1.0 Introduction

The Yellowstone cutthroat trout is native to Montana and is a species of special concern. Historically, Yellowstone cutthroat trout occupied waters in Montana, Wyoming, Idaho, Nevada, and Utah[3]; however, a host of factors has resulted in a reduced and fragmented distribution (Figure 1-1). In response to this decline, state and federal agencies, and tribes, have conferred special status designations on Yellowstone cutthroat trout and begun associated conservation planning efforts to promote recovery of the species.

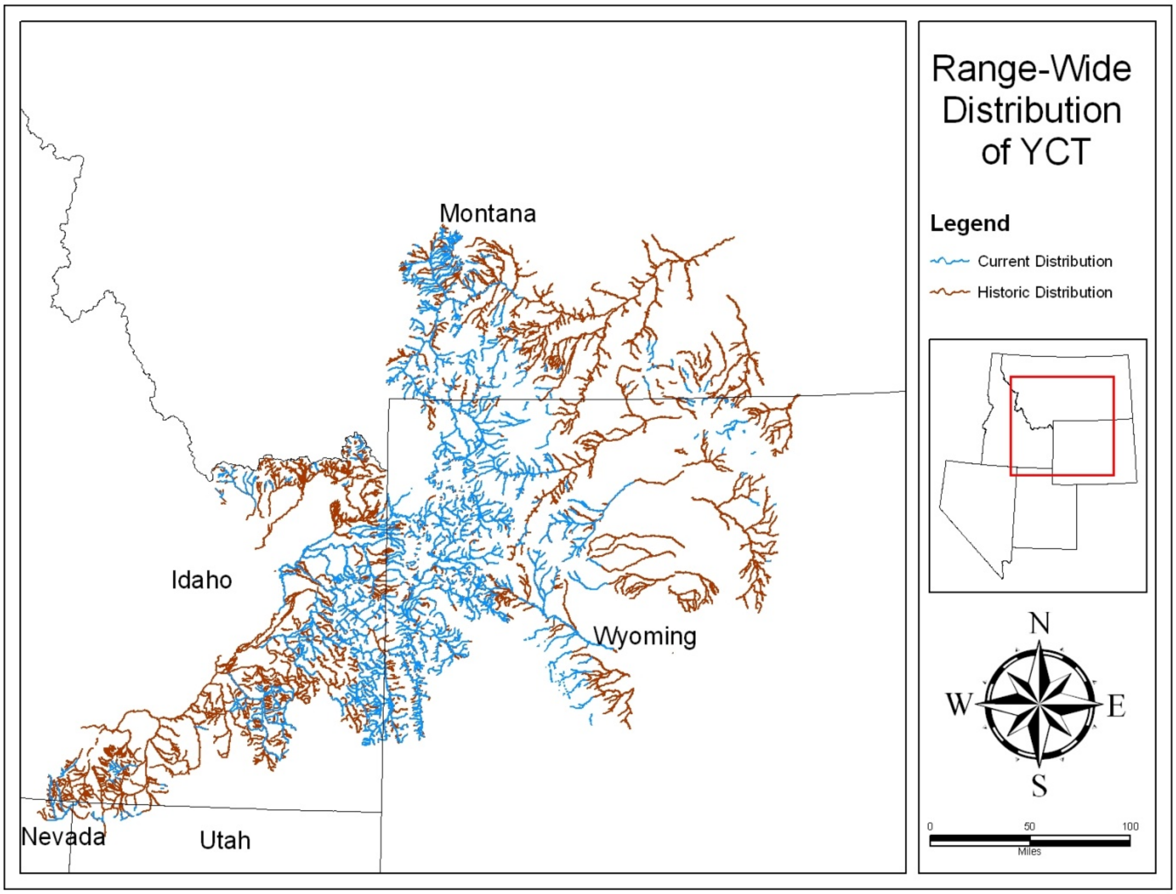

Figure 1-1: Historic and current (2009) distribution of Yellowstone cutthroat trout throughout its range (FWP geographical information system [GIS] database).

In 2007, the MCTSC completed a memorandum of understanding and conservation agreement (the Agreement) to expedite implementation of conservation measures for Yellowstone cutthroat trout and westslope cutthroat trout (*O. clarkii lewisii*) in Montana (MCTSC 2007). The MCTSC includes representatives from resource agencies, conservation groups, tribes, industry, and resource users (Table 1-1). The Agreement documents Montana's efforts as part of coordinated

[3] The period of European "discovery" of the West (around 1800) is the reference period used in this and other cutthroat trout status assessments in defining historic distribution (May et al. 2007).

multistate, range-wide efforts to conserve cutthroat trout. Signatories consent to accept the goals and objectives presented in the Agreement, will incorporate them into their planning processes, and will strive to accomplish the goals and objectives within the identified timeframes.

Table 1-1: Participants in the MCTSC and signatories to Montana's cutthroat trout agreement.

Category	*Entity*	*MCTSC Participants*	*Agreement Signatories*
Conservation and Resource Users	American Wildlands	✓	✓
	Federation of Fly Fishers	✓	✓
	Greater Yellowstone Coalition	✓	✓
	Montana Chapter of the American Fisheries Society (MCAFS)	✓	✓
	Montana Trout Unlimited	✓	✓
	Montana Wildlife Federation	✓	✓
Industry	Montana Farm Bureau	✓	✓
	Montana Stockgrowers Association	✓	✓
	Plum Creek	✓	✓
Resource Agencies (federal)	Bureau of Land Management (BLM)	✓	✓
	Glacier National Park	✓	✓
	Natural Resources and Conservation Service (NRCS)	✓	✓
	U.S. Fish and Wildlife Service (USFWS)		✓
	U.S. Forest Service (USFS)	✓	✓
	Yellowstone National Park (YNP)	✓	✓
Resource Agencies (state)	Department of Environmental Quality (DEQ)		✓
	Department of Natural Resources and Conservation (DNRC)	✓	✓
	Montana Fish, Wildlife & Parks (FWP)	✓	✓
Tribes	Blackfeet Tribe	✓	✓
	Confederated Salish and Kootenai Tribes	✓	✓
	Crow Tribe	✓	✓

The management goals and objectives described in the Agreement provide an integrative strategy to reduce threats leading to decline of cutthroat trout. The goals are as follows:

- Ensure the long-term, self-sustaining persistence of each subspecies distributed across their historical ranges as identified in recent status reviews (Shepard et al. 2003; May et al. 2007);
- Maintain the genetic integrity and diversity of non-introgressed populations, as well as the diversity of life histories represented by remaining cutthroat trout populations; and
- Protect the ecological, recreational, and economic values associated with each subspecies.

The Agreement lists five objectives that will lead to attainment of management goals for cutthroat trout in Montana, which are as follows:

- Maintain, secure, and/or enhance all cutthroat trout populations designated as conservation populations, especially the nonhybridized components;
- Continue to survey waters to locate additional cutthroat trout populations and determine their distribution, abundance, and genetic status;
- Seek collaborative opportunities to restore and/or expand populations of each cutthroat trout subspecies into selected suitable habitats within their respective historic ranges;
- Continue to monitor cutthroat trout distributions, genetic status, and abundance using a robust, range-wide, statistically sound monitoring design;
- Provide public outreach, technical information, interagency coordination, administrative assistance, and financial resources to meet the listed objectives and encourage conservation of cutthroat trout.

The Agreement for cutthroat trout conservation relegated specifics on achieving these goals to conservation documents detailing strategies to be implemented on a regional or watershed levels. This document presents the conservation strategy for Yellowstone cutthroat trout throughout its historic distribution in Montana, with the exception of the Shields River watershed above the Chadbourne diversion, which is addressed separately (FWP et al. 2012).

2.0 Watershed Characterization

In Montana, Yellowstone cutthroat trout are native to streams and lakes in the Yellowstone River watershed and historically occupied waters with suitable habitat and thermal regime, from the headwaters near Cooke City, Montana, to the Tongue River watershed (Figure 2-1)**.** The headwaters of the Yellowstone River originate in Yellowstone National Park, and include the area contributing to Yellowstone Lake. The Yellowstone River enters Montana near Gardiner, Montana, and flows north through Paradise Valley, with the Gallatin Range forming the western boundary, and the Absaroka Mountains the eastern. Mountain ranges on the north side of the Yellowstone River include the Bridger, Bangtail, and Crazy mountain ranges. On the south side of the Yellowstone River, the Beartooth and Pryor mountain ranges provided suitable lake and stream habitat for Yellowstone cutthroat trout.

