Range-Wide Status of Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis*): 2008

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This status assessment was a cooperative effort by the Rio Grande Cutthroat Trout Conservation Team. The purpose of this document is to provide a five-year status assessment of Rio Grande cutthroat trout. The information for this assessment came from a database that was developed by the Rio Grande Cutthroat Trout Conservation Team. Members of the Conservation Team are representatives of the signatory entities to the range-wide conservation agreement for Rio Grande cutthroat trout, including the Colorado Division of Wildlife, New Mexico Department of Game and Fish, U.S. Forest Service, U. S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, and Jicarilla Apache Nation.

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Executive Summary

The distribution and abundance of Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*; RGCT) have declined from historical levels over their entire range. For this RGCT range-wide status assessment we used existing information provided by 15 fisheries professionals applied through a consistent methodology to assess the extent of RGCT historical range, their current distribution, including genetic status, and evaluated the foreseeable risks to 120 populations designated as "conservation populations" by management agencies.

We estimated RGCT historically occupied about 6,660 miles of habitat in Colorado and New Mexico. RGCT currently occupy 810 miles of stream habitat in 14 of the 19 4th level HUC's historically occupied. RGCT currently occupy 12% of the stream miles within the historic range of the subspecies. Of the 810 currently occupied miles, 51 occur outside of our estimate of historical habitat. Eleven percent of historically occupied habitat is currently occupied, with an additional 1% of occupied habitat found above historic barriers in stream segments not believed to have been historically occupied but still within the historic range of RGCT.

Genetic testing has been completed across 598 miles of habitat (80% of occupied habitats). Sample size and genetic techniques applied were variable. RGCT with no evidence of genetic introgression currently occupy about 469 stream miles (58%) of occupied habitat. An additional 104 miles of occupied habitat were identified as containing genetically unaltered RGCT based on no record of stocking or by having no hybridizing species present. Most of the habitats currently occupied by RGCT (57% of currently occupied habitat) were on lands administrated by Federal agencies. Fifty-four percent of all occupied habitats occur on National Forests. An additional 19 miles were in designated National Parks and four miles were within Bureau of Land Management managed lands.

A total of 120 separate RGCT populations currently occupying 690 miles of habitat were designated as "conservation populations" (86% of currently occupied habitat, 10% of historical). These conservation populations were spread throughout the historical range, occurring in 14 of the 19 hydrologic units historically occupied by RGCT. Over ninety percent of these conservation populations were isolated from other populations, isolated populations occurred in 560 miles or 69% of occupied habitat; no well-connected meta-populations occurred in occupied habitat. Of the 120 designated conservation populations, 96 (79%) tested as genetically unaltered or were viewed as being potentially unaltered. More isolated populations were at higher risks due to temporal variability, population size, and isolation than meta-populations, but these isolated populations were generally at less risk from hybridization and disease than meta-populations.

This assessment shows RGCT currently are distributed across their northern historical range, with no populations persisting in southern portions of the historical range. The data suggest genetically unaltered RGCT occupy at least 58% and possibly up to 71% of currently occupied habitats. Two different conservation management strategies are being implemented to conserve RGCT. One strategy concentrates on preventing introgression, disease and competition risks through isolation of RGCT, while the other concentrates on preserving or re-establishing meta-

population function and multiple life-history strategies by connecting occupied habitats. Currently, most conservation populations are isolated although there are ongoing restoration efforts to create meta-populations.

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Introduction

Within the last two decades, assessments have been conducted related to the status of Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*; RGCT) over part or all of their historical range (Behnke 1992, Rinne 1995, Stumpff and Cooper 1996, Behnke 2002, Pritchard and Cowley 2006). These assessments were either conducted over only a portion of RGCT historical range, involved a small number of experts with specific detailed knowledge of the assessment area, or were constrained by a lack of consistency in the sources of information and criteria used. In addition, the RGCT Conservation Team has been tracking the status of RGCT since 2006. This report is meant to update these past assessments using a protocol consistently applied throughout the RGCT historical range. We assessed historically occupied range, current distribution, general abundance, genetic status, and risks for RGCT throughout their historical range. Fisheries professionals from Colorado and New Mexico (state wildlife agencies, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, Jicarilla Game and Fish, and Bureau of Land Management) provided the information for this assessment. State fisheries staffs identified and designated "conservation populations", but information from many different sources was used to assess risks and threats to these populations. The information for this status update was compiled from RGCT Conservation Team workshops during 2006 and 2007. This assessment was accomplished as a critical component of range-wide coordination for RGCT conservation under the guidance of the 2003 Conservation Agreement (RGCT Conservation Team 2003). This status update will be helpful in meeting the objectives of the range-wide conservation effort in a number of respects, and should be viewed as a "snap shot" for RGCT distribution, relative population health and a valuable benchmark for evaluating future changes. This assessment provides consistent information on the status of RGCT through 2006 and is intended to be used as an information base by individual states and other agencies, working collaboratively to assess, plan and prioritize their ongoing and future RGCT conservation efforts, and by the U.S. Fish and Wildlife Service (FWS) in relation to their responsibilities under the federal Endangered Species Act of 1973, as amended (ESA).

The two states where RGCT presently occur (Colorado and New Mexico) have the primary responsibility under their respective state wildlife laws to manage and conserve RGCT. The U.S. Forest Service (FS), Bureau of Land Management (BLM), National Park Service (NPS), Tribal governments, and other federal land and resource management agencies play an essential role in this conservation effort because of their legal responsibility for ensuring species viability and for management of aquatic habitats on federal and Tribal lands. Through the petition process of ESA, the FWS concluded in a 90-day finding in September 1998 that a February 1998, citizen-based petition to list RGCT did not contain sufficient or substantial information to indicate a listing may be warranted (63 FR 49062). In 2002, following a candidate status review the FWS determined that listing of RGCT was not warranted. In summer 2003, a cooperative conservation strategy and agreement was signed by the Directors of the two State wildlife agencies, Regions 2 and 3 of the FS, Regions 2 and 6 of the FWS, Jicarilla Apache Nation (JAN), NPS, and BLM. The above parties recognize the mutual benefits of collaboration to further the collective knowledge of this subspecies, implement conservation actions, and provide the best scientific information as the basis for RGCT conservation. The FWS initiated a new status review of RGCT in 2007 and it is expected for release in 2008.

Analysis Area

The analysis area included the known historical range of RGCT within Colorado and New Mexico. RGCT historic range was delineated from historic records documented by Behnke (1992, 2002) (**Figure 1**). This area includes the mountainous portions of the Upper Rio Grande, Canadian and Pecos drainages within Colorado and New Mexico, comprised by the Canadian, Rio Grande Headwaters, Lower Rio Grande and Pecos river drainages. Populations of this subspecies occurring outside designated historical range have not been recognized to date by fisheries experts within this cooperative program. The current range-wide conservation effort partitioned RGCT range into four Geographic Management Units (GMU's). These watershed-based GMU's were designated to allow for more focused conservation planning and implementation at a finer scale of resolution.

Methods

An interstate and interagency working group of fishery biologists, managers, and GIS specialists representing the states of Colorado, New Mexico, BLM, NPS, JAN, and FS met May 18-19, 2006, in Raton, New Mexico to initiate a range-wide effort to update status information for RGCT. This group agreed the assessment would include: 1) estimating the historically occupied range; 2) determining current distribution and identifying specific population characteristics; 3) identifying conservation populations and assessing relative population health using a ranking system similar to that proposed by Rieman et al. (1993); and 4) evaluating expansion and restoration potential of conservation populations. The group recognized such an assessment would be based primarily on expert opinion supported by existing empirical data and in some cases, particularly when historically occupied range was assessed, the assessment would be more qualitative. Field data were used in most cases. The Rio Grande cutthroat trout protocol summarized below was developed by Bruce May and Shannon Albeke and is a modified version of protocols used for the westslope (Shepard et al.2003), Yellowstone (May et al. 2003), Colorado River (Hirsch et al. 2006) and Bonneville (May et al. 2005) cutthroat trout assessments. Appendix A contains a detailed description of the protocol. This protocol and the status assessments produced by it have been relied upon by the FWS for status reviews of the above mentioned cutthroat trout subspecies.

Geographic Information System

This assessment used the National Hydrography Dataset (NHD) as the base for the effort (see **http://nhd.usgs.gov/** for more information on NHD). We used the 1:24,000 scale of NHD as available. Some watershed areas required using the 1:100,000 scale. The USFS Natural Resource Information System (NRIS) provided ArcGIS tools that greatly assisted with this process. To increase continuity and consistency, only streams identified on the stream layer as being perennial had information entered into the database. We acknowledge intermittent and ephemeral streams may provide habitat used by RGCT during specific periods when sufficient flows occur; however this assessment did not include these streams. Consequently, we may have underestimated both historically and currently occupied habitats. We also acknowledge some perennial streams that historically and/or currently support RGCT will not be shown on the stream layer and therefore they will not be included in this assessment. It is anticipated these streams will be added in the future during subsequent efforts to improve NHD. However NHD is the best hydrography layer currently available and it is the national standard.

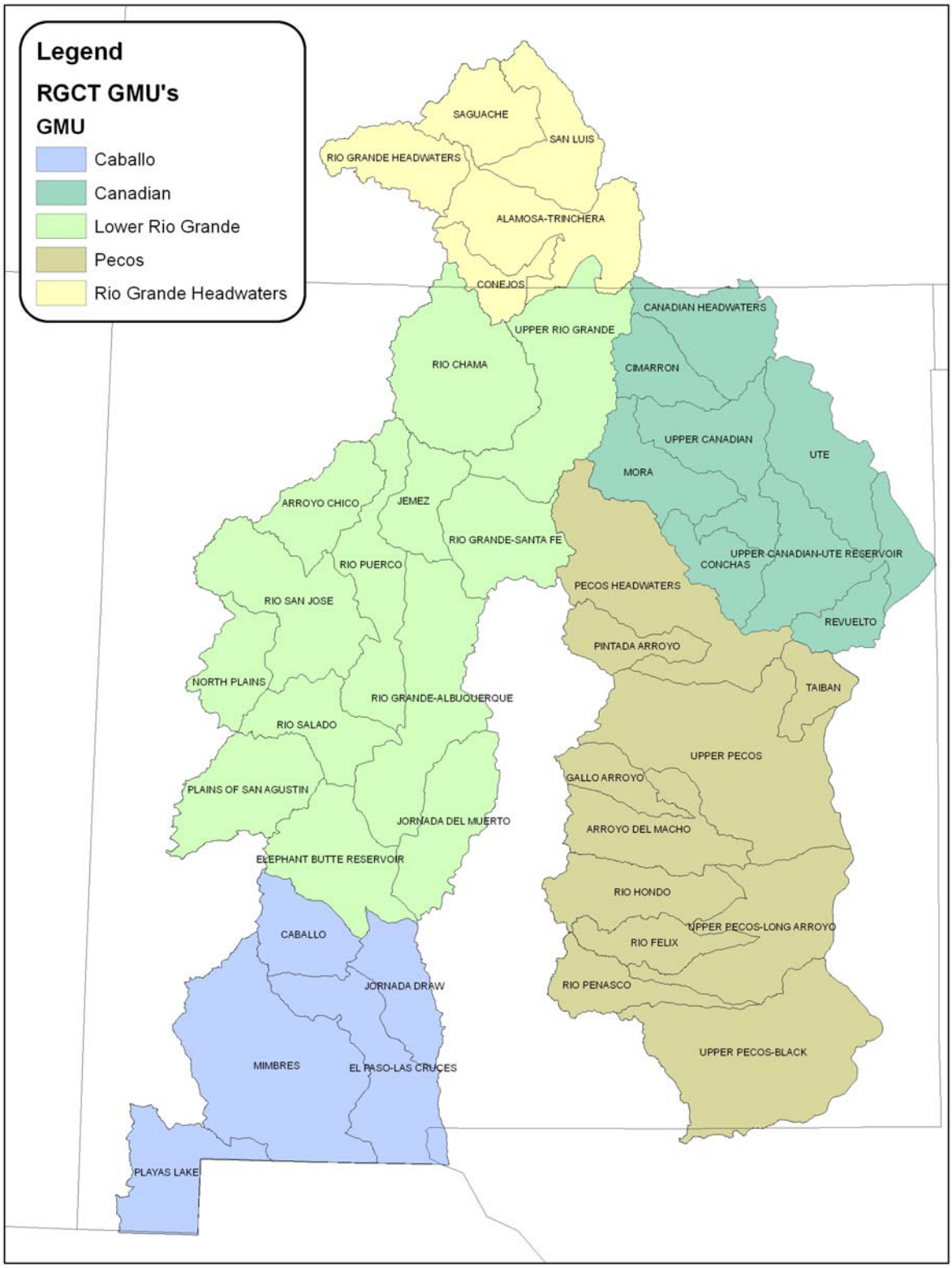


Figure 1. RGCT geographic management units based on second level hydrologic unit boundaries.

Data Quality Control and Assurance

This study ranked the reliability of information based on its source (**Table 1**). Information associated with judgment calls and anecdotal sources, in general, were viewed as being less reliable and/or accurate than information developed as part of detailed surveys and studies that has undergone substantial analysis and review.

In order to assure consistency and completeness, a specific work group (team) completed the assessment of a given 4th level hydrologic unit code (HUC, 8-digit EPA designation) before moving to another HUC. There were 19 4th level HUCs in basins that historically supported RGCT. During the assessment of each HUC, the teams employed a systematic approach by starting at the mouth of the largest stream and proceeding to its headwaters. Each tributary system beginning in a clockwise fashion and starting at the lower most portion of the main stream was completed using the same orderly process. The actual stream layers were attributed through a database with the specific information developed during the status update using fish biologists and a GIS-data entry person as a critical members of the team.

Table 1. Ranking of the relative reliability of data sources.

Information Source	Relative Degree of Reliability
Professional Judgment	Lower
Anecdotal Information	Lower
Letter	Lower
News Account	Lower
Data Files	Moderate
Agency Report	Moderate
Published Paper	Higher
Thesis or Dissertation	Higher

The assessment protocol was partitioned into four primary components for conducting this assessment. First, the historical range occupied by RGCT at the time of the first European exploration (approximately 1800) of the Southern Rocky Mountains was estimated. Second, the current distribution with density, genetic status and habitat information for RGCT was developed and displayed on a mapping segment basis. Third, conservation populations were identified and classified as either isolated or meta-populations (networked or connected populations – e.g., interbreeding populations) and their relative health was evaluated. Relative health was assessed based on three aspects: 1) influences associated with genetic introgression, 2) influences associated with disease, and 3) a general population health determination. Health determinations represented relative determinations indicating a higher or lower level of concern. The mapping and population health determinations were completed for all conservation populations including those associated with lakes (adfluvial) that are maintained by natural reproduction. RGCT populations supported entirely by annual or routine stocking were not included as part of this assessment. Exceptions would be those populations serving as a wild broods that require periodic stocking to bring in new genetic material as part of the brood maintenance plan. Genetic, disease and population risk assessments were done for each conservation population. Fourth and finally, the assessment included evaluation of the potential for restoration of

conservation populations within the historical boundary and for the expansion of existing conservation populations.

Barriers

Prior to delineating historically and currently occupied habitats, we identified all significant barriers to upstream fish movement. Barriers (either long-term geologic, natural short-term, or anthropogenic) that prevented or dramatically reduced upstream fish movement were considered "significant" and long term-geologic barriers were used to assess whether individual stream segments were likely historically occupied by RGCT, assess potential influences of genetic introgression or disease to existing RGCT populations, and determine whether existing subpopulations were connected with other subpopulations. The identification of barrier location and distinguishing characters was very important. During the effort to describe the historical distribution of the subspecies, we identified those barriers that represent long-term geologic features that may have influenced historical distributions. These barrier locations were located (as points in ArcGIS) on the population mapping segments. Before mapping current distribution, we identified other significant barriers (e.g., natural short-term and/or anthropogenic barriers), their locations (as points in ArcGIS), and other relevant features, including barrier type, blockage extent, and barrier significance. Only those barriers believed to have a significant influence on cutthroat distribution or population integrity (life history expression, spawning, competition and hybridization) were identified. Data sources for barriers were also identified. If the barrier extended over an extended distance (e.g., temperature or chemical barrier) the downstream point of the barrier was marked on the map.

Part 1 - Determining Historical Distribution

The historically occupied range of RGCT was assessed based on the believed distribution at the time Europeans first entered the Rocky Mountain West (approximately 1800). We recognize the fact that Spanish settlers entered this area prior to the selected reference period. The extent of activities leading to the decline of RGCT, however, was perceived to be minor prior to 1800. This assessment was done at a relatively coarse level. There was an initial effort to adjust the base stream layer by identifying the lower extremes of historical distribution based on the lowest probable elevation limits (6000 feet in elevation or 5500 feet on north-facing slopes). Fishery professionals familiar with each major drainage basin (4^{th} code HUC) defined historical distribution for the remaining stream mapping segments within each 4^{th} code HUC by identifying the historical range based on their personal knowledge of the area, known anecdotal information, known habitat restrictions, known geologic barriers, and historical fisheries data and reports. This information was used to edit RGCT historical range maps. RGCT were assumed to have occupied all stream segments within the adjusted base stream layer of their known historical distribution unless information or professional judgment indicated RGCT likely did not occupy specific mapping segments of stream.

Part 2 - Determining Current Distribution, Genetic Status, Density and Habitat Conditions

The lower and upper bounds of all stream segments presently occupied by naturally self-sustaining populations of RGCT were located and data sources associated with the individual characteristics of the occupied segments were identified. Each 4^{th} level HUC working group made initial determinations on occupied habitat based on viewing the map and referring to available information. When there was no upstream barrier or distribution survey available, professional judgment was used to determine upstream distribution and, less commonly,

downstream distribution. Specific information associated with current occupancy was tracked on a stream segment basis. Barrier locations, fish stocking records, genetic information, cutthroat trout population demographics, and information on habitat and nonnative fish were important in these determinations. Each identified segment must have all attributes in common. If one or more attributes changed, a new segment was created.

Part 3 - Identification of Individual Conservation Populations and Application of Relative Health Evaluations for each Population

For this stage of assessment the focus changed from RGCT-occupied mapping segments to conservation populations and the factors that have the potential to influence the well-being of the identified populations. Determinations were made relative to which occupied mapping units were combined into a specific conservation population with conservation being the primary management objective. In general, stream segments and adjacent streams were combined into one conservation population if there were no complete barriers restricting movement between them; however exceptions were made at the discretion of the local biologist. Conservation populations were further categorized based on connectedness into meta-populations or as isolated populations. To be considered connected in a meta-population, a total barrier could not be present within the meta-population's stream network. Both meta-populations and isolated populations were identified as conservation populations. Conservation populations were categorized as genetically unaltered (i.e., core conservation populations), or displaying unique life history traits, ecological or behavioral characteristics, and/or generally having less than 10% introgression (i.e., conservation populations) (UDWR 2000). Life history attributes of the population and status of the conservation population as a source or a sink were identified. A population was considered a "source" if individuals could move into another population, providing a source of gene flow to the receiving population. A population was considered a "sink" if it could receive individuals from another population. Information on conservation activities, land-use and fishery management were identified for each conservation population. *The level of impact or effectiveness of these activities was not described, listing merely means that these things occurred in the occupied watershed.*

Conservation Population Health Evaluations

Only conservation populations were evaluated for relative genetic and disease influences and general population health. It is important to note these evaluations did not and should not define inherent probability of persistence or exclusion but rather identified index conditions indicating varying degrees of individual population risk.

Genetic Stability Assessment A genetic stability index was made for each conservation population (e.g., networked or isolated) using an index ranking of 1 to 4 to indicate low to progressively higher levels of possible risk. The index should be viewed merely an indicator of possible or potential genetic influences.

Significant Disease Influence Assessment A significant disease influence assessment was made for each meta- (networked) or isolated population using a ranking of 1 to 5 to indicate low to progressively higher levels of risk associated with the possible or potential influence of significant diseases. Population isolation and security were important considerations but do not assure protection. The diseases of concern are those that cause severe and significant impacts to population health and include but are not limited to whirling disease, furunculosis, infectious

pancreatic necrosis virus, etc. The level of influence should be viewed as an indicator of possible or potential disease influences.

Conservation Population General Health Assessment

A generalized population health assessment was completed for each meta- or isolated population using an index ranking that includes consideration of four factors: temporal variability relative to stochastic influences (based on habitat size), adult population size, environmental attributes affecting population production, and population connectivity based on Rieman et al. (1993). The ranking for temporal variability was derived as a cumulative length total of stream segments identified as being part of the conservation population. Population size of RGCT (12 cm and larger) were derived from the density information associated with the stream segments identified for each conservation population (Shepard et al. 2003, Young and Guenther-Gloss 2004). This size range was believed to reasonably reflect that component of a RGCT population that can be viewed as sexually mature (e.g., approximating an effective population). Population production ranking was derived from stream segment information associated with habitat quality, presence of non-native fish, potential for disease and the level of land use interaction with the population. The degree of connectedness was based on migration of individuals, the presence of subpopulations and opportunity for gene flow between them, and the relative ease of movement between them. The index value for general population health is just a qualitative assessment of possible or potential health.

The population assessment identified source/sink relationships that may exist between headwater RGCT conservation populations and those conservation populations lower in the drainage, especially where barriers to upstream movement might exist. While headwater RGCT populations may include those isolated by impassible barriers to upstream fish movement (and thus could not be re-founded or receive external genetic material without human intervention), these headwater populations may be important sources for re-founding and augmenting lower populations. This was handled by a simple identifier indicating that a given population operates as a source. The most downstream population would automatically become a "sink" recipient.

Part 4 - Evaluation of Potential RGCT Population Restoration and Expansion Opportunities.

This evaluation was based on an initial range-wide review of stream segments not currently associated with conservation populations. The potential for restoration and/or expansion of RGCT populations was assessed during this evaluation. Similar to the mapping exercise associated with currently occupied stream segments, lower and upper bounds of all stream segments viewed as having the potential to support RGCT were identified and evaluated. Using the base hydrography layer within each 4th level HUC overlaid with current RGCT occupied habitat, conservation population and barrier locations, each team systematically identified and evaluated RGCT restoration and expansion potentials on a stream segment basis.

The assessment teams identified and grouped as many connected stream segments as possible. Locations of existing barriers, or potential sites where a barrier could be constructed, were an important component for locating downstream boundaries of potential restoration areas, as was 1) fish stocking and/or nonnative fish presence, 2) habitat quality attributes, and 3) significance of any fishery present. Each identified stream segment had all attributes in common or, if one or more attributes changed, a new segment was created. The relative complexity of removal

(chemical and/or physical removals) of any existing fish within the potential restoration or expansion segment was also identified as a fourth variable.

A generalized restoration opportunity assessment for each potential restoration stream segment was performed by ranking the latter four variables identified above. The ranking for each restoration variable was derived from the information and judgment of the working group doing the assessment. Ranking scores for each of the four variables are presented in Appendix A. The ranks assigned to each of the variables were combined into a rating of overall restoration potential for each stream segment. The four variables were weighted equally to derive the overall restoration ranking. The overall score was divided into logical rankings associated with restoration potential (High Restoration Potential = 4 to 6; Intermediate Restoration Potential = 7 to 9; Low Restoration Potential = 10 to 13; and, Very Low Restoration Potential = 14 to 16). If a complete barrier occurred in the lower portion of a segment, the ranking was elevated to the next higher restoration or expansion rank. The identification of one or more unknown conditions associated with the restoration variables resulted in labeling that segment as having unknown restoration potential.

Workshops, Assessment Teams, HUC's, GMU's and the Geo-database

Two workshops were held to obtain the information for this status assessment. Workshops were held in Monte Vista, Colorado in summer of 2006 and spring of 2007. Parts 1-3 of the assessment were completed at the 2006 workshop. At each workshop a systematic application of the assessment protocol was undertaken (**Appendix A**). A total of 15 fisheries professionals from state, federal and tribal agencies provided the information used in this assessment. In addition to the fisheries professionals, two GIS and data management specialists (one with a fisheries background) also participated in these workshops to assist with data entry and display of status information (**Appendix B**). Consistency was maintained by having the same two individuals with specific knowledge of the protocol attend both workshops. To the degree possible, information on RGCT was verified and edited at each workshop. A second workshop was held during the spring of 2007 to complete Part 4 of the protocol, correct errors found during data validation, and insert data collected during the summer of 2006. Data validation consisted of comparing the conservation population information in this database to the existing databases and files maintained by the RGCT conservation team. Information stored in individual databases was available in hard copy files or in computer databases brought to the workshops by the participants to assist them in providing information for the status assessment. The RGCT Conservation Team has committed to annual updates of the database during which new information will be added and corrections will be made.

The fisheries professionals that completed this assessment had experience levels ranging from several months to several decades. Collectively, these fishery professionals had a combined total of 171 years of professional fisheries experience, of which 127 years were directly applicable to RGCT conservation and management. Several of the participants had Master of Science degrees (5), nine had Bachelor of Science degrees, and two had Bachelor of Arts degrees.

Results and Discussion

Initially 40, 4th level HUC's were included in this status update. A total of 19 HUC's were judged to contain stream segments defined as historical habitat. Twenty-one HUC's were excluded from further analysis because there was a consensus that these HUC's were not historically (circa 1800) occupied by RGCT. The base NHD stream coverage included a variety of channels including perennial streams, ephemeral and intermittent channels, ditches, and canals. The status assessment attempted to refine the NHD layer by removing all ditches, canals, most ephemeral and intermittent channels and other habitats deemed as incapable of supporting RGCT. Ditches currently supporting RGCT were retained.

Historical Range

As described in the methods section, the historical perspective for this status update was based on habitat believed to be inhabited by RGCT circa 1800. In general, streams currently capable of supporting trout were assumed to have been historically occupied if they were not above a historical barrier. Conversely, streams which cannot currently support trout were assumed not to have been historically occupied unless they were known to be degraded by such things as water withdrawals, channel alterations, human-caused barriers, or chemical contamination. At the completion of the systematic review, 6,660 miles of stream habitat were identified as having the potential of being historically occupied by RGCT (**Figure 2**). The estimated amount of historical range in each state was about 3,229 miles in Colorado (48%), and 3,431 miles (52%) in New Mexico (**Figure 3**). The historical range subdivided by GMU was 638 miles (10%) in Canadian, 3,279 miles (49%) in Rio Grande Headwaters, 2,110 miles (32%) in Lower Rio Grande, 10 miles (.2%) in Caballo, and 623 miles (9%) in Pecos.

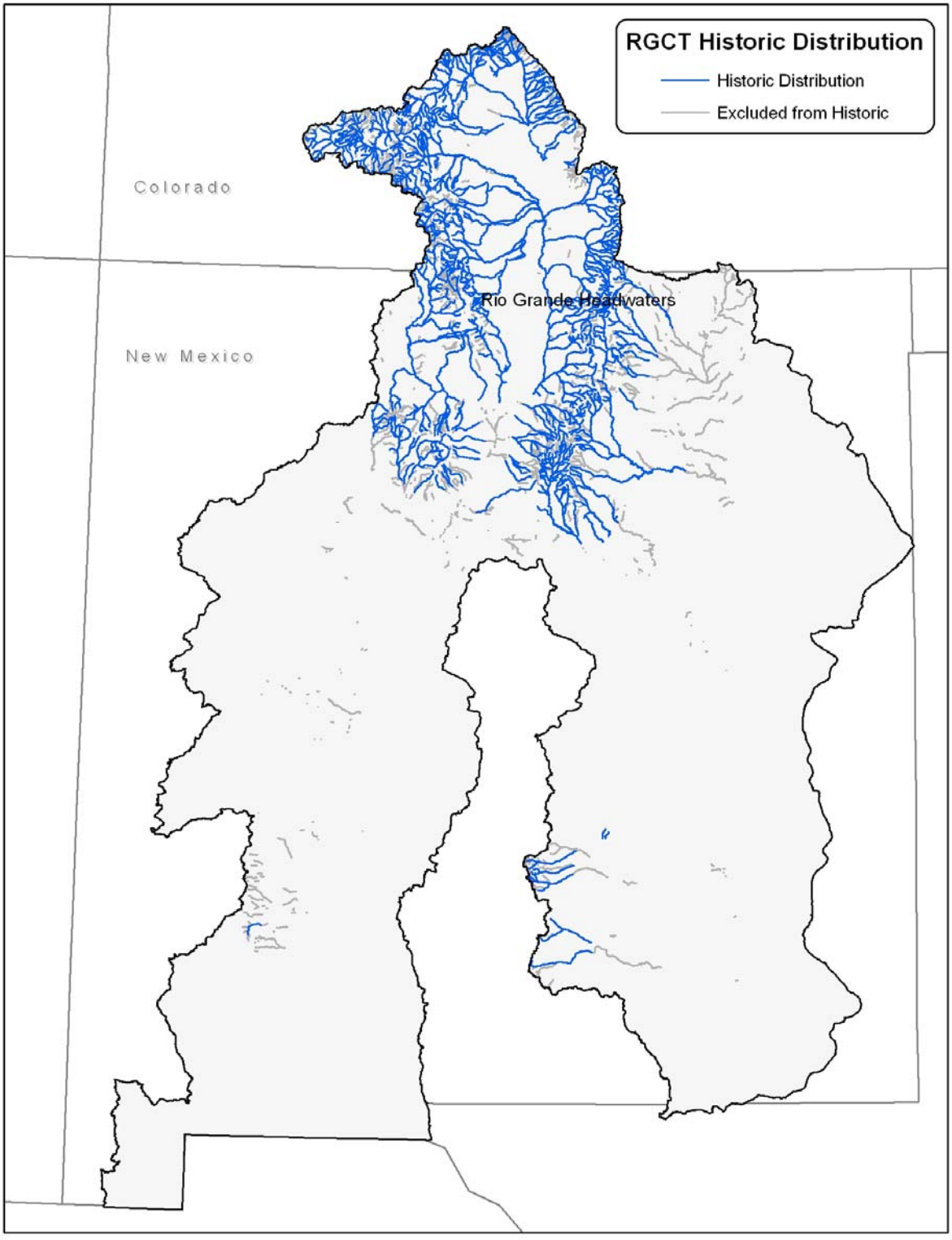


Figure 2. Streams included (blue) as part of the historical distribution and perennial streams excluded (gray) from the stream layer for historically occupied watersheds.

