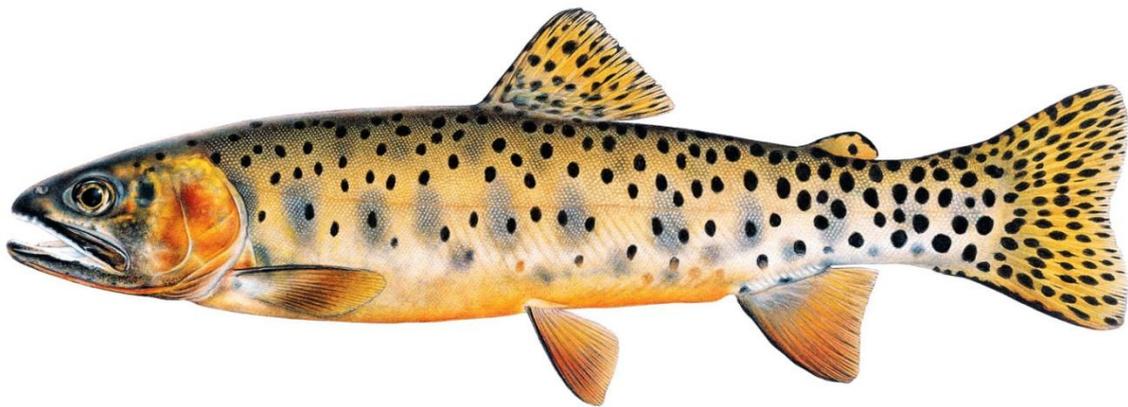


**Cutthroat trout (*Oncorhynchus clarkii*) Species and Conservation Assessment
for the Grand Mesa, Uncompahgre, and Gunnison National Forests**



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INTRODUCTION

The purpose of this conservation assessment is to provide land managers and the general public with an overview of the distribution and status of native cutthroat trout (*Oncorhynchus clarkii* spp.) on the Grand Mesa, Uncompahgre, and Gunnison National Forests (hereafter, GMUG). Cutthroat trout are one of a suite of Management Indicator Species (MIS) “...which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent (Forest Service Manual 2620.5).” MIS assessments are revised every five years and each is a synthesis of the most recent field-based observations and peer-reviewed science pertaining to the species.

Cutthroat trout along with three species of non-native “common” trout are MIS representing aquatic habitats on the GMUG. A variety of land management activities can affect lake and stream habitats, including traditional forestry practices, road construction and maintenance, fire and fuels management, and water development. As an MIS species, the presence of cutthroat trout in a watershed is not an obstacle to active forest management. On the contrary, MIS species are used by Forest personnel to gauge the response of the entire forest ecosystem to land management projects we implement.

Cutthroat trout are the only member of the genus *Oncorhynchus* native to the GMUG and the Rocky Mountain region of the United States. There are 2 varieties of native cutthroat trout present on the GMUG¹: Colorado River-lineage cutthroat trout and greenback-lineage cutthroat trout. At this time we are not characterizing the two varieties of native cutthroat trout as subspecies, of which there are 14 distributed across the western United States (Behnke 1992). In addition to their status as MIS, Colorado River cutthroat trout (*O. c. pleuriticus*) are classified as a Sensitive Species by Region 2 of the Forest Service and greenback cutthroat trout (*O. c. stomias*) are protected as a threatened species according to provisions of the United States Endangered Species Act (hereafter, ESA).

¹ See Summary of Key Findings below

SUMMARY OF KEY FINDINGS

When the initial conservation assessment for cutthroat trout on the GMUG was completed in 2005, resource managers were under the assumption that Colorado River cutthroat trout were the only subspecies present in the upper parts of the Colorado River watershed including the GMUG. New genetic analyses have revealed genetic differentiation among native cutthroat trout populations on the GMUG (Metcalf et al., 2007). What is known is that a genetic signature associated with greenback cutthroat trout has been observed in a number of cutthroat trout collected on Colorado's western slope (Metcalf et al., 2007). Populations having this genetic signature are sometimes called greenback-lineage or GB-lineage cutthroat trout. Cutthroat trout populations lacking the greenback genetic signature are called Colorado River-lineage or CR-lineage cutthroat trout. Prior to the discovery of the GB-lineage genetic signature, it was believed Colorado River cutthroat trout was the sub-species native to Colorado's western slope (Behnke 1992; Hirsch et al., 2006). Genetic analysis of cutthroat trout populations on the GMUG is incomplete; however, it appears GB-lineage cutthroat trout are more common on the GMUG than was initially believed. Whether or not this information leads to the eventual recognition of both subspecies on the GMUG remains to be determined. However, greenback cutthroat trout are protected as a threatened species under provisions of the ESA. The U.S. Department of Interior Fish and Wildlife Service recently authored a memorandum in which they explained that while the evolutionary relationships between the subspecies are being determined, GB-lineage fish would be treated as greenback cutthroat trout (see Appendix A). The implication of this decision is that land management actions that could affect populations of GB-lineage fish or their habitat are subject to consultation with the Fish and Wildlife Service according to Section 7 of the ESA. In accordance with the policy articulated by the Fish and Wildlife Service, GB-lineage fish on the GMUG are being treated as if they were greenback cutthroat trout. At this time we have chosen to identify individual populations as either "CR-lineage" or "GB-lineage" in technical documentation. Information regarding known populations of CR- and GB-lineage cutthroat trout on the GMUG is summarized in this conservation assessment.

According to the most recent compilation of population survey data there are at least 39 conservation populations² of cutthroat trout on GMUG lands. Of these 38 are located in streams. Eighteen of the 38 known populations are CR-lineage cutthroat trout. Extant stream populations occupy habitat patches ranging in size from 1 to 18 kilometers, with an average habitat patch length of 6 km. The most recent estimate of the historical distribution of cutthroat trout habitat on the GMUG is approximately 3,710 km. The total length of stream habitat occupied by cutthroat trout presently is 221 km, approximately 6 % of the historic range on the GMUG. About half of the occupied habitat patches are isolated by some type of in-stream barrier, such as a culvert. However, only 8 of the 37 stream habitat patches are fragmented by one or more

² Conservation populations are those identified through genetic analysis, having at no more than 10% non-native genes (Hirsch et al., 2006).

barriers located inside the patch. Most cutthroat trout populations on the GMUG are found in relatively pristine watersheds. Eighty-four percent of extant populations occupy watersheds having Watershed Integrity Class ratings of 1 or 2, indicating little or no degradation associated with human activity.

In the last 5 years GMUG personnel have worked extensively to document the distribution of native cutthroat trout on the Forest. Future activities will include 1) monitoring known populations to insure they are stable and to identify existing and potential threats to their long-term persistence; 2) increasing the amount of occupied habitat on the GMUG through translocations of native cutthroat trout into unoccupied streams; and 3) monitoring stream temperature throughout occupied streams in order to model the potential effects of climate change on the size and distribution of suitable cutthroat trout habitat on the Forest.

