewer fry, and maintaining minimum in-stream flows was recommended to increase fry production (Hennessey 1998).

Genetic investigations have focused on fluvial spawners and out-migrating fry (Table 6-34). Nonhybridized Yellowstone cutthroat trout and slightly hybridized fish use Locke Creek during the spawning period. Fry tested as 97.9% nonhybridized. These results indicated Locke Creek supports a conservation population of fluvial spawners.

**Table 6-34: Summary of genetic samples collected in Locke Creek (MFISH database).**

| *Sample No.* | *Sample Size* | *Target Species* | *Percent of Genes* | *Collection Date* |
|---|---|---|---|---|
| 1326 | 15 | YCT | 95.8 | 06/02/1998 |
| 1326 | 15 | RBT | 4.2 | 06/02/1998 |
| 1296 | 4 | YCT | 100.0 | 06/02/1998 |
| 606 | 24 | YCT | 97.9 | 07/23/1991 |
| 606 | 24 | RBT | 2.1 | 07/23/1991 |

A water lease has been in place in Locke Creek since 2001; however, channel alterations in the Yellowstone River have blocked Yellowstone cutthroat trout attempting to access the stream. The floods of 1997 shifted the main flow of the Yellowstone River to the north, away from Locke Creek. Before this shift, the Yellowstone River backwatered the lower portion of the creek during high flows, which allowed Yellowstone cutthroat trout access to it through a railroad culvert. A combination of diminished peak flows, and the lack of backwatering now makes this culvert impassable in some years. The reduced access may be in part responsible for dramatic declines in Yellowstone cutthroat trout in the Springdale sampling reach (Opitz 2004).

Less work has been focused on Locke Creek's resident fishery. An irrigation diversion upstream of the reach used by fluvial spawners is an apparent fish barrier. Spot sampling upstream of this structure captured 26 resident Yellowstone cutthroat trout (B.B. Shepard, FWP retired, personal communication). These fish tested as being hybrids, with 4.2% of alleles being characteristic of rainbow trout (Table 6-34). Sampling upstream of the diversion in 2012 found only putative Yellowstone cutthroat trout. Results of genetics sampling are pending. Additional survey to determine distribution and health of the Locke Creek Yellowstone cutthroat trout population would be useful.

Conservation priorities for Locke Creek include protecting its fluvial run of nonhybridized and hybridized fish. Restoring the accessibility of Locke Creek by modifying the stream downstream of the railroad culvert is a potential future action. Likewise, continued maintenance of minimum in-stream flows is warranted. Fisheries investigations aimed at determining status and distribution of resident Yellowstone cutthroat trout would assist in development of conservation actions for the rest of Locke Creek and its tributaries.

### 6.2.35 Greeley/Peterson Creek

This watershed (Figure 6-14) originates in foothills south of the Yellowstone River and flows entirely through private lands across its 5 ½ mile length. Stream name designations are unclear for Greeley and Peterson Creek. USGS maps label both Greeley and Peterson, but do not designate the name of the stream below the confluence of these streams. The national hydrologic layer used in GIS designates Greeley Creek as the main stem. Locals know the stream as Peterson Creek. Fisheries investigators have been variable in what they consider Greeley or Peterson Creek.

Fisheries investigations in the Peterson/Greeley Creek watershed have focused on its use by fluvial Yellowstone cutthroat trout. Peterson Creek was among the high-quality spawning tributaries identified by Clancy (1985), and nonhybridized, radio-tagged Yellowstone cutthroat trout were observed in Greeley Creek during the early 2000s (DeRito 2004). Genetic investigations have found nonhybridized and slightly hybridized spawners ascending the stream (Table 6-35). Genetic analyses of out-migrating fry in 1991 found these to be Yellowstone cutthroat trout × rainbow trout hybrids.

**Table 6-35: Summary of genetic analyses conducted in the Peterson/Greeley Creek watershed (MFISH database).**

| *Sample No.* | *Sample Size* | *Target Species* | *Percent of Genes* | *Count* | *Collection Date* |
|---|---|---|---|---|---|
| 3711 | 50 | YCT | 99.7 | | 05/02/2007 |
| 3711 | 50 | RBT | 0.3 | | 05/02/2007 |
| 2873 | 16 | YCT | | 15 | 06/15/2003 |
| 2873 | 1 | YCT×WCT | | 1 | 06/15/2003 |
| 607 | 10 | YCT | 76.8 | | 07/24/1991 |
| 607 | 10 | RBT | 23.2 | | 07/24/1991 |

Little information is available on the species composition and distribution of the resident fishery. The lowest half-mile of stream may support hybridized Yellowstone cutthroat trout. Peterson Creek and Greeley creeks may support hybridized Yellowstone cutthroat trout, along with nonnative rainbow trout and brown trout (Table 6-36 and Table 6-37). These species pose a threat to persistence of resident Yellowstone cutthroat trout in the Peterson/Greeley Creek watershed.