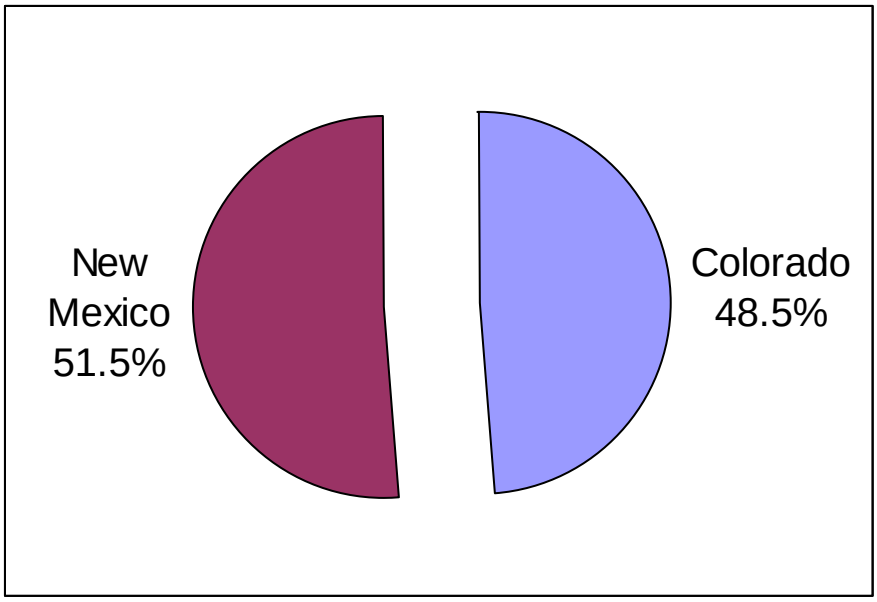


Figure 3. Percent of the 6,660 miles of historically occupied streams by state.

Current Distribution

RGCT currently occupy about 809.5 miles of habitat (**Figure 2**) of which 51 miles occur outside delineated historical habitats. RGCT currently occupy about 348.4 miles in Colorado (43% of total currently occupied habitat; 10.6% of Colorado historical habitat) and 461.2 miles in New Mexico (57% of total current; 13.4% of historical) (**Figure 4**). The Rio Grande Headwaters GMU contained the largest amount of occupied habitat (348.4 stream miles), followed by the Lower Rio Grande GMU (317.3 mi.), Canadian GMU (103.8 mi.), and Pecos GMU (40.1 mi.). The Caballo GMU contains a significantly hybridized population of cutthroat trout that was not included within the current distribution of RGCT. RGCT occupied habitat in 14 of the 19 fourth level HUC's determined to support historical habitat (**Table 2**). They are believed to be extirpated from the following 5 fourth level HUC's: Arroyo Del Macho, Caballo, Upper Canadian, Rio Hondo and Rio Penasco.

Persistence (the amount of historical habitat still occupied) varied from 6% in the Pecos GMU, to 16% in the Canadian GMU. While the Rio Grande Headwaters only contains 11% of the historical habitat, it has 43% of the currently occupied stream miles (**Table 2**).

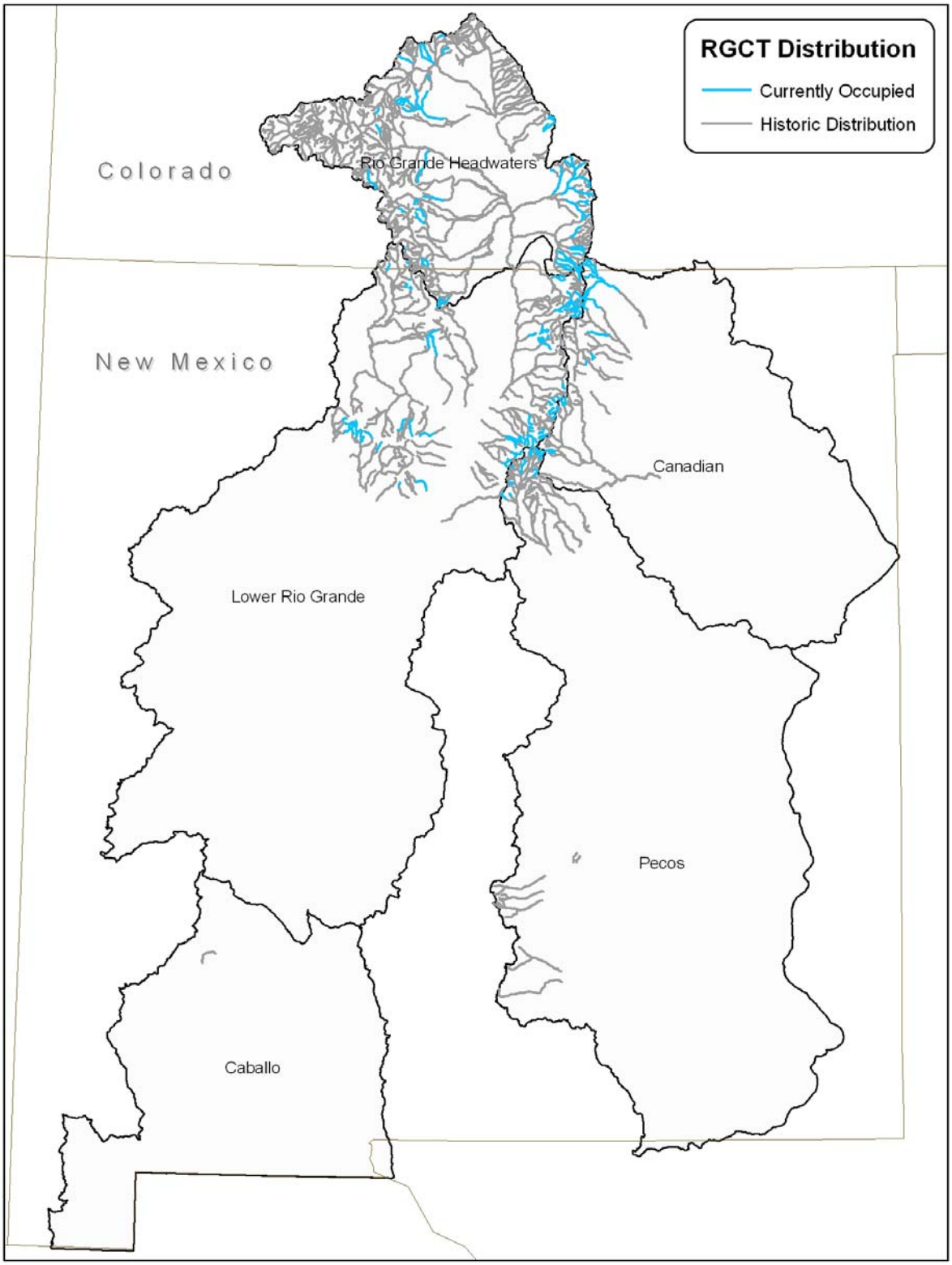


Figure 4. Currently occupied stream segments supporting RGCT overlaying the historically designated habitat.

Table 2. Currently occupied RGCT habitat presented by hydrologic unit and percentage of historically-occupied habitat. All watersheds within each GMU are presented.

HUC code	Unit Name	Historical Miles (percent of total historical miles)	Currently Occupied Miles (percent of total currently occupied miles)	Percent of Unit Historical Habitat Currently Occupied
11080001	Canadian Headwaters	88.9 (1.3%)	56.8 (7.0%)	63.9%
11080002	Cimarron	256.9 (3.9%)	31.6 (3.9%)	12.3%
11080003	Upper Canadian	14.4 (0.2%)	0	0.0%
11080004	Mora	277.5 (4.2%)	15.3 (1.9%)	5.5%
11080005	Conchas	0	0	
11080006	Upper Canadian-Ute Res	0	0	
11080007	Ute	0	0	
11080008	Revuelto	0	0	
	Canadian GMU total	**637.7 (9.6%)**	**103.8 (12.8%)**	**16.3%**
13010001	Rio Grande Headwaters	812.1 (12.2%)	15.1 (1.9%)	1.9%
13010002	Alamosa-Trinchera	947.6 (14.2%)	201.3 (24.9%)	21.2%
13010003	San Luis	510.6 (7.7%)	14.2 (1.8%)	2.8%
13010004	Saguache	543.0 (8.2%)	94.4 (11.7%)	17.4%
13010005	Conejos	465.4 (7.0%)	23.4 (2.9%)	5.0%
	Rio Grande Headwaters GMU total	**3278.6 (49.2%)**	**348.4 (43.0%)**	**10.6%**
13020101	Upper Rio Grande	943.6 (14.2%)	207.4 (25.6%)	22.0%
13020102	Rio Chama	809.5 (12.2%)	54.6 (6.7%)	6.7%
13020201	Rio Grande-Santa Fe	76.8 (1.2%)	9.8 (1.2%)	12.8%
13020202	Jemez	222.4 (3.3%)	32.4 (4.0%)	14.6%
13020203	Rio Grande-Albuquerque	0	0	
13020204	Rio Puerco	57.8 (0.9%)	13.1 (1.6%)	22.6%
13020205	Arroyo Chico	0	0	
13020206	North Plains	0	0	
13020207	Rio San Jose	0	0	
13020208	Plains of San Agustin	0	0	
13020209	Rio Salador	0	0	
13020210	Jornada Del Muerto	0	0	
13020211	Elephant Butte Reservoir	0	0	
	Lower Rio Grande GMU total	**2110.2 (31.7%)**	**317.3 (39.2%)**	**15.0%**
13030101	Caballo	10.4 (0.2%)	0.0	0.0%
13030102	El Paso-Las Cruces	0	0	
13030103	Jornada Draw	0	0	
	Caballo GMU total	**10.4 (0.2%)**	**0.0 (0.0%)**	**0.0%**
13060001	Pecos Headwaters	452.6 (6.8%)	40.1 (4.9%)	8.9%
13060002	Pintada Arroyo	0	0	
13060003	Upper Pecos	0	0	
13060004	Taiban	0	0	
13060005	Arroyo Del Macho	7.9 (0.1%)	0.0	0.0%
13060006	Gallo Arroyo	0	0	
13060007	Upper Pecos-Long Arroyo	0	0	
13060008	Rio Hondo	96.1 (1.4%)	0.0	0.0%
13060009	Rio Felix	0	0	
13060010	Rio Penasco	66.5 (1.0%)	0.0	0.0%
13060011	Upper Pecos-Black	0	0	
	Pecos GMU total	**623.2 (9.4%)**	**40.1 (4.9%)**	**6.4%**
	GRAND TOTAL	**6660 (100.0%)**	**809.5 (100.0%)**	**12.2%**

In many 4th level watersheds, restoration efforts improved the proportion of RGCT persistence when compared to historical habitats. Currently occupied RGCT habitats created by introduction and population expansion are presented in **Table 3**.

Table 3. Percent of historical habitat occupied in currently occupied RGCT watersheds and the number of refounded or expanded populations, number of miles of occupied habitat outside the historical range, and historical habitat density.

Name	Miles of refounded or expanded populations	Occupied miles outside historical range	Percent of Historical Occupied	Historical Habitat Density (mi/mi^2)
Canadian Headwaters	12	0	63.9%	0.05
Cimarron	14	0	12.3%	0.25
Mora	3	0	5.5%	0.19
Canadian GMU total	**29**	**0**	**16.3%**	**0.10**
Rio Grande Headwaters	0	0	1.9%	0.61
Alamosa-Trinchera	67	4	21.2%	0.37
San Luis	14	18	2.8%	0.32
Saguache	6	0	17.4%	0.41
Conejos	4	1	5.0%	0.58
Rio Grande Headwaters GMU total	**91**	**23**	**10.6%**	**0.43**
Upper Rio Grande	26	18	22.0%	0.29
Rio Chama	8	3	6.7%	0.26
Rio Grande-Santa Fe	0	0	12.8%	0.04
Jemez	7	0	14.6%	0.21
Rio Puerco	17	0	22.6%	0.03
Lower Rio Grande GMU total	**59**	**20**	**15.0%**	**0.18**
Pecos Headwaters	15	8	8.9%	0.12
Pecos GMU total	**15**	**8**	**6.4%**	**0.17**
GRAND TOTAL	**194**	**51**	**12.2%**	**0.23**

Genetic Status

Genetic testing of RGCT across all of the currently occupied area has not been completed and existing tests were not conducted in a random fashion. Consequently, the available genetics information does not constitute a representative sample taken from the entire RGCT population. Instead, there was a tendency to sample fish from known populations and from newly discovered populations that appeared to be typical of the RGCT phenotype. Genetic sampling has been conducted in over 598 miles of occupied habitats (80% of occupied habitats). Results of genetic sampling were extrapolated across the currently occupied segment from which the sample was taken. No evidence of introgression was found from samples covering about 469 miles (78 % of tested area, 58 % of occupied habitats, and 7% of historical habitats; **Table 4**; **Figure 5**). RGCT identified in 104 miles (13% of occupied habitats and 2% of historical habitats) were suspected of being genetically unaltered, based on the absence of introduced hybridizing species and the lack of records that identify stocking of hybridizing species, good meristic characteristics, or the population was adjacent to a pure population. RGCT in about 129 miles (16% of occupied habitats or 2% of historical habitat) were hybridized based on genetic testing. Another 108 miles of occupied habitat (13% of occupied habitats and 2% of historical habitats) were identified as having the potential of being hybridized due to the presence, or past stocking, of hybridizing nonnative species or subspecies (**Table 4**). Genetic results associated with each GMU are presented in **Table 5**.

Table 4. Genetic status for Rio Grande cutthroat trout by stream length (miles) within their current range as of 2007.

Genetic status		Miles	% of occupied	% of historical
Tested; Unaltered (<1% introgressed)		468.6	57.9%	7.0%
Tested; ≥1% to ≤10% introgressed		100.6	12.4%	1.5%
Tested; >10% to ≤20% introgressed		13.7	1.7%	0.2%
Tested; >20% introgressed		14.8	1.8%	0.2%
Suspected Unaltered		103.7	12.8%	1.6%
Potentially Altered		108.1	13.3%	1.6%
TOTAL		**809.5**		**12.2%**

Table 5. Stream miles currently occupied by Rio Grande cutthroat trout by genetic status in each GMU.

	GMU			
Genetic status	**Canadian**	**Lower Rio Grande**	**Pecos**	**Rio Grande Headwaters**
Tested; Unaltered (<1% introgressed)	51 (49.2%)	158 (49.7%)	20 (49.9%)	240 (68.8%)
Tested; ≥1% to ≤10% introgressed	8 (8.0%)	61 (19.2%)	12 (29.3%)	20 (5.6%)
Tested; >10% to ≤20% introgressed	6 (5.7%)	3 (1.0%)	3 (6.9%)	2 (0.5%)
Tested; >20% introgressed	0	10 (3.2%)	0	5 (1.4%)
Suspected Unaltered	22 (21.0%)	34 (10.7%)	4 (8.7%)	44 (12.7%)
Potentially Altered	17 (16.0%)	51 (16.2%)	2 (5.2%)	38 (10.9%)
Total	**104 (100.0%)**	**317 (100.0%)**	**40 (100.0%)**	**348 (100.0%)**

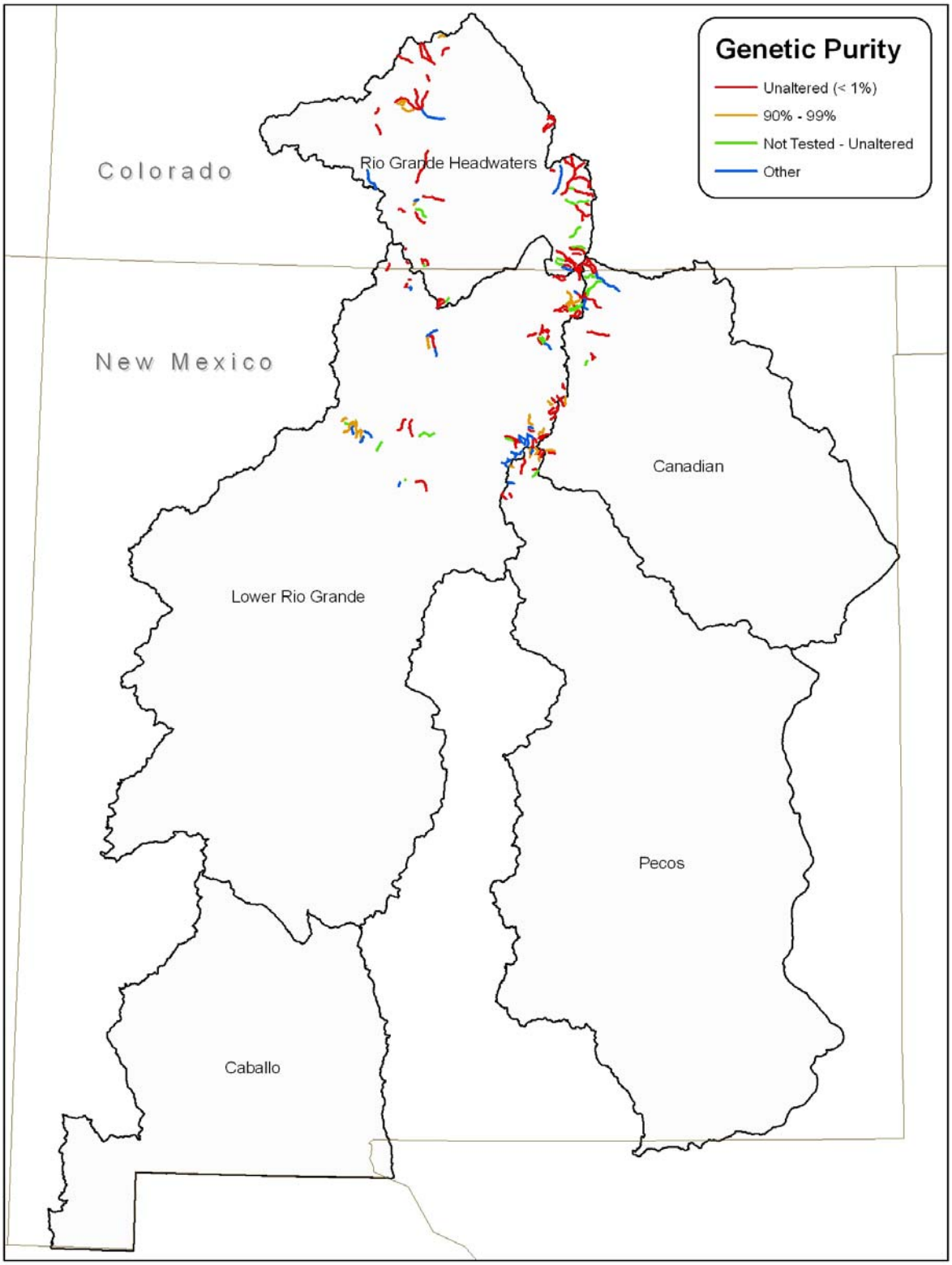


Figure 5. Genetic status of currently occupied RGCT stream segments.

Elevation

RGCT occupied elevations ranged from about 6,000 feet to over 12,500 feet. The elevation range of historical habitat was slightly larger (**Figure 6**). Sixty-nine percent of currently occupied habitat was between 8,500 and 11,000 feet. Only 48% of historical habitat occurred in that range. Cutthroat persistence (how much historical habitat is still occupied) ranged from 13% to 21% between 8,000 and 10,500 feet (**Table 6**).

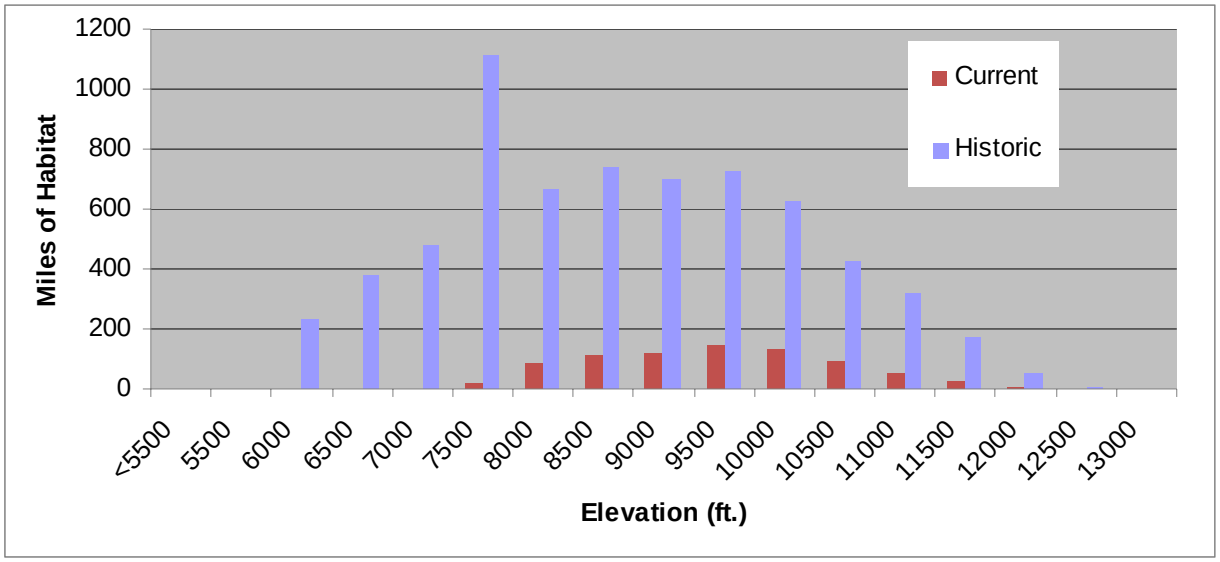


Figure 6. Histogram of elevation of historical and currently occupied habitat.

Table 6. Amount of historical and currently occupied habitat by elevation range and the percent of historical occupied by elevation.

Elevation (feet)	Miles occupied	Miles of historical	% of historical occupied
<5500	0.0	0.0	0.0%
5500	0.0	2.0	0.0%
6000	2.4	230.5	1.0%
6500	0.6	381.6	0.2%
7000	3.1	478.5	0.7%
7500	19.4	1,111.8	1.7%
8000	83.8	668.9	12.5%
8500	115.0	740.7	15.5%
9000	120.6	698.1	17.3%
9500	147.9	727.3	20.3%
10000	135.8	629.5	21.6%
10500	91.4	427.5	21.4%
11000	54.8	321.9	17.0%
11500	27.7	176.0	15.7%
12000	5.7	55.8	10.2%
12500	0.9	4.7	19.2%
13000	0.0	1.8	0.0%

Rio Grande Cutthroat Trout Densities

Densities of RGCT (≥ 12 cm) were based on number of adults per mile for each steam segment. Densities were summarized into density ranges by state (**Table 7**) and included all RGCT occupied streams regardless of genetic purity. A total of 130 miles of occupied habitat (16% of currently occupied habitat) supported populations identified within the 0 to 50 fish/mile range. Densities of 51-150 and 151-400 RGCT/mile of occupied habitat occurred in 20% and 30%, respectively, of total occupied habitat. Densities over 400 RGCT/mile occurred in 117 miles of RGCT habitat (15%). The remaining 156 occupied stream miles (19%) had unknown RGCT densities. RGCT densities also varied by GMU (**Table 8**).

Table 7. Currently-occupied stream miles in Colorado and New Mexico and total percentage by density categories of sexually mature RGCT in the two states.

Density Range (fish/mile)	Colorado	New Mexico	Total
0 to 50	62 (17.2%)	68 (15.1%)	130 (16.1%)
51 to 150	74 (20.7%)	88 (19.4%)	162 (20.0%)
151 to 400	140 (39.0%)	104 (23.2%)	244 (30.2%)
Over 400	56 (15.5%)	61 (13.6%)	117 (14.5%)
Unknown	27 (7.6%)	129 (28.6%)	156 (19.3%)
Total	**359 (100.0%)**	**451 (100.0%)**	**810 (100.0%)**

Table 8. Currently occupied stream habitat (miles) in each of the four occupied GMU's by density categories of sexually mature RGCT.

Density Range (fish/mile)	Canadian	Lower Rio Grande	Pecos	Rio Grande Headwaters
0 to 50	19 (18.2%)	49 (15.6%)	0	62 (17.8%)
51 to 150	32 (30.4%)	64 (20.2%)	4 (10.5%)	62 (17.8%)
151 to 400	11 (10.3%)	67 (21.2%)	19 (48.5%)	147 (42.2%)
Over 400	0	64 (20.2%)	0	53 (15.2%)
Unknown	43 (41.1%)	72 (22.8%)	16 (41.0%)	25 (7.1%)
Total	**104 (100.0%)**	**317 (100.0%)**	**40 (100.0%)**	**348 (100.0%)**

Habitat Quality

The evaluation of habitat quality took both natural characteristics (e.g., gradient and stream size) and human disturbance (e.g., sediment from roads or grazing) into account. The total amount of RGCT habitat viewed as excellent was approximately 146 miles (18% of currently occupied). Habitat amounts associated with good, fair, and poor conditions were 312 (39%), 273 (34%), and 22 (3%), respectively. Only 56 (7%) miles of occupied habitat conditions were unknown. Habitat quality considerations by state and GMU are presented in **Tables 9 and 10**.

Table 9. Habitat quality ratings in currently occupied stream miles in Colorado and New Mexico.

Habitat Quality	Colorado	New Mexico	Total
Excellent	94 (26.1%)	52 (11.6%)	146 (18.0%)
Good	99 (27.6%)	213 (47.3%)	312 (38.6%)
Fair	150 (41.7%)	124 (27.4%)	273 (33.7%)
Poor	13 (3.6%)	9 (2.1%)	22 (2.7%)
Unknown	4 (1.1%)	52 (11.6%)	56 (6.9%)
Total	**359 (100.0%)**	**451 (100.0%)**	**810 (100.0%)**

Table 10. Currently occupied stream miles by habitat quality rating in each of the four occupied GMU's.

Habitat Quality	Canadian	Lower Rio Grande	Pecos	Rio Grande Headwaters
Excellent	10 (9.9%)	52 (16.2%)	4 (8.7%)	81 (23.2%)
Good	62 (60.0%)	134 (42.2%)	17 (43.5%)	99 (28.3%)
Fair	21 (20.1%)	93 (29.4%)	7 (16.4%)	152 (43.7%)
Poor	0	9 (2.9%)	0	13 (3.7%)
Unknown	10 (10.0%)	29 (9.2%)	13 (31.4%)	4 (1.1%)
Total	**104 (100.0%)**	**317 (100.0%)**	**40 (100.0%)**	**348 (100.0%)**

Occupied Stream Width

The average width of occupied stream segments was assessed for all occupied habitat. Over 90% of the occupied streams were less than 15 feet wide, with the highest percentage in the 5 to 10 foot range (Table 11). This pattern was fairly consistent across GMU's. The Rio Grande Headwaters GMU overall had the largest streams with 4.5% of the occupied streams greater than 20 feet wide (Table 12).

Table 11. Stream width of currently occupied stream miles in Colorado and New Mexico.

Stream Width	Colorado	New Mexico	Total
< 5 feet	93 (26.0%)	132 (29.3%)	225 (27.9%)
5 to 10 feet	178 (49.5%)	223 (49.5%)	401 (49.5%)
10 to 15 feet	72 (20.1%)	64 (14.2%)	136 (16.8%)
15 to 20 feet	16 (4.3%)	3 (0.6%)	18 (2.3%)
Unknown	0	28 (6.3%)	28 (3.5%)
Total	**359 (100.0%)**	**451 (100.0%)**	**810 (100.0%)**

Table 12. Currently occupied stream miles by stream width in each of the four occupied GMU's.

Stream Width	Canadian	Lower Rio Grande	Pecos	Rio Grande Headwaters
< 5 feet	17 (16.3%)	105 (33.1%)	7 (17.3%)	96 (27.7%)
5 to 10 feet	70 (67.7%)	144 (45.4%)	23 (56.8%)	164 (47.1%)
10 to 15 feet	17 (16.0%)	45 (14.3%)	2 (5.7%)	72 (20.7%)
15 to 20 feet	0	3 (0.8%)	0	16 (4.5%)
Unknown	0	20 (6.4%)	8 (20.2%)	0
Total	**104 (100.0%)**	**317 (100.0%)**	**40 (100.0%)**	**348 (100.0%)**

Stocking and Presence of Non-Native Species

Within the currently occupied RGCT habitat approximately 703 miles (87%) have no record of non-native fish stocking. The remaining 106 miles (13%) of occupied habitat have at least one record of stocking of non-native fish. Non-native stocking by state and GMU are presented in **Tables 13 and 14**.

Table 13. Currently-occupied RGCT stream habitat (miles) by state for which records of stocking with non-native salmonids has not (no record) or has (records exist) occurred.

Record of Stocking	Colorado	New Mexico	Total
No record of non-native stocking	291 (81.2%)	412 (91.4%)	703 (86.9%)
Record of non-native stocking	68 (18.8%)	39 (8.6%)	106 (13.1%)
Total	**359 (100.0%)**	**451 (100.0%)**	**810 (100.0%)**

Table 14. Non-native stocking records for currently occupied stream habitat (miles) in the four occupied GMU's.

Record of Stocking	Canadian	Lower Rio Grande	Pecos	Rio Grande Headwaters
No record of non-native stocking	69 (66.0%)	302 (95.1%)	40 (100.0%)	293 (84.0%)
Record of non-native stocking	35 (34.0%)	16 (4.9%)	0	56 (16.0%)
Total	**104 (100.0%)**	**317 (100.0%)**	**40 (100.0%)**	**348 (100.0%)**

Even more pertinent was the information associated with presence of non-native fish that were considered sympatric with RGCT. Within the currently occupied habitat there were 343 miles (42%) that were identified as having no non-native fish present. A total of 444 miles (44%) of occupied habitat were identified as having sympatric RGCT and non-native fish. The status of the remaining 22 miles (3%) is unknown. Percent of occupied habitat without non-native trout was 51% and 31% in New Mexico and Colorado, respectively (**Table 15**). Within GMU's, the Pecos GMU had the lowest percentage of occupied miles where RGCT and non-native trout were sympatric (21%). The Canadian and the Rio Grande Headwaters GMU's had the highest percentage of occupied miles where RGCT and non-native trout were sympatric at over 60% and 70% respectively (**Table 16**).

In most areas, there are more miles of stream with non-native trout than there are miles with records of stocking, implying that there has been either invasion or unrecorded stocking in significant parts of the occupied range. In New Mexico, 412 miles of occupied habitat (91%) do not have any stocking records associated with them; however, only 231 miles (51%) remain free of non-native trout. In Colorado 291 miles of occupied habitat (81%) have no stocking records associated with them, yet only 112 miles (31%) remain free of non native trout. At the GMU scale, all four show increases between the miles of stream with stocking records and the miles of occupied habitat with non-native trout.