MANAGEMENT STATUS

Colorado River cutthroat trout

- Sensitive species, USDA Forest Service Rocky Mountain Region
- Sensitive species, U.S. Bureau of Land Management, Colorado State Office
- Species of concern, State of Colorado

Greenback cutthroat trout

- Threatened species, U.S. Endangered Species Act
- Sensitive species, U.S. Bureau of Reclamation, Colorado State Office
- Threatened species, State of Colorado

Existing management and conservation frameworks

- Grand Mesa, Uncompahgre, and Gunnison National Forests Amended Land and Resource Plan, 1991.
- Greenback cutthroat trout recovery plan, 1998 (U.S. Fish and Wildlife Service 1998).
- Conservation agreement for Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) in the states of Colorado, Utah, and Wyoming, 2006.

NATURAL HISTORY³

General species description

Colorado River and greenback cutthroat trout are members of the family Salmonidae. Recognizable species within this group include Pacific salmon (*Oncorhynchus* spp.), rainbow trout (and their anadromous life-history form, steelhead; *O. mykiss*), brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), grayling (*Thymallus arcticus*), and whitefish (*Prosopium* spp.). The common anatomical feature of the group is a small fin located in front of the tail, known as the adipose fin (see panels 1 and 3, Figure 1). Salmonid fishes are found throughout the world and occupy large and small rivers, lakes, and oceans. Throughout the world, these species are important as both commercial and recreational fisheries.

Cutthroat trout are named for the orange or red stripe located on the lower side of the gill cover (see panel 3, Figure 1). Colorado River and greenback cutthroat trout are sufficiently similar in appearance that is difficult to differentiate them in the field (Young 2008, 2009). Both subspecies have dark spots concentrated on the upper and rear portions of the body (see Figure 1). Body coloration ranges from pale yellow to intense shades of orange and red and will change seasonally associated with spawning (Behnke 1992). Because of their similarity, genetic analysis is routinely used to determine which subspecies is present within a watershed.

Historical distributions

Until recently the historical distributions of the two subspecies were believed to be separated by the Continental Divide. A recent assessment of the historical and current distribution of Colorado River cutthroat trout shows that the subspecies probably occupied all the mid- to high-elevation watersheds in the upper Colorado River basin (Behnke 1992; Hirsch et al., 2006; Figure 2). The entire GMUG falls within the historical distribution of Colorado River cutthroat trout. Greenback cutthroat trout are believed to have occupied the upstream portions of the Arkansas and South Platte River basins located on Colorado's Front Range (Behnke 1992; Young 2009; Figure 2).

The clear delineation of the two subspecies' range at the continental divide has been called into question based on the discovery of genetic markers of greenback cutthroat trout in watersheds believed to be occupied exclusively by Colorado River cutthroat trout and vice versa (Metcalf et al., 2007; Young 2009). Resolving the issues created by "greenback-lineage" cutthroat trout on the western side of the Continental Divide is the goal of ongoing research. Both Colorado River-lineage and greenback-lineage cutthroat trout exist on the GMUG.

³ The Natural History section is largely a synopsis of exhaustive reviews for both species available in USFS General Technical Bulletins for Colorado River and greenback cutthroat trout. Readers seeking more information on the biology and ecology of these species should consult Young 2008 and Young 2009, references for which are available at the end of this document.

Habitat associations

Extant cutthroat trout populations are generally confined to mid- to high-elevation streams (> 2,500 m) with associated high gradients (Young 2008, 2009). Large-scale patterns of habitat occupancy are believed to result from the incursion of non-native fish species along with water development in downstream portions of occupied watersheds (Young 2008). Occupied streams are located disproportionately on public lands, particularly Forest Service lands (Hirsch et al. 2006).

Stream temperature is the most important habitat variable for stream-dwelling fish. Research has demonstrated cutthroat trout can survive for brief periods when water temperatures are above 22 °C; however, most cutthroat trout populations are associated with average stream temperatures that range from 10 to 18 °C (Behnke 1992; Young 2008, 2009). While cutthroat trout are viewed generally as a cold-water fish species, it is possible that populations are limited by cold water temperature in some areas. In streams where average summer temperatures are less than 10 ° survival of juvenile fish can be limited (Young 2008, 2009). When water is too cold juvenile fish will not be able to grow to a sufficient size to survive winter.

Numerous studies have shown stream-dwelling cutthroat trout to favor pool habitats over other portions of the stream channel in nearly all seasons (Young 2008, 2009). Pools provide cover from predators, refuge from streamflow and inclement conditions including floods and winter ice formations. In addition to pools, cutthroat trout density has been shown to be positively correlated to the amount of wood present in a stream (Young 2008, 2009). At larger habitat scales, cutthroat trout populations are associated with relatively pristine streams that do not contain excess amounts of fine sediment and flow through healthy and intact riparian areas (USDA Forest Service, GMUG and San Juan National Forests, 2005).

Food habits

All cutthroat trout are opportunistic, sight-feeding predators (Behnke 1992; Young 2008, 2009). The majority of their diet is made up of aquatic insects, such as mayflies, caddisflies, and stoneflies. In the summer, cutthroat trout will feed extensively on terrestrial insects, including grasshoppers. Fish are not a significant portion of the diet for most cutthroat populations because small, forage fishes are rare in streams occupied by the species.



Figure 1. Six cutthroat trout captured in streams on the GMUG. Panels 1, 2, and 3 are genetically pure native cutthroat trout. Panels 4, 5, and 6 are individuals that appear to have hybridized with rainbow trout.