**Table 6-36: Distribution and abundance of fishes in Greeley Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 0 | 0.53 | Yellowstone cutthroat trout | Abundant | Unknown | Resident | Tested conservation | EBS |

**Table 6-37: Distribution and abundance of fishes in Peterson Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| 0 | 3 | Brown trout | Abundant | Resident | N/A | N/A | EBS |
| 0 | 3 | Mottled sculpin | Common | Resident | N/A | N/A | EBS |
| 0 | 3 | Mountain Whitefish | Common | Resident | Adfluvial | N/A | EBS |
| 0 | 3 | Rainbow trout | Common | Resident | N/A | N/A | EBS |
| 0 | 0.69 | Yellowstone cutthroat trout | Abundant | Unknown | Resident | Tested conservation | EBS |

Peterson/Greeley Creek experienced a substantial flood event in spring of 2011that resulted in considerable channel alterations, especially near the mouth, where Interstate 90 and a frontage road cross the creek. The stream made large vertical adjustments, making large head cuts, which also contributed to the already sizeable load of sediment coming through the stream. This event resulted in enough sediment to fill the interstate and railroad crossings. MDT is proceeding with channel rehabilitation and replacing the two culverts under the west-bound portion of the interstate with a bridge.

Despite the degree of disturbance with this flood event, Yellowstone cutthroat trout had a strong spawning run the following spring. Trapping of fluvial spawners yielded 52 Yellowstone cutthroat trout. Fry traps deployed in August captured over 30 Yellowstone cutthroat trout fry, which is a promising given the amount of sediment still in the lower gradient reaches of the stream.

Conservation planning for this watershed should include a strategy to protect and enhance its use by nonhybridized fluvial Yellowstone cutthroat trout. Additionally, investigations into the species composition, distribution, and genetic status of resident fishes would guide development of an approach to protect or restore resident Yellowstone cutthroat trout where feasible.

### 6.2.36 Duck Creek

Duck Creek (Figure 6-15) originates along the south slope of the Crazy Mountains, and flows south before its confluence with the Yellowstone River near Springdale, Montana. Most of the watershed is in private ownership, although streams do flow through several sections of GNF, and some state owned lands.