Table 15. Record of presence or absence of non-native trout sympatric with RGCT within currently occupied RGCT habitat (stream miles) in Colorado and New Mexico.

Presence or Absence of Non-Native Trout	Colorado	New Mexico	Total
No record of non-native trout	112 (31.2%)	231 (51.3%)	343 (42.4%)
Record of non-native trout	244 (67.9%)	201 (44.5%)	444 (54.9%)
Unknown	3 (0.9%)	19 (4.2%)	22 (2.8%)
Total	**359 (100.0%)**	**451 (100.0%)**	**810 (100.0%)**

Table 16. Record of presence or absence of non-native trout sympatric with RGCT within currently occupied RGCT habitat (stream miles) in four occupied GMU's.

Presence or Absence of Non-Native Trout	Canadian	Lower Rio Grande	Pecos	Rio Grande Headwaters
No record of non-native trout	40 (38.2%)	178 (56.1%)	23 (57.5%)	102 (29.4%)
Record of non-native trout	62 (59.7%)	131 (41.4%)	8 (20.9%)	243 (69.6%)
Unknown	2 (2.0%)	8 (2.6%)	9 (21.5%)	3 (1.0%)
Total	**104 (100%)**	**317 (100%)**	**40 (100%)**	**348 (100%)**

RGCT Occurrence by Land Status

Of the 810 miles of habitats currently occupied by RGCT, 462 miles (57% of currently occupied habitats) were associated with land administrated by Federal agencies. Over half of all occupied habitats (54%) occurred on National Forests (USFS). An additional 19 miles were in designated National Parks (NPS) and 4 miles were on Bureau of Land Management (BLM) administered lands. Approximately 348 miles occurred on land with other administrative designations including 5 miles associated with habitat on Tribal lands (**Table 17; Figure 7**). Remaining habitat occurred on State (8 miles) and private (335 miles) lands. It is important to note that the legislative mandate associated with the NPS has a strong focus on preservation of natural environmental conditions. A similar focus would be associated with lands designated as wilderness. The legislative mandate for the USFS and the BLM on most lands outside of wilderness includes a multiple use resource theme that is much broader than that of the NPS. Included in the multiple use focus of the land use agencies is direction associated with the conservation of biodiversity and the protection of the environmental components such as soil and water. As such, the land use agencies have developed land use plans that provide necessary direction intended to keep the multiple uses of these lands consistent with conservation of biodiversity and protection of basic environmental conditions and processes, including special protection for cutthroat trout (e.g., stream buffers or road location and density restrictions).

Table 17. Miles of habitat occupied within the various land ownership boundaries associated with RGCT by occupied GMU.

GMU	NPS	FS	BLM	Tribal	State	Water	Private
Canadian	--	22	--	--	--	--	82
Lower Rio Grande	5	256	0.2	5	1	--	50
Pecos	--	40	--	--	--	--	--
Rio Grande Headwaters	14	120	4	--	7	1	202
Total	19 (2%)	438 (54%)	4 (1%)	5 (1%)	8 (1%)	1 (0.1%)	334 (41%)

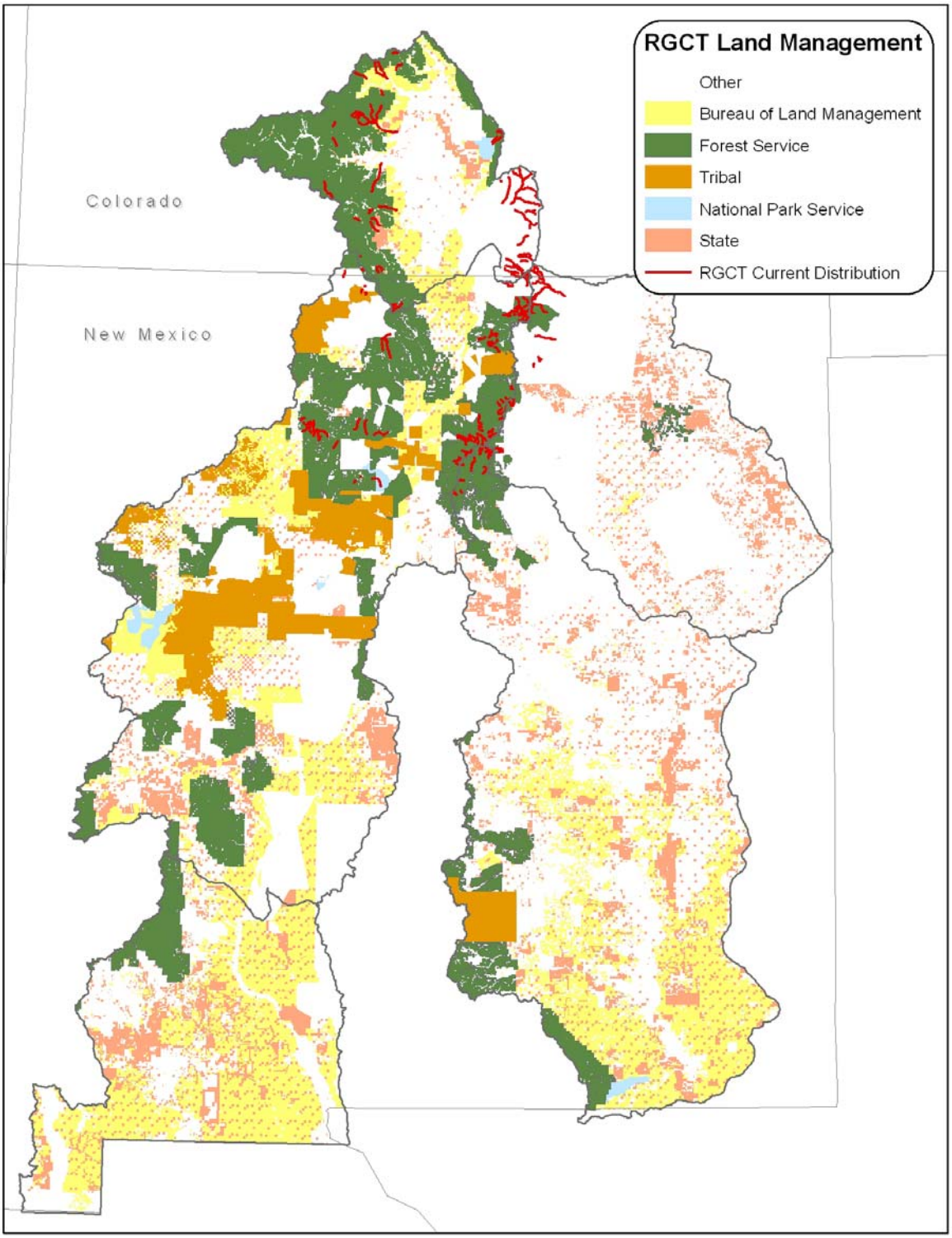


Figure 7. Currently occupied RGCT habitat associated with the primary agencies (USFS, BLM, NPS, State, and Tribal).

Conservation Populations

A total of 120 populations of RGCT occupying about 690 miles of habitat (86% of currently occupied habitats; 10.4 % of historical range) were designated as conservation populations by State agencies (**Figure 8**). Twenty-six populations occurring in 49.8 miles of habitat occur above historical barriers and therefore outside of our estimate of historical range. Conservation populations are known (genetic testing complete) or suspected to be at least 90 percent genetically pure or were otherwise determined to be important for RGCT conservation. The designated conservation populations were spread throughout the historical range, occurring in habitat within both States, in 4 GMU's, and in 14 of the 19 fourth level HUC's identified as being historically occupied by RGCT. Five conservation populations occupied habitats that crossed state boundaries. New Mexico had more conservation populations than Colorado. However, average length of habitat occupied by a population was greater in Colorado than New Mexico. (**Table 18**). Conservation populations were more densely concentrated within the Rio Grande Headwaters and the Lower Rio Grande compared to other GMU's (**Figure 9**).

Table 18. Distribution of RGCT conservation populations across Colorado and New Mexico. Five populations cross state lines and are double counted in this table.

State	Number of conservation populations	Miles of stream occupied by conservation populations	Percent of State's historical habitat occupied	Average length of habitat occupied by population (range)
Colorado	41	293.7	9.1%	7.2 (0.5-53)
New Mexico	84	396.5	11.6%	4.7 (0.4-28)
Total	**120***	**690.2**	**10.4%**	**5.7 (0.4-53)**

* 5 populations cross state boundaries.

Individual conservation populations occupied stream lengths ranging from less than 0.44 miles to over 52.5 miles of occupied habitat (median = 4.2 miles, **Table 19**). The distribution of lengths of habitat occupied by conservation populations was skewed with most (71%) of the populations occupying 5 miles or less (**Figure 10**). Most of the GMU's had a similar median stream length occupied per conservation population of about four miles; the exception was the Pecos GMU with a median length of 2.8 miles.

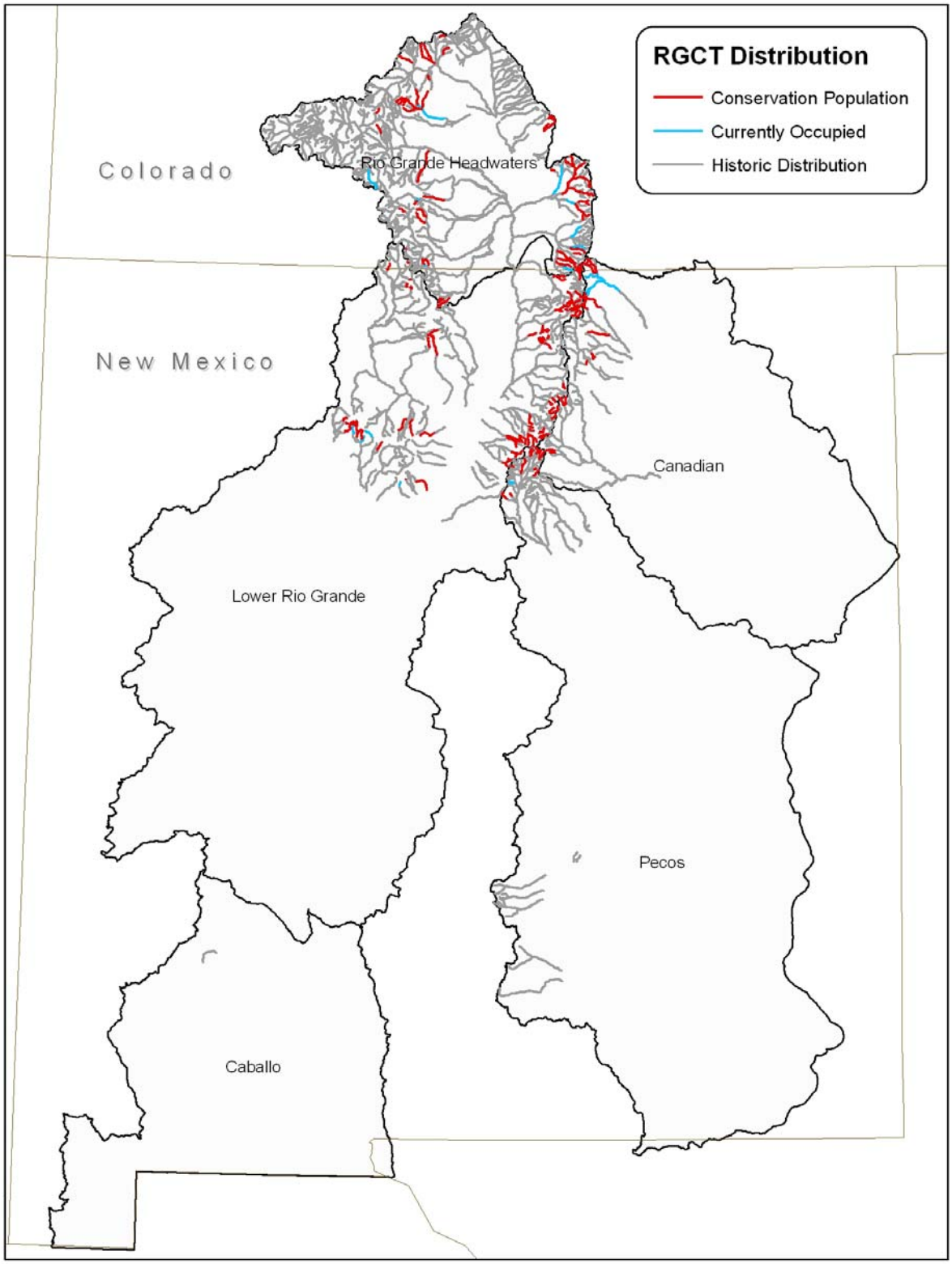


Figure 8. Map comparing historical range to stream section currently occupied by RGCT and those stream sections occupied by conservation populations.

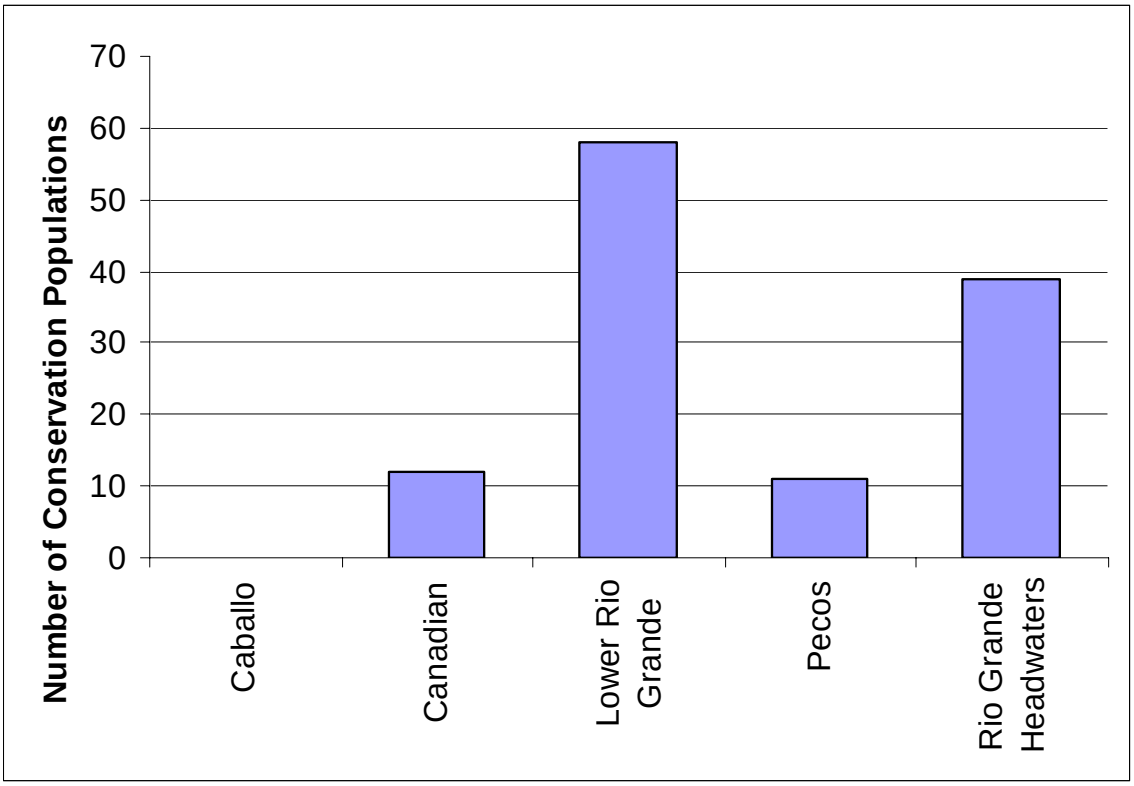


Figure 9. Number of conservation populations associated with each GMU.

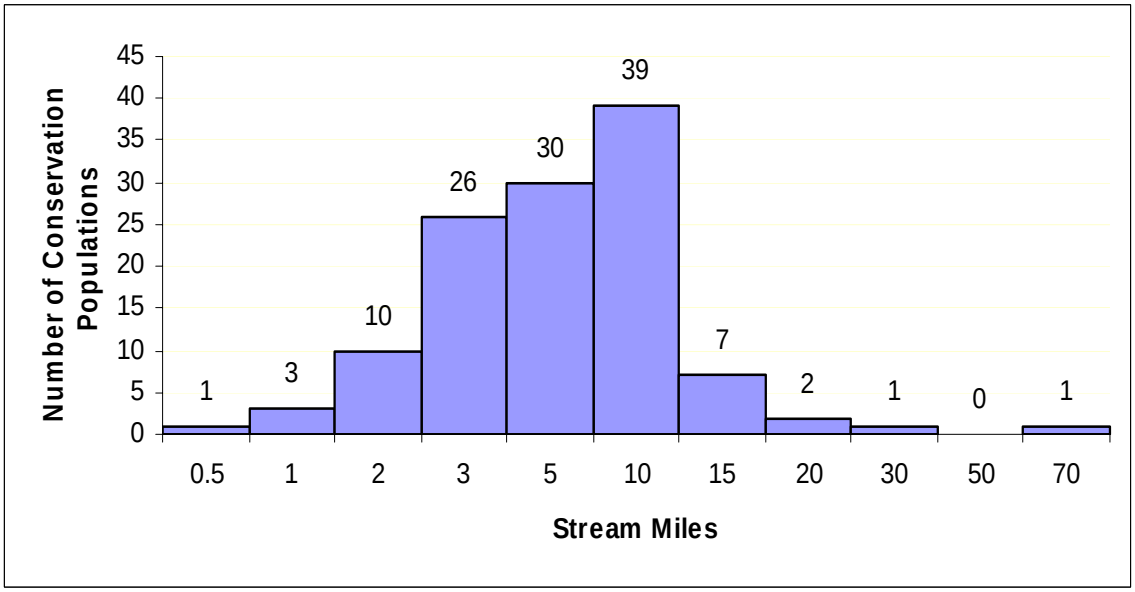


Figure 10. Frequencies of the number of miles occupied by designated conservation populations of Rio Grande cutthroat trout throughout their range. Mileage bins are labeled with the top of the bin range such that those in bin "2" are those populations ranging in length from 1 to 2 miles.

Table 19. Descriptive statistics of amount of habitat occupied by conservation populations by GMU.

GMU name	Number of populations	Miles occupied	Percent of historical occupied	Median length occupied (mi)	Range	
					minimum	maximum
Caballo	0	0	0.0%	n/a	n/a	n/a
Canadian	12	67.5	10.6%	4.4	1.91	11.19
Lower Rio Grande	58	304.1	14.4%	4	0.44	27.81
Pecos	11	37.3	6.0%	2.8	1.54	7.05
Rio Grande Headwaters	39	281.4	8.6%	4.6	0.54	52.55
Total	**120**	**690.2**	**10.4%**	**4.2**	**0.44**	**52.55**

Most conservation populations (112 populations, 555 miles) exist as independent non-networked units (e.g., a single stream or stream segment) and were not connected to adjacent populations (**Table 20**). Seven conservation populations (111 miles) exist with very little connectivity and one conservation population (28 miles) has a moderate degree of connectivity within the population provided by 2 to 5 tributary streams. No populations were judged as having strong connectivity (i.e., associated with more than 5 streams and migratory forms present).

Table 20. Number and miles of conservation populations of RGCT by degree of within population network or connectivity for the four occupied GMU's.

	Strong Network		Moderate Network		Weak Network		Non-Networked	
GMU	**#**	**Miles**	**#**	**Miles**	**#**	**Miles**	**#**	**Miles**
Canadian	-	-			1	4.2	11	63.3
Lower Rio Grande	-	-	1	27.8	4	36.5	53	239.8
Pecos	-	-					11	37.3
Rio Grande Headwaters	-	-			2	66.7	37	214.6
Total	**-**	**-**	**1**	**27.8**	**7**	**107.4**	**112**	**555.0**

Approximately 40% of conservation populations occur either with non-native trout or have a record of non-native trout stocking (**Table 21**). The percentage of conservation populations occurring with non-native trout or with a record of stocking ranges from 18% to 44% among the different GMUs.

Table 21. Distribution of conservation populations by GMU and the occurrence of non-native trout or stocking records.

GMU name	Number of conservation populations	# with stocking and/or non-native trout (percent)	Miles occupied by conservation populations	Miles with stocking and/or non-native trout (percent)
Canadian	12	4 (33.3%)	67.5	25.7 (38.0%)
Lower Rio Grande	58	25 (43.1%)	304.1	139.1 (45.7%)
Pecos	11	2 (18.2%)	37.3	7.7 (20.7%)
Rio Grande Headwaters	39	17 (43.6%)	281.3	171.0 (60.7%)
Totals	**120**	**48 (40.0%)**	**690.2**	**343.4 (49.7%)**

Life history characterizations expressed as resident, fluvial or ad-fluvial were tracked for each conservation population. A resident only life history was associated with 116 populations (97%). A resident and adfluvial combination were identified in 4 (3%) conservation populations (**Figure 11**).

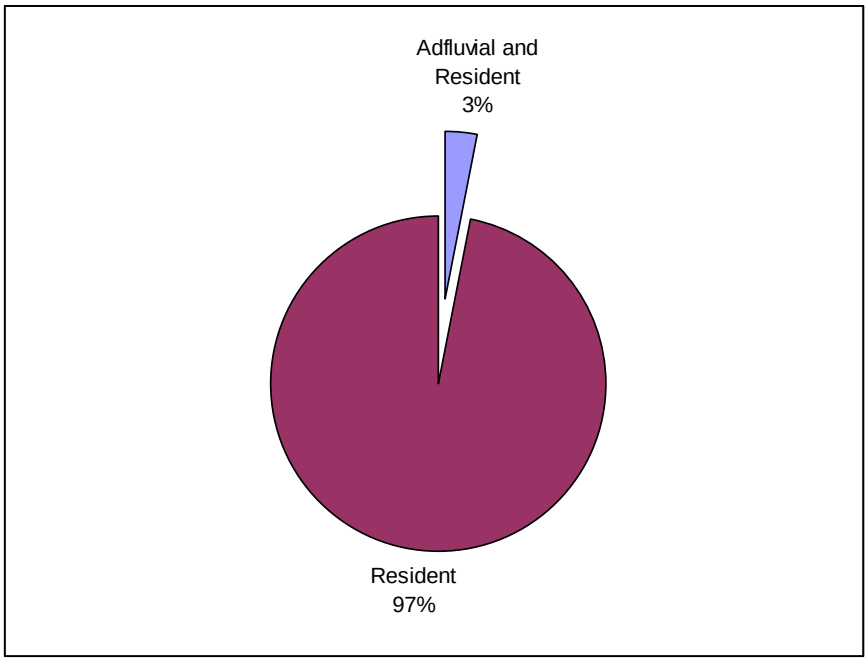


Figure 11. Percentage breakdown associated with the varying life history characterizations expressed in RGCT conservation populations. Percentage breakdown is based on miles of stream occupied.

Of the 120 conservation populations, 91 (76%) were identified as "core" conservation populations, defined as being at least 99% pure based on genetic testing. These core conservation populations occurred in 544 (79%) miles of habitat (**Figures 12 and 13**). Other conservation populations were known or suspected to be at least 90% pure and were put into functional categories. There were 29 conservation populations that occupied about 146 miles of habitat (21%) that were identified as being likely to become part of the RGCT conservation focus.

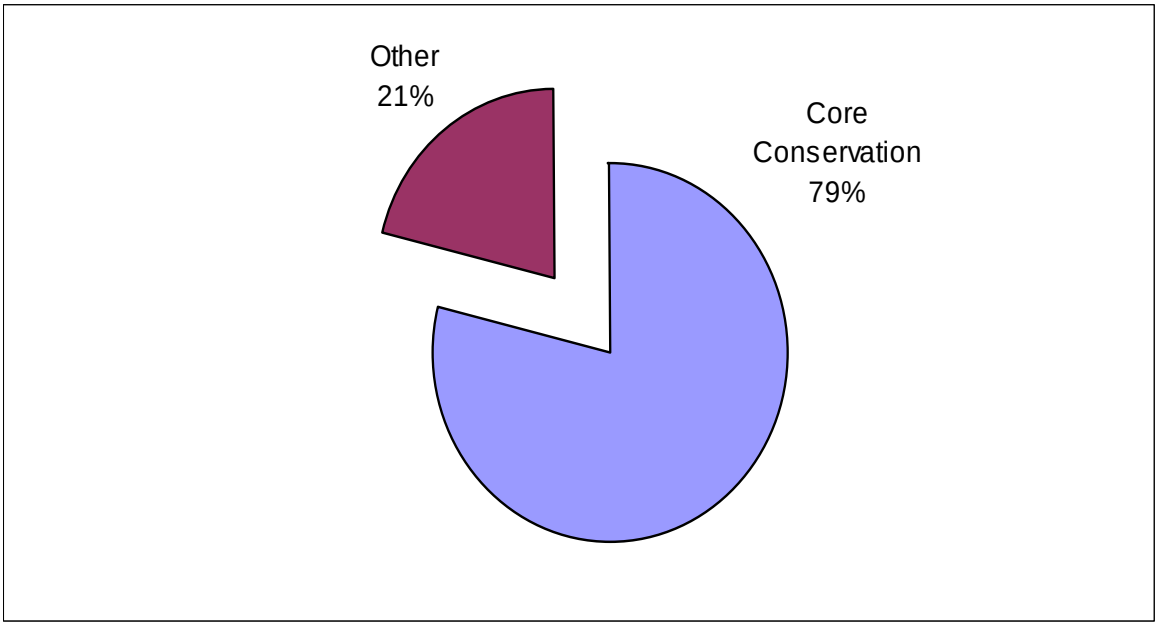
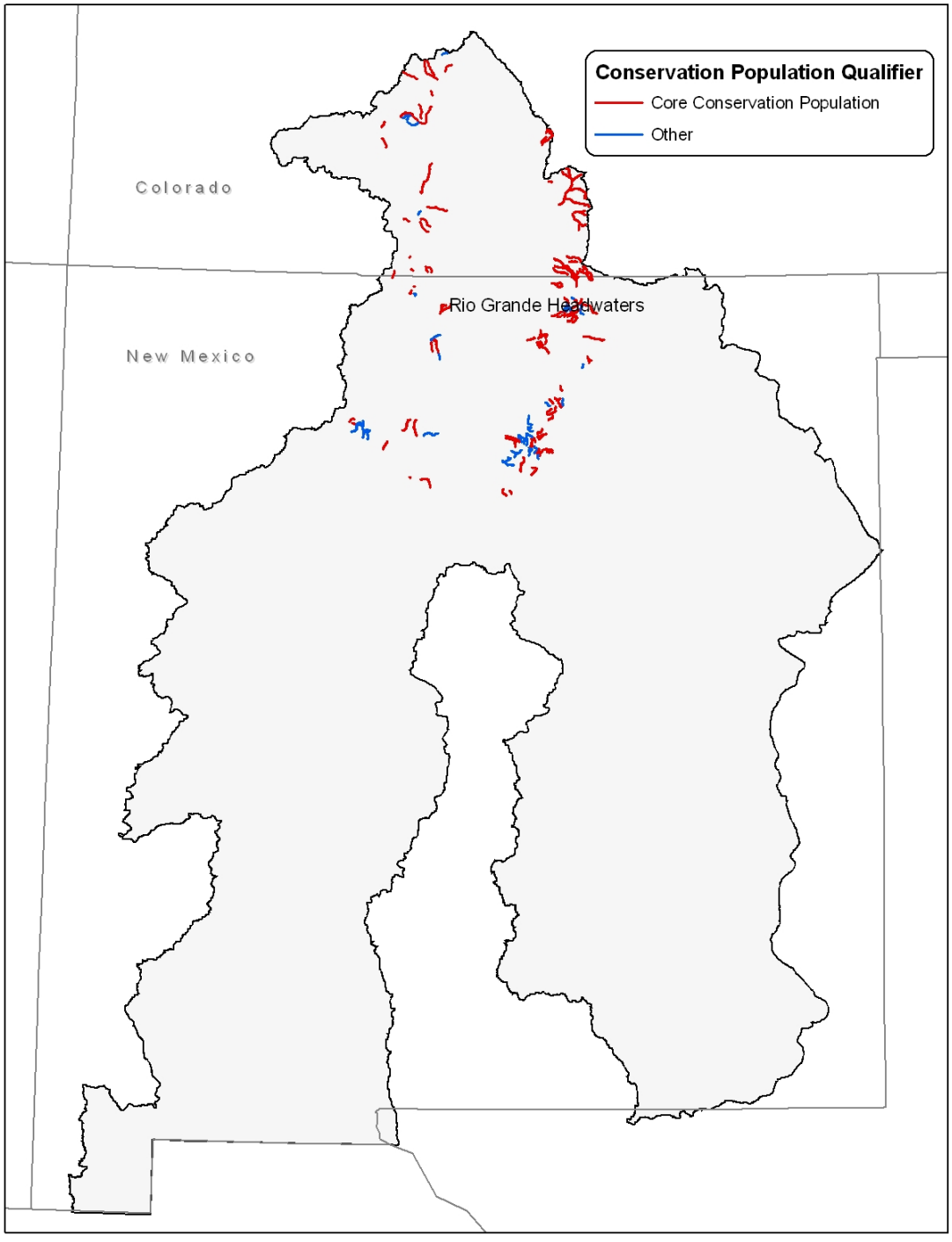


Figure 12. Percent breakdown for miles of habitat by conservation population qualifier for Rio Grande cutthroat trout.

Figure 13. Designated conservation populations of RGCT and the reason for which they were designated throughout their range.



Half of the individual conservation populations are protected by a complete barrier (**Table 22**). Populations above a complete barrier had a slightly smaller average population length than those with no barrier or a partial barrier. **Table 23** displays the barrier status of conservation populations in each GMU.

Table 22. Presence and effectiveness of barriers below conservation populations. Although there are only 120 conservation populations, there are 123 segments with barrier status. This occurs when a population contains one or more barriers within its range. This occurred only in the Rio Grande Headwaters GMU.

Barrier Type	Number of conservation populations	% of total conservation populations	Total stream length occupied	% of total stream length occupied	Average population length
Complete	60	50%	311 miles	45%	5.2 miles
Partial	14	12%	77 miles	11%	5.5 miles
None	45	38%	272 miles	39%	6.0 miles
Unknown	4	3%	30 miles	4%	7.5 miles
Total	**123**		**690 miles**		**5.7 miles**

Table 23. Barrier effectiveness by GMU. Populations are segmented by partial barriers within the Rio Grande Headwaters GMU and therefore the count is higher than the number of populations.