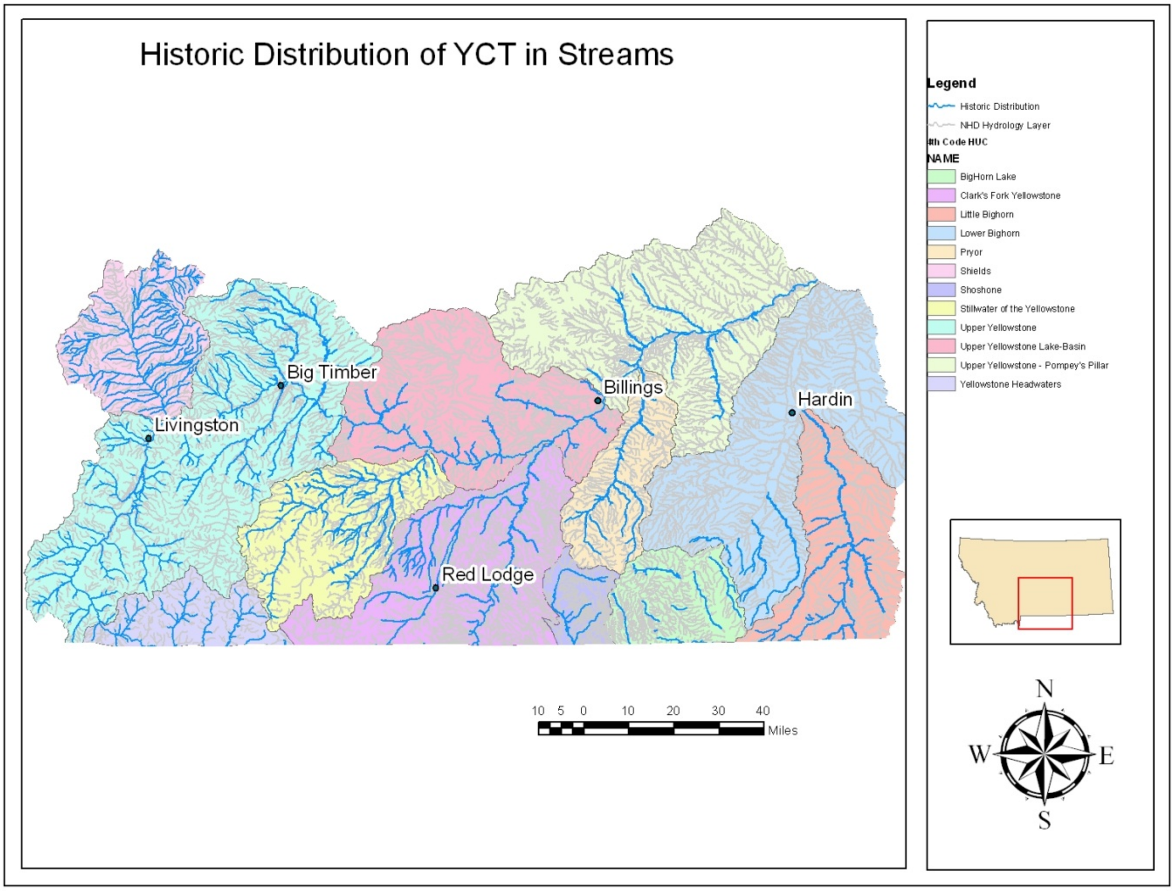

Figure 2-1: Historic range of Yellowstone cutthroat trout in Montana streams (FWP GIS database).

Habitats unsuitable for Yellowstone cutthroat trout include the main stems of several major tributaries of the Yellowstone River; for example, the lower reaches of rivers such as the Tongue River, which are more suitable for warm-water fisheries that are adapted to higher levels of suspended sediment. Although the lower reaches are unsuitable for Yellowstone cutthroat trout, the headwaters of these streams supported this species historically, and some streams still provide habitat for isolated populations.

A variety of lake types currently provide habitat to Yellowstone cutthroat trout in Montana. High elevation lakes, primarily cirques formed by alpine glaciers, are a common lentic habitat within the Yellowstone cutthroat trout's historic range. Many of these lakes were historically fishless; however, widespread introductions of Yellowstone cutthroat trout and other sport fishes have provided recreational fisheries in these lakes. Human-made impoundments, intended to store water for irrigation and recreation, are relatively recent additions to the available habitats. Private recreational ponds are increasingly common in the area. FWP's regulations require stocking permits for private ponds to ensure unwanted fish species do not adversely affect public waters, so for many ponds, Yellowstone cutthroat trout is the only species permitted.

Climatic patterns are variable across the Yellowstone cutthroat trout's historic range. Climate data managed by the Western Regional Climate Center from representative climate stations demonstrate this variability, which relates primarily to elevation. For example, the average maximum daily temperature for July at Cooke City, located about 7,500 feet above mean sea level, is 74 °F (Table 2-1). The average total snowfall is 209 inches, and the average annual precipitation is about 26 inches. In contrast, at Big Timber the average maximum temperature in July is 87 ° (Table 2-2). At this elevation, about 4,100 feet, average total snowfall amounts to only 46 inches, and the mean annual precipitation is 15 inches.

Table 2-1: Climate summary data for climate station 241995, Cooke City, elevation ≈ 7,500 feet above sea level, for the period of record 11/01/1967 to08/31/2012 (Western Regional Climate Center 2012).

Parameter	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	***Annual***
Average Max. Temperature (°F)	24	30	37	44	54	65	74	72	62	49	32	24	47
Average Min. Temperature (°F)	4	6	12	19	28	34	39	37	30	23	12	5	21
Average Total Precipitation (in.)	2	2	2	2	3	3	2	2	2	2	2	2	26
Average Total Snow Fall (in.)	41	29	27	19	9	2	0	0	2	11	30	39	209
Average Snow Depth (in.)	30	36	37	27	6	0	0	0	0	1	8	19	14

Table 2-2: Climate summary data for climate station 240780, Big Timber, elevation ≈ 4,100 feet above sea level, for the period of record 4/01/1894 to 7/13/2012 (Western Regional Climate Center).

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
Average Max. Temperature (F)	37	41	48	59	68	77	87	86	74	62	47	39	60
Average Min. Temperature (F)	17	19	23	32	40	47	53	51	42	35	26	19	34
Average Total Precipitation (in.)	1	0	1	2	3	3	1	1	1	1	1	1	15
Average Total Snow-fall (in.)	9	6	8	5	1	0	0	0	0	4	7	7	46
Average Snow Depth (in.)	2	1	1	0	0	0	0	0	0	0	1	1	0

Stream flows in the area are characteristic of snowmelt driven systems, and flow data from the Yellowstone River near Livingston illustrate the typical hydrograph (Figure 2-2). The spring rise begins in April, with peak flows occurring from late May through June. Precipitation tends to be greater during these months (Table 2-1 and Table 2-2), which also augments stream flows. Although snowmelt is a primary influence on flow, in many streams, irrigation withdrawals often have a dramatic effect by causing a more abrupt drop of the declining limb and lower stream flows through the irrigation season, which can extend to October in some locations. Thunderstorms during summer months result in localized increases in stream flow in smaller streams, which can sometimes be substantial and result in localized flooding.