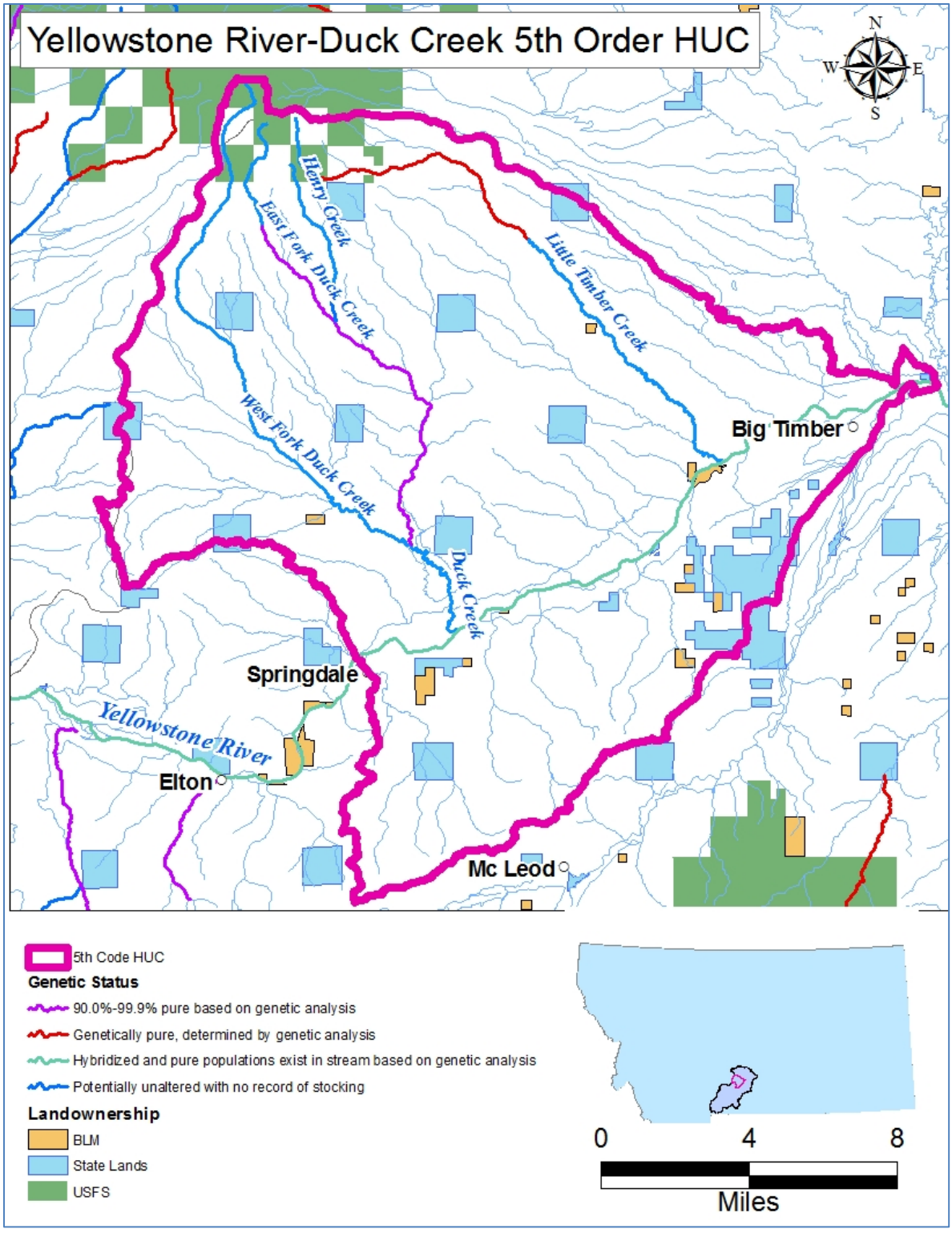


**Figure 6-15: Distribution of Yellowstone cutthroat trout in the Yellowstone River-Duck Creek Watershed (FWP GIS database).**

Fisheries information is limited for the Duck Creek watershed. No fish surveys have been conducted in West Fork Duck Creek or the main stem, and information on species composition is conjectural (Table 6-38). In 1984, a fisheries investigation in East Fork Duck Creek found Yellowstone cutthroat trout to outnumber brown by a substantial margin (White 1984). Alarmingly, FWP found a reversal in species dominance in 2007, with brown trout being considerably more abundant than Yellowstone cutthroat trout. Genetic analysis of Yellowstone cutthroat trout captured in this effort found less than 1% introgression by rainbow trout genes, which makes this a core population of Yellowstone cutthroat trout (Leary 2007).

**Table 6-38: Distribution and abundance of fishes in the Duck Creek watershed (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Use Type* | *Life History* | *Genetic Status* | *Data Rating* |
|---|---|---|---|---|---|---|---|
| Duck Creek | | | | | | | |
| 0 | 4 | Brown trout | Common | Year-round resident | N/A | N/A | NSPJ |
| 0 | 4 | rainbow trout | Common | Year-round resident | N/A | N/A | NSPJ |
| 0 | 4 | Yellowstone cutthroat trout | Rare | Unknown | Resident | Potentially hybridized | NSPJ |
| East Fork Duck Creek | | | | | | | |
| 0 | 16 | Brown trout | Common | Year-round resident | N/A | N/A | NSPJ |
| 0 | 12 | Yellowstone cutthroat trout | Unknown | Resident and fluvial/adfluvial populations | Combination | Tested conservation | NSPJ |
| West Fork Duck Creek | | | | | | | |
| 3 | 18 | Brook trout | Rare | Year-round resident | N/A | N/A | NSPJ |
| 0 | 3 | Brown trout | Common | Year-round resident | N/A | N/A | NSPJ |
| 3 | 18 | Brown trout | Rare | Year-round resident | N/A | N/A | NSPJ |
| 0 | 3 | Longnose Dace | Common | Year-round resident | N/A | N/A | NSPJ |
| 0 | 3 | Mountain Whitefish | Common | Year-round resident | N/A | N/A | NSPJ |
| 0 | 3 | Rainbow trout | Common | Year-round resident | N/A | N/A | NSPJ |
| 3 | 18 | Rainbow trout | Rare | Year-round resident | N/A | N/A | NSPJ |
| 0 | 9 | Yellowstone cutthroat trout | Rare | Both resident and Fluvial/Adfluvial populations | Combination | Potentially hybridized | NSPJ |