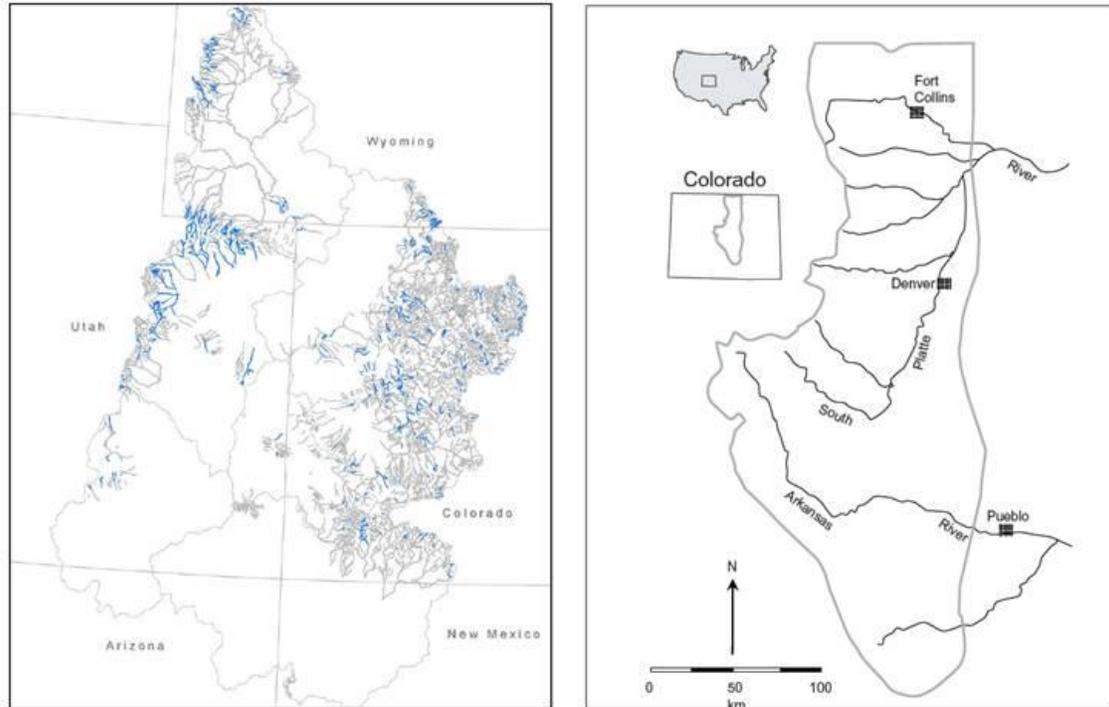


Figure 2. Historical distributions of Colorado River (left panel) and greenback cutthroat trout (right panel). Blue lines in the left panel denote the current distribution of Colorado River cutthroat trout. Figures taken from Young 2008 (Colorado River) and Young 2009 (greenback).

Life history and movements

Cutthroat trout spawn in the spring when average water temperatures reach 7-10 °C (Young 2008, 2009). Spawning may occur from April through July, with the peak typically occurring in May and June. Historically, substantial movement could have been associated with spawning as adult fish migrated from larger rivers that served as wintering habitat to small streams where juvenile fish have a greater chance of surviving after hatching. In some watersheds spawning movements can be 10 to 100s of kilometers (Schmetterling 2001; Schrank and Rahel 2004); however, long-distance movements are restricted for most extant populations by some form of barrier. Eggs hatch and fry emerge from the gravel from August through October, depending upon the time of spawning and water temperature. Juveniles are recruited into the adult population typically at age 3. Stream-dwelling cutthroat trout are generally 150-250 mm as adults, although larger individuals are common in many populations (Behnke 1992).

Cutthroat trout are highly mobile. Spawning movements by many populations can be extensive and are very likely to have been more extensive prior to widespread water development in the Rocky Mountains (Schrank and Rahel 2004; Young 2008, 2009). Today most populations are

isolated by some form of barrier that restricts downstream movements and the full expression of migratory life histories (Schmetterling 2003; Hirsch et al., 2006; Young 2008, 2009).

Intra-season movements by cutthroat trout are also common. Numerous studies on inland cutthroat trout have shown them to make movements of 10s to 100s of meters throughout the summer (Young 2008, 2009). Movements may be triggered by interactions with other individuals or stochastic events such as floods. Individual fish may also move among several pools within their home range over the course of days or weeks (Young 1996; Hilderbrand and Kershner 2000).

CUTTHROAT TROUT STATUS ON THE GMUG

Distribution and abundance

There are at least 38 populations of cutthroat trout on the GMUG that possess genetic integrity necessary to be classified as conservation populations in the 2010 Colorado River cutthroat trout conservation database (Table 1). Conservation populations are those possessing genetic compositions with less than 10% non-native genes (Hirsch et al., 2006). Of the 38 known conservation populations, 11 have less than 1% non-native genes (Table 1).

Conservation populations are located across the GMUG (Figure 3). Nearly half the populations reside on or adjacent to the Grand Mesa, located in the northern part of the Forest (Figure 3). Other populations are clustered near Gunnison, CO and at the southern end of the Uncompahgre Plateau (Figure 3).

Population densities of cutthroat trout were varied greatly across the GMUG (Table 2). Estimates of population density ranged from 61 cutthroat trout per km in South Twin Creek to 1,965/km in Robinson Creek (Table 2). We considered adult fish to be those longer than 150 mm. Estimates of adult density ranged from 41/km in South Twin Creek to 526/km in Cochetopa Creek (Table 2).

The precision of population estimates varied dramatically among streams. A review of the data upon which the estimates in Table 2 are based shows that low precision was caused by low or inconsistent capture efficiency during stream sampling. Additionally, we were not able to generate population estimates for several streams because fish were not captured during a second pass through a sampling reach. Capturing at least one individual during a second pass is requisite for statistical estimation of population size. Sampling stream fish populations is difficult and it is not always possible to collect data that will yield statistically defensible population estimates. Streams for which we have no or imprecise population estimates will be visited in 2011 or 2012.

Table 1. Known conservation populations of cutthroat trout on the GMUG NF. Patch sizes were estimated, and fragmentation and isolation were evaluated using spatial data in the Colorado River cutthroat trout conservation database. See text for discussion of fragmentation and isolation.

| Water body | Ranger district | Patch size | Fragmentation | Isolation | Subspecies |
|---------------------------------|-----------------|------------|---------------|-----------|------------|
| Streams | | | | | |
| Beaver Creek | Gunnison | 18.34 km | yes | yes | CR |
| Beaver Dams Creek* | Ouray | 2.65 | no | yes | GB |
| Chair Creek | Paonia | 3.08 | no | no | GB |
| Cliff Creek | Paonia | 6.99 | no | yes | CR |
| Cochetopa Creek | Gunnison | 8.02 | no | yes | CR |
| Coon Creek | Grand Valley | 6.81 | no | no | GB |
| Cunningham Creek | Paonia | 2.29 | yes | yes | GB |
| Deep Creek ^a | Norwood | 8.13 | no | yes | CR |
| Deep Creek* | Paonia | 8.90 | no | yes | GB |
| Deer Beaver Creek | Gunnison | 6.89 | no | no | CR |
| Dyke Creek | Paonia | 8.84 | yes | yes | GB |
| East Fork Big Creek | Grand Valley | 3.12 | no | yes | CR |
| East Fork Brush Creek | Grand Valley | 3.84 | no | yes | GB |
| East Fork Dry Creek* | Ouray | 4.40 | no | yes | GB |
| East Fork Minnesota Creek | Paonia | 4.85 | no | yes | CR |
| East Fork South Beaver Creek | Gunnison | 6.05 | yes | no | CR |
| East Fork Terror Creek | Gunnison | 4.05 | yes | no | GB |
| Elk Creek | Norwood | 6.71 | no | no | CR |
| Fall Creek | Gunnison | 5.86 | no | yes | CR |
| Goat Creek* | Norwood | 4.42 | no | yes | GB |
| Lake Fork Cochetopa Creek | Gunnison | 3.16 | no | yes | CR |
| Main Hubbard Creek* | Paonia | 2.32 | no | yes | GB |
| Middle Hubbard Creek* | Paonia | 2.12 | no | yes | GB |
| Nate Creek | Ouray | 3.32 | no | no | GB |
| North Anthracite Creek | Paonia | 4.45 | yes | yes | CR |
| North Fork Tabeguache Creek | Norwood | 9.25 | no | yes | CR |
| North Smith Fork Gunnison River | Paonia | 12.76 | no | no | CR |
| Pryor Creek* | Ouray | 2.59 | no | yes | GB |
| Red Canyon Creek | Norwood | 3.38 | no | no | GB |
| Roberts Creek* | Paonia | 6.46 | no | no | GB |
| Robinson Creek ^b | Paonia | 12.49 | no | no | GB |
| Rock Creek* | Paonia | 1.39 | no | no | GB |
| South Twin Creek* | Paonia | 1.06 | no | yes | CR |
| West Antelope Creek* | Gunnison | 13.31 | no | no | CR |
| West Beaver Creek | Gunnison | 9.89 | yes | no | CR |
| West Fork Brush Creek | Grand Valley | 4.97 | no | yes | GB |
| West Fork Terror Creek | Paonia | 3.96 | yes | yes | GB |
| Reservoir | | | | | |
| Young's Creek Reservoir #2 | Grand Valley | 0.06 | no | yes | CR |

*Population has less than 1% non-native genes.