	Barrier Type			
GMU	**Complete**	**Partial**	**None**	**Unknown**
Canadian	6	0	5	1
Lower Rio Grande	23	9	25	1
Pecos	7	1	2	1
Rio Grande Headwaters	24	4	13	1

Genetic purity varied across conservation populations. Table 24 presents genetic status of conservation populations. One hundred percent of streams with RGCT 90% to 99% pure are considered conservation populations. Streams less than 90% pure or suspected hybridized have also been included as conservation populations when the designating state agency determined the populations had important conservation value. Streams with pure RGCT not included as conservation populations may be added as conservation populations in the future. The discrepancy between miles of unaltered RGCT streams reported in Table 4 and Table 24 below can be explained as follows. Segments of Middle Fork Carnero Creek and North Fork Carnero Creek below man-made barriers currently are inhabited by unaltered RGCT and are managed as core conservation populations but were incorrectly excluded as conservation populations in this assessment. At the next update we will revise the database to include these waters in the South Fork Carnero Creek conservation population.

Table 24. Miles of stream occupied by conservation population by genetic category. Streams with no genetic testing results available were assumed to be unaltered or hybridized based on stocking records.

GMU	Unaltered	90% - 99%	80% - 89%	< 80%	Not Tested - Unaltered	Not Tested - Hybridized	Total
Canadian	51.1	8.3	6.0	0.0	2.1	0.0	67.5
Lower Rio Grande	157.7	61.0	0.0	0.0	34.1	51.3	304.1
Pecos	20.0	11.7	0.0	0.0	3.5	2.1	37.3
Rio Grande Headwaters	236.4	19.6	0.0	0.0	25.3	0.0	281.3
Genetic Category Totals	**465.2**	**100.6**	**6.0**	**0.0**	**65.0**	**53.4**	**690.2**

Risks to Conservation Populations

This status assessment evaluated two types of risks associated with conservation populations: 1) risks associated with genetic contamination and 2) risks associated with catastrophic diseases.

Genetic Contamination Risks:
Risk of genetic contamination was evaluated by determining the proximity and accessibility of hybridizing species. A total of 80 conservation populations (67%) were ranked as being at no risk of genetic contamination due to the presence of a secure barrier preventing immigration of hybridizing species. Four (3%) and 32 (27%) populations were at either low to moderate risk, respectively. Another four populations (3%) were rated as being at high genetic risk (**Figure 14**). Low genetic risk was defined as hybridizing species being greater than 10 km away from the population, moderate risk was defined as hybridizing species being within 10 km from the population, and high genetic risk was defined as hybridizing species being sympatric with the population. Genetic risks to the 120 RGCT conservation populations by population numbers and miles of habitat occupied also varied by GMU (**Table 25**). Degree of connectivity of conservation populations was evaluated against the degree of genetic risk (**Table 26**). Of the populations considered as having a low risk of genetic contamination 80 (95%) were identified as being non-networked independent or isolated entities (**Figure 15**). No conservation populations viewed to be at low risk had either moderate or strongly networked within population connectivity. In general, populations of RGCT are not well connected. In addition, populations having limited connectivity were at a lower level of genetic risk when compared to populations with greater degrees of connectivity and larger within population networks. Also, across levels of connectivity, the "no risk" populations (those protected by a barrier) were smaller than populations with higher levels of risk (**Figure 15**); the percentage of "no risk" populations is greater than the percentage of "no risk" stream miles.

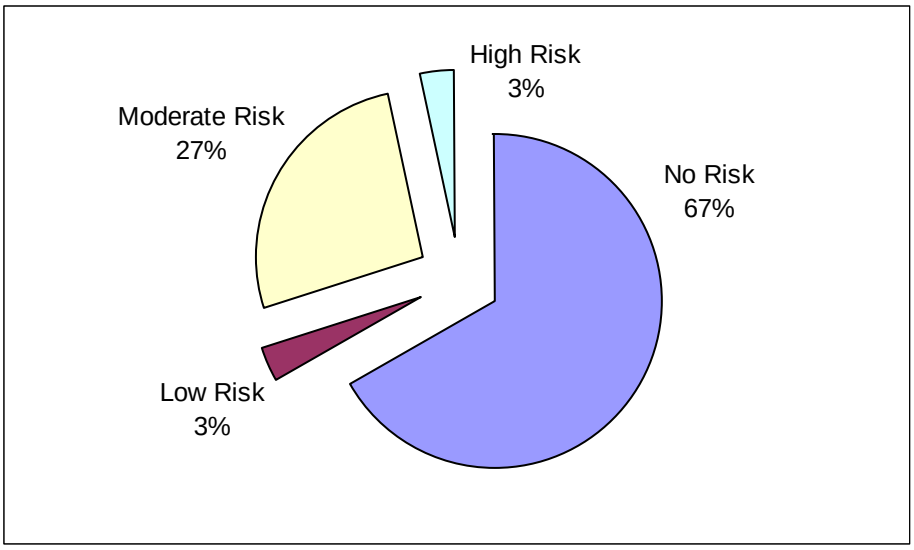


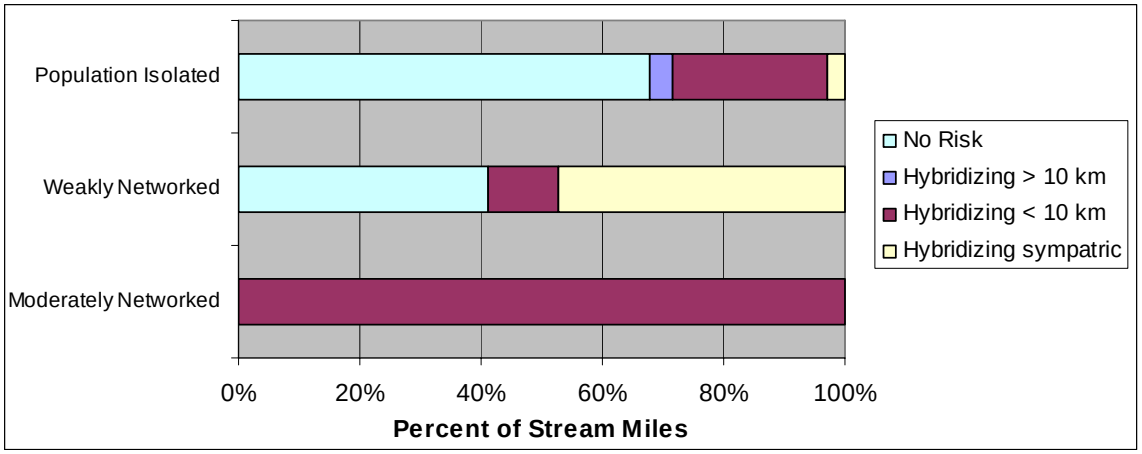
Figure 14. Relative risk of genetic contamination for the 120 RGCT conservation populations.

Table 25. Ranked risks associated with genetic contamination for the 120 conservation populations by GMU. Values reflect number of populations and miles occupied.

	Ranked Risk by Number of Populations				Ranked Risk by Miles Occupied			
GMU	**No Risk**	**Low Risk**	**Mod. Risk**	**High Risk**	**No Risk**	**Low Risk**	**Mod. Risk**	**High Risk**
Canadian	6	--	6	--	44	--	23	--
Lower Rio Grande	34	4	19	1	161	21	119	2
Pecos	6	--	5	--	16	--	21	--
Rio Grande Headwaters	34	--	2	3	197	--	17	67
Totals	80	4	32	4	419	21	181	69

Table 26. Ranked risks associated with genetic contamination for the 120 conservation populations by degree of within population connectivity (networks). Values reflect number of populations and miles occupied.

	Ranked Risks by Number of Populations				Ranked Risks by Miles Occupied			
Within Population Connectivity	**No Risk**	**Low Risk**	**Mod Risk**	**High Risk**	**No Risk**	**Low Risk**	**Mod Risk**	**High Risk**
Population Isolated	76	4	29	3	373	21	140	17
Weakly Connected	4	--	2	1	46	--	13	53
Moderately Connected	--	--	1	--	--	--	28	--
Strongly Connected	--	--	--	--	--	--	--	--
Totals	**80**	**4**	**32**	**4**	**419**	**21**	**181**	**69**



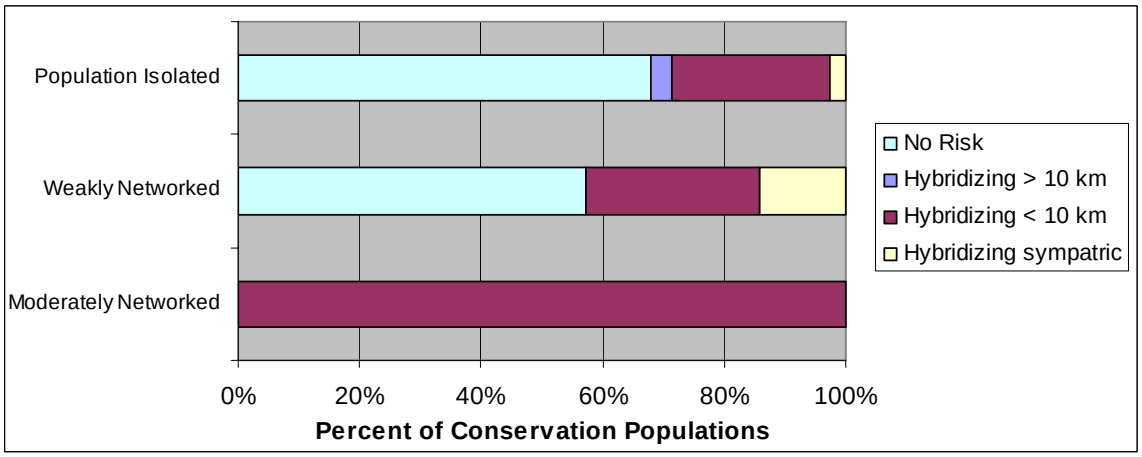


Figure 15. Genetic risk for percent of stream miles and percent of conservation populations. Data is grouped by connectedness, showing a more explicit relationship. RGCT conservation populations are ranked into four risk groups from no risk of hybridization to sympatric hybridization. The other risk groups were associated with hybridizing fish being further away or closer than 10 km.

Catastrophic Disease Risk

Catastrophic disease risk was assessed based on proximity and accessibility of disease causing pathogens. The diseases of concern are those that could cause severe and significant impacts to population health and include but are not limited to whirling disease, furunculosis, infectious pancreatic necrosis virus, etc.

One hundred five populations (88%) were judged to have very limited risk from disease because disease and pathogens are not known to exist in the watershed or a barrier provides complete blockage to upstream fish movement. Six populations (5%) are at minimal disease risk because they are either farther than 10 kilometers from significant diseases or pathogens or they are protected by a barrier, but the barrier may be at risk of failure. Eight populations (7%) were at moderate risk because disease or pathogens have been identified within 10 kilometers of the conservation population, but not within the same stream segment. No populations are at high risk because disease or pathogens are sympatric with the cutthroat population. One population (1%) is known to be infected with a significant disease (**Table 27**).

Table 27. Ranked risks associated with catastrophic diseases for the 120 conservation populations by GMU. Values reflect number of populations and miles occupied.

	Ranked Risks by Number of Populations					**Ranked Risks by Miles Occupied**				
GMU	**Limited Risk**	**Min. Risk**	**Mod. Risk**	**High Risk**	**Infected**	**Limited Risk**	**Min. Risk**	**Mod. Risk**	**High Risk**	**Infected**
Canadian	10	--	2	--	--	59	--	8	--	--
Lower Rio Grande	53	4	1	--	--	273	27	5	--	--
Pecos	9	--	2	--	--	26	--	11	--	--
Rio Grande Headwaters	33	2	3	--	1	187	4	38	--	53
Totals	**105**	**6**	**8**	**0**	**1**	**546**	**30**	**62**	**0**	**53**

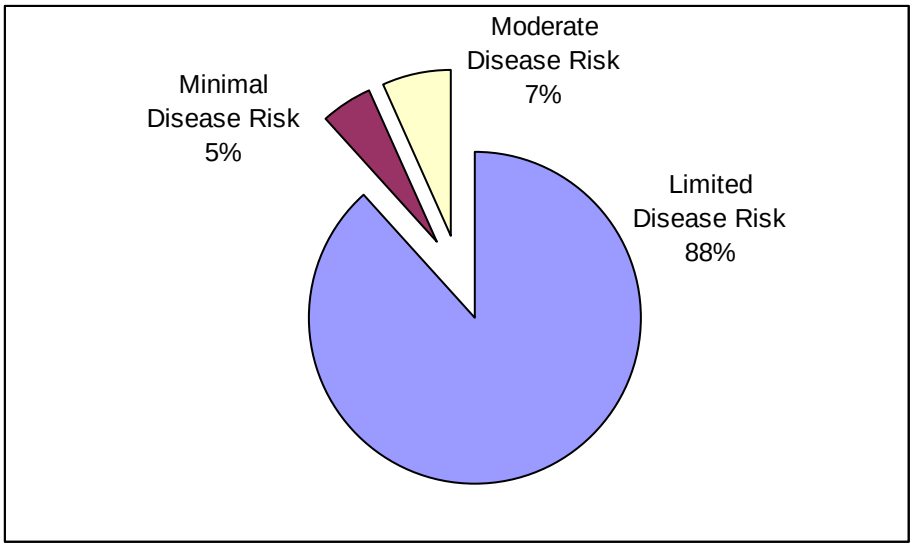
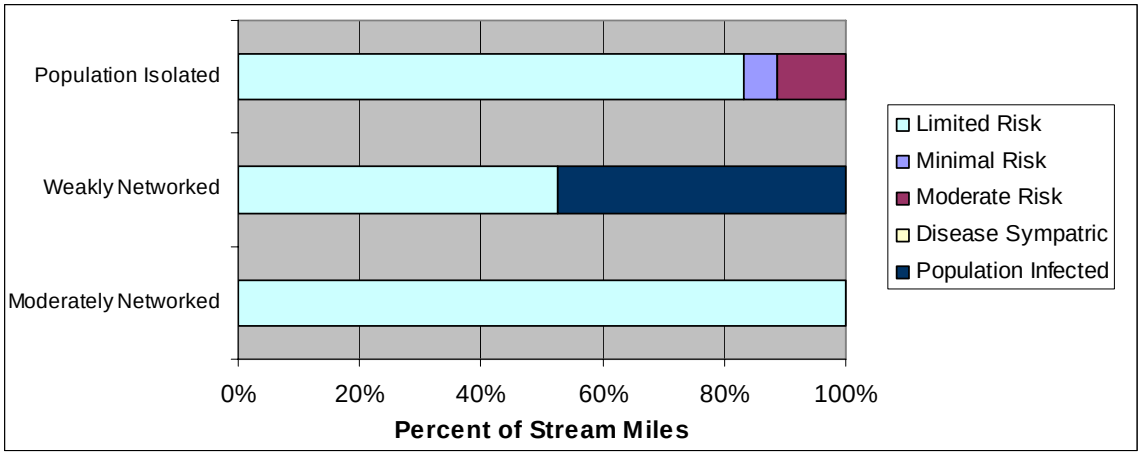


Figure 16. Relative risk of catastrophic disease for the 120 RGCT conservation populations.

Degree of connectivity of conservation population was evaluated against the degree of catastrophic disease risk (**Table 27; Figure 16**). Of the 105 populations considered as having a limited risk of catastrophic disease, 93% were identified as being non-networked independent or isolated entities (**Table 28**). One weakly connected population was infected with a disease (**Figure 17**).

Table 28. Ranked risks associated with catastrophic diseases for the 120 conservation populations by degree of within population connectivity (networks). Values reflect number of populations and miles occupied.

	Ranked Risk by Number of Populations					**Ranked Risk by Miles Occupied**				
Within Population Connectivity	**Limited Risk**	**Min. Risk**	**Mod. Risk**	**High Risk**	**Infected**	**Limited Risk**	**Min. Risk**	**Mod. Risk**	**High Risk**	**Infected**
Population Isolated	98	6	8	--	--	460	30	62	--	--
Weakly Connected	6	--	--	--	1	59	--	--	--	53
Moderately Connected	1	--	--	--	--	28	--	--	--	--
Strongly Connected	--	--	--	--	--	--	--	--	--	--
Totals	**105**	**6**	**8**	**0**	**1**	**546**	**30**	**62**	**0**	**53**



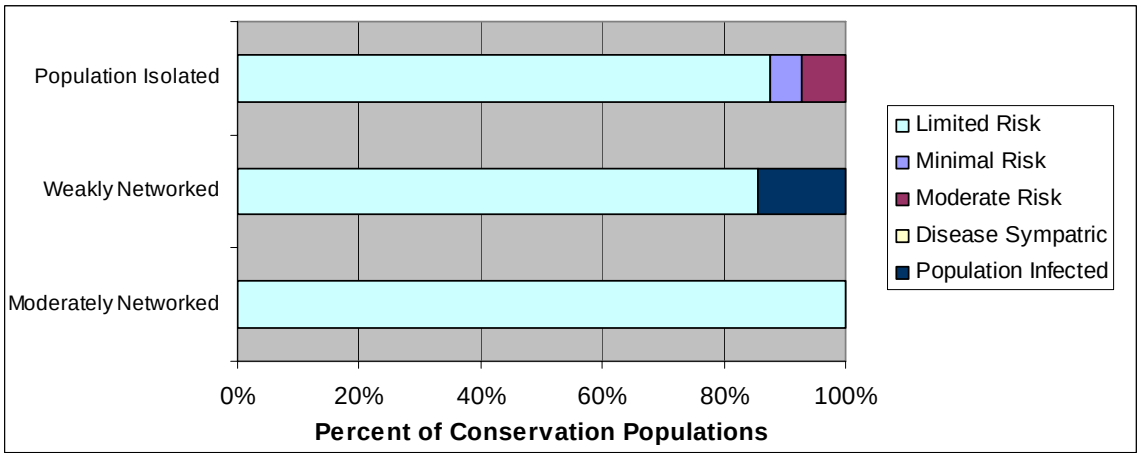


Figure 17. Disease Risk for percent of stream miles and percent of conservation populations. Data is grouped by connectedness. RGCT conservation populations are ranked into five risk groups from limited disease risk to infected populations.

General Population Health

A generalized population health evaluation based on four indicators of health was completed for each conservation population. Components of the health evaluation included: 1) **Temporal variability** associated the amount of occupied habitat as an indicator of patch size and resiliency; 2) **Population size** of adults as an estimator of effective population size; 3) **Population demographics** (growth and survival) estimator based on habitat quality, presence of non-native fish and disease, and consideration of land use influences; and, 4) **Degree of within population connection**. These indicators of relative health were analyzed individually and as a composite based on a weighted formula. **Table 29** provides a review of each of the health indicators by number of conservation populations and by miles of habitat occupied by conservation populations. It is important to note that individual health indicators and the composite of these indicators is merely a relative indicator of general health much like a physician's general exam or health screening.

Temporal variability information contained in **Table 29** indicates the majority (75) of conservation populations (63%) occupied habitats that were less than 6 miles in length. Forty-three populations (36%) occupied between 6 and 19 miles of habitat. There were 2 populations that had either high (1 population, at least 50 miles) or moderately high (1 populations, 20 to 49 miles) ratings for the amount of habitat occupied.

Population size information presented in **Table 29** indicates 18% of the populations (22) had at least 2,000 adults. Roughly one-third of the populations (38) had between 500 and 2,000 adults and another third (37) had 50 to 500 adults. About nineteen percent of the populations (23) had adult population estimates of fewer than 50 fish.

Production potential (growth and survival): There were no conservation populations with a production potential demographics rating of low. Most of the conservation populations (93%) were judged to have a moderately high health condition related to quality factors associated with production potential. Seven populations (6%) were judged to have moderately low production potential. One population (1%) was judged to have high population potential. Habitat quality, presence of non-native trout species, presence or proximity of catastrophic diseases, land uses, and recovery actions were included in this metric.

Population connectivity: Assessment of within population connectivity or networks indicated that a substantial majority of populations (93%, 112 populations) exist as non-networked (single stream) entities. There were 7 weakly connected populations (6%) in which adult straying into the population are possible. One population was considered moderately connected, having migratory forms present but only occasional genetic exchange possible. No populations were considered strongly connected, with migratory forms present and open migration corridors.

Table 29. Population health ratings associated with the 120 conservation populations by number of populations and miles of stream occupied for the various health indictors and the composite of these indicators.

	Ranked Health Scores by Number of Populations					Ranked Health by Miles Occupied			
Rank Scores	**High**	**Mod-High**	**Mod-Low**	**Low**		**High**	**Mod-High**	**Mod-Low**	**Low**
Temporal Variability-Stream Length	1	1	43	75		53	28	383	226
Population Size-Mature Adults	22	38	37	23		273	186	154	77
Production Potential-Quality Factors	1	112	7	0		7	567	116	0
Levels of Within Population Connectivity	0	1	7	112		0	28	107	555
Composite Rating	**1**	**68**	**50**	**1**		**28**	**496**	**164**	**2**

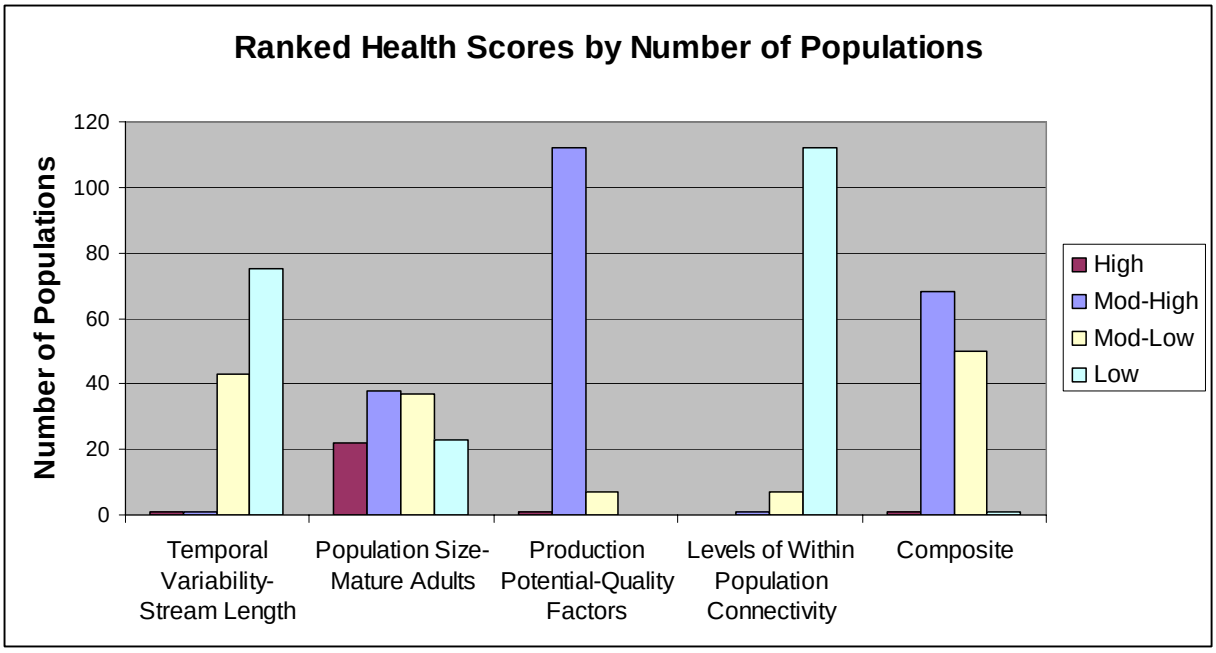
Composite scores of general population health for the 120 conservation populations (**Table 30, Figure 18**) allowed for a more balanced or tempered review of general health conditions associated with RGCT conservation populations. Only one conservation population (less than 1%) was judged to have a high degree of general health. Sixty-eight RGCT conservation populations (57%) were judged to have a moderately high degree of general health. Of the remaining populations, 50 (42%) were judged to have a moderately low level of general health and 1 (1%) had a low level of general health. The generally short stream length and isolated condition of RGCT conservation populations appear to be the factors most contributing to their general persistence risks. However, the isolated condition reduces the population's risk of genetic or disease contamination. General RGCT population health was somewhat influenced by expanded within population connectivity associated with larger networks (**Table 31, Figures 19 and 20**). Again, it is important to note that individual health indicators and the composite ratings of these indicators do not represent existing problems, but summarize risk factors relating to overall population health.

Table 30. Population health composite rating associated with the 120 conservation populations by number of populations and miles of stream occupied for the various GMU's.

	Ranked Health Scores by Number of Populations (%)					Ranked Health by Miles Occupied			
Rank Scores	**High 1**	**Mod-High 2**	**Mod-Low 3**	**Low 4**		**High 1**	**Mod-High 2**	**Mod-Low 3**	**Low 4**
Canadian	0	6 (50%)	5 (42%)	1 (8%)		0	40 (59%)	26 (38%)	2 (3%)
Lower Rio Grande	1 (2%)	30 (52%)	27 (47%)	0		28 (9%)	189 (62%)	88 (29%)	0
Pecos	0	3 (27%)	8 (73%)	0		0	17 (46%)	20 (54%)	0
Rio Grande Headwaters	0	29 (74%)	10 (26%)	0		0	250 (89%)	31 (11%)	0
Totals	**1 (1%)**	**68 (57%)**	**50 (42%)**	**1 (1%)**		**28 (4%)**	**496 (72%)**	**164 (24%)**	**2 (0.3%)**

Table 31. Population health associated with the composite health scores for the 120 conservation populations by level of connectivity. Values reflect number of populations and miles occupied for the health composite rating.

	Ranked Health by Number of Populations by Composite Rating					Ranked Health by Miles Occupied by Composite Rating			
Composite Rating	**High 1**	**Mod-High 2**	**Mod-Low 3**	**Low 4**		**High 1**	**Mod-High 2**	**Mod-Low 3**	**Low 4**
Connectivity									
Population Strongly Connected	0	0	0	0		0	0	0	0
Population Moderately Connected	1	0	0	0		28	0	0	0
Population Weakly Connected	0	6	1	0		0	107	4	0
Populations Independent	0	62	49	1		0	389	160	2
Totals	**1**	**68**	**50**	**1**		**28**	**496**	**164**	**2**



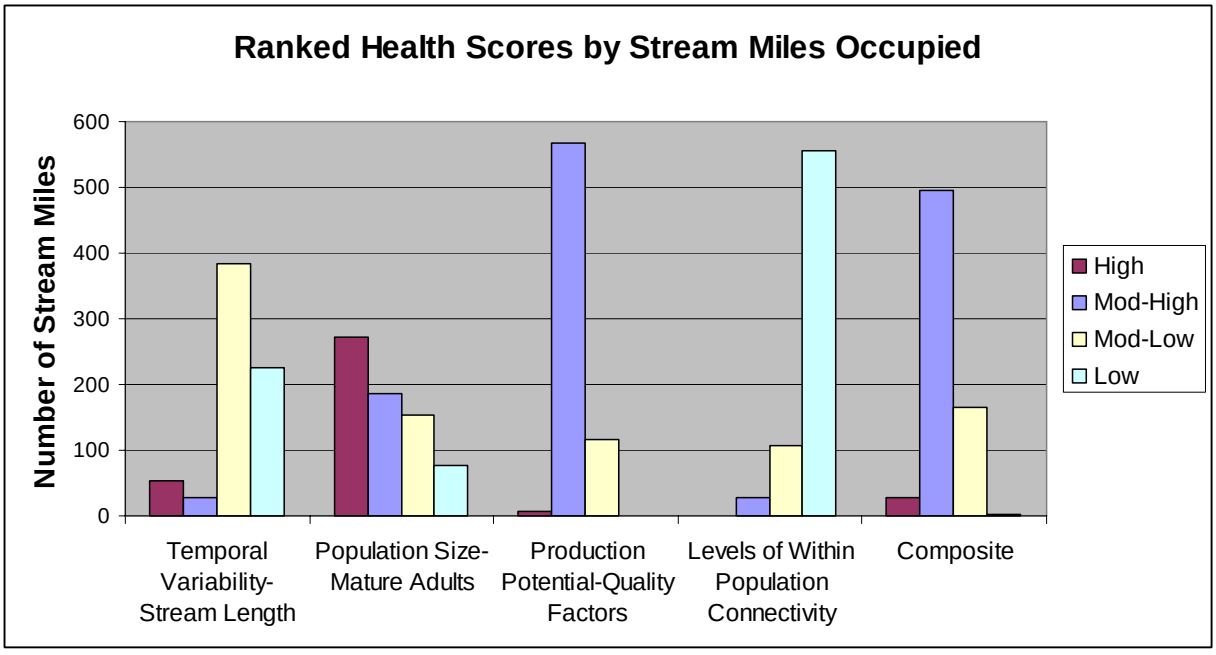
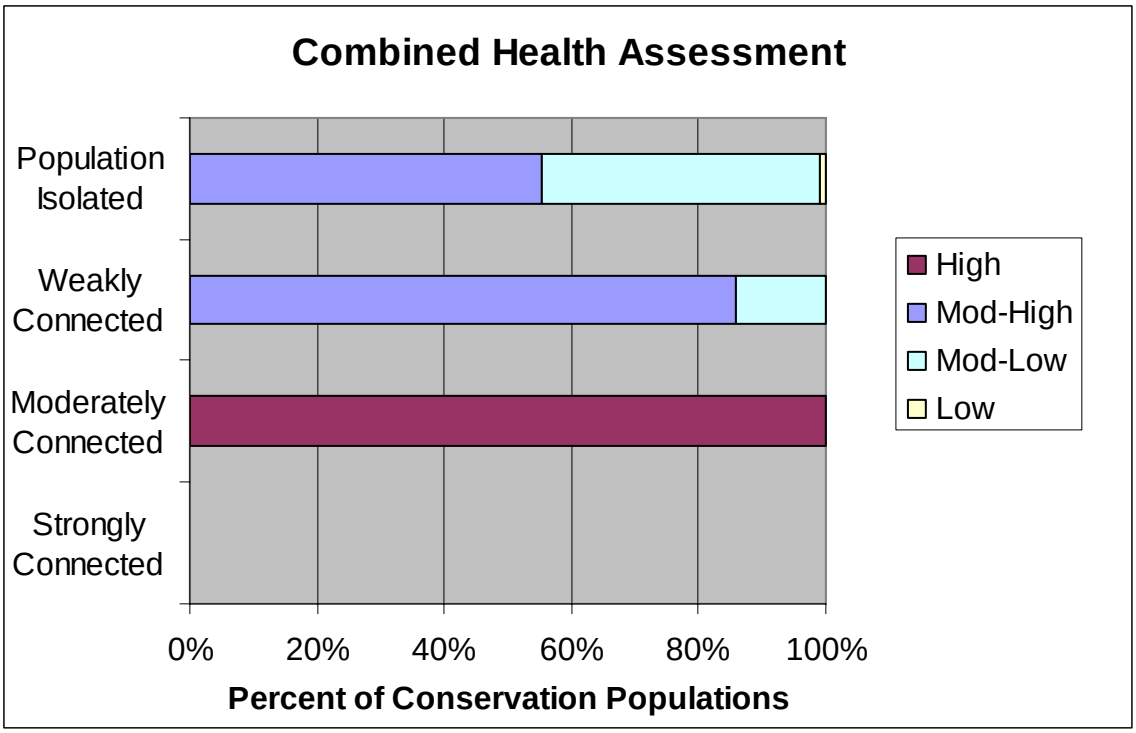


Figure 18. Ranked health scores by number of populations (top) and stream miles occupied (bottom). RGCT conservation populations are ranked into low to high levels of health.