Conservation actions are underway in the Duck Creek watershed. In 2009, FWP transferred fertilized Yellowstone cutthroat trout eggs above a waterfall on Henry Creek, a tributary of the

East Fork Duck Creek. The objectives of this effort are to expand the miles of stream occupied, and establish a secure subpopulation that can be used as brood stock in the future.

Securing the watershed's Yellowstone cutthroat trout population is a conservation priority. Sympatry with brown trout presents a significant threat to the persistence of Yellowstone cutthroat trout in the basin. Removal or suppression of brown trout are among the tools likely to be applied. Protecting the basin from invasion of nonnatives is another concern. An irrigation diversion about 1 mile from the mouth of Duck Creek is a barrier to upstream movement; however, the irrigation canal may carry fish from neighboring streams.

Other conservation opportunities include restoring riparian function and fish habitat. A considerable portion of the basin's streams is in excellent condition; however, some reaches show impairment relating to grazing practices that disrupted riparian health and function (C.L. Endicott, FWP, personal communication). FWP will work with interested landowners on implementing projects to benefit streams that are also compatible with agricultural uses.

### 6.2.37 Little Timber Creek

The Little Timber Creek (Figure 6-15) watershed is the drainage to the east of Duck Creek. Its waters originate in the south side of the Crazy Mountains, and flows mostly through rangeland until they merge with the Yellowstone River. Most of the watershed is under private ownership, with the exception of short reaches flowing through GNF in the headwaters.

Limited fisheries information is available for streams in this drainage; however, the stream presumably supports a mixture of native and nonnative species (Table 6-39). Surveys in 1993 found nonhybridized Yellowstone cutthroat trout in the upper reaches of Little Timber Creek (Leary 1995). In 2008, the U.S. Geological Survey sampled fish about 1 mile from the mouth of Little Timber Creek and found longnose dace, brown trout, mountain sucker, and longnose sucker (Cleasby 2008).

**Table 6-39: Distribution and abundance of fishes in Little Timber Creek (MFISH database).**

| *Begin Mile* | *End Mile* | *Species* | *Abundance* | *Data Quality* | *Genetic Status* | *Life History* |
|---|---|---|---|---|---|---|
| 0 | 19 | Brook trout | Abundant | NSPJ | Not Applicable | N/A |
| 0 | 19 | Brown trout | Abundant | EFSSO[10] | Not Applicable | N/A |
| 1.5 | 2.5 | Longnose Dace | Abundant | EFSSO | Not Applicable | N/A |
| 1.5 | 2.5 | Longnose Sucker | Rare | EFSSO | Not Applicable | N/A |
| 1.5 | 2.5 | Mountain Sucker | Common | EFSSO | Not Applicable | N/A |
| 10 | 17.3 | Yellowstone cutthroat trout | Common | NSPJ | Nonhybridized | Resident |

[10] EFSSO = Extrapolated from a single survey or observation

Securing the existing Yellowstone cutthroat trout population in Little Timber Creek is a conservation priority. Fish surveys to determine the distribution of brown trout and Yellowstone cutthroat trout are necessary to guide development of a specific conservation approach. Depending on findings, potential actions include nonnative removal or suppression and construction of a barrier to protect the headwaters Yellowstone cutthroat trout population.

The potential for Little Timber Creek to provide spawning habitat for fluvial Yellowstone cutthroat trout is unknown. Determining the sufficiency of flow and habitat condition in the lower end of Little Timber Creek would aid in determining the suitability of the stream to support a spawning run. FWP will seek opportunities to work with private landowners on water use efficiency and habitat management should these be identified as useful in promoting a spawning run in Little Timber Creek.

### 6.2.38 Big Timber Creek

Big Timber Creek (Figure 6-16) has its headwaters in the GNF, on the east flank of the Crazy Mountains. It flows for about 35 miles before it joins the Yellowstone River near the town of Big Timber. Valley portions of the watershed are mostly under private ownership, although several state-owned parcels are present.