^aIncludes East Fork Deep Creek

^bIncludes Kauffman Creek

Most streams for which we have population data contained 2 to 4 age classes of cutthroat trout. Our conclusion is based on the size range of fish in samples. For example, Beaver Creek contained fish ranging from 59 to 195 mm in length (Table 2). Such a size distribution is indicative of multiple age classes, including young-of-the-year fish that were spawned and hatched in 2008 (the year in which data for Beaver Creek were collected). The size distribution of fish captured in four of the streams in Table 2 (Chair, Cunningham, East Fork Minnesota, and South Twin) is truncated at about 100 mm. Based on the lack of fish less than 100 mm in length,

these data may indicate limited reproduction in these streams during the year in which they were sampled. We will collect additional data at these streams in the next two years in order to evaluate reproduction.

Population trends

The 2005 status assessment included 7 stream populations (Brush Creek, Doug Creek, Henderson Creek, Lake Fork of the Gunnison River, Road Beaver Creek, Second Creek, and Trail Gulch) and 1 reservoir population (Young's Creek Reservoir #3) that we did not include in 2010 assessment. We removed these streams from the list of conservation populations on the GMUG for 2 reasons: genetic testing showed more than 10% introgression with non-native species or the water body was not classified as a conservation population in the 2010 cutthroat trout conservation database. Additionally, the results of genetic analysis were used to add 12 streams to the list of conservation populations on the GMUG (Cliff Creek, Coon Creek, East Fork Brush Creek, East Fork Minnesota Creek, Fall Creek, Goat Creek, Lake Fork Cochetopa Creek, North Fork Tabeguache Creek, Red Canyon Creek, Robinson Creek, South Twin Creek, and West Fork Brush Creek). As a result of these changes, the amount of occupied habitat on the Forest increased from 158.4 to 220.8 km.

Since 2002 GMUG personnel have made multiple visits to most of the streams containing conservation populations of cutthroat trout. Despite a vigorous data collection effort, the lack of a standardized stream sampling protocol limits our ability to assess rigorously trends in cutthroat trout populations on the GMUG. Specifically, our failure to return to the same sampling reach within a stream on successive visits makes inter-year comparisons difficult. Beginning in 2011, the GMUG will employ a standardized stream fish sampling protocol that will allow us to make comparisons between successive population estimates for cutthroat trout populations.

Despite limitations there is no evidence of meaningful, Forest-wide changes in cutthroat trout populations. Our conclusion is based on data collected at 8 streams between 2002 and 2010: Beaver Dams, Cunningham, Dyke, Main Hubbard, Middle Hubbard, Roberts, Rock, and West Fork Terror Creeks. Adult population estimates for these streams in Table 2 are greater than those in the 2005 status assessment for 7 of 8 streams. Readers are cautioned that additional data are needed to draw meaningful conclusions about individual populations.

Habitat quality and quantity

Conservation populations occupy about 221 km of streams on the GMUG, which represents about 6 percent of the species' historic range on the Forest. Patch lengths ranged from 1.06 km in South Twin Creek to 18.34 km in Beaver Creek (Table 1) and averaged 5.7 km. We delineated contributing watersheds for each the stream lines shown in Figure 3 using a GIS. The total area of occupied watersheds on the GMUG is 696.2 km². On average, patch area is 18.8 km².