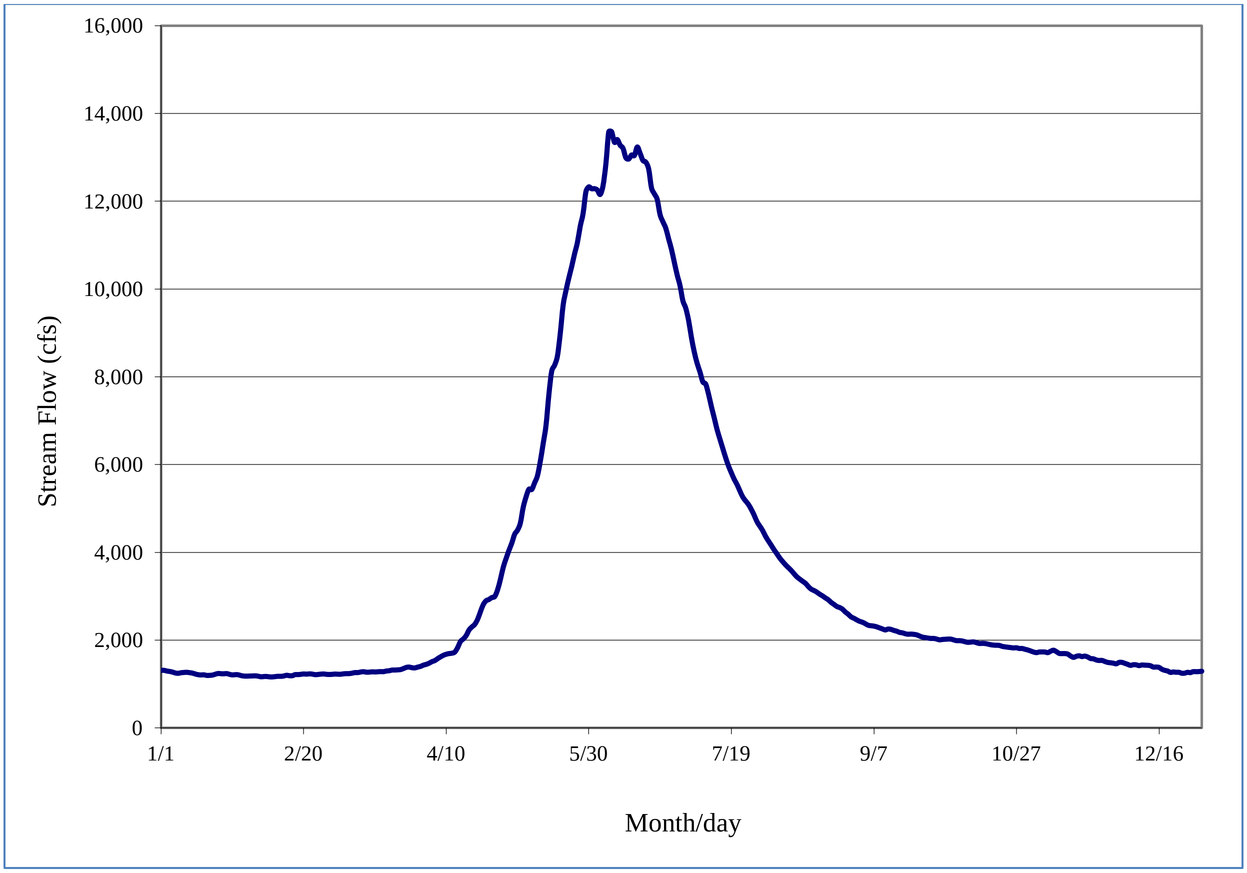

Figure 2-2: Average daily stream flow for the past 30 years (May 5, 1978 through May 5, 2008) at the Livingston gage on the Yellowstone River (U.S. Geological Survey [USGS] station 6192500).

Spring creeks also provide habitat for Yellowstone cutthroat trout, and these differ from other streams in terms of flow and temperature regimes and productivity. Spring creeks tend to have relatively stable flows year round, unless irrigation withdrawals are substantial. Likewise, as groundwater is the primary source of flow, spring creeks maintain cooler temperatures in the summer, and warmer winter temperatures. Furthermore, these streams often emerge from limestone formations and the calcium carbonate rich waters support productive ecosystems, which often maintain high densities of fish. Many are renowned for producing large trout. Spring creeks are among the high quality spawning streams for fluvial Yellowstone cutthroat trout in the Yellowstone River (Clancy 1988).

Current landownership within the fish's native range in Montana is a mix of private, public, and tribal lands (May et al. 2007). The majority of habitat falls on private lands, and the USFS holds the second greatest amount of Yellowstone cutthroat trout habitat (Figure 2-3). Other federal lands include Yellowstone National Park, which accounts for 3%, and BLM, which possesses less than 1%. About 3% of the current range lies on the Crow Indian Reservation.

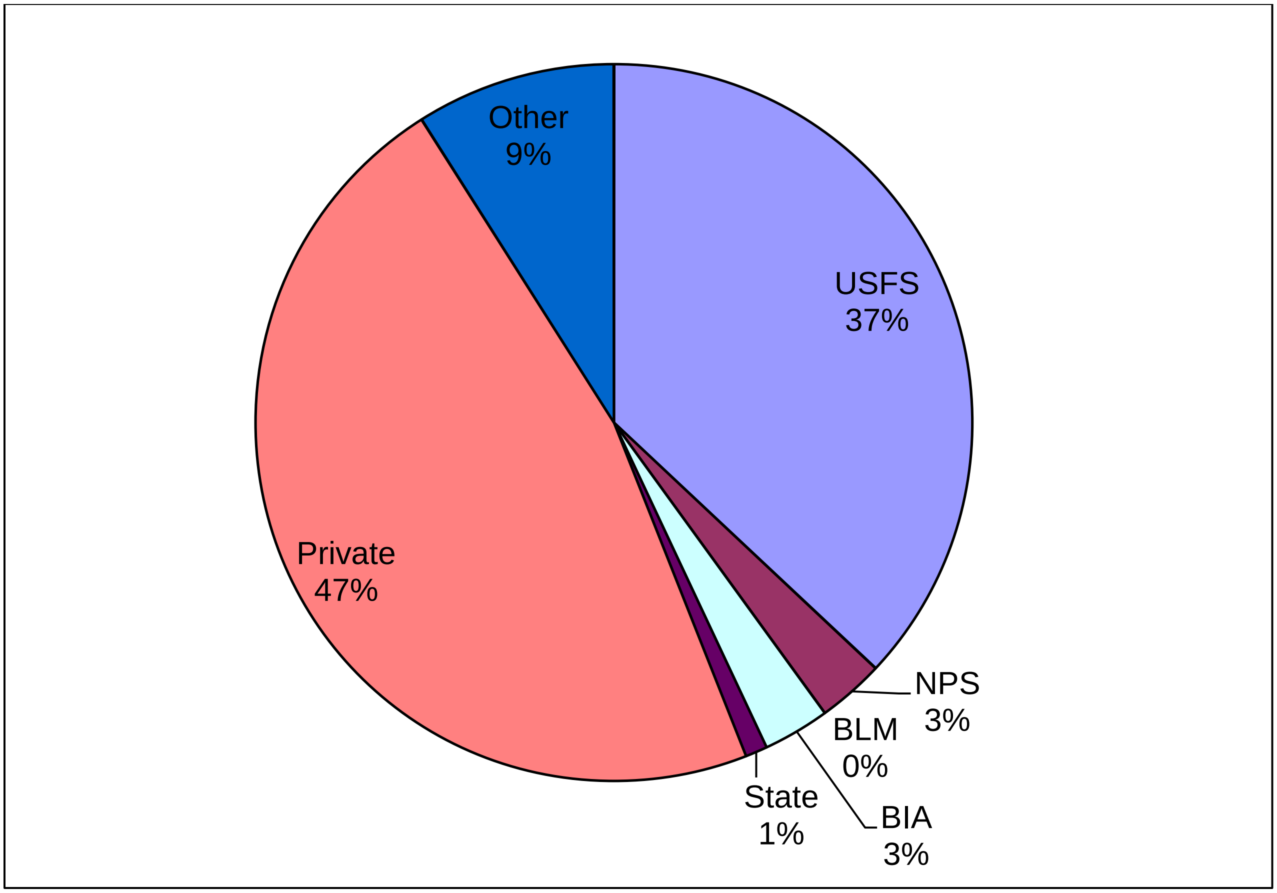

Figure 2-3: Landownership within the historic range of Yellowstone cutthroat trout in Montana (May et al. 2007).