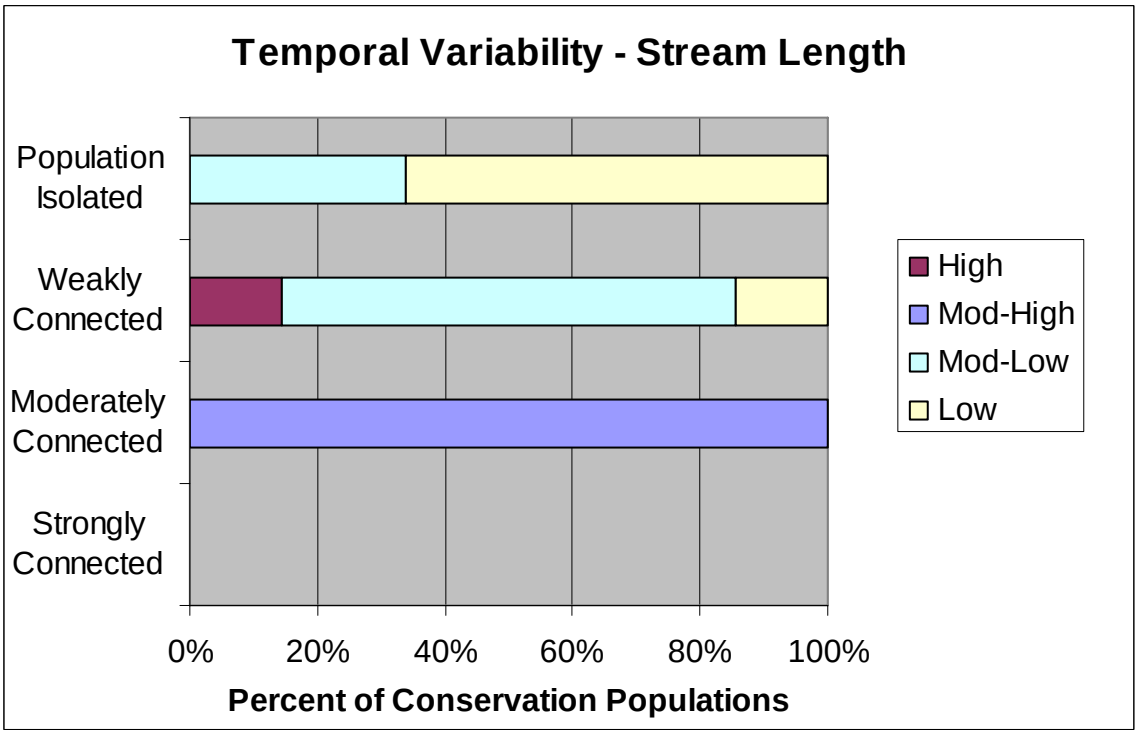


Figure 19. Ranked health scores for percent of conservation populations. Data is grouped by connectedness. RGCT conservation populations are ranked into low to high levels of health.

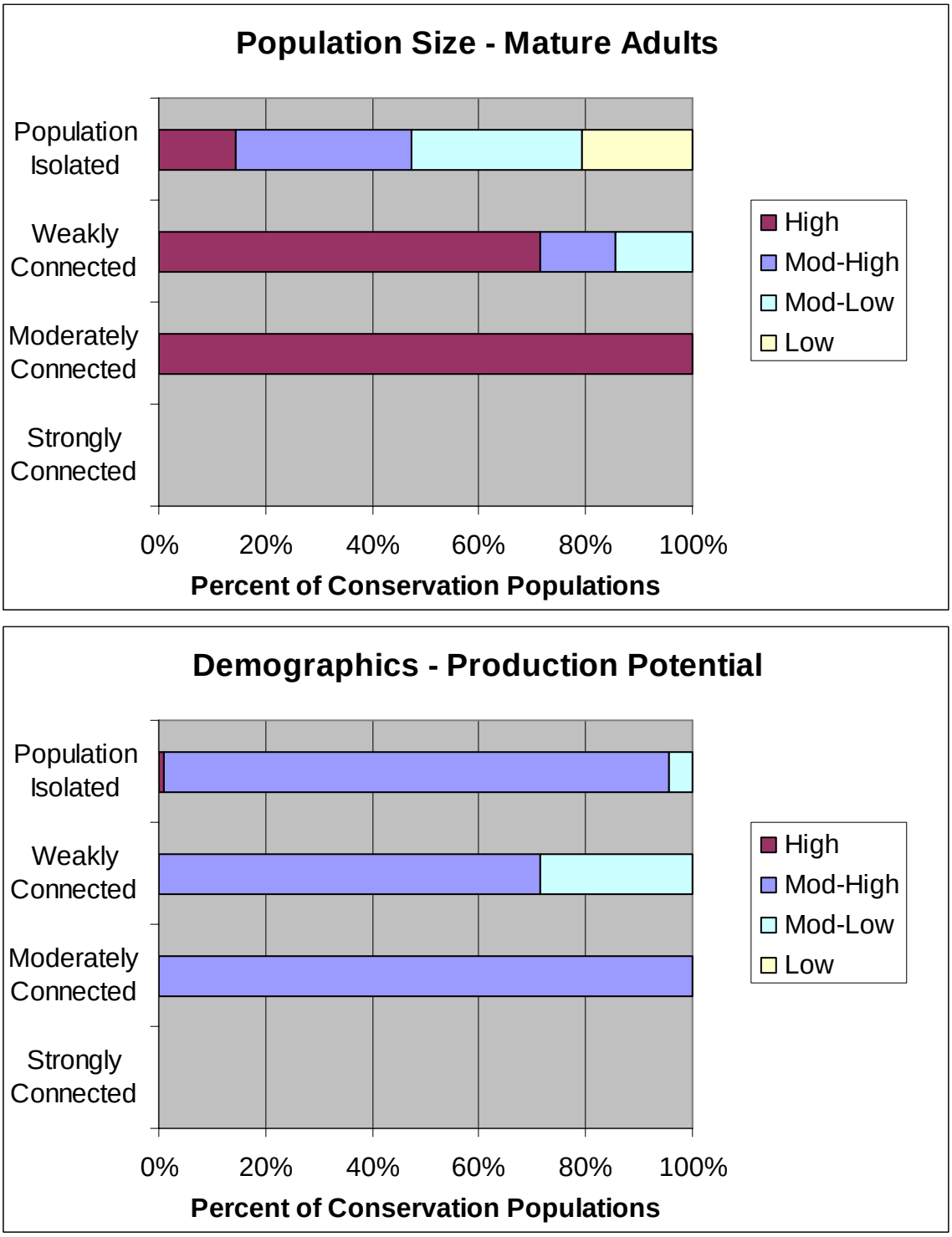


Figure 20. Ranked health scores for percent of conservation populations. Data is grouped by connectedness. RGCT conservation populations are ranked into low to high levels of health.

Restoration Activities Implemented for Conservation Populations

Restoration, conservation, and management activities that had been implemented to conserve designated conservation populations were evaluated for the 120 conservation populations (**Table 32**). The majority of populations (90%) had one or more conservation actions (e.g., activities or projects) implemented to improve conditions. For 10% of the conservation populations no specific conservation actions were identified. During this status update there was no attempt to address the significance of the conservation actions, either on a specific RGCT population or with regard to conservation in general. Relative significance will have to be addressed in subsequent assessments conducted by the coordinated conservation effort. Common activities include special fishing regulations (85%), land-use mitigation or protections (58%), barrier construction (29%), population covered by special protective management emphasis (26%), and removal of competing or hybridizing species by chemical means (13%) or physical means (6%).

Land Uses Associated with Conservation Populations

Similar to the approach associated with conservation actions, land uses and human activities associated with the 120 RGCT conservation populations were identified (**Table 33**). No attempt was made to address significance of these activities, either on a specific RGCT population or with regard to conservation in general. The relative significance of these activities may be addressed in subsequent assessments. The majority of populations (97%) had one or more land uses or human activities (e.g., angling, roads, recreation, etc) occurring within the influence zone of the population. Only three (3%) of the populations were judged as having no land use activities within the population influence zone. Common land use activities include non-angling recreation (90%), livestock grazing (87%), angling (84%), roads (58%), and timber harvest (19%).

Table 32. Number and percentage of RGCT conservation populations (120) that have had various types of conservation, restoration, and management actions implemented to conserve them as of 2007. Each population can have multiple actions.

Conservation Action	Count	Percent of Total
Special Angling Regulations	102	85%
Land-use mitigation direction and requirements (e.g. Forest Plan direction, regulation, permit req., coordination stipulations, etc)	70	58%
Barrier construction	35	29%
Population covered by special protective mgt emphasis (e.g. Nat'l Park, wilderness, special mgt area, conservation easement, etc.)	31	26%
Chemical removal of competing/hybridizing species	16	13%
Population Restoration/Expansion	10	8%
Other (List in comments)	7	6%
Physical removal of competing/hybridizing species	7	6%
Riparian fencing	6	5%
Riparian restoration	5	4%
Re-founding pure population	3	3%
Bank stabilization	2	2%
Channel restoration	2	2%
Population supplementation (e.g. to implement genetic swamping or to reduce potential of bottle necking, etc.)	2	2%
Public outreach efforts at site (Interpretative site)	2	2%
Culvert replacement	1	1%
Diversion modification	1	1%
Pool development	1	1%
None	12	10%

Table 33. Number and percentage (of the 120 conservation populations evaluated) of designated RGCT conservation populations where various land uses were identified. Each population can have multiple activities present.

Land Use Activity	Count	Percent of Total
Recreation (non-angling)	108	90%
Range (Livestock grazing)	104	87%
Angling	101	84%
Roads	69	58%
Timber Harvest	23	19%
De-watering	20	17%
Fish Stocking (e.g. non-native fish)	12	10%
Mining	3	3%
None	3	3%

Restoration and Expansion Analysis

Restoration and expansion opportunities were assessed in unoccupied historical habitat. For this exercise, currently occupied habitats were not considered. About 6,020 miles of historical habitat (90%) were identified as not currently occupied by conservation populations of RGCT (**Figure 21**). The assessment subsequently focused on these stream segments for their restoration/expansion potential. In order to objectively evaluate the restoration or expansion potential within this unoccupied area it was deemed important to determine how much of the historical habitat was currently incapable of supporting RGCT due to significant environmental changes. The working groups reviewed the unoccupied stream sections and made judgments on current suitability and determined that 1,314 miles of this habitat (22%) is unsuitable based on current habitat limitations (e.g., excessive temperatures, significantly reduced stream flows, channel alteration, etc.) or because they were judged to be associated with recreational fisheries of such importance to make consideration of their use in RGCT conservation unrealistic at this time. The remaining stream miles (4,706) of suitable habitat were carried through the assessment and rated in relation to the potential for restoration or expansion of RGCT conservation populations. Unoccupied habitat considered unsuitable ranged from 0 to 28% among GMUs (**Table 34**).

There were four general attributes deemed of particular importance to the potential success of restoration or expansion in these suitable habitats. The first attribute related to past stocking and presence of non-native fish, especially other trout species that would compete or genetically contaminate RGCT. The second attribute addressed the relative quality of the habitat. The third attribute dealt with a consideration of the significance of any existing fishery within the suitable stream segments. The fourth attribute addressed the relative complexity of removal of any non-native fish present within the stream segments. These attributes were assessed individually and in combination. There was

also consideration given to the presence of barriers that could provide security from competing and/or contaminating species of fish.

Table 34. Potential restoration and expansion opportunity assessment base information by GMU (miles and percentages).

GMU	Historical habitat not occupied by RGCT – miles	Historical RGCT habitat no longer suitable for RGCT – miles (% of GMU)	Unoccupied historical RGCT habitat that is suitable for RGCT restoration – miles (% of GMU)
Caballo	10	0	10 (100%)
Canadian	570	23 (4%)	547 (96%)
Lower Rio Grande	1,826	383 (21%)	1,443 (79%)
Pecos	594	64 (11%)	529 (89%)
Rio Grande Headwaters	3,020	844 (28%)	2,176 (72%)
Totals	**6,020**	**1,314 (22%)**	**4,706 (78%)**

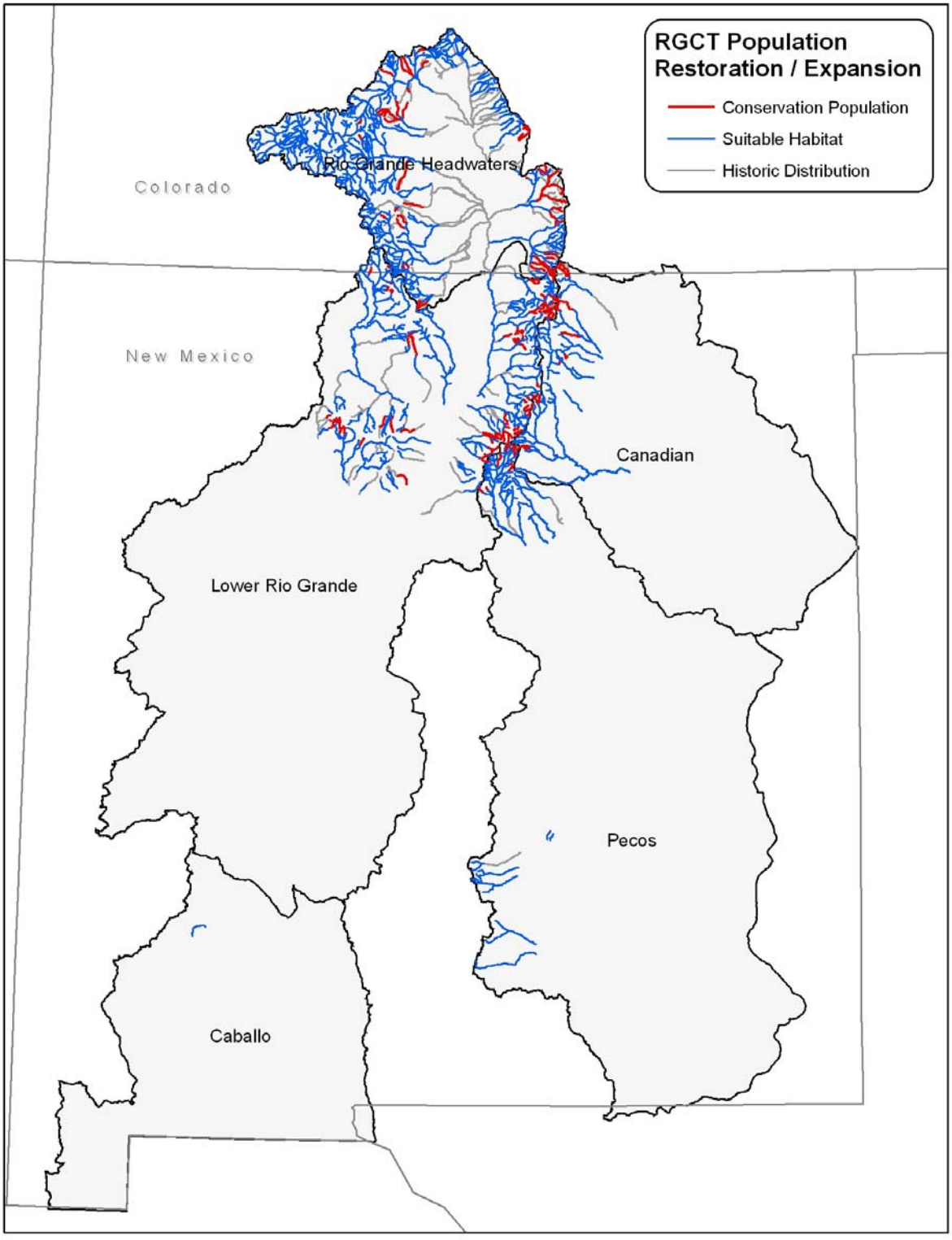


Figure 21. Map displaying all historical habitat, habitat occupied by conservation populations (red) and habitat suitable for restoration and expansion (blue). Grey lines are either unsuitable or currently occupied by a RGCT population not considered a conservation population.

Past Stocking and Presence of Non-native Trout

Of the 4,706 miles identified as potentially suitable habitat, 75 miles (2%) had no record of non-native fish stocking or they were judged to be barren of fish. Another 56 miles (1%) of stream either had a record of stocking or they contained only RGCT that were not included within the conservation populations. Five hundred twelve miles (11%) had records indicating that non-native trout were present in low numbers. Another 3,693 miles (78%) had non-native trout in high numbers and in the remaining 371 miles (8%) of suitable habitat it was unknown whether non-native trout were present (**Tables 35 and 36**).

Table 35. Non-native trout stocking or presence in habitat suitable for RGCT expansion or reclamation.

Record of Stocking and Presence or Non-Native Trout	Miles of Suitable Historical Habitat (percent of total)
No record of Stocking--Segment is Barren	75 (2%)
Record of Stocking and/or Segment has only RGCT – Not Included as Conservation Population	56 (1%)
Record of Stocking and Segment has Non-native Trout in Low Numbers	512 (11%)
Record of Stocking and Segment has Non-native Trout in High Numbers	3,693 (78%)
Unknown Presence of Non-native Trout	371 (8%)
Total	**4,706**

Table 36. Non-native trout stocking or presence in suitable habitat by GMU.

Non-native presence	Caballo	Canadian	Lower Rio Grande	Pecos
Barren	0	30 (5%)	17 (1%)	8 (2%)
RGCT only	0	33 (6%)	15 (1%)	8 (2%)
Few non-natives	0	53 (10%)	143 (10%)	9 (2%)
Many non-natives	10 (100%)	420 (77%)	1,098 (76%)	377 (71%)
Unknown	0	12 (2%)	170 (12%)	128 (24%)
Total	**10**	**547**	**1,443**	**529**

Non-native presence	Rio Grande Headwaters
Barren	20 (1%)
RGCT only	0
Few non-natives	307 (14%)
Many non-natives	1,788 (82%)
Unknown	61 (3%)
Total	**2,176**

Quality Considerations of Habitat Associated with Restoration and Expansion of RGCT

Of the 4,706 miles of suitable but unoccupied habitat, 170 miles (4%) had habitat quality rated as excellent. Another 2,911 miles (62%) had habitat quality rated as good. About 1,013 miles (22%) had habitat rated as fair. Two hundred forty eight miles (5%) had habitat quality rated as poor and 365 miles (8%) of suitable habitat had unknown quality (Tables 37 and 38).

Table 37. Information relative to habitat quality of suitable habitat (miles) being considered for conservation population restoration or expansion.

Habitat Quality	Miles of Suitable Historical Habitat
Excellent Habitat Quality	170 (4%)
Good Habitat Quality	2,911 (62%)
Fair Habitat Quality	1,013 (22%)
Poor Habitat Quality	248 (5%)
Unknown Habitat Quality	365 (8%)
Total	**4,706**

Table 38. Habitat quality by GMU in suitable habitat considered for RGCT restoration.

Habitat Quality	Caballo	Canadian	Lower Rio Grande	Pecos
Excellent	0	1 (<1%)	54 (4%)	46 (9%)
Good	10 (100%)	425 (78%)	642 (45%)	179 (34%)
Fair	0	66 (12%)	461 (32%)	122 (23%)
Poor	0	30 (5%)	164 (11%)	54 (10%)
Unknown	0	25 (5%)	122 (8%)	128 (24%)
Total	**10**	**547**	**1,443**	**529**

Habitat Quality	Rio Grande Headwaters
Excellent	68 (3%)
Good	1,654 (76%)
Fair	363 (17%)
Poor	0
Unknown	90 (4%)
Total	**2,176**

Significance of Recreational Fisheries Associated with Restoration and Expansion of RGCT

Of the 4,706 miles of suitable but unoccupied habitat, 73 miles (2%) were judged to have no fishery present. Another 940 miles (20%) had fisheries of minor significance. Nine hundred seventy four miles (21%) had fisheries rated as of moderate significance. Another 2,462 miles (52%) had fisheries rated as major significance and 257 miles (5%) had unknown fisheries significance (**Tables 39 and 40**).

Table 39. Information relative to significance of fisheries associated with current recreational fisheries (miles) being considered for conservation population restoration or expansion.

Significance of Fisheries	Miles of Suitable Historical Habitat
No fisheries Present	73 (2%)
Fisheries of Minor Significance	940 (20%)
Fisheries of Moderate Significance	974 (21%)
Fisheries of Major Significance	2,462 (52%)
Unknown Fisheries Significance	257 (5%)
Total	**4,706**

Table 40. Information relative to significance of fisheries associated with current recreational fisheries (miles) being considered for conservation population restoration or expansion by GMU.

Fishery Significance	Caballo	Canadian	Lower Rio Grande	Pecos
No fishery	0	30 (5%)	6 (<1%)	8 (1%)
Minor	10 (100%)	53 (10%)	284 (20%)	75 (14%)
Moderate	0	205 (38%)	288 (20%)	22 (4%)
Major	0	247 (45%)	753 (52%)	297 (56%)
Unknown	0	12 (2%)	113 (8%)	128 (24%)
Total	**10**	**547**	**1,443**	**529**

Fishery Significance	Rio Grande Headwaters
No fishery	30 (1%)
Minor	518 (24%)
Moderate	459 (21%)
Major	1,166 (54%)
Unknown	4 (<1%)
Total	**2,176**

Considerations Associated with the Complexity of Removal of Non-Native Trout

Of the 4,706 miles of suitable but unoccupied habitat, 64 miles (1%) had no fish present. Another 175 miles (4%) were judged to have minor complexity of fish removal. About 600 miles (13%) had moderate complexity of fish removal. Three thousand six hundred eleven miles (77%) were judged to have major complexity of fish removal and 256 miles (5%) had unknown complexity of fish removal (**Tables 41 and 42**).

Table 41. Information relative to complexity of non-native trout removal associated with suitable habitat (miles) being considered for conservation population restoration or expansion.

Complexity of non-native removal	Miles of Suitable Historical Habitat
No fish Present	64 (1%)
Minor Complexity of Fish Removal	175 (4%)
Moderate Complexity of Fish Removal	600 (13%)
Major Complexity of Fish Removal	3,611 (77%)
Unknown Complexity of Fish Removal	256 (5%)
Total	**4,706**

Table 42. Information relative to complexity of non-native trout removal associated with suitable habitat (miles) being considered for conservation population restoration or expansion by GMU.

Removal complexity	Caballo	Canadian	Lower Rio Grande	Pecos
No fish present	0	30 (5%)	6 (<1%)	8 (1%)
Minor	0	54 (10%)	67 (5%)	0
Moderate	10 (100%)	68 (12%)	210 (15%)	68 (13%)
Major	0	370 (68%)	1,068 (74%)	326 (62%)
Unknown	0	25 (5%)	93 (6%)	128 (24%)
Total	**10**	**547**	**1,443**	**529**

Removal complexity	Rio Grande Headwaters
No fish present	20 (1%)
Minor	54 (3%)
Moderate	244 (11%)
Major	1,847 (85%)
Unknown	10 (<1%)
Total	**2,176**

Combined Rating of Restoration and Expansion Rankings of RGCT

Of the 4,706 miles of suitable but unoccupied habitat, only 36 miles (1%) were judged to have high potential for RGCT restoration or expansion. Another 154 miles (3%) had intermediate restoration or expansion potential. About 1,573 miles (33%) were rated has having a low potential for restoration or expansion and 2,493 miles (53%) were rated as very low potential for RGCT restoration or expansion. The remaining 451 miles (10%) had unknown potential for restoration or expansion due to one or more missing pieces of information (**Table 43**). **Table 44** displays the combined restoration ratings by GMU.

Table 43. Information relative to significance of fisheries associated with suitable habitat (miles) being considered for conservation population restoration or expansion.

Combined RGCT Restoration or Expansion Rating	Miles of Suitable Historical Habitat
High Overall Potential	36 (1%)
Intermediate Potential	154 (3%)
Low Potential	1,573 (33%)
Very Low Potential	2,493 (53%)
Unknown Potential	451 (10%)
Total	**4,706**

Table 44. Restoration potential (miles of habitat) by GMU for RGCT.

Restoration Potential	Caballo	Canadian	Lower Rio Grande	Pecos
High	0	0	16 (1%)	8 (1%)
Intermediate	0	71 (13%)	9 (1%)	0
Low	10 (100%)	213 (39%)	464 (32%)	156 (29%)
Very Low	0	238 (43%)	755 (52%)	238 (45%)
Unknown	0	25 (5%)	199 (14%)	128 (24%)
Total	**10**	**547**	**1,443**	**529**

Restoration Potential	Rio Grande Headwaters
High	11 (1%)
Intermediate	74 (3%)
Low	729 (34%)
Very Low	1,263 (58%)
Unknown	98 (5%)
Total	**2,176**

Conclusions

Historical Perspective

The entire historic range of RGCT cannot be known with certainty, due to the paucity of early distribution data (Alves et. al. 2004). Previous historical distribution was often defined as all streams in the Rio Grande, Pecos and Canadian drainages of Colorado and New Mexico presently capable of supporting trout (Stumpff and Cooper 1996). A single quantitative estimate of Rio Grande cutthroat trout historical distribution was available prior to this status assessment effort (Pritchard and Cowley 2006). In their assessment, they estimated historical habitat at 6,200 miles. For comparison, this assessment estimated approximately 6,660 miles of historic habitat, a 7.4% difference. Other status assessments focused on current distribution (Rinne 1995, Stumpff and Cooper 1996).

To account for the various changes that influence historical RGCT distribution, this status update used a systematic approach to provide an estimation of the amount of stream habitat that was historically occupied. The NHD stream layer (primarily at the 1:24,000 scale) was used as the basis for the assessment. This status update also anchored the historical perspective to a more definitive point in time (circa 1800). It was felt that a perspective closely associated with the movement into the Rio Grande Basin by early European settlers provided a reasonable point of reference for comparison with present conditions. Our estimates suggest approximately 6,660 miles of streams located within 19, 4th level HUC's were occupied by RGCT before the year 1800 (**Figure 1**). Of our total, New Mexico contained more historical habitat (3,431 miles; 52% of total) than Colorado (3,229 miles, 48%) (**Figure 2**). The 6,660 miles of historically occupied habitat is in stark contrast to the nearly 81,827 miles of stream contained in the 1:24,000 NHD hydrography layer associated with the RGCT historically inhabited 4th level watersheds. About 75,100 miles of streams were excluded from the NHD coverage as being historically occupied due to a number of factors including passage barriers (e.g., physical, temperature, etc.), artificial channels (e.g., ditches and canals) and inadequate habitat (e.g., minimal flows, excessive gradients, intermittent or ephemeral flows, excessive temperatures, etc.).

Our status assessment attempted to deal with sources of variation by applying a standard protocol in a uniform manner. We used the NHD stream layer at the 1:24,000 scale and because the maps were geo-referenced. The actual calculation of miles was completed with GIS capabilities. We also anchored to a specific point in time (circa 1800). We believe these and other improvements allowed for a relatively precise determination of the historical perspective. Because of these improvements we believe that our estimate of historical habitat occupied by RGCT provides a solid basis for determining the current status of the subspecies.

Current Distribution and Conservation Populations

Over the last three decades others have attempted to define the nature of contemporary RGCT distribution (Behnke 1979, Behnke 1992, Rinne 1995, Stumpff and Cooper 1996, and Pritchard and Cowley 2006). These attempts have varied due to the reference time, the amount and quality of the information from which the assessment was derived, and scope of the respective assessment. These previous assessments defined the current status by identifying the number of populations and sometimes the extent of occupied habitat known to exist at the time of the

assessment. The more detailed early assessments were conducted by agency employees and focused on a limited portion of the range (e.g., Rinne 1995 and Stumpff and Cooper 1996). Rinne (1995) listed 62 and 36 known pure or relatively pure populations in New Mexico and Colorado, respectively. Similarly, Stumpff and Cooper (1996) identified 53 and 39 populations of RGCT in New Mexico and Colorado, respectively. Calamusso and Rinne (2004) identified 52 genetically pure populations (>95%) in New Mexico though their study was limited to Forest Service lands in New Mexico. Colorado documented 65 genetically pure populations in their 2004 conservation plan (Alves et. al. 2004). In comparison, this assessment documented 120 conservation populations throughout the range of RGCT, of which 91 were core conservation populations.

Our status assessment provided a further refinement of status information based on information provided by 15 professional fishery biologists having specific knowledge of RGCT. This recent information update identified 809.5 miles of occupied stream habitat in 14 4th level HUC's. Of the 809.5 currently occupied miles, 51 occurred outside of historical habitats we delineated. Eleven percent of the historically occupied habitats we designated are currently occupied. The 51 miles of occupied habitat outside estimated historical habitat would equal an additional 1% of the total historically occupied habitat. These streams are typically above historical barriers in stream segments not believed to have been historically occupied but still within the historical range.

Following a systematic review of the occupied habitat, 120 conservation populations were identified. These populations included 91 judged to be "core conservation populations" based on genetic testing (less than 1% introgressed) and information indicating no record of non-native stocking and no contaminating species being present and 25 additional conservation populations having other attributes viewed as important to RGCT conservation. In total these 120 conservation populations occupy 690 miles (10.4% of historical habitat) of habitat. Pritchard and Cowley (2006) estimated current occupied range of conservation populations at just over 11% of historic range (713 mi.). Since the original assessments in the 1990s, more populations of RGCT were discovered, refounded, or expanded (**Table 45**).

Table 45. Numbers and miles/acres of RGCT conservation populations in Colorado and New Mexico known to exist Rinne (1995), Stumpff and Cooper (1996) and from this status assessment (2007).