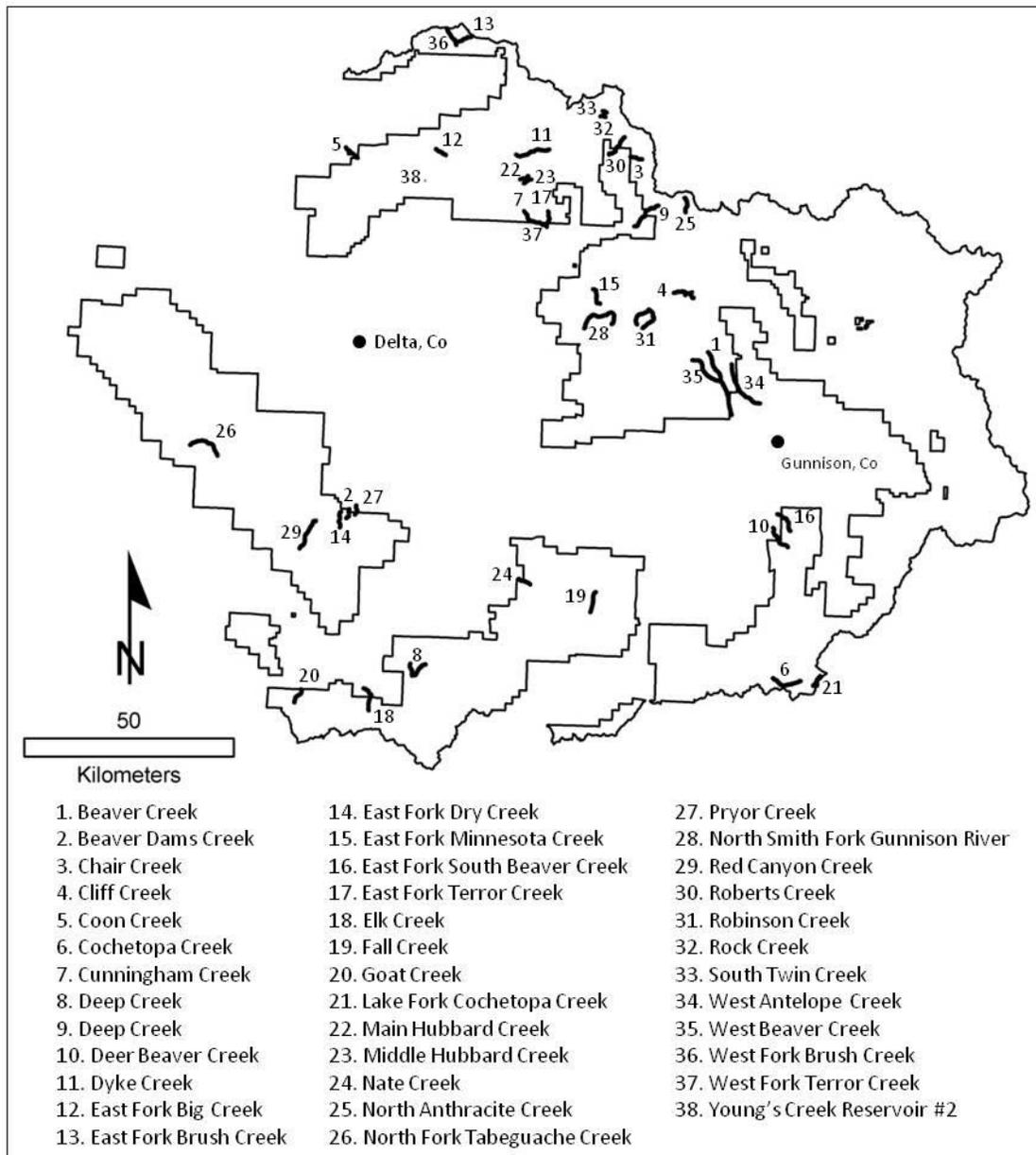


Figure 3. Distribution of cutthroat trout conservation populations on the GMUG NF.

Table 2. Characteristics of conservation populations on the GMUG NF. Density estimates for adults and total populations are followed, in parentheses, by 95% confidence intervals. The number of stream reaches sampled follow, in parentheses, the total number of cutthroat trout observed. Streams having no data available have not been sampled by GMUG or CDOW personnel in the last 10 years. Streams marked with asterisks were sampled by CDOW personnel.

| Water body | Year | Adults/KM | Cutthroat/KM | Observed | Range (mm) |
|--------------------------------|------|-----------|--------------|-------------------|------------|
| Stream | | | | | |
| Beaver Creek (Gunnison RD) | 2008 | - | - | 20 (2) | 59-195 |
| Beaver Dams Creek | 2007 | 81 (111) | 311 (43) | 145 (3) | 58-209 |
| Chair Creek | 2008 | 162 (219) | 268 (569) | 20 (1) | 97-217 |
| Cliff Creek* | 2007 | 422 (25) | 591 (126) | 43 (1) | 25-265 |
| Cochetopa Creek | 2004 | 526 (30) | 1097 (82) | 83 (1) | 40-300 |
| Coon Creek | 2005 | - | - | 11 (1) | 52-202 |
| Cunningham Creek | 2008 | 242 (8) | 271 (8) | 19 (3) | 114-220 |
| Deep Creek (Norwood RD) | 2004 | - | - | 1 (1) | 144 |
| Deep Creek (Paonia RD) | 2010 | 52 (9) | 415 (33) | 54 (1) | 38-232 |
| Deer Beaver Creek* | 1999 | - | - | 40 (1) | 90-236 |
| Dyke Creek | 2007 | - | 115 (16) | 48 (4) | 68-185 |
| East Fork Big Creek | 2005 | 63 (8) | 228 (29) | 28 (1) | 82-235 |
| East Fork Brush Creek* | 2010 | - | - | No data available | |
| East Fork Deep Creek* | 2003 | 56 (211) | 153 (122) | 15 (1) | 65-254 |
| East Fork Dry Creek | 2007 | - | 315 (11) | 71 (2) | 61-161 |
| East Fork Minnesota Creek* | 2009 | 99 (14) | 191 (35) | 24 (1) | 112-225 |
| East Fork South Beaver Creek* | 2010 | - | - | 30 (1) | 87-235 |
| East Fork Terror Creek | 2010 | 295 (40) | 885 (17) | 37 (2) | 21-136 |
| Elk Creek | 2004 | - | 207 (30) | 13 (1) | 75-252 |
| Fall Creek | 2002 | 70 (12) | 213 (20) | 49 (2) | 76-365 |
| Goat Creek | 2010 | - | - | 27 (2) | 59-243 |
| Lake Fork Cochetopa Creek | 2004 | 820 (19) | 1327 (59) | 99 (1) | 58-302 |
| Main Hubbard Creek | 2007 | 82 (61) | 91 (44) | 39 (3) | 60-232 |
| Middle Hubbard Creek | 2007 | 159 (13) | 195 (11) | 38 (3) | 60-252 |
| Nate Creek | 2007 | - | - | 31 (3) | 75-294 |
| North Anthracite Creek* | 2005 | 63 (47) | 238 (724) | 15 (1) | 59-245 |
| North Fork Tabeguache Creek* | - | - | - | No data available | |
| North Smith Fork Gunnison Rvr. | - | - | - | No data available | |
| Pryor Creek | 2007 | - | - | 27 (2) | 69-144 |
| Red Canyon Creek | 2009 | 192 (920) | 786 (224) | 62 (2) | 80-203 |
| Roberts Creek | 2008 | 102 (22) | 548 (27) | 77 (2) | 43-243 |
| Robinson Creek* | 2006 | 493 (120) | 1965 (226) | 151 (1) | 35-220 |
| Rock Creek | 2008 | 270 (13) | 747 (49) | 39 (2) | 34-199 |
| South Twin Creek | 2005 | 41 (30) | 61 (15) | 8 (2) | 49-186 |
| West Antelope Creek | 2006 | - | 864 (53) | 61 (1) | 45-145 |
| West Beaver Creek | 2008 | 256 (62) | 438 (115) | 107 (3) | 65-307 |
| West Fork Brush Creek* | 2007 | - | - | 12 (1) | 155-214 |
| West Fork Terror Creek | 2010 | 73 (13) | 408 (38) | 76 (2) | 50-241 |
| Reservoir | | | | | |
| Young's Creek Reservoir #2 | 2006 | - | - | 3 (1) | 270-363 |

* Sampled by CDOW

We used spatial data describing occupied habitat and barriers associated with the Colorado River cutthroat trout conservation database to identify fragmented and isolated habitat patches. A patch was classified as fragmented if an identified barrier was located inside the boundaries of the patch. We considered a habitat patch isolated if there was an identified barrier (e.g. natural barrier, culvert) located downstream and adjacent to the patch. Results of the fragmentation and isolation analyses are contained in Table 1.

We overlaid the Forest's Watershed Integrity Class (WIC) ratings (USDA Forest Service, GMUG and San Juan National Forests, 2005) for 6th-level hydrologic unit codes (HUC) onto a map of conservation populations in order to evaluate broad-scale habitat quality associated with cutthroat trout populations. Thirty-two of 38 conservation populations are located in watersheds with WIC ratings of 1 or 2, which translates to about 84 percent of occupied stream kilometers (Table 3). WIC 1 and 2 watersheds are those least influenced by past and current land-management practices and therefore exhibit relatively natural watershed processes and biota. WIC 3 and 4 watersheds are those most influenced by past and on-going management activities and may contain areas where watershed processes and biota have been degraded. Six of the 38 conservation populations occupy WIC 3 and 4 watersheds (Table 3). The 2005 Status Assessment reported that 86 percent occupied streams were in WIC 1 and 2 watersheds. The decrease is a result of changes made to the list of Conservation Populations described in the *Population Trends* section above.