Land uses within the Yellowstone cutthroat trout's historic range are typical of largely rural watersheds in the Intermountain West. Forested headwaters support timber harvest, recreation, and livestock grazing. Mineral development occurs at discrete locations, usually at higher elevations. Valley portions of watersheds are principally agricultural, with livestock, forage crops, small grains, and sugar beets being typical agricultural products. Urban development is limited, with Billings, near the downstream extent of the historic range, being the largest city with a population of nearly 104,000, according to the 2010 U.S. census data. Livingston is the second largest city with about 7,000 people in 2010. According to the U.S. Census, the other towns within the historic range have fewer than 2,000 people. Outside of the relatively few towns, most area residents live on widely spaced ranches, although rural subdivisions are increasing.

Energy development is an emerging land use within the native range of the Yellowstone cutthroat trout in Montana. Energy development that is underway or pending includes traditional oil and gas, coal bed methane, and wind energy. Hydraulic fracturing, a means to free gas or oil from deep shale formations by pumping water, proppants, and chemicals at high pressure, is an expanding type of energy development that may occur within the historic range of the Yellowstone cutthroat trout. Areas with considerable potential for exploration and development of oil or gas include the Shields River watershed and the southern and eastern flanks of the Crazy Mountains. Energy development in the Yellowstone River corridor is likely, as DNRC has leased mineral rights underlying the riverbed.

Currently, the Yellowstone River watershed within the Yellowstone cutthroat trout's native range supports 34 species of fish representing 11 families (Table 2-3). Twenty of these species are native to these waters. Yellowstone cutthroat trout and mountain whitefish are the only native members of the Salmonidae, the family encompassing trout, grayling, whitefish, and salmon. Introduced salmonids include rainbow trout, brown trout, and brook trout, all of which have wide distribution within the Yellowstone cutthroat trout's native range. Golden trout and Arctic grayling are present in some high elevation lakes, and an illegal introduction of lake trout into Yellowstone Lake presents a substantial threat to Yellowstone cutthroat trout in the lake.

Table 2-3: Fishes occupying the historic range of the Yellowstone cutthroat trout.

Family	***Common Name***	***Scientific Name***	***Origin***
Hiodontidae (Mooneye Family)	Goldeye	*Hiodon alosoides*	Native
Catostomidae (Sucker Family)	Shorthead redhorse	*Moxostoma macrolepidotum*	Native
	River carpsucker	*Carpiodes carpio*	Native
	White sucker	*Catostomus commersoni*	Native
	Longnose sucker	*C. catostomus*	Native
	Mountain sucker	*C. platyrhhynchus*	Native
Cyprinidae (Minnow Family)	Lake chub	*Cousieus plumbeus*	Native
	Flathead chub	*Platygobio gracilis*	Native
	Longnose dace	*Rhinichthys cataractae*	Native
	Western silvery minnow	*Hypognathus argyritis*	Native
	Fathead minnow	*Pimephales promelas*	Native
	Emerald shiner	*Notropis atherinoides*	Native
	Common carp	*Cyprinus carpio*	Introduced
Salmonidae (trout, grayling, whitefish, and salmon)	Rainbow trout	*Oncorhynchus mykiss*	Introduced
	Yellowstone cutthroat trout	*O. clarkii bouvieri*	Native
	Golden trout	*O. aguabonita*	Introduced
	Brown trout	*Salmo trutta*	Introduced
	Brook trout	*Salvelinus fontinalis*	Introduced
	Lake trout	*S. namaycush*	Introduced
	Mountain whitefish	*Prosopium williamsoni*	Native
	Arctic grayling	*Thymallus arcticus*	Introduced
Ictaluridae (Bullhead Catfish Family)	Channel catfish	*Ictaluris punctatus*	Native
	Black bullhead	*Ameirus melas*	Introduced
	Stonecat	*Noturus flavus*	Native
Gadidae (Codfish Family)	Burbot	*Lota lota*	Native
Gasterosteidae (Stickleback Family)	Brook stickleback	*Culaea inconstans*	Introduced
Centrarchidae	Smallmouth bass	*Micropterus dolomieu*	Introduced
	Largemouth bass	*M. salmoides*	Introduced
	Bluegill	*Lepomis macrochirus*	Introduced
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*	Native
Cottidae	Mottled sculpin	*Cottus bairdi*	Native
Percidae	Yellow perch	*Perca flavescens*	Introduced
	Sauger	*Sander canadensis*	Native
	Walleye	*S. vitreus*	Introduced

The Yellowstone River supports the greatest number of species, with several of these barely overlapping with historically held Yellowstone cutthroat trout habitat. Warm-water fishes, such as several of the cyprinids (minnow family members), channel catfish, freshwater drum, shorthead redhorse, and river carpsucker, encroach into Yellowstone cutthroat trout range in the Yellowstone River seasonally, and at relatively low densities. Burbot have broad distribution in warm-water and cold-water habitats in Montana, but are rare in the Yellowstone River drainage upstream of its confluence with the Shields River.

Introductions account for occurrence of several nonnative species within high elevation lakes. Golden trout and Arctic grayling have been introduced into mountain lakes in the Beartooth and Absaroka mountains. Likewise, largemouth bass, bluegill, and yellow perch have been stocked in lakes in the area. Many of these lakes may have previously been fishless, although some may have supported adfluvial Yellowstone cutthroat trout populations.

3.0 Status and Ecology of Yellowstone Cutthroat Trout

Information on distribution and status of Yellowstone cutthroat trout across its historic range comes from a 2006 status review (May et al. 2007). This document is the second iteration in evaluating the range-wide status of Yellowstone cutthroat trout, and it updates and refines the previous status review (May et al. 2003). Both reviews employed a replicable, quantitative approach within a project geographical information system (GIS). The 2006 effort expanded the protocol to include additional attribute information in four categories: 1) presence of nonnative fishes; 2) evaluation of habitat quality; 3) incorporation of stocking records at the stream or segment level; and 4) description of life history behaviors for each population (May and Shepard 2007). This chapter examines results from the twelve fourth level HUCs in the Montana portion of the range (6.0 Subbasin Assessments and Conservation Opportunities).

3.1 Genetic Considerations

The 2006 status review (May et al. 2007) identified seven categories of genetic status for Yellowstone cutthroat trout populations in its historic range (Table 3-1). These categories included classes for populations subjected to genetic testing, and those not yet tested. Other criteria for class designation involved extent of genetic alteration within a population, which was either presumed or tested.

Table 3-1: Genetic considerations used for assessing genetic status of Yellowstone cutthroat trout in the 2006 status assessment (May et al. 2007).

Code	*Genetic Status*
1	Genetically unaltered (<1% introgression detected) as a result of introduced species interactions (tested using electrophoresis or DNA)
2	≥1% to ≤10 introgression (hybridized) with introduced species (tested using allozyme of DNA, and introgression indicated to be from a hybrid swarm
3	>10% to ≤25% introgression (hybridized) with introduced species (tested using allozyme or DNA, and introgression indicated to be from a hybrid swarm)
4	>25% introgression (hybridized) with introduced species (tested using using allozyme or DNA, and introgression indicated to be from a hybrid swarm)
5	Not genetically tested, suspected unaltered with no record of stocking or contaminated species being stocked or occurring in stream
6	Not genetically tested, potentially hybridized with records of introduced hybridizing species being stocked or occurring in stream
7	Hybridized and nonhybridized populations co-exist (sympatric mixed stock) in stream (use only if there is evidence of reproductive isolation, non-random mating, and genetic testing has been completed)

During the assessments, biologists further classified each cutthroat trout population as: 1) core conservation populations, which are genetically unaltered (>99%); 2) conservation populations that may be either genetically unaltered or slightly introgressed, but have attributes worthy of conservation (>90%); and 3) sport fish populations that are managed primarily for their recreational fishery value (May et al. 2003). Core populations have important genetic value and could serve as donor sources for developing either captive brood or for refounding additional populations. Management will emphasize conservation, including potential expansion, of both core and conservation populations.

3.2 Distribution

The Yellowstone cutthroat trout is native to waters in the upper portions of the Yellowstone River drainage in Montana and Wyoming, and the upper Snake River watershed in Idaho, Wyoming, Nevada, and Utah; however, distribution and abundance has changed markedly from the historic condition (Figure 2-1; May et al. 2007). The 2006 status review estimated Yellowstone cutthroat trout occupied over 17,700 miles range-wide, with about 43% still occupied by core, conservation, and sport fishing populations (May et al. 2007). Although distribution in streams has decreased, Yellowstone cutthroat trout have increased substantially in the number of lakes occupied, owing to introductions into previously fishless lakes. An estimated 205 lakes currently support Yellowstone cutthroat trout populations, compared to 61 historically occupied lakes.