Geographic Management Units	Existing RGCT Conservation Populations					
	1995		1996		2007	
	#	Miles	#	Miles	#	Miles
State of Colorado-Total	39		39		41	293.7
State of New Mexico- Total	62		53		84	396.5
Rio Grande Headwaters			24		39	281.3
Pecos			9		11	37.3
Lower Rio Grande			41		58	304.1
Canadian			5		12	67.5
Grand Total	101	+	92*	+	120	690.2

+ = mileage or acreage information is incomplete.
* = populations identified by GMU did not sum to total number of populations within the assessment

It is important to note there was a significant difference in how populations were identified in the various status assessments. Previous assessments identified populations based on the occupied stream without consideration whether the streams were in the same drainage basin and connected either directly or indirectly. In early assessments, a few occupied streams across the range were identified. As additional inventories were completed, other streams within occupied drainages were found to contain RGCT and were subsequently referred to as populations (e.g., Columbine Creek, Placer Creek, and Willow Creek), even though they were tributary to the same stream (e.g., Columbine Creek). Caution should be used when comparing the number of RGCT populations identified in the various status assessments. Because most early assessments linked RGCT populations to specific streams there would be a tendency to overestimate the number of actual populations. Our assessment applied a systematic approach focused on teasing out RGCT populations based on connectivity throughout the whole range. We identified a number of populations (8) that consisted of multiple connected streams or stream segments that made up population networks. We also identified a substantial number of populations (112) which were non-networked, or isolated. An attempt was made to count the number of individual streams in each population, but it should be noted some of these streams were unnamed and may not have been recognized as a stream population previously.

As of 2007, the RGCT Conservation Team was tracking seven lakes containing or connected to conservation populations. Lakes with conservation populations were either connected to a stream system or not connected to a known stream population of RGCT but are still believed to have important conservation value. There are other lakes that will be included as conservation populations in the future.

This status assessment evaluated several important characteristics associated with conservation populations. The first characteristic was the relative risk to each population associated with genetic contamination, either as an initial influence or as a continuation of influences. A majority of conservation populations (70%) were rated as having no risk to a low risk of genetic contamination. Thirty percent of the populations were considered to be a moderate to high risk.

The second characteristic was associated with the risks associated with catastrophic diseases (e.g., whirling disease), either as an initial influence or as a continuation of influences. The majority of conservation populations (92%) were identified as having limited or minimal level of risk from disease. Seven percent of the populations were rated as segments having a moderate to high risk from catastrophic diseases and 1% were identified as already being infected. This status assessment also made a determination of general population health based on the interaction of four important variables (i.e., amount of habitat occupied as a surrogate for temporal variability, population size of reproductive RGCT, demographic interaction of habitat quality, presence of competing species, disease risk and within population connectedness). Sixty-nine RGCT populations (57%) were rated as having either high general health (1 population) or moderately high general health (68 populations). Fifty populations (42%) were rated as having moderately low general health and 1 population (1%) was rated as having low general health.

A majority of conservation populations (90%) had been influenced by one or more conservation activities or projects (e.g., habitat enhancement, population enhancement, special fishing regulations, or improved land use coordination). All but 3 conservation populations were associated with land uses occurring within their respective watersheds. As was pointed out in the methods section and in the protocol, no level of significance was attached to either the value or significance of influence associated with the conservation actions or land uses identified.

Conservation Population Restoration and Expansion Potential

This status assessment included an effort to explore opportunities for conservation restoration or expansion. We reviewed the component of the historically occupied habitat not currently supporting RGCT. To our knowledge this was a first systematic approach taken to assess restoration or expansion potentials. While the approach applied can be viewed as cursory, it did generate many pieces of important information. About 6,020 miles (90%) of historical habitat are not currently occupied by RGCT. Of this total, 1,314 miles (22%) were judged to be unsuitable for restoration due to habitat changes associated with reduced stream flows, elevated temperatures, significant channel alterations and other important habitat considerations or were judged to be associated with recreational fisheries of such importance to make consideration of their use for RGCT conservation unrealistic at this time. In total, 4,706 miles (78%) of historical habitat were evaluated for their potential to contribute to future RGCT conservation by passing them through a screen of four important considerations (i.e., presence of non-native trout, habitat quality, significance of any fishery, and relative complexity of removal of undesirable fish). For 451 of these suitable miles (10%) not all of the considerations could be addressed and therefore we were unable to complete the restoration and expansion evaluation. Of the remaining suitable miles, 36 were judged as having a high potential, 154 miles had intermediate potential, 1,573 miles had low potential, and 2,493 miles had very low potential.

We are certain the findings of this assessment represent a marked improvement in information associated with RGCT status throughout the sub-species range. Our basic assessment approach was strengthened by the knowledge and expertise of 15 professional fishery biologists. Collectively, this group had a combined total of 171 years of fishery experience, 127 of which were specific to cutthroat trout management or conservation. Use of geo-referenced database

(i.e., ArcGIS 9.0) was applied by two capable GIS and data management specialists. The information developed in this RGCT status update represents the best scientific information available to assist in the conservation and management of RGCT. This assessment will serve as a baseline for measuring future conservation progress. In addition, this information will be used for prioritizing RGCT conservation efforts and assist in conservation planning by the states, tribes, and others with RGCT management responsibility. Updating this database with data from a well-designed field-monitoring program could serve as a barometer to monitor the status of RGCT over time.

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Appendix A. Assessment Protocol

Rio Grande Cutthroat Trout Range-wide Database Update: Historical Range, Current Status, Risk and Population Health Determinations and Population Restoration Potential Protocols 2006

(Revised Version 6/12/2006; Prepared by Bruce May and Shannon Albeke)

This revision provides information for updating a range-wide status and conservation database for Yellowstone cutthroat trout (RGCT; *Oncorhynchus clarkii virginalis*) This update will: 1) estimate historically occupied habitat; 2) identify specific attributes associated with current distributions; 3) identify conservation populations and revise information for currently identified populations, including assessing relative population health using a ranking system approach adapted from Rieman et al. (1993) and evaluating risks associated with genetic introgression and catastrophic disease; and 4) evaluate potential for further expansion and restoration of conservation populations within historical habitats. The protocol detailed below represents a modified version of the Westslope, Yellowstone, Colorado River and Bonneville cutthroat assessment specifically tailored to a RGCT status update. The assessment is being done as a critical component of the range-wide coordination for RGCT. Completion of the status update will be helpful in meeting the objectives of the range-wide conservation effort in a number of respects. The status update for 2006 should be viewed as a 'snap shot' of RGCT distribution and relative population health. This status update will serve as a valuable benchmark for evaluating future changes that are anticipated to occur.

This status update will use National Hydrography Dataset (NHD) as the base geographic information system (GIS) hydrography layer for the effort (see **http://nhd.usgs.gov/** for more information on NHD). The NHD layer has become the most nationally accepted GIS layer for displaying stream and river hydrography. In addition, all of the stream and river mapping has been done at the 1:24,000 scale for NHD. The USFS Natural Resource Information System (NRIS) has ArcGIS tools available that greatly assist with this process. An event creation tool, developed by the NRIS team, will be used to geo-reference RGCT population segments. This tool utilizes a "point–and-click" user interface to reference these population segments against the NHD stream network.

To maintain continuity and consistency, only those streams identified on the NHD stream layer will have information entered into the database. Applying this criterion will mean that some intermittent and ephemeral streams that could potentially provide habitats used or occupied by RGCT, especially during high flow periods, will be omitted. It is anticipated that these streams will be added during subsequent efforts to update the NHD stream layer. This version of the database will include information for lakes and reservoirs identified on the NHD lake layer.

Sources of information will be identified and linked to rated levels of reliability to better judge reliability. Data source tables will be created to track how information was derived (Table 1). Information associated with judgment calls and anecdotal sources, in general, may be viewed as being less reliable and/or accurate than information developed as part of detailed surveys and studies that have undergone substantial analysis and review.

All data will be entered in "real-time" at workshops with groups of experts evaluating all waters within a 4th code HUC and GIS and/or database experts entering and editing those evaluations until the entire group has reached consensus within a particular HUC. There are 22 4th level HUC's within the historic range of RGCT. During the completion of the assessment for each HUC, the teams will be asked to employ a systematic approach to ensure that all information is included in the database. The use of 4th level HUC's will be for accounting purposes only. All data will be geo-referenced as either points (e.g. barrier locations), cutthroat mapping segments (e.g. stream segments occupied by RGCT), or discrete populations that make up conservation populations, using a team approach that will include fishery biologists and the GIS-data entry person as critical members of the team.

Table 1. Example look-up table for data sources with a relative index values for information reliability and accuracy.

Information 'Source	Relative Degree of Reliability
Anecdotal Information	Lower 1
Letter	Lower 1
Professional Judgment	Lower 2
Data Files	Moderate 3
Agency Report	Moderate 3
Thesis or Dissertation	Higher 4
Published Paper	Higher 5

This protocol is partitioned into four primary components for conducting this database update. First, NHD streams considered to be historically occupied by RGCT at the time of the first European exploration (approximately 1800) of the

Northern Rocky Mountains will be captured. Secondly, information associated with current distributions of RGCT including density, genetic status, presence of non-native species and habitat information will be developed and displayed on a mapping segment basis (e.g. stream or lake). Thirdly, conservation populations (either as an individual stream or a network of streams and lakes occupied by RGCT) will be identified, and the relative health and the risks to persistence for each population will be evaluated. Relative health and risks will be assessed based on three aspects: 1) genetic introgression, 2) disease, and 3) population size and demographics. Health and risk determinations represent relative evaluations indicating higher or lower levels of concern. All RGCT populations mapped and designated conservation populations, including those associated with lakes (adfluvial) that are maintained by natural reproduction, will have population health and risk assessments completed. Locations of lakes that support RGCT will be shown on the maps. **RGCT populations supported entirely by annual or routine stocking will not be included as part of this assessment (they can be captured as Recreation Populations). The exception would be those populations serving as wild broods that require periodic stocking to bring in new genetic material as part of the brood maintenance plan.** The fourth component of the database will provide information on the potential for creation or expansion of conservation populations within the conservation planning boundary.

Definitions of terms used for this protocol are provided in italics as they are first used.

Population mapping unit (segment) *– each RGCT occupied stream, or segment of stream, will be treated as a separate mapping unit or segment. Specific information relative to stocking record, presence of non-native fish, RGCT density, habitat quality and relative steam segment width will be recorded for each segment. Connectivity between these segments will be the basis for identification of conservation populations.*

Conservation Populations – conservation populations represent a combination of mapping segments that when united together represent a conservation unit. The identification of conservation populations is primarily the responsibly of the State fishery agencies. Conservation populations can exist in a genetically unaltered condition (e.g. core conservation populations with genetic analysis indicating greater than 99% purity and/or there is reason to believe that the genetics are unaltered) and/or they can be based on unique ecological, genetic and behavioral attribute of significance even with some level of genetic introgression (See Cutthroat Trout Management: A Position Paper – Genetic Considerations Associated with Cutthroat Trout Management). Conservation populations may exist as a network of subpopulations or streams; or they may exist as an independent stream or stream segment.

Core Conservation Population – *Those conservation populations that are known to*

be genetically unaltered by hybridization or with an extremely high probability that the population is unaltered by hybridization. Stream segments for these conservation populations have been tested and found to be unaltered or stream segments that are suspected to be unaltered and also have no record of stocking with potentially hybridizing species and no potentially hybridizing species present.

***Networked-population** – infers that interbreeding between subpopulations (population mapping segments) can occur within a few generations (3-15 years). Also referred to as a connected or meta-population. These populations occupy two or more stream segments that are connected or networked together. All subpopulations within a networked population must have at least the potential for genetic exchange among all other subpopulations within the networked population.*

***Sub-Population –** A discrete component of a meta-population or networked population. Usually associated with individual streams and/or stream segments.*

***Non-Networked Population (Isolated or Independent Population)** – populations that occupy a single stream or stream segment.*

***Genetic Risk** – risk of initial or on-going genetic introgression (hybridization) with introduced species or subspecies.*

***Relative Population Health** – evaluation of relative health based on several characteristics associated with the population. These characterizations can be linked to the influences of deterministic or stochastic factors that could lead to reduced viability for a population. Linked to temporal attributes, population size, production considerations and degree of connectedness.*

***Significant Disease (Pathogens) Risk** – Those diseases and the associated pathogens that have the potential to cause significant population decline. Including, but not limited to, the following: whirling disease, furunculosis, infectious pancreatic necrosis virus, etc.*

***Competing Species** – Those species that compete with cutthroat trout for food and space. Can be salmonid or non-salmonid. Generally, non-natives that have been introduced within cutthroat trout habitats. Certain competing species (i.e., brown and brook trout) are predatory on cutthroat trout. Introduced rainbow trout can be viewed as both a competing and hybridizing species.*

***Hybridizing Species** – Those species or subspecies of trout that readily hybridize with cutthroat trout, primarily introduced rainbow trout. Can also include subspecies of cutthroat trout that have been introduced into habitats outside of their respective historic range.*

Genetic, density and habitat information will be developed for each mapping segment. Genetic and disease risks along with a relative population health determination will be completed for each conservation population.

Barriers

All new barriers and new information on existing barriers of significance to RGCT conservation will be added to the database. Since barriers to fish movement (either long-term historical, natural short-term or anthropogenic barriers) are significant components to conservation, each known significant passage barriers will be

identified as a map point. Specific information associated with each barrier will be used to assess whether individual stream segments were likely historically occupied by RGCT, to assess potential influences of genetic introgression or disease to existing RGCT populations, or to determine whether existing subpopulations are connected with other subpopulations. The identification of barrier location and distinguishing characteristics are very important.

To determine the historical distribution, those barriers that represent long-term geologic features that would serve to influence historical distributions will be identified, where known. These are barriers that would have precluded RGCT occupation on or before 1800 (i.e. the segments were historically barren of RGCT). These barrier locations will be located (as points in ArcGIS) on the stream and river hydrography layers. During mapping of current RGCT distributions, other significant barriers (e.g., natural short-term and/or anthropogenic barriers) will be identified and located (as points in ArcGIS) and their associated characteristics, including barrier type (Table 2), blockage extent (Table 3), and significance (Table 4), will be determined and entered into data tables that are linked to the GIS points. Only barriers believed to have a significant influence on cutthroat distribution or population integrity will be identified. An attempt will be made to include all total barriers; however, surveys of all waters within the historical range of RGCT to identify fish barriers have not been completed, so only known barriers will be identified. The source of information used to locate each barrier and document its associated characteristics will be entered into a separate data table (Table 5). If a particular barrier extends over an extended distance (e.g. temperature or chemical barrier) the downstream point will be located on the GIS. **Barrier identification will be the first action taken of the four parts of the database update. Starting with the lower-most portion of the 4th code HUC, barriers will be located from the downstream-most to the upstream-most reaches in a systematic fashion until the mainstem and all tributaries and sub-tributaries are covered, and all known significant barriers have been identified.** Barrier significance is linked either to how a barrier is influencing current distribution, or how a barrier could be important to future conservation.

Table 2. Types of barriers to upstream fish movement (Check the one that best applies to each barrier).

Code	Barrier Type
1	Water diversion
2	Fish culture facility/research facility
3	Temperature
4	Bedrock
5	Culvert

Code	Barrier Type
6	Debris
7	Insufficient flow
8	Manmade Dam
9	Manmade temporary restoration barrier
10	Pollution
11	Beaver dams
12	Velocity barrier
13	Waterfall
14	Unknown

Table 3. Extent of blockage caused by barriers (Check the one that best applies).

Code	Blockage Extent
15	Complete
16	Partial
17	Unknown

Table 4. Barrier significance (Check all that apply for each barrier).

Code	Barrier Significance
1	Historically significant – Limited historical distribution
2	Prevents or limits introgression
3	Prevents ingress of competing species
4	Temporary, but presently prevents introgression or ingress of competing species
5	Confines population to small area of usable habitat
6	Limits or precludes opportunity for population re-founding
7	Limits expression of life history characteristics
8	Unknown

Table 5. Information sources associated with the barrier (Check one that best applies).

Code	Barrier Information Source
18	Judgment - Anecdotal and/or extrapolated information from other streams
19	Judgment - Ocular Reconnaissance
20	Minor Sampling – Minor amount of data collected (e.g. height or velocity)
21	Major Sampling – Major amount of data collected including fish tagging

Part 1 – Historical Distribution

The historical distribution of RGCT, including lakes, will be identified. The historically occupied range of RGCT will be assessed based on their believed distribution at the time Europeans first entered the Rocky Mountain West (approximately 1800). The NHD hydrography layers (1:24,000 scale) will be used to maintain consistency of information. Fishery professionals familiar with each major drainage basin (4th code HUC) will define historical distribution by adjusting the NHD stream layer within each HUC. The historical range will be based primarily on historical fisheries data, fisheries reports, and published historical accounts, augmented with personal knowledge of the area, known anecdotal information, known habitat restrictions, and known barriers of historical significance. Barriers of historical significance are those that would have precluded RGCT from occupying stream segments at any time prior to 1800. These barrier determinations, by necessity, will be based primarily on professional judgment (Table 6).

Table 6. Reasons to exclude or include a stream and lake segments as historical RGCT habitat.

Include or exclude		Reason
Exclude		Habitat limited – Primarily based on judgment regarding gradient, elevation, temperature
Exclude		Geologic barrier – Based on judgment. Must correspond to a mapped barrier location.
Include		Anecdotal information (e.g., newspaper, letter, journal, etc.)
Include		Historical scientific survey data (e.g., published report)
Include		Judgment

Part 2 -- Current Distribution--Genetic Status, Densities and Habitat Conditions

This part of the analysis will identify all stream segments and lake units currently occupied by RGCT. **This is not an identification of conservation populations which will come in Part 3**. Before identifying those stream and lake segments currently occupied by RGCT, the process of identifying all other barriers significant to current distribution of RGCT must be completed. These additional barriers should include any barrier that does, or could, significantly influence RGCT distribution, life history expression, spawning, competition and hybridization. After locating these barriers, the lower and upper bounds of all stream segments and lakes presently occupied by self-sustaining populations of RGCT will be located. For each stream segment and lake segment that currently supports self-sustaining RGCT, the data and data source used to justify inclusion will be identified (Tables 8 to 23). Two potential types of self-sustaining RGCT populations could be present: 1) aboriginal populations; or 2) restored populations (Table 8).

Only self-sustaining populations (i.e., no routine augmentation with hatchery fish) of RGCT will be addressed in this status review. All potentially occupied habitats must be reviewed, so workgroups will work in a systematic fashion from the downstream end of each HUC to the headwaters. The specific information associated with current occupancy will be tracked either by stream segment or by each lake or reservoir (Tables 8 to 23). When delineating stream segments currently occupied by RGCT barrier locations must be considered and included in the rationale for delineating each segment (in addition, barrier significance attributes may be adjusted as the workgroup determines how each barrier might be affecting RGCT within each stream segment). Information associated with each stream segment occupied by RGCT must be recorded as each segment is identified (Tables 8 to 23). Remember, each identified stream segment currently occupied by RGCT must have all attributes in common. If one or more attributes change, a new segment is created. For lakes, the attributes will represent a generalized view of the entire lake. There will be identifiers associated with each table to denote whether the information in the respective tables is associated with lake or stream habitats. Table 11 identifies fish stocking associated with the occupied stream or lake segments. Genetic information and status will be identified for each RGCT mapping segment (Tables 12 and 13). For Table 13, base the category determination on genetic information from the largest sample and/or the most recent sample. Relative density information will used to approximate effective population size for conservation populations identified in Part 3 of the protocol. Relative density or density estimates for a stream mapping segment will be recorded as the number of sexually mature RGCT adults (e.g. 12 cm and longer) (Shepard et.al.2003, USFWS 1998) (Tables 14 and 15). When actual density estimates are reported they must be linked to the estimator that was used to make the estimate (Table 14). There will be no density information associated with lake segments; RGCT associated with lake mapping segments will be included as part of the density estimates of the stream segments used for spawning by lake dwelling RGCT. Habitat information will be identified for each RGCT mapping unit (Table 17-21). The presence of non-native fish will be recorded for each stream segment and lake occupied by RGCT (Tables 22 and 23). - Total stream length and lake surface acres currently occupied will be developed through GIS capabilities.

Table 8. Origin of self-sustaining RGCT population (Check one that best applies).

Code	Origin
15	Aboriginal – naturally occurring population
16	Restored – human restoration to start population
17	Unknown

Table 10. Source of information associated with Tables 8 and 9 (Check one that best applies).

Code	Source of RGCT density information
29	Judgment-extrapolated information from other areas
30	Judgment - Ocular Reconnaissance
31	Spot Sampling
32	Trend Sampling
33	Detailed Population Sampling
34	Unknown

Table 11. Fish stocking associated with the occupied stream segment or lake (Check all that apply).

Code	Fish Stocking Status
1	No Record of fish stocking
2	Record of rainbow stocking
3	Record of brown trout stocking
4	Record of brook trout stocking
5	Record of lake trout stocking
6	Record of fine-spotted YCT stocking
7	Record of large –spotted YCT stocking
8	Record of RGCT stocking
9	Record of other cutthroat trout subspecies being stocked. Specify:
10	Other non-native fish stocked. Specify:

Table 12. Genetic status of RGCT within a stream segment or lake (Check one that best applies)

Code	Genetic Status
1	Genetically unaltered (<1% introgression detected) as a result of introduced species interaction– tested via electrophoresis or DNA
2	>1% and ≤10% introgressed (hybridized) with introduced species – tested via allozyme or DNA and introgression indicated to be from a hybrid swarm
3	>10% and ≤20% introgressed (hybridized) with introduced species – tested via allozyme or DNA and introgression indicated to be from a hybrid swarm
4	. >20% introgressed (hybridized) with introduced species – tested via allozyme or DNA and introgression indicated to be from a hybrid swarm
5	Not genetically tested -- Suspected unaltered with no record of stocking or contaminating species present
6	Not genetically tested -- Potentially hybridized with records of introduced hybridizing species being stocked or occurring in stream
7	Hybridized and Pure populations co-exist (sympatric mixed-stock) in stream (use only if there is evidence of reproductive isolation, non-random mating, and/or genetic testing has been completed)

NOTE: These categories are compatible with the interstate cutthroat genetics whitepaper.

Table 13. Specify the specific information associated with genetic sampling and analysis. More than one entry can be made for a stream segment or lake. (Add the specific genetic information in this table**)(<u>This Table is not specifically included in status update as a separate entity at this time)</u>**.

Sample Number	Collection Date	Collection ID	Number of Fish Sampled	Analysis Date	Analysis Code	% Non-RGCT Genes

Analysis Code	Genetic Analysis
1	Allozymes
2	PINES
3	Microsatellites
4	DNA

Table 14. Population density (numbers per mile) of sexually mature adults (12 cm) within stream mapping segment. Include the spawning density of migratory fish that use the segment for reproduction (Check the <u>one</u> that best applies).

Code	Mapping Segment Adult Fish Density
8	0 to 50 fish per mile (Specific density within this range, if available_____)
9	50 to 150 fish per mile (Specific density within this range, if available_____)
10	151 to 400 fish per mile (Specific density within this range, if available_____)
11	> 400 fish per mile (Specific density within this range, if available_____)
14	Unknown

Table 15. Population estimates of RGCT 12 cm and larger) expressed as number per mile (Complete with specific sample information that applies). Use this information to provide the specific density value for Table 11.

Sample ID	Sample Date	Estimated fish/mile	Coefficient of Variation %	95% Confidence Interval	Estimate Type Code

Code	Population Estimate Type
	3 pass removal
	2 pass removal
	Relative abundance expansion
	Mark-recapture
	Census from spawning trap
	Snorkel survey

Table 16. Source of population density information (Check one that best applies).

Code	Source of RGCT density information
29	Judgment-extrapolated information from other areas
30	Judgment - Ocular Reconnaissance
31	Spot Sampling
32	Trend Sampling
33	Detailed Population Sampling
34	Unknown

Table 17. Relative quality of occupied stream habitat (Check one that best applies). Refer to attachment B for optimal desired habitat reference conditions.

Code	Habitat Quality Determination
18	Excellent habitat quality (e.g., majority of attributes in optimal condition (e.g. ample pool environment, low sediment levels, optimal temperatures, quality riparian habitat, etc.)
19	Good habitat quality (may have some habitat attributes that are slightly less than ideal)
20	Fair habitat quality (has a greater number of attributes that are less than ideal)
21	Poor habitat quality (most habitat attributes reflect inferior conditions
22	Unknown

Table 18. For stream segment habitat quality determinations rated as good to excellent, identify the three most important habitat characteristics that influenced the quality determination (Check up to three that best apply). Refer to attachment B for optimal desired habitat reference conditions.

Code	Quality Characteristics of Primary Importance for Good to Excellent Habitat
1	Substrate fine sediment (less than 6.3 mm) levels generally within 0 to 24%.
2	Water temperatures within 8 to 16 C during spawning and incubation periods.
3	Pool habitat within 35 to 60% of total stream habitat area.
4	Amount of stream habitat in excess of 6 miles.
5	Stream shading within 50 to 70% during mid-day.
6	Streambank vegetative cover greater than 25%
7	Streambank stability greater than 90%

Table 19. For stream segment habitat quality determinations rated as fair to poor, identify the three most important habitat characteristics that influenced the quality determination (Check the three that best apply). Refer to attachment B for optimal desired habitat reference conditions.

Code	Habitat Quality Determination
8	Substrate fine sediments (less than 6.3mm) exceed 25%.
9	Water temperatures in summer consistently above 16 C or below 8C.
10	Amount of pool habitat either below 35% or above 60%
11	Amount of stream habitat less than 17 miles.
12	Mid-day stream shading either less than 50% or greater than 70%.
13	Streambank vegetative cover less than 25%.
14	Streambank stability less than 75%.

Table 20. Approximate width of occupied stream segment (Check one that best applies).

Code	Average width of occupied stream segment
23	< 5 feet
24	5 to 10 feet
25	10 to 15 feet
26	15 to 20 feet
27	20 to 25 feet
28	> 25 feet
55	Unknown

Table 21. Source of stream habitat quality and width information Check **one** that best applies).

Code	Source of habitat information
35	Judgment-extrapolated information from other streams
36	Judgment - Ocular Reconnaissance
37	Spot Habitat Sampling
38	Trend Habitat Sampling
39	Detailed Habitat Sampling
40	Unknown

Table 22. Presence of non native fish sympatric with RGCT in the mapping segment stream or lake. In situations where fine-spotted and large-spotted RGCT are in natural sympatry do not list either as non-native. (Check all that apply).

Code	Presence of Non-Native Fish
1	No non-native fish present
2	Rainbow trout
3	Brown trout
4	Brook trout
5	Lake trout
6	Fine-spotted YCT
7	Large-spotted YCT
8	Other cutthroat trout subspecies. Specify:
9	Other trout. Specify:
10	Other fish. Specify:
11	Unknown

Table 23. Source information associated with presence of non-native fish (Check one that best applies).

Code	Source of non-native fish information
41	Judgment-information extrapolated from other streams
42	Judgment -- Ocular Reconnaissance
43	Spot Sampling
44	Trend Sampling
45	Detailed Sampling
46	Unknown

Part 3 -- Change in Focus – Identification of Individual Conservation Populations and Application of Relative Health and Risk Evaluations for each Population

At this point the assessment will change from a focus on RGCT occupied mapping segments to a level of assessment related to specific conservation populations and factors that have potential to influence the well-being of these populations. A determination will be made relative to which occupied mapping units (i.e. lake and streams) will be combined into specific conservation

populations each having conservation as the primary management focus. **Please refer to the definition of conservation populations. Remember: genetics is only one of many factors that can be used to identify a conservation population**.

A connected or population network cannot have a total barrier within the population's stream network. Both networked populations and independent populations can serve as conservation populations. Identify the nature of subpopulation networks or connectedness of the population (Table 24). Conservation populations can be genetically unaltered (i.e., core conservation populations), or they can reflect a focus on unique traits and characteristics in the presence of documented or potential hybridization (i.e., conservation populations) (Table 25). Identify the life history attributes of the population (Table 26). Information on conservation activities and human-uses (e.g. land uses) will be identified for each conservation population (Tables 27 and 28). **It is also important to note that no degree of significance is attributed to the conservation activities or the human uses that are identified as being associated with each conservation population. The significance of the conservation activities and/or human uses to each specific conservation population will have to be addressed in subsequent specific assessments.**

Table 24. Degree of network or connectedness associated with the conservation population (Check one that best applies).

Code	Degree of Connectedness
1	Strongly networked. Migratory forms (fluvial/ad-fluvial) must be present and migration corridors must be open (significant connectivity). Occupied habitat consists of numerous (> 5) individual streams w/ sub-populations.
2	Moderately networked. Migratory forms are present but connection periodically disrupted. Genetic exchange limited at times. Occupied habitat consists of a few (4-5) individual streams w/ sub-populations.
3	Weakly networked. Questionable whether migratory forms exist within connected habitat; however possible infrequent straying of adults within occupied connected habitat. Occupied habitats consist of 2 to 3 streams w/ sub-populations.
4	Population not networked or connected. Population functions as an independent entity (single stream or stream segment with no interaction with other sub-populations.

Code	Source of connectedness information
22	Judgment-information extrapolated from other streams
23	Judgment -- Ocular Reconnaissance
24	Spot Sampling
25	Trend Sampling
26	Detailed Sampling
27	Unknown

Table 25. Conservation Population Qualifier (Check one that best applies)

Code	Conservation Population Qualifier
5	Core Conservation Population (must be tested genetically unaltered – greater than 99% RGCT genes and/or only have stream and lakes segments suspected of being unaltered…Tables 12 and 13).
6	Known or Probable Unique Life History (fluvial, ad-fluvial, or non-migratory) Or may include populations that represent the last, best RGCT populations within a given watershed or drainage basin.
7	Known or Probable Ecological Adaptation to extreme environmental condition (e.g. temperature, alkalinity, pH, sediment)
8	Known or Probable Predisposition for large size or unique coloration
9	Other – There is insufficient information to place the population in another category but professional judgment indicates the population and the habitat that is occupied are likely to become part of the RGCT conservation focus.

Code	Source of Qualifier information
28	Judgment-information extrapolated from other streams
29	Judgment -- Ocular Reconnaissance
30	Spot Sampling
31	Trend Sampling
32	Detailed Sampling
33	Unknown

Table 26. Specific life history attributes associated with the conservation population (Check all that apply).