In 2006 GMUG personnel completed a broad-scale assessment of stream and riparian habitat conditions using the PACFISH/INFISH Biological Opinion (PIBO) protocol (Adams 2006). Habitat data were collected in 19 reference watersheds. Reference watersheds were those exhibiting the least human influence and represented the most "natural" conditions on the Forest. Within each watershed a variety of abiotic and biotic data were collected in a response reach (Table 3). Six of the 19 reference watersheds contain conservation populations of cutthroat trout.

The data in Table 3 represent baseline microhabitat information for streams exhibiting the most natural conditions on the Forest. Future management activities may impact stream and riparian habitat conditions in streams supporting native cutthroat trout. It is likely that stream habitat surveys will be prompted by project proposals that include management activity which may affect streams and riparian areas. Baseline information is necessary to insure best-management practices and mitigation measures are effective in maintaining habitat conditions conducive to healthy stream fish populations.

In the future, stream habitat surveys on the Forest should be conducted so that data may be compared to baseline conditions presented in the 2006 study. The PIBO habitat sampling approach uses an intensive survey protocol that is not practical for frequent use on the GMUG. However, several of the variables, including residual pool depth, undercut banks, bank stability, and width-to-depth ratio, may be measured using repeatable techniques allowing for comparisons with the data presented in Table 3.

Table 3. Reach-scale stream habitat characteristics collected in response reaches of 19 reference watersheds on the GMUG NF. Data were collected using the PACFISH/INFISH Biological Opinion (PIBO) protocol (Kershner et al., 2004). Table adapted from Adams 2006.

| Attribute | Mean (SD) | Range |
|-------------------------|-----------------|----------------|
| Residual pool depth (m) | 0.28 (0.13) | 0.12 – 0.69 |
| Undercut depth (m) | 0.68 (0.60) | 0.19 – 3.02 |
| Undercut banks (%) | 30.30 (15.13) | 4.76 – 60.00 |
| Bank angle | 107.45 (14.05) | 76.00 – 132.31 |
| Bank stability (%) | 95.95 (5.04) | 78.57 – 100.00 |
| Width to depth ratio | 22.03 (4.99) | 8.02 – 36.34 |
| Pool fines, < 2 mm (%) | 14.20 (24.14) | 0.00 – 99.33 |
| Pool fines, < 6 mm (%) | 16.20 (24.31) | 0.00 – 99.43 |
| D50 (mm) | 61.29 (40.49) | 2 – 134 |
| D85 (mm) | 143.66 (100.00) | 6.84 – 350 |
| Conductivity | 97.90 (74.58) | 30 – 270 |
| Alkalinity | 90.79 (45.54) | 20 – 240 |

In a study of isolated cutthroat trout populations, Hilderbrand and Kershner (2000) found that 8 km of stream habitat provided enough space to support robust populations with a high likelihood of long-term persistence. Twenty-seven of 38 stream-dwelling conservation populations occupy habitat patches having less than 8 km of stream habitat and only 4 populations occupy habitat patches containing more than 10 km (Table 1). Harig and Fausch (2002) evaluated potential translocation sites for greenback cutthroat trout and found that habitat patches less than 14.7 km² in area had low population density or did not contain cutthroat trout. Seventeen of 37 stream habitat patches had watershed areas of less than 14.7 km². Median patch area for occupied habitat on the GMUG was 16.4 km². While dimensions of a large proportion of occupied habitat patches on the GMUG do not meet the thresholds identified by Hilderbrand and Kershner (2000) and Harig and Fausch (2002) the major conclusion we can draw from these data is that native cutthroat trout on the GMUG exist in small and isolated habitat patches. Such a landscape-scale pattern is typical of salmonid populations throughout the western United States (Propst et al., 1992; Dunham et al., 1997; Nelson et al., 2002). Creating new populations through translocation and expanding the range of existing populations is a high priority for cutthroat trout management on the GMUG (see *Cutthroat Conservation on the GMUG* below).

Table 3. Watershed integrity classes of cutthroat trout conservation populations on the GMUG National Forest.

| Watershed Integrity Class | Conservation population |
|---------------------------|---|
| 1 | Beaver, Chair, Cliff, Deer Beaver, Dyke, East Fork South Beaver, Fall, Main Hubbard, Middle Hubbard, North Fork Tabeguache, North Smith Fork Gunnison, Red Canyon, Roberts, Rock, South Twin, West Beaver, Young's Creek Reservoir #2 |
| 2 | Beaver Dams, Coon, Cunningham, East Fork Brush, East Fork Dry, East Fork Terror, Elk, Nate, Lake Fork Cochetopa Creek, North Anthracite, Pryor, West Fork Brush, West Fork Terror |
| 3 | Deep (Norwood), East Fork Big, East Fork Deep, West Antelope |
| 4 | Deep (Paonia), Goat |

Threats

Non-native species, specifically brook trout and rainbow trout, are by far the biggest threat to the long-term persistence of native cutthroat trout on the GMUG. The mechanisms by which these two non-natives impact cutthroat trout differ. Juvenile brook trout have been found to be superior competitors when in sympatry with juvenile cutthroat trout resulting in decreased recruitment into the cutthroat trout population and eventual extirpation (Dunham et al., 2002). Rainbow trout inter-breed with cutthroat trout resulting in the loss of native genetic stocks (Weigel et al., 2003).

In the last 5 years, brook trout were observed in sympatry with cutthroat trout in 7 streams: Beaver, Coon, Dyke, Rock, South Twin, West Beaver, and West Fork West Beaver Creeks. Additional monitoring is needed to determine if brook trout numbers are increasing in the streams listed above. A recent study demonstrated success in controlling invasive brook trout using intensive electrofishing (Carmona-Catot et al., 2010). If monitoring indicated brook trout numbers were increasing in these streams, physical control is a possibility. However, such activities would need to be coordinated with the Colorado Division of Wildlife.

Rainbow trout were observed in sympatry with cutthroat trout in Beaver Dams Creek in 2007. Beaver Dams Creek is a core conservation population (Table 1) and the presence of rainbow trout in this stream represents a significant threat to the native population. We will return to Beaver Dams Creek in 2011 to search for rainbow trout and evaluate the threat they pose to cutthroat trout in this stream. Rainbow trout have also invaded Elk Creek, after spring run-off removed a series of beaver dams that served as natural barriers to upstream fish movement (D. Kowalski, CDOW, personal communication). At this time we are retaining Elk Creek as a conservation population. However, hybridization with rainbow trout will eventually result in the Elk Creek population losing its designation as a conservation population. Rainbow trout may threaten the conservation population in Deep Creek, on the Paonia Ranger District (Table 1). In 2010 a natural barrier was destroyed and it may be possible for non-native species to move

upstream into habitat occupied exclusively by cutthroat trout. In 2011 the GMUG will be partnering with a private landowner and the Colorado Division of Wildlife to construct a permanent barrier to fish movement in Deep Creek. The purpose of the barrier is to prevent permanently incursion of non-native trout into stream habitat occupied exclusively by genetically pure GB-lineage cutthroat trout.