In Montana, Yellowstone cutthroat trout historically occurred in nearly 4,300 miles of stream, which accounted for 24% of the fish’s total historic distribution (May et al. 2007). Currently, core, conservation, and sport populations occupy 31% of their historic stream miles in Montana (Figure 3-1). The western parts of its historic range, particularly in the upper Yellowstone River and Shields hydrologic units, support the greatest extent of the remaining Yellowstone cutthroat trout populations. Proceeding east in the watershed, fewer Yellowstone cutthroat trout populations are found, and these remaining populations are rarely connected with others.

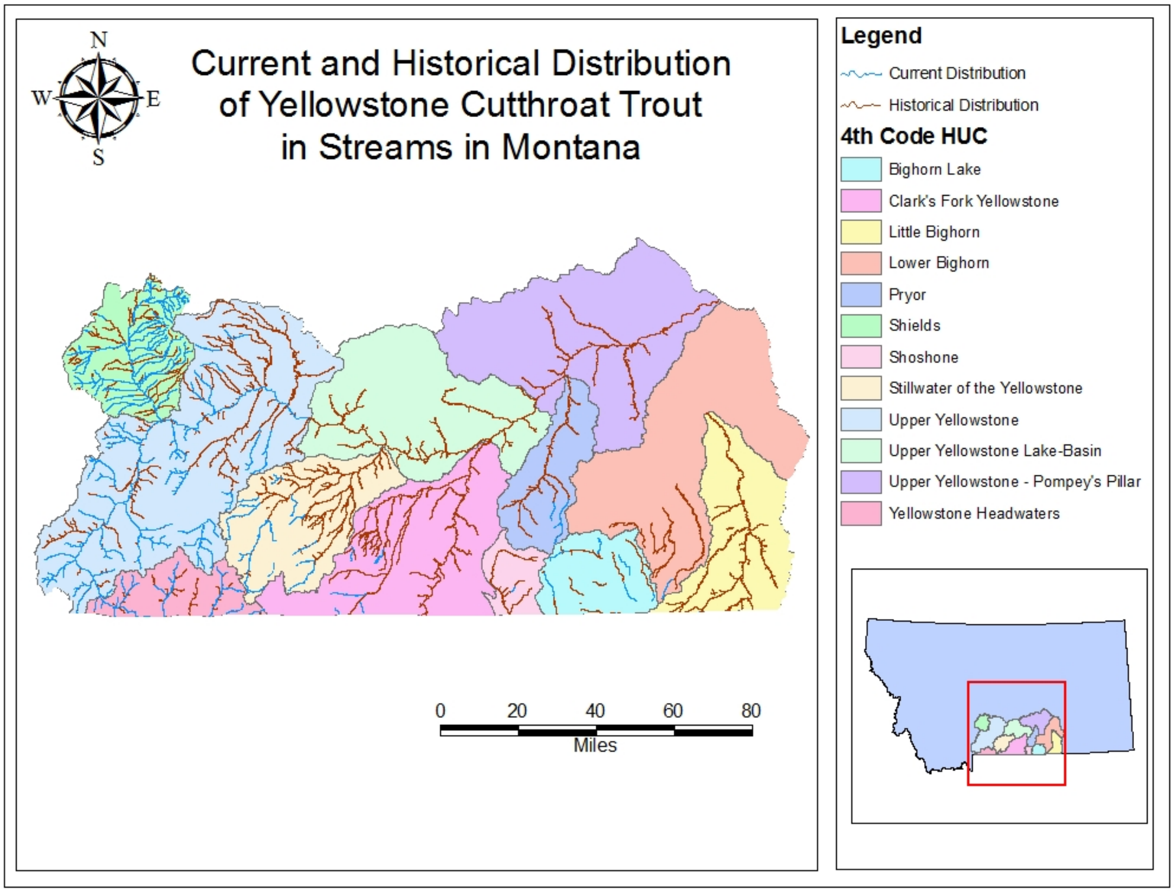

Figure 3-1: Current and historic distribution of Yellowstone cutthroat trout in Montana (FWP GIS database).

Examination of the percent of historically occupied stream miles still supporting Yellowstone cutthroat trout further demonstrates the trend for greater fragmentation and reduced distribution in the eastern extent of its range (Table 3-2). The Yellowstone Headwaters Subbasin, which lies mostly in Wyoming, supports a nearly intact distribution of Yellowstone cutthroat trout, with 96% of historically occupied waters still containing this fish. The Shields and Upper Yellowstone subbasins rank second and third respectively, in terms amount of historically occupied habitat still supporting Yellowstone cutthroat trout. In other HUCs, Yellowstone cutthroat trout still reside in as little as 2% of their historic habitat, or are no longer present.

Table 3-2: Comparison of historically and currently occupied stream miles for 4th code HUCs with water in Montana (from May et al. 2007).

Name	*HUC*	*Historically Occupied Miles*	*Currently Occupied Miles*	*Percent of Historical Habitat Still Occupied*
Yellowstone Headwaters	10070001	952	915	96
Upper Yellowstone	10070002	1116	560	50
Shields	10070003	682	453	66
Upper Yellowstone-Lake Basin	10070004	288		00
Stillwater	10070005	416	103	25
Clarks Fork Yellowstone	10070006	525	81	15
Upper Yellowstone-Pompey's Pillar	10070007	273		0
Pryor	10070008	226	27	12
Bighorn Lake	10080010	278	65	23
Shoshone	10080014	0172	4	2
Lower Bighorn	10080015	422	7	2
Little Bighorn	10080016	224	20	9

According to May et al. (2007), widespread stocking of Yellowstone cutthroat trout has greatly expanded the number of lakes occupied by Yellowstone cutthroat trout, especially in Wyoming and Montana. The extent of this expansion in Montana is currently unclear, as errors in the data entry process resulted in the inadvertent omission of several lakes believed to support Yellowstone cutthroat trout historically. The next iteration of the Yellowstone cutthroat trout status review will include these refined determinations of origin of lake dwelling populations, either aboriginal or anthropogenic.

3.3 Life History Strategies

Yellowstone cutthroat trout exhibit three primary life history strategies (Gresswell 1995). Fluvial fish reside principally in larger streams and rivers, and migrate to tributaries to spawn. Juvenile fish vary in the length of their residency in natal streams. Fluvial fry drift to the Yellowstone River soon after emergence (Byorth 1990). Resident fish live their entire lives within tributary watersheds, although these fish may also have migratory tendencies, using different parts of the watershed for spawning, rearing, and overwintering. Adfluvial fish reside in lakes, but return to streams for spawning. Maintenance and restoration of this diversity of life history strategies are conservation goals under the Yellowstone cutthroat trout Agreement, and are therefore a substantial concern in this restoration strategy.

3.4 Causes of Decline and Threats

The diminished and fragmented distribution of Yellowstone cutthroat trout is the result of a variety of disturbances across the landscape. Introduction of nonnative salmonids (rainbow trout, brown trout, and brook trout) has been especially deleterious (Gresswell 1995, Kruse et al. 2000). Hybridization with rainbow trout is a major concern, as the resulting fertile offspring form hybrid swarms (Allendorf and Leary 1988) and the effects of hybridization are irreversible. Likewise, brown trout and brook trout tend to displace native cutthroat trout through competition and predation (Behnke 1992). The rate at which brook trout are accelerating invasion and displacement of Yellowstone cutthroat trout in many headwaters streams is alarming and requires action to reverse this trend. Lake trout present a substantial threat to Yellowstone cutthroat trout in Yellowstone Lake. Discovered in 1994 (Kaeding et al. 1995), this illegal introduction is the subject of considerable effort to remove the highly piscivorous lake trout.

Habitat alterations in the form of dewatering and passage barriers have also contributed to the decline. Dewatering in tributaries of the Yellowstone River presents a major constraint to fluvial fish, as incubation, emergence, and drift coincide with peak demands for irrigation water (Clancy 1988, Byorth 1990). Conversely, irrigation does benefit some streams by contributing cooler groundwater from irrigation return flows later in the season. Barriers formed by impassable road crossings or irrigation diversion structures fragment the habitat and select against complex life history strategies (Rieman and Dunham 2000). In addition, the resulting isolation can contribute to extirpation of populations relegated to headwaters (Dunham et al. 1997).