Code	Life History Attributes
1	Resident Life History (e.g. Resides in one stream or a network of smaller streams for entire life)
2	Fluvial Life History (e.g. Resides primarily in a larger stream or river but migrates to other streams to spawn)
3	Ad-fluvial Life History (e.g. Resides primarily in a lake environment but migrates to riverine environments to spawn)

Code	Source of Life History information
34	Judgment-information extrapolated from other streams
35	Judgment -- Ocular Reconnaissance
36	Spot Sampling
37	Trend Sampling
38	Detailed Sampling
39	Unknown

Table 27. Conservation activities associated with the conservation population (Check all that apply).

Code	Conservation Actions
1	Water lease/In-stream flow enhancement
2	Channel restoration
3	Bank stabilization
4	Riparian restoration
5	Diversion modification
6	Barrier removal
7	Barrier construction
8	Culvert replacement
9	Installation of fish screens to prevent loss
10	Fish ladders to provide access
11	Spawning habitat enhancement
12	Woody debris placement
13	Pool development
14	Increase irrigation efficiency
15	Grade control
16	In-stream cover habitat
17	Re-founded population
18	Riparian fencing
19	Physical removal of competing/hybridizing species
20	Chemical removal of competing/hybridizing species
21	Public outreach efforts at site (Interpretative site)
22	Population Expansion (e.g. expanding the occupied area of a specific population)
23	Population supplementation (e.g. to implement genetic swamping or to reduce potential of bottle necking, etc.)
24	Special Angling Regulations
25	Land-use mitigation direction and requirements (e.g., Forest Plan direction, regulation, permit req., coordination stipulations, etc.)
26	Population covered by special protective mgt emphasis (e.g., Nat'l Park, wilderness, special mgt area, conservation easement, etc.
27	Other:
28	None:

Table 28. Human-use associated with conservation population. (Check all that apply).

Code	Activity
1	Timber Harvest
2	Range (Livestock grazing)
3	Mining
4	Recreation (non-angling)
5	Angling
6	Roads
7	De-watering
8	Fish Stocking (e.g., non-native fish)
9	Hydroelectric, water storage and/or flood control
10	Other
11	None
12	Unknown

Conservation Population Risk and Health Evaluations

Only conservation populations will be evaluated for relative genetic and disease influences and general population health. **It is important to note that these evaluations are not intended to define the inherent probability of persistence or exclusion, but rather to identify index conditions that put a population at greater or lesser risk based on certain attributes.**

Genetic Stability Assessment

A genetic stability ranking will be made for each conservation population (e.g., Network- or non-networked) using an index ranking of 1 to 4 to indicate lower to progressively higher levels of possible risk (Table 29). **The index should not be viewed as an absolute but rather as an indicator of possible or potential genetic influences**

Table 29. Genetic index ranking (Check one that best applies).

Rank	Genetic stability or Risk Characterization
1	Introduced potentially hybridizing fish **cannot interact** with existing RGCT population. **Barrier provides complete blockage to upstream fish movement or potentially hybridizing fish are not present in same or adjacent drainages**.
2	Introduced potentially hybridizing fish are in same stream and/or drainage **further than 10 km** from RGCT population, but not in same stream segment as RGCT, **or within 10 km where existing barriers exist, but may be at risk of failure.**
3	Introduced potentially hybridizing fish are in same stream and/or drainage **within 10 km of RGCT population and no barriers exist** between introduced species and RGCT population. However, introduced hybridizing species have not yet been found in same stream segment as RGCT population.
4	Introduced potentially hybridizing fish are **sympatric** with RGCT in same stream segment.

Significant Disease Influence Assessment

A significant disease influence ranking will be made for each (networked or non-networked population) using a ranking index of 1 to 5 to indicate low to progressively higher levels of risk associated with the possible or potential influence of significant diseases (Table 30). Population isolation and security are important considerations, but cannot be viewed as absolutes. The diseases of concern are those that cause severe and significant impacts to population health and include, but are not limited to, whirling disease, furunculosis, infectious pancreatic necrosis virus, etc. The assessment should be completed and/or reviewed by fish health professional. **The level of influence should not be viewed as an absolute but rather as an indicator of possible or potential disease influences**.

Table 29. Significant diseases risk influence index (Check one that best applies).

Rank	Risk Characterization
1	Significant diseases and the pathogens that cause these diseases **have very limited opportunity to interact** with existing RGCT population. Significant disease and pathogens are not known to exist in the stream or watershed associated with RGCT population. **Barrier provides complete blockage to upstream fish movement**. Stocking of fish from other sources does not occur.
2	Significant diseases and/or pathogens have been introduced and/or identified in same stream and/or drainage **further than 10 km** from RGCT population, but not in same stream segment as RGCT, **or within 10 km where existing barriers exist, but may be at risk of failure.** Stocking of fish from others source areas requires fish health screening and pathogen free clearance.
3	Significant diseases and/or pathogens have been introduced and/or have been identified in same stream and/or drainage **within 10 km of RGCT population and no barriers exist** between disease and/or pathogens and diseased fish species and the RGCT population. However, diseases and/or pathogens have not yet been found in same stream segment as RGCT population.
4	Significant disease and/or pathogens and disease carrying species are **sympatric** with RGCT in same stream segment but RGCT have not tested positive.
5	RGCT population is known to be positive for significant disease and/or pathogens are present. RGCT population has a history of impacts from significant diseases. Environmental and/or biological conditions may have intensified disease impact.

Conservation Population Relative Health Assessment

A relative population health assessment will be completed for each networked or non-networked population using an index ranking that includes consideration of four factors (see attachment A). General population health will be indexed from low to high by using a 1 to 4 ranking system based on four variables identified by Rieman et al. (1993) (Table 31). The ranking for temporal variability will be derived as a cumulative total length of stream segments identified as being part of the conservation population. Population size of RGCT that are sexually mature (see criteria above) will be derived from the density information associated with the stream segments and lakes that make up each conservation population. Population production will be ranked using stream segment information associated with habitat quality, presence of non-native fish, and potential for disease (see attachment A). The degree of connectedness will be taken from Table 24. These four main factors will be weighted to derive a final index as follows: Temporal Variability = 0.7; Population Size = 1.2; Population Productivity (Growth/Survival) = 1.6; and Isolation = 0.5 (D. Lee, USDA Rocky Mountain Research Station, Boise, Idaho, personal communication). **The index value for relative population health should not be viewed as an absolute but rather as an indicator of possible or potential health**.

Table 31. Ranks of various types of general health indicators associated with conservation populations. Individual variable rankings to be generated from the information associated with currently occupied habitat data and specific conservation population information.

Variable	Description	Rank	Criteria
Temporal Variability – **Influence of stochastic catastrophic events on a whole population**	Habitat Quantity -- Stream length occupied will be used to index temporal variability. Assumption is that larger habitat patch sizes will be less likely to be in synchrony with regard to stochastic events and, to a degree, with deterministic influences. Ranking for temporal variability will be derived as a cumulative total of stream segments identified as being part of the conservation population. If a lake is part of the habitat supporting a population adjust the ranking to the next higher level.	1	At least 50 miles of occupied habitat
		2	20 to 49 miles of occupied habitat
		3	6 to 19 miles of occupied habitat
		4	< 6 miles of occupied habitat
Population Size – Associated with the number of mature, potentially sexually reproductive fish in the RGCT population.	Defined as the number of fish greater than 12 cm for streams (refer to density determinations and/or specific population survey information … Tables 14 and 15). Population size will be derived from summing the demographic information associated with the stream segments identified for each conservation population and adjusting the total to reflect the amount of occupied habitat.	1	> 2,000 Adults
		2	500 – 2,000 Adults
		3	50 – 500 Adults
		4	< 50 Adults
Population Production (Growth/ Survival) **-** **Influence of deterministic demographic factors on whole population** **See Attachment A**	Factors that influence population production include habitat quality, disease, competition, and predation. Important considerations include land-use influence on habitat that could be influencing a population's potential. As important would be the application of enhancement actions targeted to improve population condition.	1	Greater than 50% of habitat in excellent condition; no non-native competitive species present. no catastrophic diseases present.
		2	Greater than 50% of habitat in good and excellent condition; non-native competitive species maybe present in low numbers; catastrophic diseases present in close proximity.
		3	Greater than 50% of habitat in fair, good and excellent condition; non-native competitive species may be present in high numbers; catastrophic diseases present in close proximity.
		4	Greater than 50% of habitat in poor condition Population associated with poor quality habitat; non-native competitive species present in high numbers; catastrophic diseases, if present, sympatric with population.

Variable	Description	Rank	Criteria
Population Connectivity	Relates to the degree of networking associated with the conservation population. Select from information in Table 24.	1	Strongly networked. Migratory forms must be present and migration corridors must be open (connected). Occupied network consists of numerous streams (>5).
		2	Moderately networked. Migratory forms are present, but connection with migratory populations disrupted at a frequency that allows only occasional genetic exchange. Occupied network consists of several streams (4-5).
		3	Weakly networked. Questionable whether migratory form exists within connected habitat; however, possible infrequent straying of adults into area occupied by population. Occupied network consists of 2-3 streams.
		4	Population not networked. Population functions as a single entity. Generally only one stream or stream segment involved.

While headwater RGCT populations may include those isolated by impassible barriers to upstream fish movement (and thus could not be re-founded or receive external genetic material without human intervention), these headwater populations may be important sources for re-founding and augmenting lower populations.

Part 4. Evaluation of Potential RGCT Population Restoration and Expansion Opportunities.

This evaluation will be based on an initial range-wide review of historically occupied stream segments and lakes that are not currently associated with conservation populations. This mapping exercise will facilitate assessment of potential restoration and/or expansion opportunities for these stream segments and lakes. Similar to the mapping exercise associated with currently occupied stream segments and lakes, lower and upper bounds of all stream segments within the historical range that are believed to have habitat suitable for supporting self-sustaining populations of RGCT will be identified and evaluated. Using the base historical hydrography layer within each 4th level HUC over laid with currently occupied habitat specifically for conservation populations, each team will systematically proceed to identify and evaluate RGCT restoration and expansion potentials on a stream and lake segment basis.

Locations of complete barriers, or partial barriers having the potential to be upgraded to complete barriers, are logical break points.

Only historically occupied habitat will be evaluated in this exercise. Other suitable habitat (i.e. suitable habitat that exists above historical barriers and other suitable habitats where RGCT were likely extirpated prior to 1800) will be dealt with in a subsequent assessment. The initial step in this assessment of restoration and/or expansion potential will be to identify which historically occupied stream segments are currently unsuitable for sustaining RGCT populations. The associated reasons for the unsuitable determination will be linked to physical habitat (e.g. insufficient flows or degraded habitat), temperature conditions or both (Table 32 and 33). An effort will be made to evaluate all historical habitats that remain suitable. The assessment teams are encouraged to identify as large a number of segments as possible. The specific information will be tracked on a stream segment or individual lake basis

Table 32. General habitat inability to support self-sustaining populations of Rio Grande cutthroat trout. (Identify the one that best applies)

Code		Non-native Fish Stocking and/or Presence Status
1	H	The stream or stream segment has habitat that is incapable of supporting a self-sustaining population of RGCT (i.e. there are severe habitat deficiencies).
2	T	The stream or stream segment has water temperatures that preclude supporting a self-sustaining population of RGCT (i.e. water temperature that are too high or too low).
3	HT	The stream or stream segment has both habitat and temperature deficiencies.

Table 33. Source of habitat capability to support self-sustaining populations of Rio Grande cutthroat trout information. (Identify the one that best applies)

Code	Source of habitat information
1	Judgment-extrapolated information from other streams
2	Judgment - Ocular Reconnaissance
3	Spot Habitat Sampling
4	Trend Habitat Sampling
5	Detailed Habitat Sampling

Consideration of barrier locations will be important in defining the nature of stream segments. Remember, each identified stream segment must have all attributes in common. If one or more attributes change, a new segment should be created. Table 34 addresses fish stocking and/or fish presence associated with the stream segment. Table 35 identifies habitat attributes associated with the stream segment. Table 36 identifies the relative significance of any fishery associated with the segment. Table 37 identifies the relative complexity of removal (chemical and/or physical removals) of any existing fish within the potential restoration or expansion segment. The sources of information from the above tables will be combined in Table 38.

Table 34. Fish stocking and/or presence of fish associated with the restoration or expansion stream segment. (Check the one that best applies)

Code	Non-native Fish Stocking and/or Presence Status
1	No Record of fish stocking and the segment or lake is barren
2	Record of stocking RGCT and/or hybridized RGCT are the only trout present but they are not part of a conservation population.
3	Record of non-native trout stocking and/or the presence of non-native trout in low numbers. Includes all non-native trout: rainbow, brown, Brook, Lake, and other cutthroat. Hybridized RGCT may or may not be present.
4	Record of non-native trout stocking and/or the presence of non-native trout being present in high numbers. Includes all non-native trout: rainbow, brown, Brook Lake, and other cutthroat. Hybridized RGCT may or may not be present
5	Unknown presence or stocking record of non-native trout.

Table 35. Habitat quality of the potential restoration or expansion segment. (Check the one that best applies)

Code	Habitat Quality Determination
6	Excellent habitat quality (e.g., ample pool environment, low sediment levels, optimal temperatures (summer and winter), quality riparian habitat, ample depths and good water quality etc.)
7	Good habitat quality (may have some habitat attributes that are slightly less than ideal)
8	Fair habitat quality (has a greater number of attributes that are less than ideal)
9	Poor habitat quality (most habitat attributes reflect inferior conditions)
10	Habitat Quality Unknown

Table 36. Relative significance of any fishery associated with the potential restoration or expansion segment or lake. (Check the one that best applies)

Code	Relative Significance of a Fishery
11	No fishery present
12	Minor fishery (i.e., minimal use, use days generally less than 100 days/year)
13	Moderate fishery
14	Major fishery (i.e., significant level of use, use days generally exceed 1000 days/year)
15	Significance Unknown

Table 37. Relative complexity associated with removal of any fish associated with the potential restoration or expansion segment or lake. (Check the one that best applies)

Code	Relative Complexity of Non-native Fish Removal=
16	No fish present
17	Minor complexity (e.g., simple drainage, few fish, low flows, simple habitats, small lake etc.)
18	Moderate complexity
19	Major complexity (e.g., significant flows, multiple channels, many fish, complex habitats, large lake etc.)
20	Unknown complexity

Table 38. Source information for the potential RGCT restoration or expansion stream or lake segment. (Check the one that best applies to the combination of the four attributes)

Code	Description
21	Judgment-information extrapolated from other streams
22	Ocular Reconnaissance
23	Spot Sampling
24	Trend Sampling
25	Detailed Sampling
26	Unknown

A generalized restoration or expansion opportunity assessment for each potential restoration stream and lake segment will be done by electronic ranking of the information contained in Tables 34 through Table 37. Restoration potentials will be ranked using a 1 to 4 ranking system for each of the four variables identified above (Table 39). The ranks assigned to each of the variables will be combined into a rating of overall restoration potential for each stream segment. The four variables will be weighted equally to derive the overall restoration ranking. The overall score will be divided into logical rankings associated with restoration potential (High Restoration Potential = 4 to 6; Intermediate Restoration Potential = 7 to 9; Low Restoration Potential = 10 to 13; and, Very Low Restoration Potential = 14 to 16). If a complete or partial barrier that has the potential to become a complete blockage occurs in the lower portion of a segment, the ranking will be elevated to the next higher restoration or expansion rank. The identification of one or more unknown conditions associated with the restoration variables will result in labeling that segment as having unknown restoration potential.

Table 39. Summarization of the factors considered in the assessment of restoration or expansion potential.

Variable	Description	Rank	Criteria
Biological Considerations Associated with RGCT Restoration Opportunities	Specifically addresses the biological considerations associated the presence of other trout in potential restoration segments (Table 28).	1	No record of fish stocking and the segment is barren
		2	Hybridized RGCT are present in the absence of other trout and segment is not part of a conservation population.

Variable	Description	Rank	Criteria
		3	RGCT maybe present and non-native trout present in low numbers. Segment not part of conservation population.
		4	RGCT maybe present and non-native trout present in high numbers. Segment not part of conservation population
Habitat Considerations Associated with RGCT Restoration Opportunities	Specifically addresses habitat quality of potential restoration segments. See habitat quality ranking in Table 29	1	Excellent habitat quality
		2	Good habitat quality
		3	Fair habitat quality
		4	Poor habitat quality
Social and Political Considerations Associated with RGCT Restoration Opportunities	Specifically addresses the relative significance of an existing fishery (Table 30).	1	No fishery present.
		2	Minor fishery (i.e. minimal use)
		3	Moderate fishery
		4	Major fishery (i.e. significant use level)
Relative Complexity Considerations Associated with RGCT Restoration Opportunities	Specifically addresses the complexity of non-native trout or hybrid RGCT removals (chemical or physical) (Table 31).	1	No fish present
		2	Minor complexity.
		3	Moderate complexity.
		4	Major complexity.

Attachment A

Relative Population Health Evaluations

As indicated in the status update protocol each conservation population will receive a generalized population health assessment based on four (4) variables identified by Rieman et.al. (1993). Each variable will be ranked based on information contained in the status update database. The variables are related to both deterministic (e.g. changes that are predictable) and/or stochastic (e.g. changes due to chance events) processes that could influence the well-being of a population of RGCT. It should be noted that this relative health evaluation should not be viewed as an absolute but rather as a relative index of possible or potential health influences associated with the population.

Temporal Variability As used in this health evaluation, temporal variability is linked the population's ability to withstand stochastic influences to the occupied habitat. As such, the amount of occupied habitat becomes a significant indicator of how influential environmental (e.g. fire or drought) or hydrologic (e.g. flooding) events are likely to be to the population. The assumption is that increased habitat provides a greater opportunity for increased habitat complexity and a greater resistance to catastrophic events that could influence the entire population. To receive a low temporal risk ranking we are calling for at least 50 miles of occupied habitat to be present. On the other end of the scale, a very high temporal risk ranking would be associated with occupied habitat of less than 6 miles. The temporal risk ranking will be derived as a cumulative total of stream segments identified as being part of the specific conservation population.

Population Size Variability of Individuals Larger than 12 cm in streams (Shepard et.al.2003, USFWS, 1998). As used in this risk evaluation, this is the population density of the combined mapping segments. The size thresholds are viewed as reasonable lengths associated with RGCT that would be sexually active (e.g. related to the effective population). The concept of effective population size plays an important role in the long-term conservation scenario of a population by being related to genetic drift, loss of genetic diversity and population inbreeding. Effective population size is also important in maintaining "critical population mass" needed for adjustments from migration and natural selective influences. A larger sexually active population size, in general, reflects conditions where all life stages are represented in the population. The population size will be derived from the density information. To receive a low adult population size risk ranking we are calling for an adult population size of greater than 2000 individuals. At the other end of the risk scale, a very high risk ranking would be associated with an adult population size of less than 50 adults.

Population Production (Growth/Survival) Variability Factors that influence population production include habitat quality, disease, competition and predation. Human uses that influence habitat quality as well as efforts to enhance habitat are also important but will not be addressed because the information in this assessment only lists the uses and conservation actions and does not apply any degree of significance of influence to a given RGCT population. To a significant degree population production factors reflect deterministic processes. The development of a ranking for population production will include consideration of the database

information associated with habitat condition, presence of competitive fish and presence of catastrophic disease associated with the conservation population. For the purposes of developing an initial ranked score associated with population production, habitat quality will be the primary consideration. The final population production score assigned to the conservation population will be increased by one level if non-native fish are sympatric with the population and/ or disease is present. The composite scores for population production variable ranking can range from 2 to 8 with a 2 being the best production ranking and 8 being the worst ranking. Partitioning of the initial ranked scores for population production follows: High Population Production = 2; Intermediate Population Production = 3 to 4; Low Population Production = 5 to 7; and, Very Low Population Production = 8. The final ranked score will reflect an adjustment to account for the presence of non-native fish competition and predation. If non-native fish are sympatric with the conservation population, the ranked score should be adjusted to the next higher population production level (i.e. Example: If the initial ranked score falls within the intermediate population production range (score of 3 to 4) and non-native fish are present; the final ranked score will automatically be changed to the low population production level). The final ranking will be inserted as the population production potential ranking in Table 31.

Table A1. Ranks of the various habitat quality and disease determinations for the population production factors

Variable	Description	Rank	Criteria
Habitat Quality –	Habitat Quantity – Derived from the occupied stream segment habitat quality information contained in the database (Table 14).	1	> 50% of occupied stream segments judged to have an excellent habitat rating.
		2	> 50% of occupied stream segments judged to have excellent and good habitat ratings.
		3	> 50% of occupied stream segments judged to have excellent, good and fair habitat ratings.
		4	> 50% of occupied stream segments judged to be in poor habitat condition.
Presence of catastrophic disease	Developed from the risk assessment associated with significant disease (Table 26).	1	Significant diseases not known to exist and/or complete barrier to fish migration present.
		2	Significant diseases not in close proximity and/or barriers at risk of failure.
		3	Disease in close proximity and no barrier exists.
		4	Disease sympatric with population and/or known to be infected.

Population Connectivity (network) Variable Populations of RGCT exist as either independents or networks. Independent populations operate as a discrete entity usually within a single stream.

A population network (often referred to as a meta-population) consists of several local streams (sub-populations) operating with a level of movement and genetic exchange. Most often population networks represent several local sub-populations each occupying a specific component (e.g. specific streams) of a drainage network. In general, the diversity of local sub-populations and the nature of connectivity within the population network contribute to the stability of the population, especially in terms of how stochastic events might influence population performance through time. The basis for ranking population connectivity will be taken directly from the database (Table 19).

These four main factors will be weighted to derive a final index value using the following weighting criteria: Temporal Variability = 0.7; Population Size = 1.2; Population Productivity (Growth/Survival) = 1.6; and Isolation = 0.5. The individual factors and the final composite index scores represent only a relative indicator of population health. They should not be viewed as absolutes but rather as indicators of possible or potential health influences associated with each population.

Attachment B

. Riverine Habitat – Quality Reference Conditions for Cutthroat Trout Habitat. The values identified in the table should not be viewed as absolutes or management standards. They are intended to provide reference conditions reflecting quality and quantity considerations for this status assessment. Application of this specific habitat information will require professional judgment by qualified biologists. Not all habitat attributes are applicable to every stream situation.

HABITAT - Reference Conditions	Reference Condition Values	Sources
SPAWNING HABITAT		
Substrate composition Surface Fines Granitics Other Geologies Fines by Depth - % Fines (less than 6.3 mm)	 <20%(B&E channels <25% (C channels) <20% (All Channels 0-24%	 10 1,2,8,9
- % Fines (2.3 mm)	0-10%	3,4,5,9
% Gravel (0.5 - 3.0 in)	50%	9
Water temperature - mean daily range during spawning and incubation. (C)	8-13	3,4,5,13,14
Spawning Access	As needed to protect and/or provide for the specific population.	9
Quantity-% of total spawning area	>5%	3,4
REARING HABITAT (Juvenile and Adult)		
Rearing Access	As needed to protect and/or provide for the specific population.	9
Pool Habitat – Percent of total area	35-60%	3,4,5,14
Percent of pools rated "high quality and complexity"	>30%	3,4,5
Habitat Quantity – General length of occupied habitat associated with high habitat quality and high density. Length associated with lower quality habitat and density.	>6 miles >17 miles	12,13,15
Pool Habitat – Number of "primary" pools per mile B Channels – Combined Geologies	 60 (0-5' wet width) 61 (5-10' wet width)	 10

C Channels – Combined Geologies Note: For pool frequencies in other geologies, see reference 10.	53 (10-15' wet width) 40 (15-20" wet width) 24 (20-25' wet width) 20 (25-30' wet width) 15 (30-35' wet width) 11 (35-40' wet width) 99 (0-5' wet width) 99 (5-10; wet width) 56 (10-15'wet width) 53 (15-20' wet width) 21 (20-25' wet width) 30 (25-30' wet width) 44 (30-35' wet width) 12 (35-40' wet width) 4-16 (>40' wet width)	10
Streambed Composition Embeddedness Predominant sizes	 <30% >50% C+B	 2,9 3,4
Stream Shading (%) (between 10:00 am to 2:00 pm)	50-76	3,4
Stream Cover Streams in meadows dominated by grass, sedge, forb – shading would be provided by low growth overhanging vegetation; % of potential based on vegetation type plus instream cover (%) (all forms combined)	>25	3,4,9
Streambank Stability (% of potential based on inherent capability associated with natural riparian communities	>90	6,10

HABITAT – Reference Conditions	Optimal Condition Values	Sources
REARING HABITAT - Continued		
Instream Debris (instream LWD in meadow situations would not be applicable). Number of LWD per mile (LWD = pieces of wood over 4" in diameter) B Channels – Combined Geologies	50 (0-5'wet width) 171 (5-10'wet width) 217 (10-15' wet width) 207 (15-20'wet width) 95 (20-25'wet width) 113 (25-30' wet width) 79 (30-35' wet width) 75 (35-40' wet width) 42-49 (>40' wet width	10
C Channels – Combined Geologies Note: For LWD frequencies for other geologies, see reference 10	60 (0-5' wet width) 60 (5-10'wet width) 187 (10-15'wet width) 120 (15-20' wet width) 74 (20-25' wet width) 138 (25-30' wet width) 132 (30-35' wet width) 68 (35-40' wet width) 32-48 (>40' wet width)	10
Water Temperatures (mean daily range C)	8-16	3,4,5,10
Watershed Area – (Sq Miles)	>9 sq miles (approx 15 sq km)	14
Base Stream Flow (% of average annual daily)	>50	3,4,7

The following codes apply: Source codes are reference sources (see below for citations and in literature for references); substrate size codes are F = fines, G = gravel, C = cobble, B = boulder, and Bed = bedrock. Number 9 indicates that the present fisheries staff working on cutthroat have made this determination based on professional field observation and personal review of existing literature. In the case of spawning habitat, sediment levels would be associated with substrate strata that are related to egg pocket formation (for the smaller trout species this would generally be less than 4" in depth). Base stream flow guidelines may exceed that contingent upon existing water rights.

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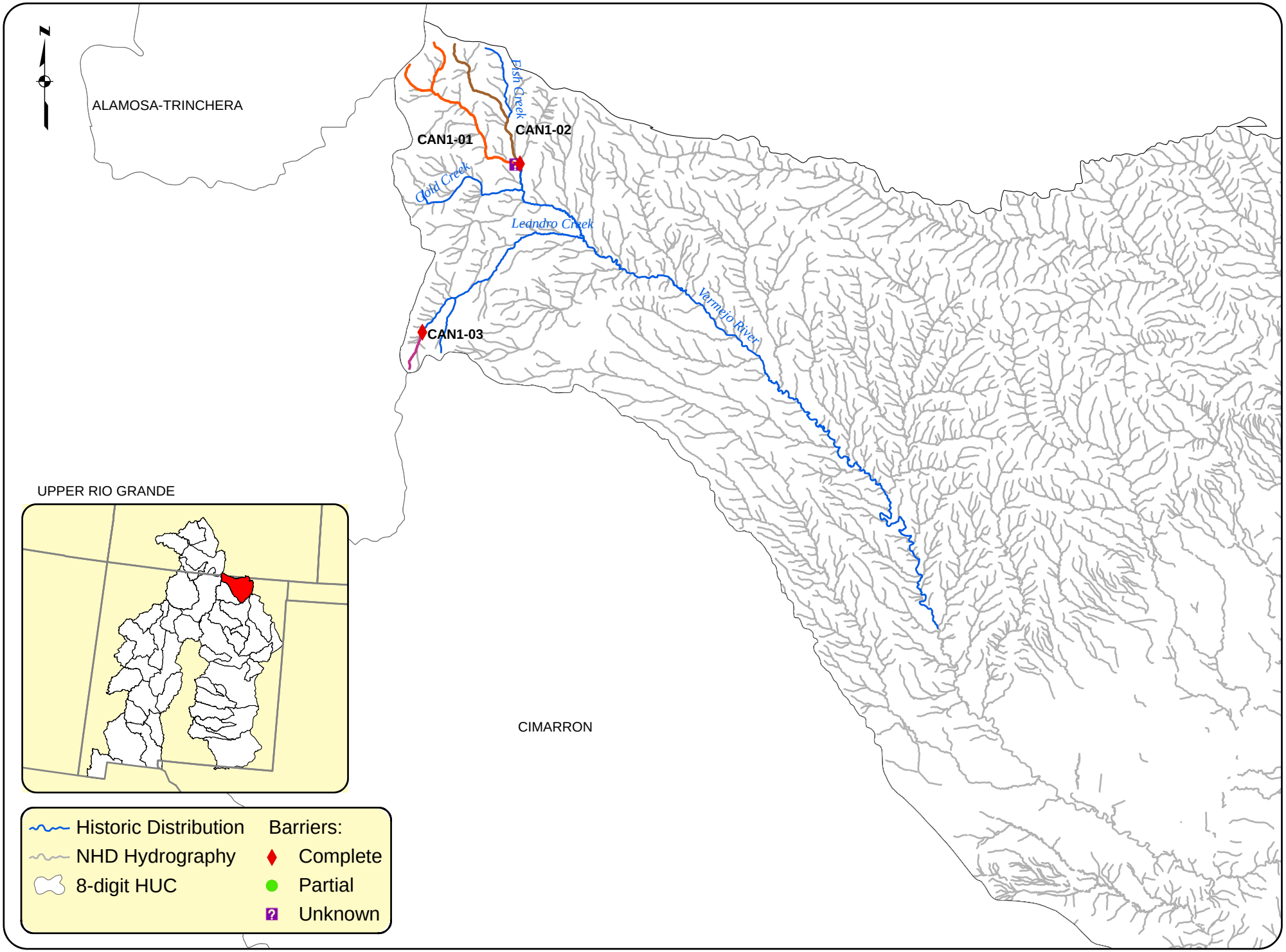
Appendix B. Fisheries professionals who participated in the RGCT assessment workshops and their experience level.

Name	Affiliation	Position Title	Highest Degree	Years Experience	Years of RGCT Management /Conservation Experience
Shannon Albeke	Stream Biometrics	Database Manager	BS	8.5	0.67
John Alves	CDOW	Aquatic Biologist	BS	19	16
Fred Bunch	NPS	Park Resource Specialist	BA	4	2
Chuck Dentino	USFS	Asst. Fishery Biologist	BS	9	3
Sean Ferrell	USFS	Fishery Biologist	BS	18	7
Eric Frey	NMDGF	NE Fisheries Manager	BS	7	7
Melissa Garcia	BLM	Wildlife/Fisheries Biologist	MS	8	8
Greg Gustina`	BLM	Fishery Biologist	MS	5	5
Mike Japhet	CDOW	Senior Aquatic Biologist	BA	34	29
Juan Martinez	USFS	Fishery Biologist	BS	9	7
Kirk Patten	NMDGF	Fishery Biologist	JD	7	5
Donna Storch	USFS	Forest Aquatic Program Manager	BS	15	15
Chris Strobel	CDOW	GIS/IT	BS	2	2
Kevin Terry	Jicarilla G&F	Fishery Biologist	BS	0.3	0.33
Jim White	Jicarrilla G&F	Fishery Biologist	MS	10	10
Barry Wiley	USFS	Forest Fisheries Biologist	MS	15	10

Appendix C. Information and maps on conservation populations collected for each RGCT Conservation Population.