Cutthroat trout are susceptible to whirling disease which can be transmitted to them by hatchery-reared salmonids or anglers wearing waders and wading boots laden with infected sediment. Whirling disease is present in the Colorado River and Gunnison River basins. However, the disease is most common in large rivers that do not contain conservation populations. Whirling disease is present on the Grand Mesa and may have caused the extirpation of some cutthroat trout populations located there (L. Martin, CDOW, personal communication).

Cutthroat trout populations are also threatened by land management activities that affect stream habitat, including livestock and grazing management, mineral extraction, road construction, timber harvest, and water development. Specific activities associated with land management on National Forest lands are identified, implemented, and monitored using frameworks outlined by the National Environmental Policy Act, the Clean Water Act, and other environmental legislation. Future activities on the GMUG will be implemented with appropriate consideration given to stream habitat, particularly in watersheds surrounding conservation populations of cutthroat trout.

At this time we view regional climate change associated with warming air temperatures documented around the globe (Intergovernmental Panel on Climate Change 2007) as threat to the long-term persistence of native cutthroat trout populations throughout their range, including the GMUG. Young (2008) provides an excellent review of the potential for changing climate to affect cutthroat trout populations in the Rocky Mountains. Briefly, increasing air temperatures will trigger an upstream shift in the distribution of habitat suitable for native cutthroat trout. If air temperatures continue to rise, the amount of suitable habitat for native cutthroat trout populations will eventually decrease. Coupled with reductions in suitable habitat is the increased likelihood that cutthroat trout populations will be exposed to severe thunderstorms and wildfires, and associated disturbances like debris flows and landslides. Populations could be lost as a result of these disturbances and habitat fragmentation will limit the demonstrated ability of salmonid fishes to colonize streams in the wake of disturbance (Rieman et al., 1997; Brown et al., 2001; Burton 2005).

The Forest recently completed a draft Watershed Vulnerability Assessment (WVA) intended to identify the potential for climate change and related disturbances to affect forest health. Conservation populations of cutthroat trout were one of a suite of “aquatic ecological values” used in the analysis (Howe et al., unpublished data). Aquatic ecological values were compared to the potential for uncharacteristic erosion and run-off events across the Forest. The analysis found that 39 percent of conservation populations were located in areas that have high erosion

sensitivity and 16 percent of conservation populations were located in areas highly sensitive to uncharacteristic run-off events (Howe et al., unpublished data). Catastrophic erosion events, such as debris flows, can alter stream habitat and kill stream fish (Benda et al., 2003; Dunham et al., 2003; Rieman and Isaak 2010). For spring-spawning fish, including cutthroat trout, uncharacteristic seasonal run-off could reduce reproductive success and impact populations. The implication of these findings is that some conservation populations on the GMUG may be vulnerable to stochastic disturbances that are expected to occur as regional climate patterns change (Rieman and Isaak 2010). However, the results of WVA will provide valuable insights to managers planning restoration and translocation projects intended to expand the occupied habitat of native cutthroat trout on the Forest (see below).

CUTTHROAT TROUT CONSERVATION ON THE GMUG

Over the next 5 years the primary conservation activity in which we will engage will be monitoring conservation populations in order to 1) permanently demarcate two sampling reaches for each conservation population, to which we can return and sample in subsequent years; 2) obtain sufficient data to assess trends in all conservation populations; and 3) evaluate the potential for non-native incursion into streams occupied by conservation populations. We will endeavor to visit all conservation populations on the GMUG in the next 3 years. Using the data we collect during that time, we will determine the appropriate return interval for individual populations based on their genetic status and population density. Our goal is to return to conservation populations every 3-5 years.

Our secondary conservation activity will be to increase the amount of occupied habitat on the GMUG via translocation of genetically pure cutthroat trout into un-inhabited watersheds. In the next 5 years we intend to conduct at least 2 translocations. The first will take place in 2011-2012 during which GB-lineage cutthroat trout will be restored to streams tributary to Woods Lake (a reservoir), located on the Norwood Ranger District (Figure 4). The Woods Lake watershed is within the historical distribution of native cutthroat trout on the GMUG. The Woods Lake project will create a 6.2 km habitat patch that includes Woods Lake. The second, much larger project involves the introduction of GB-lineage cutthroat trout to the Dominguez Creek watershed, located on the northern end of the Uncompahgre Plateau and on the Grand Valley Ranger District (Figure 4). Preliminary work for the Dominguez Creek translocation will begin in 2011 and the project is likely to take at least 4 years to complete. Upon completion, the Dominguez Creek translocation will yield a 97 km² watershed containing nearly 26 km of stream habitat for native cutthroat trout. The Woods Lake and Dominguez Creek projects will increase the amount of occupied habitat on the GMUG by nearly 16 percent.

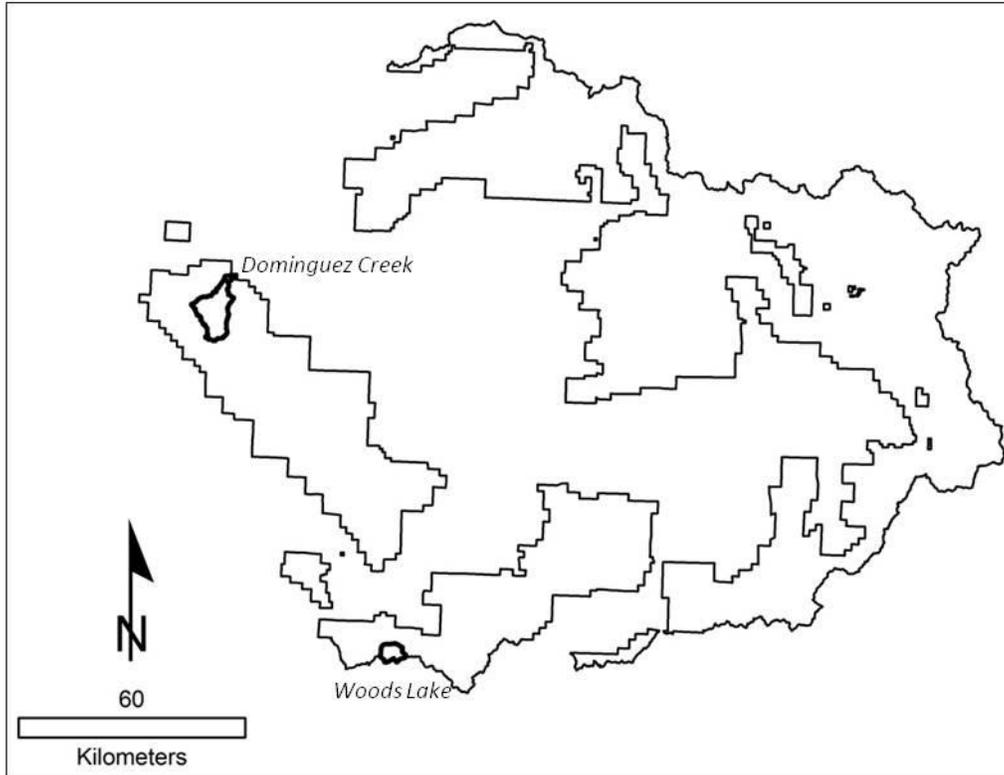


Figure 4. Woods Lake and Dominguez Creek watersheds on the GMUG. Native cutthroat trout will be restored to Woods Lake in 2011-2012. Native cutthroat trout will be introduced into Dominguez Creek in 2013-2014.