Yellowstone cutthroat trout inhabit cold, clear waters, and streamside activities that disrupt riparian health and function and change channel morphology, can have adverse effects on this species. Unless properly managed, livestock grazing, residential development, and other activities along streams have potential to increase delivery of sediment and otherwise degrade habitat quality, which is detrimental to Yellowstone cutthroat trout, and may provide an advantage to the more tolerant introduced species. Likewise, reductions in shade afforded by riparian vegetation increases temperature loading to streams, which may favor introduced fishes, as these likely have broader thermal tolerances than cutthroat trout.

Whirling disease presents another threat to Yellowstone cutthroat trout populations in Montana. *Myxobolus cerebralis*, a European protozoan, is the parasite that causes whirling disease, and this organism has been found in several important Yellowstone cutthroat trout spawning streams in Montana. Investigations in Pelican Creek, a tributary of Yellowstone Lake, have confirmed susceptibility of Yellowstone cutthroat trout to whirling disease, and documented dramatic declines in the spawning run relating to whirling disease (Koel et al. 2007). Moreover, whirling disease is present in spawning tributaries to the Yellowstone River. Yellowstone cutthroat trout are extremely susceptible, and a high rate of infection is present in these tributaries (R. Vincent, FWP retired, personal communication). FWP personnel have deployed sentinel fish deployed in Upper Yellowstone River Basin in the 1990s and 2000s; however, those data have not yet been compiled and interpreted. The extent to which whirling disease may be having population level effects on Yellowstone cutthroat trout in the Montana portion of its range is a topic in need of further study.

Spring creeks are especially vulnerable to whirling disease infection, as the winter warm/summer cool temperatures and moderate flows provide ideal habitat for *Tubifex tubifex*, the intermediate worm host for *Myxobolus cerebralis*. Several spring creeks are among the high quality spawning streams for Yellowstone cutthroat trout (Clancy 1988). Although spring creeks may have high levels of infection, the timing of release of *Myxobolus cerebralis* does not necessarily coincide with presence of vulnerable young-of-the year cutthroat trout (Neudecker 2012), so more investigation is needed for Yellowstone cutthroat trout spawning streams. Whirling disease is present in the Upper Yellowstone River Subbasin, and fish entering spring creeks can bring the parasite with them. Anglers are the other potential source of transfer. Educational efforts aimed at ensuring anglers clean their waders and other fishing gear is an essential component of reducing the spread of whirling disease.

Climate change presents a current and looming threat with projected effects on water temperature and quantity. Recent warming has already driven significant changes in the hydroclimate, with a shift towards more rainfall and less snow in the western U.S. (Knowles et al. 2006). Likewise, the peak of spring snowmelt is two weeks earlier in recent years, and this trend is anticipated to continue (Stewart et al. 2004). Probable effects of climate change in the western U.S. will be increased water shortages and warmer water temperatures, especially during late summer, which will complicate cutthroat trout restoration efforts. In addition, changes in timing of spring runoff may alter spawning cues that have maintained temporal segregation of rainbow trout and Yellowstone cutthroat trout spawning runs, which may increase hybridization in the Yellowstone River.

4.0 Conservation Actions

A variety of actions will be necessary to secure and restore Yellowstone cutthroat trout within its historic range in Montana. This chapter details the general approaches available to address factors contributing to decline of Yellowstone cutthroat trout. Stream-specific conservation actions will follow field investigations and review of the available data.

4.1 Survey and Monitoring

A considerable number of streams have never been sampled, or the sampling information is old and may no longer reflect species composition or genetic status. Discovering additional populations and determining the status of existing populations of Yellowstone cutthroat trout will require continued field monitoring and genetic testing. These actions are critical for developing an informed conservation strategy and monitoring the success of conservation efforts.

4.2 Habitat Stewardship

High quality fish habitat requires sufficient water quantity and quality flowing through functional, dynamic stream channels that transport sediments efficiently, lined by healthy riparian wetlands that provide cover and nutrients and stabilize stream banks. The USFS, BLM, and Crow Tribe are responsible for habitat management on their lands. Landowners manage streamside activities on private lands. A variety of state and federal agencies share administrative jurisdiction to protect aquatic habitats in streams and wetlands on private and public lands. The Natural Streambed and Land Preservation Act (310 permit), the Stream Protection Act (124 permit), and private pond laws are examples of state laws that require permitting and inspection of proposed projects that may affect stream habitats. Federal laws also play a role in habitat protection, such as the Clean Water Act's Section 404, which regulates the placement of fill in wetlands, or the Forest Planning Act. Floodplain permits, issued by counties or cities, are often necessary if projects occur in designated floodplain. Agency cooperators will continue to work with landowners through the permitting processes to ensure that high quality habitats can be maintained.

4.3 Habitat Restoration

A host of land and water management practices has affected many streams in the Yellowstone River basin by altering stream function and degrading fish habitat. Many opportunities exist to restore high quality habitats to benefit Yellowstone cutthroat trout. Actions such as implementation of livestock best management practices (BMPs), restoration of healthy riparian corridors, and other innovative projects that enhance or improve stream function and water quality are among the available tools. Positive, cooperative working relationships with landowners, local watershed groups, and cooperating agencies are essential in implementation of habitat restoration projects. In 2003, FWP established a position for a Yellowstone cutthroat trout restoration biologist, whose primary responsibility is working towards Yellowstone cutthroat trout conservation, with an emphasis on providing technical and financial assistance to private landowners. FWP also administers the Future Fisheries Improvement Program, which provides grants to landowners to restore habitats on their lands. Watershed groups and conservation districts provide local leadership and mechanisms to interact with private landowners. Many other state, federal, and non-governmental organizations have grant programs targeted towards restoring stream habitats.

4.4 Connectivity

Fragmentation of habitats presents a significant threat to the persistence of isolated populations of Yellowstone cutthroat trout. These populations are at risk from genetic isolation and catastrophic disturbances, such as landslides, wild fires, disease, or extreme drought. Features that limit connectivity include impassable culverts at road crossings and irrigation diversions. Eliminating these fish passage barriers, where warranted, will be an important component of Yellowstone cutthroat trout conservation in the planning area.

Connecting or isolating populations of Yellowstone cutthroat trout will need to be considered on a case-by-case basis because these strategies bring benefits and risks. Often, short-term conservation will require isolation to protect a particular Yellowstone cutthroat trout population from introgression; however, long-term conservation may require connection to allow for natural population processes (dispersal, colonization, etc.) to operate over large spatial scales.

Although passage barriers have contributed to the decline of Yellowstone cutthroat trout across its range, not all barriers are undesirable. In many cases, fish barriers protect upstream populations of nonhybridized Yellowstone cutthroat trout from encroaching nonnative salmonids. These nonnative salmonids may pose hybridization, competition, or predation risks to extant populations of Yellowstone cutthroat trout. Investigations on fish distributions and connectivity will need to be conducted over relatively large scales to determine where existing fish barriers should remain or where additional fish barriers should be considered to protect existing populations of Yellowstone cutthroat trout. Conversely, removal of existing fish barriers may be appropriate to provide connectivity among cutthroat trout populations or to allow for expression of a more migratory life history if little to no risk from nonnative introgression or competition exists.

FWP maintains a database of natural and human-made features that likely block fish movements in streams. Numerous unknown barriers likely exist across the landscape. Additional survey will be required to identify potential barriers, and develop a strategy to remove or alter those limiting Yellowstone cutthroat trout from potential habitat.

Options available to promote connectivity vary with the nature of the barrier. In some cases, modifying the channel downstream of the structure with a series of step pools or fish ladder will provide access to and through a culvert or diversion. At some road crossings, replacing impassable culverts with bridges or bottomless arch culverts may be the preferred options. Fish ladders installed on irrigation diversions, or within culverts, allow fish to move past these features.

Collaborators in this process include a variety of entities. Parties responsible for road management include the state, county, USFS, and private landowners. Modifications to irrigation diversions will require the collaboration of ditch companies and individual irrigators. FWP will work with these groups to promote fish passage throughout the basin, as appropriate.