Canadian GMU

Canadian Headwaters (11080001)



11080001 Canadian Headwaters

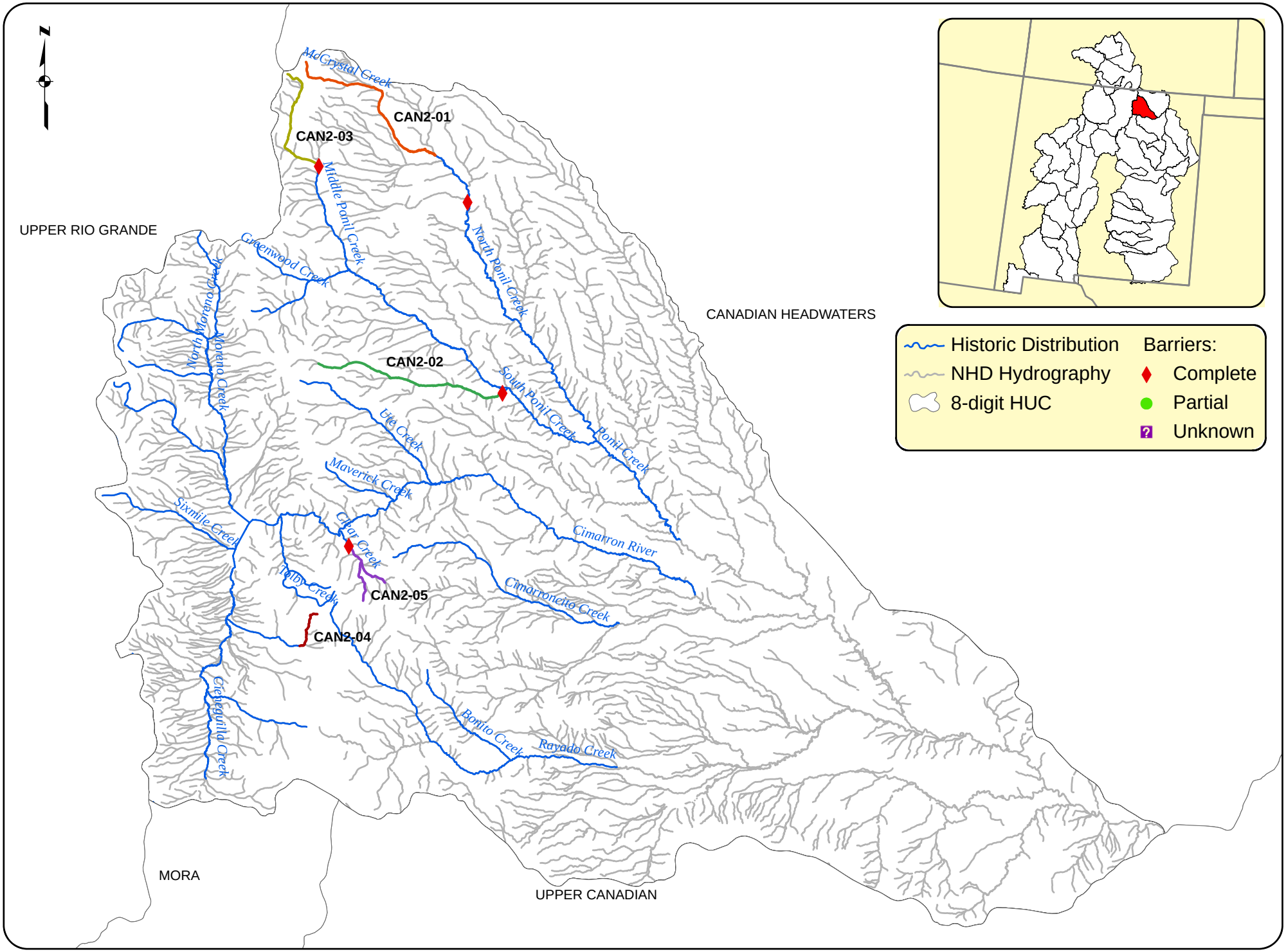
Conservation Population ***CAN1-01***	*Population Isolated*		*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*		*Resident Life History*
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
E. Trib. Ricardo Creek	11080001cd003	2.2	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	BRK
Ricardo Creek	11080001cd002	5.9	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	BRK
Ricardo Creek	11080001cd002	3.2	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	BRK

Conservation Population ***CAN1-02***	*Population Isolated*		*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*		*Resident Life History*
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Little Vermejo Creek	11080001cd001	0.9	Unaltered (< 1%)	50 to 150 fish	Excellent	5 to 10 feet	BRK
Little Vermejo Creek	11080001cd001	1.5	Unaltered (< 1%)	50 to 150 fish	Excellent	5 to 10 feet	BRK
Little Vermejo Creek	11080001cd001	5	Unaltered (< 1%)	50 to 150 fish	Excellent	5 to 10 feet	BRK

Conservation Population ***CAN1-03***	*Population Isolated*		*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*		*Resident Life History*
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Leandro Creek	11080001cd004	1.9	Unaltered (< 1%)	151 to 400 fish	Good	5 to 10 feet	None

Canadian GMU

Cimarron (11080002)



11080002 Cimarron

Conservation Population ***CAN2-01***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
McCrystal Creek	11080002cd001	9.4	Unaltered (< 1%)	0 to 50 fish	Good	5 to 10 feet	None
North Ponil Creek	11080002cd001	0.1	Unaltered (< 1%)	0 to 50 fish	Good	5 to 10 feet	None

Conservation Population ***CAN2-02***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
South Ponil Creek	11080002cd002	9.5	Unaltered (< 1%)	0 to 50 fish	Good	5 to 10 feet	None

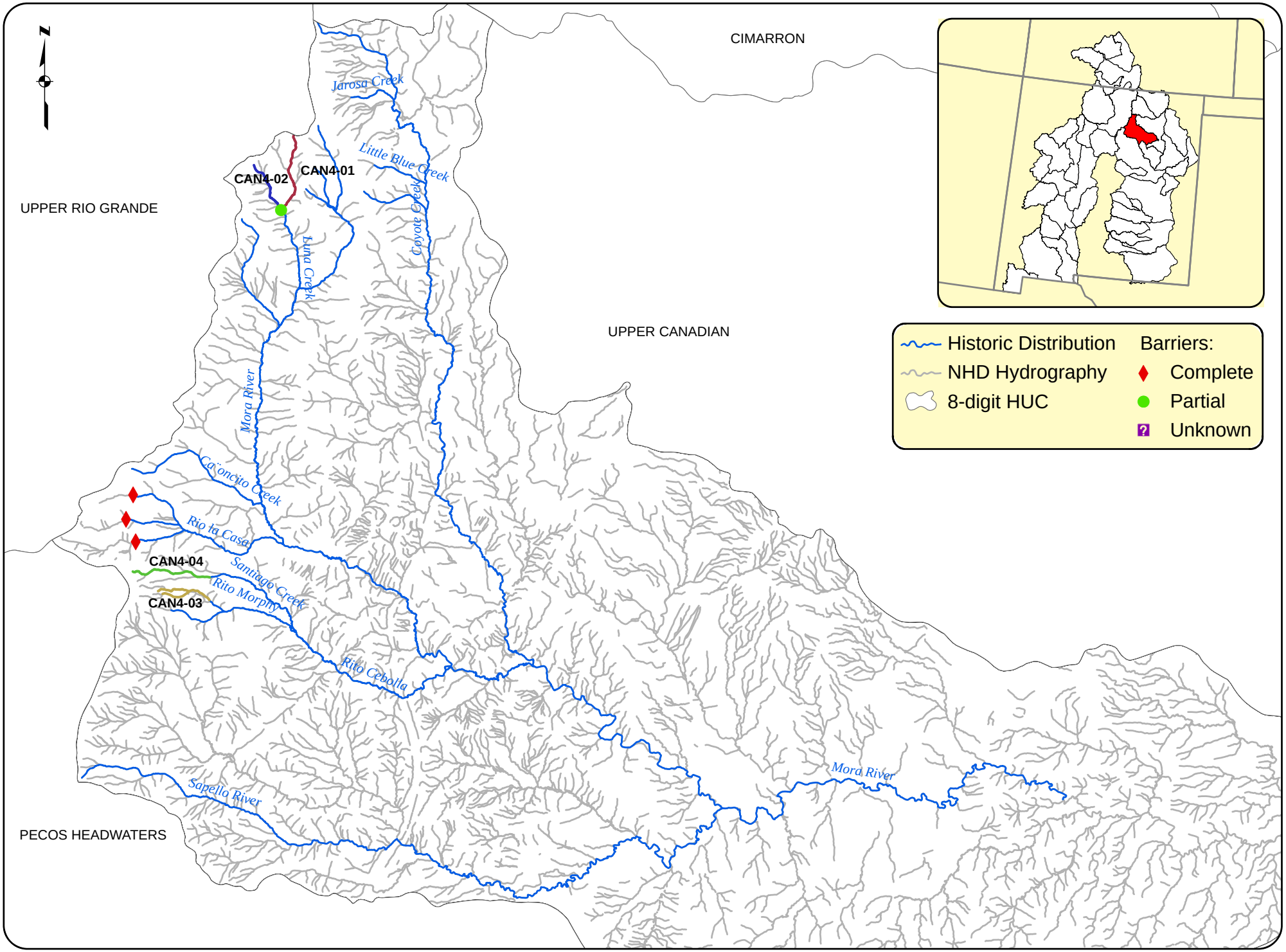
Conservation Population ***CAN2-03***	*Population Isolated*	*Moderate Disease Risk < 10 km*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Middle Ponil Creek	11080002cd003	6	>10% and <=20%	151 to 400 fish	Good	5 to 10 feet	None

Conservation Population ***CAN2-04***	*Population Isolated*	*Moderate Disease Risk < 10 km*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
American Creek	11080002cd004	2.1	Not Tested - Suspected Unaltered	Unknown	Unknown	< 5 feet	Unknown

Conservation Population ***CAN2-05***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Clear Creek	11080002cd005	3.1	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	None
Headwater Trib. to Clear Creek	11080002cd005	1.7	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	None

Canadian GMU

Mora (11080004)

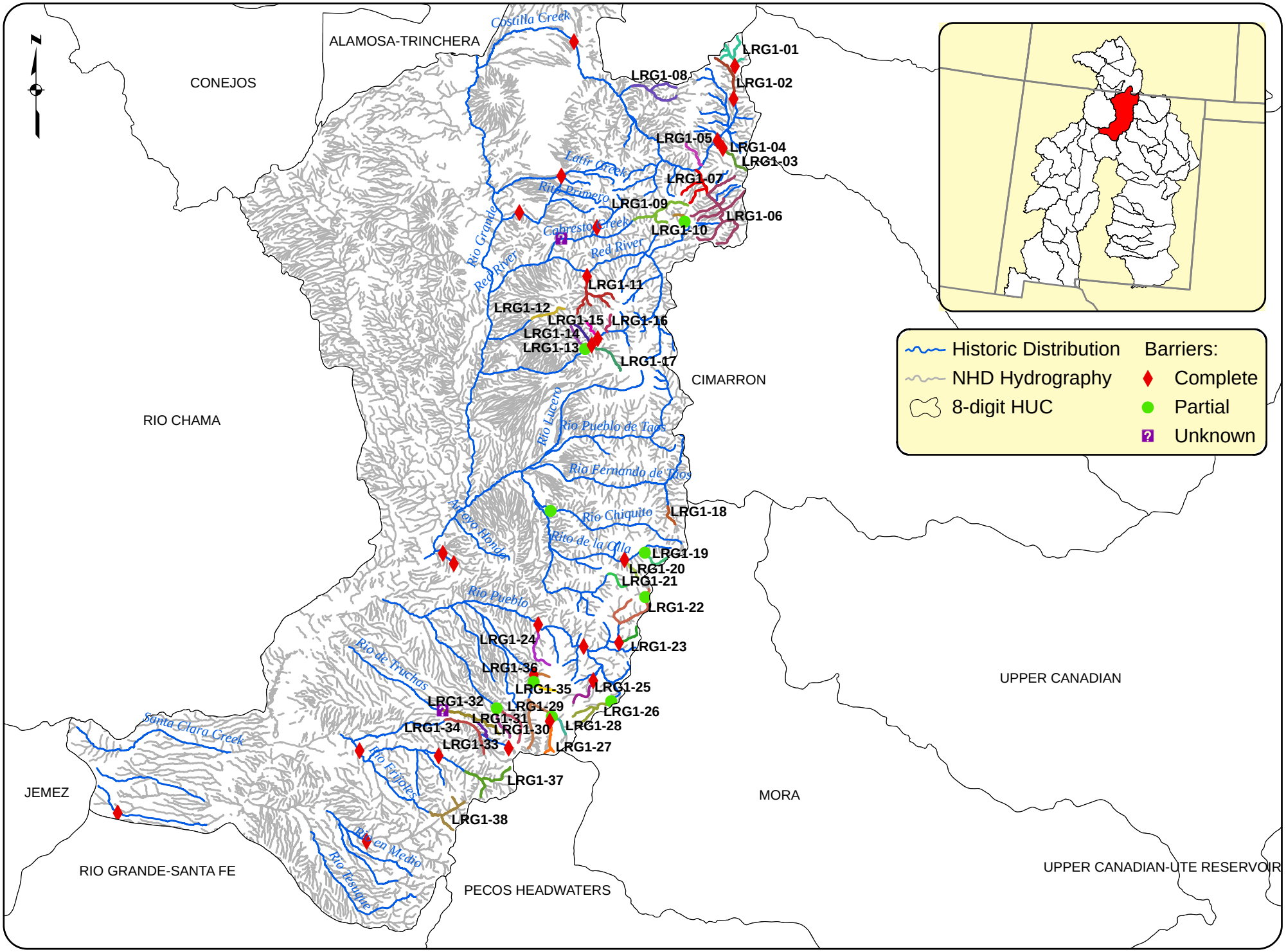


11080004 Mora

Conservation Population	***CAN4-01***	*Population Isolated*		*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*		*Resident Life History*
Individual Populations:		Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
East Fork Luna Creek		11080004cd004	4.2	>1% and <=10%	Unknown	Fair	5 to 10 feet	BRN
Conservation Population	***CAN4-02***	*Population Isolated*		*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*		*Resident Life History*
Individual Populations:		Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
West Fork Luna Creek		11080004cd001	2.8	Unaltered (< 1%)	151 to 400 fish	Excellent	5 to 10 feet	BRN
Conservation Population	***CAN4-03***	*Weakly Networked*		*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*		*Resident Life History*
Individual Populations:		Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Headwater Trib. to Rito Morphy		11080004cd005	1.6	Unaltered (< 1%)	50 to 150 fish	Unknown	< 5 feet	None
Rito Morphy		11080004cd005	2.6	Unaltered (< 1%)	50 to 150 fish	Unknown	< 5 feet	None
Conservation Population	***CAN4-04***	*Population Isolated*		*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*		*Resident Life History*
Individual Populations:		Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Santiago Creek		11080004cd006	4.1	>1% and <=10%	50 to 150 fish	Unknown	< 5 feet	None

Lower Rio Grande GMU

Upper Rio Grande (13020101)



13020101 Upper Rio Grande

Conservation Population ***LRG1-01***	*Weakly Networked*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Costilla Creek	13020101cd001	1	Unaltered (< 1%)	> 400 fish	Excellent	5 to 10 feet	None
Costilla Creek	13020101cd001	0	Unaltered (< 1%)	> 400 fish	Excellent	5 to 10 feet	None
E. Unnamed Trib. to Costilla Creek	13020101cd002	0.9	Unaltered (< 1%)	0 to 50 fish	Excellent	< 5 feet	None
East Fork Costilla Creek	13020101cd008	2.7	Unaltered (< 1%)	> 400 fish	Excellent	< 5 feet	None
Unnamed Trib #1 W Fk. Costilla Cree	13020101cd061	1.4	Unaltered (< 1%)	Unknown	Good	< 5 feet	None
Unnamed Trib #2 W Fk. Costilla Cree	13020101cd062	1	Unaltered (< 1%)	Unknown	Good	< 5 feet	None
Unnamed Trib #2 W Fk. Costilla Cree	13020101cd062	0.1	Unaltered (< 1%)	Unknown	Good	< 5 feet	None
West Fork Costilla Creek	13020101cd007	2	Unaltered (< 1%)	> 400 fish	Excellent	< 5 feet	None

Conservation Population ***LRG1-02***	*Weakly Networked*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Costilla Creek	13020101cd005	3.9	Unaltered (< 1%)	> 400 fish	Excellent	5 to 10 feet	None
Glacier Creek	13020101cd006	2.1	Unaltered (< 1%)	Unknown	Excellent	< 5 feet	None
Glacier Creek	13020101cd006	0	Unaltered (< 1%)	Unknown	Excellent	< 5 feet	None
Glacier Lake	13020101cd009	6.6	Unaltered (< 1%)				None
W. Unnamed Trib. to Costilla Creek	13020101cd006	0.3	Unaltered (< 1%)	Unknown	Excellent	< 5 feet	None

Conservation Population ***LRG1-03***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
E. Unnamed Trib. #2 to Costilla Creek	13020101cd003	3.9	Unaltered (< 1%)	151 to 400 fish	Good	< 5 feet	None

Conservation Population ***LRG1-04***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
E. Unnamed Trib. #2 to Costilla Creek	13020101cd004	1.3	Not Tested - Suspected Hybridize	50 to 150 fish	Good	< 5 feet	BRK

Conservation Population ***LRG1-05***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
NW Unnamed Trib. to Costilla Creek	13020101cd021	3.1	>1% and <=10%	50 to 150 fish	Good	< 5 feet	None

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Conservation Population ***LRG1-06***	*Moderately Networked*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Comanche Creek	13020101cd010	4	Unaltered (< 1%)	0 to 50 fish	Fair	< 5 feet	FSH
Comanche Creek	13020101cd011	4.3	Unaltered (< 1%)	151 to 400 fish	Fair	5 to 10 feet	FSH
Gold Creek	13020101cd016	3.2	Not Tested - Suspected Unaltered	0 to 50 fish	Good	< 5 feet	None
Grassy Creek	13020101cd014	3.3	Not Tested - Suspected Unaltered	Unknown	Good	< 5 feet	FSH
Holman Creek	13020101cd015	1	Not Tested - Suspected Unaltered	Unknown	Good	< 5 feet	FSH
La Belle Creek	13020101cd013	2.8	Not Tested - Suspected Unaltered	Unknown	Good	< 5 feet	FSH
Little Costilla Creek	13020101cd017	3.7	>1% and <=10%	50 to 150 fish	Good	< 5 feet	RBT
Vidal Creek	13020101cd012	5.6	Unaltered (< 1%)	0 to 50 fish	Fair	< 5 feet	FSH

Conservation Population ***LRG1-07***	*Weakly Networked*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Comanche Creek	13020101cd020	3.4	>1% and <=10%	151 to 400 fish	Fair	5 to 10 feet	FSH, RBT
W. Unnamed Trib. #2 to Comanche Cr	13020101cd019	2.6	>1% and <=10%	50 to 150 fish	Good	< 5 feet	None
W. Unnamed Trib. to Comanche Cree	13020101cd018	2.7	>1% and <=10%	0 to 50 fish	Good	< 5 feet	None

Conservation Population ***LRG1-08***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Unnamed Trib. to Ute Creek	13020101cd022	3.1	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	None
Ute Creek	13020101cd022	5.5	Unaltered (< 1%)	50 to 150 fish	Good	5 to 10 feet	None

Conservation Population ***LRG1-09***	*Population Isolated*	*Minimal Disease Risk > 10 km*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Cabresto Creek	13020101cd023	6.4	Unaltered (< 1%)	> 400 fish	Fair	5 to 10 feet	BRK
Unnamed Trib. to Cabresto Creek	13020101cd023	2.1	Unaltered (< 1%)	> 400 fish	Fair	5 to 10 feet	BRK

Conservation Population ***LRG1-10***	*Population Isolated*	*Minimal Disease Risk > 10 km*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Bitter Creek	13020101cd024	1.8	Unaltered (< 1%)	151 to 400 fish	Poor	< 5 feet	None

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Conservation Population	**LRG1-11**	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Columbine Creek	13020101cd025	3.2	Unaltered (< 1%)	50 to 150 fish	Good	10 to 15 feet	None	
Columbine Creek	13020101cd057	2.3	Unaltered (< 1%)	151 to 400 fish	Good	5 to 10 feet	None	
Placer Fork	13020101cd058	2	Unaltered (< 1%)	Unknown	Good	< 5 feet	None	
Placer Fork	13020101cd025	1.3	Unaltered (< 1%)	50 to 150 fish	Good	10 to 15 feet	None	
Willow Creek	13020101cd059	1.6	Unaltered (< 1%)	Unknown	Good	< 5 feet	None	

Conservation Population	**LRG1-12**	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
San Cristobal Creek	13020101cd031	4.1	Unaltered (< 1%)	151 to 400 fish	Excellent	10 to 15 feet	None	

Conservation Population	**LRG1-13**	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Yerba Creek	13020101cd027	2.9	Unaltered (< 1%)	50 to 150 fish	Excellent	5 to 10 feet	BRN	

Conservation Population	**LRG1-14**	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Manzanita Creek	13020101cd028	2.8	Not Tested - Suspected Unaltered	Unknown	Excellent	5 to 10 feet	None	

Conservation Population	**LRG1-15**	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Italianos Creek	13020101cd029	2.4	Not Tested - Suspected Unaltered	50 to 150 fish	Excellent	5 to 10 feet	None	

Conservation Population	**LRG1-16**	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Gavilan Creek	13020101cd030	2.1	Unaltered (< 1%)	151 to 400 fish	Excellent	5 to 10 feet	BRN	

Conservation Population	**LRG1-17**	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
South Fork Rio Hondo	13020101cd026	3.9	Not Tested - Suspected Hybridize	50 to 150 fish	Good	10 to 15 feet	BRN, RBT	

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Conservation Population	***LRG1-18***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species > 10 km*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Tienditas Creek	13020101cd032	2.3	Unaltered (< 1%)	Unknown	Fair	5 to 10 feet	BRN
Conservation Population	***LRG1-19***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Frijoles Creek	13020101cd033	3.1	Unaltered (< 1%)	50 to 150 fish	Excellent	5 to 10 feet	BRN
Conservation Population	***LRG1-20***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Palociento Creek	13020101cd034	2.5	Unaltered (< 1%)	50 to 150 fish	Excellent	5 to 10 feet	BRN
Conservation Population	***LRG1-21***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species > 10 km*	*Other*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rio Grande del Rancho	13020101cd035	2.7	>1% and <=10%	Unknown	Good	15 to 20 feet	BRN
Conservation Population	***LRG1-22***	*Population Isolated*	*Minimal Disease Risk > 10 km*	*Hybridizing species > 10 km*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rito la Presa	13020101cd037	5.5	Unaltered (< 1%)	0 to 50 fish	Fair	10 to 15 feet	None
Unnamed Trib. to Rito la Presa	13020101cd036	3.6	Unaltered (< 1%)	Unknown	Fair	5 to 10 feet	BRN
Conservation Population	***LRG1-23***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Policarpio Creek	13020101cd038	3	Unaltered (< 1%)	151 to 400 fish	Good	5 to 10 feet	None
Conservation Population	***LRG1-24***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Other*	*Resident Life History*	
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Unnamed Trib. to Rio Pueblo	13020101cd047	5.5	>1% and <=10%	0 to 50 fish	Good	5 to 10 feet	None

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Conservation Population	LRG1-25	Population Isolated	Limited Disease Risk	No Risk of Hybridization	Core Conservation Population	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Rito Angostura	13020101cd040	4	>1% and <=10%	151 to 400 fish	Good	5 to 10 feet	None	

Conservation Population	LRG1-26	Population Isolated	Minimal Disease Risk > 10 km	Hybridizing species > 10 km	Core Conservation Population	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Alamitos Creek	13020101cd039	4.5	Unaltered (< 1%)	> 400 fish	Good	10 to 15 feet	None	
Unamed N Tributary to Alamitos Cree	13020101cd060	2.6	Unaltered (< 1%)	> 400 fish	Good	5 to 10 feet	None	

Conservation Population	LRG1-27	Population Isolated	Limited Disease Risk	No Risk of Hybridization	Core Conservation Population	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Middle Fork Rio Santa Barbara	13020101cd042	3.8	Unaltered (< 1%)	151 to 400 fish	Excellent	5 to 10 feet	BRN	
Unnamed Trib. to Middle Fork Rio Sa	13020101cd042	0.6	Unaltered (< 1%)	151 to 400 fish	Excellent	5 to 10 feet	BRN	

Conservation Population	LRG1-28	Population Isolated	Limited Disease Risk	No Risk of Hybridization	Core Conservation Population	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
East Fork Rio Santa Barbara	13020101cd041	2.5	Unaltered (< 1%)	50 to 150 fish	Good	10 to 15 feet	BRN	

Conservation Population	LRG1-29	Population Isolated	Limited Disease Risk	Hybridizing species < 10 km	Other	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
East Fork Rio Santa Barbara	13020101cd044	0.1	Not Tested - Suspected Hybridize	> 400 fish	Good	10 to 15 feet	BRN	
Middle Fork Rio Santa Barbara	13020101cd044	3.5	Not Tested - Suspected Hybridize	> 400 fish	Good	10 to 15 feet	BRN	
West Fork Rio Santa Barbara	13020101cd043	5.2	Not Tested - Suspected Hybridize	50 to 150 fish	Good	10 to 15 feet	BRN	

Conservation Population	LRG1-30	Population Isolated	Limited Disease Risk	Hybridizing species < 10 km	Other	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Rio de las Trampas	13020101cd048	5.1	Not Tested - Suspected Hybridize	Unknown	Good	5 to 10 feet	None	

Conservation Population	LRG1-31	Population Isolated	Limited Disease Risk	Hybridizing species < 10 km	Other	Resident Life History		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives	
Rio San Leonardo	13020101cd049	3.6	Not Tested - Suspected Hybridize	Unknown	Good	5 to 10 feet	None	

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Conservation Population ***LRG1-32***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rio de Truchas	13020101cd050	6.5	Unaltered (< 1%)	50 to 150 fish	Fair	5 to 10 feet	None

Conservation Population ***LRG1-33***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rio de la Cebolla	13020101cd051	2.9	Unaltered (< 1%)	0 to 50 fish	Unknown	5 to 10 feet	None

Conservation Population ***LRG1-34***	*Population Isolated*	*Limited Disease Risk*	*No Risk of Hybridization*	*Core Conservation Population*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rio Quemado	13020101cd053	4.4	Not Tested - Suspected Unaltered	Unknown	Unknown	Unknown	Unknown
South Fork Rio Quemado	13020101cd052	2.2	Unaltered (< 1%)	Unknown	Unknown	< 5 feet	None

Conservation Population ***LRG1-35***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Jicarita Creek	13020101cd045	2.5	Unaltered (< 1%)	Unknown	Good	5 to 10 feet	None

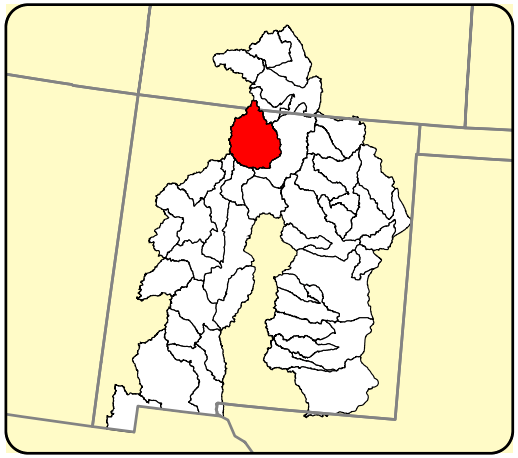
Conservation Population ***LRG1-36***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Unnamed Trib. to Rio Santa Barbara	13020101cd046	1.7	Not Tested - Suspected Hybridize	Unknown	Good	5 to 10 feet	Unknown

Conservation Population ***LRG1-37***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rio Medio	13020101cd054	6.1	Not Tested - Suspected Hybridize	Unknown	Unknown	Unknown	BRN, RBT
Unnamed Trib. to Rio Medio	13020101cd054	2.1	Not Tested - Suspected Hybridize	Unknown	Unknown	Unknown	BRN, RBT

Conservation Population ***LRG1-38***	*Population Isolated*	*Limited Disease Risk*	*Hybridizing species < 10 km*	*Other*	*Resident Life History*		
Individual Populations:	Population ID	Miles/Acres	Genetic Status	Adult RGCT/mi	Habitat	Stream Width	Non Natives
Rio Frijoles	13020101cd056	2.1	Not Tested - Suspected Hybridize	Unknown	Unknown	Unknown	Unknown
Rio Frijoles	13020101cd055	4.6	Not Tested - Suspected Hybridize	151 to 400 fish	Unknown	Unknown	BRN, RBT
Rito Jaroso	13020101cd055	1.2	Not Tested - Suspected Hybridize	151 to 400 fish	Unknown	Unknown	BRN, RBT

Lower Rio Grande GMU

Rio Chama (13020102)



Historic Distribution
NHD Hydrography
8-digit HUC

Barriers:
Complete
Partial
Unknown

ALAMOSA-TRINCHERA
ALAMOSA-TRINCHERA
CONEJOS
UPPER RIO GRANDE
RIO PUERCO
ARROYO CHICO
JEMEZ

LRG2-11
LRG2-01
LRG2-12
LRG2-03
LRG2-02
LRG2-04
LRG2-06
LRG2-05
LRG2-07
LRG2-08
LRG2-09
LRG2-10

Rio Chiquito
Wolf Creek
Willow Creek
Rio Chama
Cebolla Creek
Chavez Creek
Rio Brazos
Willow Creek
Rio Nutrias
Cantilon Creek
Rock Creek
Spring Creek
Rio Vallecitos
Rio Tusas
El Rito
Rio Ojo Caliente
Rio Gallina
Rio Capulin
Rio Puerco
Coyote Creek
Vallecitos Creek

N