In order to gain a better understanding of how climate change may affect native cutthroat trout habitat, we will be monitoring stream temperature in 30-45 streams for the next 5 years using digital temperature loggers. The data collected by temperature loggers can be used to model how stream temperatures may change in response to a variety of climate change scenarios; stream temperature being the primary determinant of habitat suitability for cutthroat trout. In addition to use by GMUG personnel, these data will be made available to researchers working on regional climate change models, including efforts at the USFS Rocky Mountain Research Station and Colorado State University.

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APPENDIX A: U.S. Department of Interior Fish and Wildlife Service memorandum that articulates the agency's position on greenback-lineage cutthroat trout.

FWS Position Paper on Lineage GB populations outside the historic range of the Greenback Cutthroat Trout

Background

The greenback cutthroat trout (*Onchorhynchus clarki stomias*) was listed as an endangered species in 1967, under a precursor to the Endangered Species Act (Act). It was re-listed as endangered under the current Act in 1974, and downlisted to threatened status, with a 4(d) rule allowing catch and release fishing, in 1978.

Greenbacks are considered native to the headwaters of the South Platte and Arkansas River drainages in eastern Colorado, and a few headwater tributaries of the South Platte in a small area of southeastern Wyoming (Behnke 1992). Another cutthroat trout subspecies, the Colorado River cutthroat trout (*Onchorhynchus clarki pleuriticus*), occurs in the Colorado and Green River drainages in the west slope of Colorado, southwestern Wyoming, and eastern Utah.

Genetics and Taxonomic Issues

Since 2006, a number of genetic studies have been undertaken to try to determine the genetic relationships between greenback, Colorado River, and Rio Grande cutthroat trout (*Onchorhynchus clarki virginialis*) (Mitton et al. 2006, Metcalf et al. 2007, Metcalf 2007, Rogers 2008). Mitton et al. (2006) found all 3 subspecies to be closely related, and did not believe that any of them warranted subspecific designation. Metcalf et al. (2007) used molecular markers from the mitochondrial and nuclear genomes to analyze individuals from greenback and Colorado River cutthroat trout. Their studies revealed two divergent lineages within the ranges of greenback and Colorado River cutthroat trout consisting of 10 unique haplotypes, which they determined corresponded with the two described subspecies. These lineages are known as GB (greenback) and CR (Colorado River). Subsequent sampling and analysis found that of 45 assumed Colorado River cutthroat populations, 12 were assigned to lineage GB. In addition, of 12 assumed greenback populations present on the east side of the Continental Divide, 11 were assigned to the CR lineage (Rogers 2008). Since publication of Rogers (2008), additional sampling has identified additional lineage GB populations on the west slope of Colorado and in eastern Utah (Rosenlund 2009 pers. com). The current Rio Grande lineage populations seem to fit well within the Rio Grande drainage.

To determine whether any taxonomic revisions to greenback or Colorado River cutthroat trout should be proposed, the Greenback Recovery Team is working on two research projects: (1) Attempting to see if the lineage markers can be found in the few cutthroat trout samples collected in the 1800's, and currently stored in museums, and (2) Attempting to determine if there is a physical difference between the three DNA

lineages (greenback, Colorado River, and Rio Grande) through morphology and meristics analyses. Results of these projects are not expected for at least two years (Rosenlund 2009 pers. com.).

At this time, it is not known if the current distribution of the GB and CR lineages is: (1) natural, (2) the result of moving fish across river drainages (i.e. stocking), (3) or as the physical characteristics suggests, the GB and CR lineages are just part of a group of fish that have not been separated long enough to form separate physical characteristics (Rosenlund 2009 pers. com.). The results from the analysis of historical samples and the morphology and meristics analyses should help to resolve this issue.

Section 7 Issue

The identification of lineage GB fish in western Colorado and eastern Utah has raised concerns regarding whether there is a need for application of the Act (particularly section 7 consultation) in these areas. Although the greenback was listed rangewide, its distribution was designated only as Colorado. Thus any greenback lineage fish found in Utah or Wyoming would not currently receive any protections under the Act. However, a question remains as to whether or not cutthroat populations containing lineage GB fish in western Colorado should receive the protections of the Act. In an e-mail provided to the U.S. Forest Service (USFS) (Linner 2007), the Service stated that we are in an interim period where there are a lot of uncertainties. During this period, we believe that management agencies should be cautious with fishery-related activities until a thorough review of the new research findings can occur. In regard to consultation requirements under the Act, we therefore find it appropriate during this interim period to use the best scientific information available to determine if a USFS action may affect greenback cutthroat trout (GBCT), including GBCT that may occur outside its historic range in western Colorado. The USFS should determine the effects of any actions they fund or authorize where GBCT are present. If an action may affect GBCT, including those found on the west slope, initiation of consultation is appropriate. Although this e-mail was specific to USFS actions, the Service believes that all federal agencies should review their activities in a similar manner.

Colorado River Cutthroat Trout Conservation

The Colorado River cutthroat trout (CRCT) Conservation Team updated the Conservation Strategy and Agreement in March 2006. Signatories to the Agreement include the State wildlife agencies of Colorado, Utah, and Wyoming; the USFS, the Bureau of Land Management (BLM), and the Service (CRCT Conservation Team 2006). The purpose of the strategy is to provide a framework for the long-term conservation of the Colorado River cutthroat, and to reduce or eliminate the threats that warrant its status as a sensitive species or species of concern by federal and state resource agencies. The objectives of the strategy are to identify and characterize all CRCT core and conservation populations, secure and enhance conservation populations, restore populations, secure and enhance watershed conditions, public outreach, data sharing, and coordination. The three States, USFS, BLM, and the Service have committed to implement the strategy.

The Service believes that implementation of the CRCT strategy to conserve and protect Colorado River cutthroat trout populations throughout their range will also adequately protect any lineage GB populations. Therefore, agencies should include these activities in their Biological Evaluations/Assessments (BE/BAs) as conservation measures for lineage GB populations.

Process

To ensure an adequate Administrative Record for all agency actions that could be subject to section 7 consultation, it will be important for federal agencies to document the presence of lineage GB populations and the protective measures being incorporated for those populations, and to evaluate the effects of their actions on the populations in their BE or BA. The Service will issue concurrence letters, or initiate formal consultation if there are adverse effects that cannot be avoided. We would be happy to discuss specific projects with agency personnel during the development of a BE or BA. The Service's contact will be Patty Gelatt in Grand Junction (970-243-2778 x 26).

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