4.5 Entrainment

Entrainment into irrigation diversions results in loss of both adult and juvenile cutthroat trout. Several options exist to reduce or eliminate fish loss to irrigation ditches. Ditch management recommendations developed by FWP (http://fwp.mt.gov/habitat/diversions.asp) provide one tool in reducing entrainment. Essentially, these guidelines call for a staggered shut down of irrigation operations that will prompt fish to return to the stream. Ditch maintenance resulting in a uniform canal, without cover or refuge for fish, further reduces fish losses, as fish are more likely to return to the stream as flows attenuate.

Installation of fish screens that prevent fish from entering irrigation systems is another approach to reduce fish loss to irrigation ditches. Several types of screen are available such as rotating drum, Coanda, farmer, and turbulent fountain screens. As screens are relatively expensive and require regular maintenance, prioritization of diversions will follow observed rates of entrainment and risks to Yellowstone cutthroat trout populations.

As the vast majority of irrigation diversions deliver water to private landowners, partnerships among FWP, watershed groups, conservation districts, and individual landowners will be required to identify problematic diversions and develop solutions. Entrainment investigations can be tied with barrier inventories to promote fish passage (where desirable) and reduce entrainment at a given structure through installation of screens and fish ladders.

4.6 Constructed Fish Barriers

Although promotion of fish movement and gene flow is often desirable, protection of remaining nonhybridized populations from invasion of brook trout, brown trout, and rainbow trout is often necessary. Installation of a fish barrier is the typical approach to protecting headwater populations from the threats of hybridization, competition, and predation. A variety of types of intentional fish barriers exist, including impassable culverts, concrete structures, and created waterfalls in bedrock. Fish from downstream cannot ascend the barrier, although fish can move downstream over the barrier.

A number of geologic, logistic, and biological considerations relate to barrier site selection. The primary geologic consideration is presence of bedrock wall confinement at a potential barrier site, which will prevent the stream from cutting around the barrier during high flows. Logistic considerations address the ability to transport and mobilize heavy equipment and materials. Isolated sites lacking road access may be infeasible, given the complications in getting equipment, personnel, and materials to the site in a cost-effective manner.

The biological considerations involve the ability of a barrier to protect a sufficient amount of habitat. Population size is a primary determinant of long-term persistence of fis,h and the length of stream often correlates to the number of fish occupying a stream (Hilderbrand and Kershner 2000). In other words, the larger the population is, and the more miles of habitat it occupies, the less likely it will go extinct over time. Smaller populations are more vulnerable to inbreeding and extirpation from random events, such as fire, drought, and disease. Furthermore, migration barriers may also isolate important habitats, such as spawning areas, from fish that are downstream of the barrier.

The possibility of excluding fish from important habitat is reduced by maximizing the amount of habitat located upstream of the barrier. Guidelines developed by Hilderbrand and Kershner (2000), and a model developed to predict extinction risks associated with habitat size and other features (Peterson et al. 2008), will guide barrier site selection. For extant Yellowstone cutthroat trout that occupy relatively short segments of headwater stream habitats, replicating these populations into another stream habitat, and constructing barriers to isolate the two populations may be necessary. If monitoring determines that one of these isolated populations either goes extinct or reaches critically low levels, the replicate population will provide the source for reestablishing the extirpated population, making humans the dispersal vector.

4.7 Reintroduction into Reclaimed Streams or Lakes

Removal of nonnative fishes, followed by reintroduction of native cutthroat trout, has been a vital tool in cutthroat trout conservation, and will be used to restore Yellowstone cutthroat trout populations in Montana. Removal typically involves the use of a piscicide, such as rotenone, which kills all fish in a stream or lake, although mechanical removal can be feasible in a few situations (Shepard and Nelson 2004). In lakes, piscicide is often the best option; however, extended gillnetting and genetic swamping may also be successful in some situations. Once the nonnative species have been removed from the stream or lake, nonhybridized Yellowstone cutthroat trout would be reintroduced. In some cases, the given lake may have been historically fishless, and introduction of Yellowstone cutthroat trout would represent a range expansion. Often, these opportunities occur in high elevation lakes within designated wilderness. The USFS has authority over acceptable activities within wilderness areas and would need to approve introductions within previously fishless waters.

4.8 Water Quantity

Dewatering related to withdrawals for irrigation or other uses is a significant constraint on fisheries in Montana. Dewatering reduces the amount of suitable habitat for all life history stages, and results in warmer water temperatures, which can result in sublethal to lethal stress to Yellowstone cutthroat trout. In addition, water withdrawals for irrigation have the potential to reduce recruitment when the irrigation season coincides with incubation, emergence, and drift of Yellowstone cutthroat trout fry. Dewatering puts redds at risk of desiccation and can result in stranding of fry.

Solutions to address the effect of dewatering on Yellowstone cutthroat trout involve a voluntary, integrative approach that decreases demand for water by increasing irrigation and conveyance efficiency, and potentially compensates irrigators for maintaining in-stream flows through water leases. Several signatories of the Agreement have been involved, and will continue to be involved, in these efforts. The NRCS provides financial and technical assistance to agricultural producers in upgrading irrigation systems to improve efficiency. Likewise, FWP provides grant writing assistance to private landowners to procure NRCS funds. FWP and nonprofit groups can purchase water leases that maintain in-stream flows during critical summer months.

4.9 Water Quality

Although habitat restoration described above will benefit water quality through reduced loading of sediment, nutrients, and temperature, the total maximum daily load (TMDL) process is the primary mechanism available to improve water quality. These plans allocate an acceptable level of a pollutant a body of water can assimilate before the pollutant prevents the full support of beneficial uses. The beneficial uses of concern for this plan are growth and propagation of cold-water fishes. Primary pollutants within the area covered by this strategy are sediment, thermal alterations, and nutrients, although metals contamination is present in several streams. To date, approved TMDLs exist for the Shields River watershed, the Cooke City TMDL planning area, Big Creek, and the Boulder River watershed.

Upon completion of a TMDL plan, local watershed groups, conservation districts, or other entities work with DEQ on development of a watershed restoration plan. These plans prioritize streams or subbasins based on factors such as landowner consent, degree of pollutant loading, and presence of species of concern. A list of potential projects may be part of the watershed restoration plan. Streams listed in a watershed restoration plan have priority for receiving 319 funding, which is money the EPA provides to states to fund abatement nonpoint source pollution under Section 319 of the Clean Water Act.

5.0 Conservation Schedule and Milestones

The Agreement includes explicit goals and milestones for conserving and restoring Yellowstone cutthroat trout within its current range (MCTCS 2007). The purpose of establishing these milestones is to evaluate progress towards meeting conservation goals. The milestones applicable to Yellowstone cutthroat trout are as follows:

1. Draft a statewide Yellowstone cutthroat trout conservation plan by December 31, 2007.
2. Complete watershed or regional plans for at least two designated Yellowstone cutthroat trout conservation areas by January 1, 2008.
3. Work on 10 conservation projects for Yellowstone cutthroat trout per year.
4. Update statewide distribution and genetic status information annually by January 1 each year.
5. Compare the genetic risk and demographic risk ratings assigned by these more recent assessments to ratings assigned during earlier assessments to determine trends in these risks over time for each subspecies.
6. Maintain the number and miles of conservation populations, including those conservation populations that are nonhybridized, at levels at least as high as identified for Yellowstone cutthroat trout in 2000.
7. Work annually to reduce genetic and demographic risks to conservation populations, as measured by the overall mean genetic and demographic risk scores across all conservation populations by implementation of conservation projects.

This document and the *Yellowstone Cutthroat Trout Conservation Strategy for the Shields River Watershed above the Chadbourne Diversion* (FWP et al. 2012) meet the requirements for the first two milestones; however, the dates of completion were well beyond the dates in the Agreement. The scope and breadth of the documents, along with the need to incorporate the local expertise of state, federal, and tribal biologists, made the one-to-two year deadlines unachievable. As prepared, these documents provide conservation planners with thorough references to evaluate status of Yellowstone cutthroat trout populations, potential conservation needs, the age and quality of available data, and data collection needs at relatively fine spatial resolution.

The third milestone addresses the agreement to work on 10 Yellowstone cutthroat trout conservation projects per year. Most projects take more than one year to accomplish given the steps required from initial identification of a potential project to its completion. Typically, a restoration project involves evaluation of feasibility and often requires gaining landowner support. Other components of conservation projects include preliminary design, cost estimation, procurement of grant funds, contractor selection, final design and cost estimation, permitting, and public involvement as required by MEPA or NEPA. The MEPA/NEPA process can require considerable effort, especially for larger and potentially controversial projects. Despite the complexity of project planning through implementation, state and federal agencies and tribes have been exceeding this milestone since inception of the Agreement in 2007. An inventory of work per year towards Yellowstone cutthroat trout conservation shows that Yellowstone cutthroat trout conservation partners work on an average of 16 projects per year since the Agreement went into effect in 2007 (Table 5-1). Undoubtedly, private landowners implementing voluntary BMPs increase the number of projects benefitting Yellowstone cutthroat trout throughout its historic range. Moreover, this list does not include conservation actions in the Shields River watershed upstream of the Chadbourne diversion, where an active watershed group has been working towards conservation of Yellowstone cutthroat trout since the 1990s.

Table 5-1: Yellowstone cutthroat trout (YCT) conservation projects worked on from 2007 through 2012.

Year(s)	***Stream***	***Work Performed***	***Project type***
2007-2012	Soda Butte Creek	Brook trout suppression	Protect conservation population of YCT
2008	Willow Creek	Project assessment & fundraising	Stream restoration
2010	Willow Creek	Fundraising	Stream restoration
2011	Willow Creek	Permitting	Stream restoration
2012	Willow Creek	Construction	Stream restoration
2007-2012	Cedar Creek	Water lease	In-stream flow
2007-2012	Mulherin Creek	Water lease	In-stream flow
2009	Rock Creek	Preliminary design	Fish passage
2010	Rock Creek	Final design, fundraising, permitting & MEPA	Fish passage
2011	Rock Creek	Railroad culvert removal and step-pool construction	Fish passage
2007-2012	Big Creek	Water lease	In-stream flow
2007	Big Creek	Engineering & design	Fish screen
2008	Big Creek	Fish screen installation	Fish screen
2007	SF Fridley Creek	Engineering & design	Fish ladder
2007-2012	Mulherin Creek	Engineering & design	Fish screen
2008	Fleshman Creek	Fundraising	Stream restoration
2009	Fleshman Creek	Permitting & construction	Stream restoration
2007	Duck Creek	Initial project assessment	Protect core population of YCT
2008-2012	Tom Miner, upper Shields	Survey waters using robust, statistically designed approach	Inventory
2009-2010	Duck Creek	Establish replicate population above a barrier falls	Protect core population of YCT
2011	Upper Boulder River	Preparation of Environmental Assessment	Establishment of a conservation population
2012	Upper Boulder River	Gillnetting and piscicide application	Establishment of a conservation population

Table 5-1 continued

Year(s)	***Stream***	***Work Performed***	***Project type***
2009	Upper Deer Creek	Brook and brown trout suppression	Protect nonhybridized population of YCT
2008	Lower Deer Creek	Initial planning and barrier site selection	Protect nonhybridized population of YCT
2009	Lower Deer Creek	Preliminary design and cost estimation	Protect nonhybridized population of YCT
2008	Lower Deer Creek	Fundraising	Protect nonhybridized population of YCT
2009	Lower Deer Creek	Fundraising & MEPA	Protect nonhybridized population of YCT
2010	Lower Deer Creek	Barrier construction	Protect nonhybridized population of YCT
2011	Lower Deer Creek	Removal of nonnatives	Protect nonhybridized population of YCT
2010	Shields River	Fundraising	Restore and retrofit Chadbourne diversion
2011	Shields River	Stability investigation	Restore and retrofit Chadbourne diversion
2012	Shields River	Design and permitting	Restore and retrofit Chadbourne diversion
2009	Shields River and headwater tributaries	Survey and brook trout suppression	Protect nonhybridized population of YCT
2009	South Fork Horse Creek	Project assessment	Stream restoration
2010	South Fork Horse Creek	Fundraising	Stream restoration
2011	South Fork Horse Creek	Permitting & construction	Stream restoration
2009	Middle Fork Horse Creek	Project assessment	Stream restoration
2010	Middle Fork Horse Creek	Fundraising	Stream restoration
2011	Middle Fork Horse Creek	Permitting & construction	Stream restoration
2008	Bangtail Creek	Willow plantings	Stream restoration
2011-2012	Shields River and headwater tributaries	PIT tag research	Life history, movement, & ecological investigation
2007-2009	Goose Creek and Goose Lake	Removal of nonnatives	Protect core population of YCT, expand habitat, create broodstock
2007	Crooked Creek	Barrier construction	Protect and expand core population of YCT
2007-2009	Crooked Creek	Mechanical removal of nonnatives	Protect and expand core population of YCT
2007	Crooked Creek	Preparation of Environmental Assessment addendum	Protect and expand core population of YCT
2008	Crooked Creek	Chemical removal of nonnatives	Protect and expand core population of YCT
2010-2011	Sage Creek	Chemical removal of nonnatives	Restore a core population of YCT
2012	Sage Creek	Follow-up monitoring to evaluate effectiveness of chemical removal	Inventory
2009	Piney Creek	Grant applications	Protect nonhybridized population of YCT
2010	Piney Creek	Construct fish screen	Protect nonhybridized population of YCT
2011	Piney Creek	Install riparian fencing	Protect nonhybridized population of YCT
2011	Piney Creek	Install habitat improvements	Protect nonhybridized population of YCT

The fourth milestone addresses data management of recent fisheries surveys and results of genetic analyses. Updating the database entails several mechanisms. FWP biologists enter their data into the data management system soon after they are collected. Likewise, the genetic analyses are entered into the database and department library as soon as they are received from the laboratory. Other agencies or entities require permits to sample fish in Montana, and they must submit their data by the end of the year. Finally, a data management specialist meets with biologists of all agencies on a yearly basis to ensure data addressing fish populations, genetic status, risks to persistence, and barriers are entered into FWP's database.

The fifth milestone occurs on 5-year intervals using data collected annually through regular reporting requirements. The result is a status report that identifies demographic and genetic risks. May et al. (2003) and May et al. (2007) are the first two iterations of this milestone. The next version will provide updates on these factors.

The conservation projects described under the third milestone provide the mechanism to meet the sixth and seventh milestones. Examples of conserving the number and miles of conservation populations include the Lower Deer Creek and Crooked Creek barrier and piscicide projects, the Piney Creek fish screen and habitat enhancement. Each of these projects conserved a core Yellowstone cutthroat trout population at risk of extirpation from sympatry with nonnative species or entrainment into an irrigation canal. Moreover, the conservation partners have restored Yellowstone cutthroat trout to 24 miles in the Sage Creek watershed in the Pryor Mountains. Reclamation of Sage Creek removed the threats posed by nonnative brook trout and rainbow trout. All of the projects worked on annually (Table 5-1) lead towards meeting the sixth and seventh conservation objectives.

6.0 Subbasin Assessments and Conservation Opportunities

This chapter describes the status of Yellowstone cutthroat trout and potential conservation opportunities for individual streams and watersheds. A note on hydrologic nomenclature may be useful in reading this document. The NRCS classification system designates hydrologic units hierarchically, according to a numeric coding system that assigns a hydrologic unit code (HUC) and an associated term[4]. For example, the area draining into the Shields River until its confluence with the Yellowstone River comprises a 4th code HUC, and under this system its narrative descriptor is "subbasin"; therefore, the Shields River 4th code HUC is technically referred to as the Shields River Subbasin. The next smaller hydrologic division is a 5th code HUC, which this system denotes as a watershed. Mill Creek and its tributaries are a designated 5th code HUC, and the technical name for this hydrological unit is the Mill Creek Watershed. In common use, the terms watershed, basin, and drainage are used interchangeably and typically without regard to the size of the drainage under consideration. This document uses the NRCS

[4] http://www.nrcs.usda.gov/programs/rwa/Watershed_HU_HUC_WatershedApproach_defined_6-18-07.pdf